This is a reproduction of a library book that was digitized by Google as part of an ongoing effort to preserve the information in books and make it universally accessible.

Google™ books

https://books.google.com

Radcliffe Observatory
OXFORD.

Regaudo 465

Digitized by Google

Digitized by Google

Digitized by Google

TABLES

REQUISITE TO BE USED WITH THE

NAUTICAL EPHEMERIS,

FOR FINDING THE

LATITUDE & LONGITUDE AT SEA.

FIRST PUBLISHED IN LONDON BY ORDER OF THE

COMMISSIONERS OF LONGITUDE.

TO WHICH ARE NOW ADDED, THE MOST USEFUL

ASTRONOMICAL TABLES

BY

MASKELYNE, LA LANDE, ROBERTSON, VINCE, MACKAY, MENDOZA RIOS, DE BORDA, &c.

WITH MANY NEW PROBLEMS EXPLAINING THEIR USE.

BY

JOHN GARNETT,

EDITOR OF THE AMERICAN NAUTICAL ALMANAC.

RADCLIFFE OBSERVATORY OXFORD.

NEW-BRUNSWICK, NEW-JERSEY,

PRINTED FOR THE EDITOR.

SOLD BY T. AND J. SWORDS, NEW-YORK; SAMUEL F. BRADFORD, PHILADELPHIA; THOMAS AND ANDREWS, BOSTON; AND ALL THE PRINCIPAL BOOKSELLERS IN THE UNITED-STATES.

1806.

D.

Digitized by Google

BODLEIAN
25 JAN. 1935
LIBRARY

District of New-Jersey, to wit.

BE IT REMEMBERED, that on the eleventh day of October, in the thirty-first year of the independence of the United-States of America, John Garnett, of the said district, hath deposited in this office the title of a book the right whereof he claims as author, in the words following, to wit, "Tables requisite to be used with the Nautical Ephemeris, for finding the Latitude and Longitude at sea. First published in London by order of the Commissioners of Longitude. To which are now added, the most useful Astronomical Tables by Maskelyne, La Lande, Robertson, Vince, Mackay, Mendoza Rios, de Borda, &c. with many new Problems explaining their use. By John Garnett, Editor of the American Nautical Almanac." In conformity to the act of the Congress of the United States, entitled "an act for the encouragement of learning, by securing the copies of maps, charts, and books, to the authors and proprietors of such copies during the times therein mentioned," and also to the act entitled "an act supplementary to an act entitled an act for the encouragement of learning, by securing the copies of maps, charts, and books to the authors and proprietors of such copies during the times therein mentioned, and extending the benefits thereof to the arts of designing, engraving, and etching, historical and other prints.

ROBERT BOGGS, Clerk of the District of New-Jersey.

Digitized by Google

PREFACE.

The Nautical Almanac and Astronomical Ephemeris having been printed in America from the years 1803 to 1809 inclusive, an edition of the REQUISITE TABLES is now offered, not only including those published by Dr. Maskelyne, but also those by La Lande, Robertson, Vince, Mackay, Mendoza Rios, De Borda, &c. which the present improved state of Navigation has made necessary, with considable additions by the Editor, which he thinks will be found useful in navigation, geography, and surveying; to students in universities and academies, the practical navigator, geographer, and surveyor. On comparison they will be found to have considerable advantages over any practical tables hitherto published. The logarithms, logarithmic sines and tangents, &c. are carried to six places of figures; and the differences with proportional parts are generally given, to expedite the intermediate division, and making any errors instantly discoverable The proportional logarithms are carried to five places with the differences at the foot, and adapted to 12 hours as well as 3 hours: the table of the proportional parts of 12 hours serves also for 24 hours and 6 hours, by taking the half or double by inspection; and also for any sexagesimal proportion.

The Explanation of the Tables, it is hoped, will remove every difficulty in their use; and among the Problems to exemplify them, many new methods are given for finding the Latitude and Longitude, which the author flatters himself will be found of considerable use in the astronomical part of na-

Digitized by Google

vigation; particularly Problem xv, which may often be used instead of the more difficult common one by double altitudes and the elapsed time;—and a collection of the most approved methods of correcting the moon's distance from the sun or a star from the effects of parallax and refraction, including a new method of his own which requires only the common tables, includes a proof of its own operation, and requires only four places of figures in the logarithms. The table of natural sines, are particularly adapted to this purpose, as the arcs can be taken out for any second by mere inspection.

The method of giving the solutions of the Problems by registered forms, with the help of algebraic signs, which makes any other written rule almost unnecessary, is a valuable improvement, for which the Editor is indebted to ROBERT PATTERSON, Esq. Profess. of Mathem. in the University of Pennsylvania, as well as for many other valuable hints in the course of this work.

New-Brunswick, New-Jersey,
October 11, 1806.

The reader is requested to make the following corrections.

ERRATA.

TABLE I. of Logarithms, read No. 319 instead of 219, and read No. 397 instead of 497.
Log. of No. 4847, for 4473 read 5473.
IV. Nat. sine of 89°, from 1′ to 60′ expunge the characteristics 9. and 10.
From 3° 30′ to 3° 34′, under S—″, for 4.665 read 4.685.
Log. sines and tangents of 18°, from 1′ to 59′ the decimal point should be after the first figure 9.
V. Prop. Logs. of 3h. for 0h. 42m. read 0h. 24m.
0° 37′ 35″ for 67028 read 68028.
0 37 36 for 009 read 68009.
0 37 37 for 989 read 67989.
1 32 58 for 795 read 695 } *also in de Mendoza Rios's tables.*
1 32 59 for 787 read 687 }
XXXV. Argument, for — long. moon's node read + long. moon's node; *also in Mackay's tables.*
Page 20, Table of latitude and long. &c. H. W. Sandy Hook, for 8h. 10m. read 6h. 37m.
PROBLEM IX. Note at bottom *2, for *latitude* read *co-latitude.*
XV. line 7 from top, for 50° 30′ read 51° 30′.

Digitized by Google

CONTENTS.

TABLE *A* *Mean Refraction.*

B *Parallax of the Sun in Altitude.*

C *Depression of the Horizon.*

D *Augmentation of the Moon's Semidiameter.*

E *Contraction of Semidiameters of Sun and Moon.*

F *Reduction of Latitude and Moon's Horizontal Parallax for the Earth's Spheroid.*

G *Correction of the Mean Refraction.*

H *Correction of the Moon's Apparent Altitude.*

I *Logarithmic Difference.*

K *Correction of the Logarithmic Difference when the Moon's Distance from the Sun is observed.*

L *Correction of the Logarithmic Difference when the Moon's Distance from a Star is observed.*

M *Reduction of the Sun's* true *Altitude to the* apparent.

N *Reduction of the Moon's* true *Altitude to the* apparent.

O *Reduction of a Star's* true *Altitude to the* apparent.

P *Altitude to be observed in order to ascertain the apparent Time with the greatest Accuracy.*

Q *Correction of observed Altitude for the spheroidal Figure of the Earth.*

R *Dip of the Sea at different distances from the Observer.*

S *Distances of the visible Horizon from an Observer or Object according to the Elevation in feet above the Surface of the Sea.*

T *Lengths, in Minutes, of the Equator, of one Degree of the different Parallels of Latitude, both for the Sphere and Spheroid; and of the different Arcs of the Meridian in the Spheroid, from the Equator to the Pole.*

I. *Logarithms of Numbers from* 1 *to* 10800.

II. *Sexagesimal Logs. of the seconds and tenths of minutes, or minutes and tenths of hours.*

III. *Shewing the Proportional Parts for any number of seconds when the minutes and differences for one minute are given less than* 300.

Digitized by Google

TABLES.

IV. Logarithmic *Sines, Co-sines, Tangents, Co-tangents, and* Natural *sines and Co-sines.*

V. *Proportional Logarithms of* 3 *or* 12 *Degrees or Hours.*

VI. *To reduce the Longitude, Latitude, Right Ascension, Declination, Horizontal Parallax, Semidiameter &c. as given in the Nautical Almanac, to any intermediate time.*

VII. *Half elapsed and middle time, to find the Latitude by double Altitudes.*

VIII. *Log-rising, to find the Latitude by double Altitudes.*

IX. *The Moon's equatorial semidiameter in time.*

X. *Increase of the Moon's equatorial semidiameter in time.*

XI. *To convert Degrees &c. into time, and conversely.*

XII. *To convert parts of the Equator into mean time.*

XIII. *To convert mean time into parts of the Equator.*

XIV. *To reduce the time of the Moon's Passage over the Meridian of Greenwich, to the time of its Passage over any other Meridian.*

XV. *Acceleration of the fixed stars in mean time.*

XVI. *Equation of the time of High Water.*

XVII. *Height of the tides.*

XVIII. *Difference between the Meridian Altitude of an Object, and its Altitude one minute before, or after the time of transit.*

XIX. *To reduce the numbers in the preceding table to other given Intervals of time from Noon.*

XX. *Amplitudes.*

XXI. *Variations of Amplitude answering to a change of one hundred Minutes in the sun's Altitude.*

XXII. *Time in seconds, answering to a change of* 100′ *of Altitude. near the Horizon.*

XXIII. *To find the time of rising and setting of a celestial Object.*

XXIV. *For computing the Equation of equal Altitudes.*

XXV. *Correction of equal Alts. sufficiently accurate for sea purposes.*

XXVI. *Error of Observation arising from an Error in the line of Collimation.*

XXVII. *For correcting the Latitude computed, from two observed Altitudes of the sun, and the interval of time between them.*

XXVIII. *For correcting the Latitude computed from two Altitudes of the sun, &c. and the interval of time between them.*

XXIX. *For computing the final effect of Parallax on the distance between the Moon and the Sun, or a fixed Star.*

Digitized by Google

TABLES.

XXX. *Right Ascensions and Declinations of the principal fixed stars adapted to the beginning of the year* 1805.

XXXI. *Part first of Precession in Right Ascension, for complete years.*

XXXII. *To find part second of Precession in Right Ascension: and the Precession in Declination.*

XXXIII. *Decimal Numbers for multiplying the Annual Precession of a Star in Right Ascension.*

XXXIV. *Semi-Annual Solar Equation of Northern Stars in Declination.*

*XXXIV. *Or Table* 1 *of Nutation.*

XXXV. *Or Table* 2 *of Nutation.*

XXXVI. *Equation of Equinoxes in Right Ascension.*

XXXVII. *Or Table* 1 *of Aberration.*

XXXVIII. *Or Table* 2 *of Aberration.*

XXXIX. *Or Table* 3 *of Aberration.*

XL. *The Longitude and Latitude of Stars, chiefly Zodiacal; adapted to the beginning of the year* 1800.

XLI. *Precession of the Equinoctial Points in Longitude for complete years.*

XLII. *Precession of the Equinoctial Points in Longitude for Months and Days.*

XLIII. *Secular Variation of Stars.*

XLIV. *Equation of the Equinoxes in Longitude.*

XLV. *Aberration in Longitude.*

XLVI. *Aberration of the Planets in Longitude.*

XLVII. *For computing the Right Ascension of a Planet in time.*

XLVIII. *To find the Augmentation of the Moon's Semidiameter by the Nonagesimal For the explanation of this table see Problem* XXXI.

The Latitudes and Longitudes of Places - - - - - - - - *Page* 1 — 24

General Introduction concerning the Instruments and Observations - - 25 — 30

Of the Manner of taking a complete Set of Lunar Observations - - 30 — 34

Explanation of the Tables - - - - - - - - - 34 — 56

APPENDIX.

PROBLEM I. To find the Time *at Greenwich corresponding to a given time under any other known meridian* - - - 1

II. To find the Longitude, Latitude, Right Ascension, Declination, &c. *of the sun or moon for any time, by means of the Nautical Almanac* 1

III. To find the Time at Greenwich *corresponding to any given latitude, longitude, declination,* &c. *of the moon, by means of the Nautical Almanac* 4

IV. To find the Latitude *from the meridian altitude of the* sun's *limb* 5

V. To find the Latitude *from the meridian altitude of a* fixed star 6

VI. To find the Latitude *from the meridian altitude of the* moon's *limb* 7

VII. To find the Latitude *having the latitude by account, two altitudes of the sun, the time elapsed between the observations, and the sun's declination,* 8

VIII. To correct the Latitude *found by the last problem, after the computation,* 15

IX. To find the Latitude *by two altitudes of the sun, the time elapsed between the observations, and the sun's declination, without a supposed latitude,* 19

X. *Given equal altitudes of the sun or a star, the interval between the observations, and the declination,* to find the Latitude - - 19

Digitized by Google

PROBLEMS.

XI. *Given three altitudes of the sun's limb, taken near noon at equal intervals of time,* to find the Meridian Altitude - - - 20

XII. *Given three altitudes of the sun's limb, taken near noon, at unequal intervals of time*; to find the Meridian Altitude - - 21

XIII. To find the Latitude and Declination *from three altitudes at equal given intervals of time, at any distance from noon* - - 21

XIV. To find the Latitude and Declination *from three altitudes, at unequal intervals of time, and at any distance from noon* - - 23

XV. *Given two altitudes of the sun, within half an hour of noon, and the interval of time between*; to find the Time *nearly* and Meridian Altitude, *by the help of table* XVIII - - - 24

XVI. *Given* one *altitude near noon, the time from noon, the latitude by account, and declination,* to find the Meridian Altitude. - - 24

XVII. *Given the sun's or moon's declination and semidiameter, with the interval of time between the instants when the upper and lower limbs were in the horizon*; to find the Latitude - - - 25

XVIII. *The latitude and longitude of a place, time of observation nearly, and the altitude of the* sun's limb *being given,* to find the Apparent Time 26

XIX. *The latitude and longitude of a place, time of observation nearly, and the altitude of a* known fixed star *being given,* to find the Apparent Time, 27

XX. *The latit. and longit. of a place, time of observ. nearly, and the altit. of the* moon *being given,* to find the Moon's Merid. Distance and App. Time, 28

XXI. *The apparent time and the ship's latitude and longitude being given,* to find the Sun's Apparent Altitude - - - 29

XXII. *The apparent time, and the latitude and longitude of the ship being given,* to find the Apparent Altitude of any known fixed Star - 30

XXIII. *The apparent time and the latitude and longitude of the ship being given,* to find the Apparent Altitude of the Moon's Center - 31

XXIV. *Having the apparent or observed distance of the moon from the sun or a fixed star, together with the observed altitude of each, and the moon's horizontal parallax,* to find their True Distance - - - 32—35

XXV. To find the Longitude *of a ship at sea by observations of the moon's distance from the sun, and their altitudes, taken at the same time* - 35

XXVI. To find the Longitude *of a ship at sea by the moon's distance from a known fixed star, and their altitudes, taken at the same or a different time* 37—40

XXVII. *Given the apparent time at the ship, and the moon's distance from the meridian*; to find the Longitude *at Greenwich* - - 41

XXVIII. *The moon's true distance from the sun or fixed star, or planet, and the latitude of each being given,* to find the Moon's true Longitude 42

XXIX. *Given the meridian altitude of either limb of the moon, and the latitude and longitude by account of the place of observation,* to find the Longitude of the Place - - - - - - 43

XXX. To find the difference of Longitude of two places *by the observed intervals of time between the* transits *of the* moon *and a* fixed star *over the meridian of each place* - - - - - - 45

XXXI. To find the augmentation of the moon's semidiam. *by means of* tab. XLVIII. 46

XXXII. To find the Longitude of a Place *by an eclipse of the sun, exemplified by the total eclipse of the 16th June,* 1806 - - - - 47

XXXIII. To find the Longitude of a Place *by the occultation of a fixed star by the moon*

Digitized by Google

TABLE A. MEAN REFRACTION.

Alt.	Refr.	Alt.	Refr.	Alt.	Refr.	Alt.	Refr.	Alt.	Refr.	Alt.	Refr.
° ′	′ ″	° ′	′ ″	° ′	′ ″	° ′	′ ″	° ′	′ ″	° ′	′ ″
0 0	33 0	5 0	9 54	10 0	5 15	20 0	2 35	32 20	1 30	67	24
0 5	32 10	5 5	9 46	10 10	5 10	20 10	2 34	32 40	1 29	68	23
0 10	31 22	5 10	9 38	10 20	5 5	20 20	2 32	33 0	1 28	69	22
0 15	30 35	5 15	9 30	10 30	5 0	20 30	2 31	33 20	1 26	70	21
0 20	29 50	5 20	9 23	10 40	4 56	20 40	2 29	33 40	1 25	71	19
0 25	29 6	5 25	9 15	10 50	4 51	20 50	2 28	34 0	1 24	72	18
0 30	28 23	5 30	9 8	11 0	4 47	21 0	2 27	34 20	1 23	73	17
0 35	27 41	5 35	9 1	11 10	4 43	21 10	2 26	34 40	1 22	74	16
0 40	27 0	5 40	8 54	11 20	4 39	21 20	2 25	35 0	1 21	75	15
0 45	26 20	5 45	8 47	11 30	4 34	21 30	2 24	35 20	1 20	76	14
0 50	25 42	5 50	8 41	11 40	4 31	21 40	2 23	35 40	1 19	77	13
0 55	25 5	5 55	8 34	11 50	4 27	21 50	2 21	36 0	1 18	78	12
1 0	24 29	6 0	8 28	12 0	4 23	22 0	2 20	36 30	1 17	79	11
1 5	23 54	6 5	8 21	12 10	4 20	22 10	2 19	37 0	1 16	80	10
1 10	23 20	6 10	8 15	12 20	4 16	22 20	2 18	37 30	1 14	81	9
1 15	22 47	6 15	8 9	12 30	4 13	22 30	2 17	38 0	1 13	82	8
1 20	22 15	6 20	8 3	12 40	4 9	22 40	2 16	38 30	1 11	83	7
1 25	21 44	6 25	7 57	12 50	4 6	22 50	2 15	39 0	1 10	84	6
1 30	21 15	6 30	7 51	13 0	4 3	23 0	2 14	39 30	1 9	85	5
1 35	20 46	6 35	7 45	13 10	4 0	23 10	2 13	40 0	1 8	86	4
1 40	20 18	6 40	7 40	13 20	3 57	23 20	2 12	40 30	1 7	87	3
1 45	19 51	6 45	7 35	13 30	3 54	23 30	2 11	41 0	1 5	88	2
1 50	19 25	6 50	7 30	13 40	3 51	23 40	2 10	41 30	1 4	89	1
1 55	19 0	6 55	7 25	13 50	3 48	23 50	2 9	42 0	1 3	90	0
2 0	18 35	7 0	7 20	14 0	3 45	24 0	2 8	42 30	1 2		
2 5	18 11	7 5	7 15	14 10	3 43	24 10	2 7	43 0	1 1		
2 10	17 48	7 10	7 11	14 20	3 40	24 20	2 6	43 30	1 0		
2 15	17 26	7 15	7 6	14 30	3 38	24 30	2 5	44 0	0 59		
2 20	17 4	7 20	7 2	14 40	3 35	24 40	2 4	44 30	0 58		
2 25	16 44	7 25	6 57	14 50	3 33	24 50	2 3	45 0	0 57		
2 30	16 24	7 30	6 53	15 0	3 30	25 0	2 2	45 30	0 56		
2 35	16 4	7 35	6 49	15 10	3 28	25 10	2 1	46 0	0 55		
2 40	15 45	7 40	6 45	15 20	3 26	25 20	2 0	46 30	0 54		
2 45	15 27	7 45	6 41	15 30	3 24	25 30	1 59	47 0	0 53		
2 50	15 9	7 50	6 37	15 40	3 21	25 40	1 58	47 30	0 52		
2 55	14 52	7 55	6 33	15 50	3 19	25 50	1 57	48 0	0 51		
3 0	14 36	8 0	6 29	16 0	3 17	26 0	1 56	48 30	0 50		
3 5	14 20	8 5	6 25	16 10	3 15	26 10	1 55	49 0	0 49		
3 10	14 4	8 10	6 22	16 20	3 12	26 20	1 55	49 30	0 49		
3 15	13 49	8 15	6 18	16 30	3 10	26 30	1 54	50 0	0 48		
3 20	13 34	8 20	6 15	16 40	3 8	26 40	1 53	50 30	0 47		
3 25	13 20	8 25	6 11	16 50	3 6	26 50	1 52	51 0	0 46		
3 30	13 6	8 30	6 8	17 0	3 4	27 0	1 51	51 30	0 45		
3 35	12 53	8 35	6 5	17 10	3 3	27 15	1 50	52 0	0 44		
3 40	12 40	8 40	6 1	17 20	3 1	27 30	1 49	52 30	0 44		
3 45	12 27	8 45	5 58	17 30	2 59	27 45	1 48	53 0	0 43		
3 50	12 15	8 50	5 55	17 40	2 57	28 0	1 47	53 30	0 42		
3 55	12 3	8 55	5 52	17 50	2 55	28 15	1 46	54 0	0 41		
4 0	11 51	9 0	5 48	18 0	2 54	28 30	1 45	55 0	0 40		
4 5	11 40	9 5	5 45	18 10	2 52	28 45	1 44	56 0	0 38		
4 10	11 29	9 10	5 42	18 20	2 51	29 0	1 42	57	0 37		
4 15	11 18	9 15	5 39	18 30	2 49	29 20	1 41	58	0 35		
4 20	11 8	9 20	5 36	18 40	2 47	29 40	1 40	59	0 34		
4 25	10 58	9 25	5 34	18 50	2 46	30 0	1 38	60	0 33		
4 30	10 48	9 30	5 31	19 0	2 44	30 20	1 37	61	0 32		
4 35	10 39	9 35	5 28	19 10	2 43	30 40	1 36	62	0 30		
4 40	10 29	9 40	5 25	19 20	2 41	31 0	1 35	63	0 29		
4 45	10 20	9 45	5 23	19 30	2 40	31 20	1 33	64	0 28		
4 50	10 11	9 50	5 20	19 40	2 38	31 40	1 32	65	0 26		
4 55	10 2	9 55	5 18	19 50	2 37	32 0	1 31	66	0 25		

TABLE B. Parallax of Sun in Alt.

°	′ ″
0	9
3	9
6	9
9	9
12	9
15	8
18	8
21	8
24	8
27	8
30	8
33	7
36	7
39	7
42	6
45	6
48	6
51	5
54	5
57	5
60	4
63	4
66	4
69	3
72	3
75	2
78	2
81	1
84	1
90	0

TABLE C. Depression of the Horizon.

Height of the eye.	Dip.
	′ ″
1 ft.	0 57
2	1 24
3	1 42
4	1 58
5	2 1
6	2 25
7	2 35
8	2 45
9	2 55
10	3 7
11	3 16
12	3 25
13	3 33
14	3 41
15	3 49
16	3 56
17	4 4
18	4 11
19	4 17
20	4 24
21	4 31
22	4 37
23	4 43
24	4 49
25	4 55
26	5 1
28	5 13
30	5 24
35	5 49
40	6 12
45	6 35
50	6 58
55	7 18
60	7 38
65	7 56
70	8 14
75	8 31
80	8 48
90	9 22
100	9 51
110	10 19
120	10 47
130	11 13
140	11 39
150	12 3
160	12 27
170	12 50
180	13 12
190	13 34
200	13 55
210	14 16
220	14 36
230	14 56
240	15 15
250	15 34
260	15 52
270	16 10
280	16 28
290	16 46
300	17 3

Digitized by Google

TABLE D.

ADDITION OF ☽'s SEMID.

Arg. Incli.	App. alt. of the ☽ or Semid. of the ☽						
	14°	15°	15° 30′	16°	16° 30′	17°	18°
	″	″	″	″	″	″	″
3°	1	1	2	2	2	2	2
6	1	1	2	2	2	2	2
9	2	2	2	2	3	3	3
12	3	3	3	3	4	4	4
15	4	4	4	4	5	5	5
18	4	4	5	5	5	6	6
21	5	5	6	6	6	7	7
24	5	6	6	6	7	7	8
27	6	6	7	7	8	8	8
30	7	7	8	8	9	9	9
33	7	8	8	9	10	10	10
36	8	9	9	10	10	11	11
39	9	9	10	10	11	12	12
42	9	10	10	11	12	12	13
45	9	10	11	12	12	13	14
48	10	11	12	12	13	14	15
51	10	11	12	13	14	14	15
54	11	12	13	13	14	15	16
57	11	12	13	14	15	16	17
60	12	13	14	14	15	16	17
63	12	13	14	15	16	17	18
66	12	13	14	15	16	17	18
69	13	14	15	15	16	17	19
72	13	14	15	16	17	18	19
75	13	14	15	16	17	18	19
78	13	14	15	16	17	18	19
81	13	14	15	16	17	18	19
84	13	14	15	16	18	19	20
90	13	14	16	17	18	19	20

TABLE E.

CONTRACTION OF SEMIDIAMS. OF ☉ & ☽.

Arg. Incli.	Arg. App. alt. of the ☉ or ☽.											
	10°	11°	12°	13°	14°	16°	18°	20°	24°	32°	50°	90°
	″	″	″	″	″	″	″	″	″	″	″	″
3°	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0
15	1	0	0	0	0	0	0	0	0	0	0	0
18	1	1	1	0	0	0	0	0	0	0	0	0
21	1	1	1	1	1	0	0	0	0	0	0	0
24	1	1	1	1	1	1	0	0	0	0	0	0
27	2	1	1	1	1	1	1	0	0	0	0	0
30	2	2	1	1	1	1	1	1	0	0	0	0
33	2	2	2	1	1	1	1	1	0	0	0	0
36	3	2	2	2	1	1	1	1	1	0	0	0
39	3	3	2	2	2	1	1	1	1	0	0	0
42	4	3	2	2	2	1	1	1	1	0	0	0
45	4	3	3	2	2	2	1	1	1	0	0	0
48	4	4	3	3	2	2	1	1	1	0	0	0
51	5	4	3	3	3	2	2	1	1	1	0	0
54	5	4	4	3	3	2	2	1	1	1	0	0
57	5	5	4	3	3	2	2	1	1	1	0	0
60	6	5	4	4	3	2	2	2	1	1	0	0
63	6	5	4	4	3	3	2	2	1	1	0	0
66	6	5	5	4	3	3	2	2	1	1	0	0
69	7	6	5	4	4	3	2	2	1	1	0	0
72	7	6	5	4	4	3	2	2	1	1	0	0
75	7	6	5	4	4	3	2	2	1	1	0	0
78	7	6	5	5	4	3	2	2	1	1	0	0
81	8	6	5	5	4	3	2	2	2	1	0	0
84	8	6	5	5	4	3	3	2	2	1	0	0
90	8	6	5	5	4	3	3	2	2	1	0	0

TABLE F REDUCTION of LAT. and ☽'s HOR. PAR. for the EARTH's SPHEROID; the polar and equatorial diameters being supposed as 333 to 334.

Lat.	Red Lat.	☽'s Hor. Par. 54′	57′	60′
°	′ ″	″	″	″
0	0 00.0	0.00	0.00	0.00
1	0 21.5	0.00	0.00	0.00
2	0 43.0	0.01	0.01	0.01
3	1 04.5	0.02	0.02	0.03
4	1 25.8	0.03	0.05	0.05
5	1 47.1	0.08	0.08	0.08
6	2 08.4	0.11	0.11	0.12
7	2 29.2	0.15	0.15	0.16
8	2 50.0	0.19	0.20	0.21
9	3 10.7	0.24	0.25	0.26
10	3 30.9	0.30	0.30	0.33
11	3 51.0	0.32	0.32	0.33
12	4 10.9	0.44	0.44	0.47
13	4 30.6	0.51	0.52	0.55
14	4 50.0	0.57	0.60	0.63
15	5 08.9	0.68	0.68	0.72
16	5 27.6	0.74	0.77	0.82
17	5 45.9	0.92	0.95	0.98
18	6 03.8	0.93	0.98	1.03
19	6 21.3	1.06	1.09	1.14
20	6 38.4	1.11	1.16	1.26
21	6 55.2	1.25	1.30	1.37
22	7 11.5	1.41	1.46	1.51
23	7 27.4	1.56	1.60	1.65
24	7 42.8	1.68	1.78	1.88
25	7 57.8	1.83	1.93	2.03

Lat.	Red Lat	☽'s Hor. Par. 54′	57′	60′
°	′ ″	″	″	″
25	7 52.8	1.73	1.83	1.93
26	8 06.5	1.87	1.96	2.07
27	8 19.5	2.00	2.11	2.22
28	8 31.9	2.14	2.25	2.38
29	8 43.7	2.28	2.40	2.53
30	8 54.8	2.43	2.56	2.70
31	9 05.3	2.58	2.71	2.86
32	9 15.2	2.73	2.87	3.03
33	9 24.3	2.88	3.03	3.20
34	9 32.8	3.04	3.20	3.37
35	9 40.6	3.19	3.37	3.55
36	9 47.7	3.35	3.53	3.72
37	9 54.1	3.52	3.71	3.90
38	9 59.7	3.68	3.88	4.09
39	10 04.6	3.84	4.05	4.27
40	10 08.8	4.01	4.23	4.45
41	10 12.2	4.18	4.40	4.64
42	10 14.8	4.35	4.58	4.83
43	10 16.6	4.51	4.76	5.01
44	10 18.0	4.68	4.94	5.20
45	10 18.5	4.85	5.11	5.39
46	10 18.1	5.02	5.29	5.58
47	10 17.0	5.19	5.47	5.77
48	10 15.3	5.36	5.65	5.95
49	10 12.7	5.53	5.83	6.14
50	10 09.4	5.69	6.01	6.33

Lat.	Red. Lat.	☽'s Hor. Par. 54′	57′	60′
°	′ ″	″	″	″
50	10 09.4	5.69	6.01	6.33
51	10 05.3	5.86	6.18	6.51
52	10 00.6	6.03	6.35	6.69
53	9 55.0	6.19	6.53	6.88
54	9 48.8	6.35	6.70	7.06
55	9 41.8	6.51	6.87	7.23
56	9 34.1	6.67	7.03	7.41
57	9 25.7	6.83	7.20	7.58
58	9 16.6	6.98	7.36	7.75
59	9 06.8	7.13	7.52	7.92
60	8 56.4	7.28	7.68	8.08
61	8 45.4	7.43	7.83	8.25
62	8 33.6	7.56	7.98	8.40
63	8 21.3	7.70	8.13	8.56
64	8 08.3	7.84	8.27	8.71
65	7 54.7	7.97	8.41	8.85
66	7 40.5	8.10	8.54	9.00
67	7 25.8	8.22	8.67	9.13
68	7 10.4	8.33	8.80	9.27
69	6 54.8	8.46	8.92	9.40
70	6 38.5	8.57	9.04	9.52
71	6 21.7	8.67	9.15	9.64
72	6 04.4	8.78	9.26	9.75
73	5 46.7	8.87	9.36	9.86
74	5 28.6	8.97	9.46	9.96
75	5 10.1	9.05	9.55	10.06

Digitized by Google

TABLE G. CORRECTION OF THE MEAN REFRACTION.

App. Alt.	Arg. Height of Fahrenheit's Thermometer. 20°	24°	28°	32°	36°	40°	44°	48°	52°	56°	60°	64°	68°	72°	76°	80°
° ′	+ ″	+ ″	+ ″	+ ″	+ ″	+ ″	+ ″	+ ″	— ″	— ″	— ″	— ″	— ″	— ″	— ″	— ″
0 0	2 40	2 18	1 55	1 33	1 11	51	31	10	10	29	48	1 7	1 25	1 43	2 1	2 19
0 10	2 32	2 12	1 52	1 28	1 8	48	29	10	9	27	45	1 4	1 21	1 38	1 54	2 12
0 20	2 25	2 5	1 44	1 24	1 4	46	28	9	9	26	44	1 1	1 17	1 33	1 49	2 5
0 30	2 18	1 59	1 39	1 20	1 1	44	26	9	8	25	41	58	1 13	1 28	1 43	1 59
0 40	2 11	1 53	1 34	1 16	58	42	25	8	8	24	39	55	1 10	1 24	1 30	1 53
0 50	2 5	1 48	1 29	1 12	55	40	24	8	8	23	37	52	1 6	1 20	1 34	1 48
1 0	1 59	1 43	1 25	1 9	53	38	23	8	7	21	36	50	1 3	1 17	1 30	1 43
1 10	1 53	1 38	1 21	1 6	50	36	22	7	7	20	34	48	1 0	1 13	1 26	1 38
1 20	1 48	1 33	1 17	1 3	48	34	21	7	6	19	32	45	57	1 9	1 21	1 33
1 30	1 43	1 29	1 14	1 0	46	32	20	7	6	18	31	43	54	1 6	1 18	1 29
1 40	1 39	1 25	1 11	57	44	31	18	6	6	18	30	41	52	1 4	1 15	1 25
1 50	1 35	1 21	1 8	55	42	30	17	6	6	17	28	39	50	1 1	1 11	1 21
2 0	1 31	1 18	1 5	53	41	29	17	6	5	16	27	37	48	58	1 8	1 18
2 20	1 23	1 11	1 0	48	37	26	16	5	5	15	25	35	44	54	1 3	1 11
2 40	1 17	1 6	55	44	34	24	14	5	5	14	23	32	41	50	58	1 6
3 0	1 11	1 1	51	41	32	22	13	4	4	13	21	30	38	46	54	1 1
3 20	1 6	57	47	38	29	21	13	4	4	12	20	28	35	43	50	57
3 40	1 2	53	44	36	28	20	12	4	4	11	18	26	33	40	47	53
4 0	58	49	41	33	26	18	11	4	4	10	17	24	31	37	44	50
4 30	53	45	38	31	24	17	10	3	3	9	16	22	28	34	40	45
5 0	48	41	35	28	22	16	9	3	3	9	14	20	26	31	36	40
5 30	45	38	32	26	20	14	9	3	3	8	13	19	24	29	34	38
6 0	41	35	30	24	19	13	8	3	2	7	12	17	22	26	31	35
6 30	38	33	28	22	17	12	7	2	2	7	11	15	20	24	29	33
7 0	36	31	26	21	16	12	7	2	2	6	10	14	19	23	27	31
8	32	27	23	19	15	10	6	2	2	5	9	13	16	20	24	27
9	28	24	20	16	13	9	5	2	2	5	8	11	14	18	21	24
10	26	22	18	15	12	8	5	2	1	4	7	10	13	16	19	22
11	23	20	17	14	11	8	5	2	1	4	7	9	12	15	18	20
12	21	18	15	13	10	7	4	1	1	4	6	9	11	13	16	18
13	20	17	14	12	9	7	4	1	1	3	6	8	10	12	15	17
14	18	16	13	11	8	6	4	1	1	3	5	7	9	11	14	16
15	17	15	12	10	8	6	3	1	1	3	5	7	9	11	13	15
16	16	14	12	9	7	5	3	1	1	3	5	6	8	10	12	14
17	15	13	11	9	7	5	3	1	1	3	4	6	8	9	11	13
18	14	12	10	8	6	5	3	1	1	2	4	6	7	9	10	12
19	13	11	10	8	6	4	3	1	1	2	4	5	7	8	10	11
20	13	11	9	7	6	4	2	1	1	2	4	5	6	8	9	11
21	12	10	9	7	5	4	2	1	1	2	3	5	6	7	9	10
22	11	10	8	7	5	4	2	1	1	2	3	5	6	7	8	10
23	11	9	8	6	5	4	2	1	1	2	3	4	6	7	8	9
24	10	9	7	6	5	3	2	1	1	2	3	4	5	6	8	9
25	10	8	7	6	5	3	2	1	1	2	3	4	5	6	7	8
26	9	8	7	6	4	3	2	1	1	2	3	4	5	6	7	8
27	9	8	6	5	4	3	2	1	1	2	3	4	5	6	7	8
28	9	7	6	5	4	3	2	1	0	1	2	3	5	5	6	7
30	8	7	6	5	4	3	2	1	0	1	2	3	4	5	6	7
32	7	6	5	4	3	2	1	0	0	1	2	3	4	5	5	6
34	7	6	5	4	3	2	1	0	0	1	2	3	3	4	5	6
36	6	5	5	4	3	2	1	0	0	1	2	3	3	4	5	5
38	6	5	4	4	3	2	1	0	0	1	2	2	3	4	4	5
40	6	5	4	3	3	2	1	0	0	1	2	2	3	3	4	5
45	5	4	3	3	2	2	1	0	0	1	1	2	2	3	3	4
50	4	3	3	2	2	1	1	0	0	0	1	1	1	2	2	3
60	3	2	2	2	1	1	1	0	0	0	0	1	1	1	1	2
70	2	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1
80	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0	0	0	0	0			
				—	—	—	—	—	+	+	+	+	+			
				28.26	28.56	28.85	29.15	29.45	29.75	30.05	30.35	30.64	30.93			

Arg. Height of the Barometer, in inches and decimal parts.

Digitized by Google

TABLE *H.*

CORRECTION OF THE MOON'S APPARENT ALTITUDE.

Arg. App. alt ☽	Arg. Horizontal Parallax.																								D. P.
	54′	D	55′	D.	56′	D.	57′	D.	58′	D.	59′	D.	60′	D	61′	D.									
°	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″									″
4 0	42 2	22	43 2	21	44 2	21	45 2	21	46 1	22	47 1	22	48 1	22	49 1	21									60
10	42 24	20	43 23	21	44 23	21	45 23	20	46 23	20	47 23	20	48 23	20	49 22	21									60
20	42 44	19	43 44	19	44 44	19	45 43	20	46 43	20	47 43	19	48 43	19	49 43	19									60
30	43 3	18	44 3	18	45 3	18	46 3	18	47 3	18	48 2	18	49 2	18	50 2	18									60
40	43 21	18	44 21	17	45 21	17	46 21	17	47 21	17	48 20	17	49 20	17	50 20	17									60
50	43 39	16	44 38	17	45 38	16	46 38	16	47 38	16	48 37	17	49 37	16	50 37	16									60
5 0	43 55	15	44 55	15	45 54	16	46 54	15	47 54	15	48 54	15	49 53	16	50 53	15									60
10	44 10	15	45 10	14	46 10	14	47 9	15	48 9	15	49 9	14	50 9	14	51 8	14									60
20	44 25	13	45 24	14	46 24	14	47 24	14	48 24	13	49 23	14	50 23	14	51 22	14									60
30	44 38	13	45 38	13	46 38	13	47 38	13	48 37	13	49 37	13	50 37	13	51 36	15									60
40	44 51	13	45 51	13	46 51	13	47 51	12	48 50	13	49 50	12	50 50	12	51 49	13									60
50	45 4	12	46 4	11	47 3	12	48 3	12	49 3	11	50 2	12	51 2	12	52 2	11									60
6 0	45 16	11	46 15	11	47 15	11	48 15	11	49 14	11	50 14	11	51 14	11	52 13	11									60
10	45 27	10	46 26	11	47 26	11	48 26	10	49 25	11	50 25	11	51 25	11	52 24	11									60
20	45 37	10	46 37	10	47 37	11	48 36	10	49 36	10	50 36	10	51 35	10	52 35	10									60
30	45 47	10	46 47	10	47 47	10	48 46	10	49 46	9	50 46	9	51 45	10	52 45	9									60
40	45 57	9	46 57	9	47 56	9	48 56	9	49 55	9	50 55	9	51 55	9	52 54	9									60
50	46 6	9	47 6	8	48 5	9	49 5	8	50 4	9	51 4	9	52 4	8	53 3	9									60
7 0	46 15	8	47 14	9	48 14	8	49 13	8	50 13	8	51 13	8	52 12	8	53 12	8									59
10	46 23	8	47 23	8	48 22	8	49 22	8	50 21	8	51 21	8	52 20	8	53 20	8									59
20	46 31	7	47 31	8	48 30	7	49 30	7	50 29	7	51 29	7	52 28	8	53 28	8									59
30	46 38	7	47 38	7	48 37	7	49 37	7	50 36	7	51 36	7	52 35	7	53 35	7									59
40	46 45	7	47 45	7	48 44	7	49 44	7	50 43	7	51 43	6	52 42	7	53 42	6									59
50	46 52	7	47 52	6	48 51	7	49 51	6	50 50	6	51 49	7	52 49	7	53 48	7									59
8 0	46 59	6	47 58	6	48 58	6	49 57	6	50 56	6	51 56	6	52 55	6	53 55	6									59
10	47 5	6	48 4	6	49 4	6	50 3	6	51 2	6	52 2	6	53 1	6	54 1	5									59
20	47 11	5	48 10	6	49 9	5	50 9	5	51 8	6	52 8	5	53 7	5	54 6	4									59
30	47 16	5	48 16	5	49 15	6	50 14	5	51 14	5	52 13	5	53 12	5	54 12	5									59
40	47 22	5	48 21	5	49 20	5	50 20	5	51 19	5	52 18	5	53 17	5	54 17	5									59
50	47 27	4	48 26	5	49 25	5	50 25	4	51 24	5	52 23	5	53 22	5	54 22	4									59
9 0	47 31	5	48 31	4	49 30	5	50 29	7	51 29	4	52 28	4	53 27	4	54 26	5									59
10	47 36	4	48 35	5	49 35	4	50 34	6	51 33	4	52 32	4	53 31	4	54 31	4									59
20	47 40	5	48 40	4	49 39	4	50 38	4	51 37	4	52 36	4	53 36	4	54 35	4									59
30	47 45	3	48 44	4	49 43	6	50 42	4	51 41	4	52 40	4	53 40	3	54 39	4									59
40	47 48	4	48 48	3	49 47	3	50 46	4	51 45	4	52 44	4	53 43	4	54 43	3									59
50	47 52	4	48 51	3	49 50	4	50 50	3	51 49	3	52 48	3	53 47	3	54 46	3									59
10 0	47 56	3	48 55	3	49 54	3	50 53	3	51 52	3	52 51	3	53 50	3	54 49	4									59
10	47 59	3	48 58	3	49 57	3	50 56	3	51 55	3	52 54	3	53 53	4	54 53	5									59
20	48 2	3	49 1	3	50 0	3	50 59	3	51 58	3	52 57	3	53 57	2	54 56	2									59
30	48 5	3	49 4	3	50 3	3	51 2	3	52 1	3	53 0	3	53 59	2	54 58	3									59
40	48 8	3	49 7	3	50 6	3	51 5	3	52 4	3	53 3	3	54 2	2	55 1	2									59
50	48 11	2	49 10	2	50 9	3	51 8	3	52 7	2	53 6	3	54 4	3	55 3	3									59
11	48 14	12	49 12	13	50 12	11	51 10	12	52 9	12	53 7	11	54 7	11	55 6	11									59
12	48 26	8	49 25	7	50 23	8	51 22	7	52 21	7	53 18	7	54 18	7	55 17	12									59
13	48 34	4	49 32	4	50 31	4	51 29	4	52 28	3	53 25	4	54 25	2	55 23	3									58
14	48 38	2	49 36	1	50 35	0	51 33	0	52 31	0	53 29	0	54 27	0	55 26	1									58
15	48 40	—	49 37	—	50 35	—	51 33	—	52 31	—	53 29	—	54 27	—	55 25	4									58
16	48 38	2	49 35	2	50 33	2	51 31	2	52 28	3	53 26	3	54 24	3	55 21	6									58
17	48 34	7	49 31	7	50 28	6	51 26	7	52 23	7	53 21	8	54 18	8	55 15	8									57
18	48 27	8	49 24	8	50 22	9	51 19	10	52 16	10	53 13	10	54 10	10	55 7	11									57
19	48 19	10	49 16	11	50 13	11	51 9	11	52 6	11	53 3	12	54 0	13	54 56	12									57
20	48 9	12	49 5	12	50 2	13	50 58	13	51 55	14	52 51	14	53 47	14	54 44	15									56
21	47 57	13	48 53	14	49 49	14	50 45	14	51 41	15	52 37	15	53 33	15	54 29	16									56
22	47 44	15	48 39	15	49 35	16	50 31	16	51 26	16	52 22	17	53 18	18	54 13	18									56
23	47 29	17	48 24	17	49 19	17	50 14	17	51 10	18	52 5	19	53 0	19	53 55	19									55
24	47 12	17	48 7	18	49 2	19	50 57	19	51 52	20	52 46	20	53 41	20	54 36	21									55
25	46 55	19	47 49	19	48 43	19	49 38	19	50 32	21	51 27	22	52 21	22	53 15	22									55
26	46 36	21	47 30	21	48 24	22	49 17	21	50 11	22	51 5	22	51 59	23	52 53	23									54
27	46 15	21	47 9	22	48 2	22	48 56	23	49 49	23	50 43	24	51 36	24	52 30	25									54
28	45 54		46 47		47 40		48 33		49 26		50 19		51 12		52 5										54

Digitized by Google

TABLE II.

CORRECTION OF THE MOON'S APPARENT ALTITUDE.

Arg. app. alt ☽	Arg. Moon's Horizontal Parallax. 54′	D.	55′	D.	56′	D.	57′	D.	58′	D.	59′	D.	60′	D.	61′	D.	D. P.
°	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	+
29	45 31	—	46 24	—	47 16	—	48 9	—	49 1	—	49 54	—	50 46	—	51 39	—	53″
30	45 7	24	45 59	25	46 51	26	47 43	26	48 35	26	49 27	27	50 19	27	51 11	28	52
31	44 43	24	45 34	25	46 25	26	47 17	26	48 8	27	49 0	27	49 51	28	50 43	28	52
32	44 17	26	45 8	26	45 58	27	46 49	28	47 40	28	48 31	29	49 22	29	50 13	30	51
33	43 50	27	44 40	28	45 30	28	46 21	29	47 11	29	48 1	30	48 52	30	49 42	31	50
34	43 22	28	44 12	28	45 1	29	45 51	30	46 41	30	47 30	31	48 20	32	49 10	32	50
35	42 53	29	43 42	30	44 31	31	45 20	31	46 9	32	46 59	32	47 48	33	48 37	34	49
36	42 23	30	43 11	31	44 0	31	44 49	32	45 37	33	46 26	33	47 14	34	48 3	35	48
37	41 52	31	42 40	32	43 28	32	44 16	33	45 4	34	45 52	34	46 40	34	47 28	37	48
38	41 20	32	42 8	32	42 55	33	43 42	34	44 29	35	45 17	35	46 4	37	46 51	37	47
39	40 48	32	41 34	34	42 21	34	43 8	34	43 54	36	44 41	36	45 27	37	46 14	38	46
40	40 14	34	41 0	34	41 46	35	42 32	36	43 18	36	44 4	37	44 50	39	45 36	39	46
41	39 40	34	40 25	35	41 10	36	41 56	36	42 41	38	43 26	38	44 11	39	44 57	40	45
42	39 5	35	39 49	36	40 34	36	41 18	38	42 3	38	42 48	39	43 32	40	44 17	41	45
43	38 29	36	39 12	37	39 56	38	40 40	38	41 24	39	42 8	40	42 5	41	43 36	42	44
44	37 52	37	38 35	37	39 18	38	40 1	39	40 44	40	41 27	41	42 11	42	42 54	43	43
45	37 14	38	37 56	39	38 39	39	39 21	40	40 4	40	40 46	42	41 25	43	42 11	44	43
46	36 36	38	37 17	39	37 52	40	38 41	40	39 22	42	40 4	43	40 46	44	41 27	44	42
47	35 57	39	36 38	40	37 10	42	37 57	42	38 40	42	39 21	44	40 2	44	40 43	45	41
48	35 17	40	35 57	41	36 37	42	37 17	43	37 57	43	38 37	44	39 18	46	39 58	46	40
49	34 36	41	35 16	42	35 55	43	36 34	43	37 14	45	37 53	45	38 32	46	39 12	47	40
50	33 55	42	34 34	43	35 12	44	35 51	45	36 29	45	37 8	46	37 46	47	38 25	48	39
51	33 13	43	33 51	44	34 28	44	35 6	45	35 44	46	36 22	47	36 59	47	37 37	48	38
52	32 30	43	33 7	44	33 44	45	34 21	46	34 58	47	35 35	47	36 12	48	36 49	49	37
53	31 47	44	32 23	45	32 59	46	33 35	46	34 11	47	34 48	49	35 24	49	36 0	50	36
54	31 3	44	31 38	45	32 13	46	32 49	47	33 24	48	33 59	48	34 35	50	35 10	51	35
55	30 19	46	30 53	45	31 27	47	32 2	48	32 36	48	33 11	50	33 45	51	34 19	51	34
56	29 33	46	30 7	46	30 40	47	31 14	48	31 48	50	32 21	50	32 54	50	33 28	52	33
57	28 48	45	29 20	47	29 53	48	30 26	49	30 58	49	31 31	51	32 4	52	32 36	52	32
58	28 1	47	28 33	47	29 5	49	29 37	50	30 9	49	30 40	51	31 12	52	31 44	53	32
59	27 15	48	27 45	48	28 16	49	28 47	50	29 18	51	29 49	52	30 20	53	30 51	54	31
60	26 27	48	26 57	49	27 27	50	27 57	51	28 27	51	28 57	52	29 27	53	29 5	54	30
61	25 39	48	26 8	49	26 37	50	27 6	51	27 36	53	28 5	53	28 34	54	29 3	55	29
62	24 51	49	25 19	49	25 47	51	26 15	51	26 43	52	27 12	54	27 40	54	28 8	55	28
63	24 2	49	24 29	50	24 56	51	25 24	52	25 51	53	26 18	54	26 45	55	27 13	56	27
64	23 13	50	23 39	50	24 5	52	24 32	53	24 58	54	25 24	54	25 50	55	26 17	57	26
65	22 23	50	22 48	51	23 13	52	23 39	53	24 4	54	24 30	56	24 55	56	25 2	57	25
66	21 33	51	21 57	52	22 21	52	22 46	53	23 10	54	23 34	55	23 59	57	24 23	57	24
67	20 42	51	21 5	52	21 29	53	21 52	54	22 16	55	22 39	56	23 2	57	23 26	58	24
68	19 51	52	20 13	52	20 36	54	20 58	54	21 21	55	21 43	56	22 6	58	22 28	58	23
69	18 59	52	19 21	52	19 42	54	20 4	54	20 25	56	20 47	57	21 8	58	21 31	59	22
70	18 7	52	18 28	53	18 49	55	19 9	55	19 30	57	19 50	57	20 11	59	20 31	59	21
71	17 15	52	17 35	54	17 54	54	18 14	56	18 33	56	18 53	58	19 12	59	19 31	59	20
72	16 23	52	16 41	54	17 0	55	17 18	56	17 37	57	17 55	57	18 14	59	18 33	60	19
73	15 30	53	15 47	54	16 5	55	16 22	56	16 40	57	16 58	59	17 15	59	17 33	60	18
74	14 37	53	14 53	54	15 10	56	15 26	56	15 43	58	15 59	58	16 16	60	16 33	61	17
75	13 43	54	13 59	54	14 14	56	14 30	57	14 45	57	15 1	59	15 16	59	15 32	61	16
76	12 49	54	13 4	55	13 19	56	13 33	57	13 48	58	14 2	59	14 17	61	14 31	61	15
77	11 56	55	12 9	55	12 23	57	12 36	57	12 50	59	13 3	59	13 16	60	13 30	61	14
78	11 1	55	11 14	55	11 26	57	11 39	58	11 51	58	12 4	60	12 16	60	12 29	61	13
79	10 7	54	0 19	55	10 30	57	10 41	58	10 53	59	11 4	60	11 16	61	11 28	62	12
80	9 13	54	9 23	56	9 33	57	9 44	58	9 54	59	10 5	60	10 15	61	10 26	62	11
81	8 18	55	8 27	56	8 37	57	8 46	58	8 55	59	9 5	60	9 14	61	9 24	62	9
82	7 23	55	7 31	56	7 40	58	7 48	58	7 56	59	8 5	61	8 13	61	8 21	63	8
83	6 28	55	6 35	56	6 42	57	6 50	58	6 57	59	7 4	60	7 12	62	7 19	62	7
84	5 32	56	5 39	56	5 45	57	5 52	59	5 58	60	6 4	60	6 10	61	6 17	63	6
85	4 37	55	4 43	56	4 48	58	4 53	59	4 58	59	5 4	61	5 9	62	5 14	63	5
86	3 42	55	3 46	57	3 50	58	3 55	59	3 59	60	4 3	61	4 7	62	4 11	63	4
87	2 47	55	2 50	56	2 53	57	2 56	59	2 59	60	3 2	60	3 5	61	3 9	62	3
88	1 51	56	1 53	57	1 55	58	1 57	59	1 59	60	2 2	61	2 4	62	2 6	63	2
89	0 56	55	0 57	56	0 58	57	0 59	58	1 0	59	1 1	61	1 2	62	1 3	63	1

Digitized by Google

TABLE I.
LOGARITHMIC DIFFERENCE.

Arg. app. alt ☽	Arg. Moon's Horizontal Parallax. 54′	D.	55′	D.	56′	D.	57′	D.	58′	D.	59′	D.	60′	D.	61′	D.	d. P
3°	9831		9823		9815		9807		9799		9790		9782		9774		
		115		117		120		122		124		126		129		131	8
4	9716		9706		9695		9685		9675		9664		9653		9643		10
		117		119		121		124		126		128		130		133	
5	9599		9587		9574		9561		9549		9536		9523		9510		12
		118		121		123		124		127		129		131		134	
6	9481		9466		9451		9437		9422		9407		9392		9376		15
		118		121		123		126		128		130		132		134	
7	9363		9345		9328		9311		9294		9277		9260		9242		17
		119		120		122		125		127		130		132		134	
8	9244		9225		9206		9186		9167		9147		9128		9108		19
		118		120		123		124		127		129		131		133	
9	9126		9105		9083		9062		9040		9018		8997		8975		22
		117		120		122		125		126		128		131		133	
10	9009		8985		8961		8937		8914		8890		8866		8842		23
		118		120		122		124		127		129		131		133	
11	8891		8865		8839		8813		8787		8761		8735		8709		26
		117		119		121		123		125		127		130		132	
12	8774		8746		8718		8690		8662		8634		8605		8577		28
	9.99	116		118		121		123		126		128		129		132	
13	8658		8628		8597		8567		8536		8506		8476		8445		30
		116		118		120		123		124		126		129		131	
14	8542		8510		8477		8444		8412		8380		8347		8314		33
		116		119		120		122		124		127		129		131	
15	8426		8391		8357		8322		8288		8253		8218		8183		35
		115		116		119		121		123		125		127		129	
16	8311		8275		8238		8201		8165		8128		8091		8054		36
		114		117		119		121		124		126		128		130	
17	8197		8158		8119		8080		8041		8002		7963		7924		39
		114		116		118		120		122		124		126		128	
18	8083		8042		8001		7960		7919		7878		7837		7796		41
	9.99	113		115		117		119		121		124		126		129	
19	7970		7927		7884		7841		7798		7754		7711		7667		43
		113		115		117		119		121		122		125		126	
20	7857		7812		7767		7722		7677		7632		7586		7541		45
		112		114		116		118		121		123		124		127	
21	7745		7698		7651		7604		7556		7509		7462		7414		48
		110		112		115		117		118		121		123		124	
22	7635		7586		7536		7487		7438		7388		7339		7290		49
		110		112		114		116		119		120		123		125	
23	7525		7474		7422		7371		7319		7268		7216		7165		51
		110		112		113		116		117		118		121		123	
24	7415		7362		7309		7255		7202		7148		7095		7042		53
	9.99	108		110		113		114		116		118		120		123	
25	7307		7252		7196		7141		7086		7030		6975		6919		55
		108		110		112		114		116		117		120		120	
26	7199		7142		7084		7027		6970		6913		6855		6798		57
		107		109		110		112		114		117		118		121	
27	7092		7033		6974		6915		6856		6796		6737		6677		59
		105		107		110		112		114		116		118		120	
28	6987		6926		6864		6803		6742		6680		6619		6557		61
		105		107		108		110		112		114		116		118	
29	6882		6819		6756		6693		6630		6566		6503		6439		63
		103		106		108		110		112		113		116		117	
30	6779		6713		6648		6583		6518		6453		6387		6322		65
	9.99	103		104		106		108		110		113		114		116	
31	6676		6609		6542		6475		6408		6340		6273		6206		67
		101		103		105		107		109		110		112		115	
32	6575		6506		6437		6368		6299		6230		6161		6091		69
		101		103		105		106		108		110		112		113	
33	6474		6403		6332		6262		6191		6120		6049		5978		71
		100		101		103		105		107		109		110		112	
34	6374		6302		6229		6157		6084		6011		5939		5866		73
		97		100		101		104		105		107		109		111	
35	6277		6202		6128		6053		5979		5904		5830		5755		76
		97		99		101		102		104		106		108		110	
36	6180		6103		6027		5951		5875		5798		5722		5645		77
	9.99	96		97		99		101		103		104		107		108	
37	6084		6006		5928		5850		5772		5694		5615		5537		78
		95		96		98		100		102		104		105		107	
38	5989		5910		5830		5750		5670		5590		5510		5430		82
		93		95		97		98		100		102		103		105	
39	5896		5815		5733		5652		5570		5488		5407		5325		83
		92		94		95		98		99		100		103		104	
40	5804		5721		5638		5554		5471		5388		5304		5221		84
		91		93		94		95		97		99		100		102	
41	5713		5628		5544		5459		5374		5289		5204		5119		85
		89		90		93		94		96		98		99		101	
42	5624		5538		5451		5365		5278		5191		5105		5018		87
	9.99	88		90		91		93		94		96		98		99	
43	5536		5448		5360		5272		5184		5095		5007		4919		88
		86		88		89		91		93		94		96		98	
44	5450		5360		5271		5181		5091		5001		4911		4821		90
		85		86		89		90		91		93		94		96	
45	5365		5274		5182		5091		5000		4908		4817		4725		91
		83		85		86		88		90		91		93		94	
46	5282		5189		5096		5003		4910		4817		4724		4631		93
		82		84		85		87		88		90		91		93	
47	5200		5105		5011		4916		4822		4727		4633		4538		94
	9.99	81		82		84		85		87		88		90		91	
48	5119		5023		4927		4831		4735		4639		4543		4447		95
		79		80		82		83		85		86		88		89	
49	5040		4943		4845		4748		4650		4553		4455		4358		97
		78		79		80		82		83		85		86		88	
50	4962		4864		4765		4666		4567		4468		4369		4270		99
		76		78		79		80		81		83		84		85	
51	4886		4786		4686		4586		4486		4385		4285		4185		100
		74		76		77		79		80		81		83		84	
52	4812		4710		4609		4507		4406		4304		4202		4101		102
		73		73		75		76		78		79		80		82	
53	4739		4637		4534		4431		4328		4225		4122		4019		103
		71		73		74		75		76		78		80		80	
54	4668		4564		4460		4356		4252		4147		4043		3939		104
	9.99	69		70		72		73		75		75		77		79	
55	4599		4494		4388		4283		4177		4072		3966		3860		106
		67		69		69		71		72		74		75		76	
56	4532		4425		4319		4212		4105		3998		3891		3784		107
		66		67		69		70		71		72		73		74	
57	4466		4358		4250		4142		4034		3926		3818		3710		108
		63		64		66		67		68		69		70		72	
58	4403		4294		4184		4075		3966		3857		3748		3638		109
		62		64		64		66		67		68		69		70	
59	4341		4230		4120		4009		3899		3789		3679		3568		110
		60		61		62		63		64		66		67		68	
60	4281		4169		4058		3946		3835		3723		3612		3500		111
	9.99	59		59		61		61		63		63		65		66	
61	4222		4110		3997		3885		3772		3660		3547		3434		113
		57		58		59		60		61		63		63		64	
62	4165		4052		3938		3825		3711		3597		3484		3370		114
		55		56		57		59		59		60		61		62	
63	4110		3996		3881		3766		3652		3537		3422		3308		115
		53		55		55		56		58		58		59		61	

TABLE I.
LOGARITHMIC DIFFERENCE.

Arg. App. alt ☽ | Arg. Moon's Horizontal Parallax.

	54′	D.	55′	D.	56′	D.	57′	D.	58′	D.	59′	D.	60′	D.	61′	D.	d.P
64°	4057	52	3941	53	3826	54	3710	54	3594	55	3479	57	3363	57	3247	58	116
65	4005	49	3888	50	3772	51	3656	53	3539	53	3422	54	3306	55	3189	56	117
66	3956	48	3838	48	3721	49	3603	50	3486	51	3368	51	3251	53	3133	53	118
67	3908	46	3790	47	3672	48	3553	48	3435	49	3317	50	3198	51	3080	52	119
68	3862	44	3743	45	3624	46	3505	47	3386	48	3267	49	3147	49	3028	50	120
69	3818	41	3698	42	3578	43	3458	43	3338	44	3218	45	3098	46	2978	47	120
70	3777	40	3656	41	3535	41	3415	42	3294	43	3173	43	3052	44	2931	44	121
71	3737	38	3615	39	3494	39	3373	40	3251	40	3130	42	3008	42	2887	43	122
72	3699	35	3576	35	3455	37	3333	38	3211	39	3088	39	2966	40	2844	41	122
73	3664	34	3541	35	3418	36	3295	37	3172	37	3049	37	2926	38	2803	38	123
74	3630	33	3506	33	3382	33	3258	33	3135	34	3012	35	2888	35	2765	36	124
75	3597	30	3473	30	3349	31	3225	32	3101	33	2977	33	2853	34	2729	35	124
76	3567	27	3443	28	3318	29	3193	29	3068	29	2944	30	2819	31	2694	31	125
77	3540	26	3415	27	3289	26	3164	27	3039	27	2914	28	2788	28	2663	29	125
78	3514	23	3388	23	3263	24	3137	24	3012	25	2886	26	2760	26	2634	26	126
79	3491	22	3365	22	3239	22	3113	23	2987	23	2860	23	2734	24	2608	24	126
80	3469	19	3343	20	3217	21	3090	21	2964	21	2837	21	2710	21	2584	22	126
81	3450	17	3323	17	3196	18	3069	18	2943	19	2816	19	2689	20	2562	20	127
82	3433	15	3306	16	3178	16	3051	16	2924	17	2797	17	2669	17	2542	17	128
83	3418	13	3290	13	3162	13	3035	14	2907	14	2780	15	2652	14	2525	15	128
84	3405	12	3277	12	3149	12	3021	12	2893	12	2765	12	2638	13	2510	13	128
85	3393	9	3265	10	3137	10	3009	10	2881	10	2753	10	2625	10	2497	10	128
86	3384	7	3255	7	3127	7	2999	8	2871	8	2743	8	2615	8	2487	8	128
87	3377	6	3248	6	3120	6	2991	6	2863	6	2735	6	2607	7	2479	7	128
88	3371	3	3242	3	3114	3	2985	3	2857	3	2729	3	2600	3	2472	3	128
89	3368	2	3239	2	3111	3	2982	2	2854	3	2726	3	2597	1	2469	2	129
90	3366		3237		3108		2980		2853		2725		2596		2467		129

TABLE K.
CORRECTION OF THE LOGARITHMIC DIFFERENCE, WHEN THE MOON'S DISTANCE FROM THE *SUN* IS OBSERVED.

App. altit. sun.	Cor. Sub.	App alt. sun.	Cor. Sub.	App alt. sun.	Cor. Sub.	App alt. sun.	Cor. Sub.	App alt. sun.	Cor. Sub.
° ′	—	° ′	—	°	—	°	—	°	—
0 0	140	4 0	19	19	7	43	13	67	17
10	126	10	18	20	8	44	13	68	17
20	114	20	17	21	8	45	13	69	17
30	104	30	16	22	8	46	13	70	17
40	94	40	15	23	8	47	14	71	18
50	85	50	15	24	9	48	14	72	18
1 0	77	5 0	14	25	9	49	14	73	18
10	70	20	13	26	9	50	14	74	18
20	64	40	12	27	9	51	14	75	18
30	58	6 0	11	28	9	52	15	76	18
40	53	20	10	29	10	53	15	77	18
50	49	40	10	30	10	54	15	78	18
2 0	45	7	9	31	10	55	15	79	18
10	41	8	8	32	10	56	16	80	18
20	38	9	7	33	10	57	16	81	18
30	35	10	7	34	11	58	16	82	18
40	33	11	7	35	11	59	16	83	19
50	30	12	6	36	11	60	16	84	19
3 0	28	13	6	37	11	61	16	85	19
10	26	14	6	38	11	62	16	86	19
20	25	15	6	39	12	63	17	87	19
30	23	16	6	40	12	64	17	88	19
40	22	17	7	41	12	65	17	89	19
50	20	18	7	42	13	66	17	90	19

TABLE L.
CORRECT. OF THE LOG. DIFF. WHEN THE ☽'s DISTANCE FROM A *STAR* IS OBSERVED.

App. altit. star.	Cor. Sub.	App. alt. star.	Cor. Sub.	App. alt. star.	Cor. Sub.
° ′	—	° ′	—	°	—
0 0	140	4 0	18	19	1
10	126	10	17	20	1
20	114	20	16	21	1
30	103	30	15	22	1
40	94	40	14	23	1
50	85	50	13	24	1
1 0	77	5 0	12	25	1
10	70	20	11	26	1
20	64	40	10	27	1
30	58	6 0	9	28	1
40	53	20	8	29	1
50	48	40	8	30	0
2 0	44	7	7	31	0
10	41	8	6	32	0
20	37	9	5	33	0
30	35	10	4	34	0
40	32	11	3	35	0
50	29	12	3	36	0
3 0	27	13	2	40	0
10	25	14	2	50	0
20	23	15	1	60	0
30	22	16	1	70	0
40	20	17	1	80	0
50	19	18	0	90	0

Digitized by Google

TABLES

FOR REDUCING THE *TRUE* ALTITUDES OF THE SUN, MOON, AND STARS, TO THEIR *APPARENT* ALTITUDES.

TABLE *M.*

Reduction of the ☉'s alt.

Arg. True altit.	′	″
0	1	
1 0	21	53
1 10	20	59
1 20	20	7
1 30	19	19
1 40	18	33
1 50	17	47
2 0	17	7
2 10	16	28
2 20	15	51
2 30	15	16
2 40	14	43
2 50	14	12
3 0	13	43
3 20	12	49
3 40	12	1
4 0	11	17
4 20	10	38
4 40	10	2
5 0	9	29
5 30	8	46
6 0	8	8
6 30	7	33
7 0	7	4
7 30	6	38
8 0	6	15
8 30	5	55
9 0	5	36
10	5	3
11	4	36
12	4	12
13	3	53
14	3	35
15	3	20
16	3	7
17	2	55
18	2	45
19	2	35
20	2	27
21	2	19
22	2	12
23	2	6
24	2	0
25	1	54
26	1	48
27	1	43
28	1	39
29	1	34
30	1	30
31	1	27
32	1	23
33	1	20
34	1	17
35	1	14
36	1	11

TABLE *N.*

REDUCTION OF THE MOON's *TRUE* ALTITUDE.

Arg. Moon's Horizontal Parallax.

Arg.	53′		54′		55′		56′		57′		58′		59′		60′		61′		62′	
	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″
0	25	15	26	8	27	1	27	54	28	47	29	40	30	32	31	25	32	18	33	10
10	26	28	27	21	28	13	29	6	29	59	30	52	31	45	32	38	33	31	34	24
20	27	36	28	29	29	23	30	16	31	9	32	3	32	56	33	49	34	42	35	35
30	28	40	29	34	30	27	31	21	32	15	33	9	34	2	34	56	35	50	36	43
40	29	42	30	36	31	29	32	23	33	17	34	11	35	5	35	59	36	53	37	46
50	30	40	31	34	32	28	33	22	34	16	35	11	36	5	36	59	37	53	38	47
0	31	35	32	29	33	24	34	19	35	13	36	8	37	3	37	57	38	52	39	46
10	32	27	33	22	34	17	35	12	36	7	37	1	37	56	38	51	39	46	40	41
20	33	17	34	12	35	7	36	2	36	57	37	53	38	48	39	43	40	38	41	33
30	34	3	34	59	35	54	36	49	37	45	38	40	39	36	40	31	41	26	42	22
40	34	48	35	43	36	39	37	35	38	30	39	25	40	20	41	16	42	12	43	7
50	35	29	36	25	37	21	38	17	39	13	40	8	41	4	42	0	42	56	43	52
0	36	9	37	5	38	1	38	58	39	54	40	50	41	46	42	42	43	38	44	34
10	37	22	38	19	39	15	40	12	41	8	42	4	42	59	43	56	44	53	45	49
20	38	26	39	23	40	19	41	16	42	13	43	10	44	7	45	4	46	1	46	58
30	39	23	40	20	41	17	42	14	43	11	44	9	45	6	46	3	47	0	47	57
40	40	13	41	11	42	8	43	6	44	3	45	1	45	58	46	55	47	53	48	50
50	40	58	41	56	42	54	43	52	44	50	45	47	46	44	47	42	48	40	49	38
0	41	40	42	38	43	36	44	34	45	32	46	30	47	28	48	26	49	23	50	21
10	42	33	43	31	44	29	45	27	46	25	47	23	48	22	49	20	50	18	51	16
20	43	18	44	17	45	15	46	14	47	12	48	11	49	9	50	7	51	5	52	4
30	43	57	44	56	45	54	46	53	47	51	48	50	49	49	50	46	51	45	52	44
40	44	32	45	30	46	29	47	28	48	26	49	25	50	24	51	22	52	20	53	19
50	45	2	46	1	47	0	47	59	48	57	49	56	50	54	51	53	52	42	53	51
0	45	28	46	27	47	26	48	24	49	23	50	22	51	21	52	20	53	19	54	17
10	45	49	46	48	47	47	48	46	49	45	50	43	51	42	52	41	53	40	54	39
20	46	8	47	7	48	6	49	5	50	4	51	2	52	1	53	0	53	59	54	58
30	46	38	47	37	48	36	49	35	50	34	51	32	52	31	53	30	54	29	55	28
40	47	1	48	0	48	59	49	58	50	57	51	55	52	54	53	53	54	51	55	50
50	47	18	48	16	49	15	50	14	51	13	52	11	53	10	54	9	55	8	56	7
0	47	29	48	28	49	26	50	25	51	23	52	22	53	21	54	19	55	18	56	16
10	47	36	48	35	49	33	50	32	51	30	52	29	53	27	54	25	55	23	56	22
20	47	42	48	40	49	38	50	36	51	34	52	33	53	31	54	29	55	27	56	25
30	47	42	48	40	49	38	50	36	51	34	52	32	53	30	54	28	55	26	56	24
40	47	39	48	37	49	34	50	32	51	30	52	27	53	25	54	23	55	21	56	19
50	47	36	48	33	49	31	50	28	51	26	52	23	53	20	54	18	55	15	56	12
0	47	29	48	26	49	23	50	21	51	18	52	15	53	12	54	9	55	6	56	3
10	47	21	48	18	49	14	50	11	51	8	52	5	53	2	53	59	54	56	55	52
20	47	11	48	8	49	4	50	0	50	57	51	53	52	50	53	47	54	43	55	40
30	46	59	47	55	48	51	49	47	50	44	51	40	52	36	53	32	54	28	55	25
40	46	45	47	41	48	37	49	32	50	28	51	24	52	20	53	16	54	11	55	7
50	46	30	47	26	48	21	49	16	50	11	51	7	52	3	52	58	53	53	54	49
0	46	14	47	9	48	4	48	59	49	54	50	49	51	44	52	39	53	35	54	29
10	45	56	46	51	47	45	48	40	49	35	50	29	51	24	52	18	53	13	54	8
20	45	37	46	32	47	26	48	20	49	14	50	8	51	3	51	57	52	51	53	45
30	45	17	46	11	47	4	47	58	48	52	49	46	50	39	51	33	52	27	53	21
40	44	55	45	49	46	42	47	35	48	28	49	22	50	15	51	8	52	2	52	55
50	44	33	45	26	46	19	47	12	48	4	48	57	49	50	50	43	51	35	52	28
0	44	9	45	2	45	54	46	46	47	38	48	31	49	23	50	15	51	7	51	59
10	43	44	44	36	45	28	46	19	47	11	48	2	48	55	49	46	50	38	51	30
20	43	18	44	10	45	1	45	51	46	43	47	34	48	25	49	17	50	8	50	59
30	42	51	43	42	44	33	45	23	46	14	47	5	47	55	48	46	49	36	50	27
40	42	24	43	14	44	4	44	54	45	45	46	34	47	24	48	14	49	4	49	54
50	41	55	42	44	43	34	44	23	45	33	46	2	46	52	47	41	48	30	49	20

TABLE *O.*

Reduction of a Star's altitude.

	′	″
0	22	2
10	21	8
20	20	16
30	19	28
40	18	42
50	17	58
0	17	10
10	16	37
20	16	0
30	15	25
40	14	52
50	14	21
0	13	52
10	12	58
20	12	10
30	11	26
40	10	47
50	10	11
0	9	38
10	8	55
20	8	17
30	7	42
40	7	13
50	6	47
0	6	24
10	6	4
20	5	45
30	5	12
40	4	45
50	4	21
0	4	2
10	3	44
20	3	29
30	3	16
40	3	4
50	2	54
0	2	44
10	2	35
20	2	27
30	2	20
40	2	14
50	2	7
0	2	2
10	1	56
20	1	51
30	1	47
40	1	42
50	1	38
0	1	35
10	1	31
20	1	28
30	1	24
40	1	21
50	1	18

Digitized by Google

TABLES

FOR REDUCING THE *TRUE* ALTITUDES OF THE SUN, MOON, AND STARS, TO THEIR *APPARENT* ALTITUDES.

TABLE *M.*

Arg. True altit.	Reduct of the ☉'s alt.
°	′ ″
37	1 9
38	1 6
39	1 3
40	1 1
41	58
42	56
43	54
44	53
45	51
46	49
47	47
48	45
49	43
50	42
51	40
52	39
53	37
54	36
55	35
56	33
57	32
58	30
59	29
60	28
61	27
62	26
63	25
64	24
65	22
66	21
67	20
68	19
69	18
70	17
71	16
72	15
73	14
74	14
75	13
76	12
77	11
78	10
79	9
80	8
81	8
82	7
83	6
84	5
85	4
86	3
87	3
88	2
89	1
90	0

TABLE *N.*

REDUCTION OF THE MOON's *TRUE* ALTITUDE.

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

TABLE *O.*

Reduction of a Star's Altitude.

′	″
1	16
1	13
1	10
1	8
1	5
1	3
1	1
	59
	57
	55
	53
	51
	49
	48
	46
	44
	43
	41
	40
	38
	37
	35
	34
	32
	30
	29
	28
	26
	25
	24
	23
	22
	21
	19
	18
	17
	16
	15
	14
	13
	12
	11
	10
	9
	8
	7
	6
	5
	4
	3
	2
	1
	0

Digitized by Google

TABLE P.

ALTITUDE TO BE OBSERVED, IN ORDER TO ASCERTAIN THE APPARENT TIME WITH THE GREATEST ACCURACY.

Arg. Latit.	Arg. 2°	Arg. 4°	Declination of the Sun or Star, of the same name as the Latitude. 6°	8°	10°	12°	14°	16°	18°	20°	22°	24°
°	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
1	30 1	14 29	9 37	7 12	5 46	4 49	4 8	3 38	3 14	2 55	2 40	2 28
2	90 0	30 1	19 30	14 31	11 36	9 40	8 18	7 17	6 29	5 52	5 21	4 55
3	41 49	48 37	30 3	22 5	17 32	14 35	12 36	10 57	9 45	8 48	8 2	7 24
4	30 1	90 0	41 52	30 5	23 41	19 36	16 45	14 40	13 3	11 46	10 44	9 53
5	23 36	53 10	56 30	38 46	30 8	24 47	21 7	18 26	16 23	14 46	13 27	12 22
6	19 30	41 52	90 0	48 40	37 0	30 11	25 36	22 17	19 46	17 48	16 12	14 53
7	16 38	34 55	59 4	61 7	44 34	35 53	30 15	26 14	23 14	20 52	18 59	17 26
8	14 31	30 5	48 41	90 0	53 16	42 1	35 7	30 20	26 46	24 1	21 48	20 1
9	12 53	26 29	41 56	62 50	64 16	48 48	40 17	34 35	30 25	27 13	24 41	22 37
10	11 35	23 41	37 0	53 17	90 0	56 38	45 52	39 3	34 11	30 30	27 37	25 16
11	10 32	21 27	33 13	46 50	65 31	69 36	52 4	43 48	38 8	33 55	30 37	27 59
12	9 40	19 36	30 11	42 2	56 39	90 0	59 15	48 58	42 17	37 26	33 42	30 44
13	8 55	18 4	27 41	38 13	50 32	67 33	68 25	54 42	46 43	41 8	36 54	33 35
14	8 18	16 45	25 36	35 7	45 53	59 15	90 0	61 22	51 31	45 1	40 13	36 30
15	7 45	15 38	23 49	32 32	42 8	53 27	69 11	69 53	56 53	49 11	43 43	39 31
16	7 16	14 40	22 17	30 20	39 4	48 59	61 23	90 0	63 6	53 43	47 22	42 39
17	6 51	13 48	20 57	28 26	36 26	45 20	55 50	70 31	71 7	58 44	51 18	45 57
18	6 29	13 3	19 46	26 46	34 11	42 17	51 32	63 8	90 0	64 37	55 34	49 26
19	6 9	12 22	18 44	25 18	32 14	39 41	48 0	57 51	71 39	72 9	60 21	53 10
20	5 51	11 46	17 48	24 1	30 31	37 27	45 2	53 43	64 37	90 0	65 54	57 13
21	5 35	11 12	16 57	22 51	28 59	35 28	42 28	50 17	59 34	72 37	73 4	61 46
22	5 21	10 44	16 12	21 49	27 37	33 43	40 14	47 22	55 35	65 56	90 0	67 5
23	5 7	10 17	15 31	20 52	26 23	32 9	38 15	44 52	52 16	61 5	73 29	73 52
24	4 55	9 53	14 53	20 1	25 17	30 45	36 30	42 40	49 27	57 15	67 6	90 0
25	4 44	9 30	14 19	19 14	24 16	29 28	34 55	40 43	46 59	54 2	62 25	74 14
26	4 34	9 9	13 48	18 31	23 21	28 19	33 30	38 58	44 50	51 18	58 44	68 7
27	4 25	8 50	13 19	17 51	22 29	27 15	32 12	37 23	42 54	48 53	55 36	63 37
28	4 16	8 33	12 52	17 15	21 43	26 17	31 1	35 57	41 10	46 47	52 57	60 3
29	4 8	8 16	12 27	16 41	20 59	25 23	29 56	34 39	39 36	44 52	50 37	57 2
30	4 0	8 1	12 4	16 10	20 19	24 34	28 56	33 27	38 11	43 10	48 32	54 26
31	3 53	7 47	11 43	15 41	19 42	23 48	28 1	32 21	36 52	41 37	46 40	52 9
32	3 47	7 34	11 23	15 14	19 8	23 6	27 10	31 20	35 41	40 12	45 0	50 8
33	3 40	7 22	11 4	14 48	18 36	22 26	26 22	30 24	34 34	38 54	43 27	48 19
34	3 35	7 10	10 46	14 25	18 5	21 50	25 38	29 32	33 33	37 43	42 4	46 40
35	3 29	6 59	10 30	14 3	17 37	21 15	24 57	28 43	32 36	36 36	40 47	45 10
36	3 24	6 49	10 15	13 42	17 11	20 43	24 18	27 58	31 43	35 39	36 43	43 48
37	3 19	6 39	10 0	13 22	16 46	20 12	23 42	27 16	30 54	34 38	38 30	42 31
38	3 15	6 31	9 47	13 4	16 23	19 44	23 9	26 36	30 8	33 45	37 29	41 22
39	3 11	6 22	9 34	12 47	16 1	19 17	22 36	25 59	29 24	32 55	36 32	40 16
40	3 7	6 14	9 21	12 30	15 40	18 52	22 7	25 24	28 44	32 9	35 39	39 15
42	2 59	5 59	8 59	11 59	15 3	18 6	21 12	24 20	27 30	30 45	34 3	37 26
44	2 53	5 46	8 39	11 33	14 29	17 25	20 23	23 23	26 25	29 30	32 38	35 50
46	2 47	5 34	8 21	11 10	13 58	16 48	19 39	22 32	25 27	28 24	31 23	34 26
48	2 41	5 23	8 5	10 48	13 31	16 15	19 0	21 46	24 34	27 27	30 16	33 11
50	2 36	5 13	7 50	10 28	13 6	15 45	18 25	21 5	23 48	26 32	29 17	32 4
52	2 32	5 5	7 37	10 11	12 44	15 18	17 53	20 29	23 6	25 44	28 23	31 5
54	2 28	4 57	7 25	9 54	12 24	14 53	17 24	19 55	22 28	25 1	27 35	30 11
56	2 25	4 50	7 14	9 40	12 6	14 32	16 58	19 25	21 53	24 22	26 52	29 23
58	2 22	4 43	7 4	9 27	11 49	14 12	16 35	18 58	21 22	23 47	26 13	28 40
60	2 19	4 37	6 56	9 15	11 34	13 54	16 15	18 33	20 54	23 16	25 38	28 1
62	2 16	4 31	6 48	9 4	11 21	13 37	15 54	18 12	20 30	22 48	25 7	27 26
64	2 14	4 27	6 41	8 53	11 9	13 23	15 37	17 53	20 7	22 22	24 38	26 54
66	2 12	4 22	6 34	8 46	10 58	13 10	15 22	17 34	19 46	22 0	24 13	26 26
68	2 9	4 19	6 28	8 37	10 48	12 58	15 8	17 18	19 28	21 39	23 50	26 1
70	2 8	4 15	6 23	8 31	10 39	12 47	14 55	17 3	19 12	21 21	23 30	25 39
72	2 6	4 12	6 19	8 25	10 31	12 38	14 44	16 51	18 58	21 5	23 12	25 19
74	2 5	4 9	6 15	8 20	10 25	12 30	14 35	16 40	18 45	20 51	22 56	25 2
76	2 4	4 7	6 11	8 15	10 19	12 23	14 27	16 30	18 34	20 39	22 43	24 47
78	2 3	4 5	6 8	8 11	10 14	12 16	14 19	16 22	18 25	20 29	22 31	24 34
80	2 2	4 4	6 5	8 8	10 10	12 11	14 14	16 15	18 17	20 20	22 22	24 24

Digitized by Google

TABLE Q.

CORRECTION OF OBSERVED ALT. FOR SPHEROIDAL FIGURE OF THE EARTH.

azim. +	Arg. Latitude of the Place of Obervation. 2°	4°	6°	9°	12°	15°	18°	21°	24°	27°	30°	35°	40°	45°	azim. —
°	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	°
0	0 43	1 26	2 8	3 11	4 11	5 8 6	3	6 53	7 39	8 19	8 55	9 41	10 9	10 18	180
5	0 43	1 26	2 7	3 10	4 10	5 7	6 2	6 51	7 37	8 17	8 53	9 38	10 7	10 16	175
10	0 42	1 25	2 6	3 8	4 7	5 3	5 58	6 47	7 32	8 11	8 46	9 32	9 59	10 8	170
15	0 41	1 23	2 4	3 4	4 2	4 57	5 51	6 39	7 23	8 2	8 36	9 21	9 48	9 57	165
18	0 41	1 22	2 2	3 2	3 59	4 53	5 45	6 33	7 17	7 55	8 28	9 13	9 39	9 48	162
21	0 40	1 20	1 59	2 58	3 54	4 47	5 39	6 25	7 9	7 46	8 19	9 2	9 27	9 37	159
24	0 39	1 19	1 57	2 55	3 49	4 41	5 32	6 17	6 59	7 36	8 9	8 51	9 16	9 25	156
27	0 38	1 17	1 54	2 50	3 44	4 34	5 23	6 8	6 49	7 25	7 57	8 38	9 3	9 11	153
30	0 37	1 15	1 51	2 45	3 37	4 27	5 14	5 58	6 38	7 12	7 43	8 23	8 47	8 54	150
32	0 36	1 13	1 49	2 42	3 33	4 21	5 8	5 50	6 29	7 3	7 34	8 13	8 36	8 44	148
34	0 35	1 11	1 46	2 38	3 28	4 15	5 1	5 42	6 20	6 54	7 24	8 2	8 25	8 32	146
36	0 35	1 10	1 44	2 34	3 23	4 9	4 54	5 34	6 11	6 44	7 13	7 50	8 13	8 20	144
38	0 34	1 8	1 41	2 31	3 18	4 3	4 46	5 26	6 2	6 33	7 2	7 38	8 0	8 7	142
40	0 33	1 6	1 38	2 26	3 12	3 59	4 38	5 16	5 52	6 22	6 50	7 25	7 46	7 53	140
42	0 32	1 4	1 35	2 22	3 7	3 49	4 30	5 7	5 41	6 11	6 38	7 12	7 32	7 39	138
44	0 31	1 2	1 32	2 17	3 1	3 42	4 21	4 57	5 30	5 59	6 25	6 58	7 18	7 25	136
46	0 30	1 0	1 29	2 13	2 54	3 34	4 12	4 47	5 19	5 47	6 12	6 44	7 3	7 9	134
48	0 29	0 58	1 26	2 8	2 48	3 26	4 3	4 36	5 7	5 35	5 58	6 29	6 47	6 53	132
50	0 26	0 55	1 22	2 3	2 41	3 18	3 53	4 25	4 55	5 21	5 44	6 13	6 31	6 37	130
51	0 27	0 54	1 21	2 0	2 38	3 14	3 48	4 20	4 49	5 14	5 37	6 6	6 23	6 29	129
52	0 26	0 53	1 19	1 58	2 35	3 10	3 43	4 14	4 43	5 7	5 29	5 58	6 15	6 20	128
53	0 26	0 52	1 17	1 55	2 31	3 5	3 38	4 8	4 36	5 0	5 22	5 50	6 7	6 12	127
54	0 25	0 51	1 15	1 52	2 27	3 1	3 33	4 3	4 30	4 53	5 14	5 41	5 58	6 3	126
55	0 25	0 49	1 13	1 50	2 24	2 57	3 28	3 57	4 23	4 46	5 7	5 33	5 49	5 54	125
56	0 24	0 48	1 12	1 47	2 20	2 53	3 23	3 51	4 17	4 39	4 59	5 25	5 41	5 46	124
57	0 23	0 47	1 10	1 44	2 17	2 48	3 18	3 45	4 10	4 32	4 51	5 16	5 32	5 37	123
58	0 23	0 46	1 8	1 41	2 13	2 43	3 12	3 39	4 3	4 24	4 43	5 8	5 23	5 27	122
59	0 22	0 44	1 6	1 38	2 9	2 39	3 7	3 33	3 56	4 17	4 35	4 59	5 14	5 18	121
60	0 22	0 43	1 4	1 35	2 5	2 34	3 2	3 26	3 50	4 10	4 27	4 51	5 5	5 9	120
61	0 21	0 42	1 2	1 33	2 2	2 29	2 56	3 20	3 43	4 2	4 19	4 42	4 55	4 58	119
62	0 20	0 40	1 0	1 30	1 58	2 25	2 50	3 14	3 36	3 54	4 11	4 33	4 46	4 50	118
63	0 20	0 39	0 58	1 27	1 54	2 20	2 45	3 8	3 28	3 47	4 3	4 24	4 36	4 41	117
64	0 19	0 38	0 56	1 24	1 50	2 15	2 39	3 1	3 21	3 39	3 55	4 15	4 27	4 31	116
65	0 18	0 36	0 54	1 21	1 46	2 10	2 33	2 55	3 14	3 31	3 46	4 6	4 17	4 21	115
66	0 18	0 35	0 52	1 18	1 42	2 5	2 28	2 48	3 7	3 23	3 38	3 56	4 8	4 11	114
67	0 17	0 34	0 50	1 15	1 38	2 0	2 22	2 41	2 59	3 15	3 29	3 47	3 58	4 2	113
68	0 16	0 32	0 48	1 12	1 34	1 55	2 16	2 35	2 52	3 7	3 20	3 38	3 48	3 51	112
69	0 15	0 31	0 46	1 8	1 30	1 50	2 10	2 28	2 45	2 59	3 12	3 28	3 38	3 41	111
70	0 15	0 29	0 44	1 5	1 26	1 45	2 4	2 21	2 37	2 51	3 3	3 19	3 28	3 31	110
71	0 14	0 28	0 42	1 2	1 22	1 40	1 58	2 14	2 29	2 42	2 54	3 9	3 18	3 21	109
72	0 13	0 27	0 40	0 59	1 18	1 35	1 52	2 8	2 22	2 34	2 45	2 59	3 8	3 11	108
73	0 13	0 25	0 37	0 56	1 13	1 30	1 46	2 1	2 14	2 26	2 36	2 50	2 58	3 1	107
74	0 12	0 24	0 35	0 53	1 9	1 25	1 40	1 54	2 6	2 18	2 27	2 40	2 48	2 50	106
75	0 11	0 22	0 33	0 49	1 5	1 20	1 34	1 47	1 59	2 9	2 18	2 30	2 38	2 40	105
76	0 10	0 21	0 31	0 46	1 1	1 14	1 28	1 40	1 51	2 1	2 9	2 21	2 27	2 29	104
77	0 10	0 19	0 29	0 43	0 56	1 9	1 22	1 33	1 43	1 52	2 0	2 11	2 17	2 19	103
78	0 9	0 18	0 27	0 40	0 52	1 4	1 15	1 26	1 35	1 44	1 50	2 1	2 7	2 8	102
79	0 8	0 16	0 24	0 36	0 48	0 59	1 9	1 19	1 28	1 35	1 42	1 51	1 56	1 58	101
80	0 7	0 15	0 22	0 33	0 44	0 53	1 3	1 12	1 20	1 27	1 33	1 41	1 46	1 47	100
81	0 7	0 13	0 20	0 30	0 39	0 48	0 57	1 5	1 12	1 18	1 24	1 31	1 35	1 37	99
82	0 6	0 12	0 18	0 27	0 35	0 43	0 51	0 57	1 4	1 9	1 14	1 21	1 25	1 26	98
83	0 5	0 10	0 16	0 23	0 31	0 38	0 44	0 50	0 56	1 1	1 5	1 11	1 14	1 15	97
84	0 5	0 9	0 13	0 20	0 26	0 32	0 38	0 43	0 48	0 52	0 56	1 1	1 4	1 5	96
85	0 4	0 7	0 11	0 17	0 22	0 27	0 32	0 36	0 40	0 44	0 47	0 51	0 53	0 54	95
86	0 3	0 6	0 9	0 13	0 18	0 21	0 25	0 29	0 32	0 35	0 37	0 41	0 42	0 43	94
87	0 2	0 5	0 7	0 10	0 13	0 16	0 19	0 22	0 24	0 26	0 28	0 30	0 32	0 32	93
88	0 2	0 3	0 4	0 7	0 9	0 11	0 13	0 14	0 16	0 17	0 19	0 20	0 21	0 22	92
89	0 1	0 2	0 2	0 3	0 4	0 5	0 6	0 7	0 8	0 9	0 9	0 10	0 11	0 11	91
90	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	90
+ azim.	88°	86°	84°	81°	78°	75°	72°	69°	66°	63°	60°	55°	50°	45°	— azim.

Arg. Latitude of the Place of Obervation.

Digitized by Google

TABLE R. DIP OF THE SEA, At different Diſtances from the Obſerver.

Diſt. of land in S. Miles	Height of eye above ſea, in feet. 5 dip	10 dip	15 dip	20 dip	25 dip	30 dip	35 dip	40 dip
M. T.	′	′	′	′	′	′	′	′
0 .1	28	56	85	113	141	170	198	226
0 .2	14	28	42	56	71	85	99	113
0 .3	9	19	28	38	47	56	66	75
0 .4	7	14	21	28	35	42	49	57
0 .5	6	11	17	22	28	34	39	45
0 .6	5	9	14	19	23	28	33	38
0 .7	4	8	12	16	20	24	28	32
0 .8	4	7	11	14	18	21	25	28
0 .9	3	6	9	13	16	19	22	25
1 .0	3	6	9	12	15	17	20	23
1 .1	3	6	8	11	13	16	18	21
1 .2	3	5	8	10	12	15	17	19
1 .3	3	5	7	9	11	14	16	18
1 .4	3	5	7	9	11	13	15	17
1 .5	3	4	6	8	10	12	14	16
1 .6	2	4	6	8	10	11	13	15
1 .7	2	4	6	7	9	11	12	14
1 .8	2	4	6	7	9	10	12	13
1 .9	2	4	5	7	8	10	11	13
2 .0	2	4	5	7	8	9	11	12
2 .5	2	3	4	6	7	8	9	10
3 .0	2	3	4	5	6	7	8	9
3 .5	2	3	4	5	6	6	7	8
4 .0	2	3	4	5	5	6	7	7
5 .0	2	3	4	4	5	6	6	7
6 .0	2	3	4	4	5	5	6	6

TABLE S. DISTANCES of the VISIBLE HORIZON from an OBSERVER or OBJECT, according to the ELEVATION in feet above the Surface of the SEA

Elevation in feet	diſt. in miles	Elevation in feet	diſt. in miles	Elevation in feet	diſt. in miles	Elevation in feet	diſt. in miles
1	1.147	28	6.077	55	8.517	170	14.974
2	1.624	29	6.185	56	8.595	175	15.193
3	1.987	30	6.291	57	8.671	180	15.409
4	2.297	31	6.395	58	8.748	185	15.621
5	2.568	32	6.497	59	8.822	190	15.831
6	2.813	33	6.598	60	8.896	195	16.038
7	3.038	34	6.697	65	9.254	200	16.242
8	3.248	35	6.795	70	9.600	205	16.444
9	3.445	36	6.891	75	9.946	210	16.643
10	3.632	37	6.986	80	10.278	215	16.840
11	3.809	38	7.080	85	10.589	220	17.035
12	3.979	39	7.172	90	10.896	225	17.204
13	4.141	40	7.264	95	11.194	230	17.418
14	4.302	41	7.354	100	11.485	235	17.606
15	4.448	42	7.443	105	11.768	240	17.792
16	4.594	43	7.531	110	12.045	245	17.977
17	4.735	44	7.618	115	12.316	250	18.159
18	4.873	45	7.704	120	12.581	255	18.340
19	5.006	46	7.78	125	12.840	260	18.518
20	5.136	47	7.87	130	13.093	265	18.696
21	5.263	48	7.957	135	13.345	270	18.872
22	5.387	49	8.039	140	13.605	275	19.045
23	5.508	50	8.121	145	13.830	280	19.218
24	5.626	51	8.202	150	14.061	285	19.389
25	5.742	52	8.282	155	14.299	290	19.558
26	5.856	53	8.361	160	14.527	295	19.726
27	5.968	54	8.440	165	14.753	300	19.892

TABLE T. LENGTHS, in MINUTES, of the EQUATOR, of One Degree of the different Parallels of Latitude, both for the Sphere and Spheroid; and of the different Arcs of the Meridian in the Spheroid, from the Equator to the Pole.

Lat.	Deg. on ſphere.	Deg. on ſpher'd	Arc of merid.	Lat.	Deg. on ſphere	Deg. on ſpher'd	Arc of merid.	Lat.	Deg. on ſphere.	Deg. on ſpher'd	Arc of merid.
0°	60′.000	60′.000	0′.000	30	51′.962	52′.002	1790′.302	60	30′.000	30′.070	3587′.515
1	59.991	59.991	59.628	31	51 430	51.473	1850.074	61	9.089	29.158	3647.566
2	59.963	59.964	119.257	32	50.883	50.927	1909.855	62	8.168	28.237	3707.625
3	59.918	59.918	178.887	33	50.320	50.367	1969.644	63	27.239	27.307	3767.692
4	59.854	59.855	238.518	34	49.742	49.791	2029.442	64	26.302	26.369	3827.767
5	59.772	59.773	298.150	35	49.149	49.199	2089.249	65	25.357	25.422	3887.849
6	59.671	59.673	357.784	36	48.541	48.593	2149.065	66	24.404	24.468	3947.939
7	59.553	59.556	417 420	37	47.918	47.972	2208.891	67	23.444	23.506	4008.036
8	59.416	59.420	477.058	38	47.281	47.336	2268.726	68	22.476	22.537	4068.140
9	59.261	59.266	536.699	39	46.629	46.686	2328.570	69	21.502	21.561	4128.251
10	59.088	59.094	596.343	40	45.963	46.022	2388.424	70	20.521	20.578	4188.368
11	58.898	58.904	655.990	41	45.283	45.343	2448.287	71	19.534	19.589	4248.492
12	58.689	58.697	715.641	42	44.589	44.651	2508.160	72	18.541	18.593	4308.622
13	58.462	58.471	775.296	43	43.881	43.945	2568.043	73	17.542	17.592	4368.757
14	58.218	58.228	834.955	44	43.160	43.225	2627.936	74	16.538	16.586	4428.898
15	57.956	57.968	894.618	45	42.426	42.493	2687.838	75	15.529	15.574	4489.044
16	57.676	57.689	954.286	46	41.680	41.747	2747.750	76	14.515	14.558	4549.195
17	57.378	57.394	1013.959	47	40.920	40.988	2807.672	77	13.497	13.537	4609.350
18	57.063	57.080	1073.638	48	40.148	40.217	2867.603	78	12.475	12.512	4669.510
19	56.731	56.750	1133 323	49	39.364	39.434	2927.544	79	11.449	11.483	4729.674
20	56.382	56.402	1193.014	50	38.567	38.638	2987.405	80	10.419	10.450	4789.841
21	56.015	56.037	1252.711	51	37.759	37.831	3047.455	81	9.386	9.414	4850.012
22	55.631	55.655	1312.414	52	36.940	37.011	3107.425	82	8.350	8.376	4910.186
23	55.230	55.257	1372.124	53	36.109	36.181	3167.404	83	7.312	7.335	4970.362
24	54.813	54.841	1431.841	54	35.267	35.339	3227.393	84	6.272	6.291	5030.541
25	54.378	54.409	1491.565	55	34.415	34.487	3287.391	85	5.229	5.246	5090.722
26	53.928	53.960	1551.297	56	33.552	33.624	3347.398	86	4.185	4.198	5150.904
27	53.460	53.495	1611.036	57	32.678	32.750	3407.414	87	3.140	3.149	5211.088
28	52.977	53.013	1670.783	58	31.795	31.866	3467.439	88	2.094	2.099	5271.273
29	52.477	52.516	1730.538	59	30.902	30.973	3527.473	89	1.047	1.048	5331.458
								90	0.000	0.000	5391.644

Digitized by Google

A TABLE OF THE ANGLES

which every Point and Quarter Point of the Compass makes with the Meridian

NORTH.		POINTS.	° ′ ″	POINTS.	SOUTH.	
N. ¼ E.	N. ¼ W.	0 ¼	2 48 45	0 ¼	S. ¼ E.	S. ¼ W.
		0 ½	5 37 30	0 ½		
		0 ¾	8 26 15	0 ¾		
N. b. E.	N. b. W.	1	11 15 0	1	S. b. E.	S. b. W.
		1 ¼	14 3 45	1 ¼		
		1 ½	16 52 30	1 ½		
		1 ¾	19 41 15	1 ¾		
N. N. E.	N. N. W.	2	22 30 0	2	S. S. E.	S. S. W.
		2 ¼	25 18 45	2 ¼		
		2 ½	28 7 30	2 ½		
		2 ¾	30 56 15	2 ¾		
N. E. b. N.	N. W. b. N.	3	33 45 0	3	S. E. b. S.	S. W. b. S.
		3 ¼	36 33 45	3 ¼		
		3 ½	39 22 30	3 ½		
		3 ¾	42 11 15	3 ¾		
N. E.	N. W.	4	45 0 0	4	S. E.	S. W
		4 ¼	47 48 45	4 ¼		
		4 ½	50 37 30	4 ½		
		4 ¾	53 26 15	4 ¾		
N. E. b. E.	N. W. b. W.	5	56 15 0	5	S. E. b. E.	S. W. b. W.
		5 ¼	59 3 45	5 ¼		
		5 ½	61 52 30	5 ½		
		5 ¾	64 41 15	5 ¾		
E. N. E.	W. N. W.	6	67 30 0	6	E. S. E.	W. S. W.
		6 ¼	70 18 45	6 ¼		
		6 ½	73 7 30	6 ½		
		6 ¾	75 56 15	6 ¾		
E. b. N.	W. b. N.	7	78 45 0	7	E. b. S.	W. b. S.
		7 ¼	81 33 45	7 ¼		
		7 ½	84 22 30	7 ½		
		7 ¾	87 11 15	7 ¾		
EAST.	WEST.	8	90 0 0	8	EAST.	WEST.

LOGARITHMIC SINES, TANGENTS, AND SECANTS, to every Point and Quarter Point of the Compass.

Points.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-sec.	Points.
0	0.000000	10.000000	0.000000	Infinite.	10.000000	Infinite.	8
0 ¼	8.690796	9.999477	8.691319	11.308681	10.000523	11.309204	7 ¾
0 ½	8.991302	9.997904	8.993398	11.006602	10.002096	11.008698	7 ½
0 ¾	9.166520	9.995274	9.171247	10.828753	10.004726	10.833480	7 ¼
1	9.290256	9.991574	9.298662	10.701338	10.008426	10.709764	7
1 ¼	9.385571	9.986786	9.398785	10.601215	10.013214	10.614429	6 ¾
1 ½	9.462824	9.980885	9.481939	10.518061	10.019115	10.537176	6 ½
1 ¾	9.527488	9.973841	9.553647	10.446353	10.026159	10.472512	6 ¼
2	9.582840	9.965615	9.617224	10.382776	10.034385	10.417160	6
2 ¼	9.630992	9.956163	9.674829	10.325171	10.043837	10.369008	5 ¾
2 ½	9.673387	9.945430	9.727957	10.272043	10.054570	10.326613	5 ½
2 ¾	9.711050	9.933350	9.777700	10.222300	10.066650	10.288950	5 ¼
3	9.744739	9.919846	9.824893	10.175107	10.080154	10.255261	5
3 ¼	9.775027	9.904828	9.870199	10.129801	10.095172	10.224973	4 ¾
3 ½	9.802359	9.888185	9.914173	10.085827	10.111815	10.197641	4 ½
3 ¾	9.827084	9.869790	9.957295	10.042705	10.130210	10.172916	4 ¼
4	9.849485	9.849485	10.000000	10.000000	10.150515	10.150515	4
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-sec.	Secant.	

*

Digitized by Google

TRAVERSE TABLE.

Distance	0 POINTS						1 POINT								2 POINTS	
	¼		½		¾		0		¼		½		¾		0	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
1	1.00	0.05	0.99	0.10	0.99	0.15	0.98	0.20	0.97	0.24	0.96	0.29	0.94	0.34	0.92	0.38
2	2.00	0.10	1.99	0.20	1.98	0.29	1.96	0.39	1.94	0.49	1.91	0.58	1.88	0.67	1.85	0.77
3	3.00	0.15	2.99	0.29	2.97	0.44	2.94	0.59	2.91	0.73	2.87	0.87	2.82	1.01	2.77	1.15
4	4.00	0.20	3.98	0.39	3.96	0.59	3.92	0.78	3.88	0.97	3.83	1.16	3.77	1.35	3.70	1.53
5	4.99	0.25	4.98	0.49	4.95	0.75	4.90	0.98	4.85	1.21	4.78	1.45	4.71	1.68	4.62	1.91
6	5.99	0.29	5.97	0.59	5.93	0.88	5.88	1.17	5.82	1.46	5.74	1.74	5.65	2.02	5.54	2.30
7	6.99	0.34	6.97	0.69	6.92	1.03	6.87	1.37	6.79	1.70	6.70	2.03	6.59	2.36	6.47	2.68
8	7.99	0.39	7.96	0.78	7.91	1.17	7.85	1.56	7.76	1.94	7.66	2.32	7.53	2.69	7.39	3.06
9	8.99	0.44	8.96	0.88	8.90	1.32	8.83	1.76	8.73	2.19	8.61	2.61	8.47	3.03	8.31	3.44
10	9.99	0.49	9.95	0.98	9.89	1.47	9.81	1.95	9.70	2.43	9.57	2.90	9.42	3.37	9.24	3.83
11	10.99	0.54	10.95	1.08	10.88	1.61	10.79	2.15	10.67	2.67	10.53	3.19	10.36	3.71	10.16	4.21
12	11.99	0.59	11.94	1.18	11.87	1.76	11.77	2.34	11.64	2.92	11.48	3.48	11.30	4.04	11.09	4.59
13	12.98	0.64	12.94	1.27	12.86	1.91	12.75	2.54	12.61	3.16	12.44	3.77	12.24	4.38	12.01	4.97
14	13.98	0.69	13.93	1.37	13.85	2.05	13.73	2.73	13.58	3.40	13.40	4.06	13.18	4.72	12.93	5.36
15	14.98	0.74	14.93	1.47	14.84	2.20	14.71	2.93	14.55	3.64	14.35	4.35	14.12	5.05	13.86	5.74
16	15.98	0.79	15.92	1.57	15.83	2.35	15.69	3.12	15.52	3.89	15.31	4.64	15.06	5.39	14.78	6.12
17	16.98	0.84	16.92	1.67	16.82	2.49	16.67	3.32	16.49	4.13	16.27	4.93	16.01	5.73	15.71	6.51
18	17.98	0.88	17.91	1.76	17.81	2.64	17.65	3.51	17.46	4.37	17.22	5.22	16.95	6.06	16.63	6.89
19	18.98	0.93	18.91	1.86	18.79	2.79	18.63	3.71	18.43	4.62	18.18	5.51	17.89	6.40	17.55	7.27
20	19.98	0.98	19.90	1.96	19.78	2.93	19.62	3.90	19.40	4.86	19.14	5.81	18.83	6.74	18.48	7.65
21	20.98	1.03	20.90	2.06	20.77	3.08	20.60	4.10	20.37	5.10	20.10	6.10	19.77	7.07	19.40	8.04
22	21.97	1.08	21.89	2.16	21.76	3.23	21.58	4.29	21.34	5.35	21.05	6.39	20.71	7.41	20.33	8.42
23	22.97	1.13	22.89	2.25	22.75	3.37	22.56	4.49	22.31	5.59	22.01	6.68	21.65	7.75	21.25	8.80
24	23.97	1.19	23.88	2.35	23.74	3.52	23.54	4.68	23.28	5.83	22.97	6.97	22.60	8.08	22.17	9.18
25	24.97	1.24	24.88	2.45	24.73	3.67	24.52	4.88	24.25	6.07	23.92	7.26	23.54	8.42	23.10	9.57
26	25.97	1.28	25.87	2.55	25.72	3.81	25.50	5.07	25.22	6.32	24.88	7.55	24.48	8.76	24.02	9.95
27	26.97	1.33	26.87	2.65	26.71	3.96	26.48	5.27	26.19	6.56	25.84	7.84	25.42	9.10	24.94	10.33
28	27.97	1.37	27.87	2.74	27.70	4.11	27.46	5.46	27.16	6.80	26.79	8.13	26.36	9.45	25.87	10.72
29	28.97	1.42	28.86	2.84	28.69	4.25	28.44	5.66	28.15	7.05	27.75	8.42	27.30	9.77	26.79	11.10
30	29.96	1.47	29.85	2.94	29.67	4.40	29.42	5.85	29.10	7.29	28.71	8.71	28.25	10.11	27.72	11.48
31	30.96	1.52	30.85	3.04	30.66	4.55	30.40	6.05	30.07	7.53	29.66	9.00	29.19	10.44	28.64	11.86
32	31.96	1.57	31.84	3.14	31.65	4.70	31.39	6.24	31.04	7.77	30.62	9.29	30.13	10.78	29.56	12.25
33	32.96	1.63	32.84	3.23	32.64	4.84	32.37	6.44	32.01	8.02	31.58	9.58	31.07	11.12	30.49	12.63
34	33.96	1.67	33.84	3.33	33.63	4.99	33.35	6.63	32.98	8.26	32.54	9.87	32.01	11.45	31.41	13.01
35	34.96	1.72	34.83	3.43	34.62	5.14	34.33	6.83	33.95	8.50	33.49	10.16	32.95	11.79	32.34	13.39
36	35.96	1.77	35.83	3.53	35.61	5.28	35.31	7.02	34.92	8.75	34.45	10.45	33.90	12.13	33.26	13.78
37	36.96	1.82	36.82	3.63	36.60	5.43	36.29	7.22	35.89	8.99	35.41	10.74	34.84	12.46	34.18	14.16
38	37.95	1.87	37.82	3.72	37.59	5.58	37.27	7.41	36.86	9.23	36.36	11.03	35.78	12.80	35.11	14.54
39	38.95	1.91	38.81	3.82	38.58	5.72	38.25	7.61	37.83	9.48	37.32	11.32	36.72	13.14	36.03	14.92
40	39.95	1.96	39.81	3.92	39.57	5.87	39.23	7.80	38.80	9.72	38.28	11.61	37.66	13.48	36.96	15.31
41	40.95	2.01	40.80	4.02	40.56	6.02	40.21	8.00	39.77	9.96	39.23	11.90	38.60	13.81	37.88	15.69
42	41.95	2.06	41.80	4.12	41.54	6.16	41.19	8.19	40.74	10.20	40.19	12.19	39.54	14.15	38.80	16.07
43	42.95	2.11	42.79	4.21	42.53	6.31	42.17	8.39	41.71	10.45	41.15	12.48	40.49	14.49	39.73	16.46
44	43.95	2.16	43.79	4.31	43.52	6.46	43.15	8.58	42.68	10.69	42.11	12.77	41.43	14.83	40.65	16.84
45	44.95	2.21	44.78	4.41	44.51	6.60	44.14	8.78	43.65	10.93	43.06	13.06	42.37	15.16	41.57	17.22
46	45.95	2.26	45.78	4.51	45.50	6.75	45.12	8.97	44.62	11.18	44.02	13.35	43.31	15.50	42.50	17.60
47	46.94	2.31	46.77	4.61	46.49	6.90	46.10	9.17	45.59	11.42	44.98	13.64	44.25	15.83	43.42	17.99
48	47.94	2.36	47.77	4.70	47.48	7.04	47.08	9.36	46.56	11.66	45.93	13.93	45.19	16.17	44.35	18.37
49	48.94	2.41	48.76	4.80	48.47	7.19	48.06	9.56	47.53	11.91	46.89	14.22	46.14	16.51	45.27	18.75
50	49.94	2.45	49.76	4.90	49.46	7.34	49.04	9.75	48.50	12.15	47.85	14.51	47.08	16.84	46.19	19.13
51	50.94	2.50	50.75	5.00	50.45	7.48	50.02	9.95	49.47	12.39	48.80	14.80	48.02	17.18	47.12	19.52
52	51.94	2.55	51.75	5.10	51.44	7.63	51.00	10.14	50.44	12.63	49.76	15.09	48.96	17.52	48.04	19.90
53	52.94	2.60	52.74	5.19	52.43	7.78	51.98	10.34	51.41	12.88	50.72	15.38	49.90	17.86	48.97	20.28
54	53.94	2.65	53.74	5.29	53.41	7.92	52.96	10.53	52.38	13.12	51.67	15.67	50.84	18.19	49.89	20.66
55	54.93	2.70	54.73	5.39	54.40	8.07	53.94	10.73	53.35	13.36	52.63	15.96	51.78	18.53	50.81	21.05
56	55.93	2.75	55.73	5.49	55.39	8.22	54.92	10.93	54.32	13.61	53.59	16.25	52.73	18.87	51.74	21.43
57	56.93	2.80	56.72	5.59	56.38	8.36	55.90	11.12	55.29	13.85	54.55	16.54	53.67	19.20	52.66	21.81
58	57.93	2.85	57.72	5.68	57.37	8.51	56.89	11.32	56.26	14.09	55.50	16.84	54.61	19.54	53.59	22.20
59	58.93	2.90	58.72	5.78	58.36	8.66	57.87	11.51	57.23	14.34	56.45	17.13	55.55	19.88	54.51	22.58
60	59.93	2.94	59.71	5.88	59.35	8.80	58.85	11.71	58.20	14.58	57.42	17.42	56.49	20.21	55.43	22.96
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat
	¼		½		¾		0		¼		½		¾		0	
	7 POINTS.								6 POINTS							

Digitized by Google

TRAVERSE TABLE.

Distance	0 POINTS.						1 POINT.								2 POINTS.	
	¼		½		¾		0		¼		½		¾		0	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
61	60.93	2.99	60.71	5.98	60.34	8.95	59.83	11.90	59.17	14.82	58.37	17.71	57.43	20.55	56.36	23.34
62	61.93	3.04	61.70	6.08	61.33	9.10	60.81	12.10	60.14	15.06	59.33	18.00	58.38	20.89	57.28	23.72
63	62.92	3.09	62.70	6.17	62.32	9.24	61.79	12.29	61.11	15.31	60.29	18.29	59.32	21.22	58.20	24.11
64	63.92	3.14	63.69	6.27	63.31	9.39	62.77	12.49	62.08	15.55	61.24	18.58	60.26	21.56	59.13	24.49
65	64.92	3.19	64.69	6.37	64.30	9.54	63.75	12.68	63.05	15.79	62.20	18.87	61.20	21.90	60.05	24.87
66	65.92	3.24	65.68	6.47	65.28	9.68	64.73	12.88	64.02	16.04	63.16	19.16	62.14	22.23	60.98	25.26
67	66.92	3.29	66.68	6.57	66.27	9.83	65.71	13.07	64.99	16.28	64.11	19.45	63.08	22.57	61.90	25.64
68	67.92	3.34	67.67	6.66	67.26	9.98	66.69	13.27	65.96	16.52	65.07	19.74	64.02	22.91	62.82	26.02
69	68.92	3.39	68.67	6.76	68.25	10.12	67.67	13.46	66.93	16.77	66.02	20.03	64.97	23.24	63.75	26.41
70	69.92	3.44	69.66	6.86	69.24	10.27	68.66	13.66	67.90	17.01	66.98	20.32	65.91	23.58	64.67	26.79
71	70.92	3.48	70.66	6.96	70.23	10.42	69.64	13.85	68.87	17.25	67.94	20.61	66.85	23.92	65.60	27.17
72	71.91	3.53	71.65	7.06	71.22	10.56	70.62	14.05	69.84	17.49	68.90	20.90	67.79	24.26	66.52	27.55
73	72.91	3.58	72.65	7.15	72.21	10.71	71.60	14.24	70.81	17.74	69.86	21.19	68.73	24.59	67.44	27.94
74	73.91	3.63	73.64	7.25	73.20	10.86	72.58	14.44	71.78	17.98	70.81	21.48	69.67	24.93	68.37	28.32
75	74.91	3.68	74.64	7.35	74.19	11.00	73.56	14.63	72.75	18.22	71.77	21.77	70.62	25.27	69.29	28.70
76	75.91	3.73	75.63	7.45	75.18	11.15	74.54	14.83	73.72	18.47	72.73	22.06	71.56	25.60	70.21	29.08
77	76.91	3.78	76.63	7.55	76.17	11.30	75.52	15.02	74.69	18.71	73.68	22.35	72.50	25.94	71.14	29.47
78	77.91	3.83	77.62	7.64	77.15	11.45	76.50	15.22	75.66	18.95	74.64	22.64	73.44	26.28	72.06	29.85
79	78.91	3.88	78.62	7.74	78.14	11.59	77.48	15.41	76.63	19.20	75.60	22.93	74.38	26.61	72.99	30.23
80	79.90	3.93	79.61	7.84	79.13	11.74	78.46	15.61	77.60	19.44	76.55	23.22	75.32	26.95	73.91	30.61
81	80.90	3.98	80.61	7.94	80.12	11.88	79.44	15.80	78.57	19.68	77.51	23.51	76.27	27.29	74.83	31.00
82	81.90	4.02	81.60	8.04	81.11	12.03	80.42	16.00	79.54	19.92	78.47	23.80	77.21	27.62	75.76	31.38
83	82.90	4.07	82.60	8.14	82.10	12.18	81.41	16.19	80.51	20.17	79.43	24.09	78.15	27.96	76.68	31.76
84	83.90	4.12	83.59	8.23	83.09	12.32	82.39	16.39	81.48	20.41	80.38	24.38	79.09	28.30	77.61	32.15
85	84.90	4.17	84.59	8.33	84.08	12.47	83.37	16.58	82.45	20.65	81.34	24.67	80.05	28.63	78.53	32.53
86	85.90	4.22	85.58	8.43	85.07	12.62	84.35	16.78	83.42	20.90	82.30	24.96	80.97	28.97	79.45	32.91
87	86.90	4.27	86.58	8.53	86.06	12.76	85.33	16.97	84.39	21.14	83.25	25.25	81.91	29.31	80.38	33.29
88	87.89	4.32	87.58	8.63	87.05	12.91	86.31	17.17	85.36	21.38	84.21	25.54	82.86	29.65	81.30	33.68
89	88.89	4.37	88.57	8.72	88.04	13.06	87.29	17.36	86.33	21.62	85.17	25.83	83.80	29.98	82.23	34.06
90	89.89	4.42	89.57	8.82	89.02	13.21	88.27	17.56	87.30	21.87	86.12	26.12	84.74	30.32	83.15	34.44
91	90.89	4.47	90.56	8.92	90.01	13.35	89.25	17.75	88.27	22.11	87.08	26.41	85.68	30.66	84.07	34.82
92	91.89	4.52	91.56	9.02	91.00	13.50	90.23	17.95	89.24	22.35	88.04	26.70	86.62	30.99	85.00	35.21
93	92.89	4.56	92.55	9.12	91.99	13.65	91.21	18.14	90.21	22.60	89.00	27.00	87.56	31.33	85.92	35.59
94	93.89	4.61	93.55	9.21	92.98	13.79	92.19	18.34	91.18	22.84	89.95	27. 9	88.51	31.67	86.84	35.97
95	94.89	4.66	94.54	9.31	93.97	13.94	93.17	18.53	92.15	23.08	90.91	27.58	89.45	32.00	87.77	36.35
96	95.88	4.71	95.54	9.41	94.96	14.09	94.16	18.73	93.12	23.33	91.87	27.87	90.39	32.34	88.69	36.74
97	96.88	4.76	96.53	9.51	95.95	14.23	95.14	18.92	94.09	23.57	92.82	28.16	91.33	32.68	89.62	37.12
98	97.88	4.81	97.53	9.61	96.94	14.38	96.12	19.12	95.06	23.81	93.78	28.45	92.27	33.01	90.54	37.50
99	98.88	4.86	98.52	9.70	97.93	14.53	97.10	19.31	96.03	24.05	94.74	28.74	93.21	33.35	91.46	37.89
100	99.88	4.91	99.52	9.80	98.92	14.67	98.08	19.51	97.00	24.30	95.69	29.03	94.15	33.69	92.39	38.27
101	100.9	4.96	100.5	9.90	99.91	14.82	99.06	19.70	97.97	24.54	96.65	29.32	95.10	34.03	93.31	38.65
102	101.9	5.01	101.5	10.00	100.9	14.97	100.0	19.90	98.94	24.78	97.61	29.61	96.04	34.36	94.24	39.03
103	102.9	5.05	102.5	10.10	101.9	15.11	101.0	20.09	99.91	25.02	98.56	29.90	96.98	34.70	95.16	39.42
104	103.9	5.10	103.5	10.19	102.9	15.26	102.0	20.29	100.9	25.27	99.52	30.19	97.92	35.04	96.08	39.80
105	104.9	5.15	104.5	10.29	103.9	15.41	103.0	20.48	101.9	25.51	100.5	30.48	98.86	35.37	97.01	40.18
106	105.9	5.20	105.5	10.39	104.9	15.55	104.0	20.68	102.8	25.76	101.4	30.77	99.80	35.71	97.93	40.56
107	106.9	5.25	106.5	10.49	105.8	15.70	104.9	20.87	103.8	26.00	102.4	31.06	100.7	36.05	98.86	40.95
108	107.9	5.30	107.5	10.59	106.8	15.89	105.9	21.07	104.8	26.24	103.4	31.35	101.7	36.38	99.78	41.33
109	108.9	5.35	108.5	10.68	107.8	15.99	106.9	21.26	105.7	26.48	104.3	31.64	102.6	36.72	100.7	41.71
110	109.9	5.40	109.5	10.78	108.8	16.14	107.9	21.46	106.7	26.73	105.3	31.93	103.6	37.06	101.6	42.10
111	110.9	5.45	110.5	10.88	109.8	16.29	108.9	21.66	107.7	26.97	106.2	32.22	104.5	37.39	102.6	42.48
112	111.9	5.50	111.5	10.98	110.8	16.43	109.8	21.85	108.6	27.21	107.2	32.51	105.5	37.73	103.5	42.86
113	112.9	5.55	112.5	11.08	111.8	16.58	110.8	22.05	109.6	27.46	108.1	32.80	106.4	38.07	104.4	43.24
114	113.9	5.59	113.5	11.17	112.8	16.73	111.8	22.24	110.6	27.70	109.1	33.09	107.3	38.41	105.3	43.63
115	114.9	5.64	114.4	11.27	113.8	16.87	112.8	22.44	111.6	27.94	110.0	33.38	108.3	38.74	106.2	44.01
116	115.9	5.69	115.4	11.37	114.7	17.02	113.8	22.63	112.5	28.19	111.0	33.67	109.2	39.08	107.2	44.39
117	116.9	5.74	116.4	11.47	115.7	17.17	114.8	22.83	113.5	28.43	112.0	33.96	110.2	39.42	108.1	44.77
118	117.9	5.79	117.4	11.57	116.7	17.31	115.7	23.02	114.5	28.67	112.9	34.25	111.1	39.75	109.0	45.16
119	118.8	5.84	118.4	11.66	117.7	17.46	116.7	23.22	115.4	28.91	113.9	34.54	112.0	40.09	109.9	45.54
120	119.9	5.89	119.4	11.76	118.7	17.61	117.7	23.41	116.4	29.16	114.8	34.83	113.0	40.43	110.9	45.92
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	¼		½		¾		0		¼		½		¾		0	
	7 POINTS.								6 POINTS.							

Digitized by Google

TRAVERSE TABLE.

Distance	2 POINTS.						3 POINTS.								4 POINTS.	
	¼		½		¾		0		¼		½		¾		0	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
1	0.90	0.43	0.88	0.47	0.86	0.51	0.83	0.56	0.80	0.60	0.77	0.63	0.74	0.67	0.71	0.71
2	1.81	0.85	1.76	0.94	1.72	1.03	1.66	1.11	1.61	1.19	1.55	1.27	1.48	1.34	1.41	1.41
3	2.71	1.28	2.65	1.41	2.57	1.54	2.49	1.67	2.41	1.79	2.32	1.90	2.22	2.01	2.12	2.12
4	3.62	1.71	3.53	1.89	3.43	2.06	3.33	2.22	3.21	2.38	3.09	2.54	2.96	2.69	2.83	2.83
5	4.52	2.14	4.41	2.36	4.29	2.57	4.16	2.78	4.02	2.98	3.86	3.17	3.70	3.36	3.53	3.53
6	5.42	2.56	5.29	2.83	5.15	3.08	4.99	3.33	4.82	3.57	4.64	3.81	4.45	4.03	4.24	4.24
7	6.33	2.99	6.17	3.30	6.00	3.60	5.82	3.89	5.62	4.17	5.41	4.44	5.19	4.70	4.95	4.95
8	7.23	3.42	7.06	3.77	6.86	4.11	6.65	4.44	6.43	4.76	6.18	5.07	5.93	5.37	5.66	5.66
9	8.14	3.85	7.94	4.24	7.72	4.63	7.48	5.00	7.23	5.36	6.96	5.71	6.67	6.04	6.36	6.36
10	9.04	4.28	8.82	4.71	8.58	5.14	8.31	5.56	8.03	5.96	7.73	6.34	7.41	6.72	7.07	7.07
11	9.94	4.70	9.70	5.18	9.43	5.65	9.15	6.11	8.83	6.55	8.50	6.98	8.15	7.39	7.78	7.78
12	10.85	5.13	10.58	5.66	10.29	6.17	9.98	6.67	9.64	7.15	9.28	7.61	8.89	8.06	8.49	8.49
13	11.75	5.56	11.46	6.13	11.15	6.68	10.81	7.22	10.44	7.74	10.05	8.25	9.63	8.73	9.19	9.19
14	12.66	5.99	12.35	6.60	12.01	7.20	11.64	7.78	11.24	8.33	10.82	8.88	10.37	9.40	9.90	9.90
15	13.56	6.41	12.23	7.07	12.87	7.71	12.47	8.33	12.05	8.93	11.59	9.52	11.11	10.07	10.61	10.61
16	14.46	6.84	14.11	7.54	13.72	8.23	13.30	8.89	12.85	9.52	12.37	10.15	11.85	10.75	11.31	11.31
17	15.37	7.27	14.99	8.01	14.58	8.74	14.13	9.44	13.66	10.12	13.14	10.78	12.60	11.42	12.02	12.02
18	16.27	7.70	15.87	8.48	15.44	9.25	14.97	10.00	14.46	10.71	13.91	11.42	13.34	12.09	12.73	12.75
19	17.18	8.12	16.76	8.95	16.30	9.77	15.80	10.56	15.26	11.31	14.69	12.04	14.08	12.76	13.45	13.43
20	18.08	8.55	17.64	9.45	17.16	10.28	16.63	11.11	16.06	11.91	15.46	12.69	14.82	13.43	14.14	14.14
21	18.98	8.98	18.52	9.90	18.01	10.80	17.46	11.67	16.87	12.51	16.23	13.32	15.56	14.10	14.85	14.85
22	19.89	9.41	19.40	10.37	18.87	11.31	18.29	12.22	17.67	13.11	17.01	13.96	16.30	14.77	15.56	15.56
23	20.79	9.83	20.28	10.84	19.73	11.82	19.12	12.78	18.47	13.70	17.78	14.59	17.04	15.45	16.26	16.26
24	21.69	10.26	21.17	11.31	20.59	12.34	19.96	13.33	19.28	14.30	18.55	15.22	17.78	16.12	16.97	16.97
25	22.60	10.69	22.05	11.78	21.44	12.85	20.79	13.89	20.08	14.89	19.33	15.86	18.52	16.79	17.68	17.68
26	23.50	11.12	22.93	12.25	22.30	13.37	21.62	14.44	20.88	15.49	20.10	16.49	19.26	17.46	18.38	18.38
27	24.41	11.54	23.81	12.72	23.16	13.88	22.45	15.00	21.69	16.09	20.87	17.13	20.01	18.13	19.09	19.09
28	25.31	11.97	24.69	13.20	24.02	14.39	23.28	15.56	22.49	16.68	21.64	17.76	20.75	18.81	19.80	19.80
29	26.22	12.40	25.58	13.67	24.88	14.91	24.11	16.11	23.29	17.28	22.42	18.40	21.49	19.48	20.51	20.51
30	27.12	12.83	26.46	14.14	25.75	15.42	24.94	16.67	24.10	17.87	23.19	19.03	22.23	20.15	21.21	21.21
31	28.02	13.25	27.34	14.61	26.59	15.94	25.78	17.22	24.90	18.46	23.96	19.67	22.97	20.82	21.92	21.92
32	28.93	13.68	28.23	15.09	27.45	16.45	26.61	17.78	25.70	19.06	24.74	20.30	23.71	21.49	22.63	22.63
33	29.83	14.11	29.11	15.56	28.31	16.96	27.44	18.33	26.51	19.66	25.51	20.93	24.45	22.16	23.33	23.33
34	30.74	14.54	29.99	16.03	29.16	17.48	28.27	18.89	27.31	20.25	26.28	21.57	25.19	22.83	24.04	24.04
35	31.64	14.96	30.87	16.51	30.02	17.99	29.10	19.45	28.11	20.85	27.05	22.20	25.95	23.51	24.75	24.75
36	32.54	15.39	31.76	16.98	30.88	18.51	29.95	20.00	28.91	21.45	27.85	22.84	26.67	24.18	25.46	25.46
37	33.45	15.82	32.64	17.45	31.74	19.02	30.76	20.56	29.72	22.04	28.60	23.47	27.42	24.85	26.16	26.16
38	34.35	16.25	33.52	17.92	32.60	19.53	31.60	21.11	30.52	22.64	29.37	24.10	28.16	25.52	26.87	26.87
39	35.26	16.68	34.40	18.39	33.45	20.05	32.43	21.67	31.33	23.23	30.15	24.74	28.90	26.19	27.58	27.58
40	36.16	17.10	35.28	18.86	34.31	20.56	33.26	22.22	32.13	23.83	30.92	25.38	29.64	26.86	28.28	28.28
41	37.06	17.53	36.16	19.33	35.17	21.08	34.09	22.78	32.93	24.42	31.69	26.01	30.38	27.53	28.99	28.99
42	37.97	17.96	37.04	19.80	36.02	21.59	34.92	23.33	33.73	25.02	32.47	26.64	31.12	28.21	29.70	29.70
43	38.87	18.38	37.92	20.27	36.88	22.10	35.75	23.89	34.54	25.62	33.24	27.28	31.86	28.88	30.41	30.41
44	39.78	18.81	38.80	20.74	37.74	22.62	36.58	24.45	35.34	26.21	34.01	27.91	32.60	29.55	31.11	31.11
45	40.63	19.24	39.69	21.21	38.60	23.13	37.42	25.00	36.14	26.82	34.78	28.55	33.34	30.22	31.82	31.82
46	41.58	19.67	40.57	21.68	39.46	23.65	38.25	25.56	36.94	27.41	35.56	29.18	34.08	30.89	32.53	32.53
47	42.49	20.10	41.45	22.15	40.32	24.16	39.08	26.11	37.75	28.01	36.33	29.81	34.82	31.57	33.25	33.25
48	43.39	20.52	42.33	22.62	41.17	24.68	39.91	26.67	38.55	28.61	37.10	30.45	35.57	32.24	33.94	33.94
49	44.29	20.95	43.21	23.09	42.03	25.19	40.74	27.22	39.36	29.20	37.88	31.08	36.31	32.91	34.65	34.65
50	45.20	21.38	44.10	23.57	42.89	25.70	41.57	27.78	40.17	29.79	38.65	31.72	37.05	33.58	35.36	35.36
51	46.10	21.81	44.98	24.04	43.74	26.22	42.40	28.33	40.96	30.38	39.42	32.35	37.79	34.25	36.06	36.06
52	47.01	22.23	45.86	24.51	44.60	26.73	43.24	28.89	41.77	30.98	40.20	32.99	38.53	34.92	36.77	36.77
53	47.91	22.66	46.74	24.98	45.46	27.25	44.07	29.45	42.57	31.57	40.97	33.62	39.27	35.59	37.48	37.48
54	48.82	23.08	47.62	25.45	46.32	27.76	44.90	30.00	43.37	32.17	41.74	34.26	40.01	36.27	38.18	38.18
55	49.72	23.52	48.51	25.92	47.18	28.27	45.73	30.56	44.18	32.76	42.52	34.89	40.75	36.94	38.89	38.89
56	50.62	23.94	49.39	26.40	48.03	28.79	46.56	31.11	44.98	33.36	43.29	35.53	41.49	37.61	39.60	39.60
57	51.53	24.37	50.27	26.87	48.89	29.30	47.39	31.67	45.78	33.96	44.06	36.16	42.23	38.28	40.31	40.31
58	52.43	24.79	51.15	27.34	49.75	29.82	48.23	32.22	46.59	34.55	44.83	36.79	42.98	38.95	41.01	41.01
59	53.33	25.23	52.03	27.81	50.61	30.33	49.06	32.78	47.39	35.15	45.61	37.43	43.72	39.63	41.72	41.72
60	54.24	25.65	52.92	28.28	51.46	30.85	49.89	33.33	48.19	35.74	46.38	38.06	44.46	40.29	42.43	42.43
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	¼		½		¾		0		¼		½		¾		0	
	5 POINTS.								4 POINTS.							

Digitized by Google

TRAVERSE TABLE.

Distance	2 POINTS.						3 POINTS.								4 POINTS.	
	¼		½		¾		0		¼		½		¾		0	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
61	55.14	26.08	53.80	28.75	52.32	31.36	50.72	33.89	49.00	36.34	47.15	38.70	45.20	40.97	43.13	43.13
62	56.05	26.51	54.68	29.22	53.18	31.87	51.55	34.45	49.80	36.93	47.93	39.33	45.94	41.64	43.84	43.84
63	56.95	26.94	55.56	29.70	54.04	32.39	52.38	35.00	50.60	37.53	48.70	39.96	46.68	42.31	44.55	44.55
64	57.85	27.36	56.44	30.17	54.90	32.90	53.21	35.56	51.40	38.13	49.47	40.60	47.42	42.98	45.25	45.25
65	58.76	27.79	57.33	30.64	55.75	33.42	54.05	36.11	52.21	38.72	50.25	41.24	48.16	43.65	45.96	45.96
66	59.66	28.22	58.21	31.11	56.61	33.93	54.88	36.67	53.01	39.32	51.02	41.87	48.90	44.33	46.67	46.67
67	60.57	28.65	59.09	31.58	57.47	34.44	55.71	37.22	53.81	39.91	51.79	42.50	49.64	44.99	47.38	47.38
68	61.47	29.07	59.97	32.05	58.33	34.96	56.54	37.78	54.62	40.51	52.56	43.13	50.38	45.67	48.08	48.08
69	62.37	29.50	60.85	32.52	59.19	35.47	57.37	38.33	55.42	41.11	53.34	43.77	51.13	46.34	48.79	48.79
70	63.28	29.93	61.73	33.00	60.04	35.99	58.20	38.89	56.22	41.70	54.11	44.41	51.87	47.01	49.50	49.50
71	64.18	30.36	62.62	33.47	60.90	36.50	59.03	39.45	57.03	42.29	54.88	45.04	52.61	47.68	50.20	50.20
72	65.08	30.78	63.50	33.94	61.76	37.01	59.87	40.00	57.83	42.89	55.66	45.67	53.35	48.35	50.91	50.91
73	65.99	31.21	64.38	34.41	62.62	37.53	60.70	40.56	58.63	43.49	56.43	46.31	54.09	49.02	51.62	51.62
74	66.89	31.64	65.26	34.88	63.47	38.04	61.53	41.11	59.44	44.08	57.20	46.94	54.83	49.70	52.33	52.33
75	67.80	32.07	66.14	35.35	64.33	38.56	62.36	41.67	60.24	44.68	57.98	47.58	55.57	50.37	53.03	53.03
76	68.70	32.50	67.03	35.82	65.19	39.07	63.19	42.22	61.04	45.27	58.75	48.21	56.31	51.04	53.73	53.73
77	69.60	32.92	67.91	36.29	66.05	39.58	64.02	42.78	61.85	45.87	59.52	48.84	57.05	51.71	54.45	54.45
78	70.51	33.35	68.79	36.76	66.91	40.10	64.85	43.33	62.65	46.47	60.29	49.48	57.79	52.38	55.15	55.15
79	71.41	33.78	69.67	37.24	67.76	40.61	65.69	43.89	63.45	47.06	61.07	50.11	58.54	53.06	55.86	55.86
80	72.32	34.20	70.55	37.71	68.62	41.13	66.52	44.45	64.26	47.66	61.84	50.75	59.28	53.73	56.57	56.57
81	73.22	34.63	71.44	38.18	69.48	41.64	67.35	45.00	65.06	48.25	62.61	51.38	60.02	54.40	57.28	57.28
82	74.12	35.06	72.32	38.65	70.33	42.16	68.18	45.56	65.86	48.85	63.39	52.02	60.76	55.07	57.98	57.98
83	75.03	35.49	73.20	39.12	71.19	42.67	69.01	46.11	66.67	49.44	64.16	52.65	61.50	55.74	58.69	58.69
84	75.93	35.92	73.08	39.59	72.05	43.18	69.84	46.67	67.47	50.04	64.93	53.29	62.24	56.41	59.40	59.40
85	76.84	36.34	74.96	40.07	72.91	43.70	70.67	47.23	68.27	50.64	65.71	53.92	62.98	57.08	60.10	60.10
86	77.74	36.77	75.85	40.54	73.77	44.21	71.51	47.78	69.08	51.24	66.48	54.55	63.72	57.76	60.81	60.81
87	78.64	37.20	76.73	41.01	74.62	44.73	72.34	48.33	69.88	51.83	67.25	55.19	64.46	58.43	61.52	61.52
88	78.55	37.63	77.61	41.48	75.48	45.24	73.17	48.88	70.68	52.42	68.02	55.82	65 20	59.10	62.23	62.23
89	80.45	38.06	78.49	41.95	76.34	45.75	74.00	49.45	71.48	53.02	68.80	56.46	65.94	59.77	62.93	62.93
90	81.36	38.48	79.37	42.43	77.20	46.27	74.83	50.00	72.29	53.61	69.57	57.09	66.69	60.44	63.64	63.64
91	82.26	38.91	80.26	42.90	78.05	46.78	75.66	50.56	73.09	54.21	70.34	57.75	67.43	61.11	64.35	64.35
92	83.16	39.34	81.14	43.37	78.91	47.30	76.50	51.11	73.90	54.80	71.12	58.36	68.17	61.78	65.05	65.05
93	84.07	39.78	82.02	43.84	79.77	47.81	77.33	51.67	74.70	55.40	71.89	59.00	68.91	62.46	65.76	65.76
94	84.97	40.20	82.90	44.31	80.63	48.32	78.16	52.22	75.50	56.00	72.66	59.63	69.65	63.13	66.47	66.47
95	85.88	40.63	83.78	44.78	81.49	48.84	78.99	52.78	76.30	56.59	73.44	60.26	70.39	63.80	67.18	67.18
96	86.78	41.06	84.67	45.25	82.34	49.35	79.82	53.33	77.11	57.19	74.21	60.90	71.13	64.47	67.88	67.88
97	87.68	41.49	85.55	45.72	83.20	49.87	80.65	53.89	77.91	57.78	74.98	61.53	71.87	65.14	68.59	68.59
98	88.59	41.91	86.43	46.19	84.06	50.38	81.48	54.45	78.71	58.38	75.75	62.17	72.61	65.82	69.30	69.30
99	89.49	42.34	87.31	46.66	84.92	50.89	82.32	55.00	79.52	58.98	76.53	62.80	73.35	66.49	70.00	70.00
00	90.40	42.76	88.19	47.14	85.77	51.41	83.15	55.56	80.32	59.57	77.30	63.44	74.09	67.16	70.71	70.71
01	91.30	43.18	89.07	47.61	86.63	51.92	83.98	56.11	81.12	60.17	78.07	64.07	74.84	67.83	71.42	71.42
02	92.20	43.61	89.96	48.08	87.49	52.44	84.81	56.67	81.93	60.76	78.85	64.71	75.58	68.50	72.12	72.12
03	93.11	44.04	90.84	48.55	88.35	52.95	85.64	57 22	82.73	61.36	79.62	65.34	76.32	69.17	72.83	72.83
04	94.01	44.47	91.72	49.02	89.21	53.47	86.47	57.78	83.53	61.95	80.39	65.97	77.06	69.84	73.54	73.54
05	94.92	44.90	92.60	49.49	90.06	53.98	87.30	58.33	84.34	62.55	81.17	66.61	77.80	70.52	74.25	74.25
06	95.82	45.33	93.48	49.96	90.92	53.49	88.14	58.89	85.14	63.15	81.94	67.24	78.54	71.19	74.95	74.95
07	96.72	45.75	94.37	50.44	91.78	55.01	88.97	59.45	85.94	63.74	82.71	67.88	79.28	71.86	75.66	75.66
08	97.63	46.18	95.25	50.91	92.64	55.52	89.80	60.00	86.75	64 34	83.48	68.51	80.02	72.53	76.37	76.37
09	98.55	46.51	96.13	51.38	93.50	56.04	90.63	60.56	87.55	64.93	84.26	69.15	80.76	73.20	77.07	77.07
10	99.44	47.03	97.01	51.85	94.35	56.55	91.46	61.11	88.35	65.53	85.03	69.78	81.50	73.87	77.78	77.78
11	100.3	47.46	97.89	52.32	95.21	57.06	92.29	61.67	89.16	66.12	85.80	70.42	82.25	74.54	78.49	78.49
12	101.2	47.89	98.78	52.79	96.07	57.58	93.12	62.22	89.96	66.72	86.58	71.05	82.99	75.22	79.20	79.20
13	102 1	48.31	99.66	53.27	96.92	58.09	93.96	62 78	90.76	67.31	87.35	71.68	83.73	75.89	79.90	79.90
14	103.1	48.74	100.5	53.74	97.78	58.61	94.79	63.34	91.57	67.91	88.12	72.32	84.47	76.56	80.61	80.61
15	104.1	49.17	101.4	54.21	98.64	59.12	95.62	63.89	92.37	68.51	88.90	72.95	85.21	77.23	81.32	81.32
16	104.9	49.60	102.3	54.68	99.50	59.63	96.45	64.45	93.17	69.10	89.67	73.58	85.95	77.90	82.02	82.02
17	105.8	50.03	103.2	55.15	100.4	60.15	97.28	65.00	93.97	69.70	90.44	74.22	86.69	78.58	82.73	82.73
18	106.7	50.45	104.1	55.62	101.2	60.66	98.11	65.56	94.78	70.29	91.21	74.85	87.43	79.25	83.44	83.44
19	107.6	50.88	105.0	56.09	102.1	61.18	98.94	66.11	95.58	70.89	91.99	75.49	88.17	79.92	84.15	84.15
20	108.5	51.31	105.8	56.57	102.9	61.69	99.78	66.67	96.39	71.48	92.76	76.13	88.91	80.59	84.85	84.85
	Dep	Lat.	Dep	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	¼		½		¾		0		¼		½		¾		0	
	5 POINTS.								4 POINTS.							

Digitized by Google

TRAVERSE TABLE.

Distance	0 DEGREES.						1 DEGREE.					
	15 Min.		30 Min.		45 Min.		0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep	Lat.	Dep
1	1.00	0.00	1.00	0.01	1.00	0.01	1.00	0.02	1.00	0.02	1.00	0.03	1.00	0.03
2	2.00	0.01	2.00	0.02	2.00	0.03	2.00	0.03	2.00	0.04	2.00	0.05	2.00	0.06
3	3.00	0.01	3.00	0.03	3.00	0.04	3.00	0.05	3.00	0.07	3.00	0 08	3.00	0.09
4	4.00	0.02	4.00	0.03	4.00	0.05	4.00	0.07	4.00	0.09	4.00	0.10	4.00	0.12
5	5.00	0.02	5.00	0.04	5.00	0.07	5.00	0.09	5.00	0.11	5.00	0.13	5.00	0.15
6	6.00	0.03	6.00	0.05	6.00	0.08	6.00	0.10	6.00	0.13	6.00	0.16	6.00	0.18
7	7.00	0.03	7.00	0.06	7.00	0.09	7.00	0.12	7.00	0.15	7.00	0.18	7.00	0.21
8	8.00	0.03	8.00	0.07	8.00	0.10	8.00	0.14	8.00	0.17	8.00	0.21	8.00	0.24
9	9.00	0.04	9.00	0.08	9.00	0.12	9.00	0.16	9.00	0.20	9.00	0.24	9.00	0.27
10	10.00	0.04	10.00	0.09	10.00	0.13	10.00	0.17	10.00	0.22	10.00	0.26	10.00	0.31
11	11.00	0.05	11.00	0.10	11.00	0.14	11.00	0.19	11.00	0.24	11.00	0.29	10.99	0.34
12	12.00	0.05	12.00	0.10	12.00	0.16	12.00	0 21	12.00	0.26	12.00	0.31	11.99	0.37
13	13.00	0.06	13.00	0.11	13.00	0.17	13.00	0 23	13.00	0.28	13.00	0.34	12.99	0.40
14	14.00	0.06	14.00	0.12	14.00	0.18	14.00	0.24	14.00	0.31	14.00	0.37	13.99	0.43
15	15.00	0.07	15.00	0.13	15.00	0.20	15.00	0.26	15.00	0.33	14.99	0.39	14.99	0.46
16	16.00	0.07	16.00	0.14	16.00	0.21	16.00	0.28	16.00	0.35	15.99	0.42	15.99	0.49
17	17.00	0.07	17.00	0.15	17.00	0.22	17.00	0.30	17.00	0.37	16.99	0.45	16.99	0.52
18	18.00	0.08	18.00	0.16	18.00	0.24	18.00	0.31	18.00	0.39	17.99	0.47	17.99	0.55
19	19.00	0.08	19.00	0.17	19.00	0.25	19.00	0.33	19.00	0.41	18.99	0.50	18.99	0.58
20	20.00	0.09	20.00	0.17	20.00	0.26	20.00	0.35	20.00	0.44	19.99	0.52	19.99	0.61
21	21.00	0.09	21.00	0.18	21.00	0.27	21.00	0.37	21.00	0.46	20.99	0.55	20.99	0.64
22	22.00	0.10	22.00	0.19	22.00	0.29	22.00	0.38	21.99	0.48	21.99	0.58	21.99	0.67
23	23.00	0.10	23.00	0.20	23.00	0.30	23.00	0.40	22.99	0.50	22 99	0.60	22.99	0.70
24	24.00	0.10	24.00	0.21	24.00	0.31	24.00	0.42	23.99	0.52	23.99	0.63	23.99	0.73
25	25.00	0.11	25.00	0.22	25.00	0.33	25.00	0.44	24.99	0.55	24.99	0.65	24.99	0.76
26	26.00	0.11	26.00	0.23	26.00	0.34	26.00	0.45	25.99	0.57	25.99	0.68	25.99	0.79
27	27.00	0.12	27.00	0.24	27.00	0.35	27.00	0.47	26.99	0.59	26.99	0.71	26.99	0.82
28	23.00	0.12	28.00	0.24	28.00	4.37	28.00	0.49	27.99	0 61	27.99	0.73	27 99	0.86
29	29.00	0.13	29.00	0.25	29.00	0.38	29.00	0.51	28.99	0.63	28.99	0 76	28.99	0.89
30	30.00	0.13	30.00	0.26	30.00	0.39	30.00	0.52	29.99	0.65	29.99	0.79	29.99	0.92
31	31.00	0.14	31.00	0.27	31.00	0.41	31.00	0.54	30.99	0.68	30.99	0.81	30.99	0.95
32	32.00	0.14	32.00	0.28	32.00	0.42	32.00	0.56	31.99	0.70	31.99	0.84	31.99	0.98
33	33.00	0.14	33.00	0.29	33.00	0.43	33.00	0.58	32.99	0.72	32.99	0.86	32.98	1.01
34	34.00	0.15	34.00	0.30	34.00	0.44	33.99	0.59	33.99	0.74	33.99	0.89	33.98	1.04
35	35.00	0.15	35.00	0.31	35.00	0.46	34.99	0.61	34.99	0.76	34.99	0.92	34.98	1.07
36	36.00	0.16	36.00	0.31	36.00	0.47	35.99	0.63	35.99	0.79	35.99	0.94	35.98	1.10
37	37.00	0.16	37.00	0.32	37.00	0.48	36.99	0.65	36.99	0.81	36.99	0.97	36.98	1.13
38	38.00	0.17	38.00	0.33	38.00	0.50	37 99	0.66	37.99	0.83	37.99	0.99	37.98	1.16
39	39.00	0.17	39.00	0.34	39.00	0.51	38.99	0 68	38.99	0.85	38.99	1.02	38.98	1.19
40	40.00	0.17	40.00	0.35	40.00	0.52	39.99	0.70	39.99	0.87	39.99	1.05	39.98	1.22
41	41.00	0.18	41.00	0.36	41.00	0.54	40.99	0.72	40.99	0.89	40.99	1.07	40.98	1.25
42	42.00	0.18	42.00	0.37	42.00	0.55	41.99	0.73	41.99	0.92	41.99	1.10	41.98	1.28
43	43.00	0.19	43.00	0.38	43.00	0.56	42.99	0.75	42.99	0.94	42.99	1 13	42.98	1.31
44	44.00	0.19	44.00	0.38	44.00	0.58	43.99	0.77	43.99	0.96	43.98	1.15	43.98	1.34
45	45.00	0.20	45.00	0.39	45.00	0.59	44.99	0.79	44.99	0.98	44.98	1.18	44.98	1.37
46	46.00	0.20	46.00	0.40	46.00	0.50	45.99	0.80	45.99	1.00	45.98	1.20	45.98	1.40
47	47.00	0.21	47.00	0.41	47.00	0.62	46.99	0.82	46.99	1.03	46.98	1.23	46.98	1.44
48	48.00	0.21	48.00	0.42	48.00	0 63	47.99	0.84	47.99	1.05	47.98	1 26	47.98	1.47
49	49.00	0.21	49.00	0.43	49.00	0.64	48.99	0.85	48.99	1.07	48.98	1.28	48.98	1.50
50	50.00	0.22	50.00	0.44	50.00	0.65	49 99	0.87	49.99	1.09	49.98	1.31	49.98	1.53
51	51.00	0.22	51.00	0.45	51.00	0.67	50.99	0.89	50.99	1.11	50.98	1.34	50.98	1.56
52	52.00	0.23	52.00	0.45	52.00	0.68	51 99	0.91	51.99	1.13	51.98	1.36	51.98	1.59
53	53.00	0 23	53.00	0.46	53.00	0 69	52.99	0.93	52.99	1.16	52.98	1.39	52.98	1.62
54	54.00	0.24	54.00	0.47	54.00	0.71	53.99	0.94	53.99	1.18	53.98	1.41	53.97	1.65
55	55.00	0.24	55.00	0.48	55.00	0.72	54.99	0.96	54.99	1.20	54.98	1.44	54.97	1.68
56	56.00	0.24	56.00	0.49	56.00	0.73	55.99	0.98	55.99	1.22	55.98	1.47	55.97	1.71
57	57.00	0.25	57.00	0 50	57.00	0.75	56.99	0 99	56.99	1.24	56.98	1.49	56.97	1.74
58	58 00	0.25	58.00	0.51	57.99	0.76	57.99	1.01	57.99	1.27	57.98	1.52	57.97	1.77
59	59.00	0.26	59.00	0.51	58.99	0.77	58.99	1.03	58.99	1.29	58.98	1.54	58.97	1.80
60	60.00	0.26	60.00	0.52	59.99	0.79	59.99	1.05	59.99	1.31	59.98	1.57	59.97	1.83
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	45 Min.		30 Min.		15 Min.		0 Min.		45 Min.		30 Min.		15 Min.	
	89 DEGREES.						88 DEGREES.							

Digitized by Google

TRAVERSE TABLE.

Distance	0 DEGREES.						1 DEGREE.							
	15 Min.		30 Min.		45 Min.		0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
61	61.00	0.27	61.00	0.53	60.99	0.80	60.99	1.06	60.99	1.33	60.98	1.60	60.97	1.86
62	62.00	0.27	62.00	0.54	61.99	0.81	61.99	1.08	61.99	1.35	61.98	1.62	61.97	1.89
63	63.00	0.27	63.00	0.55	62.99	0.82	62.99	1.10	62.98	1.37	62.98	1.65	62.97	1.92
64	64.00	0.28	64.00	0.56	63.99	0.84	63.99	1.12	63.98	1.40	63.98	1.68	63.97	1.95
65	65.00	0.28	65.00	0.57	64.99	0.85	64.99	1.13	64.98	1.42	64.98	1.70	64.97	1.99
66	66.00	0.29	66.00	0.58	65.99	0.86	65.99	1.15	65.98	1.44	65.98	1.73	65.97	2.02
67	67.00	0.29	67.00	0.58	66.99	0.88	66.99	1.17	66.98	1.46	66.98	1.75	66.97	2.05
68	68.00	0.30	68.00	0.59	67.99	0.89	67.99	1.19	67.98	1.48	67.98	1.78	67.97	2.08
69	69.00	0.30	69.00	0.60	68.99	0.90	68.99	1.20	68.98	1.51	68.98	1.81	68.97	2.11
70	70.00	0.31	70.00	0.61	69.99	0.92	69.99	1.22	69.98	1.53	69.98	1.83	69.97	2.14
71	71.00	0.31	71.00	0.62	70.99	0.93	70.99	1.24	70.98	1.55	70.98	1.86	70.97	2.17
72	72.00	0.31	72.00	0.63	71.99	0.94	71.99	1.26	71.98	1.57	71.98	1.88	71.97	2.20
73	73.00	0.32	73.00	0.64	72.99	0.96	72.99	1.27	72.98	1.59	72.98	1.91	72.97	2.23
74	74.00	0.32	74.00	0.65	73.99	0.97	73.99	1.29	73.98	1.61	73.97	1.94	73.97	2.26
75	75.00	0.33	75.00	0.65	74.99	0.98	74.99	1.31	74.98	1.64	74.97	1.96	74.97	2.29
76	76.00	0.33	76.00	0.66	75.99	0.99	75.99	1.33	75.98	1.66	75.97	1.99	75.96	2.32
77	77.00	0.34	77.00	0.67	76.99	1.01	76.99	1.34	76.98	1.68	76.97	2.02	76.96	2.35
78	78.00	0.34	78.00	0.68	77.99	1.02	77.99	1.36	77.98	1.70	77.97	2.04	77.96	2.38
79	79.00	0.34	79.00	0.69	78.99	1.03	78.99	1.38	78.98	1.72	78.97	2.07	78.96	2.41
80	80.00	0.35	80.00	0.70	79.99	1.05	79.99	1.40	79.98	1.75	79.97	2.09	79.96	2.44
81	81.00	0.35	81.00	0.71	80.99	1.06	80.99	1.41	80.98	1.77	80.97	2.12	80.96	2.47
82	82.00	0.36	82.00	0.72	81.99	1.07	81.99	1.43	81.98	1.79	81.97	2.15	81.96	2.50
83	83.00	0.36	83.00	0.72	82.99	1.09	82.99	1.45	82.98	1.81	82.97	2.17	82.96	2.53
84	84.00	0.37	84.00	0.73	83.99	1.10	83.99	1.47	83.98	1.83	83.97	2.20	83.96	2.57
85	85.00	0.37	85.00	0.74	84.99	1.11	84.99	1.48	84.98	1.85	84.97	2.23	84.96	2.60
86	86.00	0.38	86.00	0.75	85.99	1.13	85.99	1.50	85.98	1.88	85.97	2.25	85.96	2.63
87	87.00	0.38	87.00	0.76	86.99	1.14	86.99	1.52	86.98	1.90	86.97	2.28	86.96	2.66
88	88.00	0.38	88.00	0.77	87.99	1.15	87.99	1.54	87.98	1.92	87.97	2.30	87.96	2.69
89	89.00	0.39	89.00	0.78	88.99	1.16	88.99	1.55	88.98	1.94	88.97	2.33	88.96	2.72
90	90.00	0.39	90.00	0.79	89.99	1.18	89.99	1.57	89.98	1.96	89.97	2.36	89.96	2.75
91	91.00	0.40	91.00	0.79	90.99	1.19	90.99	1.59	90.98	1.99	90.97	2.38	90.96	2.78
92	92.00	0.40	92.00	0.80	91.99	1.20	91.99	1.61	91.98	2.01	91.97	2.41	91.96	2.81
93	93.00	0.41	93.00	0.81	92.99	1.22	92.99	1.62	92.98	2.03	92.97	2.43	92.96	2.84
94	94.00	0.41	94.00	0.82	93.99	1.23	93.99	1.64	93.98	2.05	93.97	2.46	93.96	2.87
95	95.00	0.41	95.00	0.83	94.99	1.24	94.99	1.66	94.98	2.07	94.97	2.49	94.96	2.90
96	96.00	0.42	96.00	0.84	95.99	1.26	95.99	1.68	95.98	2.09	95.97	2.51	95.96	2.93
97	97.00	0.42	97.00	0.85	96.99	1.27	96.99	1.69	96.98	2.12	96.97	2.54	96.95	2.96
98	98.00	0.43	98.00	0.86	97.99	1.28	97.99	1.71	97.98	2.14	97.97	2.57	97.95	2.99
99	99.00	0.43	99.00	0.86	98.99	1.30	98.98	1.73	98.98	2.16	98.97	2.59	98.95	3.02
100	100.0	0.44	100.0	0.87	99.99	1.31	99.98	1.75	99.98	2.18	99.97	2.62	99.95	3.05
101	101.0	0.44	101.0	0.88	101.0	1.32	101.0	1.76	101.0	2.20	101.0	2.64	101.0	3.08
102	102.0	0.45	102.0	0.89	102.0	1.34	102.0	1.78	102.0	2.23	102.0	2.67	102.0	3.12
103	103.0	0.45	103.0	0.90	103.0	1.35	103.0	1.80	103.0	2.25	103.0	2.70	103.0	3.15
104	104.0	0.45	104.0	0.91	104.0	1.36	104.0	1.82	104.0	2.27	104.0	2.72	104.0	3.18
105	105.0	0.46	105.0	0.92	105.0	1.37	105.0	1.83	105.0	2.29	105.0	2.75	105.0	3.21
106	106.0	0.46	106.0	0.92	106.0	1.39	106.0	1.85	106.0	2.31	106.0	2.77	106.0	3.24
107	107.0	0.47	107.0	0.93	107.0	1.40	107.0	1.87	107.0	2.33	107.0	2.80	107.0	3.27
108	108.0	0.47	108.0	0.94	108.0	1.41	108.0	1.88	108.0	2.36	108.0	2.83	108.0	3.30
109	109.0	0.48	109.0	0.95	109.0	1.43	109.0	1.90	109.0	2.38	109.0	2.85	109.0	3.33
110	110.0	0.48	110.0	0.96	110.0	1.44	110.0	1.92	110.0	2.40	110.0	2.88	110.0	3.36
111	111.0	0.48	111.0	0.97	111.0	1.45	111.0	1.94	111.0	2.42	111.0	2.91	111.0	3.39
112	112.0	0.49	112.0	0.98	112.0	1.47	112.0	1.95	112.0	2.44	112.0	2.93	112.0	3.42
113	113.0	0.49	113.0	0.99	113.0	1.48	113.0	1.97	113.0	2.47	113.0	2.96	113.0	3.45
114	114.0	0.50	114.0	0.99	114.0	1.49	114.0	1.99	114.0	2.49	114.0	2.98	114.0	3.48
115	115.0	0.50	115.0	1.00	115.0	1.51	115.0	2.01	115.0	2.51	115.0	3.01	115.0	3.51
116	116.0	0.51	116.0	1.01	116.0	1.52	116.0	2.02	116.0	2.53	116.0	3.04	116.0	3.54
117	117.0	0.51	117.0	1.02	117.0	1.53	117.0	2.04	117.0	2.55	117.0	3.06	117.0	3.57
118	118.0	0.51	118.0	1.03	118.0	1.54	118.0	2.06	118.0	2.57	118.0	3.09	118.0	3.60
119	119.0	0.52	119.0	1.04	119.0	1.56	119.0	2.08	119.0	2.60	119.0	3.12	119.0	3.63
120	120.0	0.52	120.0	1.05	120.0	1.57	120.0	2.09	120.0	2.62	120.0	3.14	120.0	3.66
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	45 Min.		30 Min.		15 Min.		0 Min.		45 Min.		30 Min.		15 Min.	
	89 DEGREES.						88 DEGREES.							

Digitized by Google

TRAVERSE TABLE.

2 DEGREES.

Distance	0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
1	1.00	0.03	1.00	0.04	1.00	0.04	1.00	0.05
2	2.00	0.07	2.00	0.08	2.00	0.09	2.00	0.10
3	3.00	0.10	3.00	0.12	3.00	0.13	3.00	0.14
4	4.00	0.14	4.00	0.16	3.99	0.17	4.00	0.19
5	5.00	0.17	5.00	0.20	5.00	0.22	4.99	0.24
6	6.00	0.21	6.00	0.24	5.99	0.26	5.99	0.29
7	7.00	0.24	6.99	0.27	6.99	0.31	6.99	0.34
8	8.00	0.28	7.99	0.31	7.99	0.35	7.99	0.38
9	8.99	0.31	8.99	0.35	8.99	0.39	8.99	0.43
10	9.99	0.35	9.99	0.39	9.99	0.44	9.99	0.48
11	10.99	0.38	10.99	0.43	10.99	0.48	10.99	0.53
12	11.99	0.42	11.99	0.47	11.99	0.52	11.99	0.58
13	12.99	0.45	12.99	0.51	12.99	0.57	12.99	0.62
14	13.99	0.49	13.99	0.55	13.99	0.61	13.98	0.67
15	14.99	0.52	14.99	0.59	14.99	0.65	14.98	0.72
16	15.99	0.56	15.99	0.63	15.98	0.70	15.98	0.77
17	16.99	0.59	16.99	0.67	16.98	0.74	16.98	0.82
18	17.99	0.63	17.99	0.71	17.98	0.79	17.98	0.86
19	18.99	0.66	18.99	0.75	18.98	0.83	18.98	0.91
20	19.99	0.70	19.98	0.79	19.98	0.87	19.98	0.96
21	20.99	0.73	20.98	0.82	20.98	0.92	20.98	1.01
22	21.99	0.77	21.98	0.86	21.98	0.96	21.97	1.06
23	22.99	0.80	22.98	0.90	22.98	1.00	22.97	1.10
24	23.99	0.84	23.98	0.94	23.98	1.05	23.97	1.15
25	24.98	0.87	24.98	0.98	24.98	1.09	24.97	1.20
26	25.98	0.91	25.98	1.02	25.98	1.13	25.97	1.25
27	26.98	0.94	26.98	1.06	26.97	1.18	26.97	1.30
28	27.98	0.98	27.98	1.10	27.97	1.22	27.97	1.34
29	28.98	1.01	28.98	1.14	28.97	1.27	28.97	1.39
30	29.98	1.05	29.98	1.18	29.97	1.31	29.97	1.44
31	30.98	1.08	30.98	1.22	30.97	1.35	30.96	1.49
32	31.98	1.12	31.98	1.26	31.97	1.40	31.96	1.54
33	32.98	1.15	32.97	1.30	32.97	1.44	32.96	1.58
34	33.98	1.19	33.97	1.33	33.97	1.48	33.96	1.63
35	34.98	1.22	34.97	1.37	34.97	1.53	34.96	1.68
36	35.98	1.26	35.97	1.41	35.97	1.57	35.96	1.73
37	36.98	1.29	36.97	1.45	36.96	1.61	36.96	1.78
38	37.98	1.33	37.97	1.49	37.96	1.66	37.96	1.82
39	38.98	1.36	38.97	1.53	38.96	1.70	38.96	1.87
40	39.98	1.40	39.97	1.57	39.96	1.74	39.95	1.92
41	40.98	1.43	40.97	1.61	40.96	1.79	40.95	1.97
42	41.97	1.47	41.97	1.65	41.96	1.83	41.95	2.02
43	42.97	1.50	42.97	1.69	42.96	1.88	42.95	2.06
44	43.97	1.54	43.97	1.73	43.96	1.92	43.95	2.11
45	44.97	1.57	44.97	1.77	44.96	1.96	44.95	2.16
46	45.97	1.61	45.96	1.81	45.96	2.01	45.95	2.21
47	46.97	1.64	46.96	1.85	46.96	2.05	46.95	2.26
48	47.97	1.68	47.96	1.88	47.95	2.09	47.94	2.30
49	48.97	1.71	48.96	1.92	48.95	2.14	48.94	2.35
50	49.97	1.75	49.96	1.96	49.95	2.18	49.94	2.40
51	50.97	1.78	50.96	2.00	50.95	2.22	50.94	2.45
52	51.97	1.81	51.96	2.04	51.95	2.27	51.94	2.49
53	52.97	1.85	52.96	2.08	52.95	2.31	52.94	2.54
54	53.97	1.88	53.96	2.12	53.95	2.36	53.94	2.59
55	54.97	1.92	54.96	2.16	54.95	2.40	54.94	2.64
56	55.97	1.95	55.96	2.20	55.95	2.44	55.94	2.69
57	56.97	1.99	56.96	2.24	56.95	2.49	56.93	2.73
58	57.96	2.02	57.96	2.28	57.94	2.53	57.93	2.78
59	58.96	2.06	58.96	2.32	58.94	2.57	58.93	2.83
60	59.96	2.09	59.96	3.36	59.94	2.62	59.93	2.88
Distance	Dep.	Lat.	Lat.	Dep.	Lat.	Dep.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.	

88 DEGS. 87 DEGREES.

3 DEGREES.

	0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
1	1.00	0.05	1.00	0.06	1.00	0.06	1.00	0.0
2	2.00	0.10	2.00	0.11	2.00	0.12	2.00	0.1
3	3.00	0.16	3.00	0.17	2.99	0.18	2.99	0.1
4	3.99	0.21	4.00	0.22	3.99	0.24	3.99	0.2
5	4.99	0.26	4.99	0.28	4.99	0.31	4.99	0.3
6	5.99	0.31	5.99	0.34	5.99	0.37	5.99	0.4
7	6.99	0.37	6.99	0.40	6.99	0.43	6.99	0.4
8	7.99	0.42	7.99	0.45	7.99	0.49	7.98	0.5
9	8.99	0.47	8.99	0.51	8.98	0.55	8.98	0.5
10	9.99	0.52	9.98	0.57	9.98	0.61	9.98	0.6
11	10.98	0.58	10.98	0.62	10.98	0.67	10.98	0.7
12	11.98	0.63	11.98	0.68	11.98	0.73	11.97	0.7
13	12.98	0.68	12.98	0.74	12.98	0.79	12.97	0.8
14	13.98	0.73	13.98	0.79	13.97	0.85	13.97	0.9
15	14.98	0.79	14.98	0.85	14.97	0.92	14.97	0.9
16	15.98	0.84	15.97	0.91	15.97	0.98	15.97	1.0
17	16.98	0.89	16.97	0.96	16.97	1.04	16.96	1.1
18	17.98	0.94	17.97	1.02	17.97	1.10	17.96	1.1
19	18.97	0.99	18.97	1.08	18.96	1.16	18.96	1.2
20	19.97	1.05	19.97	1.13	19.96	1.22	19.96	1.3
21	20.97	1.10	20.97	1.19	20.96	1.28	20.96	1.3
22	21.97	1.15	21.97	1.25	21.96	1.34	21.95	1.4
23	22.97	1.20	22.96	1.30	22.96	1.40	22.95	1.5
24	23.97	1.26	23.96	1.36	23.96	1.47	23.95	1.5
25	24.97	1.31	24.96	1.42	24.95	1.53	24.95	1.6
26	25.96	1.36	25.96	1.47	25.95	1.59	25.94	1.7
27	26.96	1.41	26.96	1.53	26.95	1.65	26.94	1.7
28	27.96	1.47	27.96	1.59	27.95	1.71	27.94	1.8
29	28.96	1.52	28.95	1.64	28.95	1.77	28.94	1.9
30	29.96	1.57	29.95	1.70	29.94	1.83	29.94	1.9
31	30.96	1.62	30.95	1.76	30.94	1.89	30.93	2.0
32	31.96	1.67	31.95	1.81	31.94	1.95	31.93	2.0
33	32.95	1.73	32.95	1.87	32.94	2.01	32.93	2.1
34	33.95	1.78	33.95	1.93	33.94	2.08	33.93	2.2
35	34.95	1.83	34.94	1.98	34.93	2.14	34.93	2.2
36	35.95	1.88	35.94	2.04	35.93	2.20	35.92	2.3
37	36.95	1.94	36.94	2.10	36.93	2.26	36.92	2.4
38	37.95	1.99	37.94	2.15	37.93	2.32	37.92	2.4
39	38.95	2.04	38.94	2.21	38.93	2.38	38.92	2.5
40	39.95	2.09	39.94	2.27	39.93	2.44	39.91	2.6
41	40.94	2.15	40.93	2.32	40.92	2.50	40.91	2.6
42	41.94	2.20	41.93	2.38	41.92	2.56	41.91	2.7
43	42.94	2.25	42.93	2.44	42.92	2.63	42.91	2.8
44	43.94	2.30	43.93	2.49	43.92	2.69	43.91	2.8
45	44.94	2.36	44.93	2.55	44.92	2.75	44.90	2.9
46	45.94	2.41	45.93	2.61	45.91	2.81	45.90	3.0
47	46.94	2.46	46.92	2.66	46.91	2.87	46.90	3.0
48	47.93	2.51	47.92	2.72	47.91	2.93	47.90	3.1
49	48.93	2.56	48.92	2.78	48.91	2.99	48.90	3.1
50	49.93	2.62	49.92	2.83	49.91	3.05	49.89	3.2
51	50.93	2.67	50.92	2.89	50.90	3.11	50.89	3.3
52	51.93	2.72	51.92	2.95	51.90	3.17	51.89	3.4
53	52.93	2.77	52.91	3.00	52.90	3.24	52.89	3.4
54	53.93	2.83	53.91	3.06	53.90	3.30	53.88	3.5
55	54.92	2.88	54.91	3.12	54.90	3.36	54.88	3.6
56	55.92	2.93	55.91	3.17	55.90	3.42	55.88	3.6
57	56.92	2.98	56.91	3.23	56.89	3.48	56.88	3.7
58	57.92	3.04	57.91	3.29	57.89	3.54	57.88	3.7
59	58.92	3.09	58.91	3.34	58.89	3.60	58.87	3.8
60	59.92	3.14	59.90	3.40	59.89	3.66	59.87	3.8
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	L
	0 Min.		45 Min.		30 Min.		15 Min.	

86 DEGREES.

Digitized by Google

TRAVERSE TABLE.

Distance	2 DEGREES								3 DEGREES							
	0 Min.		15 Min.		30 Min.		45 Min.		0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
61	60.96	2.13	60.95	2.39	60.94	2.66	60.93	2.93	60.92	3.19	60.90	3.46	60.89	3.72	60.87	3.99
62	61.96	2.16	61.95	2.43	61.94	2.70	61.93	2.97	61.92	3.24	61.90	3.52	61.88	3.79	61.87	4.06
63	62.96	2.20	62.95	2.47	62.94	2.75	62.93	3.02	62.91	3.30	62.90	3.57	62.88	3.85	62.87	4.12
64	63.96	2.23	63.95	2.51	63.94	2.79	63.93	3.07	63.91	3.35	63.90	3.63	63.88	3.91	63.86	4.19
65	64.96	2.27	64.95	2.55	64.94	2.84	64.93	3.12	64.91	3.40	64.90	3.69	64.88	3.97	64.86	4.25
66	65.96	2.30	65.95	2.59	65.94	2.88	65.92	3.17	65.91	3.45	65.89	3.74	65.88	4.03	65.86	4.32
67	66.96	2.34	66.95	2.65	66.94	2.92	66.92	3.21	66.91	3.51	66.89	3.80	66.88	4.09	66.86	4.38
68	67.96	2.37	67.95	2.67	67.94	2.97	67.92	3.26	67.91	3.56	67.89	3.86	67.87	4.15	67.85	4.45
69	68.96	2.41	68.95	2.71	68.93	3.01	68.92	3.31	68.91	3.61	68.89	3.91	68.87	4.21	68.85	4.51
70	69.96	2.44	69.95	2.75	69.92	3.05	69.92	3.36	69.90	3.66	69.89	3.97	69.87	4.27	69.85	4.58
71	70.96	2.48	70.95	2.79	70.93	3.10	70.92	3.41	70.90	3.72	70.88	4.03	70.87	4.33	70.85	4.64
72	71.96	2.51	71.94	2.83	71.93	3.14	71.92	3.43	71.90	3.77	71.88	4.08	71.87	4.40	71.85	4.71
73	72.96	2.55	72.94	2.87	72.93	3.18	72.92	3.50	72.90	3.82	72.88	4.14	72.86	4.46	72.84	4.77
74	73.95	2.58	73.94	2.91	73.93	3.23	73.91	3.55	73.90	3.87	73.88	4.20	73.86	4.52	73.84	4.84
75	74.95	2.62	74.94	2.94	74.93	3.27	74.91	3.60	74.90	3.93	74.88	4.25	74.86	4.58	74.84	4.91
76	75.95	2.65	75.94	2.98	75.93	3.32	75.91	3.65	75.90	3.98	75.88	4.31	75.86	4.64	75.84	4.97
77	76.95	2.69	76.94	3.02	76.93	3.36	76.91	3.69	76.89	4.03	76.88	4.37	76.86	4.70	76.84	5.04
78	77.95	2.72	77.94	3.06	77.93	3.40	77.91	3.74	77.89	4.08	77.87	4.42	77.85	4.76	77.83	5.10
79	78.95	2.76	78.94	3.10	78.92	3.45	78.91	3.79	78.89	4.13	78.87	4.48	78.85	4.82	78.83	5.17
80	79.95	2.79	79.94	3.14	79.92	3.49	79.91	3.84	79.89	4.19	79.87	4.54	79.85	4.88	79.83	5.23
81	80.95	2.83	80.94	3.18	80.92	3.53	80.91	3.89	80.89	4.24	80.87	4.59	80.85	4.94	80.83	5.30
82	81.95	2.86	81.94	3.22	81.92	3.58	81.91	3.93	81.89	4.29	81.87	4.65	81.85	5.01	81.82	5.36
83	82.95	2.90	82.94	3.26	82.92	3.62	82.90	3.98	82.89	4.34	82.87	4.71	82.85	5.07	82.82	5.45
84	83.95	2.93	83.94	3.30	83.92	3.66	83.90	4.03	83.88	4.40	83.86	4.76	83.84	5.13	83.82	5.49
85	84.95	2.97	84.93	3.34	84.92	3.71	84.90	4.08	84.88	4.45	84.86	4.82	84.84	5.19	84.82	5.56
86	85.95	3.00	85.93	3.38	85.92	3.75	85.90	4.13	85.88	4.50	85.86	4.88	85.84	5.25	85.82	5.62
87	86.95	3.04	86.93	3.42	86.92	3.79	86.90	4.17	86.88	4.55	86.86	4.93	86.84	5.31	86.81	5.69
88	87.95	3.07	87.93	3.45	87.92	3.84	87.90	4.22	87.88	4.61	87.86	4.99	87.84	5.37	87.81	5.76
89	88.95	3.11	88.93	3.49	88.92	3.88	88.90	4.27	88.88	4.66	88.86	5.05	88.85	5.43	88.81	5.82
90	89.95	3.14	89.93	3.53	89.91	3.93	89.90	4.32	89.88	4.71	89.86	5.10	89.85	5.49	89.81	5.89
91	90.94	3.18	90.93	3.57	90.91	3.97	90.90	4.37	90.88	4.76	90.85	5.16	90.83	5.56	90.81	5.95
92	91.94	3.21	91.93	3.61	91.91	4.01	91.89	4.41	91.87	4.81	91.85	5.22	91.83	5.62	91.80	6.02
93	92.94	3.25	92.93	3.65	92.91	4.06	92.89	4.46	92.87	4.87	92.85	5.27	92.83	5.68	92.80	6.08
94	93.94	3.28	93.93	3.69	93.91	4.10	93.89	4.51	93.87	4.92	93.85	5.33	93.82	5.74	93.80	6.15
95	94.94	3.32	94.93	3.73	94.91	4.14	94.89	4.56	94.87	4.97	94.85	5.39	94.82	5.80	94.80	6.21
96	95.94	3.35	95.93	3.77	95.91	4.19	95.89	4.61	95.87	5.02	95.85	5.44	95.82	5.86	95.79	6.28
97	96.94	3.39	96.93	3.81	96.91	4.23	96.89	4.65	96.87	5.08	96.84	5.50	96.82	5.92	96.79	6.34
98	97.94	3.42	97.92	3.85	97.91	4.27	97.89	4.70	97.87	5.13	97.84	5.56	97.82	5.98	97.79	6.41
99	98.94	3.46	98.92	3.89	98.91	4.32	98.89	4.75	98.86	5.18	98.84	5.61	98.82	6.04	98.79	6.47
100	99.94	3.49	99.92	3.93	99.90	4.36	99.88	4.80	99.86	5.23	99.84	5.67	99.81	6.10	99.79	6.54
101	100.9	3.53	100.9	3.96	100.9	4.41	100.9	4.85	100.9	5.29	100.8	5.73	100.8	6.17	100.8	6.61
102	101.9	3.56	101.9	4.00	101.9	4.45	101.9	4.89	101.9	5.34	101.8	5.78	101.8	6.23	101.8	6.67
103	102.9	3.59	102.9	4.04	102.9	4.49	102.9	4.94	102.9	5.39	102.8	5.84	102.8	6.29	102.8	6.74
104	103.9	3.63	103.9	4.08	103.9	4.54	103.9	4.99	103.9	5.44	103.8	5.90	103.8	6.35	103.8	6.80
105	104.9	3.66	104.9	4.12	104.9	4.58	104.9	5.04	104.9	5.50	104.8	5.95	104.8	6.41	104.8	6.87
106	105.9	3.70	105.9	4.16	105.9	4.62	105.9	5.09	105.9	5.55	105.8	6.01	105.8	6.47	105.8	6.93
107	106.9	3.73	106.9	4.20	106.9	4.67	106.9	5.13	106.9	5.60	106.8	6.07	106.8	6.53	106.8	7.00
108	107.9	3.77	107.9	4.24	107.9	4.71	107.9	5.18	107.9	5.65	107.8	6.12	107.8	6.59	107.8	7.06
109	108.9	3.80	108.9	4.28	108.9	4.75	108.9	5.23	108.9	5.70	108.8	6.18	108.8	6.65	108.8	7.13
110	109.9	3.84	109.9	4.32	109.9	4.80	109.9	5.28	109.8	5.76	109.8	6.24	109.8	6.72	109.8	7.19
111	110.9	3.87	110.9	4.36	110.9	4.84	110.9	5.30	110.8	5.81	110.8	6.29	110.8	6.78	110.8	7.26
112	111.9	3.91	111.9	4.40	111.9	4.89	111.9	5.37	111.8	5.86	111.8	6.35	111.8	6.84	111.8	7.33
113	112.9	3.94	112.9	4.44	112.9	4.93	112.9	5.42	112.8	5.91	112.8	6.41	112.8	6.90	112.8	7.39
114	113.9	3.98	113.9	4.48	113.9	4.97	113.9	5.47	113.8	5.97	113.8	6.46	113.8	6.96	113.8	7.46
115	114.9	4.01	114.9	4.51	114.9	5.02	114.9	5.52	114.8	6.02	114.8	6.52	114.8	7.02	114.8	7.52
116	115.9	4.05	115.9	4.55	115.9	5.06	115.9	5.57	115.8	6.07	115.8	6.58	115.8	7.08	115.8	7.59
117	116.9	4.08	116.9	4.59	116.9	5.10	116.9	5.61	116.8	6.12	116.8	6.63	116.8	7.14	116.7	7.65
118	117.9	4.12	117.9	4.63	117.9	5.15	117.9	5.66	117.8	6.18	117.8	6.69	117.8	7.20	117.7	7.72
119	118.9	4.15	118.9	4.67	118.9	5.19	118.9	5.71	118.8	6.23	118.8	6.75	118.8	7.26	118.7	7.78
120	119.9	4.19	119.9	4.71	119.9	5.23	119.9	5.76	119.8	6.28	119.8	6.80	119.8	7.32	119.7	7.85
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.		0 Min.		45 Min.		30 Min.		15 Min.	
	88 DEG.		87 DEGREES						86 DEGREES							

Digitized by Google

TRAVERSE TABLE.

Distance	4 DEGREES								5 DEGREES							
	0 Min.		15 Min.		30 Min.		45 Min.		0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep
1	1.00	0.07	1.00	0.07	1.00	0.08	1.00	0.08	1.00	0.09	1.00	0.09	1.00	0.10	1.00	0.10
2	2.00	0.14	1.99	0.15	1.99	0.16	1.99	0.17	1.99	0.17	1.99	0 18	1.99	0.19	1.99	0.20
3	2.99	0.21	2.99	0.22	2.99	0 24	2.99	0.25	2.99	0.26	2.99	0.27	2.98	0.29	2.98	0.30
4	3.99	0.28	3.99	0.30	3.99	0.31	3.99	0.33	3.98	0.35	3.98	0.37	3.98	0.38	3.98	0.40
5	4.99	0.35	4.98	0.37	4.98	0.39	4.98	0.41	4.98	0.44	4.98	0.46	4.98	0.48	4.97	0.50
6	5.98	0.42	5.98	0.44	5.98	0.47	5.98	0.50	5.98	0.52	5.97	0.55	5.97	0.58	5.97	0.60
7	6.98	0.49	6.98	0.52	6.98	0.55	6.98	0.58	6.97	0.61	6.97	0.64	6.97	0.67	6.96	0.70
8	7.98	0.56	7.98	0.59	7.98	0.63	7.97	0.66	7.97	0.70	7.97	0.73	7.96	0.77	7.96	0.80
9	8.98	0.63	8.98	0.67	8.97	0.71	8.97	0.75	8.97	0.7	8.96	0.82	8.96	0.86	8.95	0.90
10	9.98	0.70	9.97	0.74	9.97	0.78	9.97	0.83	9.9	0.87	9.96	0.92	9.95	0.96	9.95	1.00
11	10.97	0.77	10.97	0.82	10.97	0.86	10.96	0.91	10 96	0.96	10.95	1.01	10.9	1.05	10.94	1.10
12	11.97	0.84	11.97	0.89	11.96	0.94	11.96	0.99	11.95	1.05	11.95	1.10	11.94	1.15	11.94	1.20
13	12.97	0.91	12.96	0.96	12.96	1.02	12.96	1 08	12.95	1.13	12.95	1.19	12.94	1.25	12.95	1.30
14	13.97	0.98	13.96	1.04	13.96	1.10	13.95	1.16	13.95	1.22	13.94	1.28	13.94	1.34	13.95	1.40
15	14.96	1.05	14.96	1.11	14.95	1.18	14.95	1 24	14.94	1.31	14.94	1.37	14.93	1.44	14.92	1.50
16	15.96	1.12	15.96	1.19	15.95	1.26	15.95	1.33	15.94	1.39	15.93	1.46	15.93	1.53	15.92	1.60
17	16.96	1.19	16.95	1.26	16.95	1.33	16.94	1.41	16.94	1.48	16.93	1.56	16.92	1.63	16 91	1.70
18	17.96	1.26	17.95	1.33	17.94	1.41	17.94	1.49	17.93	1.57	17.92	1.65	17.92	1.73	17.91	1.80
19	18.95	1.33	18.95	1.41	18.94	1.49	18.93	1.57	18.93	1.66	18.92	1.74	18.91	1.82	18.90	1.90
20	19.95	1.40	19.95	1.48	19.94	1.57	19.93	1.66	19.92	1.74	19.92	1.83	19.91	1.92	19.90	2.00
21	20.95	1.46	20.94	1.56	20.94	1.65	20.93	1.74	20.92	1.83	20.91	1.92	20.90	2.01	20.88	2.10
22	21.95	1.53	21.94	1.63	21.93	1.73	21.92	1.82	21.92	1.91	21.91	2.01	21.90	2.11	21.89	2.20
23	22.94	1.60	22.94	1.70	22.93	1.80	22.92	1.90	22.91	2.00	22 90	2.10	22.89	2.20	22.88	2.30
24	23.94	1.67	23.93	1.78	23.93	1.88	23.92	1.99	23.91	2.09	23.90	2.20	23.89	2.30	23.88	2.40
25	24.94	1.74	24.93	1.85	24.92	1.96	24.91	2.07	24.90	2 18	24.90	2.29	24.88	2.40	24.87	2.50
26	25.94	1.81	25.93	1.93	25.92	2.04	25.91	2.15	25.90	2.27	25.89	2.38	25.88	2.49	25.87	2.60
27	26.93	1.88	26.93	2.00	26.92	2.12	26.91	2.24	26.90	2.35	26.89	2.47	26.88	2.59	26.86	2.71
28	27.93	1.95	27.92	2.08	27.91	2.20	27.90	2.32	27.89	2.44	27.88	2.56	27.87	2.68	27.86	2.81
29	28 93	2.02	28.92	2.15	28.91	2.28	28.90	2.40	28.89	2.53	28.88	2.65	28.87	2.78	28.85	2.91
30	29.93	2.09	29.92	2.22	29.91	2.35	29.90	2.48	29.89	2.61	29.87	2.75	29.86	2.88	29.85	3 01
31	30.92	2.16	30.91	2.30	30.90	2.43	30.89	2.57	30.88	2.70	30.87	2.84	30.86	2.97	30.84	3.11
32	31.92	2.23	31.91	2.37	31.90	2.51	31.89	2.65	31.88	2.79	31.87	2.93	31.85	3.07	31.84	3.21
33	32.92	2.30	32.91	2.45	32.90	2.59	32.89	2.73	32.87	2.88	32.86	3.02	32.85	3.16	32.83	3.31
34	33.92	2.37	33.91	2.52	33.90	2.67	33.88	2.82	33.87	2.96	33.86	3.11	33.84	3.26	33.83	3.41
35	34.91	2.44	34.90	2.59	34.89	2.75	34.88	2.90	34.87	3.05	34.85	3.20	34.84	3.35	34.82	3.51
36	35.91	2.51	35.90	2.67	35.89	2.82	35.88	2.98	35.86	3.14	35.85	3.29	35.83	3.45	35.82	3.61
37	36.91	2.58	36.90	2.74	36.89	2.90	36.87	3.06	36.86	3.22	36.84	3.39	36.83	3.55	36.81	3.71
38	37.91	2.65	37.90	2.82	37.88	2.98	37 87	3.15	37.86	3.31	37.84	3.48	37.83	3.64	37.81	3.81
39	38.91	2.72	38.89	2.89	38.88	3.06	38.87	3.23	38.85	3.40	38.84	3.57	38.82	3.74	38.80	3.91
40	39.90	2.79	39.89	2.96	39.88	3 14	39.86	3.31	39.85	3.49	39.83	3.66	39.82	3.83	39.80	4.01
41	40.90	2.86	40.89	3.04	40.87	3.22	40.86	3.40	40.84	3.57	40.83	3.75	40.81	3.93	0.79	4.11
42	41.90	2.93	41.88	3.11	41.87	3.30	41.86	3.48	41.84	3.66	41.82	3.84	41.81	4.02	41.79	4.21
43	42 90	3.00	42.88	3.19	42.87	3.37	42.85	3.56	42.84	3.75	42.82	3.93	42.80	4.12	42.78	4.31
44	43.89	3.07	43.88	3.26	43.86	3.45	43.85	3.64	43.83	3.83	43.82	4.02	43.80	4.22	43.78	4.41
45	44.89	3.14	44.88	3.33	44.86	3.53	44.85	3.72	44.85	3.92	44.81	4.12	44.79	4.31	44.77	4.51
46	45.89	3.21	45.87	3.41	45.86	3.61	45.84	3.81	45.83	4.01	45.81	4.21	45.79	4.41	45.77	4.61
47	46.89	3.28	46.87	3.48	46.86	3.69	46.84	3.89	46.82	4.10	46.80	4.30	46.78	4.50	46.76	4.71
48	47.88	3.35	47.87	3.56	47.85	3.77	47.84	3.97	47.82	4.18	47.80	4.39	47.78	4.60	47.76	4.81
49	48.88	3.42	48.87	3.63	48.85	3.84	48.83	4.06	48.81	4.27	48.79	4.48	48.77	4.70	48.75	4.91
50	49.88	3.49	49.86	3.71	49.85	3.92	49.83	4.14	49.81	4.36	49.79	4.58	49.77	4.79	49.77	5.01
51	50.88	3.56	50.86	3.78	50.84	4.00	50.82	4.22	50.81	4.44	50.79	4.67	50.77	4.89	50.74	5.11
52	51.87	3.63	51.86	3.85	51.84	4.08	51.82	4.31	51.80	4.53	51.78	4.76	51.76	4.98	51.73	5.21
53	52.87	3.70	52.85	3.93	52.84	4.16	52.82	4.39	52.80	4.62	52 78	4.85	52.76	5.08	52.73	5.31
54	53.87	3.77	53.85	4.00	53.83	4 24	53.81	4.47	53.79	4.71	53.77	4.94	53.75	5.18	53.73	5.41
55	54.87	3.84	54.85	4.08	54.83	4.32	54.81	4.55	54.79	4.79	54.77	5.03	54.75	5.27	54.72	5.51
56	55.86	3.91	55.85	4.15	55.83	4.39	55.81	4.64	55.79	4.88	55.77	5.12	55.74	5.37	55.72	5.61
57	56.86	3.98	56.84	4.22	56.82	4.47	56.80	4.72	56.78	4 97	56.76	5.22	56.74	5.46	56.71	5.71
58	57.86	4.05	57.84	4.30	57.82	4.55	57.80	4.80	57.78	5.06	57.76	5.31	57.73	5.56	57.71	5.81
59	58.86	4.12	58.84	4.37	58.82	4.63	58 80	4.89	58.78	5.14	58.75	5.40	58.73	5.65	58.70	5.91
60	59.85	4.19	59.84	4.45	59.82	4.71	59.79	4.97	59.77	5.23	59.75	5.49	59.72	5.7	59.70	6.01
Distance	Dep.	Lat.	Dep.	Lat	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.		0 Min.		45Min.		30 Min.		15 Min.	
	86 DEG		85 DEGREES						84 DEGREES							

Digitized by Google

TRAVERSE TABLE.

4 DEGREES

Distance	0 Min. Lat.	0 Min. Dep.	15 Min. Lat.	15 Min. Dep.	30 Min. Lat.	30 Min. Dep.	45 Min. Lat.	45 Min. Dep.
61	60.85	4.26	60.83	4.52	60.81	4.79	60.79	5.05
62	61.85	4.32	61.83	4.59	61.81	4.86	61.79	5.13
63	62.85	4.39	62.83	4.67	62.81	4.94	62.78	5.22
64	63.84	4.46	63.82	4.74	63.80	5.02	63.78	5.30
65	64.84	4.53	64.82	4.82	64.80	5.10	64.78	5.38
66	65.84	4.60	65.82	4.89	65.80	5.18	65.77	5.47
67	66.84	4.67	66.82	4.97	66.79	5.26	66.77	5.55
68	67.83	4.74	67.81	5.04	67.79	5.34	67.77	5.63
69	68.83	4.81	68.81	5.11	68.79	5.41	68.76	5.71
70	69.83	4.88	69.81	5.19	69.78	5.49	69.76	5.80
71	70.83	4.95	70.80	5.26	70.78	5.57	70.76	5.88
72	71.82	5.02	71.80	5.34	71.78	5.65	71.75	5.96
73	72.82	5.09	72.80	5.41	72.78	5.75	72.75	6.05
74	73.82	5.16	73.80	5.48	73.77	5.81	73.75	6.13
75	74.82	5.23	74.79	5.56	74.77	5.88	74.74	6.21
76	75.81	5.30	75.79	5.63	75.77	5.96	75.74	6.29
77	76.81	5.37	76.79	5.71	76.76	6.04	76.74	6.38
78	77.81	4.44	77.79	5.78	77.76	6.12	77.75	6.46
79	78.81	5.51	78.78	5.85	78.76	6.20	78.73	6.54
80	79.81	5.58	79.78	5.93	79.75	6.28	79.73	6.62
81	80.80	5.65	80.78	6.00	80.75	6.36	80.72	6.71
82	81.80	5.72	81.77	6.08	81.75	6.43	81.72	6.79
83	82.80	5.79	82.77	6.15	82.74	6.51	82.71	6.87
84	83.80	5.86	83.77	6.23	83.74	6.59	83.71	6.96
85	84.79	5.93	84.77	6.30	84.74	6.67	84.71	7.04
86	85.79	6.00	85.76	6.37	85.73	6.75	85.70	7.12
87	86.79	6.07	86.76	6.45	86.73	6.83	86.70	7.20
88	87.79	6.14	87.76	6.52	87.73	6.90	87.70	7.29
89	88.78	6.21	88.76	6.60	88.73	6.98	88.69	7.37
90	89.78	6.28	89.75	6.67	89.72	7.06	89.69	7.45
91	90.78	6.35	90.75	6.74	90.72	7.14	90.69	7.54
92	91.78	6.42	91.75	6.82	91.72	7.22	91.68	7.62
93	92.77	6.49	92.74	6.89	92.71	7.30	92.68	7.70
94	93.77	6.56	93.74	6.97	93.71	7.38	93.68	7.78
95	94.77	6.63	94.74	7.04	94.71	7.45	94.67	7.87
96	95.77	6.70	95.74	7.11	95.70	7.53	95.67	7.95
97	96.76	6.77	96.73	7.19	96.70	7.61	96.67	8.03
98	97.76	6.84	97.73	7.26	97.70	7.69	97.66	8.12
99	98.76	6.91	98.73	7.34	98.69	7.77	98.66	8.20
100	99.76	6.98	99.73	7.41	99.69	7.85	99.66	8.28
101	100.8	7.05	100.7	7.49	100.7	7.92	100.6	8.36
102	101.8	7.12	101.7	7.56	101.7	8.00	101.6	8.45
103	102.7	7.18	102.7	7.63	102.7	8.08	102.6	8.53
104	103.7	7.25	103.7	7.71	103.7	8.16	103.6	8.61
105	104.7	7.32	104.7	7.78	104.7	8.24	104.6	8.69
106	105.7	7.39	105.7	7.86	105.7	8.32	105.6	8.78
107	106.7	7.46	106.7	7.93	106.7	8.40	106.6	8.86
108	107.7	7.55	107.7	8.00	107.7	8.47	107.6	8.94
109	108.7	7.60	108.7	8.08	108.7	8.55	108.6	9.03
110	109.7	7.67	109.7	8.15	109.7	8.63	109.6	9.11
111	110.7	7.74	110.7	8.23	110.7	8.71	110.6	9.19
112	111.7	7.81	111.7	8.30	111.7	8.79	111.6	9.27
113	112.7	7.88	112.7	8.37	112.7	8.87	112.6	9.36
114	113.7	7.95	113.7	8.45	113.6	8.94	113.6	9.44
115	114.7	8.02	114.7	8.52	114.6	9.02	114.6	9.52
116	115.7	8.09	115.7	8.60	115.6	9.10	115.6	9.61
117	116.7	8.16	116.7	8.67	116.6	9.18	116.6	9.69
118	117.7	8.23	117.7	8.74	117.6	9.26	117.6	9.77
119	118.7	8.30	118.7	8.82	118.6	9.34	118.6	9.85
120	119.7	8.37	119.7	8.89	119.6	9.42	119.6	9.94

5 DEGREES

Distance	0 Min. Lat.	0 Min. Dep.	15 Min. Lat.	15 Min. Dep.	30 Min. Lat.	30 Min. Dep.	45 Min. Lat.	45 Min. Dep.
61	60.77	5.32	60.74	5.58	60.72	5.85	60.69	6.11
62	61.76	5.40	61.74	5.67	61.71	5.94	61.69	6.21
63	62.76	5.49	62.74	5.76	62.71	6.04	62.68	6.31
64	63.76	5.58	63.73	5.86	63.71	6.13	63.68	6.41
65	64.75	5.67	64.73	5 95	64.70	6.23	64.67	6.51
66	65.75	5.75	65.72	6.04	65.70	6.33	65.67	6.61
67	66.74	5.84	66.72	6.13	66.69	6.42	66.66	6.71
68	67.74	5.93	67.71	6.22	67.69	6.52	67.66	6.81
69	68.74	6.01	68.71	6.31	68.68	6.61	68.65	6.91
70	69.73	6.10	69.71	6.41	69.68	6.71	69.65	7.01
71	70.73	6.19	70.70	6.50	70.67	6.81	70.64	7.11
72	71.73	6.28	71.70	6.59	71.67	6.90	71.64	7.21
73	72.72	6.36	72.69	6.68	72.66	7.00	72.63	7.31
74	73.72	6.45	73.69	6.77	73.66	7.09	73.63	7.41
75	74.71	6.54	74.69	6.86	74.65	7.19	74.62	7.51
76	75.71	6.62	75.68	6.95	75.65	7.28	75.62	7.61
77	76.71	6.71	76.68	7.05	76.65	7.38	76.61	7.71
78	77.70	6.80	77.67	7.14	77.64	7.48	77.61	7.81
79	78.70	6.89	78.67	7.23	78.64	7.57	78.60	7.91
80	79.70	6.97	79.66	7.32	79.63	7.67	79.60	8.02
81	80.69	7.06	80.66	7.41	80.63	7.76	80.59	8.12
82	81.69	7.15	81.66	7.50	81.62	7.86	81.59	8.22
83	82.68	7.23	82.65	7.59	82.62	7.96	82.58	8.32
84	83.68	7.32	83.65	7.69	83.61	8.05	83.58	8.42
85	84.68	7.41	84.64	7.78	84.61	8.15	84.57	8.52
86	85.67	7.50	85.64	7.87	85.60	8.24	85.57	8.62
87	86.67	7.58	86.64	7.96	86.60	8.34	86.56	8.72
88	87.67	7.67	87.63	8.05	87.59	8.43	87.56	8.82
89	88.66	7.76	88.63	8.14	88.59	8.53	88.55	8.92
90	89.66	7.84	89.62	8.24	89.59	8.63	89.55	9.02
91	90.65	7.93	90.62	8.33	90.58	8.72	90.54	9.12
92	91.65	8.02	91.61	8.42	91.58	8.82	91.54	9.22
93	92.64	8.11	92.61	8.51	92.57	8.91	92.53	9.32
94	93.64	8.19	93.61	8 60	93.57	9.01	93.53	9.42
95	94.64	8.28	94.60	8.69	94.56	9.11	94.52	9.52
96	95.63	8.37	95 60	8.78	95.56	9.20	95.52	9.62
97	96.63	8.45	96.59	8.88	96.55	9.30	96.51	9.72
98	97.63	8.54	97.59	8.97	97.55	9.39	97.51	9.82
99	98.62	8 63	98.58	9.06	98.54	9.49	98.50	9.92
100	99.62	8.72	99 58	9.15	99.54	9.58	99.50	10.02
101	100.6	8.80	100.6	9.24	100.5	9.68	100.5	10.12
102	101.6	8.89	101.6	9.33	101.5	9.78	101.5	10.22
103	102.6	8.98	102.6	9.42	102.5	9.87	102.5	10.32
104	103.6	9.06	103.6	9.52	103.5	9.97	103.5	19.42
105	104.6	9.15	104.6	9.61	104.5	10.06	104.5	10.52
106	105.6	9.24	105.6	9.70	105.5	10.16	105.5	10.62
107	106.6	9.33	106.6	9.79	106.5	10.26	106.5	10.72
108	107.5	9.41	107.5	9.88	107.5	10.35	107.5	10.82
109	108.5	9.50	108.5	9.97	108.5	10.45	108.5	10.92
110	109.5	10.07	109.5	10.54	109.4	11.02	109.4	11.02
111	110.5	10.16	110.5	10.64	110.4	11.12	110.4	11.12
112	111.5	10.25	111.5	10.73	111.4	11.22	111.4	11.22
113	112.5	10 34	112.5	10.83	112.4	11.32	112.4	11.32
114	113.5	10.43	113 5	10.93	113.4	11.42	113.4	11.42
115	114.5	10.52	114.5	11.02	114.4	11.52	114.4	11.52
116	115.5	10.61	115.5	11.12	115.4	11.62	115.4	11.62
117	116.5	10.71	116.5	11.21	116.4	11.72	116.4	11.72
118	117.5	10.80	117.5	11.31	117.4	11.82	117.4	11.82
119	118.5	10 89	118.5	11.40	118.4	11.92	118.4	11.92
120	119.5	10.98	119.5	11.50	119.4	12.02	119.4	12.02

Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.		0 Min.		45 Min.		30 Min.		15 Min.	
	86 DEG.		85 DEGREES						84 DEGREES							

Digitized by Google

TRAVERSE TABLE.

6 DEGREES

Distance	0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
1	0.99	0.10	0.99	0.11	0.99	0.11	0.99	0.12
2	1.99	0.21	1.99	0.22	1.99	0.23	1.99	0.24
3	2.98	0.31	2.98	0.33	2.98	0.34	2.98	0.35
4	3.98	0.42	3.98	0.44	3.97	0.45	3.97	0.47
5	4.97	0.52	4.97	0.54	4.97	0.57	4.97	0.59
6	5.97	0.63	5.96	0.65	5.96	0.68	5.96	0.71
7	6.96	0.73	6.96	0.76	6.96	0.79	6.95	0.82
8	7.96	0.84	7.95	0.87	7.95	0.91	7.94	0.94
9	8.95	0.94	8.95	0.98	8.94	1.02	8.94	1.06
10	9.95	1.05	9.94	1.09	9.94	1.13	9.93	1.18
11	10.94	1.15	10.93	1.20	10.93	1.25	10.92	1.29
12	11.93	1.25	11.93	1.31	11.92	1.36	11.92	1.41
13	12.93	1.36	12.92	1.42	12.92	1.47	12.91	1.53
14	13.92	1.46	13.92	1.52	13.91	1.58	13.90	1.65
15	14.92	1.57	14.91	1.63	14.90	1.70	14.90	1.76
16	15.91	1.67	15.90	1.74	15.90	1.81	15.89	1.88
17	16.91	1.78	16.90	1.85	16.89	1.92	16.88	2.00
18	17.90	1.88	17.89	1.96	17.88	2.04	17.88	2.12
19	18.90	1.99	18.89	2.07	18.88	2.15	18.87	2.23
20	19.89	2.09	19.88	2.18	19.87	2.26	19.86	2.35
21	20.89	2.20	20.88	2.29	20.86	2.38	20.85	2.47
22	21.88	2.30	21.87	2.40	21.86	2.49	21.85	2.59
23	22.87	2.40	22.86	2.50	22.85	2.60	22.84	2.70
24	23.87	2.51	23.86	2.61	23.85	2.72	23.83	1.82
25	24.86	2.61	24.85	2.72	24.84	2.83	24.83	2.94
26	25.86	2.72	25.85	2.83	25.83	2.94	25.82	3.06
27	26.85	2.82	26.84	2.94	26.83	3.06	26.81	3.17
28	27.85	2.93	27.83	3.05	27.82	3.17	27.81	3.29
29	28.84	3.03	28.83	3.16	28.81	3.28	28.80	3.41
30	29.84	3.14	29.82	3.27	29.81	3.40	29.79	3.53
31	30.83	3.24	30.82	3.37	30.80	3.51	30.79	3.64
32	31.82	3.34	31.81	3.48	31.79	3.62	31.78	3.76
33	32.82	3.45	32.80	3.59	32.79	3.74	32.77	3.88
34	33.81	3.55	33.80	3.70	33.78	3.85	33.76	4.00
35	34.81	3.66	34.79	3.81	34.78	3.96	34.76	4.11
36	35.80	3.76	35.79	3.92	35.77	4.08	35.75	4.23
37	36.80	3.87	36.78	4.03	36.76	4.19	36.74	4.35
38	37.79	3.97	37.77	4.14	37.76	4.30	37.74	4.47
39	38.79	4.08	38.77	4.25	38.75	4.41	38.73	4.58
40	39.78	4.18	39.76	4.35	39.74	4.53	39.72	4.70
41	40.78	4.29	40.76	4.46	40.74	4.64	40.72	4.82
42	41.77	4.39	41.75	4.57	41.73	4.75	41.71	4.94
43	42.76	4.49	42.74	4.68	42.72	4.87	42.70	5.05
44	43.76	4.60	43.74	4.79	43.72	4.98	43.70	5.17
45	44.75	4.70	44.73	4.90	44.71	5.09	44.69	5.29
46	45.75	4.81	45.73	5.01	45.70	5.21	45.68	5.41
47	46.74	4.91	46.72	5.12	46.70	5.32	46.67	5.52
48	47.74	5.02	47.71	5.23	47.69	5.43	47.67	5.64
49	48.73	5.12	48.71	5.33	48.69	5.55	48.66	5.76
50	49.73	5.23	49.70	5.44	49.68	5.66	49.65	5.88
51	50.73	5.33	50.70	5.55	50.67	5.77	50.65	5.99
52	51.72	5.44	51.69	5.66	51.67	5.89	51.64	6.11
53	52.71	5.54	52.69	5.77	52.66	6.00	52.63	6.23
54	53.70	5.64	53.68	5.88	53.65	6.11	53.63	6.35
55	54.70	5.75	54.67	5.99	54.65	6.23	54.62	6.46
56	55.69	5.85	55.67	6.10	55.64	6.34	55.61	6.58
57	56.69	5.96	56.66	6.21	56.63	6.45	56.60	6.70
58	57.68	6.06	57.66	6.31	57.63	6.57	57.60	6.82
59	58.68	6.17	58.65	6.42	58.62	6.68	58.59	6.93
60	59.67	6.27	59.64	6.53	59.61	6.79	59.58	7.05
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.	
	84 DEG.				83 DEGREES			

7 DEGREES

	0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
1	0.99	0.12	0.99	0.13	0.99	0.13	0.99	0.13
2	1.99	0.24	1.98	0.25	1.98	0.26	1.98	0.27
3	2.98	0.37	2.98	0.38	2.97	0.39	2.97	0.40
4	3.97	0.49	3.97	0.50	3.97	0.52	3.96	0.54
5	4.96	0.61	4.96	0.63	4.96	0.65	4.95	0.67
6	5.96	0.73	5.95	0.76	5.95	0.78	5.95	0.81
7	6.95	0.85	6.94	0.88	6.94	0.91	6.94	0.94
8	7.94	0.98	7.94	1.01	7.93	1.04	7.93	1.08
9	8.93	1.10	8.93	1.14	8.92	1.17	8.92	1.21
10	9.93	1.22	9.92	1.26	9.91	1.31	9.91	1.35
11	10.92	1.34	10.91	1.39	10.91	1.44	10.90	1.48
12	11.91	1.46	11.90	1.51	11.90	1.57	11.89	1.62
13	12.90	1.58	12.90	1.64	12.89	1.70	12.88	1.75
14	13.90	1.71	13.89	1.77	13.88	1.83	13.87	1.89
15	14.89	1.83	14.88	1.89	14.87	1.96	14.86	2.02
16	15.88	1.95	15.87	2.02	15.86	2.09	15.85	2.16
17	16.87	2.07	16.86	2.15	16.85	2.22	16.84	2.29
18	17.87	2.19	17.86	2.27	17.85	2.35	17.84	2.43
19	18.86	2.32	18.85	2.40	18.84	2.48	18.83	2.56
20	19.85	2.44	19.84	2.52	19.83	2.61	19.82	2.70
21	20.84	2.56	20.83	2.65	20.82	2.74	20.81	2.83
22	21.84	2.68	21.82	2.78	21.81	2.87	21.80	2.97
23	22.83	2.80	22.82	2.90	22.80	3.00	22.79	3.10
24	23.82	2.92	23.81	3.03	23.79	3.13	23.78	3.24
25	24.81	3.05	24.80	3.16	24.79	3.26	24.77	3.37
26	25.81	3.17	25.79	3.28	25.78	3.39	25.76	3.51
27	26.80	3.29	26.78	3.41	26.77	3.52	26.75	3.64
28	27.79	3.41	27.78	3.53	27.76	3.65	27.74	3.78
29	28.78	3.53	28.77	3.66	28.75	3.79	28.74	3.91
30	29.78	3.66	29.76	3.79	29.74	3.92	29.73	4.05
31	30.77	3.78	30.75	3.91	30.73	4.05	30.72	4.18
32	31.76	3.90	31.74	4.04	31.73	4.18	31.71	4.32
33	32.75	4.02	32.74	4.16	32.72	4.31	32.70	4.45
34	33.75	4.14	33.73	4.29	33.71	4.44	33.69	4.58
35	34.74	4.27	34.72	4.42	34.70	4.57	34.68	4.72
36	35.73	4.39	35.71	4.54	35.69	4.70	35.67	4.85
37	36.72	4.51	36.70	4.67	36.68	4.83	36.66	4.99
38	37.72	4.63	37.70	4.80	37.67	4.96	37.65	5.12
39	38.71	4.75	38.69	4.92	38.67	5.09	38.64	5.26
40	39.70	4.87	39.68	5.05	39.66	5.22	39.63	5.39
41	40.69	5.00	40.67	5.17	40.65	5.35	40.63	5.53
42	41.69	5.12	41.66	5.30	41.64	5.48	41.62	5.66
43	42.68	5.24	42.66	5.43	42.63	5.61	42.61	5.80
44	43.67	5.36	43.65	5.55	43.62	5.74	43.60	5.93
45	44.66	5.48	44.64	5.68	44.62	5.87	44.59	6.07
46	45.65	5.61	45.63	5.81	45.61	6.00	45.58	6.20
47	46.65	5.73	46.62	5.93	46.60	6.13	46.57	6.34
48	47.64	5.85	47.62	6.06	47.59	6.27	47.56	6.47
49	48.63	5.97	48.61	6.18	48.58	6.40	48.55	6.61
50	49.63	6.09	49.60	6.31	49.57	6.53	49.54	6.74
51	50.62	6.22	50.59	6.44	50.56	6.66	50.53	6.88
52	51.61	6.34	51.58	6.56	51.56	6.79	51.53	7.01
53	52.60	6.46	52.58	6.69	52.55	6.92	52.52	7.15
54	53.60	6.58	53.57	6.81	53.54	7.05	53.51	7.28
55	54.59	6.70	54.56	6.94	54.55	7.18	54.50	7.42
56	55.58	6.82	55.55	7.07	55.52	7.31	55.49	7.55
57	56.58	6.95	56.54	7.19	56.51	7.44	56.48	7.69
58	57.57	7.07	57.54	7.32	57.50	7.57	57.47	7.82
59	58.56	7.19	58.53	7.45	58.50	7.70	58.46	7.96
60	59.55	7.31	59.52	7.57	59.49	7.83	59.45	8.09
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.	
	82 DEGREES							

Digitized by Google

TRAVERSE TABLE.

Distance	6 DEGREES								7 DEGREES							
	0 Min.		15 Min.		30 Min.		45 Min.		0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
61	60.67	6.38	60.64	6.64	60.61	6.91	60.58	7.17	60.55	7.43	60.51	7.70	60.48	7.96	60.44	8.23
62	61.66	6.48	61.63	6.75	61.60	7.02	61.57	7.29	61.54	7.56	61.50	7.82	61.47	8.09	61.43	8.36
63	62.65	6.59	62.63	6.86	62.60	7.13	62.56	7.40	62.53	7.68	62.50	7.95	62.46	8.22	62.42	8.50
64	63.65	6.69	63.62	6.97	63.59	7.25	63.56	7.52	63.52	7.80	63.49	8.08	63.45	8.35	63.42	8.63
65	64.64	6.79	64.61	7.08	64.58	7.36	64.55	7.64	64.52	7.92	64.48	8.20	64.44	8.48	64.41	8.77
66	65.64	6.90	65.61	7.19	65.58	7.47	65.54	7.76	65.51	8.04	65.47	8.33	65.44	8.61	65.40	8.90
67	66.63	7.00	66.60	7.29	66.57	7.58	66.54	7.88	66.50	8.17	66.46	8.46	66.43	8.75	66.39	9.04
68	67.63	7.11	67.60	7.40	67.56	7.70	67.52	7.99	67.49	8.29	67.46	8.58	67 42	8.88	67.38	9.17
69	68.62	7.21	68.59	7.51	68.56	7.81	68.52	8.11	68.49	8.41	68 45	8.71	68.41	9.01	68.37	9.30
70	69.62	7.32	69.58	7.62	69 55	7.92	69.51	8.23	69.48	8.53	69.44	8.85	69.40	9.14	69.36	9.44
71	70.61	7.42	70.58	7.73	70.54	8.04	70.51	8.35	70.47	8.65	70.43	8.96	70.39	9.27	70.35	9.57
72	71.61	7.53	71.57	7.84	71.54	8.15	71.50	8.46	71.46	8.77	71.42	9.09	71.38	9.40	71.34	9.71
73	72.60	7.63	72.57	7.95	72.53	8.26	72.49	8.58	72.46	8.90	72.42	9.21	72.38	9.53	72.33	9.84
74	73.59	7.74	73.56	8.06	73.52	8.38	73.49	8.70	73.45	9.02	73.41	9.34	73.37	9.66	73.32	9.98
75	74.59	7.84	74.55	8.17	74.52	8.49	74.48	8.82	74.44	9.14	74.40	9.46	74.36	9.79	74.31	10.11
76	75.58	7.94	75.55	8.27	75.51	8.60	75.47	8.93	75.43	9.26	75.39	9.59	75.35	9.92	75.31	10.25
77	76.58	8.05	76.54	8.38	76.51	8.72	76.47	9.05	76.43	9.38	76.38	9.72	76.34	10.05	76.30	10.38
78	77.57	8.15	77.54	8.49	77.50	8.83	77.46	9.17	77.42	9.51	77.38	9.84	77.33	10.18	77.29	10.52
79	78.57	8.26	78.53	8 60	78.49	8.94	78.45	9.29	78.41	9.63	78.37	9.97	78.32	10.31	78.28	10.65
80	79.56	8.36	79.52	8.71	79.48	9.06	79.45	9.40	79.40	9.75	79.36	10.10	79.32	10.44	79.27	10.79
81	80.56	8.47	80.52	8.82	80.48	9.17	80.44	9.52	80.40	9.87	80.35	10.22	80.31	10.57	80.26	10.92
82	81.55	8.57	81.51	8.93	81.47	9.28	81.43	9.64	81.39	9.99	81.34	10.35	81.30	10.70	81.25	11.06
83	82.55	8.68	82.51	9.04	82.47	9.40	82.43	9.76	82.38	10.12	82.34	10.47	82.29	10.83	82.24	11.19
84	83.54	8.78	83.50	9.14	83.46	9.51	83.42	9.87	83.37	10.24	83.33	10.60	83.28	10.96	83.23	11.33
85	84.53	8.88	84.49	9.25	84.45	9.62	84.41	9.99	84.37	10.36	84 32	10.72	84.27	11.09	84.22	11.46
86	85.53	8.99	85.49	9.36	85.45	9.74	85.40	10.11	85.36	10.48	85.31	10.85	85.26	11.23	85.21	11.60
87	86.52	9.09	86.48	9.47	86.44	9.85	86.40	10.23	86.35	10.60	86 30	10.98	86.26	11.36	86.21	11.73
88	87.52	9.20	87.48	9.58	87.43	9.96	87.39	10.34	87.34	10.72	87.30	11.11	87.25	11.49	87.20	11.87
89	88.51	9.30	88.47	9.69	88.43	10.08	88.38	10.46	88.34	10.85	88.29	11.23	88.24	11.62	88.19	12.00
90	89.51	9.41	89.47	9.80	89.42	10.19	89.38	10.58	89.33	10.97	89.28	11.36	89.23	11.75	89.18	12.14
91	90.50	9.51	90.46	9.91	90.42	10.30	90.37	10.70	90.32	11.09	90.27	11.48	90.22	11.88	90.17	12.27
92	91.50	9.62	91.45	10.02	91.41	10.41	91.36	10.81	91.31	11.21	91.26	11.61	91.21	12.01	91.16	12.41
93	92.49	9.72	92.45	10.12	92.40	10.53	92.36	10.93	92.31	11.33	92.26	11.74	92.20	12.14	92.15	12.54
94	93.49	9.83	93.44	10.23	93.40	10.64	93.35	11.05	93.30	11.46	93.25	11.86	93.20	12.27	93.14	12.68
95	94.48	9.93	94.44	10.34	94.39	10.75	94.34	11.17	94.29	11.58	94.24	11.99	94.19	12.40	94.13	12.81
96	95.47	10.03	95.43	10.45	95.38	10.87	95.33	11.28	95.28	11.70	95.23	12.12	95.18	12.53	95.12	12.95
97	96.47	10.14	96.42	10.56	96.38	10.98	96.33	11.40	96.28	11.82	96.22	12.24	96.17	12.66	96.11	13.08
98	97.46	10.24	97.42	10.67	97.37	11.09	97.32	11.52	97.27	11.94	97.22	12.37	97.16	12.79	97.10	13.22
99	98.46	10.35	98.41	10.78	98.36	11.21	98.31	11.64	98.26	12.07	98.21	12.49	98.15	12.92	98.10	13.35
100	99.45	10.45	99.41	10.89	99.36	11.32	99.31	11.75	99.25	12.19	99.20	12.62	99.14	13.05	99.09	13.49
101	100.4	10.56	100.4	11.00	100.4	11.43	100.3	11.87	100.2	12.31	100.2	12.75	100.1	13.18	100.1	13.62
102	101.4	10.66	101.4	11.10	101.3	11.55	101.3	11.99	101.2	12.43	101 2	12.87	101.1	13.31	101.1	13.75
103	102.4	10.77	102.4	11.21	102.3	11.66	102.3	12.11	102.2	12.55	102.2	12.99	102.1	13.44	102.1	13.89
104	103.4	10.87	103.4	11.32	103.3	11.77	103.3	12.22	103.2	12.67	103.2	13.12	103.1	13.57	103.1	14.02
105	104.4	10.98	104.4	11.42	104.3	11.89	104.3	12.34	104.2	12.80	104.2	13.25	104.1	13.71	104.0	14.16
106	105.4	11.08	105.4	11.54	105.3	12.00	105.3	12.46	105.2	12.92	105.2	13.38	105.1	13.84	105.0	14.29
107	106.4	11.18	106.4	11.65	106.3	12.11	106.3	12.58	106.2	13.04	106.1	13.50	106.1	13.97	106.0	14.43
108	107.4	11.29	107.4	11.76	107.3	12.23	107.3	12.69	107 2	13.16	107.1	13.63	107.1	14.10	107.0	14.56
109	108.4	11.39	108.4	11.87	108.3	12.34	108.2	12.81	108.2	13.28	108.1	13.76	108.1	14.23	108.0	14.70
110	109.4	11.50	109.3	11.98	109.3	12.45	109.2	12.93	109.2	13.41	109.1	13.88	109.1	14.36	109.0	14.83
111	110.4	11.60	110.3	12.08	110.3	12.57	110.2	13.05	110.2	13.53	110.1	14.01	110.1	14.49	110.0	14.97
112	111.4	11.71	111.3	12.19	111.2	12.68	111.2	13.16	111.2	13.65	111.1	14.13	111.0	14.62	111.0	15.10
113	112.4	11.81	112.3	12.30	112 3	12.79	112.2	13.28	112.2	13.77	112.1	14 26	112.0	14.75	112.0	15.24
114	113.4	11.92	113.3	12.41	113.3	12.91	113.2	13.40	113.2	13.89	113.1	14.39	113.0	14.88	113.0	15.37
115	114.4	12.02	114.3	12.52	114.3	13.02	114.2	13.52	114.1	14.02	114.1	14.51	114.0	15.01	113.9	15.51
116	115.4	12.13	115.3	12.63	115.2	13.13	115.2	13.63	115.1	14.14	115.1	14.64	115.0	15.17	114.9	15.64
117	116.4	12.23	116.3	12.74	116.3	13.24	116.2	13.75	116.1	14.26	116.1	14.77	116.0	15.27	115.9	15.78
118	117.4	12.33	117.3	12.85	117.2	13.36	117.2	13.87	117.1	14.38	117.1	14.89	117.0	15.40	116.9	15.91
119	118.3	12.44	118.3	12.96	118.2	13.47	118.2	13.99	118 1	14.50	118.0	15.02	118.0	15.53	117.9	16.05
120	119.3	12.54	119.3	13.06	119.2	13.58	119.2	14.10	119.1	14.62	119.0	15.14	119.0	15.66	118.9	16.18
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.		0 Min.		45 Min.		30 Min.		15 Min.	
	84 DEG.		83 DEGREES						82 DEGREES							

Digitized by Google

TRAVERSE TABLE.

8 DEGREES

Distance	0 Min. Lat.	0 Min. Dep.	15 Min. Lat.	15 Min. Dep.	30 Min. Lat.	30 Min. Dep.	45 Min. Lat.	45 Min. Dep.
1	0.99	0.14	0.99	0.14	0.99	0.15	0.99	0.15
2	1.98	0.28	1.98	0.29	1.98	0.30	1.98	0.30
3	2.97	0.42	2.97	0.43	2.97	0.44	2.97	0.46
4	3.96	0.56	3.96	0.57	3.96	0.59	3.95	0.61
5	4.95	0.70	4.95	0.72	4.95	0.74	4.94	0.76
6	5.94	0.84	5.94	0.86	5.93	0.89	5.93	0.91
7	6.93	0.97	6.93	1.00	6.92	1.03	6.92	1.06
8	7.92	1.11	7.92	1.15	7.91	1.18	7.91	1.22
9	8.91	1.25	8.91	1.29	8.90	1.33	8.90	1.37
10	9.90	1.39	9.90	1.43	9.89	1.48	9.88	1.52
11	10.89	1.53	10.89	1.58	10.88	1.63	10.87	1.67
12	11.88	1.67	11.88	1.72	11.87	1.77	11.86	1.83
13	12.87	1.81	12.87	1.87	12.86	1.92	12.85	1.98
14	13.86	1.95	13.86	2.01	13.85	2.07	13.84	2.13
15	14.85	2.09	14.84	2.15	14.84	2.22	14.83	2.28
16	15.84	2.23	15.83	2.30	15.82	2.37	15.81	2.43
17	16.83	2.37	16.82	2.44	16.81	2.51	16.80	2.59
18	17.82	2.51	17.81	2.58	17.80	2.66	17.79	2.74
19	18.82	2.64	18.80	2.73	18.79	2.81	18.78	2.89
20	19.81	2.78	19.79	2.87	19.78	2.96	19.77	3.04
21	20.80	2.92	20.78	3.01	20.77	3.10	20.76	3.19
22	21.79	3.06	21.77	3.16	21.76	3.25	21.74	3.35
23	22.78	3.20	22.76	3.30	22.75	3.40	22.73	3.50
24	23.77	3.34	23.75	3.44	23.74	3.55	23.72	3.65
25	24.76	3.48	24.74	3.59	24.73	3.70	24.71	3.80
26	25.75	3.62	25.73	3.73	25.71	3.84	25.70	3.96
27	26.74	3.76	26.72	3.87	26.70	3.99	26.69	4.11
28	27.73	3.90	27.71	4.02	27.69	4.14	27.67	4.26
29	28.72	4.04	28.70	4.16	28.68	4.29	28.66	4.41
30	29.71	4.18	29.69	4.30	29.67	4.43	29.65	4.56
31	30.70	4.31	30.68	4.45	30.66	4.58	30.64	4.72
32	31.69	4.45	31.67	4.59	31.65	4.73	31.63	4.87
33	32.68	4.59	32.66	4.74	32.64	4.88	32.62	5.02
34	33.67	4.73	33.65	4.88	33.63	5.03	33.60	5.17
35	34.66	4.87	34.64	5.02	34.62	5.17	34.59	5.32
36	35.65	5.01	35.63	5.17	35.60	5.32	35.58	5.48
37	36.64	5.15	36.62	5.31	36.59	5.47	36.57	5.63
38	37.63	5.29	37.61	5.45	37.58	5.62	37.56	5.78
39	38.62	5.43	38.60	5.60	38.57	5.76	38.55	5.93
40	39.61	5.57	39.59	5.74	39.56	5.91	39.55	6.08
41	40.60	5.71	40.58	5.88	40.55	6.06	40.52	6.24
42	41.59	5.85	41.57	6.03	41.54	6.21	41.51	6.39
43	42.5	5.98	42.56	6.17	42.53	6.36	42.50	6.54
44	43.57	6.12	43.54	6.31	43.52	6.50	43.49	6.69
45	44.56	6.26	44.53	6.46	44.51	6.65	44.48	6.85
46	45.55	6.40	45.52	6.60	45.49	6.80	45.46	7.00
47	46.54	6.54	46.51	6.74	46.48	6.95	46.45	7.15
48	47.53	6.68	47.50	6.89	47.47	7.09	47.44	7.30
49	48.52	6.82	48.49	7.03	48.46	7.24	48.43	7.45
50	49.51	6.96	49.48	7.17	49.45	7.39	49.42	7.61
51	50.50	7.10	50.47	7.32	50.44	7.54	50.41	7.76
52	51.49	7.24	51.46	7.46	51.43	7.69	51.39	7.91
53	52.48	7.38	52.45	7.61	52.42	7.83	52.38	8.06
54	53.47	7.52	53.44	7.75	53.41	7.98	53.37	8.21
55	54.46	7.65	54.43	7.89	54.40	8.13	54.36	8.37
56	55.46	7.79	55.42	8.04	55.38	8.28	55.35	8.52
57	56.45	7.93	56.41	8.18	56.37	8.43	56.34	8.67
58	57.44	8.07	57.40	8.32	57.36	8.57	57.33	8.82
59	58.43	8.21	58.39	8.47	58.35	8.72	58.31	8.98
60	59.42	8.35	59.38	8.61	59.34	8.87	59.30	9.13

9 DEGREES

0 Min. Lat.	0 Min. Dep	15 Min. Lat.	15 Min. Dep.	30 Min. Lat.	30 Min. Dep.	45 Min. Lat.	45 Min. Dep.
0.99	0.16	0.99	0.16	0.99	0.17	0.99	0.17
1.98	0.31	1.97	0.32	1.97	0.33	1.97	0.34
2.96	0.47	2.96	0.48	2.96	0.50	2.96	0.51
3.95	0.63	3.95	0.64	3.95	0.66	3.94	0.68
4.94	0.78	4.94	0.80	4.93	0.83	4.93	0.85
5.93	0.94	5.92	0.96	5.92	0.99	5.91	1.02
6.91	1.10	6.91	1.13	6.90	1.16	6.90	1.19
7.90	1.25	7.90	1.29	7.89	1.32	7.88	1.35
8.88	1.41	8.88	1.45	8.88	1.49	8.87	1.52
9.87	1.61	9.86	1.65	9.86	1.69	9.86	1.69
10.86	1.72	10.86	1.77	10.85	1.82	10.84	1.86
11.85	1.88	11.84	1.93	11.84	1.98	11.83	2.03
12.84	2.03	12.83	2.09	12.82	2.15	12.81	2.20
13.83	2.19	13.82	2.25	13.81	2.31	13.80	2.37
14.82	2.35	14.80	2.41	14.79	2.48	14.78	2.54
15.80	2.50	15.79	2.57	15.78	2.64	15.77	2.71
16.78	2.66	16.78	2.73	16.77	2.81	16.75	2.88
17.77	2.82	17.77	2.89	17.75	2.97	17.74	3.05
18.75	2.97	18.75	3.05	18.74	3.14	18.73	3.22
19.74	3.13	19.74	3.21	19.73	3.30	19.71	3.39
20.73	3.29	20.73	3.38	20.71	3.47	20.70	3.56
21.71	3.44	21.71	3.54	21.70	3.63	21.68	3.73
22.70	3.60	22.70	3.70	22.68	3.80	22.67	3.90
23.69	3.75	23.69	3.86	23.67	3.96	23.65	4.06
24.67	3.91	24.67	4.02	24.66	4.13	24.64	4.23
25.66	4.07	25.66	4.18	25.64	4.29	25.62	4.40
26.65	4.22	26.65	4.34	26.63	4.46	26.61	4.57
27.64	4.38	27.64	4.50	27.62	4.62	27.60	4.74
28.64	4.54	28.62	4.66	28.60	4.79	28.58	4.91
29.63	4.69	29.61	4.82	29.59	4.95	29.57	5.08
30.62	4.85	30.60	4.98	30.57	5.12	30.55	5.25
31.61	5.01	31.58	5.14	31.56	5.28	31.54	5.42
32.59	5.16	32.57	5.30	32.55	5.45	32.52	5.59
33.58	5.32	33.56	5.47	33.53	5.61	33.51	5.76
34.57	5.48	34.54	5.63	34.52	5.78	34.49	5.93
35.56	5.63	35.53	5.79	35.51	5.94	35.48	6.10
36.54	5.79	36.52	5.95	36.49	6.11	36.47	6.27
37.53	5.94	37.51	6.11	37.48	6.27	37.45	6.44
38.52	6.10	38.49	6.27	38.47	6.44	38.44	6.60
39.51	6.26	39.48	6.43	39.45	6.60	39.42	6.77
40.50	6.41	40.47	6.59	40.44	6.77	40.41	6.94
41.48	6.57	41.45	6.75	41.42	6.93	41.39	7.11
42.47	6.73	42.44	6.91	42.41	7.10	42.38	7.28
43.46	6.88	43.43	7.07	43.40	7.26	43.36	7.45
44.45	7.04	44.41	7.23	44.38	7.43	44.35	7.62
45.43	7.20	45.40	7.39	45.37	7.59	45.34	7.78
46.42	7.35	46.39	7.55	46.36	7.76	46.32	7.96
47.41	7.51	47.38	7.72	47.34	7.92	47.31	8.13
48.40	7.66	48.36	7.88	48.33	8.09	48.29	8.30
49.38	7.82	49.35	8.04	49.31	8.25	49.28	8.47
50.37	7.98	50.34	8.20	50.30	8.42	50.26	8.64
51.36	8.13	51.32	8.36	51.29	8.58	51.25	8.81
52.35	8.29	52.31	8.52	52.27	8.75	52.23	8.98
53.34	8.45	53.30	8.68	53.26	8.91	53.22	9.15
54.33	8.60	54.28	8.84	54.23	9.08	54.21	9.32
55.31	8.76	55.27	9.00	55.23	9.24	55.19	9.49
56.30	8.92	56.26	9.16	56.22	9.41	56.18	9.66
57.29	9.07	57.25	9.32	57.20	9.57	57.16	9.83
58.27	9.23	58.23	9.48	58.19	9.75	58.15	9.99
59.26	9.39	59.22	9.64	59.18	9.90	59.13	10.

Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep	Lat.	Dep	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.		0 Min.		45 Min.		30 Min.		15 Min.	
	82 DEG.		81 DEGREES						80 DEGREES							

Digitized by Google

TRAVERSE TABLE.

Distance	8 DEGREES								9 DEGREES							
	0 Min.		15 Min.		30 Min.		45 Min.		0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
61	60.41	8.49	60.37	8.75	60.33	9.02	60.29	9.28	60.25	9.54	60.21	9.81	60.16	10.07	60.12	10.33
62	61.40	8.63	61.36	8.90	61.32	9.16	61.28	9.43	61.24	9.70	61.19	9.97	61.15	10.23	61.10	10.50
63	62.39	8.77	62.35	9.04	62.31	9.31	62.27	9.58	62.22	9.86	62.18	10.15	62.14	10.40	62.09	10.67
64	63.38	8.91	63.34	9.18	63.30	9.46	63.26	9.74	63.21	10.01	63.17	10.29	63.12	10.56	63.08	10.84
65	64.37	9.05	64.33	9.33	64.29	9.61	64.24	9.89	64.20	10.17	64.15	10.45	64.11	10.73	64.06	11.01
66	65.36	9.19	65.32	9.47	65.28	9.76	65.23	10.04	65.19	10.32	65.14	10.61	65.09	10.89	65.05	11.18
67	66.35	9.32	66.31	9.61	66.26	9.90	66.22	10.19	66.18	10.48	66.13	10.77	66.08	11.06	66.03	11.35
68	67.34	9.46	67.30	9.76	67.25	10.05	67.21	10.34	67.16	10.64	67.12	10.93	67.07	11.22	67.02	11.52
69	68.33	9.60	68.29	9.90	68.24	10.20	68.20	10.50	68.15	10.79	68.10	11.09	68.05	11.39	68.00	11.69
70	69.32	9.74	69.28	10.04	69.23	10.33	69.19	10.65	69.14	10.95	69.09	11.25	69.04	11.55	68.99	11.85
71	70.31	9.88	70.27	10.19	70.22	10.49	70.17	10.80	70.13	11.11	70.08	11.41	70.03	11.72	69.97	12.02
72	71.30	10.02	71.25	10.33	71.21	10.64	71.16	10.95	71.11	11.26	71.06	11.57	71.01	11.88	70.96	12.19
73	72.29	10.16	72.24	10.48	72.20	10.79	72.15	11.11	72.10	11.42	72.05	11.73	72.00	12.05	71.95	12.36
74	73.28	10.30	73.23	10.62	73.19	10.94	73.14	11.26	73.09	11.58	73.04	11.90	72.99	12.21	72.93	12.53
75	74.27	10.44	74.22	10.76	74.18	11.09	74.13	11.41	74.08	11.73	74.02	12.06	73.97	12.38	73.92	12.70
76	75.26	10.58	75.21	10.91	75.17	11.23	75.12	11.56	75.06	11.89	75.01	12.22	74.96	12.54	74.90	12.87
77	76.25	10.72	76.20	11.05	76.15	11.38	76.10	11.71	76.05	12.05	76.00	12.38	75.94	12.71	75.89	13.04
78	77.24	10.86	77.19	11.19	77.14	11.53	77.09	11.87	77.04	12.20	76.99	12.54	76.93	12.87	76.87	13.21
79	78.23	10.99	78.18	11.34	78.13	11.68	78.08	12.02	78.03	12.36	77.97	12.70	77.92	13.04	77.86	13.38
80	79.22	11.13	79.17	11.48	79.12	11.82	79.07	12.17	79.02	12.51	78.96	12.86	78.90	13.20	78.84	13.55
81	80.21	11.27	80.16	11.62	80.11	11.97	80.06	12.32	80.00	12.67	79.95	13.02	79.89	13.37	79.83	13.72
82	81.20	11.41	81.15	11.77	81.10	12.12	81.05	12.47	80.99	12.83	80.93	13.18	80.88	13.53	80.82	13.89
83	82.19	11.55	82.14	11.91	82.09	12.27	82.03	12.63	81.98	12.98	81.92	13.34	81.86	13.70	81.80	14.06
84	83.18	11.69	83.13	12.05	83.08	12.42	83.02	12.78	82.97	13.14	82.91	13.50	82.85	13.86	82.79	14.23
85	84.17	11.83	84.12	12.20	84.07	12.56	84.01	12.93	83.95	13.30	83.89	13.66	83.83	14.03	83.77	14.39
86	85.16	11.97	85.11	12.34	85.06	12.71	85.00	13.08	84.94	13.45	84.88	13.82	84.82	14.19	84.76	14.56
87	86.15	12.11	86.10	12.48	86.04	12.86	85.99	13.23	85.93	13.61	85.87	13.98	85.81	14.36	85.74	14.73
88	87.14	12.25	87.09	12.63	87.03	13.01	86.98	13.39	86.92	13.77	86.86	14.15	86.79	14.52	86.73	14.90
89	88.13	12.39	88.08	12.77	88.02	13.16	87.96	13.54	87.90	13.92	87.84	14.31	87.78	14.69	87.71	15.07
90	89.12	12.53	89.07	12.91	89.01	13.30	88.95	13.69	88.89	14.08	88.83	14.47	88.77	14.85	88.70	15.24
91	90.11	12.66	90.06	13.06	90.00	13.45	89.94	13.84	89.88	14.24	89.82	14.63	89.75	15.02	89.69	15.41
92	91.10	12.80	91.05	13.20	90.99	13.60	90.93	14.00	90.87	14.39	90.80	14.79	90.74	15.18	90.67	15.58
93	92.09	12.94	92.04	13.34	91.98	13.75	91.92	14.15	91.86	14.55	91.79	14.95	91.72	15.35	91.66	15.75
94	93.09	13.08	93.03	13.49	92.97	13.89	92.91	14.30	92.84	14.70	92.78	15.11	92.71	15.51	92.64	15.92
95	94.08	13.22	94.02	13.63	93.96	14.04	93.89	14.45	93.83	14.86	93.76	15.27	93.70	15.68	93.63	16.09
96	95.07	13.36	95.01	13.78	94.95	14.19	94.88	14.60	94.82	15.02	94.75	15.43	94.68	15.84	94.61	16.26
97	96.06	13.50	96.00	13.92	95.93	14.34	95.87	14.76	95.81	15.17	95.74	15.59	95.67	16.01	95.60	16.43
98	97.05	13.64	96.99	14.06	96.92	14.49	96.86	14.91	96.79	15.33	96.73	15.75	96.66	16.17	96.58	16.60
99	98.04	13.78	97.98	14.21	97.91	14.65	97.85	15.06	97.78	15.49	97.71	15.91	97.64	16.34	97.57	16.77
100	99.03	13.92	98.97	14.35	98.90	14.78	98.84	15.21	98.77	15.64	98.70	16.07	98.62	16.50	98.56	16.94
101	100.0	14.06	99.95	14.49	99.89	14.92	99.82	15.36	99.76	15.80	99.69	16.24	99.61	16.67	99.54	17.10
102	101.0	14.20	100.9	14.64	100.9	15.08	100.8	15.52	100.7	15.96	100.7	16.40	100.6	16.83	100.5	17.27
103	102.0	14.33	101.9	14.78	101.9	15.22	101.8	15.67	101.7	16.11	101.7	16.56	101.6	17.00	101.5	17.44
104	103.0	14.47	102.9	14.92	102.9	15.37	102.8	15.82	102.7	16.27	102.6	16.72	102.6	17.17	102.5	17.61
105	104.0	14.61	103.9	15.07	103.8	15.52	103.8	15.97	103.7	16.43	103.6	16.88	103.6	17.33	103.5	17.78
106	105.0	14.75	104.9	15.21	104.8	15.67	104.8	16.13	104.7	16.58	104.6	17.04	104.5	17.50	104.5	17.95
107	106.0	14.89	105.9	15.35	105.8	15.82	105.8	16.28	105.7	16.74	105.6	17.20	105.5	17.66	105.5	18.12
108	106.9	15.03	106.9	15.50	106.8	15.96	106.7	16.43	106.7	16.90	106.6	17.36	106.5	17.83	106.4	18.29
109	107.9	15.17	107.9	15.64	107.8	16.11	107.7	16.58	107.7	17.05	107.6	17.52	107.5	17.99	107.4	18.46
110	108.9	15.31	108.9	15.78	108.8	16.26	108.7	16.73	108.6	17.21	108.6	17.68	108.5	18.16	108.4	18.63
111	109.9	15.45	109.9	15.93	109.8	16.41	109.7	16.89	109.6	17.36	109.6	17.84	109.5	18.32	109.4	18.80
112	110.9	15.59	110.8	16.07	110.8	16.55	110.7	17.04	110.6	17.52	110.5	18.00	110.5	18.49	110.3	18.97
113	111.9	15.73	111.8	16.21	111.8	16.70	111.7	17.19	111.6	17.68	111.5	18.16	111.5	18.65	111.4	19.14
114	112.9	15.87	112.8	16.36	112.7	16.85	112.7	17.34	112.6	17.83	112.5	18.32	112.4	18.81	112.4	19.31
115	113.9	16.00	113.8	16.50	113.7	17.00	113.7	17.49	113.6	17.99	113.5	18.48	113.4	18.98	113.3	19.48
116	114.9	16.14	114.8	16.65	114.7	17.15	114.7	17.65	114.6	18.15	114.5	18.65	114.4	19.1	114.3	19.64
117	115.9	16.28	115.8	16.79	115.7	17.29	115.6	17.80	115.6	18.30	115.5	18.81	115.4	19.31	115.3	19.81
118	116.9	16.42	116.8	16.93	116.7	17.44	116.6	17.95	116.5	18.46	116.5	18.97	116.4	19.48	116.3	19.98
119	117.8	16.56	117.8	17.08	117.7	17.59	117.6	18.10	117.5	18.62	117.5	19.13	117.3	19.64	117.3	20.15
120	118.8	16.70	118.8	17.22	118.7	17.74	118.6	18.25	118.5	18.77	118.4	19.29	118.3	19.80	118.3	20.32
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.		0 Min.		45 Min.		30 Min.		15 Min.	
	82 DEG.		81 DEGREES						80 DEGREES							

Digitized by Google

Distance	10 DEGREES								11 DEGREES							
	0 Min.		15 Min.		30 Min.		45 Min.		0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep
1	0.98	0.17	0.98	0.18	0.98	0.18	0.98	0.19	0.98	0.19	0.98	0.20	0.98	0.20	0.98	0.2
2	1.97	0.35	1.97	0.36	1.97	0.36	1.96	0.37	1.95	0.38	1.96	0.39	1.96	0.40	1.96	0.4
3	2.95	0.52	2.95	0.53	2.95	0.55	2.95	0.56	2.94	0.57	2.94	0.59	2.94	0.60	2.94	0.6
4	3.94	0.69	3.94	0.71	3.93	0.73	3.93	0.75	3.93	0.76	3.92	0.78	3.92	0.80	3.92	0.8
5	4.92	0.87	4.92	0.89	4.92	0.91	4.91	0.93	4.91	0.95	4.90	0.98	4.90	1.00	4.90	1.0
6	5.91	1.04	5.90	1.07	5.90	1.09	5.89	1.12	5.89	1.14	5.88	1.17	5.88	1.20	5.87	1.2
7	6.89	1.22	6.89	1.25	6.88	1.28	6.88	1.31	6.87	1.34	6.87	1.37	6.86	1.40	6.85	1.4
8	7.88	1.39	7.87	1.42	7.87	1.46	7.86	1.49	7.85	1.53	7.85	1.56	7.84	1.59	7.83	1.6
9	8.86	1.56	8.86	1.60	8.85	1.64	8.84	1.68	8.83	1.72	8.83	1.76	8.82	1.79	8.81	1.8
10	9.85	1.74	9.84	1.78	9.83	1.82	9.82	1.87	9.82	1.91	9.81	1.95	9.80	1.99	9.79	2.0
11	10.83	1.91	10.82	1.96	10.82	2.00	10.81	2.05	10.80	2.10	10.79	2.15	10.78	2.19	10.77	2.2
12	11.82	2.08	11.81	2.14	11.80	2.19	11.79	2.24	11.78	2.29	11.77	2.34	11.76	2.39	11.75	2.4
13	12.80	2.26	12.78	2.31	12.78	2.37	12.77	2.42	12.76	2.48	12.75	2.54	12.74	2.59	12.73	2.6
14	13.79	2.43	13.78	2.49	13.77	2.55	13.75	2.61	13.74	2.67	13.73	2.73	13.72	2.79	13.71	2.8
15	14.77	2.60	14.76	2.67	14.75	2.73	14.74	2.80	14.72	2.86	14.71	2.93	14.70	2.99	14.69	3.0
16	15.76	2.78	15.74	2.85	15.73	2.92	15.72	2.98	15.71	3.05	15.69	3.12	15.68	3.19	15.66	3.2
17	16.74	2.95	16.73	3.03	16.72	3.10	16.70	3.17	16.69	3.24	16.67	3.32	16.66	3.39	16.64	3.4
18	17.73	3.13	17.71	3.20	17.70	3.28	17.68	3.35	17.67	3.43	17.65	3.51	17.64	3.59	17.62	3.6
19	18.71	3.30	18.70	3.38	18.68	3.46	18.67	3.54	18.65	3.63	18.63	3.71	18.62	3.79	18.60	3.8
20	19.70	3.47	19.68	3.56	19.67	3.64	19.65	3.73	19.65	3.82	19.62	3.90	19.60	3.99	19.58	4.0
21	20.68	3.65	20.66	3.74	20.65	3.83	20.63	3.92	20.61	4.01	20.60	4.10	20.58	4.19	20.56	4.2
22	21.67	3.82	21.65	3.91	21.63	4.01	21.61	4.10	21.60	4.20	21.58	4.29	21.56	4.39	21.54	4.4
23	22.65	3.99	22.63	4.09	22.61	4.19	22.60	4.29	22.58	4.39	22.56	4.49	22.54	4.59	22.52	4.6
24	23.64	4.17	23.62	4.27	23.60	4.37	23.58	4.48	23.56	4.58	23.54	4.68	23.52	4.78	23.50	4.8
25	24.62	4.34	24.60	4.45	24.58	4.56	24.56	4.66	24.54	4.77	24.52	4.88	24.50	4.98	24.48	5.0
26	25.61	4.51	25.59	4.63	25.56	4.74	25.54	4.85	25.52	4.96	25.50	5.07	25.48	5.18	25.46	5.2
27	26.59	4.69	26.57	4.80	26.55	4.92	26.53	5.04	26.50	5.15	26.48	5.27	26.46	5.38	26.43	5.5
28	27.57	4.86	27.55	4.98	27.53	5.10	27.51	5.22	27.49	5.34	27.46	5.46	27.44	5.58	27.41	5.7
29	28.56	5.04	28.54	5.16	28.51	5.28	28.49	5.41	28.47	5.53	28.44	5.66	28.42	5.78	28.39	5.9
30	29.54	5.21	29.52	5.34	29.50	5.47	29.47	5.60	29.45	5.72	29.42	5.85	29.40	5.98	29.37	6.1
31	30.53	5.38	30.51	5.52	30.48	5.65	30.46	5.78	30.43	5.92	30.40	6.05	30.38	6.18	30.35	6.3
32	31.51	5.56	31.49	5.69	31.46	5.83	31.44	5.97	31.41	6.11	31.39	6.24	31.36	6.38	31.33	6.5
33	32.50	5.73	32.47	5.87	32.45	6.01	32.42	6.16	32.39	6.30	32.37	6.44	32.34	6.58	32.31	6.7
34	33.48	5.90	33.46	6.05	33.43	6.20	33.40	6.34	33.38	6.49	33.35	6.63	33.32	6.78	33.29	6.9
35	34.47	6.08	34.44	6.23	34.41	6.38	34.39	6.53	34.36	6.68	34.33	6.83	34.30	6.98	34.27	7.1
36	35.45	6.25	35.43	6.41	35.40	6.56	35.37	6.71	35.34	6.87	35.31	7.02	35.28	7.18	35.25	7.3
37	36.44	6.43	36.41	6.58	36.38	6.74	36.35	6.90	36.32	7.06	36.29	7.22	36.26	7.38	36.22	7.5
38	37.42	6.60	37.39	6.76	37.36	6.92	37.33	7.09	37.30	7.25	37.27	7.41	37.24	7.58	37.20	7.7
39	38.41	6.77	38.38	6.94	38.35	7.11	38.32	7.27	38.28	7.44	38.25	7.61	38.22	7.78	38.18	7.9
40	39.39	6.95	39.36	7.12	39.33	7.29	39.30	7.46	39.27	7.63	39.23	7.80	39.20	7.97	39.16	8.1
41	40.38	7.12	40.35	7.30	40.31	7.47	40.28	7.65	40.25	7.82	40.21	8.00	40.18	8.17	40.14	8.3
42	41.36	7.29	41.33	7.47	41.30	7.65	41.26	7.83	41.25	8.01	41.19	8.19	41.16	8.37	41.12	8.5
43	42.35	7.47	42.31	7.65	42.28	7.84	42.25	8.02	42.21	8.20	42.17	8.39	42.14	8.57	42.10	8.7
44	43.33	7.64	43.30	7.83	43.26	8.02	43.22	8.21	43.19	8.40	43.15	8.58	43.12	8.77	43.08	8.9
45	44.32	7.81	44.28	8.01	44.25	8.20	44.21	8.39	44.17	8.59	44.14	8.78	44.10	8.97	44.06	9.1
46	45.30	7.99	45.27	8.19	45.23	8.38	45.19	8.58	45.15	8.78	45.12	8.97	45.08	9.17	45.04	9.3
47	46.29	8.16	46.25	8.36	46.21	8.57	46.18	8.77	46.14	8.97	46.10	9.17	46.06	9.37	46.02	9.5
48	47.27	8.34	47.24	8.54	47.20	8.75	47.16	8.95	47.12	9.16	47.08	9.36	47.04	9.57	46.99	9.7
49	48.26	8.51	48.22	8.72	48.18	8.93	48.14	9.14	48.11	9.35	48.06	9.56	48.02	9.77	47.97	9.9
50	49.24	8.68	49.20	8.90	49.16	9.11	49.12	9.33	49.08	9.54	49.04	9.75	49.00	9.97	48.95	10.1
51	50.23	8.86	50.19	9.08	50.15	9.29	50.11	9.51	50.06	9.73	50.02	9.95	49.98	10.17	49.93	10.3
52	51.21	9.03	51.17	9.25	51.13	9.48	51.09	9.70	51.04	9.92	51.00	10.14	50.96	10.37	50.91	10.5
53	52.19	9.20	52.15	9.43	52.11	9.66	52.07	9.89	52.03	10.11	51.98	10.34	51.94	10.57	51.89	10.7
54	53.18	9.38	53.14	9.61	53.10	9.84	53.05	10.07	53.01	10.30	52.96	10.53	52.92	10.77	52.87	11.0
55	54.16	9.55	54.12	9.79	54.08	10.02	54.03	10.26	53.99	10.49	53.94	10.73	53.90	10.97	53.85	11.2
56	55.15	9.72	55.11	9.96	55.06	10.21	55.02	10.45	54.97	10.69	54.92	10.93	54.88	11.16	54.83	11.4
57	56.13	9.90	56.09	10.14	56.05	10.39	56.00	10.63	55.95	10.88	55.90	11.12	55.86	11.36	55.81	11.6
58	57.12	10.07	57.07	10.32	57.03	10.57	56.98	10.82	56.93	11.07	56.89	11.32	56.84	11.56	56.78	11.8
59	58.10	10.25	58.06	10.50	58.01	10.75	57.96	11.00	57.92	11.26	57.87	11.51	57.82	11.76	57.76	12.0
60	59.09	10.42	59.04	10.68	59.00	10.93	58.95	11.19	58.90	11.45	58.85	11.71	58.80	11.96	58.74	12.2
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.		0 Min.		45 Min.		30 Min.		15 Min.	
	80 DEG.		79 DEGREES						78 DEGREES							

Digitized by Google

Distance	10 DEGREES								11 DEGREES							
	0 Min.		15 Min.		30 Min.		45 Min.		0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
61	60.07	10.59	60.03	10.85	59.98	11.12	59.93	11.38	59.88	11.64	59.83	11.90	59.78	12.16	59.72	12.42
62	61.06	10.77	61.01	11.03	60.96	11.30	60.91	11.56	60.86	11.83	60.81	12.10	60.76	12.36	60.70	12.63
63	62.04	10.94	61.99	11.21	61.95	11.48	61.89	11.75	61.84	12.02	61.79	12.28	61.74	12.56	61.68	12.83
64	63.03	11.11	62.98	11.39	62.93	11.66	62.88	11.94	62.82	12.21	62.77	12.49	62.72	12.76	62.66	13.03
65	64.01	11.29	63.96	11.57	63.91	11.85	63.86	12.12	63.81	12.40	63.75	12.68	63.70	12.96	63.64	13.24
66	65.00	11.46	64.95	11.74	64.89	12.03	64.84	12.31	64.79	12.59	64.73	12.88	64.68	13.16	64.62	13.44
67	65.98	11.63	65.93	11.92	65.88	12.21	65.82	12.50	65.77	12.78	65.71	13.07	65.66	13.36	65.60	13.64
68	66.97	11.81	66.91	12.10	66.86	12.39	66.81	12.68	66.75	12.98	66.69	13.27	66.63	13.56	66.58	13.85
69	67.95	11.98	67.90	12.28	67.84	12.57	67.79	12.87	67.73	13.17	67.67	13.46	67.61	13.76	67.55	14.05
70	68.94	12.16	68.88	12.46	68.83	12.76	68.77	13.06	68.71	13.36	68.66	13.66	68.59	13.96	68.53	14.25
71	69.92	12.33	69.87	12.63	69.81	12.94	69.75	13.24	69.70	13.55	69.64	13.85	69.57	14.16	69.51	14.46
72	70.91	12.50	70.85	12.81	70.79	13.12	70.74	1 43	70.68	13.74	70.62	14.05	70.55	14.35	70.49	14.66
73	71.89	12.68	71.84	12.99	71.78	13.30	71.72	13.62	71.66	13.93	71.60	14.24	71.55	14.55	71.47	14.87
74	72.88	12.85	72.82	13.17	72.76	13.49	72.70	13.80	72.64	14.12	72.58	14.44	72.51	14.75	72.45	15.07
75	73.86	13.02	73.80	13.35	73.74	13.67	73.68	13.99	73.62	14.31	73.56	14.65	73.49	14.95	73.43	15.27
76	74.85	13.20	74.79	13.52	74.73	13.85	74.67	14.18	74.60	14.50	74.54	14.85	74.47	15.15	74.41	15.48
77	75.83	13.37	75.77	13.70	75.71	14.03	75.65	14.36	75.59	14.69	75.52	15.02	75.45	15.35	75.39	15.68
78	76.82	13.54	76.76	13.88	76.69	14.21	76.63	14.55	76.57	14.88	76.50	15.22	76.43	15.55	76.37	15.88
79	77.80	13.72	77.74	14.06	77.68	14.40	77.61	14.74	77.55	15.07	77.48	15.41	77.41	15.75	77.34	16.09
80	78.78	13.89	78.72	14.24	78.66	14.58	78.60	14.92	78.53	15.26	78.46	15.61	78.39	15.95	78.32	16.29
81	79.77	14.07	79.71	14.41	79.64	14.76	79.58	15.11	79.51	15.46	79.44	15.80	79.37	16.15	79.30	16.50
82	80.75	14.24	80.69	14.59	80.63	14 94	80.56	15.30	80.49	15.65	80.42	16.00	30.35	16.35	80.28	16.70
83	81.74	14.41	81.68	14.77	81.61	15.13	81.54	15.48	81.48	15.84	81.41	16.19	81.33	16.55	81.26	16.90
84	82.72	14.59	82.66	14.95	82.59	15.31	82.53	15.67	82.46	16.03	82.39	16.39	82.31	16.75	82.24	17.11
85	83.71	14.76	83.64	15.13	83.58	15.49	83.51	15.85	83.44	16.22	83.37	16.58	83.29	16.95	83.22	17.31
86	84.69	14.93	84.63	15.30	84.56	15.67	84.49	16.04	84.42	16.41	84.35	16.78	84.27	17.15	84.20	17.51
87	85.68	15.11	85.61	15.48	85.54	15.85	85.47	16.23	85.40	16.60	85.33	16.97	85.25	17.35	85.18	17.72
88	86.66	15.28	86.60	15.66	86.53	16.04	86.46	16.41	86.38	16.79	86.31	17.17	86.23	17.54	86.16	17.92
89	87.65	15.45	87.58	15.84	87.51	16.22	87.44	16.60	87.36	16.98	87.29	17.36	87.21	17.74	87.14	18.12
90	88.63	15.63	88.56	16.01	88.49	16.40	88.42	16.79	88.35	17.17	88.27	17.56	88.19	17.94	88.11	18.33
91	89.62	15.80	89.55	16.19	89.48	16.58	89.40	16.97	89.33	17.36	89.25	17.75	89.17	18.14	89.09	18.53
92	90.60	15.98	90.53	16.37	90.46	16.77	90.39	17.16	90.31	17.55	90.23	17.95	90.15	18.34	90.07	18.74
93	91.59	16.15	91.52	16.55	91.44	16.95	91.37	17.3	91.29	17.75	91.21	18.14	91.13	18.54	91.05	18.94
94	92.57	16.32	92.50	16.73	92.43	17.13	92.35	17.5	92.27	17.94	92.19	18.34	92.11	18.74	92.03	19.14
95	93.56	16.50	93.48	16.90	93.41	17.31	93.33	17.72	93.25	18.13	93.17	18.53	93.09	18.94	93.01	19.35
96	94.54	16.67	94.47	17.08	94.39	17.49	94.32	17.91	94.24	18.32	94.16	18.73	94.07	19.14	95.99	19.55
97	95.53	16.84	95.45	17.26	95.38	17.68	95.30	18.09	95.22	18.51	95.14	18.92	95.05	19.34	94.97	19.75
98	96.51	17.02	96.44	17.44	96.36	17.86	96.28	18.28	96.20	18.70	96.12	19.12	96.03	19.54	95.95	19.96
99	97.50	17.19	97.42	17.62	97.34	18.04	97.26	18.47	97.18	18.89	97.10	19.31	97.01	19.74	96.93	20.16
100	98.48	17.36	98.40	17.79	98.33	18.22	98.25	18.65	98.16	19.08	98.08	19.51	97.99	19.94	97.90	20.36
101	99.47	17.54	99.39	17.97	99.31	18.41	99.23	18.84	99.14	19.27	99.06	19.70	98.97	20.14	98.88	20.57
102	100.4	17.71	100.4	18.15	100 3	18.59	100.2	19.03	100.1	19.46	100.0	19.90	99.95	20.34	99.86	20.77
103	101.4	17.89	101.4	18.33	101.3	18.77	101.2	19.21	101.1	19.65	101.0	20.09	100.9	20.53	100.8	20.98
104	102.4	18.06	102.3	18.51	102.3	18.95	102.2	19.40	102.1	19.84	102.0	20.29	101.9	20.73	101.8	21.18
105	103.4	18.23	103.3	18.68	103.2	19.13	103.2	19.59	103.1	20.04	103.0	20.48	102.9	20.93	102.8	21.38
106	104.4	18.41	104.3	18.86	104.2	19.32	104.1	19.77	104.1	20.23	104.0	20.68	105.9	21.13	103.8	21.59
107	105.4	18.58	105.3	19.04	105.2	19.50	105.1	19.96	105.0	20.42	104.9	20.87	104.9	21.33	104.8	21.79
108	106.4	18.75	106.3	19.22	106.2	19.68	106.1	20.14	106.0	20.61	105.9	21.07	105.8	21.53	105.7	21.99
109	107.3	18.93	107.3	19.40	107.2	19.86	107.1	20.33	107.0	20.80	106.9	21.26	106.8	21.73	106.7	22.20
110	108.3	19.10	108.2	19.57	108.2	20.05	108.1	20.52	108.0	20.99	107.9	21.46	107.8	21.93	107.8	22.40
111	109.3	19.28	109.2	19.75	109.1	20.23	109.1	20.70	109.0	21.18	108.9	21.66	108.8	22.13	108.7	22.60
112	110.3	19.45	110.2	19.93	110.1	20.41	110.0	20.88	109.9	21.37	109.8	21.85	109.8	22.33	109.7	22.81
113	111.3	19.62	111.2	20.11	111.1	20.59	111.0	21.08	110.9	21.56	110.8	22.05	110.7	22.53	110.6	23.01
114	112.3	19.80	112.2	20.29	112.1	20 77	112.0	21.26	111.9	21.75	111.8	22.24	111.7	22.73	111.6	23.22
115	113.3	19.97	113.2	20.46	113.1	20.96	113.0	21.45	112.9	21.94	112.8	22.44	112.7	22.93	112.6	23.42
116	114.2	20.14	114.1	20.64	114.1	21.14	114.0	21.64	113.9	22.12	113.8	22.65	113.7	23.13	113.6	23.62
117	115.2	20.32	115.1	20.82	115.0	21.32	114.9	21.8	114 9	22.32	114.7	22.83	114.6	23.33	114.5	23.83
118	116.2	20.49	116.1	21.00	116.0	21.50	115.9	22.01	115.8	22.52	115.7	23.02	115.6	23.53	115.5	24.03
119	117.2	20.66	117.1	21.18	117.0	21.69	116.9	22.20	116.8	22.71	116.7	23.22	116.6	23.72	116.5	24.23
120	118.2	20.84	118.1	21.35	118.0	21.87	117.9	22.38	117.8	22.90	117.7	23.41	117.6	23.92	117.5	24.44
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.		0 Min.		45 Min.		30 Min.		15 Min.	
	80 DEG.		79 DEGREES						78 DEGREES							

Digitized by Google

TRAVERSE TABLE.

Distance	12 DEGREES								13 DEGREES							
	0 Min.		15 Min.		30 Min.		45 Min.		0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
1	0.98	0.21	0.98	0.21	0.98	0.22	0.98	0.22	0.97	0.23	0.97	0.23	0.97	0.23	0.97	0.24
2	1.96	0.42	1.95	0.42	1.95	0.43	1.95	0.44	1.95	0.45	1.95	0.46	1.94	0.47	1.94	0.48
3	2.93	0.62	2.93	0.64	2.93	0.65	2.93	0.66	2.92	0.67	2.92	0.69	2.92	0.70	2.91	0.71
4	3.91	0.83	3.91	0.85	3.91	0.87	3.90	0.88	3.90	0.90	3.89	0.92	3.89	0.93	3.89	0.95
5	4.89	1.04	4.89	1.06	4.88	1.08	4.88	1.10	4.87	1.12	4.87	1.15	4.86	1.17	4.86	1.19
6	5.87	1.25	5.86	1.27	5.86	1.30	5.85	1 32	5.85	1.35	5.84	1.38	5.83	1.40	5.83	1.43
7	6.85	1.46	6.84	1.49	6.83	1.52	6.83	1.54	6.82	1.57	6.81	1.60	6.81	1.63	6.80	1.66
8	7.83	1.66	7.82	1.70	7.81	1.73	7.80	1 77	7.80	1.80	7.79	1.83	7.78	1.87	7.77	1.90
9	8.80	1.87	8.80	1.91	8.79	1.95	8.78	1.99	8.77	2.02	8.76	2.06	8.75	2.10	8.74	2.14
10	9.78	2.08	9.77	2.12	9.76	2.16	9.75	2.21	9.74	2.25	9.73	2.29	9.72	2.33	9.71	2.38
11	10.76	2.29	10.75	2.33	10.74	2.38	10.73	2.43	10 72	2.47	10.71	2.52	10.70	2.57	10.68	2.61
12	11.74	2.49	11.73	2.55	11.72	2.60	11.70	2.65	11.69	2.70	11.68	2.75	11.67	2.80	11.66	2.85
13	12.72	2.70	12.70	2.76	12.69	2.81	12.68	2.87	12.67	2.92	12.65	2.98	12.64	3.05	12.63	3.09
14	13.69	2.91	13.68	2.97	13 67	3.03	13.65	3.09	13.64	3.15	13.63	3.21	13.61	3.27	13.60	3.33
15	14.67	3.12	14.66	3.18	14.64	3 25	14.63	3.31	14.62	3.37	14.60	3.44	14.59	3.50	14.57	3.57
16	15.65	3 33	15.64	3.39	15.62	3.46	15.61	3.53	15.58	3.60	15.57	3.67	15.56	3.74	15.54	3.80
17	16.63	3.53	16.61	3.61	16.60	3.68	16.58	3.75	16.56	3.82	16.55	3.90	16.53	3.97	16 51	4.04
18	17.61	3.74	17.59	3.82	17.57	3.90	17.56	3.97	17.54	4.05	17.52	4.13	17.50	4.20	17.48	4.28
19	18.58	3.95	18.57	4.03	18.55	4.11	18.53	4.19	18.51	4.27	18.49	4.35	18.48	4.44	18.46	4.52
20	19.56	4.16	19.54	4.24	19.53	4.33	19.51	4.41	19.49	4 50	19.47	4.58	19.45	4.67	19.43	4.75
21	20.54	4.37	20.52	4.46	20.50	4.55	20.48	4.63	20.46	4.72	20.44	4.81	20.42	4.90	20.40	4.99
22	21.52	4.57	21.50	4.67	21.48	4 76	21.46	4.86	21.44	4.95	21.41	5.04	21.39	5.14	21.37	5.23
23	22.50	4.78	22.48	4.88	22.45	4.98	22.43	5.08	22.41	5.17	22 39	5.27	22.36	5.37	22.34	5.47
24	23.48	4.99	23.45	5.09	23.43	5.19	23.41	5.30	23.38	5.40	23.36	5.50	23.34	5.60	23.31	5.70
25	24.45	5.20	24.43	5.30	24.41	5.41	24.38	5.52	24.36	5.62	24.33	5.73	24.31	5.84	24.28	5.94
26	25.43	5.41	25.41	5.52	25.38	5.63	25.36	5.74	25.33	5.85	25.31	5.96	25.28	6.07	25.25	6.18
27	26.41	5.61	26.39	5.73	26.36	5.84	26.33	5.96	26.31	6.07	26.28	6.19	26.25	6.30	26.23	6.42
28	27.39	5.82	27.36	5.94	27.34	6.06	27.31	6.18	27.28	6.30	27.25	6.42	27.23	6.54	27.20	6.66
29	28 37	6.03	28.34	6.15	28.31	6.28	28.28	6.40	28.26	6.52	28.23	6.65	28.20	6.77	28.17	6.89
30	29.34	6.24	29.32	6.37	29.29	6.49	29.26	6.62	29.23	6.75	29.20	6.88	29.17	7.00	29.14	7.13
31	30.32	6.45	30.29	6.58	30.27	6.71	30.24	6.84	30.21	6.97	30.17	7.11	30.14	7.24	30.11	7.37
32	31.30	6.65	31.27	6.79	31.24	6.93	31.21	7.06	31.18	7.20	31.15	7.33	31.12	7.47	31.08	7.61
33	32.28	6.86	32.25	7.00	32.22	7.14	32.19	7.28	32.15	7.42	32.12	7.56	32.09	7.70	32.05	7.84
34	33.26	7.07	33.23	7.21	33.19	7.36	33.16	7.50	33.12	7.65	33.09	7.79	33.06	7.94	33.03	8.08
35	34.24	7.28	34.20	7.43	34.17	7.58	34.14	7.72	34.10	7.87	34.07	8.02	34.03	8.17	34.00	8.32
36	35.21	7.48	35.18	7.64	35.15	7.79	35.11	7.95	35.08	8.10	35.04	8.25	35.01	8.40	34.97	8.56
37	36.19	7.69	36.16	7.85	36.12	8.01	36.09	8.17	36.05	8.32	36.02	8.48	35.98	8.64	35.94	8.79
38	37.17	7.90	37.13	8.06	37.10	8.22	37.06	8.39	37.02	8.55	36.99	8.71	36 95	8.87	36.91	9.03
39	38.15	8.11	38.11	8.27	38.08	8.44	38.04	8.61	38.00	8.77	37.96	8.94	37.92	9.10	37.88	9.27
40	39.13	8.32	39.09	8.49	39.05	8.66	39.01	8.83	38.97	9.00	38.94	9.17	38.89	9.34	38.85	9.51
41	40.10	8.52	40 07	8.70	40.03	8 87	39.99	9.05	39.95	9.22	39.91	9.40	39.87	9.57	39.83	9.75
42	41.08	8.73	41.04	8.91	41.00	9.09	40.96	9.27	40.92	9.45	40.88	9.63	40.84	9.80	40.80	9.98
43	42.06	8.94	42.02	9.12	41.98	9.31	41.94	9.49	41.90	9.67	41.86	9.86	41.81	10.04	41.77	10.22
44	43 04	9.15	43.00	9.34	42.96	9.52	42.92	9.71	42.87	9.90	42.83	10.08	42.78	10.27	42.74	10.46
45	44.02	9.36	43.98	9.55	43.93	9.74	43.89	9.93	43.85	10.12	43.80	10.31	43.76	10.51	43.71	10.70
46	44.99	9.56	44.94	9.76	44.91	9.96	44.87	10.15	44.82	10.35	44.78	10.54	44.73	10.74	44.68	10.93
47	45.97	9.77	45.93	9.97	45.89	10.17	45.84	10.37	45.80	10.57	45.75	10.77	45.70	10.97	45.65	11.17
48	46.95	9.98	46.91	10.18	46.86	10.39	46.82	10.59	46.77	10.80	46.72	11.00	46.67	11.21	46.62	11.41
49	47.93	10.19	47.88	10.40	47.84	10.61	47.79	10.81	47.74	11.02	47.70	11.23	47.65	11.44	47.60	11.65
50	48.91	10.40	48.86	10.61	48.81	10.82	48.77	11.03	48.72	11.25	48.67	11.46	48.62	11.67	48.57	11.88
51	49.88	10.60	49.84	10.82	49.79	11.04	49 74	11.26	49.69	11.47	49.64	11.69	49.59	11.91	49.54	12.12
52	50.86	10.81	50.82	11.03	50.77	11.25	50.72	11.48	50.67	11.70	50.62	11.92	50.56	12.13	50.51	12.36
53	51.84	11.02	51.79	11.25	51.74	11.47	51.69	11.70	51.64	11.94	51.59	12.15	51.54	12.37	51.48	12.60
54	52.82	11.23	52.77	11.46	52.72	11.69	52.67	11.92	52.62	12.15	52 58	12.38	52.51	12.61	52.45	12.84
55	53.80	11.44	53.75	11.67	53.70	11.90	53.64	12.14	53.59	12.37	53.54	12.61	53.48	12.84	53.42	13.07
56	54.78	11.64	54.72	11.88	54.67	12.12	54.62	12.36	54.56	12.60	54.51	12.84	54.45	13.07	54.40	13.31
57	55.75	11.85	55.70	12.09	55.66	12.34	55.59	12.58	55.54	12.82	55.48	13.06	55.43	13.31	55.37	13.55
58	56.73	12.06	56.68	12.31	56.63	12.55	56.57	12.80	56.51	13.05	56.46	13.29	56.40	13.54	56.34	13.79
59	57.71	12.27	57.66	12.52	57.60	12.77	57.55	13.02	57.49	13.27	57.43	13.52	57.37	13.77	57.31	14.02
60	58.69	12.47	58.63	12.73	58.58	12.99	58 52	13.24	58.47	13.50	58.40	13.75	58.34	14.01	58.28	14.26
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.		0 Min.		45 Min.		30 Min.		15 Min.	
	78 DEG.		77 DEGREES						76 DEGREES							

Digitized by Google

TRAVERSE TABLE.

12 DEGREES

Distance	0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep	Lat.	Dep.	Lat.	Dep.
61	59.67	12.68	59.61	12.94	59.55	13.20	59.50	13.46
62	60.65	12.89	60.59	13.16	60.53	13.42	60.47	13.68
63	61.62	13.10	61.57	13.37	61.51	13.64	61.45	13.90
64	62.60	13.31	62.54	13.58	62.48	13.85	62.42	14.12
65	63.58	13.51	63.52	13.79	63.46	14.07	63.40	14.35
66	64.56	13.72	64.50	14.00	64.44	14.28	64.37	14.57
67	65.54	13.93	65.47	14.22	65.41	14.50	65.35	14.79
68	66.51	14.14	66.45	14.43	66.39	14.72	66.32	15.01
69	67.49	14.35	67.43	14.64	67.36	14.93	67.30	15.23
70	68.47	14.55	68.41	14.85	68.34	15.15	68.27	15.45
71	69.45	14.76	69.38	15.06	69.32	15.37	69.25	15.67
72	70.43	14.97	70.36	15.28	70 29	15.58	70.22	15.89
73	71.40	15.18	71.34	15.49	71.27	15.80	71.20	16.11
74	72.38	15.39	72.32	15.70	72.25	16.02	72.18	16.33
75	73.36	15.59	73.29	15.91	73.22	16.23	73.15	16.55
76	74.34	15.80	74.27	16.13	74.20	16.45	74.13	16.77
77	75.32	16.01	75.25	16.34	75.17	16.67	75.10	16.99
78	76.30	16.22	76.22	16.55	76.15	16.88	76.08	17.21
79	77.27	16.43	77.20	16.76	77.13	17.10	77.05	17.44
80	78.25	16.63	78.18	16.97	78.10	17.32	78.03	17 66
81	79.23	16.84	79.16	17.19	79.08	17.53	79.00	17.88
82	80.21	17.05	80.13	17.40	80.06	17.75	79.98	18.10
83	81.19	17.26	81.11	17.61	81.03	17.96	80.95	18.32
84	82.16	17.46	82.09	17.82	82.01	18.18	81.93	18.54
85	83.14	17.67	83.06	18.04	82.99	18.40	82.90	18.76
86	84.12	17.88	84.04	18.25	83.96	18.61	83.88	18.98
87	85.10	18.09	85.02	18.46	84.94	18.83	84.85	19.20
88	86.08	18.30	86.00	18.67	85.91	19.05	85.83	19.42
89	87.06	18.50	86.97	18.88	86.89	19.26	86.81	19.64
90	88.03	18.71	87.95	19.10	87.87	19.48	87.78	19.86
91	89.01	18.92	88.95	19.31	88.84	19.70	88.76	20.08
92	89.99	19.13	89.91	19.52	89.82	19.91	89.73	20.30
93	90.97	19.34	90.88	19.72	90.80	20.13	90.71	20.52
94	91.95	19.54	91.86	19.94	91.77	20.35	91.68	20 75
95	92.92	19.75	92.84	20.16	92.75	20.56	92.66	20.97
96	93.90	19.96	93.81	20.37	93.72	20.78	93.63	21.19
97	94.88	20.17	94.79	20.58	94.70	20.99	94.61	21.41
98	95.86	20.38	95.77	20.79	95.68	21.21	95.58	21.63
99	96.84	20.58	96.75	21.01	96.65	21.43	96.56	21.85
100	97.81	20.79	97.72	21.22	97.63	21.64	97.53	22.07
101	98.79	21.00	98.70	21.43	98.61	21.86	98.51	22.29
102	99.77	21.21	99.68	21.64	99.58	22.08	99.49	22.51
103	100.7	21.41	100.7	21.85	100.6	22.29	100.5	22.73
104	101.7	21.62	101.6	22.07	101.5	22.51	101.4	22.95
105	102.7	21.83	102.6	22.28	102.5	22.73	102.4	23.17
106	103.7	22.04	103.6	22.49	103.5	22.94	103.4	23.39
107	104.7	22.25	104.6	22.70	104.5	23.16	104.4	23.61
108	105.6	22.45	105.5	22.92	105.4	23.38	105.3	23.84
109	106.6	22.66	106.5	23.13	106.4	23.59	106.3	24.06
110	107.6	22.87	107.5	23.34	107.4	23.81	107.3	24.28
111	108.6	23.08	108.5	23.55	108.4	24.02	108.3	24.50
112	109.6	23.29	109.4	23.76	109.3	24.24	109.2	24.72
113	110.5	23.49	110.4	23.98	110.3	24.46	110.2	24.94
114	111.5	23.70	111.4	24.19	111.3	24.67	111.2	25.16
115	112.5	23.91	112.4	24.40	112 3	24.89	112.2	25.38
116	113.5	24.12	113.4	24.61	113.3	25.11	113.1	25.60
117	114.4	24.33	114.3	24.82	114.2	25.32	114.1	25.82
118	115.4	24.53	115.3	25.04	115.2	25.54	115 1	26.04
119	116.4	24.74	116.3	25.25	116.2	25.76	116.1	26.26
120	117.4	24.95	117.3	25.46	117.2	25.97	117.0	26.68
Distance	Dep.	Lat	Dep.	Lat	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.	

78 DEG. 77 DEGREES

13 DEGREES

	0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
	59.44	13.72	59.38	13.98	59.31	14.24	59.25	14.50
	60.41	13.95	60.35	14.21	60.29	14.47	60.22	14.74
	61.39	14.17	61.32	14.44	61.26	14.71	61.19	14 97
	62.36	14.40	62.30	14.67	62.23	14.94	62.17	15-21
	63.33	14.62	63.27	14.90	63.20	15.17	63.14	15-45
	64.31	14.85	64.24	15.13	64.18	15.41	64.11	15.69
	65.28	15.07	65.22	15.36	65.15	15.64	65.08	15.93
	66.26	15.30	66.19	15.59	66.12	15.87	66.05	16.16
	67.23	15.52	67.16	15.81	67.09	16.11	67.02	16.40
	68.21	15.75	68.14	16.04	68.07	16.34	67.99	16.64
	69.18	15.97	69.11	16.27	69.04	16.57	68 97	16.88
	70 15	16.20	70.08	16.50	70.01	16.81	69.94	17.11
	71.13	16.42	71.06	16.73	70.98	17.04	70.91	17.35
	72.10	16 65	72.03	16.96	71.96	17.28	71.88	17.59
	73.08	16.87	73.00	17.19	72.93	17.51	72.85	17.83
	74.05	17.10	73.98	17.42	73.90	17.74	73.82	18.06
	75.03	17.32	74.95	17.65	74.87	17.98	74.79	18.30
	76.00	17.55	75.92	17.88	75.84	18.21	75.76	18.54
	76.98	17.77	76.90	18.11	76.82	18.44	76.74	18.78
	77.95	18.00	77.87	18.34	77.79	18.68	77.71	19.01
	78.92	18.22	78.84	18.57	78.76	18.91	78.68	19.25
	79.90	18.45	79.82	18.79	79.73	19.14	79.65	19.49
	80.87	18.67	80.79	19.02	80.71	19.38	80.62	19.73
	81.85	18.90	81.76	19.25	81.68	19.61	81.59	19.97
	82.82	19.12	82.74	19.48	82.65	19.84	82.56	20.20
	83.80	19.35	83.71	19.71	83.62	20.08	83.53	20.44
	84.77	19.57	84.68	19.94	84.60	20.31	84.51	20.68
	85.74	19.80	85.66	20.17	85.57	20.54	85.48	20.99
	86.72	20.02	86.63	20 40	86.54	20.78	86 45	21.13
	87.69	20.25	87.60	20.63	87.51	21.01	87.42	21.39
	88.67	20.47	88.58	20.86	88.49	21.24	88.39	21.63
	89.64	20.70	89.55	21.09	89.46	21.48	89.36	21.87
	90.62	20.92	90.52	21.32	90.43	21.71	90.33	22.10
	91.59	21.15	91.50	21.54	91.40	21.94	91.31	22.3
	92.57	21.37	92.47	21.77	92.38	22.18	92.28	22.5
	93.54	21.60	93.44	22.00	93.35	22.41	93.25	22.8
	94.51	21.82	94.42	22.23	94.32	22.64	94.23	23.0
	95.49	22.05	95.39	22.46	95.29	22.88	95.19	23.2
	96.46	22.27	96.36	22.69	96.26	23.11	96.16	23.5
	97.44	22.50	97.34	22.92	97.24	23 34	97.13	23.7
	98.41	22.72	98.31	23.15	98.21	23.58	98.11	24.0
	99.39	22.94	99.28	23.38	99.18	23.81	99.08	24.2
	100.4	23.17	100.3	23.61	100.2	24 04	100.0	24.4
	101.3	23.40	101.2	23.84	101.1	24.28	101 0	24.7
	102.3	23 62	102.2	24.07	102.1	24.51	102.0	24.9
	103.3	23.84	103.2	24.30	103.1	24.75	103.0	25.1
	104.3	24.07	104.2	24.52	104.0	24.98	103.9	25.4
	105.2	24.29	105.1	24.75	105.0	25.21	104.9	25.6
	106.2	24.52	106.1	24.98	106.0	25.45	105.9	25.9
	107.2	24.74	107.1	25.21	107.0	25.68	106.8	26.1
	108.2	24.97	108.0	25.44	107.9	25.91	107.8	26.3
	109.1	25.19	109.0	25.67	108.9	26.15	108.8	26.6
	110.1	25.42	110.0	25.90	109.9	26.38	109.8	26.8
	111.1	25.64	111.0	26.13	110.9	26.61	110.7	27.1
	112.1	25.87	111.9	26.36	111.8	26.85	111.7	27.3
	113.0	26.09	112.9	26.59	112.8	27.08	112.7	27.5
	114.0	26.32	113.9	26.82	113.8	27.31	113.6	27.8
	115.0	26.54	114.9	27.05	114.7	27.55	114.6	28.0
	116.0	26.77	115.8	27.27	115.7	27.78	115.6	28.3
	116.9	26.99	116.8	27.50	116.7	28.01	116.6	28.5
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	La
	0 Min.		45 Min.		30 Min.		15 Min	

76 DEGREES

Digitized by Google

14 DEGREES

Distance	0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
1	0.97	0.24	0.97	0.25	0.97	0.25	0.97	0.25
2	1.93	0.48	1.94	0.49	1.94	0.50	1.93	0.51
3	2.91	0.73	2.91	0.74	2.90	0.75	2.90	0.76
4	3.88	0.97	3.88	0.98	3.87	1.00	3.87	1.02
5	4.85	1.21	4.85	1.23	4.84	1.25	4.84	1.27
6	5.82	1.45	5.82	1.48	5.81	1.50	5.80	1.53
7	6.79	1.69	6.78	1.72	6.78	1.75	6.77	1.78
8	7.76	1.94	7.75	1.97	7.75	2.00	7.74	2.04
9	8.73	2.18	8.72	2.22	8.71	2.25	8.70	2.29
10	9.70	2.42	9.69	2.46	9.68	2.50	9.67	2.55
11	10.67	2.66	10.66	2.71	10.65	2.75	10.64	2.80
12	11.64	2.90	11.63	2.95	11.62	3.00	11.60	3.06
13	12.61	3.15	12.60	3.20	12.59	3.25	12.57	3.31
14	13.58	3.39	13.57	3.45	13.55	3.51	13.54	3.56
15	14.55	3.63	14.54	3.69	14.52	3.76	14.51	3.82
16	15.52	3.87	15.51	3.94	15.49	4.01	15.47	4.07
17	16.50	4.11	16.48	4.18	16.46	4.26	16.44	4.33
18	17.47	4.35	17.45	4.43	17.43	4.51	17.41	4.58
19	18.44	4.60	18.42	4.68	18.39	4.76	18.37	4.84
20	19.41	4.84	19.38	4.92	19.36	5.01	19.34	5.09
21	20.38	5.08	20.35	5.17	20.33	5.26	20.31	5.35
22	21.35	5.32	21.32	5.42	21.30	5.51	21.28	5.60
23	22.32	5.56	22.29	5.66	22.27	5.76	22.24	5.86
24	23.29	5.81	23.26	5.91	23.24	6.01	23.21	6.11
25	24.26	6.05	24.23	6.15	24.20	6.26	24.18	6.37
26	25.23	6.29	25.20	6.40	25.17	6.51	25.14	6.62
27	26.20	6.53	26.17	6.65	26.14	6.76	26.11	6.87
28	27.17	6.77	27.14	6.89	27.11	7.01	27.08	7.13
29	28.14	7.02	28.11	7.14	28.08	7.26	28.04	7.38
30	29.11	7.26	29.08	7.38	29.04	7.51	29.01	7.64
31	30.08	7.50	30.05	7.63	30.01	7.76	29.98	7.89
32	31.05	7.74	31.02	7.88	30.98	8.01	30.95	8.15
33	32.02	7.98	31.98	8.12	31.95	8.26	31.91	8.40
34	32.99	8.23	32.95	8.37	32.92	8.51	32.88	8.66
35	33.96	8.47	33.92	8.62	33.89	8.76	33.85	8.91
36	34.93	8.71	34.89	8.86	34.85	9.01	34.81	9.17
37	35.90	8.95	35.86	9.11	35.82	9.26	35.78	9.42
38	36.87	9.19	36.82	9.35	36.79	9.51	36.75	9.67
39	37.84	9.43	37.80	9.60	37.76	9.76	37.71	9.93
40	38.81	9.68	38.77	9.85	38.73	10.02	38.68	10.18
41	39.78	9.92	39.74	10.09	39.69	10.27	39.65	10.44
42	40.75	10.16	40.71	10.34	40.66	10.52	40.62	10.69
43	41.72	10.40	41.68	10.58	41.63	10.77	41.58	10.95
44	42.69	10.64	42.65	10 83	42.60	11.02	42.55	11.20
45	43.66	10.89	43.62	11.08	43.57	11.27	43.52	11.46
46	44.63	11.13	44.58	11.32	44.53	11.52	44.48	11.71
47	45.60	11.37	45.55	11.57	45.50	11.77	45.45	11.97
48	46.57	11.61	46.52	11.82	46.47	12.02	46.42	12.22
49	47.54	11.85	47.49	12.06	47.44	12.27	47.39	12.48
50	48.51	12.10	48.46	12.31	48.41	12.52	48.35	12.73
51	49.49	12.34	49.43	12.55	49.38	12.77	49.32	12.98
52	50.46	12.58	50.40	12.80	50.34	13.02	50.29	13.24
53	51.43	12.82	51.37	13.05	51.31	13.27	51.25	13.49
54	52.40	13.06	52.34	13.29	52.28	13.52	52.22	13.75
55	53.37	13.31	53.31	13.54	53.25	13.77	53.19	14.00
56	54.34	13.55	54.28	13.78	54.22	14.02	54.15	14.26
57	55.31	13.79	55.25	14.03	55.18	14.27	55.12	14.51
58	56.28	14.03	56.22	14.28	56.15	14.52	56.08	14.77
59	57.25	14.27	57.18	14.52	57.12	14.77	57.06	15.02
60	58.22	14.52	58.15	14.77	58.09	15.02	58.02	15.28
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.	

76 DEG. — 75 DEGREES.

15 DEGREES

	0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
1	0.97	0.26	0.96	0.26	0.96	0.27	0.96	0.28
2	1.93	0.52	1.93	0.52	1.93	0.53	1.92	0.55
3	2.90	0.78	2.89	0.79	2.89	0.80	2.89	0.81
4	3.86	1.04	3.86	1.05	3.85	1.07	3.85	1.09
5	4.83	1.29	4.82	1.32	4.82	1.34	4.81	1.36
6	5.80	1.55	5.79	1.58	5.78	1.60	5.77	1.63
7	6.76	1 81	6.75	1.84	6.75	1.87	6.74	1.90
8	7.73	2.07	7.72	2.10	7.71	2.14	7.70	2.17
9	8.69	2 33	8.68	2.37	8.67	2.41	8.66	2.44
10	9.66	2.59	9.65	2.63	9.64	2.67	9.62	2.71
11	10.63	2.85	10.61	2.89	10.60	2.94	10.59	2.99
12	11.59	3.11	11.58	3.16	11.56	3.21	11.55	3.26
13	12.56	3.36	12.54	3.42	12.53	3.47	12.51	3.53
14	13.52	3.62	13.51	3.68	13.49	3.74	13.47	3.80
15	14.49	3.88	14.47	3.95	14.45	4.01	14.44	4.07
16	15.45	4.14	15.44	4.21	15.42	4.28	15.40	4.34
17	16.42	4.40	16.40	4.47	16.38	4.54	16.36	4.61
18	17.39	4.66	17.37	4.73	17.35	4.81	17.32	4.89
19	18.35	4.92	18.33	5.00	18.31	5.08	18.29	5.16
20	19.32	5.18	19.30	5.26	19.27	5.34	19.25	5.43
21	20.28	5.44	20.26	5.52	20.24	5.61	20.21	5.70
22	21.25	5.69	21.23	5.79	21.20	5.88	21.17	5.97
23	22.22	5.95	22.19	6.05	22.16	6.15	22.14	6.24
24	23.18	6.21	23.15	6.31	23.13	6.41	23.10	6.51
25	24.15	6.47	24.12	6.58	24.09	6.68	24.06	6.79
26	25.11	6.73	25.08	6.84	25.05	6.95	25.02	7.06
27	26.08	6.99	26.05	7.10	26.02	7.22	25.99	7.33
28	27.05	7.25	27.01	7.36	26.98	7.48	26.95	7.60
29	28.01	7.51	27.98	7.63	27.95	7.75	27.91	7.87
30	28.98	7.76	28.94	7.89	28.91	8.02	28.87	8.14
31	29.94	8.02	29.91	8.15	29.87	8.28	29.84	8.41
32	30.91	8.28	30.87	8.42	30.84	8.55	30.80	8.69
33	31.88	8.54	31.84	8.68	31.80	8.82	31.76	8.96
34	32.84	8.80	32.80	8.94	32.76	9.09	32.72	9.23
35	33.81	9.06	33.77	9.21	33.73	9.35	33.69	9.50
36	34.77	9.32	34.73	9.47	34.69	9.62	34.65	9.77
37	35.74	9.58	35.70	9.73	35.65	9.89	35.61	10.04
38	36.71	9.84	36.66	10.00	36.62	10.16	36.57	10.31
39	37.67	10.09	37.63	10.26	37.58	10.42	37.54	10.59
40	38.64	10.35	38.59	10.52	38.55	10.69	38.50	10.86
41	39.60	10.61	39.56	10.78	39.51	10.96	39.46	11.13
42	40.57	10.87	40.52	11.05	40.47	11.22	40.42	11.40
43	41.53	11.13	41.49	11.31	41.44	11.49	41.39	11.67
44	42.50	11.39	42.45	11.57	42.40	11.76	42.35	11.94
45	43.47	11.65	43.42	11.84	43.36	12.03	43.31	12.21
46	44.43	11 91	44.38	12.10	44.33	12.29	44.27	12.49
47	45.40	12.16	45.35	12.36	45.29	12.56	45.24	12.76
48	46.36	12.42	46.31	12.63	46.25	12.83	46.20	13.03
49	47.33	12.68	47.27	12.89	47.22	13.09	47.16	13.30
50	48.30	12.94	48.24	13.15	48.18	13.36	48.12	13.57
51	49.26	13.20	49.20	13.41	49.15	13.63	49.09	13.84
52	50.23	13.46	50.17	13.68	50.11	13.90	50.05	14.11
53	51.19	13.72	51.15	13.94	51.07	14.16	51.01	14.38
54	52.16	13.98	52.10	14.20	52.04	14.43	51.97	14.65
55	53.13	14.24	53.06	14.47	53.00	14.70	52.94	14.92
56	54.09	14.49	54.03	14.73	53.96	14.97	53.90	15.20
57	55.06	14.75	54.99	14.99	54.93	15.23	54.86	15.47
58	56.02	15.01	55.96	15.26	55.89	15.50	55.82	15.75
59	56.99	15.27	56.92	15.52	56.85	15.77	56.78	16.02
60	57.96	15.53	57.89	15.78	57.82	16.03	57.75	16.29
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.	

74 DEGREES

Digitized by Google

TRAVERSE TABLE.

14 DEGREES

Distance	0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
61	59.19	14.76	59.12	15.02	59.06	15.27	58.99	15.53
62	60.16	15.00	60.09	15.26	60.02	15.52	59.96	15.79
63	61.13	15.24	61.06	15.51	60.99	15.77	60.92	16.04
64	62.10	15.48	62.03	15.75	61.96	16.02	61.89	16.29
65	63.07	15.72	63.00	16.00	62.93	16.27	62.86	16.55
66	64.04	15.97	63.97	16.25	63.90	16.53	63.83	16.80
67	65.01	16.21	64.94	16.49	64.87	16.78	64.79	17.06
68	65.98	16.45	65.91	16.74	65.83	17.03	65.76	17.31
69	66.95	16.69	66.88	16.98	66.80	17.28	66.73	17.57
70	67.92	16.93	67.85	17.23	67.77	17.53	67.69	17.82
71	68.89	17.18	68.82	17.48	68.74	17.78	68.66	18.08
72	69.86	17.42	69.78	17.72	69.71	18.03	69.63	18.33
73	70.83	17.66	70.75	17.97	70.67	18.28	70.59	18.59
74	71.80	17.90	71.72	18.22	71.64	18.53	71.56	18.84
75	72.77	18.14	72.69	18.46	72.61	18.78	72.53	19.10
76	73.74	18.39	73.66	18.71	73.58	19.03	73.50	19.35
77	74.71	18.63	74.63	18.95	74.55	19.28	74.46	19.60
78	75.68	18.87	75.60	19.20	75.52	19.53	75.45	19.86
79	76.65	19.11	76.57	19.45	76.48	19.78	76.40	20.11
80	77.62	19.35	77.54	19.69	77.45	20.03	77.36	20.37
81	78.59	19.60	78.51	19.94	78.42	20.28	78.33	20.62
82	79.56	19.84	79.48	20.18	79.39	20.53	79.30	20.88
83	80.53	20.08	80.45	20.43	80.36	20.78	80.26	21.13
84	81.50	20.32	81.42	20.68	81.32	21.03	81.23	21.39
85	82.48	20.56	82.38	20.92	82.29	21.28	82.20	21.64
86	83.45	20.81	83.35	21.17	83.26	21.53	83.17	21.90
87	84.42	21.05	84.32	21.42	84.23	21.78	84.13	22.15
88	85.39	21.29	85.29	21.66	85.20	22.03	85.10	22.41
89	86.36	21.53	86.26	21.91	86.17	22.28	86.07	22.66
90	87.33	21.77	87.23	22.15	87.13	22.53	87.03	22.91
91	88.30	22.01	88.20	22.40	88.10	22.78	88.00	23.17
92	89.27	22.26	89.17	22.65	89.07	23.04	88.97	23.42
93	90.24	22.50	90.14	22.89	90.04	23.29	89.94	23.68
94	91.21	22.74	91.11	23.14	91.01	23.54	90.90	23.93
95	92.18	22.98	92.08	23.38	91.97	23.79	91.87	24.19
96	93.15	23.22	93.05	23.63	92.94	24.04	92.84	24.44
97	94.12	23.47	94.02	23.88	93.91	24.29	93.80	24.70
98	95.09	23.71	94.98	24.12	94.88	24.54	94.77	24.95
99	96.06	23.95	95.95	24.37	95.85	24.79	95.74	25.21
100	97.03	24.19	96.92	24.62	96.81	25.04	96.70	25.46
101	98.00	24.43	97.89	24.86	97.78	25.29	97.67	25.71
102	98.97	24.68	98.86	25.11	98.75	25.54	98.64	25.97
103	99.94	24.92	99.83	25.35	99.72	25.79	99.61	26.22
104	100.9	25.16	100.8	25.60	100.7	26.04	100.6	26.48
105	101.9	25.40	101.8	25.85	101.7	26.29	101.5	26.73
106	102.9	25.64	102.7	26.09	102.6	26.54	102.5	26.99
107	103.8	25.89	103.7	26.34	103.6	26.79	103.5	27.24
108	104.8	26.13	104.7	26.58	104.6	27.04	104.4	27.50
109	105.8	26.37	105.6	26.83	105.5	27.29	105.4	27.75
110	106.7	26.61	106.6	27.08	106.5	27.54	106.4	28.01
111	107.7	26.85	107.6	27.32	107.5	27.79	107.3	28.26
112	108.7	27.10	108.6	27.57	108.4	28.04	108.3	28.52
113	109.6	27.34	109.5	27.82	109.4	28.29	109.3	28.77
114	110.6	27.58	110.5	28.06	110.4	28.54	110.2	29.02
115	111.6	27.82	111.5	28.31	111.3	28.79	111.2	29.28
116	112.6	28.06	112.4	28.55	112.3	29.04	112.2	29.53
117	113.5	28.30	113.4	28.80	113.3	29.29	113.1	29.79
118	114.5	28.55	114.4	29.05	114.2	29.54	114.1	30.04
119	115.5	28.79	115.3	29.29	115.2	29.80	115.1	30.30
120	116.4	29.03	116.3	29.54	116.2	30.05	116.0	30.55
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.	

15 DEGREES

	0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
61	58.92	15.79	58.85	16.04	58.78	16.30	58.71	16.5
62	59.89	16.05	59.82	16.31	59.75	16.57	59.67	16.8
63	60.85	16.31	60.78	16.57	60.71	16.84	60.63	17.1
64	61.82	16.56	61.75	16.83	61.67	17.10	61.60	17.3
65	62.79	16.82	62.71	17.10	62.64	17.37	62.56	17.6
66	63.75	17.08	63.68	17.36	63.60	17.64	63.52	17.9
67	64.72	17.34	64.64	17.62	64.56	17.91	64.48	18.1
68	65.68	17.60	65.61	17.89	65.53	18.17	65.45	18.4
69	66.65	17.86	66.57	18.15	66.49	18.44	66.41	18.7
70	67.61	18.12	67.54	18.41	67.45	18.71	67.37	19.0
71	68.58	18.38	68.50	18.68	68.42	18.97	68.33	19.2
72	69.55	18.64	69.46	18.94	69.38	19.24	69.30	19.5
73	70.51	18.89	70.43	19.20	70.35	19.51	70.26	19.8
74	71.48	19.15	71.39	19.46	71.31	19.78	71.22	20.0
75	72.44	19.41	72.36	19.73	72.27	20.04	72.18	20.3
76	73.41	19.67	73.32	19.99	73.24	20.31	73.15	20.6
77	74.38	19.93	74.29	20.25	74.20	20.58	74.11	20.9
78	75.34	20.19	75.25	20.52	75.16	20.84	75.07	21.1
79	76.31	20.45	76.22	20.78	76.13	21.11	76.03	21.4
80	77.27	20.71	77.18	21.04	77.09	21.38	77.00	21.7
81	78.24	20.96	78.15	21.31	78.05	21.65	77.96	21.9
82	79.21	21.22	79.11	21.57	79.02	21.91	78.92	22.2
83	80.17	21.48	80.08	21.83	79.98	22.18	79.88	22.5
84	81.14	21.74	81.04	22.09	80.95	22.45	80.85	22.8
85	82.10	22.00	82.01	22.36	81.91	22.72	81.81	23.0
86	83.07	22.26	82.97	22.62	82.87	22.98	82.77	23.3
87	84.04	22.52	83.94	22.88	83.84	23.25	83.73	23.6
88	85.00	22.78	84.90	23.15	84.80	23.52	84.70	23.8
89	85.97	23.03	85.87	23.41	85.76	23.78	85.66	24.1
90	86.93	23.29	86.83	23.67	86.73	24.05	86.62	24.4
91	87.90	23.55	87.80	23.94	87.69	24.32	87.58	24.7
92	88.87	23.81	88.76	24.20	88.65	24.59	88.55	24.9
93	89.83	24.07	89.73	24.46	89.62	24.85	89.51	25.2
94	90.80	24.33	90.69	24.72	90.58	25.12	90.47	25.5
95	91.76	24.59	91.65	24.99	91.54	25.39	91.43	25.7
96	92.73	24.85	92.62	25.25	92.51	25.65	92.40	26.0
97	93.69	25.11	93.58	25.51	93.47	25.92	93.36	26.3
98	94.66	25.36	94.55	25.78	94.44	26.19	94.32	26.6
99	95.63	25.62	95.51	26.04	95.40	26.46	95.28	26.8
100	96.59	25.88	96.48	26.30	96.36	26.72	96.25	27.1
101	97.56	26.14	97.44	26.57	97.33	26.99	97.21	27.4
102	98.52	26.40	98.41	26.83	98.29	27.26	98.17	27.6
103	99.49	26.66	99.37	27.09	99.25	27.53	99.13	27.9
104	100.5	26.92	100.3	27.36	100.2	27.79	100.1	28.2
105	101.4	27.18	101.3	27.62	101.2	28.06	101.1	28.5
106	102.4	27.43	102.3	27.88	102.1	28.33	102.0	28.7
107	103.4	27.69	103.2	28.14	103.1	28.59	103.0	29.0
108	104.3	27.95	104.2	28.41	104.1	28.86	103.9	29.3
109	105.3	28.21	105.2	28.67	105.0	29.13	104.9	29.5
110	106.3	28.47	106.1	28.93	106.0	29.40	105.9	29.8
111	107.2	28.73	107.1	29.20	107.0	29.66	106.8	30.1
112	108.2	28.99	108.1	29.46	107.9	29.93	107.8	30.4
113	109.1	29.25	109.0	29.72	108.9	30.20	108.8	30.6
114	110.1	29.51	110.0	29.99	109.8	30.47	109.7	30.9
115	111.1	29.76	111.0	30.25	110.8	30.73	110.7	31.2
116	112.0	30.02	111.9	30.51	111.8	31.00	111.6	31.4
117	113.0	30.28	112.9	30.77	112.7	31.27	112.6	31.7
118	114.0	30.54	113.8	31.04	113.7	31.53	113.6	32.0
119	114.9	30.80	114.8	31.30	114.7	31.80	114.5	32.3
120	115.9	31.06	115.8	31.56	115.6	32.07	115.5	32.5
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	45 Min.		30 Min.		15 Min.		0 Min.	

76 DEG. 75 DEGREES 74 DEGREES

Digitized by Google

TRAVERSE TABLE.

16 DEGREES

Dist.	0 Min. Lat.	0 Min. Dep.	15 Min. Lat.	15 Min. Dep.	30 Min. Lat.	30 Min. Dep.	45 Min. Lat.	45 Min. Dep.
1	0.96	0.28	0.96	0.28	0.96	0.28	0.96	0.29
2	1.92	0.55	1.92	0.56	1.92	0.57	1.92	0.58
3	2.88	0.83	2.88	0.84	2.88	0.85	2.87	0.86
4	3.85	1.10	3.84	1.12	3.84	1.14	3.83	1.15
5	4.81	1.38	4.80	1.40	4.79	1.42	4.79	1.44
6	5.77	1.65	5.76	1.68	5.75	1.70	5.75	1.73
7	6.73	1.93	6.72	1.96	6.71	1.99	6.70	2.02
8	7.69	2.21	7.68	2.24	7.67	2.27	7.66	2.31
9	8.65	2.48	8.64	2.52	8.63	2.56	8.62	2.59
10	9.61	2.76	9.60	2.80	9.59	2.84	9.58	2.88
11	10.57	3.03	10.56	3.08	10.55	3.12	10.53	3.17
12	11.54	3.31	11.52	3.36	11.51	3.41	11.49	3.46
13	12.50	3.58	12.48	3.64	12.46	3.69	12.45	3.75
14	13.46	3.86	13.44	3.92	13.42	3.98	13.41	4.03
15	14.42	4.13	14.40	4.20	14.38	4.26	14.36	4.32
16	15.38	4.41	15.36	4.48	15.34	4.54	15.32	4.61
17	16.34	4.69	16.32	4.76	16.30	4.83	16.28	4.90
18	17.30	4.96	17.28	5.04	17.26	5.11	17.24	5.19
19	18.26	5.24	18.24	5.32	18.22	5.40	18.19	5.48
20	19.23	5.51	19.20	5.60	19.18	5.68	19.15	5.76
21	20.19	5.79	20.16	5.88	20.14	5.96	20.11	6.05
22	21.15	6.06	21.12	6.15	21.09	6.25	21.07	6.34
23	22.11	6.34	22.08	6.44	22.05	6.53	22.02	6.63
24	23.07	6.62	23.04	6.72	23.01	6.82	22.98	6.92
25	24.02	6.89	24.00	7.00	23.97	7.10	23.94	7.20
26	24.98	7.17	24.96	7.28	24.93	7.38	24.90	7.49
27	25.95	7.44	25.92	7.56	25.89	7.67	25.85	7.78
28	26.92	7.72	26.88	7.84	26.85	7.95	26.81	8.07
29	27.88	7.99	27.84	8.12	27.81	8.24	27.77	8.36
30	28.84	8.27	28.80	8.39	28.76	8.52	28.73	8.65
31	29.80	8.54	29.76	8.67	29.72	8.80	29.68	8.93
32	30.76	8.82	30.72	8.95	30.68	9.09	30.64	9.22
33	31.72	9.10	31.68	9.23	31.64	9.37	31.60	9.51
34	32.68	9.37	32.64	9.51	32.60	9.66	32.56	9.80
35	33.64	9.65	33.60	9.79	33.56	9.94	33.52	10.09
36	34.61	9.92	34.56	10.07	34.52	10.22	34.47	10.38
37	35.57	10.20	35.52	10.35	35.48	10.51	35.43	10.66
38	36.53	10.47	36.48	10.63	36.44	10.79	36.39	10.95
39	37.49	10.75	37.44	10.91	37.39	11.08	37.35	11.24
40	38.45	11.03	38.40	11.19	38.35	11.36	38.30	11.53
41	39.41	11.30	39.36	11.47	39.31	11.64	39.26	11.82
42	40.37	11.58	40.32	11.75	40.27	11.93	40.22	12.10
43	41.33	11.85	41.28	12.03	41.23	12.21	41.18	12.39
44	42.30	12.13	42.24	12.31	42.19	12.50	42.13	12.68
45	43.26	12.40	43.20	12.59	43.15	12.78	43.09	12.97
46	44.22	12.68	44.16	12.87	44.11	13.06	44.05	13.26
47	45.18	12.96	45.12	13.15	45.06	13.35	45.01	13.55
48	46.14	13.23	46.08	13.43	46.02	13.63	45.96	13.83
49	47.10	13.51	47.04	13.71	46.98	13.92	46.92	14.12
50	48.06	13.78	48.00	13.99	47.94	14.20	47.88	14.41
51	49.02	14.06	48.96	14.27	48.90	14.48	48.84	14.70
52	49.99	14.33	49.92	14.55	49.86	14.77	49.79	14.99
53	50.95	14.61	50.88	14.83	50.82	15.05	50.75	15.27
54	51.91	14.88	51.84	15.11	51.78	15.34	51.71	15.56
55	52.87	15.16	52.80	15.39	52.74	15.62	52.67	15.85
56	53.83	15.44	53.76	15.67	53.69	15.90	53.62	16.14
57	54.79	15.71	54.72	15.95	54.65	16.19	54.58	16.43
58	55.75	15.99	55.68	16.23	55.61	16.47	55.54	16.72
59	56.71	16.26	56.64	16.51	56.57	16.76	56.50	17.00
60	57.68	16.54	57.60	16.79	57.53	17.04	57.45	17.29
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.	

74 DEG.

73 DEGREES

17 DEGREES

0 Min. Lat.	0 Min. Dep.	15 Min. Lat.	15 Min. Dep.	30 Min. Lat.	30 Min. Dep.	45 Min. Lat.	45 Min. Dep.
0.96	0.29	0.96	0.30	0.95	0.30	0.95	0.31
1.91	0.58	1.91	0.59	1.91	0.60	1.90	0.61
2.87	0.88	2.87	0.89	2.86	0.90	2.86	0.91
3.83	1.17	3.82	1.19	3.81	1.20	3.81	1.21
4.78	1.46	4.78	1.48	4.77	1.50	4.76	1.52
5.74	1.75	5.73	1.78	5.72	1.80	5.71	1.82
6.69	2.05	6.69	2.08	6.68	2.10	6.67	2.13
7.65	2.34	7.64	2.37	7.63	2.41	7.62	2.44
8.61	2.63	8.60	2.67	8.58	2.71	8.57	2.74
9.56	2.92	9.55	2.97	9.54	3.01	9.52	3.05
10.52	3.22	10.51	3.26	10.49	3.31	10.48	3.35
11.48	3.51	11.46	3.56	11.44	3.61	11.43	3.66
12.43	3.80	12.42	3.86	12.40	3.91	12.38	3.96
13.39	4.09	13.37	4.15	13.35	4.21	13.33	4.27
14.34	4.39	14.33	4.45	14.31	4.51	14.29	4.57
15.30	4.68	15.28	4.74	15.26	4.81	15.24	4.88
16.26	4.97	16.24	5.04	16.21	5.11	16.19	5.18
17.21	5.26	17.19	5.34	17.17	5.41	17.14	5.49
18.17	5.56	18.15	5.63	18.12	5.71	18.10	5.79
19.13	5.85	19.10	5.93	19.07	6.01	19.05	6.10
20.08	6.14	20.06	6.23	20.03	6.31	20.00	6.40
21.04	6.43	21.01	6.52	20.98	6.62	20.95	6.71
22.00	6.72	21.97	6.82	21.94	6.92	21.91	7.01
22.95	7.02	22.92	7.12	22.89	7.22	22.86	7.32
23.91	7.31	23.88	7.41	23.84	7.52	23.81	7.62
24.86	7.60	24.83	7.71	24.80	7.82	24.76	7.93
25.82	7.89	25.79	8.01	25.75	8.12	25.71	8.23
26.78	8.19	26.74	8.30	26.70	8.42	26.67	8.54
27.73	8.48	27.70	8.60	27.66	8.72	27.62	8.84
28.69	8.77	28.65	8.90	28.61	9.02	28.57	9.15
29.65	9.06	29.61	9.19	29.57	9.32	29.52	9.45
30.60	9.36	30.56	9.49	30.52	9.62	30.48	9.76
31.56	9.65	31.52	9.79	31.47	9.93	31.43	10.06
32.51	9.94	32.47	10.08	32.43	10.22	32.38	10.37
33.47	10.25	33.43	10.38	33.38	10.53	33.33	10.67
34.43	10.55	34.38	10.68	34.33	10.83	34.29	10.98
35.38	10.85	35.34	10.97	35.29	11.13	35.24	11.28
36.34	11.14	36.29	11.27	36.24	11.43	36.19	11.58
37.30	11.40	37.25	11.57	37.20	11.73	37.14	11.89
38.25	11.69	38.20	11.86	38.15	12.03	38.10	12.19
39.21	11.99	39.16	12.16	39.10	12.33	39.05	12.50
40.16	12.28	40.11	12.45	40.06	12.63	40.00	12.80
41.12	12.58	41.07	12.75	41.01	12.93	40.95	13.11
42.08	12.86	42.02	13.05	41.96	13.23	41.91	13.41
43.03	13.16	42.98	13.34	42.92	13.53	42.86	13.72
43.99	13.45	43.93	13.64	43.87	13.83	43.81	14.02
44.95	13.74	44.89	13.94	44.82	14.13	44.76	14.33
45.90	14.03	45.84	14.23	45.78	14.43	45.72	14.63
46.86	14.33	46.80	14.53	46.73	14.73	46.67	14.94
47.82	14.62	47.75	14.83	47.69	15.04	47.62	15.24
48.77	14.91	48.71	15.12	48.64	15.34	48.57	15.55
49.73	15.20	49.66	15.42	49.59	15.64	49.52	15.85
50.68	15.50	50.62	15.72	50.55	15.94	50.48	16.15
51.64	15.79	51.57	16.01	51.50	16.24	51.43	16.46
52.60	16.08	52.53	16.31	52.45	16.54	52.38	16.76
53.55	16.37	53.48	16.61	53.41	16.84	53.33	17.06
54.51	16.67	54.44	16.90	54.36	17.14	54.29	17.37
55.47	16.96	55.39	17.20	55.32	17.44	55.24	17.67
56.42	17.25	56.35	17.50	56.27	17.74	56.19	17.97
57.38	17.54	57.30	17.79	57.22	18.04	57.14	18.27
Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
0 Min.		45 Min.		30 Min.		15 Min.	

72 DEGREES

Digitized by Google

TRAVERSE TABLE.

Distance	16 DEGREES								17 DEGREES							
	0 Min.		15 Min.		30 Min.		45 Min.		0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat	Dep
61	58.64	16.81	58.56	17.07	58.49	17.32	58.41	17.58	58.33	17.83	58.26	18.09	58.18	18.34	58.1	18.6
62	59.60	17.09	59.52	17.35	59.45	17.61	59.37	17.87	59.29	18 13	59.21	18.39	59.13	18.64	59.0	18.9
63	60.56	17.37	60.48	17.63	60.41	17.89	60.33	18.16	60.25	18.42	60.17	18.68	60.08	18.94	60.0	19.2
64	61.52	17.64	61.44	17.91	61.36	18.18	61.28	18.44	61.20	18.71	61.12	18.98	61.04	19.25	60.9	19.5
65	62.48	17.92	62.40	18.19	62 32	18.46	62.24	18.73	62.16	19.00	62.08	19.28	61.99	19.55	61.91	19.8
66	63.44	18.19	63.36	18.47	63.28	18.75	63.20	19.02	63.12	19.30	63.03	19.57	62.95	19.85	62.86	20.1
67	64.40	18.47	64.32	18.75	64.24	19.03	64.16	19.31	64.07	19.59	63.99	19.87	63.90	20.15	63.81	20.4
68	65.37	18.74	65.28	19.03	65.20	19.31	65.11	19.60	65.03	19.88	64.94	20.16	64.85	20.45	64.76	20.7
69	66.33	19.02	66.24	19.31	66.16	19.60	66.07	19.89	65.99	20.17	65.90	20.46	65.81	20.75	65.72	21.0
70	67.29	19.29	67.20	19.59	67.12	19.88	67.03	20.17	66.94	20.47	66.85	20.76	66.76	21.05	66.67	21.3
71	68.25	19.57	68.16	19.87	68.08	20.17	67.99	20.46	67.90	20.76	67.81	21.05	67.71	21.35	67.62	21.6
72	69.21	19.85	69.12	20.15	69.04	20.45	68.95	20.75	68.85	21.05	68.76	21.35	68.67	21.65	68.57	21.9
73	70.17	20.12	70.08	20.43	69.99	20.73	69.90	21.04	69.81	21.34	69.72	21.65	69.62	21.95	69.52	22.2
74	71.13	20.40	71.04	20.71	70.95	21.02	70.86	21.33	70.77	21.64	70.67	21.94	70.58	22.25	70.48	22.5
75	72.09	20.67	72.00	20.99	71.91	21.30	71.82	21.61	71.72	21.93	71.63	22.24	71.53	22.55	71.43	22.8
76	73.06	20.95	72.96	21.27	72.87	21.59	72.78	21.90	72.68	22.22	72.58	22.54	72.48	22.85	72.38	23.1
77	74.02	21.22	73.92	21.55	73.83	21.87	73.73	22.19	73.64	22.51	73.54	22.83	73.44	23.15	73.33	23.4
78	74.98	21.50	74.88	21.83	74.79	22.15	74.69	22.48	74.59	22.81	74.49	23.13	74.39	23.46	74.29	23.7
79	75.94	21.78	75.84	22.11	75.75	22.44	75.65	22.77	75.55	23.10	75.45	23.43	75.34	23.76	75.24	24.0
80	76.90	22.05	76.80	22.39	76.71	22.72	76.61	23.06	76.50	23.39	76.40	23.72	76.30	24.06	76.19	24.3
81	77.86	22.33	77.76	22.67	77.66	23.01	77.56	23.34	77.46	23.68	77.36	24.02	77.25	24.36	77.14	24.6
82	78.82	22.60	78.72	22.95	78.62	23.29	78.52	23.63	78.42	23.97	78.31	24.32	78.20	24.66	78.10	25.0
83	79.78	22.88	79.68	23.23	79.58	23.57	79.48	23.92	79.37	24.27	79.27	24.61	79.16	24.96	79.05	25.3
84	80.75	23.15	80.64	23.51	80.54	23.86	80.44	24.21	80.33	24.56	80.22	24.91	80.11	25.26	80.00	25.6
85	81.71	23.43	81.60	23.79	81.50	24.14	81.39	24.50	81.29	24.85	81.18	25.21	81.07	25.56	80.95	25.9
86	82.67	23.70	82.56	24.07	82.46	24.43	82.35	24.78	82.24	25.14	82.13	25.50	82.02	25.86	81.91	26.2
87	83.63	23.98	83.52	24.35	83.42	24.71	83.31	25.07	83.20	25.44	83.09	25.80	82.97	26.16	82.86	26.5
88	84.59	24.26	84.48	24.63	84.38	24.99	84.27	25.36	84.15	25.73	84.04	26.10	83.93	26.46	83.81	26.8
89	85.55	24.53	85.44	24.90	85.34	25.28	85.22	25.65	85.11	26.02	85.00	26.39	84.88	26.76	84.76	27.1
90	86.51	24.81	86.40	25.18	86.29	25.56	86.18	25.94	86.07	26.31	85.95	26.69	85.83	27.06	85.72	27.4
91	87.47	25.08	87.36	25.46	87.25	25.85	87.14	26.23	87.02	26.61	86.91	26.99	86.79	27.36	86.67	27.7
92	88.44	25.36	88.32	25.74	88.21	26.13	88.10	26.51	87.98	26.90	87.86	27.28	87.74	27.66	87.62	28.0
93	89.40	25.63	89.28	26.02	89.17	26.41	89.05	26 80	88.94	27.19	88.82	27.58	88.70	27.97	88.57	28.3
94	90.36	25.91	90.24	26.30	90.13	26.70	90.01	27.09	89.89	27.48	89.77	27.87	89.65	28.27	89.53	28.6
95	91.32	26.19	91.20	26.58	91.09	26.98	90.97	27.38	90.85	27.78	90.73	28.17	90.60	28.57	90.48	28.9
96	92.28	26.46	92.16	26.86	92.05	27.27	91.93	27.67	91.81	28.07	91.68	28.47	91.56	28.87	91.43	29.2
97	93.24	26.74	93.12	27.14	93.01	27.55	92.89	27.96	92.76	28.36	92.64	28.76	92.51	29.17	92.38	29.5
98	94.20	27.01	94.08	27.42	93.96	27.83	93.84	28.24	93.72	28.65	93.59	29.06	93.46	29.47	93.33	29.8
99	95.16	27.29	95.04	27.70	94.92	28.12	94.80	28.53	94.67	28.94	94.55	29.36	94.42	29.77	94.29	30.1
100	96.13	27.56	96.01	27.98	95.88	28.40	95.76	28.82	95.63	29.24	95.50	29.65	95.37	30.07	95.24	30.4
101	97.09	27.84	96.97	28.26	96.84	28.69	96.71	29.11	96.59	29.53	96.46	29.95	96.33	30.37	96.19	30.7
102	98.05	28.12	97.93	28.54	97.80	28.97	97.67	29.40	97.54	29.82	97.41	30.25	97.28	30.67	97.14	31.1
103	99.01	28.39	98.89	28.82	98.76	29.25	98.63	29.68	98.50	30.11	98.37	30.54	98.23	30.97	98.10	31.4
104	99.97	28.67	99.85	29.10	99.72	29.54	99.59	29.97	99.46	30.41	99.32	30.84	99.19	31.27	99.05	31.7
105	100.9	28.94	100.8	29.38	100.7	29.82	100.5	30.26	100.4	30.70	100.3	31.14	100.1	31.57	100.0	32.0
106	101.9	29.22	101.8	29.66	101.6	30.11	101.5	30.55	101.4	30.99	101.2	31.43	101.1	31.87	101.0	32.3
107	102.9	29.49	102.7	29.94	102.6	30.39	102.4	30.84	102.3	31.28	102.2	31.75	102.0	32.18	101.9	32.6
108	103.8	29.77	103.7	30.22	103.6	30.67	103.4	31.13	103.3	31.58	103.1	32.03	103.0	32.48	102.9	32.9
109	104.8	30.04	104.6	30.50	104.5	30.96	104.4	31.41	104.2	31.87	104.1	32.32	104.0	32.78	103.8	33.2
110	105.7	30.32	105.6	30.78	105.5	31.24	105.3	31.70	105.2	32.16	105.1	32.62	104.9	33.08	104.8	33.5
111	106.7	30.60	106.6	31.06	106.4	31.53	106.3	31.99	106.1	32.45	106.0	32.92	105.9	33.38	105.7	33.8
112	107.7	30.87	107.5	31.34	107.4	31.81	107.2	32.28	107.1	32.75	107.0	35.21	106.8	33.68	106.7	34.1
113	108.6	31.15	108.5	31.62	108.3	32.09	108.2	32.57	108.1	33.04	107.9	33.51	107.8	33.98	107.6	34.4
114	109.6	31.42	109.4	31.90	109.3	32.38	109.2	32.85	109.0	33.33	108.9	33.81	108.7	34.28	108.6	34.7
115	110.5	31.70	110.4	32.18	110.3	32.66	110.1	33.14	110.0	33.62	109.8	34.10	109.7	34.58	109.5	35.0
116	111.5	31.97	111.4	32.46	111.2	32.95	111.1	33.43	110.9	33.92	110.8	34.40	110.6	34.88	110.5	35.3
117	112.5	32.25	112.3	32.74	112.2	33.23	112.0	33.72	111.9	34.21	111.7	34.70	111.6	35.18	111.4	35.6
118	113.4	32.53	113.3	32.02	113.1	33.51	113.0	34.01	112.8	34.50	112.7	34.99	112.5	35.48	112.4	35.9
119	114.4	32.80	114.2	33.30	114.1	33.80	114.0	34.30	113.8	34.79	113.6	35.29	113.5	35.78	113.3	36.2
120	115.4	33.08	115.2	33.58	115.1	34.08	114.9	34.58	114.8	35.08	114.6	35.59	114.4	36.09	114.3	36.5
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.		0 Min.		45 Min.		30 Min.		15 Min.	
	74 DEG.		73 DEGREES						72 DEGREES							

Digitized by Google

18 DEGREES

Distance	0 Min. Lat.	0 Min. Dep.	15 Min. Lat.	15 Min. Dep.	30 Min. Lat.	30 Min. Dep.	45 Min. Lat.	45 Min. Dep.
1	0.95	0.31	0.95	0.31	0.95	0.32	0.95	0.32
2	1.90	0.62	1.90	0.63	1.90	0.63	1.89	0.64
3	2.85	0.93	2.85	0.94	2.85	0.95	2.84	0.96
4	3.80	1.24	3.80	1.25	3.79	1.27	3.79	1.29
5	4.76	1.55	4.75	1.57	4.74	1.59	4.73	1.61
6	5.71	1.85	5.70	1.88	5.69	1.90	5.68	1.93
7	6.66	2.16	6.65	2.19	6.64	2.22	6.63	2.25
8	7.61	2.47	7.60	2.51	7.59	2.54	7.58	2.57
9	8.56	2.78	8.55	2.82	8.53	2.86	8.52	2.89
10	9.51	3.09	9.50	3.13	9.48	3.17	9.47	3.21
11	10.46	3.40	10.45	3.44	10.43	3.49	10.42	3.54
12	11.41	3.71	11.40	3.76	11.38	3.81	11.36	3.86
13	12.36	4.02	12.35	4.07	12.33	4.13	12.31	4.18
14	13.31	4.33	13.30	4.38	13.28	4.44	13.26	4.50
15	14.27	4.64	14.25	4.70	14.22	4.76	14.20	4.82
16	15.22	4.94	15.20	5.01	15.17	5.08	15.15	5.14
17	16.17	5.25	16.14	5.32	16.12	5.39	16.10	5.46
18	17.12	5.56	17.09	5.64	17.07	5.71	17.04	5.79
19	18.07	5.87	18.04	5.95	18.02	6.03	17.99	6.11
20	19.02	6.18	18.99	6.26	18.97	6.35	18.94	6.43
21	19.97	6.49	19.94	6.58	19.91	6.66	19.89	6.75
22	20.92	6.80	20.89	6.89	20.86	6.98	20.83	7.07
23	21.87	7.11	21.84	7.20	21.81	7.30	21.78	7.39
24	22.83	7.42	22.79	7.52	22.76	7.62	22.73	7.71
25	23.78	7.73	23.74	7.83	23.71	7.93	23.67	8.04
26	24.73	8.03	24.69	8.14	24.66	8.25	24.62	8.36
27	25.68	8.34	25.64	8.46	25.60	8.57	25.57	8.68
28	26.63	8.65	26.59	8.77	26.55	8.88	26.51	9.00
29	27.58	8.96	27.54	9.08	27.50	9.20	27.46	9.32
30	28.53	9.27	28.49	9.39	28.45	9.52	28.41	9.64
31	29.48	9.58	29.44	9.71	29.40	9.84	29.35	9.96
32	30.43	9.89	30.39	10.02	30.35	10.15	30.30	10.29
33	31.38	10.20	31.34	10.33	31.29	10.47	31.25	10.61
34	32.34	10.51	32.29	10.65	32.24	10.79	32.20	10.93
35	33.29	10.82	33.24	10.96	33.19	11.11	33.14	11.25
36	34.24	11.12	34.19	11.27	34.14	11.42	34.09	11.57
37	35.19	11.43	35.14	11.59	35.09	11.74	35.04	11.89
38	36.14	11.74	36.09	11.90	36.04	12.06	35.98	12.21
39	37.09	12.05	37.04	12.21	36.98	12.37	36.93	12.54
40	38.04	12.36	37.99	12.53	37.93	12.69	37.88	12.86
41	38.99	12.67	38.94	12.84	38.88	13.01	38.82	13.18
42	39.94	12.98	39.89	13.15	39.83	13.33	39.77	13.50
43	40.90	13.29	40.84	13.47	40.78	13.64	40.72	13.82
44	41.85	13.60	41.79	13.78	41.73	13.96	41.66	14.14
45	42.80	13.91	42.74	14.09	42.67	14.28	42.61	14.46
46	43.75	14.21	43.69	14.41	43.62	14.60	43.55	14.79
47	44.70	14.52	44.64	14.72	44.57	14.91	44.51	15.11
48	45.65	14.83	45.59	15.03	45.52	15.23	45.45	15.43
49	46.60	15.14	46.54	15.35	46.47	15.55	46.40	15.75
50	47.55	15.45	47.49	15.66	47.42	15.87	47.35	16.07
51	48.50	15.76	48.43	15.97	48.36	16.18	48.29	16.39
52	49.45	16.07	49.38	16.28	49.31	16.50	49.24	16.71
53	50.41	16.38	50.33	16.60	50.26	16.82	50.19	17.04
54	51.36	16.69	51.28	16.91	51.21	17.13	51.13	17.36
55	52.31	17.00	52.23	17.22	52.16	17.45	52.08	17.68
56	53.26	17.31	53.18	17.54	53.11	17.77	53.03	18.00
57	54.21	17.61	54.13	17.85	54.05	18.09	53.98	18.32
58	55.16	17.92	55.08	18.16	55.00	18.40	54.92	18.64
59	56.11	18.23	56.03	18.48	55.95	18.72	55.87	18.96
60	57.06	18.54	56.98	18.79	56.90	19.04	56.82	19.29
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.	

72 DEG.

19 DEGREES

	0 Min. Lat.	0 Min. Dep.	15 Min. Lat.	15 Min. Dep.	30 Min. Lat.	30 Min. Dep.	45 Min. Lat.	45 Min. Dep.
1	0.95	0.33	0.94	0.33	0.94	0.33	0.94	0.34
2	1.89	0.65	1.89	0.66	1.89	0.67	1.88	0.68
3	2.84	0.98	2.83	0.99	2.83	1.00	2.82	1.01
4	3.78	1.30	3.78	1.32	3.77	1.34	3.76	1.35
5	4.73	1.63	4.72	1.65	4.71	1.67	4.71	1.69
6	5.67	1.95	5.66	1.98	5.66	2.00	5.65	2.03
7	6.62	2.28	6.61	2.31	6.60	2.34	6.59	2.37
8	7.56	2.60	7.55	2.64	7.54	2.67	7.53	2.70
9	8.51	2.93	8.50	2.97	8.48	3.00	8.47	3.04
10	9.46	3.26	9.44	3.30	9.43	3.34	9.41	3.38
11	10.40	3.58	10.39	3.63	10.37	3.67	10.35	3.72
12	11.35	3.91	11.33	3.96	11.31	4.01	11.29	4.06
13	12.29	4.23	12.27	4.29	12.25	4.34	12.24	4.39
14	13.24	4.56	13.22	4.62	13.20	4.67	13.18	4.73
15	14.18	4.88	14.16	4.95	14.14	5.01	14.12	5.07
16	15.13	5.21	15.11	5.28	15.08	5.34	15.06	5.41
17	16.07	5.53	16.05	5.60	16.02	5.67	16.00	5.74
18	17.02	5.86	16.99	5.93	16.97	6.01	16.94	6.08
19	17.96	6.19	17.94	6.26	17.91	6.34	17.88	6.42
20	18.91	6.51	18.88	6.59	18.85	6.68	18.82	6.76
21	19.86	6.84	19.83	6.92	19.80	7.01	19.76	7.10
22	20.80	7.16	20.77	7.25	20.74	7.34	20.71	7.43
23	21.75	7.49	21.71	7.58	21.68	7.68	21.65	7.77
24	22.69	7.81	22.66	7.91	22.62	8.01	22.59	8.11
25	23.64	8.14	23.60	8.24	23.57	8.35	23.53	8.45
26	24.58	8.46	24.55	8.57	24.51	8.68	24.47	8.79
27	25.53	8.79	25.49	8.90	25.45	9.01	25.41	9.12
28	26.47	9.12	26.43	9.23	26.39	9.35	26.35	9.46
29	27.42	9.44	27.38	9.56	27.34	9.68	27.29	9.80
30	28.37	9.77	28.32	9.89	28.28	10.01	28.24	9.14
31	29.31	10.09	29.27	10.22	29.22	10.35	29.18	10.48
32	30.26	10.42	30.21	10.55	30.16	10.68	30.12	10.81
33	31.20	10.74	31.15	10.88	31.11	11.02	31.06	11.15
34	32.15	11.07	32.10	11.21	32.05	11.35	32.00	11.49
35	33.09	11.39	33.04	11.54	32.99	11.68	32.94	11.83
36	34.04	11.72	33.99	11.87	33.94	12.02	33.88	12.17
37	34.98	12.05	34.93	12.20	34.88	12.35	34.82	12.50
38	35.93	12.37	35.88	12.53	35.82	12.68	35.76	12.84
39	36.88	12.70	36.82	12.86	36.76	13.02	36.71	13.18
40	37.82	13.02	37.76	13.19	37.71	13.35	37.65	13.52
41	38.77	13.35	38.71	13.52	38.65	13.69	38.59	13.85
42	39.71	13.67	39.65	13.85	39.59	14.02	39.53	14.19
43	40.66	14.00	40.60	14.18	40.53	14.35	40.47	14.53
44	41.60	14.33	41.54	14.51	41.48	14.69	41.41	14.87
45	42.55	14.65	42.48	14.84	42.42	15.02	42.35	15.21
46	43.49	14.98	43.43	15.17	43.36	15.36	43.29	15.54
47	44.44	15.30	44.37	15.50	44.30	15.69	44.24	15.88
48	45.38	15.63	45.32	15.83	45.25	16.03	45.18	16.22
49	46.33	15.95	46.26	16.15	46.19	16.36	46.12	16.56
50	47.28	16.28	47.20	16.48	47.13	16.69	47.06	16.90
51	48.22	16.60	48.15	16.81	48.07	17.02	48.00	17.23
52	49.17	16.93	49.09	17.14	49.02	17.36	48.94	17.57
53	50.11	17.26	50.04	17.47	49.96	17.69	49.88	17.91
54	51.06	17.58	50.98	17.80	50.90	18.03	50.82	18.25
55	52.00	17.91	51.92	18.13	51.85	18.36	51.76	18.59
56	52.95	18.23	52.87	18.46	52.79	18.69	52.71	18.92
57	53.89	18.56	53.81	18.79	53.73	19.03	53.65	19.26
58	54.84	18.88	54.76	19.12	54.67	19.36	54.59	19.60
59	55.79	19.21	55.70	19.45	55.62	19.69	55.53	19.94
60	56.73	19.53	56.65	19.78	56.56	20.03	56.47	20.28
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.	

71 DEGREES

70 DEGREES

Digitized by Google

TRAVERSE TABLE.

Distance	18 DEGREES								19 DEGREES							
	0 Min.		15 Min.		30 Min.		45 Min.		0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
61	58.01	18.85	57.93	19.10	57.85	19.36	57.76	19.61	57.68	19.86	57.59	20.11	57.50	20.36	57.41	20.61
62	58.97	19.16	58.88	19.42	58.80	19.67	58.71	19.93	58.62	20.19	58.53	20.44	58.44	20.70	58.35	20.95
63	59.92	19.47	59.83	19.73	59.74	19.99	59.66	20.25	59.57	20.51	59.48	20.77	59.39	21.03	59.29	21.29
64	60.87	19.78	60.78	20.04	60.69	20.31	60 60	20.57	60.51	20.84	60.42	21.10	60.33	21.36	60.24	21.63
65	61.82	20.09	61.73	20.36	61.64	20.62	61.55	20.89	61.46	21.16	61.37	21.43	61.27	21.70	61.18	21.96
66	62.77	20.40	62.68	20.67	62 59	20.94	62.50	21.22	62.40	21.49	62.31	21.76	62.21	22.03	62.12	22.30
67	63.72	20.70	63.63	20.98	63.54	21.26	63.44	21.54	63.35	21.81	63.25	22.09	63.16	22.37	63.06	22.64
68	64.67	21.01	64.58	21.30	64.49	21.58	64.39	21.86	64.30	22.14	64.20	22.42	64.10	22.70	64.00	22.98
69	65.62	21.32	65.53	21.61	65.43	21.89	65.34	22.18	65.24	22.46	65.14	22.75	65.04	23.03	64.94	23.32
70	66.57	21.63	66.48	21.92	66.38	22.21	66.29	22.50	66.19	22.79	66.09	23.08	65.98	23.37	65.88	23.65
71	67.52	21.94	67.43	22.23	67.33	22.53	67.23	22.82	67.13	23.12	67.03	23.41	66.93	23.70	66.82	23.99
72	68.48	22.25	68.38	22.55	68.28	22.85	68.18	23.14	68.08	23.44	67.97	23.74	67.87	24.03	67.76	24.33
73	69.43	22.56	69.33	22.86	69.23	23.16	69.13	23.47	69.02	23.77	68.92	24.07	68.81	24.37	68.71	24.67
74	70.38	22.87	70.28	23.17	70.18	23.48	70.07	23.79	69.97	24.09	69.86	24.40	69.76	24.70	69.65	25.01
75	71.33	23.18	71.23	23.49	71.12	23.80	71.02	24.11	70.91	24.42	70.81	24.73	70.70	25.04	70.59	25.34
76	72.28	23.49	72.18	23.80	72.07	24.12	71.97	24.43	71.86	24.74	71.75	25.06	71.64	25.37	71.53	25.68
77	73.23	23.79	73 13	24.11	73.02	24.43	72.91	24.75	72.80	25.07	72.69	25.39	72.58	25.70	72.47	26.02
78	74.18	24.10	74.08	24.43	73.97	24.75	73.86	25.07	73.75	25.39	73.64	25.72	73.53	26.04	73.41	26.36
79	75.13	24.41	75.03	24.74	74.92	25.07	74.81	25.39	74.70	25.72	74.58	26.05	74.47	26.37	74.35	26.70
80	76.08	24.72	75.98	25.05	75.87	25.38	75.75	25.72	75.64	26.05	75.53	26.38	75.41	26.70	75.29	27.03
81	77.04	25.03	76.93	25.37	76.81	25.70	76.70	26.04	76.59	26.37	76.47	26.70	76.35	27.04	76.24	27.37
82	77.99	25.34	77.88	25.68	77.76	26.02	77.65	26.36	77.53	26.70	77.42	27.03	77.30	27.37	77.18	27.71
83	78.94	25.65	78.83	25.99	78.71	26.34	78.60	26.68	78.48	27.02	78.36	27.36	78.24	27.71	78.12	28.05
84	79.89	25.96	79.77	26.31	79.66	26.65	79.54	27.00	79.42	27.35	79.30	27.69	79.18	28.04	79.06	28.39
85	80.84	26.27	80.72	26.62	80.61	26.97	80.49	27.32	80.37	27.67	80.25	28.02	80.12	28.37	8 00	28.72
86	81.79	26.58	81.67	26.93	81.56	27.29	81.44	27.64	81.31	28.00	81.19	28.35	81.07	28.71	80.94	29.06
87	82.74	26.88	82.62	27.25	82.50	27.61	82.38	27.97	82.26	28.32	82.14	28.68	82.01	29.04	81.88	29.40
88	83.69	27.19	83.57	27.56	83.45	27.92	83.33	28.29	83.21	28.65	83.08	29.01	82.95	29.37	82.82	29.74
89	84.64	27.50	84.52	27.87	84.40	28.24	84.28	28.61	84.15	28.98	84.02	29.34	83.90	29.71	83.76	30.07
90	85.60	27.81	85.47	28.18	85.35	28.56	85.22	28.93	85.10	29.30	84.97	29 67	84.84	30.04	84.71	30.41
91	86.55	28.12	86.42	28.50	86.30	28.87	86.17	29.25	86.04	29.63	85.91	30.00	85.78	30.38	85.65	30.75
92	87.50	28.43	87.37	28.81	87.25	29.19	87.12	29.57	86.99	29.95	86.86	30.33	86.72	30.71	86.59	31.09
93	88.45	28.74	88.32	29.12	88.19	29.51	88.06	29.89	87.93	30.28	87.80	30.66	87.67	31.04	87.53	31.43
94	89.40	29.05	89.27	29.44	89.14	29.83	89.01	30.22	88.88	30.60	88.74	30.99	88.61	31.38	88.47	31.76
95	90.35	29.36	90.22	29.75	90.09	30.14	89.96	30.54	89.82	30.93	89.69	31.32	89.55	31.71	89.41	32.10
96	91.30	29.67	91.17	30.06	91.04	30.46	90.91	30.86	90.77	31.25	90.63	31.65	90.49	32.05	90.35	32.44
97	92.25	29.97	92.12	30.38	91.99	30.78	91.85	31.18	91.72	31.58	91.58	31.98	91.44	32.38	91.29	32.78
98	93.20	30.28	93.07	30.69	92.94	31.10	92.80	31.50	92.66	31.91	92.52	32.31	92.38	32.71	92.24	33.12
99	94.15	30.59	94.02	31.00	93.88	31.41	93.75	31.82	93.61	32.23	93.46	32.64	93.32	33.05	93.18	33.45
100	95.11	30.90	94.97	31.32	94.83	31.73	94.69	32.14	94.55	32.56	94.41	32.97	94.26	33.38	94.12	33.79
101	96.06	31.21	95.92	31.63	95.78	32.05	95.64	32.46	95.50	32.88	95.35	33.30	95.21	33.71	95.06	34.13
102	97.01	31.52	96.87	31.94	96.73	32.36	96.59	32.79	96.44	33.21	96.30	33.63	96.15	34.05	96.00	34.47
103	97.96	31.83	97.82	32.26	97.68	32.68	97.53	33.11	97.39	33.53	97.24	33.96	97.09	34.38	96.94	34.81
104	98.91	32.14	98.77	32.57	98.63	33.00	98.48	33.43	98.33	33.86	98.19	34.29	98.03	34.72	97.88	35.14
105	99.86	32.45	99.72	32.88	99.57	33.32	99.43	33.75	99.28	34.18	99.13	34.62	98.98	35.05	98.82	35.48
106	100.8	32.76	100.7	33.20	100.5	33.63	100.4	34.07	100.2	34.51	100.1	34.95	99.92	35.38	99.76	35.82
107	101.8	33.06	101.6	33.51	101.5	33.95	101.3	34.39	101.2	34.84	101.0	35.28	100.9	35.72	100.7	36.16
108	102.7	33.37	102.6	33.82	102.4	34.27	102.3	34.72	102.1	35.16	102.0	35.61	101.8	36.05	101.6	36.49
109	103.7	33.68	103.5	34.13	103.4	34.59	103.2	35.04	103.1	35.49	102.9	35.94	102.7	36.38	102.6	36.83
110	104.6	33.99	104.5	34.45	104.3	34.90	104.2	35.36	104.0	35.81	103.8	36.27	103.7	36.72	103.5	37.17
111	105.6	34.30	105.4	34.76	105.3	35.22	105.1	35.68	105.0	36.14	104.8	36.60	104.6	37.05	104.5	37.51
112	106.5	34.61	106.4	35.07	106.2	35.54	106.1	36.00	105.9	36.46	105.7	36.93	105.6	37.39	105.4	37.85
113	107.5	34.92	107.3	35.39	107.2	35.86	107.0	36.32	106.8	36.79	106.7	37.26	106.5	37.72	106.4	38.18
114	108.4	35.23	108.3	35.70	108.1	36.17	108.0	36.64	107.8	37.11	107.6	37.58	107.5	38.05	107.3	38.52
115	109.	35.54	109.2	36.01	109.1	36.49	108.9	36.97	108.7	37.44	108.6	37 91	108.4	38.39	108.2	38.86
116	110.3	35.85	110.2	36.33	110.0	36.81	109.8	37.29	109.7	37.77	109 5	38.23	109.5	38.72	109.2	39.20
117	111.3	36.16	111.1	36.64	111.0	37.12	110.8	37.61	110.6	38.09	110.5	38.57	110.3	39.06	110.1	39.54
118	112.2	36 46	112.1	36.95	111.9	37.44	111.7	37.93	111.6	38.42	111.4	38.90	111.2	39.39	111.1	39.87
119	113.2	36.77	113.0	37.27	112.9	37.76	112.7	38.25	112.5	38.74	112.3	39.23	112.2	39.72	112.0	40.21
120	114.1	37.08	114.0	37.58	113.8	38.08	113.6	38.57	113.5	39.07	113.3	39.56	113.1	40.06	112.9	40.55
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.		0 Min.		45 Min.		30 Min.		15 Min.	
	72 DEG.		71 DEGREES						70 DEGREES							

Digitized by Google

TRAVERSE TABLE.

20 DEGREES

Distance	0 Min. Lat.	0 Min. Dep.	15 Min. Lat.	15 Min. Dep.	30 Min. Lat.	30 Min. Dep.	45 Min. Lat.	45 Min. Dep.
1	0.94	0.34	0.94	0.35	0.94	0.35	0.94	0.35
2	1.88	0 68	1.88	0.69	1.87	0.70	1.87	0.71
3	2.82	1.03	2.81	1.04	2.81	1.05	2.81	1.06
4	3.76	1.37	3.75	1.38	3.75	1.40	3.74	1.42
5	4.70	1.71	4.69	1.73	4.68	1.75	4.68	1.77
6	5,64	2.05	5.63	2.08	5.62	2.10	5.61	2.13
7	6.58	2.39	6.57	2.42	6.56	2.45	6.55	2.48
8	7.52	2.74	7.51	2.77	7.49	2.80	7.48	2.83
9	8.46	3.08	8.44	3.12	8.43	3.15	8.42	3.19
10	9.40	3.42	9.38	3.46	9.37	3.50	9.35	3.54
11	10.34	3.76	10.32	3.81	10.30	3.85	10.29	3.90
12	11.28	4.10	11.26	4.15	11.24	4.20	11.22	4.25
13	12.22	4.45	12.20	4.50	12.18	4.55	12.16	4.61
14	13.16	4.79	13.13	4.85	13.11	4.90	13.09	4.96
15	14.10	5.13	14.07	5.19	14.05	5.25	14.03	5.31
16	15.04	5.47	15.01	5.54	14.99	5.60	14.96	5.67
17	15.97	5.81	15.95	5.88	15.92	5.95	15.90	6.02
18	16.91	6.16	16.89	6.23	16.86	6.30	16.83	6.38
19	17.85	6.50	17.83	6.58	17.80	6.65	17.77	6.73
20	18.79	6.84	18.76	6.92	18.73	7.00	18.70	7.09
21	19.73	7.18	19.70	7.27	19.67	7.35	19.64	7.44
22	20.67	7.52	20.64	7.61	20.61	7.70	20.57	7.79
23	21.61	7.87	21.58	7.96	21.54	8.05	21.51	8.15
24	22.55	8.21	22.52	8.31	22.48	8.40	22.44	8.50
25	23.49	8.55	23.45	8.65	23.42	8.76	23.38	8.86
26	24.43	8.89	24.39	9.00	24.35	9.11	24.31	9.21
27	25.37	9.23	25.33	9.35	25.29	9.46	25.25	9.57
28	26.31	9.58	26.27	9.69	26.23	9.81	26.18	9.92
29	27.25	9.92	27.21	10.04	27.16	10.16	27.12	10.27
30	28.19	10.26	28.15	10.38	28.10	10.51	28.05	10.63
31	29.13	10.60	29.08	10.73	29.04	10.86	28.99	10.98
32	30.07	10.94	30.02	11.08	29.97	11.21	29.93	11.34
33	31.01	11.29	30.96	11.42	30.91	11.56	30.86	11.69
34	31.95	11.63	31.90	11.77	31.85	11.91	31.79	12.05
35	32.89	11.97	32.84	12.11	32.78	12.26	32.73	12.40
36	33.83	12.31	33 77	12.46	33.72	12.61	33.66	12 75
37	34.77	12.65	34.71	12.81	34.66	12.96	34.60	13.11
38	35.71	13.00	35.65	13.15	35.59	13.31	35.54	13.46
39	36.65	13.34	36.59	13.50	36.53	13.66	36.47	13.82
40	37.59	13.68	37.53	13.84	37.47	14.01	37.41	14.17
41	38.53	14.02	38.47	14.19	38.40	14.36	38.34	14.53
42	39.47	14.36	39.40	14.54	39.34	14.71	39.28	14.88
43	40.41	14.71	40.34	14.88	40.28	15.06	40.21	15.23
44	41.35	15.05	41.23	15.23	41.21	15.41	41.15	15.59
45	42.29	15.39	42.22	15.58	42.15	15.76	42.08	15.94
46	43.23	15.73	43.16	15.92	43.09	16.11	43.02	16.30
47	44.17	16.07	44.09	16.27	44.02	16.46	43.95	16.65
48	45.11	16.42	45.03	16.61	44.96	16.81	44.89	17.01
49	46.04	16.76	45.97	16.96	45.90	17.16	45.82	17.36
50	46.98	17.10	46.91	17.31	46.83	17.51	46.76	17.71
51	47.92	17.44	47.85	17.65	47.77	17.86	47.69	18.07
52	48.86	17.79	48.79	18.00	48.71	18.21	48.63	18.42
53	49.80	18.13	49.72	18.34	49.64	18.56	49.56	18.78
54	50.74	18.47	50.66	18.69	50.58	18.91	50.50	19.13
55	51.68	18.81	51.60	19.04	51.52	19.26	51.43	19.49
56	52.62	19.15	52.54	19.38	52.45	19.61	52.37	19.84
57	53.56	19.50	53.48	19.73	53.39	19.96	53.30	20.19
58	54.50	19.84	54.42	20.07	54.33	20.31	54.24	20.55
59	55.44	20.18	55.35	20.42	55.26	20.66	55.17	20.90
60	56.38	20.52	56.29	20.77	56.20	21.01	56.11	21.26
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.	

70 DEG.

21 DEGREES

0 Min. Lat.	0 Min. Dep.	15 Min. Lat.	15 Min. Dep.	30 Min. Lat.	30 Min. Dep.	45 Min. Lat.	45 Min. Dep.
0.93	0.36	0.93	0.36	0.93	0.37	0.93	0.37
1.87	0.72	1.86	0.72	1.86	0.73	1.86	0.74
2.80	1.08	2.80	1.09	2.79	1.10	2.79	1.11
3.73	1.43	3.73	1.45	3.72	1.47	3.72	1.48
4.67	1.79	4.66	1.81	4.65	1.83	4.64	1.85
5.60	2.15	5.59	2.17	5.58	2.20	5.57	2.22
6.54	2.51	6.52	2.54	6.51	2.57	6.50	2.59
7.47	2.87	7.46	2.90	7.44	2.93	7.43	2.96
8.40	3.23	8.39	3.26	8.37	3.30	8.36	3.34
9.34	3.58	9.32	3.62	9.30	3.67	9.29	3.71
10.27	3.94	10.25	3.99	10.23	4.03	10.22	4.08
11.20	4.30	11.18	4.35	11.17	4.40	11.15	4.45
12.14	4.66	12.12	4.71	12.10	4.76	12.07	4.82
13 07	5.02	13.05	5.07	13.03	5.13	13.00	5.19
14.00	5.38	13.98	5.44	13.96	5 50	13.93	5.56
14.94	5.73	14.91	5.80	14.89	5.86	14.86	5.93
15.87	6.09	15.84	6.16	15.82	6.23	15.79	6.30
16.80	6.45	16.78	6.52	16.75	6.60	16.72	6.67
17.74	6.81	17.71	6.89	17.68	6.96	17.65	7.04
18.67	7.17	18.64	7.25	18.61	7.33	18.58	7.41
19.61	7.53	19.57	7.61	19.54	7.70	19.51	7.78
20.54	7.88	20.50	7.97	20.47	8.06	20.43	8.15
21.47	8.24	21.44	8.34	21.40	8.43	21.36	8.52
22.41	8.60	22.37	8.70	22.33	8.80	22.29	8.89
23.34	8.96	23.30	9.06	23.26	9.16	23.22	9.26
24.27	9.39	24.23	9.42	24.19	9.53	24.15	9.63
25.21	9.68	25.16	9.79	25.12	9.90	25.08	10.00
26.14	10.03	26.10	10.15	26.05	10.26	26.01	10.38
27.07	10.39	27.03	10.51	26.98	10.63	26.94	10.75
28.01	10.75	27.96	10.87	27.91	11.00	27.86	11.12
28.94	11.11	28.89	11.24	28.84	11.36	28.79	11.49
29.87	11.47	29.82	11.60	29.77	11.73	29.72	11.86
30.81	11.83	30.76	11.96	30.70	12.09	30.65	12.23
31.74	12.18	31.69	12.32	31.63	12.46	31.58	12.60
32.68	12.54	32.62	12.69	32.56	12.83	32.51	12.97
33.61	12.90	33.55	13.05	33.50	13.19	33.44	13.34
34.54	13.26	34.48	13.41	34.43	13.56	34.37	13.71
35.48	13.62	35.42	13.77	35.36	13.93	35.29	14.08
36.41	13.98	36.35	14.14	36.29	14.29	36.22	14.45
37.34	14.33	37.28	14.50	37.22	14.66	37.15	14.82
38.28	14.69	38.21	14.86	38.15	15.03	38.08	15.19
39.21	15.05	39.14	15.22	39.08	15.39	39.01	15.56
40.14	15.41	40.08	15.58	40.01	15.76	39.94	15.93
41.08	15.77	41.01	15.95	40.94	16.13	40.87	16.30
42.01	16.13	41.94	16.31	41.87	16.49	41.80	16.68
42.94	16.48	42.87	16.67	42.80	16.86	42.73	17.05
43.88	16.84	43.80	17.03	43.73	17.23	43.65	17.42
44.81	17.20	44.74	17.40	44.66	17.59	44.58	17.79
45.75	17.56	45.67	17.76	45.59	17.96	45.51	18.16
46.68	17.92	46.60	18.12	46.52	18.33	46.44	18.53
47.61	18.28	47.53	18.48	47.45	18.69	47.37	18.90
48.55	18.64	48.46	18.85	48.38	19.06	48.30	19.27
49.48	18.99	49.40	19.21	49.31	19.42	49.23	19.64
50.41	19.35	50.33	19.57	50.24	19.79	50.16	20.01
51.35	19.71	51.26	19.93	51.17	20.16	51.08	20.38
52.28	20.07	52.19	20.30	52.10	20.52	52.01	20.75
53.21	20.43	53.12	20.66	53.03	20.89	52.94	21.12
54.15	20.79	54.06	21.02	53.96	21.26	53.87	21.49
55.08	21.14	54.99	21.38	54.89	21.62	54.80	21.86
56.01	21.50	55.92	21.75	55.83	21.99	55.73	22.23
Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
0 Min.		45 Min.		30 Min.		15 Min.	

69 DEGREES

68 DEGREES

Digitized by Google

TRAVERSE TABLE.

20 DEGREES

Distance	0 Min. Lat.	0 Min. Dep.	15 Min. Lat.	15 Min. Dep.	30 Min. Lat.	30 Min. Dep.	45 Min. Lat.	45 Min. Dep.
61	57.32	20.86	57.23	21.11	57.14	21.36	57.04	21.61
62	58.26	21.21	58.17	21.46	58.07	21.71	57.98	21.97
63	59.20	21.55	59.11	21.81	59.01	22.06	58.91	22.32
64	60.14	21.89	60.04	22.15	59.95	22.41	59.85	22.67
65	61.08	22.23	60.98	22.50	60.88	22.76	60.78	23.03
66	62.02	22.57	61.92	22.84	61.82	23.11	61.72	23.38
67	62.96	22.92	62.86	23.19	62.76	23.46	62.65	23 74
68	63.90	23.26	63.80	23.54	63.69	23.81	63.59	24.09
69	64.84	23.60	64.74	23.88	64.63	24.16	64.52	24.45
70	65.78	23.94	65.67	24.23	65.57	24.51	65.46	24.80
71	66.72	24.28	66.61	24.57	66.50	24.86	66.39	25.15
72	67.66	24.63	67.55	24.92	67.44	25.21	67.33	25.51
73	68.60	24.97	68.49	25.27	68.38	25 57	68.26	25.86
74	69.54	25.31	69.43	25.61	69.31	25.92	69.20	26.22
75	70.48	25.65	70.36	25.96	70.25	26.27	70.14	26.57
76	71.42	25.99	71.30	26.30	71.19	26.62	71.07	26.93
77	72.36	26.34	72.24	26.65	72.12	26.97	72.01	27.28
78	73.30	26.68	73.18	27.00	73.06	27.32	72.94	27.63
79	74.24	27.02	74.12	27.34	74.00	27.67	73.88	27.99
80	75.18	27.36	75.06	27.69	74.93	28.02	74.81	28.34
81	76.12	27.70	75.99	28.04	75.87	28.37	75.75	28.70
82	77.05	28.05	76.93	28.38	76.81	28.72	76.68	29.05
83	77.99	28.39	77.87	28.73	77.74	29.07	77.62	29.41
84	78.93	28.73	78.81	29.07	78.68	29.42	78.55	29.76
85	79.87	29.07	79.75	29.42	79.62	29.77	79.49	30.11
86	80.81	29.41	80.68	29.77	80.55	30.12	80.42	30.47
87	81.75	29.76	81 62	30.11	81.49	30.47	81.36	30.82
88	82.69	30.10	82.56	30.46	82.43	30.82	82.29	31.18
89	83.63	30.44	83.50	30.80	83.36	31.17	83.23	31.53
90	84.57	30.78	84.44	31.15	84.30	31.52	84.16	31.89
91	85.51	31.12	85.38	31.50	85.24	31.87	85.10	32.24
92	86.45	31.47	86.31	31.84	86.17	32.22	86.03	32.59
93	87.39	31.81	87.25	32.19	87.11	32.57	86.97	32.95
94	88.33	32.15	88.19	32.54	88.05	32.92	87.90	33.30
95	89.27	32.49	89.13	32.88	88.98	33.27	88.84	33.66
96	90.21	32.83	90.07	33.23	89.92	33.62	89.77	34.01
97	91.15	33.18	91.00	33.57	90.86	33.97	90.71	34.37
98	92.09	33.52	91.94	33.92	91.79	34.32	91.64	34.72
99	93.03	33.86	92 88	34 27	92.73	34.67	92.58	35.07
100	93.97	34.20	93.82	34.61	93.67	35.02	93 51	35.43
101	94.91	34.54	94.76	34.96	94.60	35.37	94.45	35 78
102	95.85	34.89	95.70	35.30	95.54	35.72	95.38	36.14
103	96 79	35.25	96.63	35.65	96.48	36.07	96.32	36.49
104	97.73	35.57	97.57	36.00	97.41	36.42	97.25	36.85
105	98.67	35.91	98.51	36.34	98 35	36.77	98.19	37.20
106	99.61	36.25	99.45	36.69	99.29	37.12	99.12	37.55
107	100.5	36.60	100.4	37.03	100.2	37.47	100.1	37.91
108	101.5	36.94	101.3	37.38	101.2	37.82	101 0	38.26
109	102.4	37.28	102.3	37.73	102.1	38.17	101 9	38.62
110	103.4	37.62	103.2	38.07	103.0	38.52	102.9	38.97
111	104.3	37.96	104.1	38.42	104.0	38.87	103.8	39.33
112	105.2	38.31	105.1	38.77	104.9	39.22	104.7	39.68
113	106.2	38.65	106.0	39.11	105.8	39.57	105.7	40.03
114	107.1	38.99	107.0	39.46	106.8	39.92	106.6	40.39
115	108.1	39.33	107.9	39.80	107.7	40.27	107.5	40.74
116	109.0	39.67	108.8	40.15	108.7	40.62	108.5	41.10
117	109.9	40.02	109.8	40.50	109.6	40.97	109.4	41.45
118	110.9	40.36	110.7	40.84	110.5	41.32	110.3	41.81
119	111.8	40.70	111.6	41.19	111.5	41.67	111.3	42.16
120	112.8	41.04	112.6	41.53	112.4	42.02	112.2	42.52

Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
0 Min.		45 Min.		30 Min.		15 Min.	

70DEG.

21 DEGREES

0 Min. Lat.	0 Min. Dep.	15 Min. Lat.	15 Min. Dep.	30 Min. Lat.	30 Min. Dep.	45 Min. Lat.	45 Min. Dep.
56.95	21.86	56.85	22.11	56.76	22.36	56.66	22.60
57.88	22.22	57.78	22.47	57.69	22.72	57.59	22.97
58.82	22.58	58.72	22.83	58.62	23.09	58.52	23.35
59.75	22.94	59.65	23.20	59.55	23.46	59.44	23.72
60.68	23.29	60.58	23.56	60.48	23.82	60.37	24.09
61.62	23.65	61.51	23.92	61.41	24.19	61.30	24.46
62.55	24.01	62.44	24.28	62.34	24.56	62.23	24.83
63.48	24.37	63.38	24.65	63.27	24.92	63.16	25.20
64.42	24.73	64.31	25.01	64.20	25.29	64.09	25.57
65.35	25.09	65.24	25.37	65.13	25.66	65.02	25.94
66.28	25.44	66.17	25.73	66.06	26.02	65.95	26.31
67.22	25.80	67.10	26.10	66.99	26.39	66.87	26.68
68.15	26.16	68.04	26.46	67.92	26.75	67.80	27.05
69.08	26.52	68.97	26.82	68.85	27.12	68.73	27.42
70.02	26.88	69.90	27.18	69.78	27.49	69.66	27.79
70.95	27.24	70.83	27.55	70.71	27.85	70.59	28.16
71.89	27.59	71.76	27.91	71.64	28.22	71.52	28.53
72.82	27.95	72.70	28.27	72.57	28.59	72.45	28.90
73.75	28.31	73.63	28.63	73.50	28.95	73.38	29.27
74.69	28.67	74.56	29.00	74.43	29.32	74.30	29.64
75.62	29.03	75.49	29.36	75.36	29.69	75.23	30.02
76.55	29.39	76.42	29.72	76.29	30.05	76.16	30.39
77 49	29.74	77.36	30.08	77.22	30.42	77.09	30.76
78 42	30.10	78.29	30.44	78.16	30.79	78.02	31.13
79.35	30.46	79.22	30.81	79.09	31.15	78.95	31.50
80.29	30.82	80.15	31.17	80.02	31.52	79.88	31.87
81.22	31.18	81.08	31.53	80.95	31.89	80.81	32.24
82.16	31.54	82 02	31.89	81.88	32.25	81.74	32.61
83.09	31.89	82.95	32.26	82.81	32.62	82.66	32.98
84.02	32.25	83.88	32.62	83.74	32.99	83.59	33.35
84.96	32.61	84.91	32.98	84.67	33.35	84.52	33.72
85.89	32.97	85.74	33.34	85.60	33.72	85.45	34.09
86.82	33.33	86.68	33.71	86.53	34.08	86.38	34.46
87.76	33.69	87.61	34.07	87.46	34.45	87.31	34.83
88.69	34.04	88.54	34.43	88.39	34.82	88.24	35.20
89.62	34.40	89.47	34.79	89.32	35.18	89.17	35.57
90.56	34.76	90.40	35.16	90.25	35.55	90.09	35.94
91.49	35.12	91.34	35.52	91.18	35.92	91.02	36.31
92.43	35.48	92.27	35 88	92.11	36.28	91.95	36.69
93.36	35.84	93.20	36.24	93.04	36.65	92.88	37.06
94.29	36.20	94.13	36.61	93.97	37.02	93.81	37.43
95.23	36.55	95.06	36.97	94.90	37.38	94.74	37.80
96.16	36.91	96.00	37.33	95.83	37.75	95.67	38.17
97.09	37.27	96.93	37.69	96.76	38.12	96.60	38.54
98.03	37.63	97.86	38.06	97.69	38.48	97.55	38.91
98.96	37.99	98.79	38.42	98.62	38.85	98.45	39.28
99.89	38.35	99.72	38.78	99.55	39.22	99.38	39.65
100.8	38.70	100.7	39.14	100.5	39.58	100.3	40.02
101.8	39.06	101.6	39.51	101.4	39.95	101.2	40.39
102.7	39.42	102.5	39.87	102.3	40.32	102.2	40.76
103.6	39.78	103.5	40.23	103.3	40.68	103.1	41.13
104.6	40.14	104.4	40.59	104.2	41.05	104.0	41.50
105.5	40.50	105.3	40.96	105.1	41.41	105.0	41.87
106.4	40.85	106.2	41.32	106.1	41.78	105.9	42.24
107.4	41.21	107.2	41.68	107.0	42.15	106.8	42.61
108.3	41.57	108.1	42.04	107.9	42.51	107.7	42.98
109.2	41.93	109.0	42.41	108.9	42.88	108.7	43.36
110.2	42.29	110.0	42.77	109.8	43.25	109.6	43.73
111.1	42.65	110.9	43.13	110.7	43.61	110.5	44.10
112.0	43.00	111.8	43.49	111.7	43.98	111.5	44.47

Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
45 Min.		30 Min.		15 Min.	

68 DEGREES

Digitized by Google

TRAVERSE TABLE.

Distance	22 DEGREES								23 DEGREES							
	0 Min.		15 Min.		30 Min.		45 Min.		0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
1	0.93	0.37	0.93	0.38	0.92	0.38	0.92	0.39	0.92	0.39	0.92	0.39	0.92	0.40	0.92	0.40
2	1.85	0.73	1.85	0.76	1.85	0.77	1.84	0.77	1.84	0.78	1.84	0.79	1.83	0.80	1.83	0.81
3	2.78	1.10	2.78	1.14	2.77	1.15	2.77	1.16	2.76	1.17	2.76	1.18	2.75	1.20	2.75	1.21
4	3.71	1.50	3.70	1.51	3.70	1.53	3.69	1.55	3.68	1.56	3.68	1.58	3.67	1.60	3.66	1.61
5	4.64	1.87	4.63	1.89	4.62	1.91	4.61	1.93	4.60	1.95	4.59	1.97	4.59	1.99	4.58	2.01
6	5.56	2.25	5.55	2.27	5.54	2.30	5.53	2.32	5.52	2.34	5.51	2.37	5.50	2.39	5.49	2.42
7	6.49	2.62	6.48	2.65	6.47	2.68	6.46	2.71	6.44	2.74	6.43	2.76	6.42	2.79	6.41	2.82
8	7.42	3.00	7.40	3.03	7.39	3.06	7.38	3.09	7.36	3.13	7.35	3.16	7.34	3.19	7.32	3.22
9	8.34	3.37	8.33	3.41	8.31	3.44	8.30	3.48	8.28	3.52	8.27	3.55	8.25	3.59	8.24	3.62
10	9.27	3.75	9.26	3.79	9.24	3.83	9.22	3.87	9.21	3.91	9.19	3.95	9.17	3.99	9.15	4.03
11	10.20	4.12	10.18	4.17	10.16	4.21	10.14	4.25	10.13	4.30	10.11	4.34	10.09	4.39	10.07	4.43
12	11.13	4.50	11.11	4.54	11.09	4.59	11.07	4.64	11.05	4.69	11.03	4.74	11.00	4.79	10.98	4.83
13	12.05	4.87	12.03	4.92	12.01	4.97	11.99	5.03	11.97	5.08	11.94	5.13	11.92	5.18	11.90	5.24
14	12.98	5.25	12.96	5.30	12.93	5.36	12.91	5.41	12.89	5.47	12.86	5.53	12.84	5.58	12.81	5.64
15	13.91	5.62	13.88	5.68	13.86	5.74	13.83	5.80	13.81	5.86	13.78	5.92	13.76	5.98	13.73	6.04
16	14.83	5.99	14.81	6.06	14.78	6.12	14.76	6.19	14.73	6.25	14.70	6.32	14.67	6.38	14.65	6.44
17	15.76	6.37	15.73	6.44	15.71	6.51	15.68	6.57	15.65	6.64	15.62	6.71	15.59	6.78	15.56	6.85
18	16.69	6.74	16.66	6.82	16.63	6.89	16.60	6.96	16.57	7.03	16.54	7.11	16.51	7.18	16.48	7.25
19	17.62	7.12	17.59	7.19	17.55	7.27	17.52	7.35	17.49	7.42	17.46	7.50	17.42	7.58	17.39	7.65
20	18.54	7.49	18.51	7.57	18.48	7.65	18.44	7.73	18.41	7.81	18.38	7.89	18.34	7.98	18.31	8.05
21	19.47	7.87	19.44	7.95	19.40	8.04	19.37	8.12	19.33	8.21	19.29	8.29	19.26	8.37	19.22	8.46
22	20.40	8.24	20.36	8.35	20.33	8.42	20.29	8.51	20.25	8.60	20.21	8.68	20.18	8.77	20.14	8.86
23	21.33	8.62	21.29	8.71	21.25	8.80	21.21	8.89	21.17	8.99	21.13	9.08	21.09	9.17	21.05	9.26
24	22.25	8.99	22.21	9.09	22.17	9.18	22.13	9.28	22.09	9.38	22.05	9.47	22.01	9.57	21.97	9.67
25	23.18	9.37	23.14	9.47	23.10	9.57	23.06	9.67	23.01	9.77	22.97	9.87	22.93	9.97	22.88	10.07
26	24.11	9.74	24.06	9.84	24.02	9.95	23.98	10.05	23.93	10.16	23.89	10.26	23.84	10.37	23.80	10.47
27	25.03	10.11	24.99	10.22	24.94	10.33	24.90	10.44	24.85	10.55	24.81	10.66	24.76	10.77	24.71	10.87
28	25.96	10.49	25.92	10.60	25.87	10.72	25.82	10.83	25.77	10.94	25.73	11.05	25.68	11.16	25.63	11.28
29	26.89	10.86	26.84	10.98	26.79	11.10	26.74	11.21	26.69	11.33	26.64	11.45	26.59	11.56	26.54	11.68
30	27.82	11.24	27.77	11.36	27.72	11.48	27.67	11.60	27.62	11.72	27.56	11.84	27.51	11.96	27.46	12.08
31	28.74	11.61	28.69	11.74	28.64	11.86	28.59	11.99	28.54	12.11	28.48	12.24	28.43	12.36	28.37	12.49
32	29.67	11.99	29.62	12.12	29.56	12.25	29.51	12.37	29.46	12.50	29.40	12.63	29.35	12.76	29.29	12.89
33	30.60	12.36	30.54	12.50	30.49	12.63	30.43	12.76	30.38	12.89	30.32	13.03	30.26	13.16	30.21	13.29
34	31.52	12.74	31.47	12.87	31.41	13.01	31.35	13.15	31.30	13.28	31.24	13.42	31.18	13.56	31.12	13.69
35	32.45	13.11	32.39	13.25	32.34	13.39	32.28	13.53	32.22	13.68	32.16	13.82	32.10	13.96	32.04	14.10
36	33.38	13.48	33.32	13.63	33.26	13.78	33.20	13.92	33.14	14.07	33.08	14.21	33.01	14.36	32.95	14.50
37	34.31	13.86	34.25	14.01	34.18	14.16	34.12	14.31	34.06	14.46	34.00	14.61	33.93	14.75	33.87	14.90
38	35.23	14.23	35.17	14.39	35.11	14.54	35.04	14.69	34.98	14.85	34.91	15.00	34.85	15.15	34.78	15.30
39	36.16	14.61	36.10	14.77	36.03	14.92	35.97	15.08	35.90	15.24	35.83	15.40	35.77	15.55	35.70	15.71
40	37.09	14.98	37.02	15.15	36.96	15.31	36.89	15.47	36.82	15.63	36.75	15.79	36.68	15.95	36.61	16.11
41	38.01	15.36	37.95	15.52	37.88	15.68	37.81	15.86	37.74	16.02	37.67	16.18	37.60	16.35	37.53	16.51
42	38.94	15.73	38.87	15.90	38.80	16.07	38.73	16.24	38.66	16.41	38.59	16.58	38.52	16.75	38.44	16.92
43	39.87	16.11	39.80	16.28	39.73	16.46	39.65	16.63	39.58	16.80	39.51	16.97	39.43	17.15	39.36	17.32
44	40.80	16.48	40.72	16.66	40.65	16.84	40.58	17.02	40.50	17.19	40.43	17.37	40.35	17.54	40.27	17.72
45	41.72	16.86	41.65	17.04	41.57	17.22	41.50	17.40	41.42	17.58	41.35	17.76	41.27	17.94	41.19	18.12
46	42.65	17.23	42.57	17.42	42.50	17.60	42.42	17.79	42.34	17.97	42.26	18.16	42.18	18.34	42.10	18.53
47	43.58	17.61	43.50	17.80	43.42	17.99	43.34	18.18	43.26	18.36	43.18	18.55	43.10	18.74	43.02	18.93
48	44.50	17.98	44.43	18.18	44.35	18.37	44.27	18.56	44.18	18.76	44.10	18.95	44.02	19.14	43.93	19.33
49	45.43	18.36	45.35	18.55	45.27	18.75	45.19	18.95	45.10	19.15	45.02	19.34	44.94	19.54	44.85	19.73
50	46.36	18.73	46.28	18.93	46.19	19.13	46.11	19.34	46.03	19.54	45.94	19.74	45.85	19.94	45.77	20.14
51	47.29	19.10	47.20	19.31	47.12	19.52	47.03	19.72	46.95	19.93	46.86	20.13	46.77	20.34	46.68	20.54
52	48.21	19.48	48.13	19.69	48.04	19.90	47.95	20.11	47.87	20.32	47.78	20.53	47.69	20.74	47.60	20.94
53	49.14	19.85	49.05	20.07	48.97	20.28	48.88	20.50	48.79	20.71	48.70	20.92	48.60	21.13	48.51	21.35
54	50.07	20.23	49.98	20.45	49.89	20.66	49.80	20.88	49.71	21.10	49.61	21.32	49.52	21.53	49.43	21.75
55	51.00	20.60	50.90	20.83	50.81	21.05	50.72	21.27	50.63	21.49	50.53	21.71	50.44	21.93	50.34	22.15
56	51.92	20.98	51.83	21.20	51.74	21.43	51.64	21.66	51.55	21.88	51.45	22.11	51.36	22.33	51.26	22.55
57	52.85	21.35	52.76	21.58	52.66	21.81	52.57	22.04	52.47	22.27	52.37	22.50	52.27	22.73	52.17	22.96
58	53.78	21.73	53.68	21.96	53.58	22.20	53.49	22.43	53.39	22.66	53.29	22.90	53.19	23.13	53.09	23.36
59	54.70	22.10	54.61	22.34	54.51	22.58	54.41	22.82	54.31	23.05	54.21	23.29	54.11	23.53	54.00	23.76
60	55.63	22.48	55.53	22.72	55.43	22.96	55.33	23.20	55.23	23.44	55.13	23.68	55.02	23.93	54.92	24.16
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.		0 Min.		45 Min.		30 Min.		15 Min.	
	68 DEG				67 DEGREES								66 DEGREES			

Digitized by Google

22 DEGREES

Dist.	0 Min. Lat.	0 Min. Dep.	15 Min. Lat.	15 Min. Dep.	30 Min. Lat.	30 Min. Dep.	45 Min. Lat.	45 Min. Dep.
61	56.56	22.85	56.46	23.10	56.36	23.34	56.25	23.59
62	57.49	23.23	57.38	23.48	57.28	23.73	57.18	23.98
63	58.41	23.60	58.31	23.85	58.20	24.11	58.10	24.36
64	59.34	23.97	59.23	24.23	59.13	24.49	59.02	24.75
65	60.27	24.35	60.16	24.61	60.05	24.87	59.94	25.14
66	61.19	24 72	61.09	24.99	60.98	25.26	60.87	25.52
67	62.12	25.10	62.01	25.37	61.90	25.64	61.79	25.91
68	63.05	25.47	62.94	25.75	62.82	26.02	62.71	26.30
69	63.98	25.85	63.86	26.13	63.75	26.41	63.63	26.68
70	64.90	26 22	64.79	26.51	64.67	26.79	64.55	27.07
71	65.83	26.60	65.71	26.88	65.60	27.17	65.48	27.46
72	66-76	26.97	66.64	27.26	66.52	27.55	66.40	27.84
73	67.68	27.35	67.56	27.64	67.44	27.94	67.32	28.23
74	68.61	27.72	68.49	28.02	68.37	28.32	68.24	28.62
75	69.54	28.10	69.42	28.40	69.29	28.70	69.17	29.00
76	70.47	28.47	70.34	28.78	70.21	29.08	70.09	29.39
77	71 39	28.84	71.27	29.16	71.14	29.47	71.01	29.78
78	72.32	29.22	72.19	29.53	72-06	29.85	71.93	30.16
79	73.25	29.59	73.12	29.91	72-99	30.23	72.85	30.55
80	74.17	29.97	74.04	30.29	73-91	30.61	73.78	30.94
81	75.10	30.34	74.97	30.67	74.83	31.00	74.70	31.32
82	76.03	30.72	75.89	31-05	75-76	31-38	75.62	31.71
83	76.96	31.09	76.82	31.43	76-68	31.76	76.54	32-10
84	77.88	31.47	77.75	31.81	77.61	32-15	77.46	32.48
85	78.81	31.84	78.67	32.19	78.53	32.53	78.39	32.87
86	79.74	32.22	79.60	32.56	79.45	32.91	79.31	33.26
87	80.66	32.59	80.52	32.94	80.38	33.29	80.23	33.64
88	81.59	32.97	81.45	33.32	81-30	33.68	81-15	34 03
89	82.52	33-34	82.37	33.70	82-23	34-06	82.08	34 42
90	83.45	33.71	83.30	34.08	83.15	34.44	83.00	34.80
91	84.37	34-09	84.22	34.46	84.07	34-82	83.92	35 19
92	85.30	34.46	85.15	34.84	85-00	35-21	84.84	35-58
93	86.23	34.84	86.08	35-21	85-92	35-59	85.76	35-96
94	87.16	35.21	87.00	35.59	86.84	35.97	86.69	36-35
95	88.08	35.59	87.93	35.97	87.77	36.35	87.61	36-74
96	89.01	35.96	88.85	36.35	88.69	36.74	88.53	37.12
97	89.94	36.34	89.78	36.73	89.62	37.12	89.45	37.51
98	90.86	36.71	90.70	37.11	90.54	37.50	90.38	37.90
99	91.79	37.09	91.63	37.49	91-46	37.89	91.30	38.28
00	92.72	37.46	92.55	37.86	92.39	38.27	92.22	38.67
01	93.65	37.84	93.48	38.24	93.31	38.65	93.14	39.06
02	94.57	38.21	94.41	38.62	94.24	39.03	94.06	39.44
03	95.50	38.58	95.33	39.00	95.16	39.42	94.99	39.83
04	96.43	38.96	96.26	39.38	96.08	39.80	95.91	40.22
05	97.35	39.33	97.18	39.76	97.01	40.18	96.83	40.60
06	98.28	39.71	98.11	40.14	97.93	40.56	97.75	40.99
07	99.21	40.08	99.03	40.52	98.86	40.95	98.68	41.38
08	100.1	40.46	99.96	40.89	99.78	41.33	99.60	41.76
09	101.1	40.83	100.9	41.27	100.7	41.71	100.5	42.15
10	102.0	41.21	101.8	41.65	101 6	42.10	101.4	42.54
11	102.9	41.58	102.7	42.03	102.6	42.48	102.4	42.92
12	103.3	41.96	103.7	42.41	103.5	42.86	103-3	43.31
13	104.8	42.33	104.6	42.79	104.4	43.24	104-2	43.70
14	105.7	42.71	105.5	43.17	105.3	43.63	105.1	44.09
15	106.6	43.08	106.4	43.54	106.2	44.01	106.1	44.47
16	107.6	43.45	107.4	43.92	107.2	44.39	107.0	44.86
17	108.5	43.83	108.3	44.30	108 1	44.77	107.9	45.25
18	109.4	44.20	109.2	44.68	109.0	45.16	108.8	45.63
19	110.3	44.58	110.1	45.06	109.9	45.54	109.7	46.02
20	111.3	44.95	111.1	45.44	110.9	45.92	110.7	46.41
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.	

68 DEG. 67 DEGREES

23 DEGREES

0 Min. Lat.	0 Min. Dep.	15 Min. Lat.	15 Min. Dep.	30 Min. Lat.	30 Min. Dep.	45 Min. Lat.	45 Min. Dep.
56.15	23.83	56.05	24.08	55.94	24.32	55.83	24.57
57.07	24.23	56.97	24.47	56.86	24.72	56.75	24.97
57.99	24.62	57.88	24.87	57.77	25.12	57.66	25.37
58.91	25.01	58.80	25.26	58.69	25.52	58.58	25.78
59.83	25.40	59.72	25.66	59.61	25.92	59.50	26.18
60.75	25.79	60.64	26.05	60.53	26.32	60.41	26.58
61.67	26.18	61.56	26.45	61.44	26.72	61.33	26.98
62.59	26.57	62.48	26.84	62.36	27.11	62.24	27.39
63.51	26.96	63.40	27.24	63.28	27.51	63.16	27.79
64.44	27.35	64.32	27.63	64.19	27.91	64.07	28.19
65.36	27.74	65.23	28.03	65.11	28.31	64.99	28.60
66-28	28.13	66.15	28.42	66.03	28.71	65.90	29.00
67.20	28.52	67.07	28.82	66.95	29.11	66.82	29.40
68-12	28.91	67.99	29.21	67-86	29.51	67.73	29.80
69.04	29.30	68.91	29.61	68-78	29.91	68.65	30.21
69.96	29.70	69.83	30.00	69.70	30.30	69.56	30.61
70.88	30.09	70.75	30.40	70.61	30.70	70.48	31.01
71.80	30.48	71.67	30.79	71.53	31.10	71.39	31.41
72.72	30.87	72.58	31.18	72.45	31.50	72.31	31.82
73.64	31.26	73.50	31.58	73.36	31.90	73.22	32.22
74.56	31.65	74.42	31.97	74.28	32.30	74.14	32.62
75.48	32.04	75.34	32.37	75.20	32.70	75-06	33-03
76.40	32.43	76.26	32.76	76.12	33-10	75-97	33-43
77.32	32.82	77.18	33.16	77.03	33.49	76.89	33-83
78.24	33.21	78.10	33.55	77.95	33.89	77.80	34.23
79.16	33.60	79.02	33.95	78.87	34.29	78.72	34.64
80.08	33.99	79.93	34.34	79.78	34.69	79.63	35.04
81.00	34.38	80.85	34.74	80.70	35.09	80.55	35.44
81.92	34.78	81.77	35.13	81.62	35.49	81.46	35.84
82.85	35.17	82.69	35.53	82.54	35.89	82.38	36.25
83.77	35.56	83.61	35.92	83.45	36.29	83.29	36.65
84.69	35.95	84.53	36.32	84.37	36.68	84.21	37.05
85.61	36.34	85.45	36.71	85.29	37.08	85.12	37.46
86.53	36.73	86.37	37.11	86.20	37.48	86.04	37.86
87.45	37.12	87.29	37.50	87.12	37.88	86.95	38.26
88.37	37.51	88.20	37.90	88.04	38.28	87.87	38.66
89.29	37.90	89.12	38.29	88.95	38.68	88.79	39.07
90.21	38.29	90.04	38.68	89.87	39.08	89.70	39.47
91.13	38.68	90.96	39.08	90.79	39.48	90.62	39.87
92.05	39.07	91.88	39.47	91.71	39.87	91.53	40.27
92.97	39.46	92.80	39.87	92.62	40.27	92.45	40.68
93.89	39.85	93.72	40.26	93.54	40.67	93.36	41.08
94.81	40.25	94.64	40.66	94.46	41.07	94.28	41.48
95.73	40.64	95.55	41.05	95.37	41.47	95.19	41.89
96.65	41.03	96.47	41.45	96.29	41.87	96.11	42.29
97.57	41.42	97.39	41.84	97.21	42.27	97.02	42.69
98.49	41.81	98.31	42.24	98.13	42.67	97.94	43.09
99.41	42.20	99.23	42.63	99.04	43.07	98.85	43.50
100.3	42.59	100.1	43.03	99.96	43.46	99.77	43.90
101.3	42.98	101.1	43.42	100.9	43.86	100.7	44.30
102.2	43.37	102.0	43.82	101.8	44.26	101.6	44.70
103.1	43.76	102.9	44.21	102.7	44.66	102.5	45.11
104.0	44.15	103.8	44.61	103.6	45.06	103.4	45.51
104.9	44.54	104.7	45.00	104.5	45.46	104.3	45.91
105.9	44.93	105.7	45.40	105.5	45.86	105.3	46.32
106.8	45.32	106.6	45.79	106.4	46.25	106.2	46.72
107.7	45.72	107.5	46.19	107.3	46.65	107.1	47.12
108.6	46.11	108.4	46.58	108.2	47.05	108.0	47.52
109.5	46.50	109.3	46.97	109.1	47.45	108.9	47.93
110.5	46.89	110.3	47.37	110.0	47.85	109.8	48.33
Dep.	Lat.	Dep.	Lat.	Dep.	Lat	Dep.	Lat.
0 Min.		45 Min.		30 Min.		15 Min.	

66 DEGREES

Digitized by Google

TRAVERSE TABLE.

24 DEGREES

Distance	0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
1	0.91	0.41	0.91	0.41	0.91	0.41	0.91	0.42
2	1.82	0.81	1.82	0.82	1.82	0.83	1.82	0.84
3	2.74	1.22	2.74	1.23	2.73	1.24	2.72	1.26
4	3.65	1.63	3.65	1.64	3.64	1.66	3.63	1.67
5	4.57	2.03	4.56	2.05	4.55	2.07	4.54	2.09
6	5.48	2.44	5.47	2.46	5.46	2.49	5.45	2.51
7	6.39	2.85	6.38	2.88	6.37	2.90	6.36	2.93
8	7.31	3.25	7.29	3.29	7.28	3.32	7.27	3.35
9	8.22	3.66	8.21	3.70	8.19	3.73	8.17	3.77
10	9.14	4.07	9.12	4.11	9.10	4.15	9.08	4.19
11	10.05	4.47	10.03	4.52	10.01	4.56	9.99	4.61
12	10.96	4.88	10.94	4.93	10.92	4.98	10.90	5.02
13	11.88	5.29	11.85	5.34	11.83	5.39	11.81	5.44
14	12.79	5.69	12.76	5.75	12.74	5.81	12.71	5.86
15	13.70	6.10	13.68	6.16	13.65	6.22	13.62	6.28
16	14.62	6.51	14.59	6.57	14.56	6.64	14.53	6.70
17	15.53	6.91	15.50	6.98	15.47	7.05	15.44	7.12
18	16.44	7.32	16.41	7.39	16.38	7.46	16.35	7.54
19	17.36	7.73	17.32	7.80	17.29	7.88	17.25	7.95
20	18.27	8.13	18.24	8.21	18.20	8.29	18.16	8.37
21	19.18	8.54	19.15	8.62	19.11	8.71	19.07	8.79
22	20.10	8.95	20.06	9.04	20.02	9.12	19.98	9.21
23	21.01	9.35	20.97	9.45	20.93	9.54	20.89	9.65
24	21.95	9.76	21.88	9.86	21.84	9.95	21.80	10.05
25	22.84	10.17	22.79	10.27	22.75	10.37	22.70	10.47
26	23.75	10.58	23.71	10.68	23.66	10.78	23.61	10.89
27	24.67	10.98	24.62	11.09	24.57	11.20	24.52	11.30
28	25.58	11.39	25.53	11.50	25.48	11.61	25.43	11.72
29	26.49	11.80	26.44	11.91	26.39	12.03	26.34	12.14
30	27.41	12.20	27.35	12.32	27.30	12.44	27.24	12.56
31	28.32	12.51	28.26	12.73	28.21	12.86	28.15	12.98
32	29.23	13.02	29.18	13.14	29.12	13.27	29.06	13.40
33	30.15	13.42	30.09	13.55	30.03	13.68	29.97	13.82
34	31.06	13.83	31.00	13.96	30.94	14.10	30.88	14.23
35	31.97	14.24	31.91	14.38	31.85	14.51	31.78	14.65
36	32.89	14.64	32.83	14.79	32.76	14.93	32.69	15.07
37	33.80	15.05	33.74	15.20	33.67	15.34	33.60	15.49
38	34.71	15.46	34.65	15.61	34.58	15.76	34.51	15.91
39	35.63	15.86	35.56	16.02	35.49	16.17	35.42	16.33
40	36.54	16.27	36.47	16.43	36.40	16.59	36.33	16.75
41	37.46	16.68	37.38	16.84	37.31	17.00	37.23	17.17
42	38.37	17.08	38.29	17.25	38.22	17.42	38.14	17.58
43	39.28	17.49	39.21	17.66	39.13	17.83	39.05	18.00
44	40.20	17.90	40.12	18.07	40.04	18.25	39.96	18.42
45	41.11	18.30	41.03	18.48	40.95	18.66	40.87	18.84
46	42.02	18.71	41.94	18.89	41.86	19.08	41.77	19.26
47	42.93	19.12	42.85	19.30	42.77	19.49	42.68	19.68
48	43.85	19.52	43.76	19.71	43.68	19.91	43.59	20.10
49	44.76	19.93	44.68	20.13	44.59	20.32	44.50	20.51
50	45.68	20.34	45.59	20.54	45.50	20.73	45.41	20.93
51	46.59	20.74	46.50	20.95	46.41	21.15	46.32	21.35
52	47.50	21.15	47.41	21.36	47.32	21.56	47.22	21.77
53	48.42	21.56	48.32	21.77	48.23	21.98	48.13	22.19
54	49.33	21.96	49.24	22.18	49.14	22.39	49.04	22.61
55	50.25	22.37	50.15	22.59	50.05	22.81	49.95	23.03
56	51.16	22.78	51.06	23.00	50.96	23.22	50.86	23.44
57	52.07	23.18	51.97	23.41	51.87	23.64	51.76	23.86
58	52.99	23.59	52.88	23.82	52.78	24.05	52.67	24.28
59	53.90	24.00	53.79	24.23	53.69	24.47	53.58	24.70
60	54.81	24.40	54.71	24.64	54.60	24.88	54.49	25.12
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.	

25 DEGREES

	0 Min.		15 Min		30 Min.		45 Mi	
	Lat.	Dep.	Lat.	Dep.	Lat	Dep.	Lat.	D
1	0.91	0.42	0.90	0.43	0.90	0.43	0.90	0.
2	1.81	0.85	1.81	0.85	1.81	0.86	1.80	0.
3	2.72	1.27	2.71	1.28	2.71	1.29	2.70	1.
4	3.63	1.69	3.62	1.71	3.61	1.72	3.60	1.
5	4.53	2.11	4.52	2.13	4.51	2.15	4.50	2.
6	5.44	2.54	5.43	2.56	5.42	2.58	5.40	2.
7	6.34	2.96	6.33	2.99	6.32	3.01	6.30	3.
8	7.25	3.38	7.24	3.41	7.22	3.44	7.21	3.
9	8.16	3.80	8.14	3.84	8.12	3.87	8.11	3.
10	9.06	4.23	9.04	4.27	9.03	4.31	9.01	4.
11	9.97	4.65	9.95	4.69	9.93	4.74	9.91	4.
12	10.88	5.07	10.85	5.12	10.83	5.17	10.81	5.
13	11.78	5.49	11.76	5.55	11.73	5.60	11.71	5.
14	12.69	5.92	12.66	5.97	12.64	6.03	12.61	6.
15	13.59	6.34	13.57	6.40	13.54	6.46	13.51	6.
16	14.50	6.76	14.47	6.83	14.44	6.89	14.41	6.
17	15.41	7.18	15.38	7.25	15.34	7.32	15.31	7.
18	16.31	7.61	16.28	7.68	16.25	7.75	16.21	7.
19	17.22	8.03	17.18	8.10	17.15	8.18	17.11	8.
20	18.13	8.45	18.09	8.53	18.05	8.61	18.01	8.
21	19.03	8.88	18.99	8.96	18.95	9.04	18.91	9.
22	19.94	9.30	19.90	9.38	19.86	9.47	19.82	9.
23	20.85	9.72	20.80	9.81	20.76	9.90	20.72	9.
24	21.75	10.14	21.71	10.24	21.66	10.33	21.62	10.
25	22.66	10.57	22.61	10.66	22.56	10.76	22.52	10.
26	23.56	10.99	23.52	11.09	23.47	11.19	23.42	11.
27	24.47	11.41	24.42	11.52	24.37	11.62	24.32	11.
28	25.38	11.83	25.32	11.94	25.27	12.05	25.22	12.
29	26.28	12.26	26.23	12.37	26.18	12.48	26.12	12.
30	27.19	12.68	27.13	12.80	27.08	12.92	27.02	13.
31	28.10	13.10	28.04	13.22	27.98	13.35	27.92	13.
32	29.00	13.52	28.94	13.65	28.88	13.78	28.82	13.
33	29.91	13.95	29.85	14.08	29.79	14.21	29.72	14.
34	30.81	14.37	30.75	14.50	30.69	14.64	30.62	14.
35	31.72	14.79	31.66	14.93	31.59	15.07	31.52	15.
36	32.63	15.21	32.56	15.36	32.49	15.50	32.43	15.
37	33.53	15.64	33.46	15.78	33.40	15.93	33.33	16.
38	34.44	16.06	34.37	16.21	34.30	16.36	34.23	16.
39	35.35	16.48	35.27	16.64	35.20	16.79	35.13	16.
40	36.25	16.90	36.18	17.06	36.10	17.22	36.03	17.
41	37.16	17.33	37.08	17.49	37.01	17.65	36.93	17.
42	38.06	17.75	37.99	17.92	37.91	18.08	37.85	18.
43	38.97	18.17	38.89	18.34	38.81	18.51	38.73	18.
44	39.88	18.60	39.80	18.77	39.71	18.94	39.63	19.
45	40.78	19.02	40.70	19.20	40.62	19.37	40.53	19.
46	41.69	19.44	41.60	19.62	41.52	19.80	41.43	19.
47	42.60	19.86	42.51	20.05	42.42	20.23	42.33	20.
48	43.50	20.29	43.41	20.48	43.32	20.66	43.23	20.
49	44.41	20.71	44.32	20.90	44.23	21.10	44.15	21.
50	45.32	21.13	45.22	21.33	45.13	21.53	45.03	21.
51	46.22	21.55	46.13	21.76	46.03	21.96	45.94	22.
52	47.13	21.98	47.03	22.18	46.93	22.39	46.84	22.
53	48.03	22.40	47.94	22.61	47.84	22.82	47.74	23.
54	48.94	22.82	48.84	23.03	48.74	23.25	48.64	23.
55	49.85	23.24	49.74	23.46	49.64	23.68	49.54	23.
56	50.75	23.67	50.65	23.89	50.54	24.11	50.44	24.
57	51.66	24.09	51.55	24.31	51.45	24.54	51.34	24.
58	52.57	24.51	52.46	24.74	52.35	24.97	52.24	25.
59	53.47	24.93	53.36	25.17	53.25	25.40	53.14	25.
60	54.38	25.36	54.27	25.59	54.16	25.83	54.04	26.
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	La
	45 Min.		30 Min.		15 Min.			

Digitized by Google

TRAVERSE TABLE.

24 DEGREES

0 Min.		15 Min.		30 Min.		45 Min.	
Lat.	Dep.	Lat.	Dep	Lat.	Dep.	Lat.	Dep.
55.73	24.81	55.62	25.05	55.51	25.30	55.40	25.54
56.64	25.22	56.53	25.46	56.42	25.71	56.30	25.96
57.55	25.62	57.44	25.88	57.35	26.13	57.21	26.38
58.47	26.03	58.35	26.29	58.24	26.54	58.12	26.79
59.38	26.44	59.26	26.70	59.15	26.96	59.03	27.21
60.29	26.84	60.18	27.11	60.06	27.37	59.94	27.63
61.21	27.25	61.09	27.52	60.97	27.78	60.85	28.05
62.12	27.66	62.00	27.93	61.88	28.20	61.75	28.47
63.03	28.06	62.91	28.34	62.79	28.61	62.66	28.89
63.95	28.47	63.82	28.75	63.70	29.03	63.57	29.31
64.86	28.88	64.74	29.16	64.61	29.44	64.48	29.72
65.78	29.29	65.65	29.57	65.52	29.86	65.39	30.14
66.69	29.69	66.56	29.98	66.43	30.27	66.29	30.56
67.60	30.10	67.47	30.39	67.34	30.69	67.20	30.98
68.52	30.51	68.38	30.80	68.25	31.10	68.11	31.40
69.43	30.91	69.29	31.21	69.16	31.52	69.02	31.82
70.34	31.32	70.21	31.63	70.07	31.93	69.93	32.24
71.26	31.73	71.12	32.04	70.98	32.35	70.84	32.66
72.17	32.13	72.03	32.45	71.89	32.76	71.74	33.07
73.08	32.54	72.94	32.86	72.80	33.18	72.65	33.49
74.00	32.95	73.85	33.27	73.71	33.59	73.56	33.91
74.91	33.35	74.76	33.68	74.62	34.00	74.47	34.33
75.82	33.76	75.68	34.09	75.53	34.42	75.38	34.75
76.74	34.17	76.58	34.50	76.44	34.83	76.28	35.17
77.65	34.57	77.50	34.91	77.35	35.25	77.19	35.59
78.56	34.98	78.41	35.32	78.26	35.66	78.10	36.00
79.48	35.39	79.32	35.73	79.17	36.08	79.01	36.42
80.39	35.79	80.24	36.14	80.08	36.49	79.92	36.84
81.30	36.20	81.15	36.55	80.99	36.91	80.82	37.26
82.22	36.61	82.06	36.96	81.90	37.32	81.73	37.68
83.13	37.01	82.97	37.38	82.81	37.74	82.64	38.10
84.05	37.42	83.88	37.79	83.72	38.15	83.55	38.52
84.96	37.83	84.79	38.20	84.63	38.57	84.46	38.94
85.87	38.23	85.71	38.61	85.54	38.98	85.37	39.35
86.79	38.64	86.62	39.02	86.45	39.40	86.27	39.77
87.70	39.05	87.53	39.43	87.36	39.81	87.18	40.19
88.61	39.45	88.44	39.84	88.27	40.23	88.09	40.61
89.53	39.86	89.35	40.25	89.18	40.64	89.00	41.03
90.44	40.27	90.26	40.66	90.09	41.05	89.91	41.45
91.35	40.67	91.18	41.07	91.00	41.47	90.81	41.87
92.27	41.08	92.09	41.48	91.91	41.88	91.72	42.28
93.18	41.49	93.00	41.89	92.82	42.30	92.63	42.70
94.10	41.89	93.91	42.30	93.73	42.71	93.54	43.12
95.01	42.30	94.82	42.71	94.64	43.13	94.45	43.54
95.92	42.71	95.74	43.13	95.55	43.54	95.35	43.96
96.84	43.11	96.65	43.54	96.46	43.96	96.26	44.38
97.75	43.52	97.56	43.95	97.37	44.37	97.17	44.80
98.66	43.93	98.47	44.36	98.28	44.79	98.08	45.22
99.58	44.33	99.38	44.77	99.19	45.20	98.99	45.63
100.5	44.74	100.3	45.18	100.1	45.62	99.90	46.05
101.4	45.15	101.2	45.59	101.0	46.03	100.8	46.47
102.3	45.55	102.1	46.00	101.9	46.45	101.7	46.89
103.2	45.96	103.0	46.41	102.8	46.86	102.6	47.31
104.1	46.37	103.9	46.82	103.7	47.28	103.5	47.73
105.1	46.77	104.9	47.23	104.6	47.69	104.4	48.15
106.0	47.18	105.8	47.64	105.6	48.10	105.3	48.56
106.9	47.59	106.7	48.05	106.5	48.52	106.3	48.98
107.8	48.00	107.6	48.46	107.4	48.93	107.2	49.40
108.7	48.40	108.5	48.88	108.3	49.35	108.1	49.82
109.6	48.81	109.4	49.29	109.2	49.76	109.0	50.24
Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
0 Min.		45 Min.		30 Min.		15 Min.	
66 DEG.		65 DEGREES					

25 DEGREES

0 Min.		15 Min.		30 Min.		45 Min.	
Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep
55.28	25.78	55.17	26.02	55.06	26.26	54.94	26.50
56.19	26.20	56.08	26.45	55.96	26.69	55.84	26.94
57.10	26.63	56.98	26.87	56.86	27.12	56.74	27.37
58.00	27.05	57.89	27.30	57.77	27.55	57.64	27.80
58.91	27.47	58.79	27.73	58.67	27.98	58.55	28.24
59.82	27.89	59.69	28.15	59.57	28.41	59.45	28.67
60.72	28.32	60.60	28.58	60.47	28.84	60.35	29.11
61.63	28.74	61.50	29.01	61.38	29.27	61.25	29.54
62.54	29.16	62.41	29.43	62.28	29.71	62.15	29.98
63.44	29.58	63.31	29.86	63.18	30.14	63.05	30.41
64.35	30.01	64.22	30.29	64.08	30.57	63.95	30.85
65.25	30.43	65.12	30.71	64.99	31.00	64.85	31.28
66.16	30.85	66.02	31.14	65.89	31.43	65.75	31.71
67.07	31.27	66.93	31.57	66.79	31.86	66.65	32.15
67.97	31.70	67.83	31.99	67.69	32.29	67.55	32.58
68.88	32.12	68.74	32.42	68.60	32.72	68.45	33.02
69.79	32.54	69.64	32.85	69.50	33.15	69.35	33.45
70.69	32.96	70.55	33.27	70.40	33.58	70.25	33.89
71.60	33.39	71.45	33.70	71.30	34.01	71.16	34.32
72.50	33.81	72.36	34.13	72.21	34.44	72.06	34.76
73.41	34.23	73.26	34.55	73.11	34.87	72.96	35.19
74.32	34.65	74.17	34.98	74.01	35.30	73.86	35.62
75.23	35.08	75.07	35.41	74.91	35.73	74.76	36.06
76.13	35.50	75.97	35.83	75.82	36.16	75.66	36.49
77.04	35.92	76.88	36.26	76.72	36.59	76.56	36.93
77.94	36.35	77.78	36.68	77.62	37.02	77.46	37.36
78.85	36.77	78.69	37.11	78.52	37.45	78.36	37.80
79.76	37.19	79.59	37.54	79.43	37.89	79.26	38.23
80.66	37.61	80.50	37.96	80.33	38.32	80.16	38.67
81.57	38.04	81.40	38.39	81.23	38.75	81.06	39.10
82.47	38.46	82.31	38.82	82.14	39.18	81.96	39.53
83.38	38.88	83.21	39.24	83.04	39.61	82.86	39.97
84.29	39.30	84.11	39.67	83.94	40.04	83.76	40.40
85.19	39.73	85.02	40.10	84.84	40.47	84.67	40.84
86.10	40.15	85.92	40.52	85.75	40.90	85.57	41.27
87.01	40.57	86.82	40.9.	86.65	41.33	86.47	41.71
87.91	40.99	87.73	41.38	87.55	41.76	87.37	42.14
88.82	41.42	88.64	41.81	88.45	42.19	88.27	42.58
89.72	41.84	89.54	42.23	89.35	42.62	89.17	43.01
90.63	42.26	90.45	42.66	90.26	43.05	90.07	43.45
91.54	42.68	91.35	43.08	91.16	43.48	90.97	43.88
92.44	43.11	92.25	43.51	92.06	43.91	91.87	44.31
93.35	43.53	93.16	43.94	92.97	44.34	92.77	44.75
94.26	43.95	94.06	44.36	93.87	44.77	93.67	45.18
95.16	44.38	94.97	44.79	94.77	45.20	94.57	45.62
96.07	44.80	95.87	45.22	95.67	45.63	95.47	46.05
96.97	45.22	96.78	45.64	96.58	46.06	96.37	46.49
97.88	45.64	97.68	46.07	97.48	46.50	97.28	46.92
98.79	46.07	98.59	46.50	98.38	46.93	98.18	47.35
99.69	46.49	99.49	46.92	99.28	47.36	99.08	47.79
100.6	46.91	100.4	47.35	100.2	47.79	99.98	48.22
101.5	47.33	101.3	47.78	101.1	48.22	100.9	48.66
102.4	47.76	102.2	48.20	102.0	48.65	101.8	49.09
103.3	48.18	103.1	48.63	102.9	49.08	102.7	49.53
104.2	48.60	104.0	49.06	103.8	49.51	103.6	49.96
105.1	49.02	104.9	49.48	104.7	49.94	104.5	50.40
106.0	49.45	105.8	49.91	105.6	50.37	105.4	50.83
106.9	49.87	106.7	50.34	106.5	50.80	106.3	51.26
107.9	50.29	107.6	50.76	107.4	51.23	107.2	51.70
108.8	50.71	108.5	51.19	108.3	51.66	108.1	52.13
Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
0 Min.		45 Min.		30 Min.		15 Min.	
64 DEGREES							

Digitized by Google

TRAVERSE TABLE.

Distance	26 DEGREES								27 DEGREES							
	0 Min.		15 Min.		30 Min.		45 Min.		0 Min.		15 Min.		30 Min.		45 M	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	D
1	0.90	0.44	0.90	0.44	0.89	0.45	0.89	0.45	0.89	0.45	0.89	0.46	0.89	0.46	0.88	
2	1.80	0.88	1.79	0.88	1.79	0.89	1.79	0.90	1.78	0.91	1.78	0.92	1.77	0.92	1.77	
3	2.70	1.32	2.69	1.33	2.68	1.34	2 68	1.35	2.67	1.36	2.67	1.37	2.66	1.39	2.65	
4	3.60	1.75	3.59	1.77	3.58	1.78	3.57	1.80	3.56	1.82	3.56	1.83	3 55	1.85	3.54	
5	4.49	2.19	4.48	2.21	4.47	2.23	4.46	2.25	4.46	2.27	4.45	2.29	4.44	2.31	4.42	
6	5.39	2.63	5.38	2.65	5.37	2.68	5.36	2.70	5.35	2.72	5.33	2.75	5.32	2.77	5.31	
7	6.29	3.07	6.28	3.10	6.26	3.12	6.25	3.15	6.24	3.18	6.22	3.21	6.21	3.23	6.19	
8	7.19	3.51	7.18	3.54	7.16	3.57	7.14	3.60	7.13	3.63	7.11	3.66	7.10	3.69	7.08	
9	8.09	3.95	8.07	3.98	8.05	4.02	8.04	4.05	8.02	4.09	8.00	4.12	7.98	4.16	7.96	
10	8.99	4.38	8.97	4.42	8.95	4.46	8.93	4.50	8.91	4.54	8.89	4.58	8.87	4.62	8.85	
11	9.89	4.82	9.87	4.87	9.84	4.91	9.82	4.95	9.80	4.99	9.78	5.04	9.76	5.08	9.73	
12	10.79	5.26	10.76	5.31	10.74	5.35	10.72	5.40	10.69	5.45	10.67	5.49	10.64	5.54	10.62	
13	11.68	5.70	11.66	5.75	11.63	5.80	11.61	5.85	11.58	5.90	11.56	5.95	11.53	6.00	11.50	
14	12.58	6.14	12.56	6.19	12.53	6.25	12.50	6.30	12.47	6.36	12.45	6.41	12.42	6.46	12.39	
15	13.48	6.58	13.45	6.63	13.42	6.69	13.39	6.75	13.37	6.81	13.34	6.87	13.31	6.93	13.27	
16	14.38	7.01	14.35	7.08	14.32	7.14	14.29	7.20	14.26	7.26	14.22	7.33	14.19	7.39	14.16	
17	15.28	7.45	15.25	7.52	15.21	7.59	15.18	7.65	15.15	7.72	15.11	7.78	15.08	7.85	15.04	
18	16.18	7.89	16.14	7.96	16.11	8.03	16.07	8.10	16.04	8.17	16.00	8.24	15.97	8.31	15.93	
19	17.08	8.33	17.04	8.40	17.00	8.48	16.97	8.55	16.93	8.63	16.89	8.70	16.85	8.77	16.81	
20	17.98	8.77	17.94	8.85	17.90	8.92	17.86	9.00	17.82	9.08	17.78	9.16	17.74	9.24	17.70	
21	18.87	9.21	18.83	9.29	18.79	9.37	18.75	9.45	18.71	9.53	18.67	9.62	18.63	9.70	18.58	
22	19.77	9.64	19.73	9.73	19.69	9.82	19.65	9.90	19.60	9.99	19.56	10.07	19.51	10.16	19.47	
23	20.67	10.08	20.63	10.17	20.58	10.26	20.54	10.35	20.49	10.44	20.45	10.53	20.40	10.62	20.35	
24	21.57	10.52	21.52	10.61	21.48	10.71	21.43	10.80	21.38	10.90	21.34	10.99	21.29	11.08	21.24	
25	22 47	10.96	22.42	11.06	22.37	11.15	22.32	11.25	22.28	11.35	22.23	11.45	22.18	11.54	22.12	
26	23.37	11.40	23.32	11.50	23.27	11.60	23.22	11.70	23.17	11.80	23.11	11.90	23.06	12.01	23.01	
27	24.27	11.84	24.22	11.94	24.16	12.05	24.11	12.15	24.06	12.26	24.00	12.36	23.95	12.47	23 89	
28	25.17	12.27	25.11	12.38	25.06	12.49	25.00	12.60	24.95	12.71	24.89	12.82	24.84	12.93	24.78	
29	26.07	12.71	26.01	12.83	25.95	12.94	25.90	13.05	25.84	13.17	25.78	13.28	25.72	13.29	25.66	
30	26.96	13.15	26.91	13.27	26.85	13.39	26.79	13.50	26.73	13.62	26.67	13.74	26.61	13.85	26.55	
31	27.86	13.59	27.80	13.71	27.74	13.83	27.68	13.95	27.62	14.07	27.56	14.19	27.50	14.31	27.43	
32	28.76	14.03	28.70	14.15	28.64	14.28	28.58	14.40	28.51	14.55	28.45	14.65	28.38	14.78	28.32	
33	29.66	14.47	29.60	14.60	29.53	14.72	29.47	14.85	29.40	14.98	29.34	15.11	29.27	15.24	29.20	
34	30.56	14.90	30.49	15.04	30.43	15.17	30.36	15.30	30.29	15.44	30.23	15.57	30.16	15.70	30.09	
35	31.46	15.34	31.39	15.48	31.32	15.62	31 25	15.75	31.19	15.89	31.12	16.03	31.05	16.16	30.97	
36	32.36	15.78	32.29	15.92	32.22	16.06	32.15	16.20	32 08	16.34	32.00	16.48	31.93	16.62	31.86	
37	33.26	16.22	33.18	16.36	33.11	16.51	33.04	16.65	32.97	16.80	32.89	16.94	32.82	17.08	32.74	
38	34.15	16.66	34.08	16.81	34.01	16.96	33.93	17.10	33.86	17.25	33.78	17.40	33.71	17.55	33.63	
39	35.05	17.10	34.98	17.25	34.90	17.40	34.83	17.55	34.75	17.71	34.67	17.86	34.59	18.01	34.51	
40	35.95	17.53	35.87	17.69	35.80	17.85	35.72	18.00	35.64	18.16	35.56	18.32	35.48	18.47	35.40	
41	36.85	17.97	36.77	18.13	36.69	18.29	36.61	18.45	36.53	18.61	36.45	18.77	36.37	18.93	36.28	
42	37.75	18.41	37.67	18.58	37.59	18.74	37.51	18.90	37.42	19.07	37.34	19.23	37.25	19.39	37.17	
43	38.65	18.85	38.57	19.02	38.48	19.19	38.40	19.35	38.31	19.52	38.23	19.69	38.14	19.86	38.05	
44	39.55	19.29	39.46	19.46	39.38	19.63	39.29	19.80	39.20	19.98	39.12	20.15	39.03	20.32	38.94	
45	40.45	19.73	40.36	19.90	40.27	20.08	40.18	20.25	40.10	20.43	40.01	20.60	39.92	20.78	39.82	
46	41.34	20.17	41.26	20.35	41.17	20.53	41.08	20.70	40.99	20.88	40.89	21.06	40.80	21.24	40.71	
47	42.24	20.60	42.15	20.79	42.06	20.97	41.97	21.15	41.88	21.34	41.78	21.52	41.69	21.70	41.59	
48	43.14	21.04	43.05	21.23	42.96	21.42	42.86	21.60	42.77	21.79	42.67	21.98	42.58	22.16	42.48	
49	44.04	21.48	43.95	21.67	43.85	21.86	43.76	22.05	43.66	22.25	43.56	22.44	43.46	22.63	43.36	
50	44.94	21.92	44.84	22.11	44.75	22.31	44.65	22.50	44.55	22.70	44.45	22.89	44.35	23.09	44.25	
51	45.84	22.36	45.74	22.56	45.64	22.76	45.54	22.96	45.44	23.15	45.34	23.35	45.24	23.55	45.13	
52	46.74	22.80	46.64	23.00	46.54	23.20	46.43	23.41	46.35	23.61	46.23	23.81	46.12	24.01	46.02	
53	47.64	23.23	47.53	23 44	47.43	23.65	47.33	23.86	47.22	24.06	47.12	24.27	47.01	24.47	46.90	
54	48.53	23.67	48.43	23-88	48.33	24.09	48.22	24.31	48.11	24.52	48.01	24.73	47.90	24.93	47.79	
55	49.43	24.11	49.33	24-33	49.22	24.54	49.11	24.76	49.01	24.97	48.90	25.18	48.79	25.40	48.67	
56	50.33	24.55	50.22	24.77	50.12	24.99	50.01	25.21	49.90	25.42	49.78	25.64	49.67	25.86	49 56	
57	51.23	24.99	51.12	25.21	51.01	25.43	50.90	25.66	50.79	25.88	50.67	26.10	50.56	26.32	50.44	
58	52.13	25.43	52.02	25.65	51.91	25.88	51.79	26.11	51.68	26.33	51.56	26.56	51.45	26.78	51.33	
59	53.03	25.86	52.92	26.10	52.80	26.33	52.69	26.56	52.57	26.79	52.45	27.01	52.39	27.24	52.21	
60	53.93	26.30	53.81	26 54	53.70	26.77	53.58	27.01	53.46	27.24	53.34	27.47	53.22	27.70	53.10	
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat
	0 Min.		45 Min.		30 Min.		15 Min.		0 Min.		45 Min.		30 Min.		15 Min.	
	64 DEG.		63 DEGREES						62 DEGREES							

Digitized by Google

Distance	26 DEGREES								27 DEGREES								Distance
	0 Min.		15 Min.		30 Min.		45 Min.		0 Min.		15 Min.		30 Min.		45 Min.		
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
61	54.83	26.74	54.71	26.98	54.59	27.22	54.47	27.46	54.35	27.69	54.23	27.93	54.11	28.17	53.98	28.40	
62	55.73	27.18	55.61	27.42	55.49	27.66	55.36	27.91	55.24	28.15	55.12	28.39	54.99	28.63	54.87	28.87	
63	56.62	27.62	56.50	27.86	56.38	28.11	56.26	28.36	56.13	28.60	56.01	28.85	55.88	29.09	55.75	29.33	
64	57.52	28.06	57.40	28.31	57.28	28.56	57.15	28.81	57.02	29.06	56.90	29.30	56.77	29.55	56.64	29.80	
65	58.42	28.49	58.30	28.75	58.17	29.00	58.04	29.26	57.92	29.51	57.79	29.76	57.66	30.01	57.52	30.26	
66	59.32	28.93	59.19	29.19	59.07	29.45	58.94	29.71	58.81	29.96	58.68	30.22	58.54	30.48	58.41	30.73	
67	60.22	29.37	60.09	29.63	59.96	29.90	59.83	30.16	59.70	30.42	59.56	30.68	59.43	30.94	59.29	31.20	
68	61.12	29.81	60.99	30.08	60.86	30.34	60.72	30.61	60.59	30.87	60.45	31.14	60.32	31.40	60.18	31.66	
69	62.02	30.25	61.88	30.52	61.75	30.79	61.62	31.06	61.48	31.33	61.34	31.59	61.20	31.86	61.06	32.13	
70	62.92	30.69	62.78	30.96	62.65	31.23	62.51	31.51	62.37	31.78	62.23	32.05	62.09	32.32	61.95	32.59	
71	63.81	31.12	63.68	31.40	63.54	31.68	63.40	31.96	63.26	32.23	63.12	32.51	62.98	32.78	62.83	33.06	
72	64.71	31.56	64.57	31.84	64.44	32.13	64.29	32.41	64.15	32.69	64.01	32.97	63.86	33.25	63.72	33.52	
73	65.61	32.00	65.47	32.29	65.33	32.57	65.19	32.86	65.04	33.14	64.90	33.42	64.75	33.71	64.60	33.99	
74	66.51	32.44	66.37	32.73	66.23	33.02	66.08	33.31	65.93	33.60	65.79	33.88	65.64	34.17	65.49	34.46	
75	67.41	32.88	67.27	33.17	67.12	33.46	66.97	33.76	66.83	34.05	66.68	34.34	66.53	34.63	66. 7	34.92	
76	68.31	33.32	68.16	33.61	68.02	33.91	67.87	34.21	67.72	34.50	67.57	34.80	67.41	35.09	67.26	35.39	
77	69.21	33.75	69.06	34.06	68.91	34.36	68.76	34.66	68.61	34.96	68.45	35.26	68.30	35.55	68.14	35.85	
78	70.11	34.19	69.96	34.50	69.80	34.80	69.65	35.11	69.50	35.41	69.34	35.71	69.19	36.02	69.03	36.32	
79	71.00	34.63	70.85	34.94	70.70	35.25	70.55	35.56	70.39	35.87	70.23	36.17	70.07	36.48	69.91	36.78	
80	71.90	35.07	71.75	35.38	71.59	35.70	71.44	36.01	71.28	36.32	71.12	36.63	70.96	36.94	70.80	37.25	
81	72.80	35.51	72.65	35.83	72.49	36.14	72.33	36.46	72.17	36.77	72.01	37.09	71.85	37.40	71.68	37.71	
82	73.70	35.95	73.54	36.27	73.38	36.59	73.22	36.91	73.06	37.23	72.90	37.55	72.73	37.86	72.57	38.18	
83	74.60	36.38	74.44	36.71	74.28	37.03	74.12	37.36	73.95	37.68	73.79	38.00	73.62	38.33	73.45	38.65	
84	75.50	36.82	75.34	37.15	75.17	37.48	75.01	37.81	74.84	38.14	74.68	38.46	74.51	38.79	74.34	39.11	
85	76.40	37.26	76.23	37.59	76.07	37.93	75.90	38.26	75.74	38.59	75.57	38.92	75.40	39.25	75.22	39.58	
86	77.30	37.70	77.13	38.04	76.96	38.37	76.80	38.71	76.63	39.04	76.46	39.38	76.28	39.71	76.11	40.04	
87	78.20	38.14	78.03	38.48	77.86	38.82	77.69	39.16	77.52	39.50	77 34	39.84	77.17	40.17	76.99	40.51	
88	79.09	38.58	78.92	38.92	78.75	39.27	78.58	39.61	78.41	39.95	78.23	40.29	78.06	40.63	77.88	40.97	
89	79.99	39.01	79.82	39.36	79.65	39.71	79.48	40.06	79.30	40.41	79.12	40.75	78.94	41.10	78.76	41.44	
90	80.89	39.45	80.72	39.81	80.54	40.16	80.37	40.51	80.19	40.86	80.01	41.21	79.83	41.56	79.65	41.91	
91	81.79	39.89	81.62	40.25	81.44	40.60	81.26	40.96	81.08	41.31	80.90	41.67	80.72	42.02	80.53	42.37	
92	82.69	40.33	82.51	40.69	82.33	41.05	82.15	41.41	81.97	41.77	81.79	42.12	81.61	42.48	81.42	42.84	
93	83.59	40.77	83.41	41.13	83.23	41.50	83.05	41.86	82.86	42.22	82.68	42.58	82.49	42.94	82.30	43.30	
94	84.49	41.21	84.31	41.58	84.12	41.94	83.94	42.31	83.75	42.68	83.57	43.04	83.38	43.40	83.19	43.77	
95	85.39	41.65	85.20	42.02	85.02	42.39	84.83	42.76	84.65	43.13	84.46	43.50	84.27	43.87	84.07	44.23	
96	86.28	42.08	86.10	42.46	85.91	42.83	85.73	43.21	85.54	43.58	85.35	43.96	85.15	44.33	84.96	44.70	
97	87.18	42.52	87.00	42.90	86.81	43.28	86.62	43.66	86.43	44.04	86.23	44.41	86.04	44.79	85.84	45.16	
98	88.08	42.96	87.89	43.34	87.70	43.73	87.51	44.11	87.32	44.49	87.12	44.87	86.93	45.25	86.73	45.63	
99	88.98	43.40	88.79	43.79	88.60	44.17	88.40	44.56	88.21	44.95	88.01	45.33	87.81	45.71	87.61	46.10	
100	89.88	43.84	89.69	44.23	89.49	44.62	89.30	45.01	89.10	45.40	88.90	45.79	88.70	46.17	88.50	46.56	
101	90.78	44.28	90.58	44.67	90.39	45.07	90.19	45.46	89.99	45.85	89.79	46.25	89.59	46.64	89.38	47.03	
102	91.68	44.71	91.48	45.11	91.28	45.51	91.08	45.91	90.88	46.31	90.68	46.70	90.48	47.10	90.27	47.49	
103	92.58	45.15	92.38	45.56	92.18	45.96	91.98	46.36	91.77	46.76	91.57	47.16	91.36	47.56	91.15	47.96	
104	93.47	45.59	93.27	46.00	93.07	46.40	92.87	46.81	92.66	47.22	92.46	47.62	92.25	48.02	92.04	48.42	
105	94.37	46.03	94.17	46.44	93.97	46.85	93.76	47.26	93.56	47.67	93.35	48.08	93.14	48.48	92.92	48.89	
106	95.27	46.47	95.07	46.88	94.86	47.30	94.66	47.71	94.45	48.12	94.24	48.53	94.02	48.95	93.81	49.36	
107	96.17	46.91	95.97	47.32	95.76	47.74	95.55	48.16	95.34	48.58	95.12	48.99	94.91	49.41	94.69	49.82	
108	97.07	47.34	96.86	47.77	96.65	48.19	96.44	48.61	96.23	49.03	96.01	49.45	95.80	49.87	95.58	50.29	
109	97.97	47.78	97.76	48.21	97.55	48.64	97.33	49.06	97.12	49.49	96.90	49.91	96.68	50.33	96.46	50.75	
110	98 87	48.22	98.66	48.65	98.44	49.08	98.23	49.51	98.01	49.94	97.79	50.37	97.57	50.79	97 35	51.22	
111	99.77	48.66	99.55	49.09	99.34	49.53	99.12	49.96	98.90	50.39	98.68	50.82	98.46	51.25	98.23	51 68	
112	100.7	49.10	100.4	49.54	100.2	49.97	100.0	50.41	99.79	50.85	99.57	51.28	99.35	51.72	99.12	52.15	
113	101.6	49.54	101.3	49.98	101.1	50.42	100.9	50.86	100.7	51.30	100.5	51.74	100.2	52.18	100.0	52.61	
114	102.5	49.97	102.2	50.42	102.0	50.87	101.8	51.31	101.6	51.76	101.3	52.20	101.1	52.64	100.9	53.08	
115	103.4	50.41	103.1	50.86	102.9	51.31	102.7	51.76	102.5	52.21	102.2	52.66	102.0	53.10	101 8	53.55	
116	104.3	50.85	104.0	51.31	103.8	51.76	103.6	52.21	103.4	52.66	103.1	53.11	102.9	53.56	102.7	54.01	
117	105.2	51.29	104.9	51.75	104.7	52.21	104.5	52.66	104.2	53.12	104.0	53.57	103 8	54.02	103 5	54.48	
118	106.1	51.73	105.8	52.19	105.6	52.65	105.4	53.11	105.1	53.57	104.9	54.03	104.7	54.49	104.4	54 94	
119	107.0	52.17	106.7	52.63	106.5	53.10	106.3	53.56	106.0	54.02	105.8	54.49	105.6	54.95	105.3	55.41	
120	107.9	52.60	107.6	53.07	107.4	53.54	107.2	54.01	106.9	54.48	106.7	54.94	106.4	55.41	106.2	55.87	
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Distance
	0 Min.		45 Min.		30 Min.		15 Min.		0 Min.		45 Min.		30 Min.		15 Min.		
	64 DEG.		63 DEGREES						62 DEGREES								

Digitized by Google

TRAVERSE TABLE.

Distance	28 DEGREES								29 DEGREES							
	0 Min.		15 Min.		30 Min.		45 Min.		0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
1	0.88	0.47	0.88	0.47	0.88	0.48	0.88	0.48	0.87	0.48	0.87	0.49	0.87	0.49	0.87	0.50
2	1.77	0.94	1.76	0.95	1.76	0.95	1.75	0.96	1.75	0.97	1.75	0.98	1.74	0.98	1.74	0.99
3	2.65	1.41	2.64	1.42	2.64	1.43	2.63	1.44	2.62	1.45	2.62	1.47	2.61	1.48	2.60	1.49
4	3.53	1.88	3.52	1.89	3.52	1.91	3.51	1.92	3.50	1.94	3.49	1.95	3.48	1.97	3.47	1.98
5	4.41	2.35	4.40	2.37	4.39	2.39	4.38	2.40	4.37	2.42	4.36	2.44	4.35	2.46	4.34	2.48
6	5.30	2.82	5.29	2.84	5.27	2.86	5.26	2.89	5.25	2.91	5.24	2.93	5.22	2.95	5.21	2.98
7	6.18	3.29	6.17	3.31	6.15	3.34	6.14	3.37	6.12	3.39	6.11	3.42	6.09	3.45	6.08	3.47
8	7.06	3.76	7.05	3.79	7.03	3.82	7.01	3.85	7.00	3.88	6.98	3.91	6.96	3.94	6.95	3.97
9	7.95	4.23	7.93	4.26	7.91	4.29	7.89	4.33	7.87	4.36	7.85	4.40	7.83	4.43	7.81	4.47
10	8.83	4.69	8.81	4.73	8.79	4.77	8.77	4.81	8.75	4.85	8.73	4.89	8.70	4.92	8.68	4.96
11	9.71	5.16	9.69	5.21	9.67	5.25	9.64	5.29	9.62	5.33	9.60	5.37	9.57	5.42	9.55	5.46
12	10.60	5.63	10.57	5.68	10.55	5.73	10.52	5.77	10.50	5.82	10.47	5.86	10.44	5.91	10.42	5.95
13	11.48	6.10	11.45	6.15	11.42	6.20	11.40	6.25	11.37	6.30	11.34	6.35	11.31	6.40	11.29	6.45
14	12.36	6.57	12.33	6.63	12.30	6.68	12.27	6.73	12.24	6.79	12.21	6.84	12.18	6.89	12.15	6.95
15	13.24	7.04	13.21	7.10	13.18	7.16	13.15	7.21	13.12	7.27	13.09	7.33	13.06	7.39	13.02	7.44
16	14.13	7.51	14.09	7.57	14.06	7.63	14.03	7.70	13.99	7.76	13.96	7.82	13.93	7.88	13.89	7.94
17	15.01	7.98	14.98	8.05	14.94	8.11	14.90	8.18	14.87	8.24	14.83	8.31	14.80	8.37	14.76	8.44
18	15.89	8.45	15.86	8.52	15.82	8.59	15.78	8.66	15.74	8.73	15.70	8.80	15.67	8.86	15.63	8.93
19	16.78	8.92	16.74	8.99	16.70	9.07	16.66	9.14	16.62	9.21	16.58	9.28	16.54	9.36	16.50	9.43
20	17.66	9.39	17.62	9.47	17.58	9.54	17.53	9.62	17.49	9.70	17.45	9.77	17.41	9.85	17.36	9.92
21	18.54	9.86	18.50	9.94	18.46	10.02	18.41	10.10	18.37	10.18	18.32	10.26	18.28	10.34	18.23	10.42
22	19.42	10.33	19.38	10.41	19.33	10.50	19.29	10.58	19.24	10.67	19.19	10.75	19.15	10.83	19.10	10.92
23	20.31	10.80	20.26	10.89	20.21	10.97	20.16	11.06	20.12	11.15	20.07	11.24	20.02	11.33	19.97	11.41
24	21.19	11.27	21.14	11.36	21.09	11.45	21.04	11.54	20.99	11.64	20.94	11.73	20.89	11.82	20.84	11.91
25	22.07	11.74	22.02	11.83	21.97	11.93	21.92	12.02	21.87	12.12	21.81	12.22	21.76	12.31	21.70	12.41
26	22.96	12.21	22.90	12.31	22.85	12.41	22.79	12.51	22.74	12.61	22.68	12.70	22.63	12.80	22.57	12.90
27	23.84	12.68	23.78	12.78	23.73	12.88	23.67	12.99	23.61	13.09	23.56	13.19	23.50	13.30	23.44	13.40
28	24.72	13.15	24.66	13.25	24.61	13.36	24.55	13.47	24.49	13.57	24.43	13.68	24.37	13.79	24.31	13.89
29	25.61	13.61	25.55	13.73	25.49	13.84	25.43	13.95	25.36	14.06	25.30	14.17	25.24	14.28	25.18	14.38
30	26.49	14.08	26.43	14.20	26.36	14.31	26.30	14.43	26.24	14.54	26.17	14.66	26.11	14.77	26.05	14.88
31	27.37	14.55	27.31	14.67	27.24	14.79	27.18	14.91	27.11	15.03	27.05	15.15	26.98	15.27	26.91	15.38
32	28.25	15.02	28.19	15.15	28.12	15.27	28.06	15.39	27.99	15.51	27.92	15.64	27.85	15.76	27.78	15.88
33	29.14	15.49	29.07	15.62	29.00	15.75	28.93	15.87	28.86	16.00	28.79	16.12	28.72	16.25	28.65	16.38
34	30.02	15.96	29.95	16.09	29.88	16.22	29.81	16.35	29.74	16.48	29.66	16.61	29.59	16.74	29.52	16.87
35	30.90	16.43	30.83	16.57	30.76	16.70	30.69	16.83	30.61	16.97	30.54	17.10	30.46	17.23	30.39	17.37
36	31.79	16.90	31.71	17.04	31.64	17.18	31.56	17.32	31.49	17.45	31.41	17.59	31.33	17.73	31.26	17.86
37	32.67	17.37	32.59	17.51	32.52	17.65	32.44	17.80	32.36	17.94	32.28	18.08	32.20	18.22	32.12	18.36
38	33.55	17.84	33.47	17.99	33.40	18.13	33.32	18.28	33.24	18.42	33.15	18.57	33.07	18.71	32.99	18.86
39	34.44	18.31	34.35	18.46	34.27	18.61	34.19	18.76	34.11	18.91	34.03	19.06	33.94	19.20	33.86	19.35
40	35.32	18.78	35.24	18.93	35.15	19.09	35.07	19.24	34.98	19.39	34.90	19.54	34.81	19.70	34.73	19.85
41	36.20	19.25	36.12	19.41	36.03	19.56	35.95	19.72	35.86	19.88	35.77	20.03	35.68	20.19	35.60	20.34
42	37.08	19.72	37.00	19.88	36.91	20.04	36.82	20.20	36.73	20.36	36.64	20.52	36.55	20.68	36.46	20.84
43	37.97	20.19	37.88	20.35	37.79	20.52	37.70	20.68	37.61	20.85	37.52	21.01	37.43	21.17	37.33	21.34
44	38.85	20.66	38.76	20.83	38.67	20.99	38.58	21.16	38.48	21.33	38.39	21.50	38.30	21.67	38.20	21.83
45	39.73	21.13	39.64	21.30	39.55	21.47	39.45	21.64	39.36	21.82	39.26	21.99	39.17	22.16	39.07	22.33
46	40.62	21.60	40.52	21.77	40.43	21.95	40.33	22.13	40.23	22.30	40.13	22.48	40.04	22.65	39.94	22.83
47	41.50	22.07	41.40	22.25	41.30	22.43	41.21	22.61	41.11	22.79	41.01	22.97	40.91	23.14	40.81	23.32
48	42.38	22.53	42.28	22.72	42.18	22.90	42.08	23.09	41.98	23.27	41.88	23.45	41.78	23.64	41.67	23.82
49	43.26	23.00	43.16	23.19	43.06	23.38	42.96	23.57	42.86	23.76	42.75	23.94	42.65	24.13	42.54	24.31
50	44.15	23.47	44.04	23.67	43.94	23.86	43.84	24.05	43.72	24.24	43.62	24.43	43.52	24.62	43.41	24.81
51	45.03	23.94	44.93	24.14	44.82	24.34	44.71	24.53	44.61	24.73	44.50	24.92	44.39	25.11	44.28	25.31
52	45.91	24.41	45.81	24.61	45.70	24.81	45.59	25.01	45.48	25.21	45.37	25.41	45.26	25.61	45.15	25.80
53	46.80	24.88	46.69	25.09	46.58	25.29	46.47	25.49	46.35	25.69	46.24	25.90	46.13	26.10	46.01	26.30
54	47.68	25.35	47.57	25.56	47.46	25.77	47.34	25.97	47.23	26.18	47.11	26.39	47.00	26.59	46.88	26.80
55	48.56	25.82	48.45	26.03	48.33	26.24	48.22	26.45	48.10	26.66	47.99	26.87	47.87	27.08	47.75	27.29
56	49.45	26.29	49.33	26.51	49.21	26.72	49.10	26.94	48.98	27.15	48.86	27.36	48.74	27.58	48.62	27.79
57	50.33	26.76	50.21	26.98	50.09	27.20	49.97	27.42	49.85	27.63	49.73	27.85	49.61	28.07	49.49	28.28
58	51.21	27.23	51.09	27.45	50.97	27.68	50.85	27.90	50.73	28.12	50.60	28.34	50.48	28.56	50.36	28.78
59	52.09	27.70	51.97	27.93	51.85	28.15	51.73	28.38	51.60	28.60	51.48	28.83	51.35	29.05	51.22	29.28
60	52.98	28.17	52.85	28.40	52.73	28.63	52.60	28.86	52.48	29.09	52.35	29.32	52.22	29.55	52.09	29.77
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.		0 Min.		45 Min.		30 Min.		15 Min.	
	62 DEG.		61 DEGREES						60 DEGREES							

Digitized by Google

TRAVERSE TABLE.

28 DEGREES

Distance	0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
61	53.86	28.64	53.73	28.87	53.61	29.11	53.48	29.34
62	54.74	29.11	54.62	29.35	54.49	29.58	54.36	29.82
63	55.63	29.58	55.50	29.82	55.37	30.06	55.23	30.30
64	56.51	30.05	56.38	30.29	56.24	30.54	56.11	30.78
65	57.39	30.52	57.26	30.77	57.12	31.02	56.99	31.26
66	58.27	30.99	58.14	31.24	58.00	31.49	57.86	31.75
67	59.16	31.45	59.02	31 71	58.88	31.97	58.74	32.23
68	60.04	31.92	59.90	32.19	59.76	32.45	59.62	32.71
69	60.92	32.39	60.78	32.66	60.64	32.92	60.49	33.19
70	61.81	32.86	61.66	33.13	61.52	33.40	61.37	33.67
71	62.69	33.33	62.54	33.61	62.40	33.88	62.25	34.15
72	63.57	33.80	63.42	34.08	63.27	34.36	63.12	34.63
73	64.46	34.27	64.31	34.55	64.15	34.83	64.00	35.11
74	65.34	34.74	65.19	35.03	65.03	35.31	64.88	35.59
75	66.22	35.21	66.07	35.50	65.91	35.79	65.75	36.07
76	67.10	35.68	66.95	35.97	66.79	36.26	66.63	36.56
77	67.99	36.15	67.83	36.45	67.67	36.74	67.51	37.04
78	68.87	36.62	68.71	36.92	68.55	37.22	68.38	37.52
79	69.75	37.09	69.59	37.39	69.43	37.70	69.26	38.00
80	70.64	37.56	70.47	37.87	70.31	38.17	70.14	38.48
81	71.52	38.03	71.35	38.34	71.18	38.65	71.01	38.96
82	72.40	38.50	72.23	38.81	72.06	39.13	71.89	39 44
83	73.28	38.97	73.11	39.29	72.94	39.60	72.77	39.92
84	74.17	39 44	73.99	39.76	73.82	40.08	73.65	40.40
85	75.05	39.91	74.88	40.23	74.70	40.56	74.52	40.88
86	75.93	40.37	75.76	40.71	75.58	41.04	75.40	41.37
87	76.82	40.84	76.64	41.18	76.46	41.51	76.28	41.85
88	77.70	41.31	77.52	41.65	77.34	41.99	77.15	42.33
89	78.58	41.78	78.40	42.13	78.21	42.47	78.03	42.81
90	79.47	42.25	79.28	42.60	79.09	42.94	78.91	43.29
91	80.35	42.72	80.16	43.07	79.97	43.42	79.78	43.77
92	81 23	43.19	81.04	43.55	80.85	43.90	80.66	44.25
93	82.11	43.66	81.92	44.02	81.73	44.38	81.54	44.73
94	83.00	44.13	82.80	44.49	82.61	44.85	82.41	45.21
95	83.88	44.60	83.68	44.97	83.49	45.33	83.29	45.69
96	84.76	45.07	84.57	45.44	84.37	45.81	84.17	46.17
97	85.65	45.54	85.45	45.91	85.25	46.28	85.04	46.66
98	86.53	46.01	86.33	46.39	86.12	46.76	85.92	47.14
99	87.41	46.48	87.21	46.86	87.00	47.24	86.80	47.62
100	88.29	46.95	88.09	47.33	87.88	47.72	87.67	48.10
101	89.18	47.42	88.97	47.81	88.76	48.19	88.55	48.58
102	90.06	47.89	89.85	48.28	89.64	48.67	89.43	49.06
103	91.94	48.36	90.73	48.75	90.52	49.15	90.30	49.54
104	91.83	48.82	91.61	49.23	91.40	49.62	91.18	50.02
105	92.71	49.29	92.49	49.70	92.28	50.10	92.06	50.50
106	93.59	49.76	93.37	50.17	93.15	50 58	92.93	50.98
107	94.48	50.23	94.26	50.65	94.03	51.06	93.81	51.47
108	95.36	50.70	95.14	51-12	94.91	51.53	94.69	51.95
109	96.24	51-17	96.02	51-59	95.79	52.01	95.56	52.43
110	97.12	51-64	96.90	52.07	96.67	52.49	96.44	52.91
111	98.01	52.11	97.78	52.54	97.55	52.96	97.32	53.39
112	98.89	52.58	98.66	53-01	98.43	53-44	98.19	53.87
113	99.77	53.05	99.54	53-49	99.31	53-92	99.07	54-35
114	100.7	53 52	100.4	53-96	100.2	54.40	99.95	54.83
115	101.5	53.99	101.3	54.4	101.1	54.87	100.8	55.31
116	102.4	54.46	102.2	54.90	101.9	55.35	101.7	55.79
117	103.3	54.93	103.1	55-38	102-8	55.83	102.6	56.28
118	104.2	55.40	103.9	55.85	103.7	56.30	103.5	56.76
119	105.1	55.87	104-8	56.33	104.6	56.78	104.3	57.24
120	106.0	56.34	105.7	56.80	105.5	57.26	105.2	57.72
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.	

62 DEG.

29 DEGREES

	0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep
	53.35	29.57	53.22	29.81	53.09	30.04	52.96	30.2
	54.23	30.06	54.09	30.29	53 96	30.53	53.83	30.7
	55.10	30.54	54.97	30.78	54.83	31.02	54.70	31.2
	55.98	31.03	55.84	31.27	55.70	31 52	55.56	31.7
	56.85	31.51	56.71	31.76	56.57	32.01	56.43	32.2
	57.72	32.00	57.58	32.25	57.44	32.50	57.30	32.7
	58.60	32.48	58.46	32.74	58.31	32.99	58.17	33.2
	59.47	32.97	59.33	33.23	59.18	33.48	59.04	33.7
	60.35	33.45	60.20	33.71	60.05	33.98	59.91	34.2
	61.22	33.94	61.07	34.20	60.92	34.47	60 77	34.7
	62 10	34.42	61.95	34.69	61.80	34.96	61.64	35.2
	62.97	34.91	62.82	35.18	62.67	35.45	62.51	35.7
	63.85	35.39	63.69	35.67	63.54	35.95	63.38	36.2
	64.72	35.88	64.56	36.16	64.41	36.44	64.25	36.7
	65.60	36.36	65.44	36.65	65.28	36.93	65.11	37.2
	66.47	36.85	66 31	37.14	66.15	37.42	65.98	37.7
	67.35	37.33	67.18	37.62	67.02	37.92	66.85	38.2
	68.22	37.82	68.05	38.11	67.89	38.41	67.72	38.7
	69.09	38.30	68.93	38.60	68.76	38.90	68.59	39.2
	69.97	38.78	69.80	39.09	69.63	39.39	69.46	39.7
	70.84	39.27	70.67	39.58	70.50	39.89	70.32	40.1
	71.72	39.75	71.54	40.07	71.37	40.38	71.19	40.6
	72.59	40.24	72.42	40.56	72.24	40.87	72.06	41.1
	73.47	40.72	73.29	41.04	73.11	41.36	72.93	41.6
	74.34	41.21	74.16	41.53	73.98	41.86	73.80	42.1
	75.22	41.69	75.03	42.02	74.85	42.35	74.67	42.6
	76.09	42.18	75.91	42.51	75.72	42.84	75.53	43.1
	76.97	42.66	76.78	43.00	76.59	43.33	76.40	43.6
	77.84	43.15	77.65	43.49	77.46	43.83	77.27	44.1
	78.72	43.63	78.52	43.98	78.33	44.32	78.14	44.6
	79.59	44.12	79.40	44.46	79.20	44.81	79.01	45.1
	80.47	44.60	80.27	44-95	80.07	45-30	79.87	45.6
	81.34	45.09	81.14	45.44	80.94	45-80	80.74	46.1
	82.21	45.57	82.01	45.93	81.81	46.29	81.61	46.6
	83.09	46 06	82.89	46.42	82.68	46.78	82.48	47.1
	83.96	46.54	83.76	46.91	83.55	47.27	83.35	47.6
	84.84	47.03	84.63	47.40	84.42	47.77	84.22	48.1
	85.71	47.51	85.50	47.88	85.29	48-26	85.08	48.6
	86.59	48.00	86.38	48.37	86.17	48.75	85.95	49.1
	87.46	48.48	87.25	48.86	87.04	49.24	86.82	49.6
	88.34	48.97	88.12	49.35	87.91	49.73	87.69	50.1
	89.21	49.45	88.99	49.84	88.78	50.23	88.56	50.6
	90.09	49.94	89.87	50.33	89.65	50.72	89.42	51.1
	90.96	50.42	90.74	50.82	90.52	51.21	90.29	51.6
	91.84	50.91	91.61	51-31	91.39	51.70	91 16	52.1
	92.71	51.39	92.48	51.79	92.26	52.20	92.03	52.6
	93.58	51.87	93.36	52.28	93.13	52.69	92.90	53.1
	94.46	52.36	94.23	52.77	94.00	53.18	93.77	53.5
	95.33	52.84	95.10	53.26	94.87	53.67	94.63	54.0
	96.21	53.33	95.97	53.75	95.74	54.17	95.50	54.5
	97.08	53.81	96.85	54 24	96.61	54,66	96.37	55.0
	97.96	54.30	97.72	54.73	97.48	55.15	97.24	55.5
	98.83	54.78	98.59	55.21	98.35	55.64	98.11	56.0
	99.71	55 27	99.46	55.70	99.22	56.14	98.97	56.5
	100.6	55.75	100.3	56.19	100.1	56.63	99.84	57.0
	101.5	56.24	101.2	56.68	101.0	57.12	100.7	57.5
	102.3	56.72	102.1	57-17	101.8	57.61	101.6	58.0
	103.2	57.21	103.0	57.66	102.7	58.11	102.4	58.5
	104.1	57.69	103.8	58.15	103.6	58.6(	105.5	59.0
	105.0	58.18	104.7	58.63	104.4	59.09	104 2	59.5
	Dep.	Lat.	Dep.	Lat.	Dep	Lat.	Dep.	La
	0 Min.		45 Min.		30 Min.		15 Min.	

61 DEGREES

60 DEGREES

Digitized by Google

TRAVERSE TABLE.

Distance	30 DEGREES								31 DEGREES							
	0 Min.		15 Min.		30 Min.		45 Min.		0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
1	0.87	0.50	0.86	0.50	0.86	0.51	0.86	0.51	0.86	0.51	0.85	0.52	0.85	0.52	0.85	0.53
2	1.73	1.00	1.73	1.01	1.72	1.02	1.72	1.02	1.71	1.03	1.71	1.04	1.71	1.04	1.70	1.05
3	2.60	1.50	2.59	1.51	2.58	1.52	2.58	1.53	2.57	1.55	2.56	1.56	2.56	1.57	2.55	1.58
4	3.46	2.00	3.46	2.02	3.45	2.03	3.44	2.05	3.43	2.06	3.42	2.08	3.41	2.09	3.40	2.10
5	4.33	2.50	4.32	2.52	4.31	2.54	4.30	2.56	4.29	2.58	4.27	2.59	4.26	2.61	4.25	2.63
6	5.20	3.00	5.18	3.02	5.17	3.05	5.16	3.07	5.14	3.09	5.13	3.11	5.12	3.13	5.10	3.16
7	6.06	3.50	6.05	3.53	6.03	3.55	6.02	3.58	6.00	3.61	5.98	3.63	5.97	3.66	5.95	3.68
8	6.93	4.0	6.91	4.03	6.89	4.06	6.86	4.09	6.86	4.12	6.84	4.15	6.82	4.18	6.80	4.21
9	7.79	4.50	7.77	4.53	7.75	4.57	7.73	4.60	7.71	4.64	7.69	4.67	7.67	4.70	7.65	4.74
10	8.66	5.00	8.64	5.04	8.62	5.08	8.59	5.11	8.57	5.15	8.55	5.19	8.53	5.22	8.50	5.26
11	9.53	5.50	9.50	5.54	9.48	5.58	9.45	5.62	9.43	5.67	9.40	5.71	9.38	5.75	9.35	5.79
12	10.39	6.00	10.37	6.05	10.34	6.09	10.31	6.14	10.29	6.18	10.26	6.23	10.23	6.27	10.20	6.31
13	11.26	6.50	11.23	6.55	11.20	6.60	11.17	6.65	11.14	6.70	11.11	6.74	11.08	6.79	11.05	6.84
14	12.12	7.00	12.09	7.05	12.06	7.11	12.03	7.16	12.00	7.21	11.97	7.26	11.94	7.32	11.90	7.37
15	12.99	7.50	12.96	7.56	12.92	7.61	12.89	7.67	12.86	7.73	12.83	7.78	12.79	7.84	12.76	7.89
16	13.86	8.00	13.82	8.06	13.78	8.12	13.75	8.18	13.71	8.24	13.68	8.30	13.64	8.36	13.61	8.42
17	14.72	8.50	14.69	8.56	14.65	8.63	14.61	8.69	14.57	8.76	14.53	8.82	14.49	8.88	14.46	8.95
18	15.59	9.0	15.55	9.07	15.51	9.14	15.47	9.20	15.43	9.27	15.39	9.34	15.35	9.40	15.31	9.47
19	16.45	9.50	16.41	9.57	16.37	9.64	16.33	9.71	16.29	9.79	16.24	9.86	16.20	9.93	16.16	10.00
20	17.32	10.00	17.28	10.08	17.23	10.15	17.19	10.23	17.14	10.30	17.10	10.38	17.05	10.45	17.01	10.52
21	18.19	10.50	18.14	10.58	18.09	10.66	18.05	10.74	18.00	10.82	17.95	10.89	17.91	10.97	17.86	11.05
22	19.05	11.00	19.00	11.08	18.96	11.17	18.91	11.25	18.86	11.33	18.81	11.41	18.76	11.50	18.71	11.58
23	19.92	11.50	19.87	11.59	19.82	11.67	19.77	11.76	19.71	11.85	19.66	11.93	19.61	12.02	19.56	12.10
24	20.78	12.00	20.73	12.09	20.68	12.18	20.62	12.27	20.57	12.36	20.52	12.45	20.46	12.54	20.41	12.63
25	21.65	12.50	21.60	12.59	21.54	12.69	21.48	12.78	21.43	12.88	21.37	12.97	21.32	13.06	21.26	13.16
26	22.52	13.00	22.46	13.10	22.40	13.20	22.34	13.29	22.29	13.39	22.23	13.49	22.17	13.59	22.11	13.68
27	23.38	13.50	23.32	13.60	23.26	13.70	23.20	13.80	23.14	13.91	23.08	14.01	23.02	14.11	22.96	14.21
28	24.25	14.00	24.19	14.11	24.13	14.21	24.06	14.32	24.00	14.42	23.94	14.53	23.87	14.63	23.81	14.73
29	25.11	14.50	25.05	14.61	24.99	14.72	24.92	14.83	24.86	14.94	24.79	15.04	24.73	15.15	24.66	15.26
30	25.98	15.00	25.92	15.11	25.85	15.23	25.78	15.34	25.71	15.45	25.65	15.56	25.58	15.68	25.51	15.79
31	26.85	15.50	26.78	15.62	26.71	15.73	26.64	15.85	26.57	15.97	26.50	16.08	26.43	16.20	26.36	16.31
32	27.71	16.00	27.64	16.12	27.57	16.24	27.50	16.36	27.43	16.48	27.36	16.60	27.28	16.72	27.21	16.84
33	28.58	16.50	28.51	16.62	28.43	16.75	28.36	16.87	28.29	17.00	28.21	17.12	28.14	17.24	28.06	17.37
34	29.44	17.00	29.37	17.13	29.30	17.26	29.22	17.38	29.14	17.51	29.07	17.64	28.99	17.77	28.91	17.89
35	30.31	17.50	30.23	17.63	30.16	17.76	30.08	17.90	30.00	18.03	29.92	18.16	29.84	18.29	29.76	18.42
36	31.18	18.00	31.10	18.14	31.02	18.27	30.9	18.41	30.86	18.54	30.78	18.68	30.70	18.81	30.61	18.94
37	32.04	18.50	31.96	18.64	31.88	18.78	31.80	18.92	31.72	19.06	31.63	19.19	31.55	19.33	31.46	19.47
38	32.91	19.00	32.83	19.14	32.74	19.29	32.66	19.43	32.57	19.57	32.49	19.71	32.40	19.85	32.31	20.00
39	33.77	19.50	33.69	19.65	33.60	19.79	33.52	19.94	33.43	20.09	33.34	20.23	33.25	20.38	33.16	20.52
40	34.64	20.00	34.55	20.15	34.47	20.30	34.38	20.45	34.29	20.60	34.20	20.75	34.11	20.90	34.01	21.05
41	35.51	20.50	35.42	20.65	35.33	20.81	35.24	20.96	35.14	21.12	35.05	21.27	34.96	21.42	34.86	21.57
42	36.37	21.00	36.28	21.16	36.19	21.32	36.10	21.47	36.00	21.63	35.91	21.79	35.81	21.94	35.71	22.10
43	37.24	21.50	37.14	21.66	37.05	21.82	36.95	21.99	36.86	22.15	36.76	22.31	36.66	22.47	36.57	22.63
44	38.11	22.00	38.01	22.17	37.91	22.33	37.81	22.50	37.72	22.66	37.62	22.83	37.52	22.99	37.42	23.15
45	38.97	22.50	38.87	22.67	38.77	22.84	38.67	23.01	38.57	23.18	38.47	23.34	38.37	23.51	38.27	23.68
46	39.84	23.00	39.74	23.17	39.63	23.35	39.53	23.52	39.43	23.69	39.33	23.86	39.22	24.03	39.12	24.21
47	40.70	23.50	40.60	23.68	40.50	23.85	40.39	24.03	40.29	24.21	40.18	24.38	40.07	24.56	39.97	24.73
48	41.57	24.00	41.46	24.18	41.36	24.36	41.25	24.54	41.14	24.72	41.03	24.90	40.93	25.08	40.82	25.26
49	42.44	24.50	42.33	24.68	42.22	24.87	42.11	25.05	42.00	25.24	41.89	25.42	41.78	25.60	41.67	25.78
50	43.30	25.00	43.19	25.19	43.08	25.38	42.97	25.56	42.86	25.75	42.75	25.94	42.63	26.12	42.52	26.31
51	44.17	25.50	44.06	25.69	43.94	25.88	43.83	26.08	43.72	26.27	43.60	26.46	43.48	26.65	43.37	26.84
52	45.03	26.00	44.92	26.20	44.80	26.39	44.69	26.59	44.57	26.78	44.46	26.98	44.34	27.17	44.22	27.36
53	45.90	26.50	45.78	26.70	45.67	26.90	45.55	27.10	45.43	27.30	45.31	27.50	45.19	27.69	45.07	27.89
54	46.77	27.00	46.65	27.20	46.53	27.41	46.41	27.61	46.29	27.81	46.17	28.01	46.04	28.21	45.92	28.42
55	47.63	27.50	47.51	27.71	47.39	27.91	47.27	28.12	47.14	28.33	47.02	28.53	46.90	28.74	46.77	28.94
56	48.50	28.00	48.37	28.21	48.25	28.42	48.13	28.63	48.00	28.84	47.88	29.05	47.75	29.26	47.62	29.47
57	49.36	28.50	49.24	28.72	49.11	28.93	48.99	29.14	48.86	29.36	48.73	29.57	48.60	29.78	48.47	29.99
58	50.23	29.00	50.10	29.22	49.97	29.44	49.85	29.65	49.72	29.87	49.58	30.09	49.45	30.30	49.32	30.52
59	51.10	29.50	50.97	29.72	50.84	29.94	50.70	30.17	50.57	30.39	50.44	30.61	50.31	30.83	50.17	31.05
60	51.96	30.00	51.83	30.23	51.70	30.45	51.56	30.68	51.43	30.90	51.29	31.13	51.16	31.35	51.02	31.57
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.		0 Min.		45 Min.		30 Min.		15 Min.	
	60 DEG.		59 DEGREES													

Digitized by Google

TRAVERSE TABLE.

Distance	30 DEGREES								31 DEGREES							
	0 Min.		15 Min.		30 Min.		45 Min.		0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
61	52.83	30.50	52.09	30.73	52.56	30.96	52.42	31.19	52.29	31.42	52.15	31.65	52.01	31.87	51.87	32.10
62	53.69	31.00	53.56	31.23	53.42	31.47	53.28	31.70	53.14	31.93	53.00	32.16	52.86	32.39	52.72	32.63
63	54.56	31.50	54.42	31.74	54.28	31.97	54.14	32.21	54.00	32.45	53.86	32.68	53.72	32.92	53.57	33.15
64	55.43	32.00	55.29	32.24	55.14	32.48	55.00	32.72	54.86	32.96	54.71	33.20	54.57	33.44	54.42	33.68
65	56.29	32.50	56.15	32.75	56.01	32.99	55.86	33.23	55.72	33.48	55 57	33.72	55.42	33.96	55.27	34.20
66	57.16	33.00	57.01	33.25	56.87	33.50	56.72	33.75	56.57	33.99	56.42	34.24	56.27	34.48	56.12	34.73
67	58.02	33.50	57.88	33.75	57.73	34.01	57.58	34.26	57.43	34.51	57.28	34.76	57.13	35.01	56.98	35.26
68	58.89	34.00	58.74	34.26	58.59	34.51	58.44	34.77	58.29	35.02	58.13	35.28	57,98	35.53	57.82	35.78
69	59.76	34.50	59.60	34.76	59.45	35.02	59.30	35.28	59.14	35.54	58.99	35.80	58.83	36.05	58.67	36.31
70	60.62	35.00	60.47	35.26	60.31	35.53	60.16	35.79	60.00	36.05	59.84	36.31	59.68	36.57	59.52	36.84
71	61.49	35.50	61.33	35.77	61.18	36.04	61.02	36.30	60.86	36.57	60.70	36.83	60.54	37.10	60.37	37.36
72	62.35	36.00	62.20	36.27	62.04	36.54	61.88	36.81	61.72	37.08	61.55	37.35	61.39	37.62	61.23	37.89
73	63.22	36.50	63.06	36.78	62.90	37.05	62.74	37.32	62.57	37.60	62.41	37.87	62.24	38.14	62.08	38.41
74	64.09	37.00	63.92	37.28	63.76	37.56	63.60	37.84	63.43	38.11	63.26	38.39	63.10	38.66	62.93	38.94
75	64.95	37.50	64.79	37.78	64.62	38.07	64.46	38.35	64.29	38.63	64.12	38.91	63.95	39.19	63.78	39.47
76	65.82	38.00	65.65	38.29	65.48	38.57	65.31	38.86	65.14	39.14	64.97	39.43	64.80	39.71	64.63	39.99
77	66.68	38.50	66.52	38.79	66.35	39.08	66.17	39.37	66.00	39.66	65.83	39.95	65.65	40.23	65.48	40.52
78	67.55	39.00	67.38	39.29	67.21	39.59	67.03	39.88	66.86	40.17	66.68	40.46	66.51	40.75	66.33	41.04
79	68.42	39.50	68.24	39.80	68.07	40.10	67.89	40.39	67.72	40.69	67.54	40.98	67.36	41.28	67.18	41.57
80	69.28	40.00	69.11	40.30	68.93	40.60	68.75	40 90	68.57	41.20	68.39	41.50	68.21	41.80	68.03	42.10
81	70.15	40.50	69.97	40.81	69.79	41.11	69.61	41.41	69.43	41.72	69.25	42.02	69.06	42.32	68.88	42.63
82	71.01	41.00	70.83	41.31	70 65	41.62	70.47	41.93	70.29	42.23	70.10	42.54	69.92	42.84	69.73	43.15
83	71.88	41.50	71.70	41.81	71.52	42.13	71.33	42.44	71.14	42.75	70.96	43.06	70.77	43.37	70.58	43.68
84	72.75	42.00	72,56	42.32	72.38	42.63	72.19	42.95	72.00	43.26	71.81	43.58	71.62	43.89	71.43	44.20
85	73.61	42.50	73.43	42.82	73.24	43.14	73.05	43.46	72.86	43.76	72.67	44.10	72.47	44.41	72.28	44.73
86	74.48	43.00	74.29	43.32	74.10	43.65	73.91	43.97	73.72	44.29	73.52	44.61	73.33	44.93	73.15	45.25
87	75.34	43.50	75.15	43.85	74.96	44.16	74.77	44.48	74.57	44.81	74.38	45.13	74.18	45.46	73.98	45.78
88	76.21	44.00	76.02	44.35	75.82	44.66	75.63	44.99	75.43	45.32	75.23	45.65	75.03	45.98	74.85	46.31
89	77.08	44.50	76.88	44.84	76.69	45.17	76.49	45.51	76.29	45.84	76.09	46.17	75.89	46.50	75.68	46.83
90	77.94	45.00	77.75	45.34	77.55	45.68	77.35	46 02	77.15	46.35	76,94	46.69	76.74	47.02	76.53	47.36
91	78.81	45.50	78.61	45.84	78.41	46.19	78.21	46.53	78.00	46.87	77.80	47.21	77.59	47.55	77.38	47.89
92	79.67	46.00	79.47	46.35	79.27	46.69	79.07	47.04	78.86	47.38	78.65	47.73	78.44	48.07	78.23	48.41
93	80.54	46.50	80.34	46.85	80.13	47.20	79.92	47.55	79.72	47.90	79.51	48.25	79.30	48.59	79.08	48.94
94	81.41	47.00	81.20	47.35	80.99	47.71	80.78	48.06	80.58	48.41	80.36	48.76	80.15	49.11	79.93	49 47
95	82.27	47.50	82.06	47.86	81.85	48.22	81.64	48.57	81.43	48.93	81.22	49.28	81.00	49.64	80.78	49.99
96	83.14	48.00	82.93	48.36	82.72	48.72	82.50	49.08	82.29	49.44	82.07	49.80	81.85	50.16	81.63	50.52
97	84.00	48.50	83.79	48.87	83.58	49.23	83.36	49.60	83.15	49.96	82.93	50.32	82.71	50.68	82.48	51.04
98	84.87	49.00	84.66	49.37	84.44	49.74	84.22	50.11	84.00	50.47	83.78	50.84	83.56	51.20	83 33	51.57
99	85.74	49.50	85.52	49.87	85.30	50.25	85.08	50.62	84.86	50.99	84.64	51.36	84.41	51.73	84.18	52.10
100	86.60	50.00	86.38	50.38	86.16	50.75	85.94	51.15	85.72	51.50	85.49	51.88	85.26	52.25	85.04	52.62
101	87.47	50.50	87.25	50.88	87.02	51.26	86.80	51.64	86.57	52.02	86.35	52.40	86.12	52.77	85.89	53.15
102	88.33	51.00	88.11	51.38	87.89	51.77	87.66	52.15	87.43	52.53	87.20	52.91	86.97	53.29	86.74	53.67
103	89.20	51.50	88.97	51.89	88.75	52.28	88.52	52.66	88.29	53.05	88.06	53.43	87.82	53.82	87.59	54.20
104	90.07	52.00	89.84	52.39	89.61	52.78	89.38	53.17	89.15	53.56	88.91	53.95	88.67	54.34	88.44	54.73
105	90.93	52.50	90.70	52.90	90.47	53.29	90.24	53.69	90.00	54.08	89.77	54.47	89.53	54.86	89.29	55.25
106	91.80	53.00	91.57	53.40	91.33	53.80	91.10	54.20	90.86	54.59	90.62	54.99	90.38	55.38	90.14	55.78
107	92.66	53.50	92.43	53.90	92.19	54.31	91.96	54.71	91.72	55.11	91.48	55.51	91.23	55.91	90.99	56.30
108	93.53	54.00	93.29	54.41	93.06	54.81	92.82	55.22	92.57	55.62	92.33	56.03	92.09	56.43	91.84	56.83
109	94.40	54.50	94.16	54.91	93.92	55.32	93.68	55.73	93.43	56.14	93.19	56.55	92.94	56.95	92.69	57.36
110	95.26	55.00	95.02	55.42	94.78	55.83	94.53	56.24	94.29	56.65	94.04	57.06	93.79	57.47	93.54	57.88
111	96.13	55.50	95.89	55.92	95.64	56.34	95.39	56.75	95.15	57.17	94.90	57.58	94.64	58.00	94.39	58.41
112	96.99	56.00	96.75	56.42	96.50	56.84	96.25	57.26	96.00	57.68	95.75	58.10	95.50	58.52	95.24	58.94
113	97.86	56.50	97.61	56.93	97.36	57.35	97.11	57.78	96.86	58.20	96.61	58.62	96.35	59.04	96.09	59.46
114	98.73	57.00	98.48	57.43	98.23	57.86	97.97	58.29	97.72	58.71	97.46	59.14	97.20	59.56	96.94	59.99
115	99.59	57.50	99.34	57.93	99.09	58.37	98.83	58.80	98.57	59.25	98.31	59.66	98.05	60.09	97.79	60.51
116	100.5	58.00	100.2	58.44	99.95	58.87	99.69	59.31	99.43	59.74	99.17	60.18	98.91	60.61	98.64	61.04
117	101.3	58.50	101.1	58.94	100.8	59.38	100.6	59.82	100.3	60.26	100.0	60.70	99.76	61.13	99.49	61.57
118	102.2	59.00	101.9	59.45	101.7	59.89	101.4	60.35	101.1	60.77	100.9	61.22	100.6	61.65	100.3	62.09
119	103.1	59.50	102.8	59.95	102.5	60.40	102.3	60.84	102.0	61.29	101.7	61.73	101.5	62.18	101 2	62.62
120	103.9	60.00	103.7	60.45	103.4	60.90	103.1	61.36	102.9	61.80	102.6	62.25	102.3	62.70	102.0	63.15
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.		0 Min.		45 Min.		30 Min.		15 Min.	
	60 DEG.		59 DEGREES						58 DEGREES							

Digitized by Google

TRAVERSE TABLE.

32 DEGREES

Distance	0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
1	0.85	0.53	0.85	0.53	0.84	0.54	0.84	0.54
2	1.70	1.06	1.69	1.07	1.69	1.07	1.68	1.08
3	2.54	1.59	2.54	1.60	2.53	1.61	2.52	1.62
4	3.39	2.12	3.38	2.13	3.37	2.15	3.36	2.16
5	4.24	2.65	4.23	2.67	4.22	2.69	4.21	2.70
6	5.09	3.18	5.07	3.20	5.06	3.22	5.05	3.25
7	5.94	3.71	5.92	3.74	5.90	3.76	5.89	3.79
8	6.78	4.24	6.77	4.27	6.75	4.30	6.73	4.33
9	7.63	4.77	7.61	4.80	7.59	4.84	7.57	4.87
10	8.48	5.30	8.46	5.34	8.43	5.37	8.41	5.41
11	9.33	5.83	9.30	5.87	9.28	5.91	9.25	5.95
12	10.18	6.36	10.15	6.40	10.12	6.45	10.09	6.49
13	11.02	6.89	10.99	6.94	10.96	6.98	10.93	7.03
14	11.87	7.42	11.84	7.47	11.81	7.52	11.77	7.57
15	12.72	7.95	12.69	8.00	12.65	8.06	12.62	8.11
16	13.57	8.48	13.53	8.54	13.49	8.60	13.46	8.66
17	14.42	9.01	14.38	9.07	14.34	9.13	14.30	9.20
18	15.26	9.54	15.22	9.61	15.18	9.67	15.14	9.74
19	16.11	10.07	16.07	10.14	16.02	10.21	15.98	10.28
20	16.96	10.60	16.91	10.67	16.87	10.75	16.82	10.82
21	17.81	11.13	17.76	11.21	17.71	11.28	17.66	11.36
22	18.66	11.66	18.61	11.74	18.55	11.82	18.50	11.90
23	19.51	12.19	19.45	12.27	19.40	12.36	19.34	12.44
24	20.35	12.72	20.30	12.81	20.24	12.90	20.18	12.98
25	21.20	13.25	21.14	13.34	21.08	13.43	21.03	13.52
26	22.05	13.78	21.99	13.87	21.93	13.97	21.87	14.07
27	22.90	14.31	22.83	14.41	22.77	14.51	22.71	14.61
28	23.75	14.84	23.68	14.94	23.61	15.04	23.55	15.15
29	24.59	15.37	24.53	15.47	24.46	15.58	24.39	15.69
30	25.44	15.90	25.37	16.01	25.30	16.12	25.23	16.23
31	26.29	16.43	26.22	16.54	26.15	16.66	26.07	16.77
32	27.14	16.96	27.06	17.08	26.99	17.19	26.91	17.31
33	27.99	17.49	27.91	17.61	27.83	17.73	27.75	17.85
34	28.83	18.02	28.75	18.14	28.68	18.27	28.60	18.39
35	29.68	18.55	29.60	18.68	29.52	18.81	29.44	18.93
36	30.53	19.08	30.45	19.21	30.36	19.34	30.28	19.48
37	31.38	19.61	31.29	19.74	31.21	19.88	31.12	20.02
38	32.23	20.14	32.14	20.28	32.05	20.42	31.96	20.56
39	33.07	20.67	32.98	20.81	32.89	20.95	32.80	21.10
40	33.92	21.20	33.83	21.34	33.74	21.49	33.64	21.64
41	34.77	21.73	34.67	21.88	34.58	22.03	34.48	22.18
42	35.62	22.26	35.52	22.41	35.42	22.57	35.32	22.72
43	36.47	22.79	36.37	22.95	36.27	23.10	36.16	23.26
44	37.31	23.32	37.21	23.48	37.11	23.64	37.01	23.80
45	38.16	23.85	38.06	24.01	37.95	24.18	37.85	24.34
46	39.01	24.38	38.90	24.55	38.80	24.72	38.69	24.88
47	39.86	24.91	39.75	25.08	39.64	25.25	39.53	25.43
48	40.71	25.44	40.59	25.61	40.48	25.79	40.37	25.97
49	41.55	25.97	41.44	26.15	41.33	26.33	41.21	26.51
50	42.40	26.50	42.29	26.68	42.17	26.87	42.05	27.05
51	43.25	27.03	43.13	27.21	43.01	27.40	42.89	27.59
52	44.10	27.56	43.98	27.75	43.86	27.94	43.73	28.13
53	44.95	28.09	44.82	28.28	44.70	28.48	44.58	28.67
54	45.79	28.62	45.67	28.82	45.54	29.01	45.42	29.21
55	46.64	29.15	46.52	29.35	46.39	29.55	46.26	29.75
56	47.49	29.68	47.36	29.88	47.23	30.09	47.10	30.29
57	48.34	30.21	48.21	30.42	48.07	30.63	47.94	30.84
58	49.19	30.74	49.05	30.95	48.92	31.16	48.78	31.38
59	50.03	31.27	49.90	31.48	49.76	31.70	49.62	31.92
60	50.88	31.80	50.74	32.02	50.60	32.24	50.46	32.46
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.	

58 DEG. 57 DEGREES

33 DEGREES

	0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
1	0.84	0.54	0.84	0.55	0.83	0.55	0.83	0.55
2	1.68	1.09	1.67	1.10	1.67	1.10	1.66	1.10
3	2.52	1.63	2.51	1.64	2.50	1.66	2.49	1.65
4	3.35	2.18	3.35	2.19	3.34	2.21	3.33	2.20
5	4.19	2.72	4.18	2.74	4.17	2.76	4.16	2.75
6	5.03	3.27	5.02	3.29	5.00	3.31	4.99	3.30
7	5.87	3.81	5.85	3.84	5.84	3.86	5.82	3.85
8	6.71	4.36	6.69	4.39	6.67	4.42	6.65	4.40
9	7.55	4.90	7.53	4.93	7.51	4.97	7.48	5.00
10	8.39	5.45	8.36	5.48	8.34	5.52	8.31	5.50
11	9.23	5.99	9.20	6.03	9.17	6.07	9.15	6.10
12	10.06	6.54	10.04	6.58	10.01	6.62	9.98	6.60
13	10.90	7.08	10.87	7.13	10.84	7.18	10.81	7.20
14	11.74	7.62	11.71	7.68	11.67	7.73	11.64	7.70
15	12.58	8.17	12.54	8.22	12.51	8.28	12.47	8.25
16	13.42	8.71	13.38	8.77	13.34	8.83	13.30	8.80
17	14.26	9.26	14.22	9.32	14.18	9.38	14.14	9.35
18	15.10	9.80	15.05	9.87	15.01	9.93	14.97	10.00
19	15.93	10.35	15.89	10.42	15.84	10.49	15.80	10.51
20	16.77	10.89	16.73	10.97	16.68	11.04	16.63	11.05
21	17.61	11.44	17.56	11.51	17.51	11.59	17.46	11.55
22	18.45	11.98	18.40	12.06	18.35	12.14	18.29	12.10
23	19.29	12.53	19.23	12.61	19.18	12.69	19.12	12.65
24	20.13	13.07	20.07	13.16	20.01	13.25	19.96	13.20
25	20.97	13.62	20.91	13.71	20.85	13.80	20.79	13.75
26	21.81	14.16	21.74	14.26	21.68	14.35	21.62	14.30
27	22.64	14.71	22.58	14.80	22.51	14.90	22.45	14.85
28	23.48	15.25	23.42	15.35	23.35	15.45	23.28	15.40
29	24.32	15.79	24.25	15.90	24.18	16.01	24.11	15.95
30	25.16	16.34	25.09	16.45	25.02	16.56	24.94	16.50
31	26.00	16.88	25.92	17.00	25.85	17.11	25.78	17.05
32	26.84	17.43	26.76	17.55	26.68	17.66	26.61	17.60
33	27.68	17.97	27.60	18.09	27.52	18.21	27.44	18.15
34	28.51	18.52	28.43	18.64	28.35	18.77	28.27	18.70
35	29.35	19.06	29.27	19.19	29.19	19.32	29.10	19.25
36	30.19	19.61	30.11	19.74	30.02	19.87	29.93	19.80
37	31.03	20.15	30.94	20.29	30.85	20.42	30.76	20.35
38	31.87	20.70	31.78	20.84	31.69	20.97	31.60	20.90
39	32.71	21.24	32.62	21.38	32.52	21.53	32.43	21.45
40	33.55	21.79	33.45	21.93	33.36	22.08	33.26	22.00
41	34.39	22.33	34.29	22.48	34.19	22.63	34.09	22.55
42	35.22	22.87	35.12	23.03	35.02	23.18	34.92	23.10
43	36.06	23.42	35.96	23.58	35.86	23.73	35.75	23.65
44	36.90	23.96	36.80	24.12	36.69	24.29	36.58	24.20
45	37.74	24.51	37.63	24.67	37.52	24.84	37.42	24.75
46	38.58	25.05	38.47	25.22	38.36	25.39	38.25	25.30
47	39.42	25.60	39.31	25.77	39.19	25.94	39.08	25.85
48	40.26	26.14	40.14	26.32	40.03	26.49	39.91	26.40
49	41.09	26.69	40.98	26.87	40.86	27.04	40.74	26.95
50	41.93	27.23	41.81	27.41	41.69	27.60	41.57	27.50
51	42.77	27.78	42.65	27.96	42.53	28.15	42.40	28.05
52	43.61	28.32	43.49	28.51	43.36	28.70	43.24	28.60
53	44.45	28.87	44.32	29.06	44.20	29.25	44.07	29.15
54	45.29	29.41	45.16	29.61	45.03	29.80	44.90	29.70
55	46.13	29.96	46.00	30.16	45.86	30.36	45.73	30.25
56	46.97	30.50	46.83	30.70	46.70	30.91	46.56	30.80
57	47.80	31.04	47.67	31.25	47.53	31.46	47.39	31.35
58	48.64	31.59	48.50	31.80	48.37	32.01	48.23	31.90
59	49.48	32.13	49.34	32.35	49.20	32.56	49.06	32.45
60	50.32	32.68	50.18	32.90	50.03	33.12	49.89	33.00
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	D
	0 Min.		45 Min.		30 Min.		15 Mi	

56 DEGREES

Digitized by Google

TRAVERSE TABLE.

32 DEGREES

Distance	0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
61	51.73	32.35	51.59	32.55	51.45	32.78	51.30	33.00
62	52.58	32.86	52.44	33.08	52.29	33.31	52.14	33.54
63	53.43	33.38	53.28	33.62	53.13	33.85	52.99	34.08
64	54.28	33.91	54.13	34.15	53.98	34.39	53.83	34.62
65	55.12	34.44	54.97	34.68	54.82	34.92	54.67	35 16
66	55.97	34.97	55.82	35.22	55.66	35.46	55.51	35.70
67	56.82	35.50	56.66	35.75	56.51	36.00	56.35	36.25
68	57.67	36.03	57.51	36.29	57.35	36.54	57.19	36.79
69	58.52	36.56	58.36	36.82	58.19	37.07	58.03	37.33
70	59.36	37.09	59.20	37.35	59.04	37.61	59.87	37.87
71	60.21	37.62	60.05	37.89	59.88	38.15	59.71	38.41
72	61.06	38.15	60.89	38.42	60.72	38.69	60.55	38.95
73	61 91	38.68	61.74	38.95	61.57	39.22	61.40	39.49
74	62.76	39.21	62.58	39.49	62.41	39.76	62.24	40-03
75	63.60	39.74	63.43	40.02	63.25	40.30	63.08	40-57
76	64.45	40.27	64.28	40.55	64.10	40.83	63-92	41.11
77	65.30	40.80	65.12	41.09	64.94	41.37	64.76	41.66
78	66.15	41.33	65.97	41.62	65.78	41.91	65.60	42.20
79	67.00	41.86	66.81	42.16	66.63	42.45	66.44	42.74
80	67.84	42.39	67.66	42.69	67.47	42.98	67.28	43.28
81	68.69	42.92	68.50	43.22	68.31	43.52	68.12	43.82
82	69.54	43.45	69.35	43.76	69.16	44.06	69.97	44.36
83	70.39	43.98	70.20	44.29	70.00	44.60	69.81	44.90
84	71 24	44.51	71.04	44.82	70.84	45.13	70.65	45.44
85	72.08	45.04	71.89	45.36	71.69	45.67	71.49	45.98
86	72.93	45.57	72.73	45.89	72.53	46.21	72.33	46.52
87	73.78	46.10	73.58	46.42	73.38	46.75	73.17	47.06
88	74.63	46.63	74.42	46.96	74 22	47.28	74.01	47.61
89	75.48	47.16	75.27	47.49	75.06	47.82	74.85	48.15
90	76.32	47.69	76.12	48.03	75.91	48.36	75.69	48.69
91	77.17	48.22	76.96	48.56	76.75	48.89	76.53	49.23
92	78.02	48.75	77.81	49.09	77.59	49.43	77.38	49.77
93	78.87	49.28	78.65	49.63	78.44	49.97	78.22	50.31
94	79.72	49.81	79.50	50.16	79.28	50.51	79.06	50.85
95	80.56	50.24	80.34	50.69	80.12	51.04	79.90	51.39
96	81.41	50.87	81.19	51.23	80.97	51.58	80.74	51.93
97	82.26	51.40	82.04	51.76	81.81	52.12	81.58	52.47
98	83.11	51.93	82.88	52.29	82.65	52.66	82.42	53.02
99	83.96	52.46	83.73	52.83	83.50	53.19	83.26	53.56
100	84.80	52.99	84.57	53.36	84.34	53.73	84.10	54.10
101	85.65	53.52	85.42	53.90	85.18	54.27	84.94	54.64
102	86.50	54.05	86.26	54.43	86.03	54.80	85.79	55.18
103	87.35	54.58	87.11	54.96	86.87	55.34	86.63	55.72
104	88.20	55.11	87.96	55.50	87.71	55.88	87.47	56.26
105	89.04	55.64	88.80	56.03	88.56	56.42	88.31	56.80
106	89.89	56.17	89.65	56.56	89.40	56.95	89.15	57.34
107	90.74	56.70	90.49	57.10	90.24	57.49	89.99	57.88
108	91.59	57.23	91.34	57.63	91-09	58.03	90.83	58.42
109	92.44	57.76	92.18	58.16	91-93	58.57	91.67	58.97
110	93-29	58.29	93.03	58.70	92.77	59.10	92.51	59.51
111	94.13	58.82	93.88	59.23	93.62	59.64	93.36	60.05
112	94.98	59.35	94.72	59.76	94.46	60.18	94.20	60.59
113	95.83	59.88	95.57	60.30	95.30	60.71	95.04	61.13
114	96.68	60.41	96.41	60.83	96.15	61 25	95.88	61-67
115	97.53	60.94	97.26	61.37	96.99	61.79	96.72	62.21
116	98.37	61.47	98.10	61.90	97.83	62.33	97.56	62.75
117	99.22	62.00	98.95	62.43	98.68	62.86	98.40	63.29
118	100.1	62.53	99.80	62.97	99.52	63.40	99.24	63.83
119	100.9	63.06	100.6	63.50	100.4	63.94	100.1	64.38
120	101.8	63.59	101.5	64.03	101 2	64.48	100.9	64.92
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.	
	58 DEG.		57 DEGREES					

33 DEGREES

	0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
61	51.16	33.22	51.01	33.45	50.87	33.67	50.72	33.89
62	52.00	33.77	51.85	33.99	51.70	34.22	51.55	34.45
63	52.84	34.31	52.69	34.54	52.53	34.77	52.38	35.00
64	53.67	34.86	53.52	35.09	53.37	35.32	53.21	35.56
65	54.51	35.40	54.36	35.64	54.20	35.88	54.05	36.11
66	55.35	35.95	55.19	36.19	55.04	36.43	54.88	36.67
67	56.19	36.49	56.03	36.74	55.87	36.98	55.71	37.22
68	57.03	37.04	56.87	37.28	56.70	37.53	56.54	37.78
69	57.87	37.58	57.70	37.83	57.54	38.08	57.37	38.33
70	58.71	38.12	58.54	38.38	58.37	38.64	58.20	38.89
71	59.55	38.67	59.38	38.93	59.21	39.19	59.03	39.45
72	60.38	39.21	60.21	39.48	60.04	39.74	59.87	40.00
73	61.22	39.76	61.05	40.03	60.87	40.29	60.70	40.56
74	62.06	40.30	61.89	40.57	61.71	40.84	61.53	41.11
75	62.90	40.85	62.72	41.12	62.54	41.40	62.36	41.67
76	63.74	41.39	63.56	41.67	63.38	41.95	63.19	42.22
77	64.58	41.94	64.39	42.22	64.21	42.50	64.02	42.78
78	65.42	42.48	65-23	42.77	65.04	43.05	64-85	43.33
79	66.25	43.03	66.07	43.32	65.88	43.60	65.69	43.89
80	67.09	43.57	66.90	43.86	66.71	44.16	66.52	44.45
81	67.93	44.12	67.74	44.41	67.54	44.71	67.35	45.00
82	68.77	44.66	68.58	44.96	68.38	45.26	68.18	45.56
83	69.61	45.21	69.41	45.51	69.21	45.81	69.01	46-11
84	70.45	45.75	70.25	46.06	70.05	46.36	69.84	46.67
85	71.29	46.29	71.08	46.60	70.88	46.91	70.67	47.22
86	72.13	46.84	71.92	47.15	71.71	47.47	71.51	47.78
87	72.96	47.38	72.76	47.70	72.55	48.02	72.34	48.33
88	73.80	47.93	73.59	48.25	73.38	48.57	73.17	48.89
89	74.64	48.47	74.43	48.80	74.22	49.12	74.00	49.45
90	75.48	49.02	75.27	49.35	75.05	49.67	74.83	50.00
91	76.32	49.56	76.10	49.89	75.88	50.23	75.66	50.56
92	77.16	50.11	76.94	50.44	76.72	50.78	76.50	51.11
93	78.00	50.65	77.77	50.99	77.55	51.33	77.33	51.67
94	78 84	51.20	78.61	51.54	78.39	51.88	78.16	52.22
95	79.67	51.74	79.45	52.09	79.22	52.43	78.99	52.78
96	80.51	52.29	80.28	52.64	80.05	52.99	79.82	53.33
97	81.35	52.83	81.12	53.18	80.89	53.54	80.65	53.89
98	82.19	53.37	81.96	53.73	81.72	54.09	81.48	54.45
99	83.03	53.92	82.79	54.28	82.55	54.64	82.32	55.00
100	83.87	54.46	83.63	54.83	83.39	55.19	83.15	55.56
101	84.71	55.01	84.46	55.38	84.22	55.75	83.98	56.11
102	85.54	55.55	85.30	55.93	85.06	56.30	84.81	56.67
103	86.38	56.10	86.14	56.47	85.89	56.85	85.64	57.22
104	87.22	56.64	86.97	57.02	86.72	57.40	86.47	57.78
105	88.06	57.19	87.81	57.57	87.56	57.95	87.30	58.33
106	88.90	57.73	88.65	58.12	88.39	58.51	88.14	58.89
107	89.74	58.28	89.48	58.67	89.23	59.06	88.97	59.45
108	90.58	58.82	90.32	59.22	90.06	59 61	89.80	60.00
109	91.42	59.37	91.16	59.76	90.89	60.16	90.63	60.56
110	92.25	59.91	91.99	60-31	91.73	60.71	91.46	61.11
111	93.09	60.45	92.83	60.86	92.56	61.26	92.29	61.67
112	93.93	61.00	93.66	61.41	93.40	61.82	93.12	62.22
113	94.77	61.54	94.50	61.96	94.23	62.37	93.96	62,78
114	95.61	62.09	95.34	62.51	95.06	62.92	94.79	63.34
115	96.45	62.63	96.17	65.05	95.90	63.47	95.62	63.89
116	97.29	63.18	97.01	63.60	96.73	64.02	96.45	64.45
117	98.12	63.72	97.85	64.15	97.56	64.58	97.28	65.00
118	98.96	64.27	98.68	64.70	98.40	65.13	98.11	65.56
119	99.80	64.81	99.52	65.25	99.23	65.68	98.94	66.11
120	100.6	65.36	100.4	65.80	100.1	66.25	99.78	66.67
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.	
			56 DEGREES					

Digitized by Google

TRAVERSE TABLE.

32 DEGREES

Distance	0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
1	0.85	0.53	0.85	0.53	0.84	0.54	0.84	0.54
2	1.70	1.06	1.69	1.07	1.69	1.07	1.68	1.08
3	2.54	1.59	2.54	1.60	2.53	1.61	2.52	1.62
4	3.39	2.12	3.38	2.13	3.37	2.15	3.36	2.16
5	4.24	2.65	4.23	2.67	4.22	2.69	4.21	2.70
6	5.09	3.18	5.07	3.20	5.06	3.22	5.05	3.25
7	5.94	3.71	5.92	3.74	5.90	3.76	5.89	3.79
8	6.78	4.24	6.77	4.27	6.75	4.30	6.73	4.33
9	7.63	4.77	7.61	4.80	7.59	4.84	7.57	4.87
10	8.48	5.30	8.46	5.34	8.43	5.37	8.41	5.41
11	9.33	5.83	9.30	5.87	9.28	5.91	9.25	5.95
12	10.18	6.36	10.15	6.40	10.12	6.45	10.09	6.49
13	11.02	6.89	10.99	6.94	10.96	6.98	10.93	7.03
14	11.87	7.42	11.84	7.47	11.81	7.52	11.77	7.57
15	12.72	7.95	12.69	8.00	12.65	8.06	12.62	8.11
16	13.57	8.48	13.53	8.54	13.49	8.60	13.46	8.66
17	14.42	9.01	14.38	9.07	14.34	9.13	14.30	9.20
18	15.26	9.54	15.22	9.61	15.18	9.67	15.14	9.74
19	16.11	10.07	16.07	10.14	16.02	10.21	15.98	10.28
20	16.96	10.60	16.91	10.67	16.87	10.75	16.82	10.82
21	17.81	11.13	17.76	11.21	17.71	11.28	17.66	11.36
22	18.66	11.66	18.61	11.74	18.55	11.82	18.50	11.90
23	19.51	12.19	19.45	12.27	19.40	12.36	19.34	12.44
24	20.35	12.72	20.30	12.81	20.24	12.90	20.18	12.98
25	21.20	13.25	21.14	13.34	21.08	13.43	21.03	13.52
26	22.05	13.78	21.99	13.87	21.93	13.97	21.87	14.07
27	22.90	14.31	22.83	14.41	22.77	14.51	22.71	14.61
28	23.75	14.84	23.68	14.94	23.61	15.04	23.55	15.15
29	24.59	15.37	24.53	15.47	24.46	15.58	24.39	15.69
30	25.44	15.90	25.37	16.01	25.30	16.12	25.23	16.23
31	26.29	16.43	26.22	16.54	26.15	16.66	26.07	16.77
32	27.14	16.96	27.06	17.08	26.99	17.19	26.91	17.31
33	27.99	17.49	27.91	17.61	27.83	17.73	27.75	17.85
34	28.83	18.02	28.75	18.14	28.68	18.27	28.60	18.39
35	29.68	18.55	29.60	18.68	29.52	18.81	29.44	18.93
36	30.53	19.08	30.45	19.21	30.36	19.34	30.28	19.48
37	31.38	19.61	31.29	19.74	31.21	19.88	31 12	20.02
38	32.23	20.14	32.14	20.28	32.05	20.42	31.96	20.56
39	33.07	20.67	32.98	20.81	32.89	20.95	32.80	21.10
40	33.92	21.20	33.83	21.34	33.74	21.49	33.64	21.64
41	34.77	21.73	34.67	21.88	34.58	22.03	34.48	22.18
42	35.62	22.26	35.52	22.41	35.42	22.57	35.32	22.72
43	36.47	22.79	36.37	22.95	36.27	23.10	36.16	23.26
44	37.31	23.32	37.21	23.48	37.11	23.64	37.01	23.80
45	38.16	23.85	38.06	24.01	37.95	24.18	37.85	24.34
46	39.01	24.38	38.90	24.55	38.80	24.72	38.69	24.88
47	39.86	24.91	39.75	25.08	39.64	25.25	39.53	25.43
48	40.71	25.44	40.59	25.61	40.48	25.79	40.37	25.97
49	41.55	25.97	41.44	26.15	41.33	26.33	41.21	26.51
50	42.40	26.50	42.29	26 68	42.17	26.87	42.05	27.05
51	43.25	27.03	43.13	27.21	43.01	27.40	42.89	27.59
52	44.10	27.56	43.98	27.75	43.86	27.94	43.73	28.13
53	44.95	28.09	44.82	28.28	44.70	28.48	44.58	28.67
54	45.79	28.62	45.67	28.82	45.54	29.01	45.42	29.21
55	46.64	29.15	46.52	29.35	46.39	29.55	46.26	29.75
56	47.49	29.68	47.36	29.88	47.23	30.09	47.10	30.29
57	48.34	30.21	48.21	30.42	48.07	30.63	47.94	30.84
58	49.19	30.74	49.05	30.95	48.92	31.16	48.78	31.38
59	50.03	31.27	49.90	31.48	49.76	31.70	49.62	31.92
60	50.88	31.80	50.74	32.02	50.60	32.24	50.46	32.46
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.	

58 DEG. — 57 DEGREES

33 DEGREES

	0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
1	0.84	0.54	0.84	0.55	0.83	0.55	0.83	0.5
2	1.68	1.09	1.67	1.10	1.67	1.10	1.66	1.1
3	2.52	1.63	2.51	1.64	2.50	1.66	2.49	1.6
4	3.35	2.18	3.35	2.19	3 34	2.21	3.33	2.2
5	4.19	2.72	4.18	2.74	4.17	2.76	4.16	2.7
6	5.03	3.27	5.02	3.29	5.00	3.31	4.99	3.3
7	5.87	3.81	5.85	3.84	5.84	3.86	5.82	3.8
8	6.71	4.36	6.69	4.39	6.67	4.42	6.65	4.4
9	7.55	4.90	7.53	4.93	7.51	4.97	7.48	5.0
10	8.39	5.45	8.36	5.48	8.34	5.52	8.31	5.5
11	9.23	5.99	9.20	6.03	9.17	6.07	9.15	6.1
12	10.06	6.54	10.04	6.58	10.01	6.62	9.98	6.6
13	10.90	7.08	10.87	7.13	10.84	7.18	10.81	7.2
14	11.74	7.62	11.71	7.68	11.67	7.73	11.64	7.7
15	12.58	8.17	12.54	8.22	12.51	8.28	12.47	8.3
16	13.42	8.71	13.38	8.77	13.34	8.83	13.30	8.8
17	14.26	9.26	14.22	9.32	14.18	9.38	14.14	9.4
18	15.10	9.80	15.05	9.87	15.01	9.93	14.97	10.0
19	15.93	10.35	15.89	10.42	15.84	10.49	15.80	10.5
20	16.77	10.89	16.73	10.97	16.68	11.04	16.63	11.1
21	17.61	11.44	17.56	11.51	17.51	11.59	17.46	11.6
22	18.45	11.98	18.40	12.06	18.35	12.14	18.29	12.2
23	19.29	12.53	19.23	12.61	19.18	12.69	19.12	12.7
24	20.13	13.07	20.07	13.16	20.01	13.25	19.96	13.3
25	20.97	13.62	20.91	13.71	20.85	13.80	20.79	13.8
26	21.81	14.16	21.74	14.26	21.68	14.35	21.62	14.4
27	22.64	14.71	22.58	14.80	22.51	14.90	22.45	15.0
28	23.48	15.25	23.42	15.35	23.35	15.45	23.28	15.5
29	24.32	15.79	24.25	15.90	24.18	16.01	24.11	16.1
30	25.16	16.34	25.09	16.45	25.02	16.56	24.94	16.6
31	26.00	16.88	25.92	17.00	25.85	17.11	25.78	17.2
32	26.84	17.43	26.76	17.55	26.68	17.66	26.61	17.7
33	27.68	17.97	27.60	18.09	27.52	18.21	27.44	18.3
34	28.51	18.52	28.43	18.64	28.35	18.77	28.27	18.8
35	29.35	19.06	29.27	19.19	29.19	19.32	29.10	19.4
36	30.19	19.61	30.11	19.74	30.02	19.87	29.93	20.0
37	31.03	20.15	30.94	20.29	30.85	20.42	30.76	20.5
38	31.87	20.70	31-78	20-84	31.69	20.97	31.60	21.1
39	32.71	21.24	32.62	21.38	32.52	21.53	32.43	21.6
40	33.55	21.79	33.45	21.93	33.36	22.08	33.26	22.2
41	34.39	22.33	34.29	22.48	34.19	22.63	34.09	22.7
42	35.22	22.87	35.12	23.03	35.02	23.18	34.92	23.3
43	36.06	23.42	35.96	23.58	35.86	23.73	35.75	23.8
44	36.90	23.96	36.80	24.12	36.69	24.29	36.58	24.4
45	37.74	24.51	37.63	24.67	37.52	24.84	37.42	25.0
46	38.58	25.05	38.47	25.22	38.36	25.39	38.25	25.5
47	39.42	25.60	39.31	25.77	39.19	25.94	39.08	26.1
48	40.26	26.14	40.14	26.32	40.03	26.49	39.91	26.6
49	41.09	26.69	40.98	26.87	40.86	27.04	40.74	27.2
50	41.93	27.23	41.81	27.41	41.69	27.60	41.57	27.7
51	42.77	27.78	42.65	27.96	42.53	28.15	42.40	28.3
52	43.61	28.32	43.49	28.51	43.36	28.70	43.24	28.8
53	44.45	28.87	44.32	29.06	44.20	29.25	44.07	29.4
54	45.29	29.41	45.16	29.61	45.03	29.80	44.90	30.0
55	46.13	29.96	46.00	30.16	45.86	30.36	45.73	30.5
56	46.97	30.50	46.83	30.70	46.70	30.91	46.56	31.1
57	47.80	31.04	47.67	31.25	47.53	31.46	47.39	31.6
58	48.64	31.59	48.50	31.80	48.37	32.01	48.23	32.2
59	49.48	32.13	49.34	32.35	49.20	32.56	49 06	32.7
60	50.32	32.68	50.18	32.90	50.03	33.12	49.89	33.3
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.	

56 DEGREES

Digitized by Google

TRAVERSE TABLE.

Distance	32 DEGREES								33 DEGREES							
	0 Min.		15 Min.		30 Min.		45 Min.		0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
61	51.73	32.33	51.59	32.55	51.45	32.78	51.30	33.00	51.16	33.22	51.01	33.43	50.87	33.67	50.72	33.89
62	52.58	32.86	52.44	33.08	52.29	33.31	52.14	33.54	52.00	33.77	51.85	33.99	51.70	34.22	51.55	34.45
63	53.43	33.38	53.28	33.62	53.13	33.85	52.99	34.08	52.84	34.31	52.69	34.54	52.53	34.77	52.38	35.00
64	54.28	33.91	54.13	34.15	53.98	34.39	53.83	34.62	53.67	34.86	53.52	35.09	53.37	35.32	53.21	35.56
65	55.12	34.44	54.97	34.68	54.82	34.92	54.67	35 16	54.51	35.40	54.36	35.64	54.20	35.88	54.05	36.11
66	55.97	34.97	55.82	35.22	55.66	35.46	55.51	35.70	55.35	35.95	55.19	36.19	55.04	36.43	54.88	36.67
67	56.82	35.50	56.66	35.75	56.51	36.00	56.35	36.25	56.19	36.49	56.03	36.74	55.87	36.98	55.71	37.22
68	57.67	36.03	57.51	36.29	57.35	36.54	57.19	36.79	57.03	37.04	56.87	37.28	56.70	37.53	56.54	37.78
69	58.52	36.56	58.36	36.82	58.19	37.07	58.03	37.33	57.87	37.58	57.70	37.83	57.54	38.08	57.37	38.33
70	59.36	37.09	59.20	37.35	59.04	37.61	59.87	37.87	58.71	38.12	58.54	38.38	58.37	38.64	58.20	38.89
71	60.21	37.62	60.05	37.89	59.88	38.15	59.71	38.41	59.55	38.67	59.38	38.93	59.21	39.19	59.03	39.45
72	61.06	38.15	60.89	38.42	60.72	38.69	60.55	38.95	60.38	39.21	60.21	39.48	60.04	39.74	59.87	40.00
73	61 91	38.68	61.74	38.95	61.57	39.22	61.40	39.49	61.22	39.76	61.05	40.03	60.87	40.29	60.70	40.56
74	62.76	39.21	62.58	39.49	62.41	39.76	62.24	40.03	62.06	40.30	61.89	40.57	61.71	40.84	61.53	41.11
75	63.60	39.74	63.43	40.02	63.25	40.30	63.08	40.57	62.90	40.85	62.72	41.12	62.54	41.40	62.36	41.67
76	64.45	40.27	64.28	40.55	64.10	40.83	63.92	41.11	63.74	41.39	63.56	41.67	63.38	41.95	63.19	42.22
77	65.30	40.80	65.12	41.09	64.94	41.37	64.76	41.66	64.58	41.94	64.39	42.22	64.21	42.50	64.02	42.78
78	66.15	41.33	65.97	41.62	65.78	41.91	65.60	42.20	65.42	42.48	65.23	42.77	65.04	43.05	64.85	43.33
79	67.00	41.86	66.81	42.16	66.63	42.45	66.44	42.74	66.25	43.03	66.07	43.32	65.88	43.60	65.69	43.89
80	67.84	42.39	67.66	42.69	67.47	42.98	67.28	43.28	67.09	43.57	66.90	43.86	66.71	44.16	66.52	44.45
81	68.69	42.92	68.50	43.22	68.31	43.52	68.12	43.82	67.93	44.12	67.74	44.41	67.54	44.71	67.35	45.00
82	69.54	43.45	69.35	43.76	69.16	44.06	69.97	44.36	68.77	44.66	68.58	44.96	68.38	45.26	68.18	45.56
83	70.39	43.98	70.20	44.29	70.00	44.60	69.81	44.90	69.61	45.21	69.41	45.51	69.21	45.81	69.01	46.11
84	71 24	44.51	71.04	44.82	70.84	45.13	70.65	45.44	70.45	45.75	70.25	46.06	70.05	46.36	69.84	46.67
85	72.08	45.04	71.89	45.36	71.69	45.67	71.49	45.98	71.29	46.29	71.08	46.60	70.88	46.91	70.67	47.22
86	72.93	45.57	72.73	45.89	72.53	46.21	72.33	46.52	72.13	46.84	71.92	47.15	71.71	47.47	71.51	47.78
87	73.78	46.10	73.58	46.42	73.38	46.75	73.17	47.06	72.96	47.38	72.76	47.70	72.55	48.02	72.34	48.33
88	74.63	46.63	74.42	46.96	74 22	47.28	74.01	47.61	73.80	47.93	73.59	48.25	73.38	48.57	73.17	48.89
89	75.48	47.16	75.27	47.49	75.06	47.82	74.85	48.15	74.64	48.47	74.43	48.80	74.22	49.12	74.00	49.45
90	76.32	47.69	76.12	48.03	75.91	48.36	75.69	48.69	75.48	49.02	75.27	49.35	75.05	49.67	74.83	50.00
91	77.17	48.22	76.96	48.56	76.75	48.89	76.53	49.23	76.32	49.56	76.10	49.89	75.88	50.23	75.66	50.56
92	78.02	48.75	77.81	49.09	77.59	49.43	77.38	49.77	77.16	50.11	76.94	50.44	76.72	50.78	76.50	51.11
93	78.87	49.28	78.65	49.63	78.44	49.97	78.22	50.31	78.00	50.65	77.77	50.99	77.55	51.33	77.33	51.67
94	79.72	49.81	79.50	50.16	79.28	50.51	79.06	50.85	78 84	51.20	78.61	51.54	78.39	51.88	78.16	52.22
95	80.56	50.24	80.34	50.69	80.12	51.04	79.90	51.39	79.67	51.74	79.45	52.09	79.22	52.43	78.99	52.78
96	81.41	50.87	81.19	51.23	80.97	51.58	80.74	51.93	80.51	52.29	80.28	52.64	80.05	52.99	79.82	53.33
97	82.26	51.40	82.04	51.76	81.81	52.12	81.58	52.47	81.35	52.83	81.12	53.18	80.89	53.54	80.65	53.89
98	83.11	51.93	82.88	52.29	82.65	52.66	82.42	53.02	82.19	53.37	81.96	53.73	81.72	54.09	81.48	54.45
99	83.96	52.46	83.73	52.83	83.50	53.19	83.26	53.56	83.03	53.92	82.79	54.28	82.55	54.64	82.32	55.00
100	84.80	52.99	84.57	53.36	84.34	53.73	84.10	54.10	83.87	54.46	83.63	54.83	83.39	55.19	83.15	55.56
101	85.65	53.52	85.42	53.90	85.18	54.27	84.94	54.64	84.71	55.01	84.46	55.38	84.22	55.75	83.98	56.11
102	86.50	54.05	86.26	54.43	86.03	54.80	85.79	55.18	85.54	55.55	85.30	55.93	85.06	56.30	84.81	56.67
103	87.35	54.58	87.11	54.96	86.87	55.34	86.63	55.72	86.38	56.10	86.14	56.47	85.89	56.85	85.64	57.22
104	88.20	55.11	87.96	55.50	87.71	55.88	87.47	56.26	87.22	56.64	86.97	57.02	86.72	57.40	86.47	57.78
105	89.04	55.64	88.80	56.03	88.56	56.42	88.31	56.80	88.06	57.19	87.81	57.57	87.56	57.95	87.30	58.33
106	89.89	56.17	89.65	56.56	89.40	56.95	89.15	57.34	88.90	57.73	88.65	58.12	88.39	58.51	88.13	58.89
107	90.74	56.70	90.49	57.10	90.24	57.49	89.99	57.88	89.74	58.28	89.48	58.67	89.23	59.06	88.97	59.45
108	91.59	57.23	91.34	57.63	91.09	58.03	90.83	58.42	90.58	58.82	90.32	59.22	90.06	59.61	89.80	60.00
109	92.44	57.76	92.18	58.16	91.93	58.57	91.67	58.97	91.42	59.37	91.16	59.76	90.89	60.16	90.63	60.56
110	93.29	58.29	93.03	58.70	92.77	59.10	92.51	59.51	92.25	59.91	91.99	60.31	91.73	60.71	91.46	61.11
111	94.13	58.82	93.88	59.23	93.62	59.64	93.36	60.05	93.09	60.45	92.83	60.86	92.56	61.26	92.29	61.67
112	94.98	59.35	94.72	59.76	94.46	60.18	94.20	60.59	93.93	61.00	93.66	61.41	93.40	61.82	93.12	62.22
113	95.83	59.88	95.57	60.30	95.30	60.71	95.04	61.13	94.77	61.54	94.50	61.96	94.23	62.37	93.96	62.78
114	96.68	60.41	96.41	60.83	96.15	61 25	95.88	61.67	95.61	62.09	95.34	62.51	95.06	62.92	94.79	63.34
115	97.53	60.94	97.26	61.37	96.99	61.79	96.72	62.21	96.45	62.63	96.17	63.05	95.90	63.47	95.62	63.89
116	98.37	61.47	98.10	61.90	97.83	62.33	97.56	62.75	97.29	63.18	97.01	63.60	96.73	64.02	96.45	64.45
117	99.22	62.00	98.95	62.43	98.68	62.86	98.40	63.29	98.12	63.72	97.85	64.15	97.56	64.58	97.28	65.00
118	100.1	62.53	99.80	62.97	99.52	63.40	99.24	63.83	98.96	64.27	98.68	64.70	98.40	65.13	98.11	65.56
119	100.9	63.06	100.6	63.50	100.4	63.94	100.1	64.38	99.80	64.81	99.52	65.25	99.23	65.68	98.94	66.11
120	101.8	63.59	101.5	64.03	101 2	64.48	100.9	64.92	100.6	65.36	100.4	65.80	100.1	66.23	99.78	66.67
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat	Dep	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.		0 Min.		45 Min.		30 Min.		15 Min.	
	58 DEG.		57 DEGREES						56 DEGREES							

Digitized by Google

Distance	34 DEGREES								35 DEGREES							
	0 Min.		15 Min.		30 Min.		45 Min.		0 Min.		15 Min		30 Min.		45 Min	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat	Dep.	Lat.	De
1	0.83	0.56	0.85	0.56	0.82	0.57	0.82	0.57	0.82	0.57	0.82	0.58	0.81	0.58	0.81	0.
2	1.66	1.12	1.65	1.13	1.65	1.13	1.64	1.14	1.64	1.15	1.65	1.15	1.63	1.16	1.62	1.
3	2.49	1.68	2.48	1.69	2.47	1.70	2.46	1.71	2.46	1.72	2.45	1.73	2.44	1.74	2.43	1.
4	3.32	2.24	3.31	2.25	3.30	2.27	3.29	2.28	3.28	2.29	3.27	2.31	3.26	2.32	3.25	2.
5	4.15	2.80	4.15	2.81	4.12	2.83	4.11	2.85	4.10	2.87	4.08	2.89	4.07	2.90	4.06	2.
6	4.97	3.36	4.96	3.38	4.94	3.40	4.93	3.42	4.91	3.44	4.90	3.46	4.88	3.48	4.87	3.
7	5.80	3.91	5.79	3.94	5.77	3.96	5.75	3.99	5.73	4.01	5.72	4.04	5.70	4.06	5.68	4.
8	6.63	4.47	6.61	4.50	6.59	4.53	6.57	4.56	6.55	4.59	6.53	4.62	6.51	4.65	6.49	4.
9	7.46	5.03	7.44	5.07	7.42	5.10	7.39	5.13	7.37	5.16	7.35	5.19	7.33	5.23	7.30	5.
10	8.29	5.59	8.27	5.63	8.24	5.66	8.22	5.70	8.19	5.74	8.17	5.77	8.14	5.81	8.12	5.
11	9.12	6.15	9.09	6.19	9.07	6.23	9.04	6.27	9.01	6.31	8.98	6.35	8.96	6.39	8.93	6.
12	9.95	6.71	9.92	6.75	9.89	6.80	9.86	6.84	9.83	6.88	9.80	6.93	9.77	6.97	9.74	7.
13	10.78	7.27	10.75	7.32	10.71	7.36	10.68	7.41	10.65	7.46	10.62	7.50	10.58	7.55	10.55	7.
14	11.61	7.83	11.57	7.88	11.54	7.93	11.50	7.98	11.47	8.03	11.43	8.08	11.40	8.13	11.36	8.
15	12.44	8.39	12.40	8.44	12.36	8.50	12.33	8.55	12.29	8.60	12.25	8.66	12.21	8.71	12.17	8.
16	13.26	8.95	13.23	9.00	13.19	9.06	13.15	9.12	13.11	9.18	13.07	9.22	13.03	9.29	12.99	9.
17	14.09	9.51	14.05	9.57	14.01	9.63	13.97	9.69	13.93	9.75	13.88	9.81	13.84	9.87	13.80	9.
18	14.92	10.07	14.88	10.13	14.83	10.20	14.79	10.26	14.74	10.32	14.70	10.39	14.65	10.45	14.61	10.
19	15.75	10.63	15.71	10.69	15.66	10.76	15.61	10.83	15.56	10.90	15.52	10.97	15.47	11.03	15.42	11.
20	16.58	11.18	16.53	11.26	16.48	11.33	16.43	11.40	16.38	11.47	16.33	11.54	16.28	11.61	16.23	11.
21	17.41	11.74	17.36	11.82	17.31	11.89	17.25	11.97	17.20	12.05	17.15	12.12	17.10	12.19	17.04	12.
22	18.24	12.30	18.18	12.38	18.13	12.46	18.08	12.54	18.02	12.62	17.97	12.70	17.91	12.78	17.85	12.
23	19.07	12.86	19.01	12.94	18.95	13.03	18.90	13.11	18.84	13.19	18.78	13.27	18.72	13.36	18.67	13.
24	19.90	13.42	19.84	13.51	19.78	13.59	19.72	13.68	19.66	13.77	19.60	13.85	19.54	13.94	19.48	14.
25	20.73	13.98	20.66	14.07	20.60	14.16	20.54	14.25	20.48	14.34	20.42	14.43	20.35	14.52	20.29	14.
26	21.55	14.54	21.49	14.63	21.43	14.73	21.36	14.82	21.30	14.91	21.23	15.01	21.17	15.10	21.10	15.
27	22.38	15.10	22.32	15.20	22.25	15.29	22.18	15.39	22.12	15.49	22.05	15.58	21.98	15.68	21.91	15.
28	23.21	15.66	23.14	15.76	23.08	15.86	23.01	15.96	22.94	16.06	22.87	16.16	22.80	16.26	22.72	16.
29	24.04	16.22	23.97	16.32	23.90	16.43	23.83	16.53	23.76	16.63	23.68	16.74	23.61	16.84	23.54	16.
30	24.87	16.78	24.80	16.88	24.72	16.99	24.65	17.10	24.57	17.21	24.50	17.31	24.42	17.42	24.35	17.
31	25.70	17.34	25.62	17.45	25.55	17.56	25.47	17.67	25.39	17.78	25.32	17.89	25.24	18.00	25.16	18.
32	26.53	17.89	26.45	18.01	26.37	18.13	26.29	18.24	26.21	18.35	26.15	18.47	26.05	18.58	25.97	18.
33	27.36	18.45	27.28	18.57	27.20	18.69	27 11	18.81	27.03	18.93	26.95	19.05	26.87	19.16	26.78	19.
34	28.19	19.01	28.10	19.14	28.02	19.26	27.94	19.38	27.85	19 50	27.77	19.62	27.68	19.74	27.59	19.
35	29.03	19.57	28.93	19.70	28.84	19.82	28.76	19 95	28.67	20.08	28.58	20.20	28.49	20.32	28.41	20.
36	29.85	20.13	29.76	20.26	29.67	20.39	29.58	20.52	29.49	20.65	29.40	20.78	29.31	20.91	29.22	21.
37	30.67	20.69	30.58	20.82	30.49	20.96	30.40	21.09	30.31	21.22	30.22	21.35	30.12	21.49	30.03	21.
38	31.50	21.25	31.41	21.39	31.32	21.52	31.22	21.66	31.13	21.80	31.03	21.93	30.94	22.07	30.84	22.
39	32.33	21.81	32.24	21.95	32.14	22.09	32.04	22.23	31.95	22.37	31.85	22.51	31.75	22.65	31.65	22.
40	33.16	22.37	33.06	22.51	32.97	22.66	32.87	22.80	32.77	22.94	32.67	23.09	32.56	23.23	32.46	23.
41	33.99	22.93	33.89	23.07	33.79	23.22	33.69	23.37	33.59	23.52	33.48	23.66	33.38	23.81	33.27	23.
42	34.82	23.49	34.72	23.64	34.61	23.79	34.51	23.94	34.40	24.09	34.30	24.24	34.19	24.39	34.09	24.
43	35.65	24.05	35.54	24.20	35.44	24.36	35.33	24.51	35.22	24.66	35.12	24.82	35.01	24.97	34.90	25
44	36.48	24.60	36.37	24.76	36.26	24.92	36.15	25.08	36.04	25.24	35.93	25.39	35.82	25.55	35.71	25.
45	37.31	25.16	37.20	25.33	37.09	25.49	36.97	25.65	36.86	25.81	36.75	25.97	36.64	26.13	36.52	26.
46	38.14	25.72	38.02	25.89	37.91	26.05	37.80	26.22	37.68	26.38	37.57	26.55	37.45	26.71	37.33	26.
47	38.96	26.28	38.85	26.45	38.73	26.62	38.62	26.79	38.50	26.96	38.38	27.13	38.26	27.29	38.14	27.
48	39.79	26.84	39.68	27.01	39.56	27.19	39.44	27.36	39.32	27.53	39.20	27.70	39.08	27.87	38.96	28.
49	40.62	27.40	40.50	27.58	40.38	27.75	40.26	27.93	40.14	28.11	40.02	28.28	39.89	28.45	39.77	28.
50	41.45	27.96	41.33	28.14	41.21	28.32	41.08	28.50	40.96	28.68	40.83	28.86	40.71	29.04	40.58	29.
51	42.28	28.52	42.16	28.70	42.03	28.89	41 90	29.07	41.78	29.25	41.65	29.43	41.52	29.62	41.39	29.
52	43.11	29.08	42.98	29.27	42.85	29.45	42.73	29.64	42.60	29.83	42.47	30.01	42.33	30.20	42.20	30.
53	43.93	29.64	43.81	29.83	43.68	30.02	43.55	30.21	43.42	30.40	43.28	30.59	43.15	30.78	43.01	30.
54	44.77	30.20	44.64	30.39	44.50	30.59	44.37	30.78	44.23	30.97	44.10	31.17	43.96	31.36	43.83	31.
55	45.60	30.76	45.46	30.95	45.33	31.15	45.19	31.35	45.05	31.55	44.92	31.74	44.78	31.94	44.64	32.
56	46.43	31.31	46.29	31.52	46.15	31.72	46.01	31.92	45.87	32.12	45.73	32.32	45.59	32.52	45.45	32.
57	47.26	31.87	47.12	32.08	46.98	32.29	46.83	32.49	46.69	32.69	46.55	32.90	46.40	33.10	46.26	33.
58	48.08	32.43	47.94	32.64	47.80	32.85	47.66	33.06	47.51	33.27	47.37	33.47	47.22	33.68	47.07	33.
59	48.91	32.99	48.77	33.21	48.62	33.42	48.48	33.63	48.33	33.84	48.18	34.05	48.03	34.26	47.88	34.
60	49.74	33.55	49.60	33.77	49.45	33.98	49.30	34.20	49.15	34.41	49.00	34.63	48.85	34.84	48.69	35.
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat
	0 Min.		45 Min.		30 Min.		15 Min.		0 Min.		45 Min.		30 Min.		15 Min	
	56 DEG.		55 DEGREES								54 DEGREES					

Digitized by Google

Distance	34 DEGREES								35 DEGREES							
	0 Min.		15 Min.		30 Min.		45 Min.		0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep	Lat.	Dep.	Lat.	Dep.	Lat.	Dep
61	50.57	34.11	50.43	34.33	50.27	34.55	50.12	34.77	49.97	34.99	49.82	35.21	49.66	35.4	49.51	35.64
62	51.40	34.67	51.25	34.89	51.10	35.12	50.94	35 34	50.79	35.56	50.63	35.78	50.48	36.00	50.32	36.22
63	52.23	35.2	52.08	35.46	51.92	35.68	51.76	35.91	51.61	35.14	51.45	36.36	51.29	36.58	51.13	36.81
64	53.06	35.79	52.90	36.02	52.74	36.25	52.59	36.48	52.43	36.71	52.27	36.94	52.10	37.16	51.94	37.39
65	53.89	36.3	53.73	36.58	53.57	36.81	53.41	37.05	53.24	37.28	53.08	37.51	52.92	37.75	52.75	37.98
66	54.72	36.91	54 55	37.15	54.39	37.38	54.23	37.62	54.06	37.86	53.90	38.09	53.73	38.33	53.56	38.56
67	55.55	37.47	55.38	37.71	55.22	37.9.	55.05	38.19	54.88	38.43	54.71	38.67	54.55	38.91	54.38	39.14
68	56.37	38.03	56.21	38.27	56.04	38.5.	55.87	38.76	55.70	39.00	55.53	39.25	55.36	39.49	55.19	39.73
69	57.20	38.58	57.03	38.83	56.86	39.08	56.69	39.33	56.52	39.58	56.35	39.82	56.1	40.07	56.00	40.31
70	58.03	39.14	57.86	39.40	57.69	39.65	57.52	39.90	57.34	40.15	57.16	40.40	56.99	40.65	56.81	40.90
71	58.86	39.70	58.69	39.96	58.51	40.21	58.34	40.47	58.16	40.72	57.98	40.98	57.80	41.23	57.62	41.48
72	59.68	40.26	59.51	40.52	59.34	40.7.	59.16	41.04	58.98	41.30	58.80	41.55	58.62	41.81	58.43	40.07
73	60.52	40.82	60.34	41.08	60.16	41.33	59.98	41.61	59.80	41.87	59.61	42.13	59.43	42.39	59.24	42.65
74	61.35	41.3.	61.17	41.65	60.99	41.91	60.80	42.18	60.62	42.44	60.43	42.71	60.24	42.97	60.06	43 23
75	62.18	41.9.	61.99	42.21	61.81	42.48	61.62	42.75	61.44	43.02	61.25	43.29	61.06	43.55	60.87	45.82
76	63.01	42.5.	62.82	42.77	62.63	43.05	62.45	43.32	62.26	43.59	62.06	43.86	61.87	44.13	61.68	44.40
77	63 84	43.06	63.65	43.34	63.46	43.61	63.27	43.89	63.07	44.17	62.88	44.44	62.69	44.71	62.49	44.99
78	64.66	43.62	64.47	43.90	64.28	44.18	64.09	44.46	63.89	44.74	63.70	45.02	63.50	45.29	63.30	45.57
79	65.49	44.18	65.30	44.46	65.11	44.74	64.91	45.03	64.71	45.31	64.51	45.59	64.32	45.88	64.11	46.16
80	66.32	44.74	66.13	45.02	65.93	45.31	65.73	45.60	65.53	45.89	65.33	46.17	65.15	46.46	64.9	46.74
81	67.15	45.29	66.95	45.59	66.75	45.88	66.55	46.17	66.35	46.46	66.15	46.75	65.94	47.4	65.74	47.32
82	67.98	45.8.	67.78	46.15	67.58	46.45	67.37	46.74	67.17	47.03	66.96	47.33	66.76	47.62	66.55	47.91
83	68.81	46.41	68.61	46.71	68.40	47.01	68.20	47.31	67.99	47.61	67.78	47.90	67.57	48.20	67.36	48.49
84	69.64	46.97	69.43	47.28	69.23	47.58	69.02	47.88	68.81	48.18	68.60	48.48	68.39	48.78	68.17	49.08
85	70.47	47.5.	70.26	47.84	70.05	48.1.	69.84	48.45	69.63	48.75	69.41	49.06	69.20	49.36	68.98	49.66
86	71 30	48.09	71.09	48.40	70.87	48.71	70.66	49.02	70.45	49.33	70.23	49.63	70.01	49.9	69.80	50.25
87	72.13	48.65	71.91	48.96	71.70	49.28	71.48	49.59	71.27	49.90	71.05	50.21	70.83	50.52	70.61	50.83
88	72.96	49.21	72.74	49.53	72.52	49.84	72.30	50.16	72.09	50.47	71.86	50.79	71.64	51.10	71.42	51.41
89	73.78	49.77	73.57	50.09	73.35	50.41	73.13	50.73	72.90	51.05	72.68	51.37	72.46	51.68	72.23	52.00
90	74.61	50.33	74.39	50.65	74.17	50.98	73.95	51.30	73 72	51.62	73.50	51.94	73.27	52.26	73.04	52.58
91	75.44	50.88	75.22	51.22	75.00	51.54	74.77	51.87	74.54	52.20	74.31	52.52	74.08	52.84	73.8.	53.17
92	76.27	51.45	76.05	51.78	75.82	52.11	75.59	52.44	75.36	52.77	75.13	53.10	74.90	53.42	74.66	53.75
93	77.10	52.0.	76.87	52.34	76.64	52.68	76.41	53.01	76.18	53.34	75.95	53.67	75.71	54.01	75.48	54.34
94	77.93	52.56	77.70	52.90	77.47	53.24	77.23	53.58	77.00	53.92	76.76	54.25	76.53	54.59	76.29	54.92
95	78.76	53.1.	78.53	53.47	78.29	53.81	78.06	54.15	77 82	54.49	77.58	54.83	77.3.	55.17	77.10	55.50
96	79. 9	53.68	79.35	54.03	79.12	54.37	78.88	54.72	78.64	55.06	78.4.	55.41	78.16	55.7.	77.91	56.09
97	80.42	54.2.	80.18	54.59	79.94	54.94	79.70	55.29	79.46	55.64	79.21	55.98	78.97	56.3.	78.72	56.67
98	81.25	54.80	81.01	55.15	80.76	55.51	80.52	55.86	80.28	56.21	80.03	56.56	79.78	56.91	79.53	57.26
99	82.07	55.36	81.83	55.72	81.59	56.07	81.34	56.43	81.10	56.78	80.85	57.14	80.60	57.49	80.35	57.84
100	82.90	55.92	82.66	56.28	82.41	56.64	82.16	57.00	81.92	57.36	81.66	57.71	81.41	58.07	81.16	58.42
101	83.73	56.48	83.49	56.84	83.24	57.21	82.99	57.57	82.73	57.93	82.48	58.29	82.23	58.6.	81.97	59.01
102	84.56	57.04	84.31	57.41	84.06	57.77	83.81	58.14	83.55	58.50	83.30	58.87	83.04	59.2.	82.78	59.59
103	85.39	57.60	85.14	57.97	84 88	58.34	84.63	58.71	84.37	59.08	84.11	59.45	83.85	59.81	83.59	60.18
104	86.22	58.16	85.97	58.53	85.71	58.91	85.45	59.28	85.19	59.65	84.93	60.02	84.67	60.39	84.40	60.76
105	87.05	58.72	86.79	59.09	86.53	59.47	86.27	59 85	86.01	60.23	85.75	60.60	85.48	60.97	85.22	61.35
106	87 98	59.27	87.62	59.66	87.36	60.04	87 09	60.42	86.83	60.80	86.56	61.18	86.30	61.5.	86.03	61.93
107	88.71	59.83	88.45	60.22	88.18	60.61	87.92	60.99	87.65	61.37	87.38	61.75	87.11	62.14	86.84	62.51
108	89.54	60 39	89.27	60.78	89.01	61 17	88.74	61.56	88.47	61.95	88.2.	62.33	87.92	62 72	87.65	63.10
109	90.37	60.95	90.10	61.35	89.83	61.74	89.56	62.13	89.29	62.52	89.01	62.91	88.74	63.30	88.46	63.68
110	91.19	61.51	90.92	61.91	90.65	62.30	90.38	62.70	90.11	63.09	89.83	63.49	89 55	63.88	89.27	64.27
111	92.02	62.07	91,75	62.47	91.48	62.87	91.20	63.27	90.93	63.67	90.65	64.06	90.37	64.46	90.08	64.85
112	92.85	62.63	92.58	63.03	92.30	63.44	92.02	63.84	91.74	64.24	91.46	64.64	91.18	65.04	90.90	65.44
113	93.68	63.19	93.40	63.60	93.13	64.00	92.85	64.41	92.56	64.81	92.28	65.22	92.00	65.62	91.71	66.02
114	94.51	63.75	94.23	64.16	93.95	64.57	93.67	64.98	93.38	65.39	93.10	65.79	92.81	66.20	92.53	66.60
115	95.34	64.31	95.06	64.72	94.77	65.14	94.49	65.55	94.20	65.96	93.91	66.37	93.62	66.78	92.35	67.19
116	96.17	64.8.	95.88	65.29	95.60	65.70	95.31	66.12	95.02	66.53	94.73	66.95	94.44	67.36	94.14	67.77
117	97.00	65.43	96.71	65.85	96.42	66.27	96.13	66,69	95.84	67.11	95.55	67.53	95.25	67.9	94.95	68.36
118	97.83	65.98	97.54	66.41	97.25	66.84	96.95	67.26	96 66	67.68	96.36	68.10	96.07	68.5	95.77	68.94
119	98.66	66.54	98.36	66.97	98.07	67.40	97.78	67.83	97.48	68.26	97.18	68.68	96.88	69.10	96.58	69.53
120	99.48	67.10	99.19	67.54	98.90	67.97	98.60	68.40	98.30	68.83	98.00	69.26	97.69	69.6.	97.39	70.11
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.		0 Min.		45 Min.		30 Min.		15 Min.	
	56 DEG.		55 DEGREES						54 DEGREES							

Digitized by Google

TRAVERSE TABLE.

36 DEGREES

Distance	0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
1	0.81	0.59	0.81	0.59	0.80	0.59	0.80	0.60
2	1.62	1.18	1.61	1.18	1.61	1.19	1.60	1.20
3	2.43	1.76	2.42	1.77	2.41	1.78	2.40	1.79
4	3.24	2.35	3.23	2.37	3.22	2.38	3.20	2.39
5	4.05	2.94	4.03	2.96	4.02	2.97	4.01	2.99
6	4.85	3.53	4.84	3.55	4.82	3.57	4.81	3.59
7	5.66	4.11	5.65	4.14	5.63	4.16	5.61	4.19
8	6.47	4.70	6.45	4.73	6.43	4.76	6.41	4.79
9	7.28	5.29	7.26	5.32	7.23	5.35	7.21	5.38
10	8.09	5.88	8.06	5.91	8.04	5.93	8.01	5.98
11	8.90	6.47	8.87	6.50	8.84	6.54	8.81	6.58
12	9.71	7.05	9.68	7.10	9.65	7.14	9.61	7.18
13	10.52	7.64	10.48	7.69	10.45	7.73	10.42	7.78
14	11.33	8.23	11.29	8.28	11.25	8.33	11.22	8.38
15	12.14	8.82	12.10	8.87	12.06	8.92	12.02	8.97
16	12.94	9.40	12.90	9.46	12.86	9.52	12.82	9.57
17	13.75	9.99	13.71	10.05	13.67	10.11	13.62	10.17
18	14.56	10.58	14.52	10.64	14.47	10.71	14.43	10.77
19	15.37	11.17	15.32	11.23	15.27	11.30	15.23	11.37
20	16.18	11.76	16.13	11.83	16.08	11.90	16.03	11.97
21	16.99	12.34	16.94	12.42	16.88	12.49	16.83	12.56
22	17.80	12.93	17.74	13.01	17.68	13.09	17.63	13.16
23	18.61	13.52	18.55	13.60	18.49	13.68	18.43	13.76
24	19.42	14.11	19.35	14.19	19.29	14.28	19.23	14.36
25	20.23	14.69	20.16	14.78	20.10	14.87	20.03	14.96
26	21.03	15.28	20.97	15.37	20.90	15.47	20.83	15.56
27	21.84	15.87	21.77	15.97	21.70	16.06	21.63	16.15
28	22.65	16.46	22.58	16.56	22.51	16.65	22.44	16.75
29	23.46	17.05	23.39	17.15	23.31	17.25	23.24	17.35
30	24.27	17.63	24.19	17.74	24.12	17.84	24.04	17.95
31	25.08	18.22	25.00	18.33	24.92	18.44	24.84	18.55
32	25.89	18.81	25.81	18.92	25.72	19.03	25.64	19.15
33	26.70	19.40	26.61	19.51	26.53	19.63	26.44	19.74
34	27.51	19.98	27.42	20.10	27.33	20.22	27.24	20.34
35	28.32	20.57	28.23	20.70	28.13	20.82	28.04	20.94
36	29.12	21.16	29.03	21.29	28.94	21.41	28.85	21.54
37	29.93	21.75	29.84	21.88	29.74	22.01	29.65	22.14
38	30.74	22.34	30.64	22.47	30.55	22.60	30.45	22.74
39	31.55	22.92	31.45	23.06	31.35	23.20	31.25	23.33
40	32.36	23.51	32.26	23.65	32.15	23.79	32.05	23.93
41	33.17	24.10	33.06	24.24	32.96	24.39	32.85	24.53
42	33.98	24.69	33.87	24.83	33.76	24.98	33.65	25.13
43	34.79	25.27	34.68	25.43	34.57	25.58	34.45	25.73
44	35.60	25.86	35.48	26.02	35.37	26.17	35.26	26.33
45	36.41	26.45	36.29	26.61	36.17	26.77	36.06	26.92
46	37.21	27.04	37.10	27.20	36.98	27.36	36.86	27.52
47	38.02	27.63	37.90	27.79	37.78	27.96	37.66	28.12
48	38.83	28.21	38.71	28.38	38.59	28.55	38.46	28.72
49	39.64	28.80	39.52	28.97	39.39	29.15	39.26	29.32
50	40.45	29.39	40.32	29.57	40.19	29.74	40.06	29.92
51	41.26	29.98	41.13	30.16	41.00	30.34	40.86	30.51
52	42.07	30.56	41.94	30.75	41.80	30.93	41.67	31.11
53	42.88	31.15	42.74	31.34	42.60	31.53	42.47	31.71
54	43.69	31.74	43.55	31.93	43.41	32.12	43.27	32.31
55	44.50	32.33	44.35	32.52	44.21	32.72	44.07	32.91
56	45.30	32.92	45.16	33.11	45.02	33.31	44.87	33.51
57	46.11	33.50	45.97	33.70	45.82	33.90	45.67	34.10
58	46.92	34.09	46.77	34.30	46.62	34.50	46.47	34.70
59	47.73	34.68	47.58	34.89	47.43	35.09	47.27	35.30
60	48.54	35.27	48.39	35.48	48.23	35.69	48.08	35.90
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.	

DEG. 54 — 53 DEGREES

37 DEGREES

	0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
1	0.80	0.60	0.80	0.61	0.79	0.61	0.79	0.61
2	1.60	1.20	1.59	1.21	1.59	1.22	1.58	1.22
3	2.40	1.81	2.39	1.82	2.38	1.83	2.37	1.84
4	3.19	2.41	3.18	2.42	3.17	2.43	3.16	2.45
5	3.99	3.01	3.98	3.02	3.97	3.04	3.95	3.06
6	4.79	3.61	4.78	3.63	4.76	3.65	4.74	3.67
7	5.59	4.21	5.57	4.24	5.55	4.26	5.53	4.29
8	6.39	4.81	6.37	4.84	6.35	4.87	6.33	4.90
9	7.19	5.42	7.16	5.45	7.14	5.48	7.12	5.51
10	7.99	6.02	7.96	6.05	7.93	6.09	7.91	6.12
11	8.78	6.62	8.76	6.66	8.73	6.70	8.70	6.73
12	9.58	7.22	9.55	7.26	9.52	7.31	9.49	7.35
13	10.38	7.82	10.35	7.87	10.31	7.91	10.28	7.96
14	11.18	8.43	11.14	8.47	11.11	8.52	11.07	8.57
15	11.98	9.03	11.94	9.08	11.90	9.13	11.86	9.18
16	12.78	9.63	12.74	9.68	12.69	9.74	12.65	9.80
17	13.58	10.23	13.53	10.29	13.49	10.35	13.44	10.41
18	14.38	10.83	14.33	10.90	14.28	10.96	14.23	11.02
19	15.17	11.43	15.12	11.50	15.07	11.57	15.02	11.63
20	15.97	12.04	15.92	12.11	15.87	12.18	15.81	12.24
21	16.77	12.64	16.72	12.71	16.66	12.78	16.60	12.86
22	17.57	13.24	17.51	13.32	17.45	13.39	17.40	13.47
23	18.37	13.84	18.31	13.92	18.25	14.00	18.19	14.08
24	19.17	14.44	19.10	14.53	19.04	14.61	18.98	14.69
25	19.97	15.05	19.90	15.13	19.83	15.22	19.77	15.31
26	20.76	15.65	20.70	15.74	20.63	15.83	20.56	15.92
27	21.56	16.25	21.49	16.34	21.42	16.44	21.35	16.53
28	22.36	16.85	22.29	16.95	22.21	17.05	22.14	17.14
29	23.16	17.45	23.08	17.55	23.01	17.65	22.93	17.75
30	23.96	18.05	23.88	18.16	23.80	18.26	23.72	18.37
31	24.76	18.66	24.68	18.76	24.59	18.87	24.51	18.98
32	25.56	19.26	25.47	19.37	25.39	19.48	25.30	19.59
33	26.35	19.86	26.27	19.97	26.18	20.09	26.09	20.20
34	27.15	20.46	27.06	20.58	26.97	20.70	26.88	20.82
35	27.95	21.06	27.86	21.19	27.77	21.31	27.67	21.43
36	28.75	21.67	28.66	21.79	28.56	21.92	28.46	22.04
37	29.55	22.27	29.45	22.40	29.35	22.52	29.25	22.65
38	30.35	22.87	30.25	23.00	30.15	23.13	30.03	23.26
39	31.15	23.47	31.04	23.61	30.94	23.74	30.84	23.88
40	31.95	24.07	31.84	24.21	31.73	24.35	31.63	24.49
41	32.74	24.67	32.64	24.82	32.53	24.96	32.42	25.10
42	33.54	25.28	33.43	25.42	33.32	25.57	33.21	25.71
43	34.34	25.88	34.23	26.03	34.11	26.18	34.00	26.33
44	35.14	26.48	35.02	26.63	34.91	26.79	34.79	26.94
45	35.9	27.08	35.82	27.24	35.70	27.39	35.58	27.55
46	36.74	27.68	36.62	27.84	36.49	28.00	36.37	28.16
47	37.54	28.29	37.41	28.45	37.29	28.61	37.16	28.77
48	38.33	28.89	38.21	29.05	38.08	29.22	37.95	29.39
49	39.13	29.49	39.00	29.66	38.87	29.83	38.74	30.00
50	39.93	30.09	39.80	30.26	39.67	30.44	39.53	30.61
51	40.73	30.69	40.60	30.87	40.46	31.05	40.33	31.22
52	41.53	31.29	41.39	31.48	41.25	31.66	41.12	31 84
53	42.33	31.90	42.19	32.08	42.05	32.26	41.91	32.45
54	43.13	32.50	42.98	32.69	42.84	32.87	42.70	33.06
55	43.93	33.10	43.78	33.29	43.63	33.48	43.49	33.67
56	44.72	33.70	44.58	33.90	44.43	34.09	44.28	34.28
57	45.52	34.30	45.37	34.50	45.22	34.70	45.07	34.90
58	46.32	34.91	46.17	35.11	46.01	35.31	45.86	35.51
59	47.12	35.51	46.96	35.71	46.81	35.92	46.65	36.12
60	47.92	36.11	47.76	36.32	47.60	36.53	47.44	36.73
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.	

52 DEGREES

Digitized by Google

TRAVERSE TABLE.

Distance	36 DEGREES								37 DEGREES							
	0 Min.		15 Min.		30 Min.		45 Min.		0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
61	49.35	35.85	49.19	36.07	49.04	36.28	48.88	36.50	48.72	36.71	48.56	36.92	48.39	37.13	48.23	37.35
62	50.16	36.44	50.00	36.66	49.84	36.88	49.68	37.10	49.52	37.31	49.35	37.53	49.19	37.74	49.02	37.96
63	50.97	37.03	50.81	37.25	50.64	37.47	50.48	37.69	50.31	37.91	50.15	38.13	49.98	38.35	49.81	38.57
64	51.78	37.62	51.61	37.84	51.45	38.07	51.28	38.29	51.11	38.52	50.94	38.74	50.77	38.96	50.60	39.18
65	52.59	38.21	52.42	38.44	52.25	38.66	52.08	38.89	51.91	39.13	51.74	39.34	51.57	39.57	51.39	39.79
66	53.40	38.79	53.23	39.03	53.05	39.26	52.88	39.49	52.71	39.73	52.54	39.95	52.36	40.18	52.19	40.41
67	54.20	39.38	54.03	39.62	53.86	39.85	53.68	40.09	53.51	40.32	53.33	40.55	53.15	40.79	52.98	41.02
68	55.01	39.97	54.84	40.21	54.66	40.45	54.49	40 69	54.31	40.92	54.13	41.16	53.95	41.40	53.77	41.65
69	55.82	40.56	55.64	40.80	55.47	41.04	55.29	41.28	55.11	41.52	54.92	41.77	54.74	42.00	54.56	42.24
70	56.63	41.14	56.45	41.39	56.27	41.64	56.09	41.88	55.90	42.13	55.72	42.37	55.53	42.61	55.35	42.86
71	57.44	41.73	57.26	41.98	57.07	42.23	56.89	42.48	56.70	42.73	56.52	42.98	56.33	43.22	56.14	43.47
72	58.25	42.32	58.06	42.57	57.88	42.83	57.69	43.08	57.50	43.33	57.31	43.58	57.12	43.83	56.93	44.08
73	59.06	42.91	58.87	43.17	58.68	43.42	58.49	43.68	58.30	43.93	58.11	44.19	57.91	44.44	57.72	44.69
74	59.87	43.50	59.68	43.76	59.49	44.02	59.29	44.28	59.10	44.53	58.90	44.79	58.71	45.05	58.51	45.30
75	60.68	44.08	60.48	44.35	60.29	44.61	60.09	44.87	59.90	45.14	59.70	45.40	59.50	45.66	59.30	45.92
76	61.49	44.67	61.29	44.94	61.09	45.21	60.89	45.47	60.70	45.74	60.50	46.00	60.29	46.27	60.09	46.53
77	62.29	45.26	62.10	45.53	61.90	45.80	61.70	46 07	61.49	46.34	61.29	46.61	61.09	46.87	60.88	47.14
78	63.10	45.85	62.90	46.12	62.70	46.40	62.50	46.67	62.29	46.94	62.09	47.21	61.88	47.48	61.67	47.75
79	63.91	46.43	63.71	46.71	63.50	46.99	63.30	47.27	63.09	47.54	62.88	47.82	62.67	48.09	62.46	48.37
80	64.72	47.02	64.52	47.30	64.31	47.59	64.11	47.87	63.89	48.15	63.68	48.42	63.47	48.70	63.26	48 98
81	65.53	47.61	65.32	47.90	65.11	48.18	64.90	48.46	64.69	48.75	64.48	49.03	64.26	49.31	64.05	49.59
82	66.34	48.20	66.13	48.49	65.92	48.78	65.70	49.06	65.49	49.35	65.27	49.63	65.05	49.92	64.84	50.20
83	67.15	48.79	66.93	49.08	66.72	49.37	66.50	49.66	66.29	49.95	66.07	50.24	65.85	50.53	65.63	50.81
84	67.96	49.37	67.74	49.67	67.52	49.97	67.31	50.26	67.09	50.55	66.86	50.84	66.64	51.14	66.42	51.43
85	68.77	49.96	68.55	50.26	68.33	50.56	68.11	50.86	67.88	51.15	67.66	51.45	67.43	51.74	67.21	52.04
86	69.58	50.55	69.35	50.85	69.13	51.15	68.91	51.46	68.68	51.76	68.46	52.06	68.23	52.35	68.00	52.65
87	70.38	51 14	70.16	51.44	69.94	51.75	69.71	52.05	69.48	52.36	69.25	52.66	69.02	52.96	68.79	53.26
88	71.19	51 73	70.97	52.04	70.74	52.34	70.51	52,65	70.28	52.96	70.05	53.27	69.82	53.57	69.58	53.88
89	72.00	52,31	71.77	52.63	71.54	52.94	71.31	53.25	71.08	53.56	70.84	53.87	70.61	54.18	70.37	54.49
90	72.81	52.90	72.58	53.22	72.35	53.53	72.11	53.85	71.88	54.16	71.64	54.48	71.40	54.79	71.16	55.10
91	73.62	53.49	73.39	53.81	73.15	54.13	72.91	54.45	72.68	54.77	72.44	55.08	72.20	55.40	71.95	55.71
92	74.43	54.08	74.19	54.40	73.95	54.72	73.72	55.05	73.47	55.37	73.23	55.69	72.99	56.01	72.74	56.32
93	75.24	54.66	75.00	54.99	74.76	55.32	74.52	55.64	74.27	55.97	74.03	56.29	73.78	56.61	73.53	56.94
94	76.05	55.25	75.81	55.58	75.56	55.91	75.32	56.24	75.07	56.57	74.82	56.90	74.58	57.22	74.32	57.55
95	76.86	55.84	76.61	56.17	76.37	56.51	76.12	56.84	75.87	57.17	75.62	57.50	75.37	57.83	75.12	58.16
96	77.67	56.43	77.42	56.77	77.17	57.10	76.92	57.44	76.67	57.77	76.42	58.11	76.16	58.44	75.91	58.77
97	78.47	57.02	78.23	57.36	77.97	57.70	77.72	58.04	77.47	58.39	77.21	58.71	76.96	59.05	76.70	59.39
98	79.28	57.60	79.03	57.95	78.78	58.29	78.52	58.64	78.27	58.98	78.01	59.32	77.75	59.66	77.49	60.00
99	80.09	58.19	79.84	58.54	79.58	58.89	79.32	59.23	79.06	59.58	78.80	59.92	78.54	60.27	78.28	60.61
100	80.90	58.78	80.64	59.13	80.39	59.48	80.13	59.83	79.86	60.18	79.60	60.53	79.34	60.88	79.07	61.22
101	81.71	59.37	81.45	59.72	81.19	60.08	80.93	60.43	80.66	60.78	80.40	61.13	80.13	61.48	79.86	61.83
102	82.52	59.95	82.26	60.31	81.99	60.67	81.73	61.05	81.46	61.39	81.19	61.74	80.92	62.09	80.65	62.45
103	83.33	60.54	83.06	60.90	82.80	61.27	82.53	61.63	82.26	61.99	81.99	62.35	81.72	62.70	81.44	63.06
104	84.14	61.13	83.87	61.50	83.60	61.86	83.33	62.23	83.06	62.59	82 78	62.95	82.51	63.31	82.23	63.67
105	84.95	61.72	84.68	62.09	84.41	62.46	84.13	62.82	83.86	63.19	83.58	63.56	83.30	63.92	83.02	64.28
106	85.76	62.31	85.48	62.68	85.21	63.05	84.93	63.42	84.66	63.79	84.38	64.16	84.10	64.53	83.81	64.89
107	86.56	62.89	86.29	63.27	86.01	63.65	85.73	64.02	85.45	64.39	85.17	64.77	84.89	65.14	84.60	65.51
108	87.37	63.48	87.10	63.86	86.82	64.24	86.54	64.62	86.25	65.00	85.97	65.37	85.68	65.75	85.39	66.12
109	88.18	64.07	87.90	64.45	87.62	64.84	87.34	65.22	87.05	65.60	86.76	65.98	86.48	66.36	86.19	66.73
110	88.99	64.66	88.71	65.04	88.42	65.43	88.14	65.82	87.85	66.20	87.56	66.58	87.27	66 96	86.98	67.34
111	89.80	65.24	89.52	65.64	89.23	66.03	88.94	66.41	88.65	66.80	88.36	67.19	88.06	67.57	87.77	67.96
112	90.61	65.83	90.32	66.23	90.03	66.62	89.74	67.01	89.45	67.40	89.15	67.79	88.86	68.18	88.56	68.57
113	91.42	66.42	91.13	66.82	90.84	67.21	90.54	67.61	90.25	68.11	89.95	68 40	89.65	68.79	89.35	69.18
114	92.23	67.01	91.93	67.41	91.64	67.81	91.34	68.21	91.04	68.61	90.74	69.00	90.44	69 40	90.14	69.79
115	93.04	67.60	92.74	68.00	92.44	68.40	92.14	68.81	91.84	69.21	91.54	69.61	91.24	70.01	90.93	70.40
116	93.85	68.18	93.55	68.59	93.25	69.00	92.95	69.41	92.64	69.81	92.34	70.21	92.03	70.62	91.72	71.02
117	94.65	68.77	94.35	69.18	94.05	69.59	93.75	70.00	93.44	70.41	93.13	70.82	92.82	71.23	92.51	71.63
118	95.46	69.36	95.16	69.77	94.86	70.19	94.55	70.60	94.24	71.01	93.93	71.42	93.62	71.83	93.30	72.24
119	96.27	69.95	95.97	70.37	95.66	70.78	95.35	71.20	95.04	71.62	94.72	72.03	94.41	72.44	94.09	72.85
120	97.08	70.53	96.77	70.96	96.46	71.38	96.15	71.80	95.84	72.22	95.52	72.64	95.20	73.05	94.88	73 47
Distance	Dep.	Lat.	Dep.	Lat	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.		0 Min.		45 Min.		30 Min.		15 Min.	
	54 DEG.		53 DEGREES						52 DEGREES							

Digitized by Google

TRAVERSE TABLE.

38 DEGREES

Distance	0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
1	0.79	0.62	0.78	0.62	0.78	0.62	0.78	0.63
2	1.58	1.23	1.57	1.24	1.57	1.24	1.56	1.25
3	2.36	1.85	2.36	1.86	2.35	1.87	2.34	1.88
4	3.15	2.46	3.14	2.48	3.13	2.49	3.12	2.50
5	3.94	3.08	3.93	3.10	3.91	3.11	3.90	3.13
6	4.73	3.69	4.71	3.71	4.70	3.74	4.68	3.76
7	5.52	4.31	5.50	4.33	5.48	4.36	5.46	4.38
8	6.30	4.93	6.28	4.95	6.26	4.98	6.24	5.01
9	7.09	5.54	7.07	5.57	7.04	5.60	7.02	5.63
10	7.88	6.16	7.85	6.19	7.83	6.23	7.80	6.26
11	8.67	6.77	8.64	6.81	8.61	6.85	8.58	6.89
12	9.46	7.39	9.42	7.43	9.39	7.47	9.36	7.51
13	10.24	8.00	10.21	8.05	10.17	8.09	10.14	8.14
14	11.03	8.62	10.99	8.67	10.96	8.72	10.92	8.76
15	11.82	9.23	11.78	9.29	11.7	9.34	11.70	9.39
16	12.61	9.85	12.57	9.91	12.52	9.96	12.48	10.01
17	13.40	10.47	13.35	10.52	13.30	10.58	13.26	10.64
18	14.18	11.08	14.14	11.14	14.09	11.21	14.04	11.27
19	14.97	11.70	14.92	11.76	14.87	11.83	14.82	11.89
20	15.76	12.31	15.71	12.38	15.65	12.45	15.60	12.52
21	16.55	12.93	16.49	13.00	16.43	13.07	16.38	13.14
22	17.34	13.54	17.28	13.62	17.22	13.70	17.16	13.77
23	18.12	14.16	18.06	14.24	18.00	14.32	17.94	14.40
24	18.91	14.78	18.85	14.86	18.78	14.94	18.72	15.02
25	19.70	15.39	19.63	15.48	19.57	15.56	19.50	15.65
26	20.49	16.01	20.42	16.10	20.35	16.19	20.28	16.27
27	21.28	16.62	21.20	16.72	21.13	16.81	21.06	16.90
28	22.06	17.24	21.99	17.33	21.91	17.43	21.84	17.53
29	22.85	17.85	22.77	17.95	22.70	18.05	22.62	18.15
30	23.64	18.47	23.56	18.57	23.48	18.68	23.40	18.78
31	24.43	19.09	24.34	19.19	24.26	19.30	24.18	19.40
32	25.22	19.70	25.13	19.81	25.04	19.92	24.96	20.03
33	26.00	20.32	25.92	20.43	25.83	20.54	25.74	20.66
34	26.79	20.93	26.70	21.05	26.61	21.17	26.52	21.28
35	27.58	21.55	27.49	21.67	27.39	21.79	27.30	21.91
36	28.37	22.16	28.27	22.29	28.17	22.41	28.08	22.53
37	29.16	22.78	29.06	22.91	28.96	23.03	28.86	23.16
38	29.94	23.40	29.84	23.53	29.74	23.66	29.64	23.79
39	30.73	24.01	30.63	24.14	30.52	24.28	30.42	24.41
40	31.52	24.63	31.41	24.76	31.30	24.90	31.20	25.04
41	32.31	25.24	32.20	25.38	32.09	25.52	31.98	25.66
42	33.10	25.86	32.98	26.00	32.87	26.15	32.76	26.29
43	33.88	26.47	33.77	26.62	33.65	26.77	33.53	26.91
44	34.67	27.09	34.55	27.24	34.43	27.39	34.31	27.54
45	35.46	27.70	35.34	27.86	35.22	28.01	35.09	28.17
46	36.25	28.32	36.12	28.48	36.00	28.64	35.87	28.79
47	37.04	28.94	36.91	29.10	36.78	29.26	36.65	29.42
48	37.82	29.55	37.70	29.72	37.57	29.88	37.43	30.04
49	38.61	30.17	38.48	30.34	38.35	30.50	38.21	30.67
50	39.40	30.78	39.27	30.95	39.13	31.15	38.99	31.30
51	40.19	31.40	40.05	31.57	39.91	31.75	39.77	31.92
52	40.98	32.01	40.84	32.19	40.70	32.37	40.55	32.55
53	41.76	32.63	41.62	32.81	41.48	32.99	41.33	33.17
54	42.55	33.25	42.41	33.43	42.26	33.62	42.11	33.80
55	43.34	33.86	43.19	34.05	43.04	34.24	42.89	34.43
56	44.13	34.48	43.98	34.67	43.82	34.86	43.67	35.05
57	44.92	35.09	44.76	35.29	44.61	35.48	44.45	35.68
58	45.70	35.71	45.55	35.91	45.39	36.11	45.23	36.30
59	46.49	36.32	46.33	36.53	46.17	36.73	46.01	36.93
60	47.28	36.9	47.12	37.15	46.96	37.35	46.79	37.56
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.	

52 DEG

51 DEGREES

39 DEGREES

	0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
1	0.78	0.63	0.77	0.63	0.77	0.64	0.77	0.64
2	1.55	1.26	1.55	1.27	1.54	1.27	1.54	1.28
3	2.33	1.89	2.32	1.90	2.31	1.91	2.31	1.92
4	3.11	2.52	3.10	2.53	3.09	2.54	3.08	2.56
5	3.89	3.15	3.87	3.16	3.86	3.18	3.84	3.20
6	4.66	3.78	4.65	3.80	4.63	3.82	4.61	3.84
7	5.44	4.41	5.42	4.43	5.40	4.45	5.38	4.48
8	6.22	5.03	6.20	5.06	6.17	5.09	6.15	5.12
9	6.99	5.66	6.97	5.69	6.94	5.72	6.92	5.75
10	7.77	6.29	7.74	6.33	7.72	6.36	7.69	6.39
11	8.55	6.92	8.52	6.96	8.49	7.00	8.46	7.03
12	9.33	7.55	9.29	7.59	9.26	7.63	9.23	7.67
13	10.10	8.18	10.07	8.23	10.03	8.27	9.99	8.31
14	10.88	8.81	10.84	8.86	10.80	8.91	10.76	8.95
15	11.66	9.44	11.62	9.49	11.57	9.54	11.53	9.59
16	12.43	10.07	12.39	10.12	12.35	10.18	12.30	10.25
17	13.21	10.70	13.16	10.76	13.12	10.81	13.07	10.87
18	13.99	11.33	13.94	11.39	13.89	11.45	13.84	11.51
19	14.77	11.96	14.71	12.02	14.66	12.09	14.61	12.15
20	15.54	12.59	15.49	12.65	15.43	12.72	15.38	12.79
21	16.32	13.22	16.26	13.29	16.20	13.36	16.15	13.43
22	17.10	13.84	17.04	13.92	16.98	13.99	16.91	14.07
23	17.87	14.47	17.81	14.55	17.75	14.63	17.68	14.71
24	18.65	15.10	18.59	15.18	18.52	15.27	18.45	15.35
25	19.43	15.73	19.36	15.82	19.29	15.90	19.22	15.99
26	20.21	16.36	20.13	16.45	20.06	16.54	19.99	16.63
27	20.98	16.99	20.91	17.08	20.83	17.17	20.76	17.26
28	21.76	17.62	21.68	17.72	21.61	17.81	21.53	17.90
29	22.54	18.25	22.46	18.35	22.38	18.45	22.30	18.54
30	23.31	18.88	23.23	18.98	23.15	19.08	23.07	19.18
31	24.09	19.51	24.01	19.61	23.92	19.72	23.83	19.82
32	24.87	20.14	24.78	20.25	24.69	20.35	24.60	20.46
33	25.65	20.77	25.55	20.88	25.46	20.99	25.37	21.10
34	26.43	21.40	26.33	21.51	26.24	21.63	26.14	21.74
35	27.20	22.03	27.10	22.14	27.01	22.26	26.91	22.38
36	27.98	22.66	27.88	22.78	27.78	22.90	27.68	23.02
37	28.76	23.28	28.65	23.41	28.55	23.53	28.45	23.66
38	29.53	23.91	29.43	24.04	29.32	24.17	29.22	24.30
39	30.31	24.54	30.20	24.68	30.09	24.81	29.98	24.94
40	31.09	25.17	30.98	25.31	30.86	25.44	30.75	25.58
41	31.86	25.80	31.75	25.94	31.64	26.08	31.52	26.22
42	32.64	26.43	32.52	26.57	32.41	26.72	32.29	26.86
43	33.42	27.06	33.30	27.21	33.18	27.35	33.06	27.50
44	34.19	27.69	34.07	27.84	33.95	27.99	33.83	28.14
45	34.97	28.32	34.85	28.47	34.72	28.62	34.60	28.77
46	35.75	28.95	35.62	29.10	35.49	29.26	35.37	29.41
47	36.53	29.58	36.40	29.74	36.27	29.90	36.14	30.05
48	37.30	30.21	37.17	30.37	37.04	30.53	36.90	30.69
49	38.08	30.84	37.95	31.00	37.81	31.17	37.67	31.33
50	38.86	31.47	38.72	31.64	38.58	31.80	38.44	31.97
51	39.63	32.10	39.49	32.27	39.35	32.44	39.21	32.61
52	40.41	32.72	40.27	32.90	40.12	33.08	39.98	33.25
53	41.19	33.35	41.04	33.53	40.90	33.71	40.75	33.89
54	41.97	33.98	41.82	34.17	41.67	34.35	41.52	34.53
55	42.74	34.61	42.59	34.80	42.44	34.98	42.29	35.17
56	43.52	35.24	43.37	35.43	43.21	35.62	43.06	35.81
57	44.30	35.87	44.14	36.06	43.98	36.26	43.82	36.45
58	45.07	36.50	44.91	36.70	44.75	36.89	44.59	37.09
59	45.85	37.13	45.69	37.33	45.53	37.53	45.36	37.73
60	46.63	37.76	46.46	37.96	46.30	38.16	46.13	38.37
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.	

50 DEGREES

Digitized by Google

TRAVERSE TABLE.

Distance	38 DEGREES								39 DEGREES							
	0 Mm.		15 Min.		30 Min.		45 Min.		0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
61	48.07	37.56	47.90	37.76	47.74	37.97	47.57	38.18	47.41	38.39	47.24	38.60	47.07	38.80	46.90	39.01
62	48.86	38.17	48.69	38.38	48.52	38.60	48.35	38.81	48.18	39.02	48.01	39.23	47.84	39.44	47.67	39.65
63	49.64	38.79	49.47	39.00	49.30	39.22	49.13	39.43	48.96	39.65	48.79	39.86	48.61	40.07	48.44	40.28
64	50.43	39.40	50.26	39.62	50.09	39.84	49.91	40.06	49.74	40.28	49.56	40.49	49.38	40.71	49.21	40.92
65	51.22	40.02	51.05	40.24	50.87	40.46	50.69	40.68	50.51	40.91	50.34	41.13	50.16	41.35	49.97	41.56
66	52.01	40.63	51.83	40.86	51.65	41.09	51.47	41.31	51.29	41.54	51.11	41.76	50.93	41.98	50.74	42.20
67	52.80	41.25	52.62	41.48	52.43	41.71	52.25	41.94	52.07	42.16	51.88	42.39	51.70	42.62	51.51	42.84
68	53.58	41.86	53.40	42.10	53.22	42.33	53.03	42.56	52.85	42.79	52.66	43.02	52.47	43.25	52.28	43.48
69	54.37	42.48	54.19	42.72	54.00	42.95	53.81	43.19	53.62	43.42	53.43	43.66	53.24	43.89	53.05	44.12
70	55.16	43.10	54.97	43.34	54.78	43.58	54.59	43.81	54.40	44.05	54.21	44.29	54.01	44.53	53.82	44.76
71	55.95	43.71	55.76	43.96	55.57	44.20	55.37	44.44	55.18	44.68	54.98	44.92	54.79	45.16	54.59	45.40
72	56.74	44.33	56.54	44.57	56.35	44.82	56.15	45.07	55.95	45 31	55.76	45.55	55.56	45.80	55.36	46.04
73	57.52	44.94	57.33	45.19	57.13	45.44	56.93	45.69	56.73	45.94	56.53	46.19	56.33	46.43	56.13	46.68
74	58.31	45.56	58.11	45.81	57.91	46.07	57.71	46.32	57.51	46.57	57.31	46.82	57.10	47.07	56.89	47.32
75	59.10	46.17	58.90	46.43	58.70	46.69	58.49	46.94	58.29	47.20	58.08	47.45	57.87	47.71	57.66	47.96
76	59.89	46.79	59.68	47.05	59.48	47.31	59.27	47.57	59.06	47.83	58.85	48.09	58.64	48.34	58.43	48.60
77	60.68	47.41	60.47	47.57	60.26	47.93	60.05	48.20	59.84	48.46	59.63	48.72	59.42	48.98	59.20	49.24
78	61.46	48.02	61.25	48.29	61.04	48.56	60.83	48.82	60.62	49.09	60.40	49.35	60.19	49.61	59.97	49.88
79	62 25	48.64	62.04	48.91	61.83	49.18	61.61	49.45	61.39	49.72	61.18	49.98	60.96	50.25	60.74	50.52
80	63.04	49.25	62.83	49.53	62.61	49.80	62.39	50.07	62.17	50.35	61.95	50.62	61.73	50.89	61.51	51.16
81	63.83	49.87	63.61	50.15	63.39	50.42	63.17	50.70	62.95	50.97	62.73	51.25	62.50	51.52	62.28	51.79
82	64.62	50.48	64 40	50.77	64.17	51.05	63.95	51.33	63.73	51.60	63.50	51.88	63.27	52.16	63.04	52.43
83	65.40	51.10	65.18	51.38	64.96	51.67	64.73	51.95	64.50	52.23	64.27	52.51	64.04	52.79	63.81	53.07
84	66.19	51.72	65.97	52.00	65.74	52.29	65 51	52.58	65.28	52.86	65.05	53.15	64.82	53.43	64.58	53.71
85	66.98	52.33	66.75	52.62	66.52	52.91	66.29	53.20	66.06	53.49	65.84	53.78	65.59	54.07	65.35	54.35
86	67.77	52.95	67.54	53.24	67.30	53.54	67.07	53.83	66.83	54.12	66.60	54.41	66.36	54.70	66.12	54.99
87	68.56	53.56	68.32	53.86	68.09	54.16	67.85	54.46	67.61	54.75	67.37	55.05	67.13	55.34	66.89	55.63
88	69.34	54.18	69.11	54.48	68.87	54.78	68.63	55.08	68.39	55.38	68.15	55.68	67.90	55.97	67.66	56.27
89	70.13	54.79	69.89	55.10	69.65	55.40	69.41	55.71	69.17	56.01	68.92	56.31	68.67	56.61	68.43	56.91
90	70.92	55.41	70.68	55.72	70.45	56.02	70.19	56.33	69.94	56.64	69.70	56.94	69.45	57.25	69.20	57.55
91	71.71	56.03	71.46	56.34	71.22	56.65	70.97	56.96	70.72	57.27	70.47	57.58	70.22	57.88	69.96	58.19
92	72.50	56.64	72.25	56.96	72.00	57.27	71.75	57.58	71.50	57.90	71.25	58.21	70.99	58.52	70.73	58.83
93	73.28	57.26	73.03	57.58	72.78	57.89	72.53	58.21	72.27	58.53	72.03	58.84	71.76	59.16	71.50	59.47
94	74.07	57.87	73.82	58.19	73.57	58.52	73.31	58.84	73.05	59.16	72.79	59.47	72.53	59.79	72.27	60.11
95	74.86	58.49	74.61	58.81	74.35	59.14	74.09	59.46	73.83	59.79	73.57	60.11	73.30	60.43	73.04	60.75
96	75.65	59.10	75.39	59.43	75.15	59.76	74.87	60.09	74.61	60.41	74.34	60.74	74.08	61.06	73.81	61.39
97	76 44	59.72	76.18	60.05	75.91	60.38	75.65	60.71	75.38	61.04	75.12	61.37	74.85	61.70	74.58	62.03
98	77.22	60.33	76.96	60.67	76.70	61.01	76.43	61.34	76.16	61.67	75.89	62.01	75.62	62.34	75.35	62.66
99	78.01	60.95	77.75	61.29	77.48	61.63	77.21	61 97	76.94	62.30	76.66	62.64	76.39	62.97	76.12	63.30
100	78.80	61.57	78.53	61.91	78.26	62.25	77.99	62.59	77.71	62.93	77.44	63.27	77.16	63.61	76.88	63.94
101	79.58	62.18	79.32	62.53	79.04	62.87	78.77	63.22	78.49	63.56	78.21	63.90	77.93	64.24	77.65	64 58
102	80.38	62.80	80.10	63.15	79.83	63.50	79.55	63.84	79.27	64.19	78.98	64.54	78.71	64.88	78.42	65.22
103	81.17	63.41	80.89	63.77	80.61	64.12	80 33	64.47	80.05	64.82	79.76	65 17	79.48	65.52	79.19	65.86
104	81.95	64.0	81.67	64.39	81.39	64.74	81.11	65.10	80.82	65.45	80.54	65.80	80.25	66.15	79.96	66.50
10	82.7	64.64	82.46	65.00	82.17	65.36	81.89	65.72	81.60	66.08	81.31	66.43	81.02	66.79	80.73	67.14
106	83.53	65.26	83.24	65.62	82.96	65.99	82.67	66.35	82.38	66.71	82.09	67.07	81.79	67.42	81.50	7.78
107	84.32	65.88	84.03	66.24	83.74	66.61	83.45	66.97	83.15	67.34	82.86	67.70	82.56	68.06	82.27	68.42
108	85.11	66.49	84.81	66.86	84.52	67.23	84.23	67.60	83.93	67.97	83.63	68.33	83.34	68.70	83.04	69.06
109	85.89	67.11	85.60	67.43	85.30	67.85	85.01	68.23	84.71	68.60	84.41	68.96	84.11	69.33	83.80	69.70
110	86 68	67.72	86.38	68.10	86.09	68.48	85.79	68.85	85.49	69.23	85.18	69.60	84.88	69.97	84.57	70.34
111	87.47	68.34	87.17	68.72	86.87	69.10	86.57	69.48	86.26	69.85	85.96	70.23	85.65	70.60	85.34	70.98
112	88.26	68.95	87.96	69.34	87.65	69.72	87.35	70.10	87.04	70.48	86.73	70.86	86.42	71.24	86.11	71.62
113	89.05	69.57	88.74	69.96	88.45	70.34	88.13	70.73	87.82	71.11	87.51	71.50	87.19	71.88	86.88	72.26
114	89.83	70.19	89.53	70.58	89.22	70.97	88.91	71.36	88.59	71.74	88.28	72.13	87.97	72.51	87.65	72.90
115	90.62	70.80	90.31	71.20	90.00	71.59	89.69	71.98	89.37	72.37	89.06	72.76	88.74	73.15	88.42	73.54
116	91.41	71.42	91.10	71.81	90.78	72.21	90.47	72.61	90.15	73 00	89.83	73.39	89.51	73.79	89.19	74.17
117	92.20	72.03	91.88	72.43	91.57	72.83	91.25	73.23	90.93	73.63	90.60	74.03	90.28	74.42	89.95	74.81
118	92.99	72.65	92.67	73.05	92.35	73.46	92.03	73.86	91.70	74.26	91.38	74.66	91.05	75.06	90.72	75.45
119	93.77	73.26	93.45	73.67	93.13	74.08	92.81	74.48	92.48	74.89	92.15	75.29	91.82	75.69	91.49	76.09
120	94.56	73.88	94.24	74.29	93.91	74.70	93.59	75.11	93.26	75.52	92.93	75.92	92.59	76.33	92.26	76.73
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.		0 Min.		45 Min.		30 Min.		15 Min.	
	52 DEG.		51 DEGREES						50 DEGREES							

Digitized by Google

Distance	40 DEGREES								41 DEGREES							
	0 Min.		15 Min.		30 Min.		45 Min.		0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
1	0.77	0.64	0.76	0.65	0.76	0.65	0.76	0.65	0.75	0.66	0.75	0.66	0.75	0.66	0.75	0.6
2	1.53	1.29	1.53	1.29	1.52	1.30	1.52	1.31	1.51	1.31	1.50	1.32	1.50	1.33	1.49	1.3
3	2.30	1.93	2.29	1.94	2.28	1.95	2.27	1.96	2.26	1.97	2.26	1.98	2.25	1.99	2.24	2.0
4	3.06	2.57	3.05	2.58	3.04	2.60	3.03	2.61	3.02	2.62	3.01	2.64	3.00	2.65	2.98	2.6
5	3.83	3.21	3.82	3.23	3.80	3.25	3.79	3.26	3.77	3.28	3.76	3.30	3.74	3.31	3.73	3.2
6	4.60	3.86	4.58	3.88	4.56	3.90	4.55	3.92	4.53	3.94	4.51	3.96	4.49	3.98	4.48	4.0
7	5.36	4.50	5.34	4.52	5.32	4.55	5.30	4.57	5.28	4.59	5.26	4.62	5.24	4.64	5.22	4.6
8	6.13	5.14	6.11	5.17	6.08	5.20	6.06	5.22	6.04	5.25	6.01	5.27	5.99	5.30	5.97	5.3
9	6.89	5.79	6.87	5.82	6.84	5.84	6.82	5.87	6.79	5.90	6.77	5.93	6.74	5.96	6.71	5.9
10	7.66	6.43	7.63	6.46	7.60	6.49	7.58	6.53	7.55	6.56	7.52	6.59	7.49	6.63	7.46	6.6
11	8.43	7.07	8.40	7.11	8.36	7.14	8.33	7.18	8.30	7.22	8.27	7.25	8.24	7.29	8.21	7.3
12	9.19	7.71	9.16	7.75	9.12	7.79	9.09	7.83	9.06	7.87	9.02	7.91	8.99	7.95	8.95	7.9
13	9.96	8.36	9.92	8.40	9.89	8.44	9.85	8.49	9.81	8.53	9.77	8.57	9.74	8.61	9.70	8.6
14	10.72	9.00	10.69	9.05	10.65	9.09	10.61	9.14	10.57	9.18	10.53	9.23	10.49	9.28	10.44	9.3
15	11.49	9.64	11.45	9.69	11.41	9.74	11.36	9.79	11.32	9.84	11.28	9.89	11.23	9.94	11.19	9.9
16	12.26	10.28	12.21	10.34	12.17	10.39	12.12	10.44	12.08	10.50	12.03	10.55	11.98	10.60	11.94	10.6
17	13.02	10.93	12.97	10.98	12.93	11.04	12.88	11.10	12.83	11.15	12.78	11.21	12.73	11.26	12.68	11.3
18	13.79	11.57	13.74	11.63	13.69	11.69	13.64	11.75	13.58	11.81	13.53	11.87	13.48	11.93	13.43	11.9
19	14.55	12.21	14.50	12.28	14.45	12.34	14.39	12.40	14.34	12.47	14.28	12.53	14.23	12.59	14.18	12.6
20	15.32	12.86	15.26	12.92	15.21	12.99	15.15	13.06	15.09	13.12	15.04	13.19	14.98	13.25	14.92	13.3
21	16.09	13.50	16.03	13.57	15.97	13.64	15.91	13.71	15.85	13.78	15.79	13.85	15.73	13.91	15.67	13.
22	16.85	14.14	16.79	14.21	16.73	14.29	16.67	14.36	16.60	14.43	16.54	14.51	16.48	14.58	16.41	14.
23	17.62	14.78	17.55	14.86	17.49	14.94	17.42	15.01	17.36	15.09	17.29	15.16	17.23	15.24	17.16	15.
24	18.39	15.43	18.32	15.51	18.25	15.59	18.18	15.67	18.11	15.75	18.04	15.82	17.97	15.90	17.91	15.
25	19.15	16.07	19.08	16.15	19.01	16.24	18.94	16.32	18.87	16.40	18.80	16.48	18.72	16.57	18.65	16.
26	19.92	16.71	19.84	16.80	19.77	16.89	19.70	16.97	19.62	17.06	19.55	17.14	19.47	17.23	19.40	17.
27	20.68	17.36	20.61	17.45	20.53	17.54	20.45	17.62	20.38	17.71	20.30	17.80	20.22	17.89	20.14	17.
28	21.45	18.00	21.37	18.09	21.29	18.18	21.21	18.28	21.13	18.37	21.05	18.46	20.97	18.55	20.89	18.
29	22.22	18.64	22.13	18.74	22.05	18.83	21.97	18.93	21.89	19.03	21.80	19.12	21.72	19.22	21.64	19.
30	22.98	19.28	22.90	19.38	22.81	19.48	22.73	19.58	22.64	19.68	22.56	19.78	22.47	19.88	22.38	19.
31	23.75	19.95	23.66	20.03	23.57	20.13	23.48	20.24	23.40	20.34	23.31	20.44	23.22	20.54	23.13	20.
32	24.51	20.57	24.42	20.68	24.33	20.78	24.24	20.89	24.15	20.99	24.06	21.10	23.97	21.20	23.87	21.
33	25.28	21.21	25.19	21.32	25.09	21.43	25.00	21.54	24.91	21.65	24.81	21.76	24.72	21.87	24.62	21.
34	26.05	21.85	25.95	21.97	25.85	22.08	25.76	22.19	25.66	22.31	25.56	22.42	25.46	22.53	25.37	22.
35	26.81	22.50	26.71	22.61	26.61	22.73	26.51	22.85	26.41	22.96	26.31	23.08	26.21	23.19	26.11	23.
36	27.58	23.14	27.48	23.26	27.37	23.38	27.27	23.50	27.17	23.62	27.07	23.74	26.96	23.85	26.86	23.
37	28.34	23.78	28.24	23.91	28.13	24.03	28.03	24.15	27.92	24.27	27.82	24.40	27.71	24.52	27.60	24.
38	29.11	24.43	29.00	24.55	28.90	24.68	28.79	24.80	28.68	24.93	28.57	25.06	28.46	25.18	28.35	25.
39	29.88	25.07	29.77	25.20	29.66	25.33	29.54	25.46	29.43	25.59	29.32	25.71	29.21	25.84	29.10	25.
40	30.64	25.71	30.53	25.84	30.42	25.98	30.30	26.11	30.19	26.24	30.07	26.37	29.96	26.50	29.84	26.
41	31.41	26.35	31.29	26.49	31.18	26.63	31.06	26.76	30.94	26.90	30.83	27.03	30.71	27.17	30.59	27.
42	32.17	27.00	32.06	27.14	31.94	27.28	31.82	27.42	31.70	27.55	31.58	27.69	31.46	27.83	31.33	27.
43	32.94	27.64	32.82	27.78	32.70	27.93	32.58	28.07	32.45	28.21	32.33	28.35	32.21	28.49	32.08	28.
44	33.71	28.28	33.58	28.43	33.46	28.58	33.33	28.72	33.21	28.87	33.08	29.01	32.95	29.16	32.85	29.
45	34.47	28.93	34.35	29.08	34.22	29.23	34.09	29.37	33.96	29.52	33.83	29.67	33.70	29.82	33.57	29.
46	35.24	29.57	35.11	29.72	34.98	29.87	34.85	30.03	34.72	30.18	34.58	30.33	34.45	30.48	34.32	30.
47	36.00	30.21	35.87	30.37	35.74	30.52	35.61	30.68	35.47	30.83	35.34	30.99	35.20	31.14	35.06	31.
48	36.77	30.85	36.64	31.01	36.50	31.17	36.36	31.33	36.23	31.49	36.09	31.65	35.95	31.81	35.81	31.
49	37.54	31.50	37.40	31.66	37.26	31.82	37.12	31.99	36.98	32.15	36.84	32.31	36.70	32.47	36.56	32.
50	38.30	32.14	38.16	32.31	38.02	32.47	37.88	32.64	37.74	32.80	37.59	32.97	37.45	33.13	37.30	33.
51	39.07	32.78	38.92	32.95	38.78	33.12	38.64	33.29	38.49	33.46	38.34	33.63	38.20	33.79	38.05	33.
52	39.83	33.42	39.69	33.60	39.54	33.77	39.39	33.94	39.24	34.12	39.10	34.29	38.95	34.46	38.79	34.
53	40.60	34.07	40.45	34.24	40.30	34.42	40.15	34.60	40.00	34.77	39.85	34.95	39.69	35.12	39.54	35.
54	41.37	34.71	41.21	34.89	41.06	35.07	40.91	35.25	40.75	35.43	40.60	35.60	40.44	35.78	40.29	35.
55	42.13	35.35	41.98	35.54	41.82	35.72	41.67	35.90	41.51	36.08	41.35	36.26	41.19	36.44	41.03	36.
56	42.90	36.00	42.74	36.18	42.58	36.37	42.42	36.55	42.26	36.74	42.10	36.92	41.94	37.11	41.78	37.
57	43.66	36.64	43.50	36.83	43.34	37.02	43.18	37.21	43.02	37.40	42.85	37.58	42.69	37.77	42.53	37.
58	44.43	37.28	44.27	37.48	44.10	37.67	43.94	37.86	43.77	38.05	43.61	38.24	43.44	38.43	43.27	38.
59	45.20	37.92	45.03	38.12	44.86	38.32	44.70	38.51	44.53	38.71	44.36	38.90	44.19	39.09	44.02	39.
60	45.96	38.57	45.79	38.77	45.62	38.97	45.45	39.17	45.28	39.36	45.11	39.56	44.94	39.76	44.76	39.
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	La
	0 Min.		45 Min.		30 Min.		15 Min.		0 Min.		45 Min.		30 Min.		15 Min.	
Distance	50 DEG.		49 DEGREES						48 DEGREES							

Digitized by Google

TRAVERSE TABLE.

40 DEGREES

Distance	0 Min. Lat.	0 Min. Dep.	15 Min. Lat.	15 Min. Dep.	30 Min. Lat.	30 Min. Dep.	45 Min. Lat.	45 Min. Dep.
61	46.73	39.21	46.56	39.41	46.38	39.62	46.21	39.82
62	47.49	39.85	47.32	40.06	47.15	40.27	46.97	40.47
63	48.26	40.50	48.08	40.71	47.91	40.92	47.73	41.12
64	49.03	41.14	48.85	41.35	48.67	41.56	48.48	41.78
65	49.79	41.78	49.61	42.00	49.43	42.21	49.24	42.43
66	50.56	42.42	50.37	42.64	50.19	42.86	50.00	43.08
67	51.32	43.07	51.14	43.29	50 95	43.51	50.76	43.73
68	52.09	43.71	51.90	43.94	51.71	44.16	51.51	44.39
69	52.86	44.35	52,66	44.58	52.47	44.81	52.27	45.04
70	53.62	45.00	53.43	45.23	53.23	45.46	53.03	45.69
71	54.39	45.64	54.19	45.87	53.99	46.11	53.79	46.35
72	55.16	46.28	54.95	46.52	54.75	46.76	54.54	47.00
73	55.92	46.92	55.72	47.17	55.51	47.41	55.30	47.65
74	56.69	47.57	56.48	47.81	56.27	48.06	56.06	48.30
75	57.45	48.21	57.24	48.46	57.03	48.71	56.82	48.96
76	58.22	48.85	58 01	49.11	57.79	49.36	57.57	49.61
77	58.99	49.49	58.77	49.75	58.55	50.01	58.33	50.26
78	59.75	50.14	59.53	50.40	59.31	50.66	59.09	50 92
79	60.52	50.78	60.30	51.04	60.07	51.31	59.85	51.57
80	61.28	51.42	61.06	51.69	60.83	51.96	60.61	52.22
81	62.05	52.07	61.82	52.34	61.59	52.61	61.36	52.87
82	62.82	52.71	62.59	52.98	62.35	53.25	62.12	53.53
83	63.58	53.35	63.35	53.63	63:11	53.90	62.88	54.18
84	64.35	53.99	64.11	54.27	63.87	54.55	63.64	54.83
85	65.11	54.64	64.87	54.92	64.63	55.20	64.39	55.48
86	65.88	55.28	65.64	55.57	65.39	55.85	65.15	56.14
87	66.65	55.92	66.40	56.21	66.16	56.50	65.91	56.79
88	67.41	56.57	67.16	56.86	66.92	57.15	66.67	57.44
89	68.18	57.21	67.93	57.50	67.38	57.80	67.42	58.10
90	68.94	57.85	68.69	58 15	68.44	58.45	68.18	58.75
91	69.71	58.49	69.45	58.80	69.20	59.10	68.94	59.40
92	70.48	59.14	70.22	59.44	69.96	59.75	69.70	60.05
93	71.24	59.78	70.98	60.09	70.72	60.40	70.45	60.71
94	72.01	60.42	71.74	60.74	71.48	61.05	71.21	61.36
95	72.77	61.06	72.51	61.38	72.24	61.70	71.97	62.01
96	73.54	61.71	73.27	62.03	73.00	62.35	72.73	62.66
97	74.31	62.35	74.03	62.67	73.76	63.00	73.48	63.32
98	75.07	62.99	74.80	63.32	74.52	63.65	74.24	63.97
99	75.84	63.64	75.56	63.97	75.28	64.30	75.00	64.62
100	76.60	64.28	76.32	64.61	76.04	64.94	75.76	65.28
101	77.37	64.92	77.09	65.26	76.80	65.59	76.51	65.93
102	78.14	65.56	77.85	65.90	77.56	66.24	77.27	66.58
103	78.90	66.21	78.61	66.55	78.32	66.89	78.03	67.23
104	79.67	66.85	79.38	67.20	79.08	67.54	78.79	67.89
105	80.43	67.49	80.14	67.84	79.84	68.19	79.54	68.54
106	81.20	68.14	80.90	68.49	80.60	68.84	80.30	69.19
107	81.97	68.78	81.67	69.14	81.36	69.49	81.06	69.85
108	82.73	69.42	82.43	69.78	82.12	70.14	81 82	70.50
109	83.50	70.06	83.19	70.43	82.88	70.79	82.57	71.15
110	84.26	70.71	83.96	71.07	83.64	71.44	83.35	71.80
111	85.03	71.36	84.72	71.72	84.41	72.09	84.09	72.46
112	85.80	71.99	85.48	72.37	85.17	72.74	84.85	73.11
113	86.56	72.64	86.25	73.01	85.93	73.39	85.60	73.76
114	87.33	73.28	87.01	73.66	86.69	74.04	86.36	74.41
115	88.10	73.92	87.77	74.30	87.45	74.69	87.12	75.07
116	88.86	74.56	88.54	74.95	88.21	75.34	87.88	75.72
117	89.63	75.21	89.30	75.60	88.97	75.99	88.64	76.37
118	90.39	75.85	90.06	76.24	89.73	76.63	89.39	77.03
119	91.16	76.49	90.82	76 89	90.49	77 28	90.15	77.68
120	91.93	77.13	91.59	77.53	91.25	77.93	90.91	78.33
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.	

50 DEG.

41 DEGREES

0 Min. Lat.	0 Min. Dep.	15 Min. Lat.	15 Min. Dep.	30 Min. Lat.	30 Min. Dep.	45 Min. Lat.	45 Min. Dep.
46.04	40.02	45.86	40.22	45.69	40.42	45.51	40.62
46.79	40.68	46.61	40.88	46.44	41.08	46.26	41.28
47.55	41.33	47.37	41.54	47.18	41.75	47.00	41.95
48.30	41.99	48.12	42.20	47.93	42.41	47.75	42.62
49.06	42.64	48.87	42.86	48.68	43.07	48.49	43.28
49.81	43.30	49.62	43.52	49.43	43.73	49.24	43.95
50.57	43.96	50.37	44.18	50.18	44.40	49.99	44.61
51.32	44.61	51.13	44.84	50.93	45.06	50.73	45.28
52.07	45.27	51 88	45.49	51.68	45.72	51.48	45.95
52.83	45.92	52.63	46.15	52.43	46.38	52.22	46.61
53.58	46.58	53.38	46.81	53.18	47.05	52.97	47.28
54.34	47.24	54.13	47.47	53.92	47.71	53.72	47.94
55.09	47.89	54.88	48.13	54.67	48.37	54.46	48.61
55.85	48.55	55.64	48.79	55.42	49.03	55.21	49.28
56.60	49.20	56.39	49.45	56.17	49.70	55.95	49.94
57.36	49.86	57.14	50.11	56.92	50.36	56.70	50.61
58.11	50.52	57.89	50.77	57.67	51.02	57.45	51.27
58.87	51.17	58.64	51.43	58.42	51.68	58.19	51.94
59.62	51.83	59.40	52.09	59.17	52.35	58.94	52.60
60.38	52.48	60.15	52.75	59.92	53.01	59.68	53.27
61.13	53.14	60.90	53.41	60.67	53.67	60.43	53.94
61.89	53.80	61 65	54.07	61.41	54.33	61.18	54.60
62.64	54.45	62.40	54.73	62.16	55 00	61.92	55.27
63.40	55.11	63.15	55.38	62.91	55.66	62.67	55.93
64.15	55.76	63.91	56.04	63.66	56.32	63.41	56.60
64.90	56.42	64.66	56.70	64.41	56.99	64.16	57.27
65.66	57.08	65.41	57.36	65.16	57.65	64.91	57.93
66.41	57.73	66.16	58.02	65.91	58.31	65.65	58.60
67.17	58.39	66.91	58.68	66.66	58.97	66.40	59.26
67.92	59.05	67.67	59.34	67.41	59.64	67.15	59.93
68 68	59.70	68.42	60.00	68.15	60.30	67.89	60.60
69.43	60.36	69.17	60.66	68.90	60.96	68.64	61.26
70.19	61.01	69.92	61.32	69.65	61.62	69.38	61.95
70.94	61.67	70.67	61.98	70.40	62.29	70.13	62.59
71.70	62.33	71.42	62.64	71.15	62.95	70.88	63.26
72.45	62.98	72.18	63.30	71.90	63.61	71.62	63.92
73.21	63.64	72 93	63.96	72.65	64.27	72.37	64.59
73.96	64.29	73.68	64.62	73.40	64.94	73.11	65.26
74.72	64.95	74.43	65.28	74.15	65.60	73.86	65.92
75.47	65.61	75.18	65.93	74.90	66.26	74.61	66.59
76.23	66.26	75.94	66.59	75.64	66.92	75.35	67.25
76.98	66.92	76.69	67.25	76.39	67.59	76.10	67.92
77.74	67.57	77.44	67.91	77.14	68.25	76.84	68.59
78.49	68.23	78.19	68.57	77.89	68.91	77.59	69.25
79.24	68.89	78.94	69.23	78.64	69.58	78.34	69.92
80.00	69.54	79.70	69.89	79.39	70.24	79.09	70 58
80.75	70.20	80.45	70.55	80.14	70.90	79.85	71.25
81.51	70.85	81.20	71.21	80.89	71.56	80.57	71.92
82.26	71.51	81.95	71.87	81.64	72.23	81.32	72.58
83.02	72.17	82.70	72.53	82.38	72.89	82.07	73.25
83.77	72.82	83.45	73.19	83 15	73.55	82.81	73 91
84.53	73.48	84.21	73.85	33.88	74.21	83.56	74.58
85.28	74.13	84.96	74.51	84.63	74.88	84.30	75.24
86.04	74.79	85.71	75.17	85.38	75.54	85.05	75.91
86.79	75.45	86.46	75.82	86.15	76.20	85.80	76.58
87.55	76.10	87.21	76.48	86.88	76.86	86.54	77 22
88.30	76.76	87.97	77.14	87.63	77.53	87.29	77.91
89.06	77.42	88.72	77.80	88.38	78.19	88.03	78.57
89 81	78.07	89.47	78.46	89.13	78.85	88.78	79.24
90.57	78.73	90.22	79.12	89.87	79.51	89.53	79.91
Dep.	Lat.	Dep.	Lat.	Dep	Lat.	Dep.	Lat.
0 Min.		45 Min.		30 Min.		15 Min.	

49 DEGREES

48 DEGREES

Digitized by Google

Distance	42 DEGREES								43 DEGREES							
	0 Min.		15 Min.		30 Min.		45 Min.		0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
1	0.74	0.67	0.74	0.67	0.74	0.68	0.73	0.68	0.73	0.68	0.73	0.69	0.73	0.69	0.72	0.69
2	1.48	1.34	1.48	1.34	1.47	1.35	1.47	1.36	1.46	1.36	1.46	1.37	1.45	1.38	1.44	1.38
3	2.22	2.01	2.22	2.04	2.21	2.03	2.20	2.04	2.19	2.05	2.19	2.06	2.18	2.07	2.17	2.07
4	2.97	2.68	2.96	2.69	2.95	2.70	2.94	2.73	2.92	2.73	2.91	2.74	2.90	2.75	2.89	2.77
5	3.72	3.35	3.70	3.30	3.69	3.38	3.67	3.39	3.66	3.41	3.6	3.43	3.63	3.44	3.61	3.46
6	4.46	4.01	4.4	4.0	4.42	4.05	4.41	4.07	4.39	4.09	4.3	4.11	4.35	4.13	4.33	4.1
7	5.20	4.68	5.18	4.71	5.16	4.73	5.14	4.75	5.12	4.77	5.1	4 80	5.08	4.82	5.06	4.8
8	5.95	5.35	5.92	5.38	5.90	5.40	5.87	5.42	5.8	5.4	5.8	5.48	5.80	5.51	5.78	5.5
9	6.69	6.02	6.66	6.05	6.64	6.08	6.61	6.11	6.58	6.14	6.5	6.17	6.5	6.20	6.50	6.22
10	7.4	6.69	7.40	6.72	7.37	6.76	7.34	6.79	7.31	6.8	7.2	6.85	7.2	6.88	7.22	6.92
11	8.17	7.36	8.14	7.40	8.11	7.43	8.08	7.47	8.0	7.5	8.0	7.54	7.9	7.57	7.95	7.61
12	8.92	8.03	8.88	8.07	8.85	8.11	8.81	8.15	8.7	8.18	8.7	8.22	8.7	8.26	8.67	8.30
13	9.66	8.70	9.62	8.74	9.58	8.78	9.55	8.83	9.51	8.87	9.47	8.91	9.4	8.95	9.39	8.99
14	10.40	9.37	10.36	9.41	10.32	9.46	10.28	9.50	10.2	9.55	10.20	9.59	10.16	9.64	10.11	9.68
15	11.15	10.04	11.10	10.09	11.06	10.13	11.01	10.18	10.97	10.2	10.9	10.28	10.8	10.33	10.84	10.37
16	11.89	10.71	11.85	10.76	11.80	10.81	11.75	10.86	11.7	10.91	11.6	10.96	11.51	11.01	11.56	11.06
17	12.63	11.38	12.58	11.43	12.53	11.48	12.48	11.54	12.43	11.59	12.3	11.65	12.3	11.70	12.28	11.76
18	13.38	12.04	13.32	12.10	13.27	12.16	13.22	12.22	13.16	12.28	13.11	12.33	13.06	12.39	13.00	12.45
19	14.12	12.71	14.06	12.77	14.01	12.84	13.95	12.90	13.90	12.96	13.84	13.02	13.78	13.08	13.72	13.14
20	14.86	13.38	14.80	13.44	14.75	13.51	14.69	13.58	14.6	13.64	14.57	13.70	14.51	13.77	14.45	13.83
21	15.61	14.05	15.5	14.12	15.48	14.19	15.42	14.2	15.3	14.32	15.3	14.39	15.2	14.46	15.17	14.52
22	16.35	14.72	16.28	14.79	16.22	14.86	16.16	14.9	16.09	15.00	16.02	15.07	15.9	15.14	15.89	15.21
23	17.09	15.39	17.03	15.46	16.96	15.54	16.89	15.61	16.8	15.69	16.7	15.76	16.6	15.83	16.61	15.90
24	17.84	16.06	17.77	16.13	17.69	16.21	17.62	16.29	17.5	16 37	17.4	16.44	17.41	16.52	17.34	16.60
25	18.58	16.73	18.51	16.81	18.43	16.89	18.36	16.9	18.2	17.05	18.21	17.13	18.1	17.21	18.06	17.29
26	19.32	17.40	19.25	17.48	19.17	17.57	19.09	17.6	19.0	17.75	18.9	17.81	18.86	17.90	18.78	17.98
27	20.06	18.07	19.99	18.15	19 91	18.24	19.83	18.3	19.7	18.41	19.6	18.50	19.5	18.59	19.50	18.67
28	20.81	18 74	20.73	18.83	20.64	18.92	20.56	19.01	20.4	19.10	20.3	19.19	20.31	19.27	20.23	19.36
29	21.55	19.40	21.47	19.50	21.38	19.59	21.30	19.69	21.21	19.78	21.12	19.87	21.04	19.96	20.95	20.05
30	22.29	20.07	22.21	20.17	22.12	20.27	22.03	20.36	21.9	20.46	21.8	20.56	21.7	20.65	21.67	20.75
31	23.0	20.74	22.95	20.84	22.86	20.94	22.76	21.04	22.67	21.14	2.5	21.24	22.45	21.34	22.39	21.44
32	23.78	21.41	23.69	21.52	23.59	21.62	23.50	21.73	23.40	21.82	23.31	21.93	23.21	22.03	23.12	22.13
33	24.52	22.08	24.43	22 19	24.33	22.29	24 23	22.40	24.15	22.51	24.04	22.61	23.9	22.72	23.84	22 82
34	25.27	22.75	25.17	22.86	25.07	22.97	24.97	23.08	24.87	23.19	24.76	23.30	24.6	23.40	24.56	23.51
35	26.01	23.42	25.91	23.5	25.80	23.65	25.70	23.7	25.60	23.87	25.49	23.98	25.3	24.09	25.28	24.20
36	26.7	24.09	26.6	24.2	26.54	24.32	26.44	24.4	26.3	24.55	26.22	24.67	26.1	24.78	26.01	24.89
37	27.50	24.76	27.39	24.88	27.28	25.00	27.17	25.1	27.06	25.23	26.95	25.35	26.8	25.47	26.73	25.59
38	28.24	25.43	28.15	25.55	28.02	25.67	27.90	25.7	27.7	25.92	27.68	26.04	27.5	26.16	27.45	26 28
39	28.98	26.10	29.87	26 22	28.75	26.35	28.64	26.47	28.52	26.60	28.41	26 72	28.29	26.85	28 17	26.97
40	29.73	26.77	29.61	26.89	29.49	27.02	29.37	27 1	29.2	27.28	29.1	27.41	29.0	27.53	28.89	27.66
41	30.47	27.43	30.35	27.57	30.23	27.70	30.11	27.8	29.99	27.96	29.86	28.09	29.7	28.22	29.62	28.35
42	31.21	28.10	31.09	28.24	30.97	28.37	30.84	28.5	30.72	28.64	30.5	28.78	30.47	28.91	30.34	29.04
43	31.96	28.77	31.83	28.91	31.70	29.05	31.58	29.1	31.4	29.33	31.32	29.46	31.1	29.60	31.06	29.74
44	32.70	29.44	32.57	29.58	32.44	29.73	32.31	29.87	32.1	30.01	32.05	30.15	31.92	30.29	31.78	30.43
45	33 44	30.11	33.31	30 26	33.18	30.40	33.04	30.55	32.91	30.69	32.78	30.83	32.6	30.98	32.51	31.12
46	34.18	30.78	34.05	30.93	33.91	31.08	33.78	31.22	33.64	31.37	33.51	31.52	33.37	31.66	33.23	31.81
47	34.96	31.45	34.79	31.60	34.65	31.75	34.51	31.80	34.37	32.05	34.23	32.20	34.09	32.35	33.95	32.50
48	35.67	32.12	35.53	32.27	35.39	32.43	35.25	32 58	35.10	32.74	34.96	32.89	34.8	33.04	34.67	33.19
49	36.41	32.79	36.27	32.95	36.13	33.10	35.98	33.26	35 8	33.42	35.69	33.57	35.54	33.73	35.40	33.88
50	37.16	33.46	37.01	33.62	36.86	33.78	36.72	33.94	36.5	34.10	36 42	34.26	36.27	34.42	36.12	34.58
51	37.90	34.13	37.75	34 29	37.60	34 46	37.45	34.62	37.30	34.78	37.15	34.94	36.9	35.11	36.84	35.27
52	38.64	34.79	38.49	34.96	38.34	35.13	38.18	35.30	38.0	35.46	37.88	35.63	37.72	35.79	37.56	35.96
53	39.39	35.46	39.23	35.64	39.08	35 81	38.92	35.98	38.7	36.15	3 .60	36.31	38.44	36.48	38.29	36.65
54	40.13	36.13	39.97	36.31	39.81	36.48	39.65	36.66	39.4	36.83	39.3	37.00	39.17	37.17	39.01	37.34
55	40.87	36.80	40.71	36.98	40.55	37.16	40.39	37.33	40.2	7.51	40.06	37.69	39.90	37.86	39.73	38.03
56	41.62	37.47	41.45	37.65	41.29	37.83	41.12	38.01	40.96	38.19	40.79	38.37	40.62	38.55	40.45	38.72
57	42.36	38.14	42.19	38.32	42.02	38.51	41.86	38.69	41.69	38.87	41.52	39.06	41.35	39.24	41.17	39.42
58	43.10	38 81	42.93	39.00	42 76	39 18	42.59	39.37	42.42	39.56	42.25	39.7	42.07	39.92	41.90	40.11
59	43.85	39.48	43.67	39.67	43.50	39.86	43.32	40.05	43.15	40.24	42.97	40.43	42.80	40.61	42.62	40.80
60	44.59	40.15	44.41	40.34	44.24	40.54	44.06	40.73	43.88	40.92	43.70	41.11	43.52	41.30	43.34	41.49
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Min.		15 Min.		0 Min.		45 Min.		30 Min.		15 Min.	
	48 DEG.		47 DEGREES								46 Degrees					

Digitized by Google

TRAVERSE TABLE.

Distance	42 DEGREES								43 DEGREES							
	0 Min.		15 Min.		30 Min.		45 Min.		0 Min.		15 Min.		30 Min.		45 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
61	45.33	40.82	45.15	41.01	44.97	41.21	44.79	41.41	44.61	41.60	44.43	41.80	44.25	41.99	44.06	42.18
62	46.07	41.49	45.89	41.69	45.71	41.89	45.53	42.09	45.34	42.28	45.16	42.48	44.97	42.68	44.79	42.87
63	46.82	42.16	46.63	42.36	46.45	42.56	46.26	42.76	46.08	42.97	45.89	43.17	45.70	43.37	45.51	43.57
64	47.56	42.82	47.37	43.03	47.19	43.24	47.00	43.44	46.81	43.65	46.62	43 85	46.42	44.05	46.23	44.26
65	48.30	43.49	48.11	43.70	47.92	43.91	47.73	44.12	47.54	44.33	47.34	44.54	47.15	44.74	46.95	44.95
66	49.05	44.16	48.85	44.38	48.66	44.59	48.47	44.80	48.27	45.01	48.07	45.22	47.87	45.43	47.68	45.63
67	49.79	44.83	49.59	45.05	49.40	45.26	49.20	45.48	49.00	45.69	48.80	45.91	48.60	46.12	48.40	46.33
68	50.53	45.50	50.33	45.72	50.13	45.94	49.93	46.16	49.73	46.38	49.53	46.59	49.33	46.81	49.12	47.02
69	51.28	46.17	51.07	46.39	50.87	46.62	50.67	46.84	50.46	47.06	50.26	47.28	50.05	47.50	49.84	47.71
70	52.02	46.84	51.82	47.07	51.61	47.29	51.40	47.52	51.19	47.74	50.99	47.96	50 78	48.18	50.57	48.41
71	52.76	47.51	52.56	47.74	52.35	47.97	52.14	48.19	51.93	48.42	51.71	48.65	51.50	48.87	51.29	49.10
72	53.51	48.18	53.30	48.41	53.08	48.64	52.87	48.87	52.66	49.10	52.44	49.33	52.23	49.56	52.01	49.78
73	54.25	48.85	54.04	49.08	53.82	49.32	53.61	49.55	53.39	49.79	53.17	50.02	52.95	50.25	52.73	50.48
74	54.99	49.52	54.78	49.76	54.56	49.99	54.34	50.23	54.12	50.47	53.90	50.70	53.68	50.94	52.45	51.17
75	55.74	50.18	55.52	50.43	55.30	50.67	55.07	50.91	54.85	51.15	54.63	51.39	54.40	51.63	54.18	51.86
76	56.48	50.85	56.26	51.10	56.03	51.34	55.81	51.59	55.58	51.83	55.36	52.07	55.13	52.31	54.90	52.55
77	57.22	51.52	57.00	51.77	56.77	52.02	56.54	52.27	56.31	52.51	56.08	52.76	55.85	53.00	55.62	53.25
78	57.97	52.19	57.74	52.44	57.51	52.70	57.28	52.95	57.05	53.20	56.81	53.44	56.58	53.69	56.34	53.94
79	58.71	52.86	58.48	53.12	58.24	53.37	58.01	53.63	57.78	53.88	57.54	54.13	57.30	54.38	57.07	54.63
80	59.45	53.53	59.22	53.79	58.98	54.05	58.75	54.30	58.51	54.56	58.27	54.81	58.03	55.07	57.79	55.32
81	60.19	54.20	59.96	54.46	59.72	54.72	59.48	54.98	59.24	55.24	59.00	55.50	58.76	55.76	58.51	56.01
82	60.94	54.87	60.70	55.13	60.46	55.40	60.21	55.66	59.97	55.92	59.73	56.18	59.48	56.45	59.23	56.70
83	61.68	55.54	61.44	55.81	61.19	56.07	60.95	56.34	60.70	56.61	60.45	56.87	60.21	57.13	59.96	57.40
84	62.42	56.21	62.18	56.48	61.93	56.75	61.68	57.02	61.43	57.29	61.18	57.56	60.93	55.82	60.68	58.09
85	63.17	56.88	62.92	57.15	62.67	57.42	62.42	57.70	62.17	57.97	61.91	58.24	61.66	58.51	61.40	58.78
86	63.91	57.55	63.66	57.82	63.41	58.10	63.15	58.38	62.90	58.65	62.64	58.93	62.38	59.20	62.12	59.47
87	64.65	58.21	64.40	58.50	64.14	58.78	63.89	59.06	63.63	59.33	63.37	59.61	63.11	59.89	62 85	60.16
88	65.40	58.88	65.14	59.17	64.88	59.45	64.62	59.73	64.36	60.02	64.10	60.30	63.83	60.58	63.57	60.85
89	66.14	59.55	65.88	59.84	65.62	60.13	65.35	60.41	65.09	60.70	64.82	60.98	64.56	61.26	64.29	61.54
90	66.88	60.22	66.62	60.51	66.35	60.80	66.09	61.09	65.82	61.38	65.55	61.67	65.28	61.95	65.01	62.23
91	67.63	60.89	67.36	61.19	67.09	61.48	66.82	61.77	66.55	62.06	66.28	62.35	66.01	62 64	65.74	62.93
92	68.37	61,56	68.10	61.86	67.83	62.15	67.56	62.45	67.28	62.74	67.01	63.04	66.73	63.33	66.46	63.63
93	69.11	62.23	68.84	62.53	68.57	62.83	68.29	63.13	68.02	63.43	67.74	63.72	67.46	64.02	67.18	64.3
94	69.86	62.90	69.58	63.20	69.30	63.51	69.03	63.81	68.75	64.11	68.47	64.41	68.19	64.71	67.90	65.0
95	70.60	63.57	70.32	63.87	70.04	64.18	69.76	64.49	69.48	64.79	69.20	65.09	68.91	65.39	68.62	65.6
96	71.34	64.24	71.06	64.55	70.78	64.86	70.49	65.16	70.21	65.47	69.92	65.78	69.64	66.08	69.35	66.3
97	72.08	64.91	71.80	65.22	71.52	65.53	71.23	65.84	70.94	66.15	70.65	66.46	70.36	66.77	70.07	67.0
98	72.83	65.57	72.54	65.89	72.25	66.21	71.96	66.52	71.67	66.84	71.38	67.15	81.09	67.46	70.79	67.7
99	73.57	66.24	73.28	66.56	72.99	66.88	72.70	67.20	72.40	67.52	72.11	67.83	71.81	68.15	71.51	68.4
100	74.31	66.91	74.02	67.24	73.73	67.56	73.43	67.83	73.14	68.20	72.84	68.52	72.54	68.84	72.24	69.1
101	75.06	67.58	74.76	67.91	74.46	68.23	74.17	68.56	73.87	68.88	73.57	69.20	73.26	69.52	72.96	69.8
102	75.80	68.25	75.50	68.58	75.20	68.91	74.90	69.24	74.60	69.56	74.29	69.89	73.99	70.21	73.68	70.5
103	76.54	68.92	76.24	69.25	75.94	69.59	75.64	69.92	75.33	70.25	75.02	70.57	74.71	70.90	74.40	71.2
104	77.29	69.59	76.98	69.93	76.68	70.26	76.37	70.60	76.06	70.93	75.75	71.26	75.44	71.59	75.13	71.9
105	78.03	70.26	77.72	70.60	77.41	70.94	77.10	71.27	76.79	71.61	76.48	71.94	76.16	72.28	75.85	72.6
106	78.77	70.93	78.46	71.27	78.15	71.61	77.84	71.95	77.52	72.29	77.21	72 63	76.89	72.97	76.57	73.3
107	79.51	71.60	79.20	71.94	78.89	72.29	78.57	72.63	78.25	72.97	77.94	73.31	77.61	73.65	77.29	73.9
108	80.26	72.27	79.94	72.62	79.63	72.96	79.31	73.31	78.99	73.66	78.66	74.00	78.34	74.34	78.02	74.6
109	81.00	72.94	80.68	73.29	80.36	73.64	80.04	73.99	79.72	74.34	79.39	74.68	79.07	75.03	78.74	75.3
110	81.75	73.60	81.42	73.96	81.10	74.31	80.78	74.67	80.45	75.02	80.12	75.37	79.79	75.72	79.46	76.0
111	82.49	74.27	82.16	74.63	81.84	74.99	81.51	75.35	81.18	75.70	80.85	76.06	80.52	76.41	80.18	76.7
112	83.23	74.94	82.90	75.31	82.57	75.67	82.24	76.03	81.91	76.38	81.58	76.74	81.24	77.10	80.90	77.4
113	83.98	75.61	83.64	75.98	83.31	76.34	82.98	76.70	82.64	77.07	82.31	77.43	81.97	77.78	81.63	78.1
114	84.72	76.28	84.38	76.65	84.05	77.02	83.71	77.38	83.37	77.75	83.03	78.11	82.69	78.47	82.35	78.8
115	85.46	76.95	85.12	77.32	84.79	77.69	84.45	78.06	84.11	78.43	83.76	78.80	83 42	79.16	83.07	79.3
116	86.20	77.62	85.87	77.99	85.52	78.37	85.18	78.74	84.84	79.11	84.49	79.48	84.14	79.85	83.79	80.9
117	86 95	78.29	86.61	78.67	86.26	79.04	85.92	79.42	85.57	79.79	85.22	80.17	84.87	80.54	84.52	80.9
118	87.69	78.96	87.35	79.34	87.00	79.72	86.65	80.10	86.30	80.48	85.95	80.85	85.59	81.23	85.24	81.6
119	88.44	79.63	88.09	80.01	87.74	80.40	87 38	80.78	87.03	81.16	86.68	81.54	86.32	81.91	85.96	82.3
120	89.18	80.30	88.83	80.68	88.47	81.07	88.12	81.46	87.76	81.84	87.40	82.22	87.04	82.60	86.68	82.9
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	La
	0 Min.		45 Min.		30 Min.		15 Min.		0 Min.		45 Min.		30 Min.		15 Mi	
	48 DEG.		47 DEGREES						46 DEGREES							

Digitized by Google

Distance	44 DEGREES								45°
	0 Min.		15 Min.		30 Min.		45 Min.		Lat.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Dep.
1	.072	0.69	0.72	0.70	0.71	0.70	0.71	0.70	0.71
2	1.44	1.39	1.43	1.40	1.43	1.40	1.42	1.41	1.41
3	2.16	2.08	2.15	2.09	2.14	2.10	2.13	2.11	2.12
4	2.88	2.78	2.87	2.79	2.85	2.80	2.84	2.82	2.83
5	3.60	3.47	3.58	3.49	3.57	3.50	3.55	3.53	3.54
6	4.32	4.17	4.30	4.19	4.28	4.21	4.26	4.22	4.24
7	5.04	4.86	5.01	4.88	4.99	4.91	4.97	4.93	4.95
8	5.75	5.56	5.73	5.58	5.71	5.61	5.68	5.63	5.66
9	6.47	6.25	6.45	6.28	6.42	6.31	6.39	6.34	6.36
10	7.19	6.95	7.16	6.98	7.13	7.01	7.10	7.04	7.07
11	7.91	7.64	7.88	7.68	7.85	7.71	7.81	7.74	7.78
12	8.63	8.34	8.60	8.37	8.56	8.41	8.52	8.45	8.49
13	9.35	9.03	9.31	9.07	9.27	9.11	9.23	9.15	9.19
14	10.07	9.73	10.03	9.77	9.99	9.81	9.94	9.86	9.90
15	10.79	10.42	10.74	10.47	10.70	10.51	10.65	10.56	10.61
16	11.51	11.11	11.46	11.16	11.41	11.21	11.36	11.26	11.31
17	12.23	11.81	12.18	11.86	12.13	11.92	12.07	11.97	12.02
18	12.95	12.50	12.89	12.56	12.84	12.62	12.78	12.67	12.73
19	13.67	13.20	13.61	13.26	13.55	13.32	13.49	13.38	13.44
20	14.39	13.89	14.33	13.96	14.27	14.02	14.20	14.08	14.14
21	15.11	14.59	15.04	14.65	14.98	14.72	14.91	14.78	14.85
22	15.83	15.28	15.76	15.35	15.69	15.42	15.62	15.49	15.56
23	16.55	15.98	16.47	16.05	16.40	16.12	16.33	16.19	16.26
24	17.26	16.67	17.19	16.75	17.12	16.82	17.04	16.90	16.97
25	17.98	17.37	17.91	17.44	17.83	17.52	17.75	17.60	17.68
26	18.70	18.06	18.62	18.14	18.54	18.22	18.46	18.30	18.38
27	19.42	18 76	19.34	18.84	19.26	18.92	19.17	19.01	19.09
28	20.14	19.45	20.06	19.54	19 97	19.63	19.89	19.71	19.80
29	20.86	20.15	20.77	20.24	20.68	20.33	20.60	20.42	20.51
30	21.58	20.84	21.49	20.93	21.40	21.03	21.31	21.12	21.21
31	22.30	21.53	22.21	21.63	22.11	21.73	22.02	21.83	21.92
32	23.02	22.23	22.92	22.32	22.82	22.43	22.73	22.53	22.63
33	23.74	22.92	23.64	23.02	23.54	23.13	23.44	23.23	23.33
34	24.46	23.62	24.35	23.72	24.25	23.83	24.15	23.94	24.04
35	25.18	24.31	25.07	24.42	24.96	24.53	24.86	24 64	24.75
36	25.90	25.01	25.79	25.12	25.68	25.23	25.57	25.34	25.46
37	26.62	25.70	26.50	25.82	26.39	25.93	26.28	26.05	26.16
38	27.33	26.40	27.22	26.52	27.10	26.63	26.99	26.75	26.87
39	28.05	27.09	27.94	27.21	27.82	27.34	27 70	27.46	27.58
40	28.77	27.79	28.65	27.91	28.53	28.04	28.41	28.16	28.28
41	29.49	28.48	29.37	28.61	29.24	28.74	29.12	28.86	28.99
42	30.21	29.18	30.08	29.31	29.96	29.44	29.83	29.57	29.70
43	30.93	29.87	30.80	30 01	30.67	30.14	30.54	30.27	30.41
44	31.65	30.56	31.52	30.70	31.38	30.84	31.25	30.98	31.11
45	32.37	31.26	32.23	31.40	32.10	31.54	31.96	31.68	31.82
46	33.09	31.95	32.95	32.10	32.81	32.24	32.67	32.38	32.53
47	33.81	32.65	33.67	32.80	33.52	32.94	33.38	33.09	33.23
48	34.53	33.34	34.38	33.49	34.24	33.64	34.09	33.79	33.94
49	35.25	34.04	35.10	34 19	34.95	34.34	34.80	34.50	34.65
50	35.97	34.73	35.82	34.89	35.66	35.05	35.51	35.20	35.36
51	36.69	35.43	36.53	35.59	36.38	35 75	36.22	35.90	36.06
52	37.41	36.12	37.25	36.29	37.09	36.45	36.93	36.61	36 77
53	38.12	36.82	37.96	36.98	37.80	37.15	37.64	37.31	37.48
54	38.84	37.51	38.68	37.68	38.52	37.85	38.35	38.02	38.18
55	39.56	38.21	39.40	38.38	39.23	38.55	39.06	38.72	38.89
56	40.28	38 90	40.11	39.08	39.94	39 25	39.77	39.42	39.60
57	41.00	39.60	40.83	39.77	40.66	39.95	40.48	40.13	40.31
58	41.72	40.29	41.55	40.47	41.37	40.65	41.19	40.83	41.01
59	42.44	40.98	42.26	41.17	42.08	41.35	41.90	41.54	41.72
60	43.16	41.68	42.98	41.87	42.80	42.05	42.61	42.24	42.43
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	La .	D.L.
	0 Min.		45 Min.		30 Min.		15 Min.		0 M.
	46 DEG.		45 DEGREES						

Distance	44 DEGREES					
	0 Min.		15 Min.		30 Min.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
61	43.88	42.97	43.69	42.57	43.51	42.76
62	44.60	43.07	44.41	43.26	44.22	43.46
63	45.32	43.76	45.13	43.96	44.93	44.16
64	46.04	44.46	45.84	44.66	45.65	44.86
65	46.76	45.15	46.56	45.36	46.36	45.56
66	47.48	45.85	47.28	46.05	47.07	46.26
67	48.20	46.54	47.99	46.75	47.79	46.96
68	48.92	47.24	48.71	47.45	48.50	47.66
69	49.63	47.93	49.42	48.15	49.21	48.36
70	50.35	48.63	50.14	48.85	49.93	49.06
71	51.07	49.32	50.86	49.54	50.64	49.76
72	51.79	50.02	51.57	50.24	51.35	50.47
73	52.51	50.71	52.29	50.94	52.07	51.17
74	53.23	51.40	53.01	51.64	52.78	51.87
75	53.95	52.10	53.72	52.33	53.49	52.57
76	54.67	52.79	54.44	53.03	54.21	53.27
77	55.39	53.49	55.16	53.73	54.92	53.97
78	56.11	54.18	55.87	54.43	55.63	54.67
79	56.83	54.88	56.59	55.13	56.35	55.37
80	57.55	55.57	57.30	55.82	57.06	56.07
81	58.27	56.27	58.02	56.52	57.77	56.77
82	58.99	55.96	58 74	57.22	58.49	57.47
83	59.71	57.66	59.45	57.92	59.20	58.18
84	60.42	58.35	60.17	58 61	59 91	58.88
85	61.14	59.05	60.89	59.31	60.63	59.58
86	61.86	59.74	61.60	60.01	61.34	60.28
87	62.58	60.44	62.32	60.71	62.05	60.98
88	63.30	61.13	63.03	61.41	62.77	61.68
89	64.02	61.82	63.75	62.10	63.48	62.38
90	64.74	62.52	64.47	62.80	64.19	63.08
91	65.46	63.21	65.18	63.50	64.91	63.78
92	66.18	63.91	65.90	64.20	65.62	64.48
93	66.90	64.60	66.62	64.89	66.33	65.18
94	67.62	65.30	67.33	65.59	67.05	65.89
95	68.34	65.99	68.05	66.29	67.76	66.59
96	69.06	66.69	68.77	66.99	68.47	67.29
97	69.78	67.38	69.48	67.69	69.19	67.99
98	70.50	68.08	70.20	68.38	69.90	68.69
99	71.21	68.77	70.91	69.08	70.61	69.39
100	71.93	69.47	71.63	69.78	71.33	70.09
101	72.65	70.16	72.35	70.48	72.04	70.79
102	73.37	70.86	73.06	71.17	72.75	71.49
103	74.09	71.55	73.78	71.87	73.46	72.19
104	74.81	72.24	74.50	72.57	74.18	72.89
105	75.53	72.94	75.21	73.27	74.89	73.60
106	76.25	73.63	75.93	73.97	75.60	74.30
107	76.97	74.33	76.64	74.66	76.32	75.00
108	77.69	75.02	77.36	75.36	77.03	75.70
109	78.41	75.72	78.08	76.06	77.74	76.40
110	79.13	76.41	78.79	76.76	78.46	77 10
111	79.85	77.11	79.51	77.45	79.17	77.86
112	80.57	77.80	80.23	78.15	79.88	78.56
113	81.29	78.50	80.94	78.85	80.60	79.20
114	82.00	79.19	81.66	79.55	81.31	79.90
115	82 72	79.89	82.37	80.25	82.02	80.60
116	83.44	80.58	83.09	80.94	82.74	81.31
117	84.16	81.28	83.81	81.64	83.45	82.01
118	84.88	81.97	84.52	82.34	84.16	82.71
119	85.60	82.66	85.24	83.04	84.88	83.41
120	86.32	83.36	85.96	83.73	85.59	84.11
Distance	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	0 Min.		45 Min.		30 Mm.	
	46 DEG.		45 DEGREES			

Digitized by Google

TRAV. TABLE.

Distance	44 DEG. 45 Min. Lat.	Dep.	45° Lat. Dep.
61	43.32	42.94	43.15
62	44.03	43.65	43.84
63	44.74	44.35	44.55
64	45.45	45.06	45.25
65	46.16	45.76	45.96
66	46.87	46.47	46.67
67	47.58	47.17	47.38
68	48.29	47.87	48 08
69	49.00	48.58	48.79
70	49.71	49.28	49.50
71	50.42	49.99	50.20
72	51.13	50.69	50.91
73	51.84	51.39	51.62
74	52.55	52.10	52.33
75	53.26	52.80	53.03
76	53.97	53.51	53.74
77	54.68	54.21	54.45
78	55.39	54.91	55.15
79	56.10	55.62	55.86
80	56.81	56.32	56.57
81	57.52	57.03	57.28
82	58.24	57.73	57.98
83	58.95	58.43	58.69
84	59.66	59.14	59.40
85	60.37	59.84	60.10
86	61.08	60.55	60.81
87	61.79	61.25	61.52
88	62.50	61.95	62.23
89	63.21	62.66	62.93
90	63.92	63.36	63.64
91	64.63	64.07	64.35
92	65.34	64.77	65.05
93	66.05	65.47	65.76
94	66.76	66.18	66.47
95	67.47	66.88	67.18
96	68.18	67.59	67.88
97	68.89	68.29	68.59
98	69.60	68.99	69.30
99	70.31	69.70	70.00
100	71.02	70.40	70.71
101	71.73	71.11	71.42
102	72.44	71.81	72.12
103	73.15	72.51	72.83
104	73.86	73.22	73.54
105	74.57	73.92	74.25
106	75.28	74.63	74.95
107	75.99	75.33	75.66
108	76.70	76.03	76.37
109	77.41	76.74	77.07
110	78.12	77.44	77.78
111	78.83	78.15	78.49
112	79.54	78.85	79.20
113	80.25	79.55	79.90
114	80.96	80.26	80.61
115	81.67	80.96	81.32
116	82.38	81.67	82.02
117	83.09	82.37	82.73
118	83.80	83.07	83.44
119	84.51	83.78	84.15
120	85.22	84.48	84.85
Distance	Dep.	Lat.	D.L.
	15 Min.		0 M.
	45 DEG.		

MERIDIONAL PARTS.

Lat. Min.	0° M. P.	1° M. P.	2° M. P.	3° M. P.	4° M. P.	5° M. P.	6° M. P.	7° M. P.	8° M. P.	9° M. P.
0	0.0	60.0	120.0	180.1	240.2	300.4	360.7	421.1	481.6	542.2
1	1.0	61.0	121.0	181.1	241.2	301.4	361.7	422.1	482.6	543.3
2	2.0	62.0	122.0	182.1	242.2	302.4	362.7	423.1	483.6	544.3
3	3.0	63.0	123.0	183.1	243.2	303.4	363.7	424.1	484.6	545.3
4	4.0	64.0	124.0	184.1	244.2	304.4	364.7	425.1	485.6	546.3
5	5.0	65.0	125.0	185.1	245.2	305.4	365.7	426.1	486.6	547.3
6	6.0	66.0	126.0	186.1	246.2	306.4	366.7	427.1	487.6	548.3
7	7.0	67.0	127.0	187.1	247.2	307.4	367.7	428.1	488.6	549.3
8	8.0	68.0	128.0	188.1	248.2	308.4	368.7	429.1	489.6	550.3
9	9.0	69.0	129.0	189.1	249.2	309.4	369.7	430.1	490.7	551.4
10	10.0	70.0	130.0	190.1	250.2	310.4	370.7	431.1	491.7	552.4
11	11.0	71.0	131.0	191.1	251.2	311.4	371.7	432.1	492.7	553.4
12	12.0	72.0	132.0	192.1	252.2	312.4	372.7	433.1	493.7	554.4
13	13.0	73.0	133.0	193.1	253.2	313.4	373.7	434.2	494.7	555.4
14	14.0	74.0	134.0	194.1	254.2	314.4	374.7	435.2	495.7	556.4
15	15.0	75.0	135.0	195.1	255.2	315.4	375.7	436.2	496.7	557.4
16	16.0	76.0	136.0	196.1	256.2	316.4	376.8	437.2	497.7	558.4
17	17.0	77.0	137.0	197.1	257.2	317.5	377.8	438.2	498.7	559.4
18	18.0	78.0	138.0	198.1	258.2	318.5	378.8	439.2	499.8	560.5
19	19.0	79.0	139.0	199.1	259.2	319.5	379.8	440.2	500.8	561.5
20	20.0	80.0	140.0	200.1	260.2	320.5	380.8	441.2	501.8	562.5
21	21.0	81.0	141.0	201.1	261.2	321.5	381.8	442.2	502.8	563.5
22	22.0	82.0	142.0	202.1	262.2	322.5	382.8	443.2	503.8	564.5
23	23.0	83.0	143.0	203.1	263.2	323.5	383.8	444.2	504.8	565.5
24	24.0	84.0	144.0	204.1	264.2	324.5	384.8	445.2	505.8	566.6
25	25.0	85.0	145.0	205.1	265.2	325.5	385.8	446.3	506.8	567.6
26	26.0	86.0	146.0	206.1	266.2	326.5	386.8	447.3	507.8	568.6
27	27.0	87.0	147.0	207.1	267.2	327.5	387.8	448.3	508.9	569.6
28	28.0	88.0	148.0	208.1	268.2	328.5	388.8	449.3	509.9	570.6
29	29.0	89.0	149.0	209.1	269.2	329.5	389.8	450.3	510.9	571.6
30	30.0	90.0	150.0	210.1	270.2	330.5	390.8	451.3	511.9	572.6
31	31.0	91.0	151.0	211.1	271.2	331.5	391.8	452.3	512.9	573.6
32	32.0	92.0	152.0	212.1	272.2	332.5	392.9	453.3	513.9	574.7
33	33.0	93.0	153.1	213.1	273.2	333.5	393.9	454.3	514.9	575.7
34	34.0	94.0	154.1	214.1	274.2	334.5	394.9	455.3	515.9	576.7
35	35.0	95.0	155.1	215.1	275.2	335.5	395.9	456.3	516.9	577.7
36	36.0	96.0	156.1	216.1	276.2	336.5	396.9	457.3	518.0	578.7
37	37.0	97.0	157.1	217.1	277.2	337.5	397.9	458.4	519.0	579.7
38	38.0	98.0	158.1	218.1	278.2	338.5	398.9	459.4	520.0	580.7
39	39.0	99.0	159.1	219.1	279.2	339.6	399.9	460.4	521.0	581.8
40	40.0	100.0	160.1	220.2	280.2	340.6	400.9	461.4	522.0	582.8
41	41.0	101.0	161.1	221.2	281.2	341.6	401.9	462.4	523.0	583.8
42	42.0	102.0	162.1	222.2	282.2	342.6	402.9	463.4	524.0	584.8
43	43.0	103.0	163.1	223.2	283.2	343.6	403.9	464.4	525.0	585.8
44	44.0	104.0	164.1	224.2	284.3	344.6	404.9	465.4	526.0	586.8
45	45.0	105.0	165.1	225.2	285.3	345.6	405.9	466.4	527.1	587.8
46	46.0	106.0	166.1	226.2	286.3	346.6	407.0	467.4	528.1	588.9
47	47.0	107.0	167.1	227.2	287.3	347.6	408.0	468.4	529.1	589.9
48	48.0	108.0	168.1	228.2	288.3	348.6	409.0	469.5	530.1	590.9
49	49.0	109.0	169.1	229.2	289.3	349.6	410.0	470.5	531.1	591.9
50	50.0	110.0	170.1	230.2	290.3	350.6	411.0	471.5	532.1	592.9
51	51.0	111.0	171.1	231.2	291.3	351.6	412.0	472.5	533.1	593.9
52	52.0	112.0	172.1	232.2	292.4	352.6	413.0	473.5	534.1	595.0
53	53.0	113.0	173.1	233.2	293.4	353.6	414.0	474.5	535.1	596.0
54	54.0	114.0	174.1	234.2	294.4	354.6	415.0	475.5	536.2	597.0
55	55.0	115.0	175.1	235.2	295.4	355.6	416.0	476.5	537.2	598.0
56	56.0	116.0	176.1	236.2	296.4	356.6	417.0	477.5	538.2	599.0
57	57.0	117.0	177.1	237.2	297.4	357.6	418.0	478.5	539.2	600.0
58	58.0	118.0	178.1	238.2	298.4	358.6	419.0	479.6	540.2	601.0
59	59.0	119.0	179.1	239.3	299.4	359.7	420.0	480.6	541.2	602.1
Cor. M.P.	.0	—0.4	—0.7	—1.1	—1.5	—1.9	—2.2	—2.6	—3.0	—3.3
Cor. Lat.	.0	—0.4	—0.7	—1.1	—1.5	—1.9	—2.2	—2.6	—3.0	—3.3

Digitized by Google

MERIDIONAL PARTS.

Lat.	10°	11°	12°	13°	14°	15°	16°	17°	18°	19°	20°	21°	22°
Min	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.
0	603.1	664.1	725.3	786.8	848.5	910.5	972.7	1035.3	1098.2	1161.5	1225.1	1289.2	1353.7
1	04.1	65.1	26.3	87.8	49.5	11.5	73.8	36.3	99.3	62.5	26.2	90.3	54.8
2	05.1	66.1	27.4	88.8	50.5	12.5	74.8	37.4	1100.3	63.6	27.3	91.3	55.8
3	06.1	67.1	28.4	89.9	51.6	13.6	75.9	38.4	01.4	64.7	28.3	92.4	56.9
4	07.1	68.2	29.4	90.9	52.6	14.6	76.9	39.5	02.4	65.7	29.4	93.5	58.0
5	608.2	669.2	730.4	791.9	853.6	915.6	977.9	1040.5	1103.5	1166.8	1230.5	1294.5	1359.1
6	09.2	70.2	31.5	92.9	54.7	16.7	79.0	41.6	04.5	67.8	31.5	95.6	60.2
7	10.2	71.2	32.5	94.0	55.7	17.7	80.0	42.6	05.6	68.9	32.6	96.7	61.2
8	11.2	72.2	33.5	95.0	56.7	18.8	81.1	43.7	06.6	70.0	33.7	97.8	62.3
9	12.2	73.3	34.5	96.0	57.8	19.8	82.1	44.7	07.7	71.0	34.7	98.8	63.4
10	613.2	674.3	735.5	797.0	858.8	920.8	983.1	1045.8	1108.7	1172.1	1235.8	1299.9	1364.5
11	14.2	75.3	36.6	98.1	59.8	21.9	84.2	46.8	09.8	73.1	36.8	1301.0	65.6
12	15.3	76.3	37.6	99.1	60.9	22.9	85.2	47.9	10.8	74.2	37.9	02.1	66.6
13	16.3	77.3	38.6	800.1	61.9	23.9	86.3	48.9	11.9	75.2	39.0	03.1	67.7
14	17.3	78.4	39.6	01.2	62.9	25.0	87.3	49.9	12.9	76.3	40.0	04.2	68.8
15	618.3	679.4	740.7	802.2	864.0	926.0	988.3	1051.0	1114.0	1177.4	1241.1	1305.3	1369.9
16	19.3	80.4	41.7	03.2	65.0	27.0	89.4	52.0	15.0	78.4	42.2	06.3	71.0
17	20.3	81.4	42.7	04.2	66.0	28.1	90.4	53.1	16.1	79.5	43.2	07.4	72.0
18	21.4	82.4	43.7	05.3	67.1	29.1	91.5	54.1	17.2	80.5	44.3	08.5	73.1
19	22.4	83.5	44.8	06.3	68.1	30.1	92.5	55.2	18.2	81.6	45.4	09.6	74.2
20	623.4	684.5	745.8	807.3	869.1	931.2	993.6	1056.2	1119.3	1182.7	1246.4	1310.6	1375.3
21	24.4	85.5	46.8	08.4	70.1	32.2	94.6	57.3	20.3	83.7	47.5	11.7	76.4
22	25.4	86.5	47.8	09.4	71.2	33.3	95.6	58.3	21.4	84.8	48.6	12.8	77.4
23	26.4	87.5	48.9	10.4	72.2	34.3	96.7	59.4	22.4	85.8	49.6	13.9	78.5
24	27.4	88.6	49.9	11.4	73.2	35.3	97.7	60.4	23.5	86.9	50.7	14.9	79.6
25	628.5	689.6	750.9	812.5	874.3	936.4	998.8	1061.5	1124.5	1188.0	1251.8	1316.0	1380.7
26	29.5	90.6	51.9	13.5	75.3	37.4	99.8	62.5	25.6	89.0	52.8	17.1	81.8
27	30.5	91.6	53.0	14.5	76.3	38.4	1000.8	63.6	26.6	90.1	53.9	18.2	82.8
28	31.5	92.6	54.0	15.5	77.4	39.5	01.9	64.6	27.7	91.1	55.0	19.2	83.9
29	32.5	93.7	55.0	16.6	78.4	40.5	02.9	65.7	28.7	92.2	56.0	20.3	85.0
30	633.6	694.7	756.0	817.6	879.4	941.6	1004.0	1066.7	1129.8	1193.3	1257.1	1321.4	1386.1
31	34.6	95.7	57.1	18.6	80.5	42.6	05.0	67.8	30.9	94.3	58.2	22.5	87.2
32	35.6	96.7	58.1	19.7	81.5	43.6	06.1	68.8	31.9	95.4	59.2	23.5	88.3
33	36.6	97.7	59.1	20.7	82.5	44.7	07.1	69.9	33.0	96.4	60.3	24.6	89.4
34	37.6	98.8	60.1	21.7	83.6	45.7	08.1	70.9	34.0	97.5	61.4	25.7	90.4
35	638.6	699.8	761.1	822.7	884.6	946.7	1009.2	1072.0	1135.1	1198.6	1262.4	1326.7	1391.5
36	39.7	700.8	62.2	23.8	85.6	47.8	10.2	73.0	36.1	99.6	63.5	27.8	92.6
37	40.7	01.8	63.2	24.8	86.7	48.8	11.2	74.1	37.2	1200.7	64.6	28.9	93.7
38	41.7	02.8	64.2	25.8	87.7	49.9	12.2	75.1	38.2	01.7	65.7	30.0	94.8
39	42.7	03.9	65.2	26.9	88.7	50.9	13.3	76.2	39.3	02.8	66.7	31.1	95.8
40	643.7	704.9	766.2	827.9	889.8	951.9	1014.3	1077.2	1140.4	1203.9	1267.8	1332.1	1396.9
41	44.7	05.9	67.3	28.9	90.8	53.0	15.4	78.3	41.4	04.9	68.9	33.2	98.0
42	45.8	06.9	68.3	29.9	91.8	54.0	16.5	79.3	42.5	06.0	69.9	34.3	99.1
43	46.8	07.9	69.3	31.0	92.9	55.0	17.5	80.4	43.5	07.1	71.0	35.4	1400.2
44	47.8	09.0	70.4	32.0	93.9	56.1	18.6	81.4	44.6	08.1	72.1	36.4	01.3
45	648.8	710.0	771.4	833.0	894.9	957.1	1019.6	1082.5	1145.6	1209.2	1273.1	1337.5	1402.4
46	49.8	11.0	72.4	34.1	96.0	58.2	20.7	83.5	46.7	10.2	74.2	38.6	03.4
47	50.8	12.0	73.4	35.1	97.0	59.2	21.7	84.6	47.7	11.3	75.3	39.7	04.5
48	51.9	13.1	74.5	36.1	98.0	60.2	22.8	85.6	48.8	12.4	76.3	40.7	05.6
49	52.9	14.1	75.5	37.2	99.1	61.3	23.8	86.7	49.9	13.4	77.4	41.8	06.7
50	653.9	715.1	776.5	838.2	900.1	962.3	1024.8	1087.7	1150.9	1214.5	1278.5	1342.9	1407.8
51	54.9	16.1	77.5	39.2	01.1	63.4	25.9	88.8	52.0	15.6	79.6	44.0	08.9
52	55.9	17.1	78.6	40.2	02.2	64.4	26.9	89.8	53.0	16.6	80.6	45.1	09.9
53	57.0	18.2	79.6	41.3	03.2	65.5	28.0	90.9	54.1	17.7	81.7	46.1	11.0
54	58.0	19.2	80.6	42.3	04.3	66.5	29.0	91.9	55.1	18.8	82.8	47.2	12.1
55	659.0	720.2	781.7	843.3	905.3	967.5	1030.1	1093.0	1156.2	1219.8	1283.8	1348.2	1413.2
56	60.0	21.2	82.7	44.4	06.3	68.6	31.1	94.0	57.3	20.9	84.9	49.4	14.3
57	61.0	22.3	83.7	45.4	07.4	69.6	32.2	95.1	58.3	21.9	86.0	50.4	15.4
58	62.1	23.3	84.7	46.4	08.4	70.7	33.2	96.1	59.4	23.0	87.0	51.5	16.5
59	63.1	24.3	85.8	47.5	09.4	71.7	34.3	97.2	60.4	24.1	88.1	52.6	17.5
Cor. M. P.	3.7	—4.1	—4.5	—4.8	—5.2	—5.5	—5.9	—6.3	—6.6	—7.0	—7.3	—7.7	—8.0
Cor. Lat.	3.7	—4.0	—4.4	—4.7	—5.0	—5.4	—5.7	—6.0	—6.4	—6.7	—7.0	—7.3	—7.6

Digitized by Google

MERIDIONAL PARTS.

Lat.	23°	24°	25°	26°	27°	28°	29°	30°	31°	32°	33°	34°	35°
Min.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.
0	1418.6	1484.1	1550.0	1616.5	1683.5	1751.2	1819.4	1888.4	1958.0	2028.4	2099.5	2171.5	2244.3
1	19.7	85.2	51.1	17.6	84.6	52.3	20.6	89.5	59.2	29.6	2100.7	72.7	45.5
2	20.8	86.3	52.2	18.7	85.8	53.4	21.7	90.7	60.4	30.7	01.9	73.9	46.7
3	21.9	87.3	53.3	19.8	86.9	54.6	22.9	91.8	61.5	31.9	03.1	75.1	48.0
4	23.0	88.4	54.4	20.9	88.0	55.7	24.0	93.0	62.7	33.1	04.3	76.3	49.2
5	1424.1	1489.5	1555.5	1622.0	1689.1	1756.8	1825.2	1894.1	1963.9	2034.3	2105.5	2177.5	2250.4
6	25.1	90.6	56.6	23.2	90.3	58.0	26.3	95.3	65.0	35.5	06.7	78.7	51.6
7	26.2	91.7	57.7	24.3	91.4	59.1	27.4	96.5	66.2	36.6	07.9	79.9	52.8
8	27.3	92.8	58.8	25.4	92.5	60.2	28.6	97.6	67.4	37.8	09.1	81.1	54.1
9	28.4	93.9	59.9	26.5	93.6	61.4	29.7	98.8	68.5	39.0	10.3	82.4	55.3
10	1429.5	1495.0	1561.0	1627.6	1694.8	1762.5	1830.9	1899.9	1969.7	2040.2	2111.5	2183.6	2256.5
11	30.6	96.1	62.1	28.7	95.9	63.6	32.0	1901.1	70.9	41.4	12.7	84.8	57.7
12	31.7	97.2	63.2	29.8	97.0	64.8	33.2	02.3	72.0	42.6	13.9	86.0	59.0
13	32.8	98.3	64.3	31.0	98.1	65.9	34.3	03.4	73.2	43.7	15.1	87.2	60.2
14	33.9	99.4	65.5	32.1	99.3	67.0	35.5	04.6	74.4	44.9	16.2	88.4	61.4
15	1434.9	1500.5	1566.6	1633.2	1700.4	1768.2	1836.6	1905.7	1975.5	2046.1	2117.4	2189.6	2262.6
16	36.0	01.6	67.7	34.3	01.5	69.3	37.8	06.9	76.7	47.3	18.6	90.8	63.9
17	37.1	02.7	68.8	35.4	02.6	70.4	38.9	08.0	77.9	48.5	19.8	92.0	65.1
18	38.2	03.8	69.9	36.5	03.8	71.6	40.1	09.2	79.1	49.6	21.0	93.2	66.3
19	39.3	04.9	71.0	37.6	04.9	72.7	41.2	10.4	80.2	50.8	22.2	94.4	67.5
20	1440.4	1506.0	1572.1	1638.8	1706.0	1773.9	1842.3	1911.5	1981.4	2052.0	2123.4	2195.7	2268.8
21	41.5	07.1	73.2	39.9	07.1	75.0	43.5	12.7	82.6	53.2	24.6	96.9	70.0
22	42.6	08.2	74.3	41.0	08.3	76.1	44.6	13.8	83.7	54.4	25.8	98.1	71.2
23	43.7	09.3	75.4	42.1	09.4	77.3	45.8	15.0	84.9	55.6	27.0	2199.3	72.4
24	44.7	10.4	76.5	43.2	10.5	78.4	46.9	16.1	86.1	56.8	28.2	2200.5	73.7
25	1445.8	1511.5	1577.6	1644.3	1711.6	1779.5	1848.1	1917.3	1987.2	2057.9	2129.4	2201.7	2274.9
26	46.9	12.6	78.7	45.5	12.8	80.7	49.2	18.5	88.4	59.1	30.6	02.9	76.1
27	48.0	13.7	79.8	46.6	13.9	81.8	50.4	19.6	89.6	60.5	31.8	04.1	77.3
28	49.1	14.8	80.9	47.7	15.0	82.9	51.5	20.8	90.8	61.5	33.0	05.4	78.6
29	50.2	15.9	82.1	48.8	16.1	84.1	52.7	21.9	91.9	62.7	34.2	06.6	79.8
30	1451.3	1517.0	1583.2	1649.9	1717.3	1785.2	1853.8	1925.1	1993.1	2063.9	2135.4	2207.8	2281.0
31	52.4	18.1	84.3	51.0	18.4	86.4	55.0	24.3	94.3	65.0	36.6	09.0	82.3
32	53.5	19.2	85.4	52.2	19.5	87.5	56.1	25.4	95.5	66.2	37.8	10.2	83.5
33	54.6	20.3	86.5	53.3	20.7	88.6	57.2	26.6	96.6	67.4	39.0	11.4	84.7
34	55.6	21.4	87.6	54.4	21.8	89.8	58.4	27.8	97.8	68.6	40.2	12.6	85.9
35	1456.7	1522.5	1588.7	1655.5	1722.9	1790.9	1859.6	1928.9	1999.0	2069.8	2141.4	2213.9	2287.2
36	57.8	23.6	89.8	56.6	24.0	92.1	60.7	30.1	2000.1	71.0	42.6	15.1	88.4
37	58.9	24.7	90.9	57.8	25.2	93.2	61.9	31.2	01.3	72.2	43.8	16.3	89.6
38	60.0	25.8	92.0	58.9	26.3	94.3	63.0	32.4	02.5	73.4	45.0	17.5	90.9
39	61.1	26.9	93.1	60.0	27.4	95.5	64.2	33.6	03.7	74.5	46.2	18.7	92.1
40	1462.2	1528.0	1594.3	1661.1	1728.5	1796.6	1865.3	1934.7	2004.8	2075.7	2147.4	2219.9	2293.3
41	63.3	29.1	95.4	62.2	29.7	97.8	66.5	35.9	06.0	76.9	48.6	21.1	94.6
42	64.4	30.2	96.5	63.3	30.8	98.9	67.6	37.1	07.2	78.1	49.8	22.4	95.8
43	65.5	31.3	97.6	64.5	31.9	1800.0	68.8	38.2	08.4	79.3	51.0	23.6	97.0
44	66.6	32.4	98.7	65.6	33.1	01.2	69.9	39.4	09.5	80.5	52.2	24.8	98.2
45	1467.7	1533.5	1599.8	1666.7	1734.2	1802.3	1871.1	1940.5	2010.7	2081.7	2153.4	2226.0	2299.5
46	68.8	34.6	1600.9	67.8	35.3	03.5	72.2	41.7	11.9	82.9	54.6	27.2	2300.7
47	69.8	35.7	02.0	68.9	36.5	04.6	73.4	42.9	13.1	84.0	55.8	28.4	01.9
48	70.9	36.8	03.1	70.1	37.6	05.7	74.5	44.0	14.3	85.2	57.0	29.7	03.2
49	72.0	37.9	04.2	71.2	38.7	06.9	75.7	45.2	15.4	86.4	58.2	30.9	04.4
50	1473.1	1539.0	1605.4	1672.3	1739.8	1808.0	1876.8	1946.4	2016.6	2087.6	2159.4	2232.1	2305.6
51	74.2	40.1	06.5	73.4	41.0	09.2	78.0	47.5	17.8	88.8	60.6	33.3	06.9
52	75.3	41.2	07.6	74.5	42.1	10.3	79.1	48.7	19.0	90.0	61.8	34.5	08.1
53	76.4	42.3	08.7	75.7	43.2	11.4	80.3	49.9	20.1	91.2	63.0	35.8	09.3
54	77.5	43.4	09.8	76.8	44.4	12.6	81.5	51.0	21.3	92.4	64.2	37.0	10.6
55	1478.6	1544.5	1610.9	1677.9	1745.5	1813.7	1882.6	1952.2	2022.5	2093.6	2165.5	2238.2	2311.8
56	79.7	45.6	12.0	79.0	46.6	14.9	83.8	53.4	23.7	94.8	66.7	39.4	13.1
57	80.8	46.7	13.1	80.2	47.8	16.0	84.9	54.5	24.9	96.0	67.9	40.6	14.3
58	81.9	47.8	14.2	81.3	48.9	17.2	86.1	55.7	26.0	97.1	69.1	41.9	15.5
59	83.0	48.9	15.4	82.4	50.0	18.3	87.2	56.9	27.2	98.3	70.2	43.1	16.7
Cor. M.P.	8.4	—8.7	—9.0	—9.4	—9.7	—10.0	—10.4	—10.7	—11.0	—11.3	—11.7	—12.0	—12.3
Cor. Lat.	7.9	—8.2	—8.4	—8.7	—9.0	—9.2	—9.5	—9.7	—9.9	—10.1	—10.4	—10.6	—10.8

Digitized by Google

MERIDIONAL PARTS.

Lat.	36°	37°	38	39°	40°	41°	42°	43°	44°	45°	46°	47°	48°
Min.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.
0	2318 0	2392.6	2468.3	2544.9	2622.7	2701.6	2781.7	2863.1	2945.8	3029 9	3115.6	3202.7	3291.5
1	19·2	93.9	69.5	46.2	24.0	02.9	83.1	64.5	47.2	31.4	17.0	04.2	93.0
2	20·5	95.1	70.8	47.5	25.3	04.3	84.4	65.8	48.6	32.8	18.4	05.7	94.5
3	21·7	96.4	72.1	48.8	26.6	05.6	85.8	67.2	50.0	34.2	19.9	07.1	96 0
4	22.9	97.6	73.3	50.1	27.9	06.9	87.1	68.6	51.4	35.6	21.3	08.6	97.5
5	2324.2	2398.9	2474.6	2551.4	2629.2	2708.2	2788.4	2869.9	2952.8	3037.0	3122.8	3210.1	3299.0
6	25.4	2400.2	75.9	52.7	30.5	09.6	89.8	71.3	54.2	38.4	24.2	11.5	3300.5
7	26.7	01.4	77.1	54.0	31.8	10.9	91.1	72.7	55.6	39.8	25.6	13.0	02 0
8	27.9	02.7	78.4	55.2	33.1	12.2	92.5	74.1	57.0	41.3	27.1	14.5	03.5
9	29.1	03.9	79.7	56.5	34.5	13.5	93.8	75.4	58.3	42.7	28.5	15.9	05.0
10	2330.4	2405.2	2481.0	2557.8	2635.8	2714.9	2795.2	2876.8	2959.7	3044.1	3130.0	3217.4	3306.5
11	31.6	06.4	82.2	59.1	37.1	16.2	96.5	78.2	61.1	45.5	31.4	18.9	08.0
12	32.8	07.7	83.5	60.4	38.4	17.5	97.9	79.5	62.5	46.9	32.9	20.3	09.5
13	34.1	08.9	84.8	61.7	39.7	18.9	2799.2	80.9	63.9	48.4	34.3	21.8	11.0
14	35.3	10.2	86.1	63.0	41.0	20.2	2800.6	82.3	65.3	49.8	35.8	23.3	12.5
15	2336.6	2411.4	2487.3	2564.3	2642.3	2721.5	2801.9	2883.7	2966.7	3051.2	3137.2	3224.8	3314.0
16	37.8	12.7	88.6	65.6	43.6	22.8	03.3	85.0	68.1	52.6	38.6	26.2	15.5
17	39·0	14.0	89.9	66.9	44.9	24.2	04.6	86.4	69.5	54.0	40.1	27.7	17.0
18	40·3	15.2	91·2	68.1	46.2	25.5	06.0	87.8	70.9	55.5	41.5	29.2	18.5
19	41·5	16.5	92.4	69.4	47.6	26.8	07.3	89.1	72.3	56.9	43.0	30.7	20.0
20	2342.8	2417.7	2493.7	2570.7	2648.9	2728.2	2808.7	2890.5	2973.7	3058.3	3144.4	3232.1	3321.5
21	44.0	19.0	95.0	72 0	50.2	29.5	10.1	91.9	75.1	59.7	45.9	33.6	23.0
22	45.3	20.2	96.3	73.3	51.5	30.8	11.4	93.3	76.5	61.2	47.3	35 1	24.5
23	46.5	21.5	97.5	74.6	52.8	32.2	12.8	94.6	77.9	62.6	48.8	36.6	26.0
24	47.7	22.8	2498.8	75.9	54.1	33.5	14.1	96.0	79.3	64.0	50.2	38.0	27.5
25	2349.0	2424.0	2500.1	2577.2	2655.4	2734.8	2815.5	2897.4	2980.7	3065.4	3151.7	3239.5	3329.0
26	50.2	25.3	01 4	78.5	56.7	36.2	16.8	2898·8	82.1	66.9	53.1	41.0	30.6
27	51.5	26.5	02.6	79.8	58.1	37.5	18.2	2900·2	83.5	68.3	54.6	42.5	32.1
28	52.7	27.8	03.9	81.1	59.4	38.8	19·5	01.5	84.9	69.7	56·0	44.0	33.6
29	54.0	29.1	05.2	82.4	60.7	40.2	20.9	02.9	86.3	71.1	57.5	45.4	35.1
30	2355.2	2430.3	2506.5	2583.7	2662.0	2741.5	2822.2	2904.3	2987.7	3072.6	3158.9	3246.9	3336.6
31	56.4	31.6	07.7	85.0	63.3	42.8	23.6	05.7	89.1	74·0	60.4	48.4	38.1
32	57.7	32.8	09.0	86.3	64.6	44.2	25.0	07.0	90.5	75.4	61.8	49.9	39.6
33	58.9	34.1	10.3	87.6	65.9	45.5	26.3	08.4	91.9	76.8	63.3	51.4	41.1
34	60.2	35.4	11.6	88.9	67.5	46.8	27.7	09.8	93.3	78.3	64.7	52.8	42.6
35	2361.4	2436.6	2512.9	2590.2	2668.6	2748.2	2829.0	2911.2	2994.7	3079.7	3166.2	3254.3	3344.1
36	62.7	37.9	14.1	91.5	69.9	49.5	30.4	12.6	96.1	81.1	67.7	55.8	45.7
37	63.9	39.2	15.4	92.8	71.2	50.9	31.7	13.9	97.5	82.6	69.1	57.3	47.2
38	65.2	40.4	16.7	94·1	72.5	52.2	33.1	15.3	2998.9	84.0	70.6	58.8	48.7
39	66.4	41.7	18.0	95.4	73.9	53.5	34.5	16.7	3000.3	85.4	72.0	60.3	50.2
40	2367.6	2442.9	2519.3	2596.7	2675.2	2754.9	2835.8	2918.1	3001.7	3086.8	3173.5	3261.7	3351.7
41	68.9	44.2	20.5	98.0	76.5	56.2	37.2	19.5	03.1	88.3	74.9	63.2	53.2
42	70.1	45.5	21.8	2599.3	77.8	57.6	38.5	20 9	04.6	89·7	76.4	64.7	54.7
43	71.4	46.7	23.1	2600.5	79.1	58.9	39.9	22.2	06.0	91.1	77.9	66.2	56.2
44	72.6	48.0	24.4	01.8	80.4	60.2	41.3	23.6	07.4	92.6	79.3	67.7	57.8
45	2373.9	2449.3	2525.7	2603.1	2681.8	2761.6	2842.6	2925.0	3008.8	3094.0	3180.8	3269.2	3359.3
46	75.1	50.5	27.0	04.5	83.1	62.9	44.0	26.4	10.2	95.4	82.2	70.7	60.8
47	76.4	51.8	28.2	05.8	84.4	64.3	45.4	27.8	11.6	96.9	83.7	72.1	62.3
48	77.6	53.1	29·5	07.1	85.7	65.6	46.7	29.2	13.0	98.3	85.2	73.6	63.8
49	78.9	54.3	30.8	08.4	87.0	66.9	48.1	30.6	14.4	99.7	86.6	75.1	65.4
50	2380.1	2455.6	2532.1	2609.7	2688.4	2768.3	2849.4	2931.9	3015.8	3101.2	3188.1	3276.6	3366.9
51	81.4	56·9	33.4	11.0	89.7	69.6	50.8	33.3	17.2	02.6	89.5	78.1	68.4
52	82.6	58.1	34.7	12.3	91.0	71.0	52.2	34.7	18.6	04.0	91.0	79.6	69.9
53	83.9	59.4	35.9	13.6	92.3	72.3	53.5	36.1	20.1	05.5	92.5	81.1	71.4
54	85.1	60.7	37.2	14.9	93.7	73.6	54.9	37.5	21·5	06.9	93.9	82.6	73.0
55	2386.4	2461.9	2538.5	2616.2	2695.0	2775.0	2856.3	2938.9	3022.9	3108.4	3195.4	3284.1	3374.5
56	87.6	63.2	39.8	17.5	96.3	76.3	57.6	40.3	24.3	09.8	96.9	85.6	76.0
57	88.9	64.5	41.1	18.8	97.6	77.7	59.0	41.7	25.7	11.2	98.3	87.1	77.5
58	90.1	65.7	42.4	20.1	2699.0	79.0	60.4	43.0	27.1	12.7	99.8	88.5	79.0
59	91.4	67.0	43.6	21.4	2700.3	80.4	61.7	44.4	28.5	14.1	3201.3	90.0	80.6
Cor.M.P.	12.0	—12.9	—13.2	—13.5	—13.8	—14.0	—14.3	—14.6	—14.9	—15.1	—15.4	—15.7	—15.9
Cor.Lat.	10.9	—11.1	—11.3	—11.4	—11.6	—11.7	—11.8	—12.0	—12.1	—12.2	—12.3	—12.3	—12.4

Digitized by Google

MERIDIONAL PARTS.

Lat.	49°	50°	51°	52°	53°	54°	55°	56°	57°	58°	59°	60°	61°
Min.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.
0	3382.1	3474.5	3568.8	3665.3	3763.8	3864.6	3968.0	4073.9	4182.6	4294.3	4409.1	4527.4	4649.2
1	83.6	76.0	70.4	66.8	65.4	66.3	69.7	75.7	84.5	96.2	11.1	29.4	51.3
2	85.1	77.6	72.0	68.4	67.1	68.0	71.5	77.5	86.3	98.1	13.0	31.4	53.4
3	86.7	79.1	73.6	70.1	68.8	69.7	73.2	79.3	88.1	4300.0	15.0	33.4	55.4
4	88.2	80.7	75.2	71.7	70.4	71.5	75.0	81.1	90.0	01.9	16.9	35.4	57.5
5	3389.7	3482.3	3576.8	3673.5	3772.1	3873.2	3976.7	4082.9	4191.8	4303.7	4418.9	4537.4	4659.6
6	91.2	83.8	78.4	75.0	73.7	74.9	78.4	84.7	93.7	05.6	20.8	39.4	61.6
7	92.8	85.4	79.9	76.6	75.4	76.6	80.2	86.4	95.5	07.5	22.8	41.4	63.7
8	94.3	86.9	81.5	78.2	77.1	78.3	81.9	88.2	97.3	09.4	24.7	43.4	65.8
9	95.8	88.5	83.1	79.8	78.7	80.0	83.7	90.0	99.2	11.3	26.7	45.4	67.8
10	3397.4	3490.1	3584.7	3681.5	3780.4	3881.7	3985.4	4091.8	4201.0	4313.2	4428.6	4547.4	4669.9
11	98.9	91.6	86.3	83.1	82.1	83.4	87.2	93.6	02.9	15.1	30.6	49.4	72.0
12	3400.4	93.2	87.9	84.7	83.8	85.1	88.9	95.4	04.7	17.0	32.5	51.4	74.1
13	01.9	94.7	89.5	86.4	85.4	86.8	90.7	97.2	06.6	18.9	34.5	53.5	76.1
14	03.5	96.3	91.1	88.0	87.1	88.5	92.5	99.0	08.4	20.8	36.4	55.5	78.2
15	3405.0	3497.9	3592.7	3689.6	3788.8	3890.2	3994.2	4100.8	4210.3	4322.7	4438.4	4557.5	4680.3
16	06.5	99.4	94.3	91.3	90.4	92 0	96 0	02.6	12.1	24.6	40.3	59.5	82.4
17	08.1	3501.0	95.9	92.9	92.1	93.7	97.7	04.4	14.0	26.5	42.3	61.5	84.5
18	09.6	02.6	97.5	94.5	93.8	95.4	99.5	06.2	15.8	28.4	44.2	63.5	86.5
19	11.1	04.1	99.1	96.2	95.5	97.1	4001.2	08.0	17.7	30.3	46.2	65.6	88.6
20	3412.7	3505.7	3600.7	3697.8	3797.1	3898.8	4003.0	4109.8	4219.5	4332.2	4448.2	4567.6	4690.7
21	14.2	07.3	02.3	99.4	98.8	3900.5	04.7	11.6	21.4	34.1	50.1	69.6	92.8
22	15.7	08.8	03.9	3701.1	3800.5	02.2	06.5	13.4	23.2	36.0	52.1	71.6	94.9
23	17.3	10.4	05.5	02.7	02.2	04.0	08.3	15.2	25.1	37.9	54.1	73.6	97.0
24	18.8	12.0	07.1	04.4	03.8	05.7	10.0	17.1	26.9	39.8	56.0	75.7	99.1
25	3420.4	3513.5	3608.7	3706.0	3805 5	3907.4	4011.8	4118.9	4228.8	4341.8	4458.0	4577.7	4701.1
26	21.9	15.1	10.3	07.6	07.2	09.1	13.5	20.7	30.6	43.7	59.9	79 7	03.2
27	23.4	16.7	11.9	09.3	08.9	10.8	15.3	22.5	32.5	45.6	61.9	81.7	05.3
28	25.0	18.3	13.5	10.9	10.5	12.5	17.1	24.3	34.4	47.5	63.9	83 8	07.4
29	26.5	19.8	15.1	12.6	12.2	14.3	18.8	26.1	36.2	49.4	65.9	85.8	09.5
30	3428.0	3521.4	3616.7	3714.2	3813.9	3916.0	4020.6	4127.9	4238.1	4351.3	4467.8	4587.8	4711.6
31	29.6	23.0	18.3	15.8	15.6	17.7	22.4	29.7	39.9	53.2	69.8	89.9	13.7
32	31.1	24.5	20.0	17.5	17.3	19.4	24.1	31.5	41.8	55.1	71.8	91.9	15.8
33	32.7	26.1	21.6	19.1	19.0	21.2	25.9	33.3	43.7	57.1	73.7	93.9	17.9
34	34.2	27.7	23.2	20.8	20.6	22.9	27.7	35.2	45.5	59.0	75.7	96.0	20.0
35	3435.8	3529.3	3624.8	3722.4	3822.3	3924.6	4029.4	4137.0	4247.4	4360.9	4477.7	4598.0	4722.1
46	37.3	30.8	26.4	24.1	24.0	26.3	31.2	38.8	49.3	62.8	79.7	4600.0	24.2
37	38.8	32.4	28.0	25.7	25.7	28.1	33.0	40.6	51.1	64.7	81.6	02.1	26.3
38	40.4	34.0	29.6	27.4	27.4	29.8	34.8	42.4	53.0	66.7	83.6	04.1	28.4
39	41.9	35.6	31.2	29.0	29.1	31.5	36.5	44.2	54.8	68.6	85 6	06.2	30.5
40	3443.5	3537.1	3632.8	3730.7	3830.8	3933.2	4038.3	4146.1	4256.7	4370.5	4487.6	4608.2	4732.6
41	45.0	38.7	34.4	32.3	32.4	35.0	40.1	47.9	58.6	72.4	89.6	10.2	34.7
42	46.6	40.3	36.1	34.0	34.1	36.7	41.8	49.7	60.5	74.3	91.5	12.3	36.8
43	48.1	41.9	37.7	35.6	35.8	38.4	43.6	51.5	62.3	76.3	93.5	14.3	38.9
44	49.7	43.5	39.3	37.3	37.5	40.2	45.4	53.4	64.2	78.2	95.5	16.4	41.1
45	3451.2	3545.0	3640.9	3738.9	3839.2	3941.9	4047.2	4155.2	4266.1	4380.1	4497.5	4618.4	4743.2
46	52.8	46.6	42.5	40.6	40.9	43.6	48.9	57.0	68.0	82.1	99.5	20.5	45.3
47	54.3	48.2	44.1	42 2	42.6	45.4	50.7	58.8	69.8	84.0	4501.5	22.5	47.4
48	55.8	49.8	45.8	43.9	44.3	47.1	52.5	60.7	71.7	85.9	03.4	24.6	49.5
49	57.4	51.4	47.4	45.5	46.0	48.8	54.3	62.5	73.6	87.8	05.4	26.6	51.6
50	3458.9	3552.9	3649.0	3747.2	3847.7	3950.6	4056.1	4164.3	4275.5	4389.8	4507.4	4628.7	4753.7
51	60.5	54.5	50.6	48.8	49.4	52.3	57.8	66.1	77.4	91.7	09.4	30.7	55.9
52	62.0	56.1	52.2	50.5	51.1	54.0	59.6	68.0	79.2	93.6	11.4	32.8	58.0
53	63.6	57.7	53.8	52.2	52.8	55.8	61.4	69.8	81.1	95.6	13.4	34.8	60.1
54	65.2	59.3	55.5	53.8	54.4	57.5	63.2	71.6	83.0	97.5	15.4	36.9	62.2
55	3466.7	3560.9	3657.1	3755.5	3856.1	3959.3	4065.0	4173.5	4284.9	4399.4	4517.4	4638.9	4764.4
56	68.3	62.5	58.7	57.1	57.8	61.0	66.8	75.3	86.8	4401.4	19.4	41.0	66.5
57	69.8	64.0	60.3	58.8	59.5	62.7	68.5	77.1	88.6	03.3	21.4	43.0	68.6
58	71.4	65.6	62.0	60.4	61 2	64.5	70.3	79.0	90.5	05.3	23.4	45.1	70.7
59	72.9	67.2	63.6	62.1	62.9	66.2	72.1	80.8	92.4	07.2	25.4	47.2	72.9
Cor. M. P.	16.2	16.4	16.6	16.9	17.1	17.3	17.5	17.7	17.9	18.1	18.3	18.5	18.7
Cor. Lat.	12.5	12.5	12.5	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.5	12.5	12.4

Digitized by Google

MERIDIONAL PARTS.

Lat.	62°	63°	64°	65°	66°	67°	68°	69°	70°	71°	72°	73°	74°
Min.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.	M. P.
0	4775.0	4904.9	5039.4	5178.8	5323.5	5474.9	5630.8	5794.6	5965.9	6145.7	6334.3	6534.4	6745.1
1	77.1	07.1	41.7	81.2	26.0	76.6	33.5	97.4	68.8	48.8	38.1	37.9	49.4
2	79.3	09.4	44.0	83.5	28.4	79.1	36.2	5800.1	71.8	51.9	41.3	41.3	53.0
3	81.4	11.6	46.3	85.9	30.9	81.7	38.8	02.9	74.7	54.9	44.6	44.7	56.6
4	83.5	13.8	48.6	88.3	33.4	84.3	41.5	05.7	77.6	58.0	47.8	48.1	60.3
5	4785.7	4916.0	5050.8	5190.7	5335.8	5486.8	5644.2	5808.5	5980.6	6161.1	6351.1	6551.6	6763.9
6	87.8	18.2	53.1	93.0	38.3	89.4	46.9	11.3	83.5	64.2	54.3	55.0	67.6
7	89.9	20.4	55.4	95.4	40.8	92.0	49.6	14.2	86.4	67.3	57.6	58.5	71.2
8	92.1	22.6	57.7	5197.8	43.2	94.5	52.2	17.0	89.4	70.4	60.8	61.9	74.9
9	94.2	24.8	60.0	5200.2	45.7	97.1	54.9	19.8	92.3	73.5	64.1	65.3	78.5
10	4796.3	4927.0	5062.3	5202.6	5348.2	5499.7	5657.6	5822.6	5995.3	6176.6	6367.4	6568.8	6782.2
11	4798.5	29.2	64.6	04.9	50.7	5502.3	60.3	25.4	5998.2	79.7	70.6	72.3	85.9
12	4800.6	31.5	66.9	07.3	53.1	04.9	63.0	28.2	6001.2	82.8	73.9	75.7	89.5
13	02.8	33.7	69.2	09.7	55.6	07.4	65.7	31.0	04.1	85.9	77.2	79.2	93.2
14	04.9	35.9	71.5	12.1	58.1	10.0	68.4	33.8	07.1	89.0	80.4	82.6	6796.9
15	4807.1	4938.1	5073.8	5214.5	5360.6	5512.6	5671.1	5836.7	6010.0	6192.1	6383.7	6586.1	6800.6
16	09.2	40.3	76.1	16.9	63.1	15.2	73.8	39.5	13.0	95.2	87.0	89.6	04.3
17	11.4	42.6	78.4	19.3	65.6	17.8	76.5	42.3	16.0	6198.3	90.3	93.0	08.0
18	13.5	44.8	80.7	21.6	68.0	20.4	79.2	45.1	18.9	6201.4	93.6	6596.5	11.7
19	15.7	47.0	83.0	24.0	70.5	23.0	81.9	48.0	21.9	04.5	6396.9	6600.0	15.4
20	4817.8	4949.2	5085.3	5226.4	5373.0	5525.5	5684.6	5850.8	6024.9	6207.7	6400.2	6603.5	6819.1
21	20.0	51.5	87.6	28.8	75.5	28.1	87.3	53.6	27.8	10.8	03.4	07.0	22.8
22	22.1	53.7	89.9	31.2	78.0	30.7	90.0	56.5	30.8	13.9	06.7	10.5	26.5
23	24.3	55.9	92.3	33.6	80.5	33.3	92.7	59.3	33.8	17.0	10.1	14.0	30.2
24	26.4	58.2	94.6	36.0	83.0	35.9	95.5	62.2	36.8	20.2	13.4	17.5	33.9
25	4828.6	4960.4	5096.9	5238.4	5385.5	5538.6	5698.2	5865.0	6039.8	6223.3	6416.7	6621.0	6837.6
26	30.8	62.6	5099.2	40.8	88.0	41.2	5700.9	67.8	42.7	25.5	20.0	24.5	41.3
27	32.9	64.9	5101.5	43.2	90.5	43.8	03.6	70.7	45.7	29.6	23.3	28.0	45.1
28	35.1	67.1	03.8	45.7	93.0	46.4	06.3	73.5	48.7	32.7	26.6	31.5	48.8
29	37.3	69.4	06.2	48.1	95.5	49.0	09.1	76.4	51.7	35.9	29.9	35.0	52.5
30	4839.4	4971.6	5108.5	5250.5	5398.0	5551.6	5711.8	5879.2	6054.7	6239.0	6433.2	6638.5	6856.3
31	41.6	73.8	10.8	52.9	5400.5	54.2	14.5	82.1	57.7	42.2	36.6	42.0	60.0
32	43.8	76.1	13.1	55.3	03.0	56.8	17.3	85.0	60.7	45.3	39.9	45.6	63.8
33	45.9	78.3	15.5	57.7	05.5	59.4	20.0	87.8	63.7	48.5	43.2	49.1	67.5
34	48.1	80.6	17.8	60.1	08.1	62.1	22.7	90.7	66.7	51.7	46.6	52.6	71.3
35	4850.3	4982.8	5120.1	5262.6	5410.6	5564.7	5725.5	5893.6	6069.7	6254.8	6449.9	6656.2	6875.0
36	52.4	85.1	22.4	65.0	13.1	67.3	28.2	96.4	72.7	58.0	53.3	59.7	78.8
37	54.6	87.3	24.8	67.4	15.6	69.9	30.9	5899.3	75.7	61.2	56.6	63.3	82.6
38	56.8	89.6	27.1	69.8	18.1	72.6	33.7	5902.2	78.8	64.3	60.0	66.8	86.3
39	59.0	91.8	29.4	72.2	20.6	75.2	36.4	05.0	81.8	67.5	63.3	70.4	90.1
40	4861.1	4994.1	5131.8	5274.7	5423.2	5577.8	5739.2	5907.9	6084.8	6270.7	6466.7	6673.9	6893.9
41	63.5	96.3	34.1	77.1	25.7	80.4	41.9	10.8	87.8	73.9	70.0	77.5	6897.7
42	65.5	4998.6	36.5	79.5	28.2	83.1	44.7	13.7	90.8	77.1	73.4	81.0	6901.5
43	67.7	5000.8	38.8	82.0	30.8	85.7	47.4	16.6	93.9	80.2	76.7	84.6	05.3
44	69.9	03.1	41.1	84.4	33.3	88.4	50.2	19.4	96.9	83.4	80.1	88.2	09.1
45	4872.0	5005.4	5143.5	5286.8	5435.8	5591.0	5752.9	5922.3	6099.9	6286.6	6483.5	6691.7	6912.9
46	74.2	07.6	45.8	89.3	38.4	93.6	55.7	25.2	6103.0	89.8	86.9	95.3	16.7
47	76.4	09.9	48.2	91.7	40.9	96.3	58.5	28.1	06.0	93.0	90.2	6698.9	20.5
48	78.6	12.2	50.5	94.1	43.4	5598.9	61.2	31.0	09.0	96.2	93.6	6702.5	24.3
49	80.8	14.4	52.9	96.6	46.0	5601.6	64.0	33.9	12.1	6299.4	6497.0	06.1	28.1
50	4883.0	5016.7	5155.2	5299.0	5448.5	5604.2	5766.8	5936.8	6115.1	6302.6	6500.4	6709.6	6931.9
51	85.2	18.9	57.6	5301.5	51.1	06.9	69.5	39.7	18.2	05.8	03.8	13.2	35.7
52	87.4	21.2	59.9	03.9	53.6	09.5	72.3	42.6	21.2	09.0	07.2	16.8	39.6
53	89.6	23.5	62.3	06.3	56.1	12.2	75.1	45.5	24.3	12.3	10.6	20.4	43.4
54	91.8	25.8	64.6	08.8	58.7	14.8	77.9	48.4	27.3	15.5	14.0	24.0	47.2
55	4893.9	5028.0	5167.0	5311.2	5461.2	5617.5	5780.6	5951.3	6130.4	6318.7	6517.4	6727.6	6951.1
56	96.1	30.3	69.4	13.7	63.8	20.2	83.4	54.2	33.4	21.9	20.8	31.3	54.9
57	4898.3	32.6	71.7	16.2	66.3	22.8	86.2	57.2	36.5	25.1	24.2	34.9	58.8
58	4900.5	34.9	74.1	18.6	68.9	25.5	89.0	60.1	39.6	28.4	27.6	38.5	62.6
59	02.7	37.1	76.4	21.1	71.5	28.2	91.8	63.0	42.6	31.6	31.0	42.1	66.5
Cor.M.P.	18.3	—19.1	—19.2	—19.4	—19.5	—19.7	—19.8	—20.0	—20.1	—20.2	—20.4	—20.5	—20.6
Cor.Lat.	12.5	—12.3	—12.2	—12.2	—12.1	—12.0	—11.9	—11.1	—11.6	—11.5	—11.4	—11.2	—11.

Digitized by Google

MERIDIONAL PARTS.

Lat. Min.	75° M. P	76° M. P.	77° M. P.	78° M. P.	79° M. P	80° M. P.
0	6970.3	7210.1	7467.2	7744.6	8045.7	8375.2
1	74.2	14.2	71.7	49.4	51.0	81 0
2	78.1	18.3	76.1	54.2	56.2	86.7
3	81.9	22.5	80.6	59.0	61.5	92.5
4	85.8	26.6	85.0	63.9	66.7	8398 3
5	6989.7	7230.8	7489.5	7768.7	8072.0	8404.1
6	93.6	35.0	94.0	73.5	77.3	09.9
7	6997.5	39.1	7498.5	78.4	82.6	15.7
8	7001.4	43.3	7502.9	83.3	87.9	21.6
9	05.3	47.5	07.4	88.1	93.2	27.4
10	7009.2	7251.6	7511.9	7793.0	8098.5	8433.3
11	13.1	55.8	16.4	7797.9	8103.8	39.1
12	17.0	60.0	21.0	7802.8	09.2	45.0
13	20.9	64.2	25.5	07.7	14.5	50.9
14	24.8	68.4	30.0	12.6	19.9	56.8
15	7028.8	7272.6	7534.5	7817.5	8125.2	8462.7
16	32.7	76.8	39.1	22.4	30.6	68.6
17	36.6	81 0	43.6	27.3	35.9	74.5
18	40.6	85.3	48.1	32.2	41.3	80.4
19	44.5	89.5	52.7	37.2	46.7	86.4
20	7048.5	7293.7	7557.2	7842.1	8152.1	8492.3
21	52.4	7298.0	61.8	47.0	57.5	8498.3
22	56.4	7302.2	66.4	52.0	62.9	8504.2
23	60.3	06.4	71.0	57.0	68.4	10.2
24	64.3	10.7	75.5	61 9	73.8	16.2
25	7068.3	7314.9	7580.1	7866.9	8179.2	8522.2
26	72.2	19.2	84.7	71.9	84.7	28.2
27	76.2	23.5	89.3	76.9	90.1	34.3
28	80.2	27.7	93.9	81.9	8195.6	40.3
29	84.2	32.0	98.5	86.9	3201.1	46.3
30	7088.2	7336.3	7603.2	7891.9	8206.6	8552.4
31	92.2	40.6	07.8	7896.9	12.1	58.4
32	7096.2	44.9	12.4	7901.9	17.6	64.5
33	7100.2	49.2	17.0	07.0	23.1	70.6
34	04.2	53.5	21.7	12.0	28.6	76.7
35	7108.2	7357.8	7626.3	7917.1	8234.1	8582.8
36	12.2	62.1	31.0	22.1	39.7	88.9
37	16.2	66.4	35.6	27.2	45.2	8595.1
38	20.3	70.7	40.3	32.3	50.7	8601.2
39	24.3	75.1	45.0	37.3	56.3	07.4
40	7128.3	7379.4	7649.7	7942.4	8261.9	8613.5
41	32.4	33.7	54.3	47.5	67.5	19.7
42	36.4	88.1	59.0	52.6	73.0	25.9
43	40.5	92.4	63.7	57.7	78.6	32.0
44	44.5	7396.8	68.4	62.8	84.2	38.3
45	7148.6	7401.1	7673.1	7968.0	8289.9	8644.5
46	52.7	05.5	77.9	73.1	8295.5	50.7
47	56.7	09.9	82.6	78.2	9301.1	56.9
48	60.8	14.3	87.4	83.4	06.8	63.2
49	64.9	18.6	92.0	88.5	12.4	69.5
50	7169.0	7423.0	7696.8	7993.7	8318.1	8675.7
51	73.1	27.4	7701.5	7998.9	23.8	82.0
52	77.1	31.8	06.3	8004.0	29.4	88.3
53	81.2	36.2	11.1	09.2	35.1	8694.6
54	85.3	40.6	15.8	14.4	40.8	8700.9
55	7189.5	7445.0	7720.6	8019.6	8346.5	8707.3
56	93.6	49.5	25.4	24.8	52.2	13.6
57	7197.7	53.9	30.2	30.0	58.0	19 9
58	7201.8	58.3	35.0	35.2	63.7	26.3
59	05.9	62.8	39.8	40.5	69.4	32.7
Cor. M.P.	10.7	—20.8	—20.9	—20.9	—21.0	—21.1
Cor. Lat.	11.0	—10.8	—10.6	—10.5	—10.3	—10.2

TABLE U,
LOGARITH. VERSED SINES.

Deg.	0′	10′	20′	30′	40′	50′
0	inf. neg.	4.6264	5.2285	5.5807	5.8305	6 0244
1	6.18271	6.3166	6.4326	6.5349	6.6264	6.7092
2	6.78474	6.8543	6.9186	6.9785	7.0346	7.0872
3	7.13687	7.1838	7.2284	7.2707	7.3111	7.3497
4	7.38667	7.4221	7.4562	7.4889	7.5205	7.5510
5	7.58039	7.6089	7.6364	7.6631	7.6890	7.7142
6	7.73865	7.7624	7.7855	7.8081	7.8301	7.8515
7	7.87238	7.8928	7.9127	7.9322	7.9513	7.9699
8	7.98820	8.0061	8.0236	8.0408	8.0576	8.0741
9	8.09032	8.1062	8.1218	8.1372	8.1522	8.1671
10	8.18162	.19594	.21003	.22389	.23753	.25095
11	8.26418	.27720	.29002	.30266	.31512	.32739
12	8.33950	.35144	.36321	.37482	.38628	.39759
13	8.40875	.41976	.43064	.44138	.45199	.46247
14	8.47282	.48305	.49315	.50314	.51301	.52278
15	8.53243	.54197	.55140	.56074	.56997	.57910
16	8.58814	.59708	.60593	.61469	.62336	.63194
17	8.64043	.64885	.65717	.66542	.67359	.68168
18	8.68969	.69763	.70550	.71329	.72101	.72867
19	8.73625	.74376	.75121	.75860	.76592	.77318
20	8.78037	.78750	.79458	.80159	.80855	.81545
21	8.82230	.82908	.83582	.84250	.84913	.85570
22	8.86223	.86870	.87513	.88150	.88783	.89411
23	8.90034	.90653	.91267	.91876	.92482	.93082
24	8.93679	.94271	.94859	.95443	.96023	.96599
25	8.97170	.97738	.98302	.98862	.99419	.99972
26	9.00521	.01066	.01608	.02146	.02681	.03212
27	9.03740	.04265	.04786	.05304	.05818	.06330
28	9.06838	.07343	.07845	.08344	.08840	.09333
29	9.09823	.10310	.10794	.11275	.11754	.12229
30	9.12702	.13172	.13640	.14104	.14567	.15026
31	9.15483	.15937	.16389	.16838	.17285	.17729
32	9.18171	.18610	.19047	.19482	.19914	.20344
33	9.20771	.21197	.21620	.22041	.22459	.22876
34	9.23290	.23702	.24112	.24520	.24926	.25330
35	9.25731	.26131	.26529	.26924	.27318	.27710
36	9.28099	.28487	.28873	.29257	.29639	.30020
37	9.30398	.30775	.31150	.31523	.31894	.32264
38	9.32631	.32997	.33362	.33724	.34085	.34444
39	9.34802	.35158	.35512	.35865	.36216	.36565
40	9.36913	.37260	.37604	.37948	.38289	.38629
41	9.38968	.39305	.39641	.39975	.40308	.40639
42	9.40969	.41297	.41624	.41950	.42274	.42597
43	9.42918	.43238	.43557	.43874	.44190	.44505
44	9.44818	.45130	.45441	.45750	.46058	.46365
45	9.46671	.46975	.47278	.47580	.47881	.48180
46	9.48479	.48776	.49071	.49366	.49660	.49952
47	9.50243	.50533	.50822	.51109	.51396	.51681
48	9.51966	.52249	.52531	.52812	.53092	.53371
49	9.53648	.53925	.54201	.54475	.54749	.55021
50	9.55293	.55563	.55832	.56101	.56368	.56635
51	9.56900	.57164	.57428	.57690	.57951	.58212
52	9.58471	.58730	.58988	.59244	.59500	.59755
53	9.60008	.60261	.60513	.60765	.61015	.61264
54	9.61512	.61760	.62006	.62252	.62497	.62741
55	9.62984	.63226	.63468	.63708	.63948	.64187
56	9.64425	.64662	.64898	.65134	.65369	.65603
57	9.65836	.66068	.66299	.66530	.66760	.66989
58	9.67217	.67445	.67672	.67897	.68125	.68347
59	9.68571	.68794	.69016	.69237	.69458	.69678
60	9.69897	.70115	.70333	.70550	.70766	.70982

Digitized by Google

TABLE U. LOGARITHMIC VERSED SINES.

Deg.	0′	10′	20′	30′	40′	50′	Deg.	0′	10′	20′	30′	40′	50′
60	9.69897	70115	70335	70550	70766	70982	120	0.17009	17682	17752	1782	1899	17971
61	9.71197	71411	71624	71837	72049	72260	121	0.18042	18114	18185	1825	18326	18397
62	9.72471	72681	72890	73099	73306	73514	122	0.18467	18537	18606	1867	18745	1881
63	9.73720	73926	74131	74335	74539	74742	123	0.18889	18951	19019	1908	19155	1922
64	9.74945	75147	75348	75549	75748	75948	124	0.19290	19357	19424	1949	19557	1962
65	9.76146	76344	76542	76738	76934	77130	125	0.19689	19754	19820	1988	19950	2001
66	9.77325	77519	77713	77906	78096	78290	126	0.20079	20143	20207	2027	20335	2039
67	9.78481	78671	78861	79051	79240	79428	127	0.20461	20524	20587	2064	20711	2077
68	9.79615	79802	79989	80175	80360	80545	128	0.20835	20897	20958	2101	21080	2114
69	9.80728	80912	81095	81277	81459	81641	129	0.21201	21261	21321	2138	21440	2149
70	9.81821	82001	82181	82360	82538	82716	130	0.21558	21617	21676	2173	21792	2185
71	9.82894	83071	83247	83423	83598	83773	131	0.21908	21965	22024	2208	22136	2219
72	9.83947	84120	84293	84466	84638	84810	132	0.22249	22305	22361	2241	22472	2252
73	9.84981	85151	85321	85490	85659	85828	133	0.22583	22637	22692	2274	22801	2285
74	9.85996	86163	86330	86496	86662	86828	134	0.22908	22962	23015	2306	23121	2317
75	9.86992	87157	87321	87484	87647	87809	135	0.23226	23278	23330	2338	23434	2348
76	9.87971	88133	88294	88454	88614	88774	136	0.23536	23587	23638	2368	2373	2378
77	9.88933	89092	89250	89407	89564	89721	137	0.23839	23888	23938	2398	24036	2408
78	9.89877	90033	90188	90343	90498	90652	138	0.24135	24182	24230	2427	24326	2437
79	9.90805	90958	91111	91263	91415	91565	139	0.24424	24468	24514	2456	24608	2465
80	9.91717	91867	92017	92166	92315	92464	140	0.24706	24746	24792	2483	24882	2492
81	9.92612	92760	92907	93054	93200	93346	141	0.24982	25017	25061	2510	25150	2519
82	9.93492	93637	93781	93926	94069	94213	142	0.25237	25280	2532	2536	25409	2545
83	9.94356	94499	94641	94782	94924	95065	143	0.25494	25536	25578	2562	25662	2570
84	9.95205	95345	95485	95624	95763	95902	144	0.25744	25785	2582	2586	25907	2594
85	9.96040	96177	96315	96451	96588	96724	145	0.25987	26027	26066	2610	26145	2618
86	9.96860	96995	97130	97264	97398	97532	146	0.26222	26261	26299	2633	26375	2641
87	9.97665	97798	97931	98065	98195	98326	147	0.26450	26488	26525	2656	26598	2663
88	9.98457	98588	98718	98848	98978	99107	148	0.26671	26707	26743	2677	26815	2685
89	9.99235	99364	99492	99619	99747	99873	149	0.26885	26920	26955	2698	27024	2705
90	0.00000	00126	00252	00377	00502	00627	150	0.27092	27125	27159	2719	27225	2725
91	0.00751	00875	00999	01122	01245	01368	151	0.27291	27324	27356	2738	27420	2745
92	0.01490	01612	01733	01854	01975	02095	152	0.27484	27515	27546	2757	27608	2763
93	0.02215	02335	02455	02574	02692	02799	153	0.27669	27700	27730	2775	27789	2781
94	0.02928	03046	03163	03280	03397	03513	154	0.27848	27877	27906	2793	27963	2799
95	0.03629	03745	03860	03975	0 090	04204	155	0.28019	28047	28075	2810	28130	2815
96	0.04318	04431	04544	04658	04770	04882	156	0.28184	28211	28237	2826	28290	2831
97	0.04994	05106	05217	05328	05439	05549	157	0.28342	28367	28395	2841	28443	2846
98	0.05659	05769	05878	05987	06096	06204	158	0.28492	28517	28541	2856	28589	2861
99	0.06312	06420	06527	06634	06741	06848	159	0.28636	28660	28683	2870	28728	2875
100	0.06954	07060	07165	07270	07375	07480	160	0.28775	28795	28817	2883	28861	2888
101	0.07584	07688	07792	07895	07998	08101	161	0.28904	28925	28945	2896	28987	2900
102	0.08204	08306	08408	08509	08610	08711	162	0.29027	29047	29067	2908	29105	2912
103	0.08812	08912	09012	09112	09212	09311	163	0.29144	29162	29181	2919	29218	2923
104	0.09409	09508	09606	09704	09802	09899	164	0.29254	29271	29289	2930	2930	2934
105	0.09996	10092	10190	10286	10382	10481	165	0.29357	29375	29390	2940	29422	2943
106	0.10573	10668	10763	10857	10951	11045	166	0.29452	29469	29485	2949	29514	2952
107	0.11139	11232	11325	11418	11510	11603	167	0.29541	29557	29571	2958	29599	2961
108	0.11693	11786	11878	11969	12059	12150	168	0.29626	29639	29652	2966	29677	2969
109	0.12240	12330	12420	12509	12598	12687	169	0.29702	29714	29726	2973	29749	2976
110	0.12776	12864	12953	13040	13128	13215	170	0.29772	29783	29793	2980	29815	2982
111	0.13302	13388	13475	13561	13647	13732	171	0.29835	29845	29854	2986	29870	2988
112	0.13818	13903	13988	14070	14157	14241	172	0.29891	29900	29908	2991	29925	2993
113	0.14324	14408	14492	14574	14657	14739	173	0.29941	29948	29956	2996	29970	2997
114	0.14821	14903	14985	15066	15147	15228	174	0.29984	29990	29997	3000	30009	301
115	0.15309	15389	15468	15549	15629	15708	175	0.30020	30026	30031	3003	3004	3004
116	0.15787	15866	15944	16023	16101	16177	176	0.30050	30054	30058	3006	30066	3007
117	0.16256	16333	16410	16487	16564	16640	177	0.30075	30076	30079	3008	30085	3008
118	0.16716	16792	16867	16943	17018	17093	178	0.30090	30092	30094	3009	3009	3009
119	0.17167	17241	17315	17389	17463	17536	179	0.30100	30101	30102	3010	3010	3010
120	0.17609	17680	17755	17827	17899	17971	180	0.30103					

Digitized by Google

TABLE V.

WEIGHTS AND MEASURES, &c.

WEIGHTS.

TROY WEIGHT USED BY GOLDSMITHS.

24 Grains	make	1 Pennyweight,	marked, dwt.
20 Pennyws.		1 Ounce - -	oz.
12 Ounces	=	1 Pound . .	lb.

APOTHECARIES.

20 Grains	make	1 Scruple
3 Scruples	=	1 Dram
8 Drams	=	1 Ounce
12 Ounces	=	1 Pound

AVOIRDUPOIS WEIGHT.

16 Drams	make	1 Ounce
16 Ounces	=	1 Pound
28 Pounds	=	1 Quarter
4 Quarters	=	1 Hundred weight
20 Hundred weight		1 Ton.

WOOL WEIGHT.

7 Pounds	make	1 Clove
2 Cloves	=	1 Stone
2 Stones	=	1 Tod
6½ Tods	=	1 Wey
2 Weys	=	1 Sack
12 Sacks	=	1 Last

COMPARISON OF TROY AND AVOIRDUPOISE WEIGHTS.

175 Troy Pounds are = to 144 Avoird. Pounds
175 Troy Ounces are = to 192 Avoird. Ounces
1 Troy Pound contains 5760 Grains
1 Avoirdup. Pound contains 7000 Grains
1 Troy Ounce contains 480 Grains
1 Avoirdupois Ounce contains 437.5 Grains
1 Avoirdupois Dram contains 27.34375 grs.
1 Troy lb. = 13 oz. 2.651428576 drams Avoir.
1 Avoird. lb. = 1 lb. 2 oz. 11 dwts. 16 gr. Troy

HAY WEIGHT.

14 Pounds -	make	1 Stone
40 Pounds of straw	=	1 Truss
56 Pounds of old hay	=	1 Truss
60 Pounds of new hay	=	1 Truss
36 Trusses -	=	1 Load.

SCOTS TROY, or DUTCH WEIGHT.

16 Drops	make	1 Ounce
16 Ounces	=	1 Pound
16 Pounds	=	1 Stone

One Pound contains 7600 grains, one hundred weight Avoird. = 105lb. 2½oz. Dutch.

MEASURES.

LONG MEASURE.

12 Inches -	make -	1 Foot
3 Feet -	= -	1 Yard
5½ Yards -	= -	1 Pole
40 Poles -	= -	1 Furlong
8 Furlongs -	= -	1 Mile
69 one-tenth miles, nearly	=	1 Degree.

The Degree is also divided into 60 equal parts, called *Nautical*, or *Geographical* miles, three of which are equal to one league.

CLOTH MEASURE.

2¼ Inches	make	1 Nail
4 Nails	=	1 Quarter
4 Quarters	=	1 Yard
3 Quarters	=	1 Ell Flemish
5 Quarters	=	1 Ell English
6 Quarters	=	1 Ell French
4 Quarters 1 1-5th in. Or 37 1-5th -	=	1 Ell Scots

ENGLISH LAND MEASURE.

9 Square feet	make	1 Square Yard
30¼ Yards	=	1 Pole
40 Poles	=	1 Rood
4 Roods	=	1 Acre.

SCOTS LAND MEASURE.

36 Square Ells	make	1 Fall
40 Falls	=	1 Rood
4 Roods	=	1 Acre.

SOLID MEASURE.

1728 Cubic Inches	make	1 Cubic Foot
27 Feet	=	1 Yard or Load

COAL MEASURE.

3 Bushels	make	1 Sack
36 Bushels, or 12 Sacks	=	1 Chaldron

WINE MEASURE.

2 Pints	make	1 Quart
4 Quarts	=	1 Gallon = 231 in.
42 Gallons	=	1 Tierce
63 Gallons	=	1 Hogshead
84 Gallons, or 1½ hhd	=	1 Puncheon
2 Hogsheads	=	1 Pipe
2 Pipes	=	1 Tun.

ALE AND BEER MEASURE.

2 Pints -	make	1 Quart
4 Quarts -	=	1 Gall. = 282 inch.
8 Gall. of Ale, or 9 of Beer	=	1 Firkin
2 Firkins -	=	1 Kilderkin
2 Kilderkins	=	1 Barrel
1½ Barrels	=	1 Hogshead
2 Barrels = 1 Puncheon, and 3	=	1 Butt

ENGLISH DRY MEASURE.

8 Pints	make	1 Gallon = 268 4-5ths in.
2 Gallons	=	1 Peck
4 Pecks	=	1 Bushel
8 Bushels	=	1 Quarter

SCOTS DRY MEASURE.

4 Lippies	make	1 Peck
4 Pecks	=	1 Firlot
4 Firlots	=	1 Boll
16 Bolls	=	1 Chaldron.

CIRCLE.

60 Seconds	make	1 Minute
60 Minutes	=	1 Degree
30 Degree	=	1 Sign
12 Signs	=	1 Circle.

TIME.

60 Seconds	make	1 Minute
60 Minutes	=	1 Hour
24 Hours	=	1 Day
7 Days = 1 Week, 365¼ Days = 1 Year.		

Digitized by Google

NATURAL TANGENTS.

De.	0′	10′	20′	30′	40′	50′
0.	.00000	.00291	.00582	.00873	.01164	.01455
1	.01746	.02036	.02328	.02619	.02910	.03201
2	.03492	.03785	.04075	.04366	.04658	.04949
3	.05241	.05533	.05824	.06116	.06408	.06700
4	.06993	.07285	.07578	.07870	.08163	.08456
5	.08749	.09042	.09335	.09629	.09923	.10216
6	.10510	.10805	.11099	.11394	.11688	.11983
7	.12278	.12574	.12869	.13165	.13461	.13758
8	.14054	.14351	.14648	.14945	.15243	.15540
9	.15838	.16137	.16435	.16734	.17033	.17333
10	.17633	.17933	.18233	.18534	.18835	.19136
11	.19438	.19740	.20042	.20345	.20648	.20952
12	.21256	.21560	.21864	.22169	.22475	.22781
13	.23087	.23393	.23700	.24008	.24316	.24624
14	.24933	.25242	.25552	.25862	.26172	.26483
15	.26795	.27107	.27419	.27732	.28046	.28360
16	.28675	.28990	.29305	.29621	.29938	.30255
17	.30575	.30891	.31210	.31530	.31850	.32171
18	.32492	.32814	.33136	.33460	.33783	.34108
19	.34433	.34758	.35085	.35412	.35740	.36068
20	.36397	.36727	.37057	.37388	.37720	.38053
21	.38386	.38721	.39055	.39391	.39727	.40065
22	.40403	.40741	.41081	.41421	.41763	.42105
23	.42447	.42791	.43136	.43481	.43828	.44175
24	.44523	.44872	.45222	.45573	.45924	.46277
25	.46631	.46985	.47341	.47698	.48055	.48414
26	.48773	.49134	.49495	.49858	.50222	.50587
27	.50953	.51319	.51688	.52057	.52427	.52798
28	.53171	.53545	.53920	.54296	.54673	.55051
29	.55431	.55812	.56194	.56577	.56962	.57348
30	.57735	.58124	.58513	.58904	.59297	.59691
31	.60086	.60483	.60881	.61280	.61681	.62083
32	.62487	.62892	.63299	.63707	.64117	.64528
33	.64941	.65355	.65771	.66189	.66608	.67028
34	.67451	.67875	.68301	.68728	.69157	.69588
35	.70021	.70455	.70891	.71329	.71769	.72211
36	.72654	.73100	.73547	.73996	.74447	.74900
37	.75355	.75812	.76272	.76733	.77196	.77661
38	.78129	.78598	.79070	.79544	.80020	.80498
39	.80978	.81461	.81946	.82434	.82925	.83415
40	.83910	.84407	.84906	.85408	.85912	.86419
41	.86929	.87441	.87955	.88473	.88992	.89515
42	.90040	.90569	.91099	.91633	.92170	.92709
43	.93252	.93797	.94345	.94896	.95451	.96008
44	.96569	.97133	.97700	.98270	.98843	.99420
45	1.0000					
	60′	50′	40′	30′	20′	10′

NATURAL COTANGENTS.

0′	10′	20′	30′	40′	50′	D.
Infinite.	343.77	171.89	114.59	85.940	68.750	89
57.2900	49.104	42.964	38.188	34.368	31.242	88
28.6363	26.432	24.542	22.904	21.470	20.206	87
19.0811	18.075	17.169	16.350	15.605	14.924	86
14.3007	13.727	13.197	12.706	12.251	11.826	85
11.4301	11.059	10.712	10.385	10.078	9.7882	84
9.51436	9.2553	9.0098	8.7769	8.5555	8.3450	83
8.14435	7.9530	7.7704	7.5958	7.4287	7.2687	82
7.11537	6.9682	6.8269	6.6912	6.5606	6.4348	81
6.31375	6.1970	6.0844	5.9758	5.8708	5.7694	80
5.67128	.57638	.48451	.39552	.30928	.22566	79
5.14455	506584	498940	491516	484300	477286	78
4.70463	.63825	.57363	.51071	.44942	.38969	77
4.33148	.27471	.21933	.16530	.11256	.06107	76
4.01078	396165	391364	386671	382083	377595	75
3.73205	.68909	.64705	.60588	.56557	.52609	74
3.48741	.44951	.41236	.37594	.34023	.30521	73
3.27085	.23714	.20406	.17159	.13972	.10842	72
3.07768	.04749	301783	298868	296004	293189	71
2.90421	.87700	.85023	.82391	.79802	.77254	70
2.74748	.72281	.69853	.67462	.65109	.62791	69
2.60509	.58261	.56046	.53865	.51715	.49597	68
2.47509	.45451	.43422	.41421	.39449	.37504	67
2.35585	.33693	.31826	.29984	.28167	.26374	66
2.24604	.22857	.21132	.19430	.17749	.16090	65
2.14451	.12832	.11233	.09654	.08094	.06553	64
2.05030	.03526	.02039	200569	199116	197680	63
1.96261	.94858	.93470	.92098	.90741	.89400	62
1.88073	.86760	.85462	.84177	.82906	.81649	61
1.80405	.79174	.77955	.76749	.75556	.74375	60
1.73205	.72047	.70901	.69766	.68643	.67530	59
1.66428	.65337	.64256	.63185	.62125	.61074	58
1.60033	.59002	.57981	.56969	.55966	.54972	57
1.53986	.53010	.52043	.51084	.50133	.49190	56
1.48256	.47330	.46411	.45501	.44598	.43703	55
1.42815	.41934	.41061	.40195	.39336	.38484	54
1.37638	.36800	.35968	.35142	.34323	.33511	53
1.32704	.31904	.31110	.30323	.29541	.28764	52
1.27994	.27230	.26471	.25717	.24969	.24227	51
1.23490	.22758	.22031	.21310	.20593	.19882	50
1.19175	.18474	.17777	.17085	.16398	.15715	49
1.15037	.14363	.13694	.13029	.12369	.11713	48
1.11061	.10414	.09770	.09131	.08496	.07864	47
1.07237	.06613	.05994	.05378	.04766	.04158	46
1.03553	.02952	.02355	.01761	.01170	.00583	45
60′	50′	40′	30′	20	10′	

NATURAL COTANGENTS.

NATURAL TANGENTS.

TABLE X. *INCLINATION of MERIDIANS to the Central Meridian; at* every *Degree of Latitude, for 5° Difference of Longitude.*

LAT.	I. M.	LAT.	I. M.	LAT.	I. M.	LAT.	I. M.	LAT.	I. M.	LAT.	I. M.	LAT.	I. M.	LAT.	I. M.
°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′
1	0 3	11	0 29	21	0 54	31	1 17	41	1 38	51	1 57	61	2 11		
2	0 5	12	0 31	22	0 56	32	1 19	42	1 40	52	1 58	62	2 12		
3	0 8	13	0 34	23	0 59	33	1 22	43	1 42	53	1 60	63	2 14		
4	0 10	14	0 36	24	1 1	34	1 24	44	1 44	54	2 1	64	2 15		
5	0 13	15	0 39	25	1 3	35	1 26	45	1 46	55	2 3	65	2 16		
6	0 16	16	0 41	26	1 6	36	1 28	46	1 48	56	2 4	70	2 21		
7	0 18	17	0 44	27	1 8	37	1 30	47	1 50	57	2 6	75	2 25		
8	0 21	18	0 46	28	1 10	38	1 32	48	1 51	58	2 7	80	2 28		
9	0 23	19	0 49	29	1 13	39	1 34	40	1 53	59	2 9	85	2 29		
10	0 26	20	0 51	30	1 15	40	1 36	50	1 55	60	2 10	90	2 30		

Digitized by Google

NATURAL SECANTS.

D.	0′	10′	20′	30′	40′	50′
0	1.00000	.00000	.00002	.00004	.00007	.00011
1	1.00015	.00021	.00027	.00034	.00042	.00051
2	1.00061	.00072	.00083	.00095	.00108	.00122
3	1.00137	.00153	.00169	.00187	.00205	.00224
4	1.00244	.00265	.00287	.00309	.00333	.00357
5	1.00382	.00408	.00435	.00463	.00491	.00521
6	1.00551	.00582	.00614	.00647	.00681	.00715
7	1.00751	.00787	.00825	.00863	.00902	.00942
8	1.00983	.01024	.01067	.01111	.01155	.01200
9	1.01247	.01294	.01342	.01391	.01440	.01491
10	1.01543	.01593	.01645	.01703	.01753	.01815
11	1.01872	.01930	.01989	.02049	.02110	.02171
12	1.02234	.02298	.02362	.02428	.02494	.02562
13	1.02630	.02700	.02770	.02842	.02914	.02987
14	1.03061	.03137	.03213	.03290	.03368	.03447
15	1.03528	.03609	.03691	.03773	.03858	.03944
16	1.04030	.04117	.04206	.04295	.04385	.04477
17	1.04569	.04663	.04757	.04853	.04950	.05047
18	1.05146	.05246	.05347	.05449	.05552	.05657
19	1.05762	.05869	.05976	.06085	.06195	.06306
20	1.06418	.06531	.06645	.06761	.06878	.06995
21	1.07115	.07235	.07356	.07479	.07602	.07727
22	1.07853	.07981	.08109	.08239	.08370	.08503
23	1.08636	.08771	.08907	.09044	.09183	.09323
24	1.09464	.09606	.09750	.09895	.10041	.10189
25	1.10338	.10488	.10640	.10793	.10947	.11103
26	1.11260	.11419	.11579	.11740	.11903	.12067
27	1.12233	.12400	.12568	.12738	.12910	.13083
28	1.13257	.13433	.13610	.13789	.13970	.14152
29	1.14335	.14521	.14707	.14896	.15085	.15277
30	1.15470	.15665	.15861	.16059	.16259	.16460
31	1.16663	.16868	.17075	.17283	.17493	.17704
32	1.17918	.18133	.18350	.18569	.18790	.19012
33	1.19236	.19463	.19691	.19920	.20152	.20386
34	1.20622	.20859	.21099	.21341	.21584	.21830
35	1.22077	.22327	.22579	.22833	.23089	.23347
36	1.23607	.23869	.24134	.24400	.24669	.24940
37	1.25214	.25489	.25767	.26047	.26330	.26615
38	1.26902	.27191	.27483	.27778	.28075	.28374
39	1.28676	.28980	.29287	.29597	.29909	.30223
40	1.30541	.30861	.31183	.31509	.31837	.32168
41	1.32501	.32838	.33177	.33519	.33864	.34212
42	1.34563	.34917	.35274	.35634	.35997	.36363
43	1.36733	.37105	.37481	.37860	.38242	.38628
44	1.39016	.39409	.39804	.40203	.40606	.41019
45	1.41421					
	60′	50′	40′	30′	20′	10′

NATURAL COSECANTS.

0	10′	20′	30′	40′	50′	
Infinite	343.78	171.89	114.59	85.946	68.757	89
57.2987	49.114	42.976	38.202	34.382	31.258	88
28.6537	26.451	24.562	22.926	21.494	20.230	87
19.1073	18.103	17.198	16.380	15.637	14.958	86
14.3356	13.763	13.235	12.745	12.291	11.868	85
11.4737	11.105	10.758	10.433	10.128	9.8391	84
9.56677	9.3092	9.0652	8.8337	8.6138	8.4047	83
8.20551	8.0156	7.8344	7.6615	7.4957	7.3372	82
7.18530	7.0396	6.8998	6.7655	6.6363	6.5121	81
6.39245	6.2772	6.1661	6.0589	5.9554	5.8554	80
5.75877	.66535	.57493	.48740	.40263	.32049	79
5.24084	.16359	.08868	5.01585	4.94517	4.87649	78
4.80973	.74482	.68167	.62023	.56041	.50216	77
4.44541	.39012	.33821	.28866	.24139	.19628	76
4.13357	4.08591	4.03938	3.99393	3.94952	3.90613	75
3.86370	.82229	.78166	.74198	.70315	.66515	74
3.62796	.59154	.55587	.52094	.48671	.45317	73
3.42030	.38808	.35649	.32551	.29512	.26531	72
3.23607	.20737	.17920	.15155	.12440	.09774	71
3.07155	3.04584	3.02057	2.99574	2.97135	2.94737	70
2.92380	.90065	.87785	.85545	.83342	.81175	69
2.79045	.76945	.74881	.72850	.70851	.68884	68
2.66947	.65040	.63162	.61313	.59491	.57698	67
2.55930	.54190	.52474	.50784	.49119	.47477	66
2.45859	.44264	.42692	.41142	.39614	.38107	65
2.36620	.35154	.33708	.32282	.30875	.29487	64
2.28117	.26766	.25432	.24116	.22817	.21535	63
2.20269	.19019	.17786	.16568	.15366	.14178	62
2.13005	.11847	.10704	.09574	.08458	.07356	61
2.06267	.05191	.04128	.03077	.02039	.01014	60
2.00000	1.98998	1.98008	1.97029	1.96062	1.95105	59
1.94160	.93226	.92302	.91388	.90483	.89591	58
1.88708	.87834	.86990	.86116	.85271	.84435	57
1.83608	.82790	.81981	.81180	.80388	.79604	56
1.78829	.78062	.77303	.76552	.73808	.75073	55
1.74345	.73624	.72911	.72205	.71506	.70815	54
1.70130	.69452	.68782	.68117	.67460	.66809	53
1.66164	.65526	.64894	.64268	.63648	.63033	52
1.62427	.61825	.61229	.60639	.60054	.59475	51
1.58909	.58333	.57771	.57213	.56661	.56114	50
1.55572	.55036	.54504	.53977	.53455	.52938	49
1.52425	.51918	.51415	.50916	.50422	.49933	48
1.49448	.48967	.48491	.48019	.47551	.47087	47
1.46628	.46175	.45721	.45274	.44831	.44391	46
1.43956	.43524	.43096	.42672	.42251	.41835	45
60′	50′	40′	30′	20′	10′	D.

NATURAL COSECANTS.

NATURAL SECANTS.

TABLE Z. *INCLINATION of MERIDIANS to the* CENTRAL MERIDIAN *for various Differences of Longitude.*

Argument. LATITUDE.	DIFFERENCE OF LONGITUDE. 1°	2°	3°	4°	5°	6°	8°	10°	12°	14°	16°	18°	20°
10°	0° 5′	0° 10′	0° 16′	0° 21′	0° 26′	0° 31′	0° 41′	0° 52′	0° 62′	° 73′	° 84′	° 94′	105′
15	0 8	0 16	0 23	0 31	0 39	0 46	1 2	1 18	1 33	1 49	2 5	2 21	2° 37
20	0 10	0 21	0 31	0 41	0 51	1 1	1 22	1 43	2 4	2 24	2 45	3 6	3 27
25	0 13	0 25	0 38	0 51	1 3	1 16	1 41	2 7	2 32	2 58	3 24	3 50	4 16
30	0 15	0 30	0 45	1 0	1 15	1 30	2 0	2 30	3 0	3 31	4 1	4 31	5 2
35	0 17	0 34	0 52	1 9	1 26	1 43	2 17	2 52	3 26	4 1	4 36	5 11	5 46
40	0 19	0 39	0 58	1 17	1 36	1 55	2 34	3 13	3 52	4 31	5 10	5 49	6 28
45	0 21	0 42	1 4	1 25	1 46	2 7	2 49	3 32	4 14	4 57	5 40	6 23	7 6
50	0 23	0 46	1 9	1 32	1 55	2 18	3 4	3 50	4 36	5 22	6 8	6 54	7 41
55	0 25	0 49	1 14	1 38	2 3	2 28	3 17	4 6	4 55	5 44	6 34	7 23	8 13
60	0 26	0 52	1 18	1 44	2 10	2 36	3 28	4 20	5 12	6 4	6 56	7 48	8 41

Digitized by Google

No.	0	1	2	3	4	5	6	7	8	9	
1.00	1.0000	.99901	.99800	.99701	.99602	.99502	.99404	.99304	.99206	.99108	1
1.01	.99010	.98912	.98814	.98717	.98619	.98522	.98425	.98328	.98232	.98135	9
1.02	.98039	.97943	.97847	.97752	.97656	.97561	.97466	.97371	.97276	.97182	9
1.03	.97087	.96993	.96899	.96805	.96712	.96618	.96525	.96432	.96339	.96246	9
1.04	.96154	.96061	.95969	.95877	.95785	.95694	.96061	.95511	.95420	.95329	9
1.05	.95238	.95147	.95057	.94967	.94877	.94787	.94697	.94607	.94518	.94429	9
1.06	.94340	.94251	.94162	.94073	.93985	.93897	.93809	.93721	.93633	.93545	8
1.07	.93458	.93371	.93284	.93197	.93110	.93023	.92937	.92851	.92764	.92678	8
1.08	.9259	.92507	.92421	.92251	.92251	.92166	.02081	.91996	.91912	.91827	8
1.09	.91743	.91659	.91575	.91491	.91408	.91324	.91241	.91158	.91075	.90992	8
1.10	.90909	.90827	.90744	.90662	.90580	.90498	.90416	.90334	.90253	.90171	8
1.11	.90090	.90009	.89928	.89847	.89767	.89686	.89606	.89526	.89445	.89365	8
1.12	.89286	.89206	.89127	.89047	.88968	.88888	.88810	.88731	.88652	.88574	8
1.13	.88497	.88417	.88339	.88261	.88183	.88106	.88033	.87951	.87873	.87796	7
1.14	.87719	.87642	.87566	.87489	.87413	.87336	.87260	.87184	.87108	.87032	7
1.15	.86957	.86881	.86806	.86730	.86655	.86580	.86505	.86430	.86356	.86281	7
1.16	.86207	.86133	.86059	.85985	.85911	.85837	.85763	.85690	.85616	.85543	7
1.17	.85470	.85397	.85324	.85251	.85179	.85106	.85034	.84962	.84890	.84818	7
1.18	.84746	.84674	.84602	.84531	.84459	.84438	.84317	.84246	.84175	.84104	7
1.19	.84034	.83963	.83893	.83822	.83752	.83682	.83612	.83542	.83472	.83403	7
1.20	.83333	.83264	.83195	.83126	.83056	.82988	.82919	.82850	.82781	.82713	6
1.21	.82645	.82576	.82508	.82440	.82372	.82305	.82237	.82169	.82102	.82034	6
1.22	.81967	.81900	.81833	.81766	.81699	.81633	.81566	.81500	.81433	.81367	6
1.23	.81301	.81235	.81169	.81103	.81037	.80972	.80906	.80841	.80775	.80710	6
1.24	.80645	.80580	.80515	.80451	.80386	.80321	.80257	.80192	.80128	.80064	6
1.25	.80000	.79936	.79872	.79808	.79745	.79681	.79618	.79554	.79491	.79428	6
1.26	.79365	.79302	.79239	.79177	.79114	.79051	.78989	.78927	.78864	.78802	6
1.27	.78740	.78678	.78616	.78555	.78493	.78431	.78370	.78309	.78247	.78186	6
1.28	.78125	.78064	.78003	.77942	.77882	.77821	.77760	.77700	.77640	.77580	6
1.29	.77519	.77459	.77399	.77340	.77280	.77220	.77161	.77101	.77042	.76982	6
1.30	.76923	.76864	.76805	.76746	.76687	.76628	.76570	.76511	.76453	.76394	5
1.31	.76336	.76278	.76220	.76161	.76104	.76046	.75988	.75930	.75873	.75815	5
1.32	.75758	.75700	.75643	.75586	.75529	.75472	.75415	.75358	.75301	.75245	5
1.33	.75188	.75131	.75075	.75019	.74963	.74906	.74850	.74794	.74738	.74683	5
1.34	.74627	.74571	.74516	.74460	.74405	.74349	.74294	.74239	.74184	.74129	5
1.35	.74074	.74019	.73964	.73910	.73855	.73801	.73746	.73692	.73638	.73584	5
1.36	.73529	.73475	.73421	.73368	.73314	.73260	.73206	.73153	.73099	.730.6	5
1.37	.72993	.72939	.72886	.72833	.72780	.72727	.72674	.72622	.72569	.72516	5
1.38	.72464	.72411	.72359	.72307	.72254	.72202	.72150	.72098	.72046	.71994	5
1.39	.71942	.71891	.71839	.71788	.71736	.71685	.71633	.71582	.71531	.71480	5
1.4	.71429	.70922	.70423	.69930	.69444	.68966	.68493	.68027	.67567	.67114	5
1.5	.66666	.66225	.65789	.65359	.64935	.64516	.64103	.63694	.63291	.62893	4
1.6	.62500	.62112	.61728	.61350	.60975	.60606	.60241	.59880	.59524	.59172	3
1.7	.58824	.58480	.58140	.57803	.57471	.57143	.56818	.56497	.56180	.55866	3
1.8	.55555	.55249	.54945	.54645	.54348	.54054	.53763	.53476	.53191	.52910	3
1.9	.52632	.52356	.52083	.51813	.51546	.51282	.51020	.50761	.50505	.50251	2
2.0	.50000	.49751	.49504	.49261	.49020	.48750	.48544	.48300	.48077	.47847	2
2.1	.47619	.47393	.47170	.46948	.46729	.46512	.46296	.46083	.45872	.45662	2
2.2	.45454	.45249	.45045	.44843	.44643	.44444	.44248	.44053	.43860	.43668	2
2.3	.43478	.43290	.43103	.42918	.42735	.42553	.42373	.42194	.42017	.41841	1
2.4	.41666	.41494	.41322	.41152	.40984	.40816	.40650	.40486	.40323	.40161	1
2.5	.40000	.39841	.39683	.39526	.39370	.39216	.39063	.38911	.38760	.38610	1
2.6	.38462	.38314	.38168	.38023	.37878	.37736	.37594	.37453	.37313	.37175	1
2.7	.37037	.36900	.36765	.36630	.36496	.36363	.36232	.36101	.35971	.35842	1
2.8	.35714	.35587	.35461	.35336	.35211	.35088	.34965	.34843	.34722	.34602	1
2.9	.34483	.34364	.34246	.34130	.34014	.33898	.33783	.33670	.33557	.33445	1
3.0	.33333	.33223	.33113	.33003	.32895	.32787	.32680	.32573	.32468	.32362	1
3.1	.32258	.32154	.32051	.31949	.31847	.31746	.31646	.31546	.31447	.31348	0
3.2	.31250	.31153	.31056	.30960	.30864	.30769	.30675	.30581	.30488	.30395	0
3.3	.30303	.30211	.30120	.30030	.29940	.29851	.29762	.29674	.29586	.29499	0
3.4	.29412	.29326	.29240	.29155	.29070	.28986	.28902	.28818	.28736	.28653	8
3.5	.28571	.28490	.28409	.28329	.28248	.28169	.28090	.28011	.27933	.27855	8
3.6	.27777	.27701	.27624	.27548	.27473	.27397	.27322	.27248	.27174	.27100	7

Digitized by Google

TABLE AA. RECIPROCALS OF NUMBERS FROM 1 TO 1466.

No.	0	1	2	3	4	5	6	7	8	9	Diffs.	
3.7	.27027	.26954	.26882	.26810	.26738	.26666	.26596	.26525	.26455	.26385	73	70
3.8	.26316	.26247	.26178	.26110	.26042	.25974	.25907	.25840	.25775	.25707	69	66
3.9	.25641	.25575	.25510	.25445	.25381	.25316	.25252	.25189	.25126	.25063	66	63
4.0	.25000	.24938	.24876	.24814	.24752	.24691	.24631	.24570	.24510	.24450	62	60
4.1	.24390	.24331	.24272	.24213	.24155	.24096	.24038	.23981	.23923	.23866	59	57
4.2	.23810	.23753	.23697	.23641	.23585	.23529	.23474	.23419	.23364	.23310	57	56
4.3	.23256	.23202	.23148	.23095	.23042	.22989	.22936	.22883	.22831	.22779	54	52
4.4	.22727	.22676	.22624	.22573	.22522	.22472	.22422	.22371	.22321	.22272	51	49
4.5	.22222	.22173	.22124	.22075	.22026	.21978	.21930	.21882	.21834	.21786	49	48
4.6	.21739	.21692	.21645	.21598	.21552	.21505	.21459	.21413	.21368	.21322	47	46
4.7	.21277	.21231	.21187	.21142	.21097	.21053	.21008	.20964	.20921	.20877	46	44
4.8	.20833	.20790	.20747	.20704	.20661	.20619	.20576	.20534	.20492	.20450	43	42
4.9	.20408	.20367	.20325	.20284	.20243	.20202	.20162	.20121	.20080	.20040	41	40
5.0	.20000	.19960	.19920	.19881	.19841	.19801	.19763	.19724	.19685	.19646	40	39
5.1	.19608	.19569	.19531	.19493	.19455	.19417	.19380	.19342	.19305	.19268	39	37
5.2	.19231	.19194	.19157	.19120	.19084	.19048	.19011	.18975	.18939	.18904	37	36
5.3	.18868	.18832	.18797	.18762	.18727	.18692	.18657	.18622	.18587	.18553	36	34
5.4	.18518	.18484	.18450	.18416	.18382	.18349	.18315	.18282	.18248	.18215	34	33
5.5	.18181	.18149	.18116	.18083	.18051	.18018	.17986	.17953	.17921	.17889	32	32
5.6	.17857	.17825	.17794	.17762	.17730	.17699	.17668	.17637	.17606	.17575	32	31
5.7	.17544	.17513	.17483	.17452	.17422	.17391	.17361	.17331	.17301	.17271	31	30
5.8	.17241	.17212	.17182	.17153	.17123	.17094	.17065	.17036	.17007	.16978	29	29
5.9	.16949	.16920	.16891	.16863	.16835	.16807	.16779	.16750	.16722	.16694	29	28
6.0	.16666	.16639	.16611	.16584	.16556	.16529	.16501	.16474	.16447	.16420	27	27
6.1	.16393	.16367	.16340	.16313	.16287	.16260	.16234	.16207	.16181	.16155	26	26
6.2	.16129	.16103	.16077	.16051	.16026	.16000	.15974	.15948	.15923	.15898	26	25
6.3	.15873	.15848	.15823	.15798	.15773	.15748	.15723	.15698	.15674	.15649	25	25
6.4	.15625	.15601	.15576	.15552	.15528	.15504	.15480	.15456	.15432	.15408	24	24
6.5	.15385	.15361	.15337	.15314	.15291	.15267	.15244	.15221	.15198	.15175	24	23
6.6	.15151	.15129	.15106	.15083	.15060	.15038	.15015	.14993	.14970	.14948	23	22
6.7	.14925	.14903	.14881	.14859	.14837	.14814	.14793	.14771	.14749	.14728	22	21
6.8	.14706	.14684	.14663	.14641	.14620	.14599	.14577	.14556	.14535	.14514	22	21
6.9	.14492	.14472	.14451	.14430	.14409	.14388	.14368	.14347	.14327	.14306	21	21
7.0	.14286	.14265	.14245	.14225	.14205	.14184	.14164	.14144	.14124	.14104	21	20
7.1	.14085	.14065	.14045	.14025	.14006	.13986	.13966	.13947	.13928	.13908	20	20
7.2	.13888	.13870	.13850	.13831	.13812	.13793	.13774	.13755	.13736	.13717	19	19
7.3	.13699	.13680	.13661	.13643	.13624	.13605	.13587	.13569	.13550	.13532	19	18
7.4	.13513	.13495	.13477	.13459	.13441	.13423	.13405	.13387	.13369	.13351	18	18
7.5	.13333	.13316	.13298	.13280	.13263	.13245	.13228	.13210	.13193	.13175	18	17
7.6	.13158	.13141	.13123	.13106	.13089	.13072	.13055	.13038	.13021	.13004	17	17
7.7	.12987	.12970	.12953	.12937	.12920	.12903	.12887	.12870	.12853	.12837	17	16
7.8	.12821	.12804	.12788	.12771	.12755	.12739	.12723	.12706	.12690	.12674	17	16
7.9	.12658	.12642	.12626	.12610	.12594	.12579	.12563	.12547	.12531	.12516	16	15
8.0	.12500	.12484	.12469	.12453	.12438	.12422	.12407	.12392	.12376	.12361	16	15
8.1	.12346	.12330	.12315	.12300	.12285	.12270	.12255	.12240	.12225	.12210	16	15
8.2	.12195	.12180	.12165	.12151	.12136	.12121	.12106	.12092	.12077	.12063	15	14
8.3	.12048	.12034	.12019	.12005	.11990	.11976	.11962	.11947	.11933	.11919	14	14
8.4	.11905	.11891	.11876	.11862	.11848	.11834	.11820	.11806	.11792	.11779	14	14
8.5	.11765	.11751	.11737	.11723	.11710	.11696	.11682	.11669	.11655	.11641	14	14
8.6	.11628	.11614	.11601	.11587	.11574	.11561	.11547	.11534	.11521	.11507	14	14
8.7	.11494	.11481	.11468	.11455	.11442	.11429	.11416	.11403	.11390	.11377	13	13
8.8	.11363	.11351	.11338	.11325	.11312	.11299	.11287	.11274	.11261	.11249	13	12
8.9	.11236	.11223	.11211	.11198	.11186	.11173	.11161	.11148	.11136	.11123	13	12
9.0	.11111	.11099	.11086	.11074	.11062	.11050	.11038	.11025	.11013	.11001	12	12
9.1	.10989	.10977	.10965	.10953	.10941	.10929	.10917	.10905	.10893	.10881	12	12
9.2	.10870	.10858	.10846	.10834	.10823	.10810	.10799	.10787	.10776	.10764	12	12
9.3	.10753	.10741	.10730	.10718	.10707	.10695	.10684	.10672	.10661	.10650	12	11
9.4	.10638	.10627	.10616	.10604	.10593	.10582	.10571	.10560	.10549	.10537	11	11
9.5	.10526	.10515	.10504	.10593	.10482	.10471	.10460	.10449	.10438	.10428	11	11
9.6	.10416	.10406	.10395	.10384	.10373	.10363	.10352	.10341	.10331	.10320	10	10
9.7	.10309	.10299	.10288	.10277	.10267	.10256	.10246	.10235	.10225	.10215	10	10
9.8	.10204	.10194	.10183	.10173	.10163	.10152	.10142	.10132	.10121	.10111	10	10
9.9	.10101	.10091	.10081	.10070	.10060	.10050	.10040	.10030	.10020	.10010	10	10

Digitized by Google

TABLE *BB*, shewing the correction in minutes and tenths, to be *added* to the Middle Latitude, in Middle Latitude Sailing.

Argument. Diff. of LAT.	Argument. LESSER LATITUDE. 0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′
1	6.7	0.8	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.2
2	9.1	1.8	0.9	1.7	0.6	0.5	0.5	0.5	0.5	0.5	0.6	0.7	0.7	0.9
3	13.9	3.5	2.1	1.6	1.3	1.2	1.1	1.1	1.1	1.2	1.3	1.5	1.7	2.0
4	18.5	5.9	3.6	2.7	2.3	2.1	2.0	2.0	2.0	2.1	2.4	2.6	3.0	3.6
5	23.3	8.5	5.4	4.1	3.5	3.2	3.1	3.1	3.2	3.4	3.7	4.1	4.8	5.7
6	28.0	11.5	7.7	5.8	5.0	4.6	4.5	4.5	4.6	4.9	5.4	6.0	7.0	8.4
7	32.9	14.8	9.9	7.8	6.8	6.3	6.1	6.1	6.3	6.7	7.4	8.3	9.7	11.8
8	37.6	18.2	12.5	10.0	8.7	8.1	8.0	8.0	8.3	8.8	9.8	11.0	12.9	15.8
9	42.3	21.9	15.4	12.4	11.0	10.2	10.0	10.1	10.5	11.3	12.5	14.2	16.6	20.5
10	47.0	25.7	18.4	15.1	13.4	12.6	12.3	12.5	13.1	14.1	15.6	17.7	20.9	26.0
11	51.8	29.8	21.7	18.0	16.1	15.2	14.9	15.2	16.0	17.2	19.1	21.8	25.9	32.4
12	56.7	34.0	25.2	21.1	19.0	18.0	17.8	18.2	19.1	20.7	23.0	26.4	31.5	39.7
13	61.6	38.3	28.9	24.4	22.1	21.1	20.9	21.4	22.6	24.5	27.4	31.5	37.8	48.1
14	66.6	42.8	32.7	27.9	25.4	24.4	24.4	25.0	26.4	28.8	32.2	37.2	45.0	57.8
15	71.6	47.3	36.7	31.6	28.9	27.9	27.9	28.8	30.6	33.4	37.5	43.6	53.0	68.8
20	97.6	72.0	59.3	53.1	50.1	49.3	50.2	52.7	56.9	63.1	72.4	86.5		
25	125.5	99.7	86.5	79.8	77.2	77.5	80.3	85.7	94.1	106.6				
30	155.9	131.2	118.1	112.1	110.8	113.4	119.6	129.9	145.5					
35	189.4	165.5	154.8	150.7	152.2	158.7	170.5	188.9						
40	226.9	206.8	197.9	197.0	202.9	215.7	236.6							
45	269.2	253.1	248.4	252.7	265.7	288.4								
50	317.7	307.0	308.4	320.6	344.5	383.7								
55	373.8	430.5	320.8	405.0	446.6	600.0								
60	439.7	446.6	470.1	513.2	586.1	720.2								

CONSTRUCTION.

Log. of diff. of lat.—log. of merid. diff. lat. = the log. cosine of the MEAN PARALLEL A.

A — middle latitude = the correction of this table.

TABLE *CC*, to calculate the exact difference between the new *Loxodromic Chart* and Mercator's; which in practice is nearly insensible. It also shews the error in taking the arithmetic mean of the natural cosines of two latitudes for the cosine of the mean parallel in Middle Latitude Sailing.

Argument. Diff. of LATS.	Argument. LESSER LATITUDE. 0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°
°	′	′	′	′	′	′	′	′	′	′	+	+	+	+
1	8.1	1.0	1.1	0.6	0.3	0.2	0.1	0.1	0.1	0.0	0.1	0.1	0.2	0.3
2	22.3	6.0	3.2	2.1	1.4	1.0	0.7	0.4	0.2	0.1	0.3	0.6	0.9	1.2
3	33.0	11.2	6.6	4.4	3.1	2.2	1.5	0.9	0.6	0.2	0.7	1.3	2.0	2.9
4	44.0	17.6	10.8	7.2	5.3	3.8	2.6	1.5	0.6	0.4	1.4	2.5	3.7	5.3
5	55.0	25.0	15.8	11.0	7.9	5.6	3.8	2.2	0.7	0.7	2.3	4.0	6.0	8.6
6	66.1	32.7	21.3	15.0	10.8	7.7	5.2	2.9	0.8	1.2	3.5	6.0	8.9	12.8
7	77.2	40.9	27.2	19.3	14.0	10.0	6.6	3.6	0.8	2.0	5.1	8.4	12.6	18.1
8	88.4	49.3	33.4	24.0	17.5	12.4	8.1	4.3	0.6	3.1	7.1	11.5	16.1	24.5
9	99.6	56.9	39.8	28.9	21.1	15.0	9.7	5.0	0.4	4.3	9.4	15.2	22.4	32.2
10	109.9	66.7	46.5	34.0	24.8	18.6	11.3	5.5	0.1	5.9	12.2	19.5	28.7	41.3
15	161.6	111.2	81.7	60 7	44.4	30.4	17.8	5.6	6.7	20.0	35.1	53.5	78.1	
20	211.7	154.7	116.4	87.0	62.4	40.4	19.5	1.5	23.7	48.6	78.4	117.0		
25	259.4	195.0	148.2	109.8	75.9	44.1	12.6	20.4	56.7	99.4				
30	300.7	230.5	174.7	126.3	81.6	36.9	7.6	56.7	113.7					
35	337.4	259.6	193.7	133.9	76.1	17.2	46.2	118.7						
40	367.0	280.2	202.9	129.3	55.8	23.6	112.3							
45	387.8	290.1	199.0	108.4	13.3	92.8								
50	397.5	286.4	178.9	61.5	58.7	205.6								
55	393.2	265.0	135.9	8.9	175.8	541.0								
60	370.8	219.9	57.8	129.6	368.5	730.6								

The corrections on this side the black line must be ADDED to the greater latitude; those on the left hand side must be SUBTRACTED.

CONSTRUCTION. { 2 Nat. cos. *mean parallel* — nat. cos. lesser latitude = nat. cos. of an angle A

A — greater latitude = the *correction* of this table.

N.B. This correction × by the tangent of the greatest latitude × tangent of half the difference of longitude, is = the correction of the longitude found by the chart for any given course and distance.

Digitized by Google

TABLE I.

LOGARITHMS OF NUMBERS,

FROM 1 TO 10800.

0′	N°	Log.	4′	N°	Log.	8′	N°	Log.	12′	N°	Log.	Diff.
	1	000000	20″	26	414973		51	707570	40″	76	880814	430
20″	2	301030		27	431364	40″	52	716003		77	886491	1 43
	3	477121	40″	28	447158		53	724276	13′	78	892095	2 86 420
40″	4	602060		29	462398	9′	54	732394		79	897627	3 129 1 4
	5	698970	5′	30	477121		55	740363	20″	80	903090	4 172 2 8
1′	6	778151		31	491362	20″	56	748188		81	908485	5 215 3 12
	7	845098	20″	32	505150		57	755875	40″	82	913814	6 258 4 16
20″	8	903090		33	518514	40″	58	763428		83	919078	7 301 5 21
	9	954243	40″	34	531479		59	770852	14′	84	924279	8 344 6 25
40″	10	000000		35	544068	10′	60	778151		85	929419	9 387 7 29
	11	041393	6′	36	556303		61	785330	20″	86	934498	8 33
2′	12	079181		37	568202	20″	62	792392		87	939519	9 37
	13	113943	20″	38	579784		63	799341	40″	88	944483	410
20″	14	146128		39	591065	40″	64	806180		89	949390	1 41
	15	176091	40″	40	602060		65	812913	15′	90	954243	2 84
40″	16	204120		41	612784	11′	66	819544		91	959041	3 123 40
	17	230449	7′	42	623249		67	826075	20″	92	963788	4 164 1 4
3′	18	255273		43	633468	20″	68	832509		93	968483	5 205 2 8
	19	278754	20″	44	643453		69	838849	40″	94	973128	6 246 3 12
20″	20	301030		45	653213	40″	70	845098		95	977724	7 287 4 16
	21	322219	40″	46	662758		71	851258	16′	96	982271	8 328 5 20
40″	22	342423		47	672098	12′	72	857332		97	986772	9 369 6 24
	23	361728	8′	48	681241		73	863323	20″	98	991226	7 28
4′	24	380211		49	690196	20″	74	869232		99	995635	8 32
	25	397940	20″	50	698970		75	875061	40″	100	000000	9 36

0h	N°	Log. 0	1	2	3	4	5	6	7	8	9	390
	100	00.0000	0434	0868	1301	1734	2166	2598	3029	3461	3891	1 39
40″	101	4321	4751	5181	5609	6038	6466	6894	7321	7748	8174	2 78
	102	01. 8600	9026	9451	9876	0300	0724	1147	1570	1993	2415	3 117 38
17′	103	2837	3259	3680	4100	4521	4940	5360	5779	6197	6616	4 156 1 3
	104	02. 7033	7451	7868	8284	8700	9116	9532	9947	0361	0775	5 195 2 7
20″	105	1189	1603	2016	2428	2841	3252	3664	4075	4486	4896	6 234 3 11
	106	5306	5715	6125	6533	6942	7350	7757	8164	8571	8978	7 273 4 15
40″	107	03. 9384	9789	0195	0600	1004	1408	1812	2216	2619	3021	8 312 5 19
	108	3424	3826	4227	4628	5029	5430	5830	6230	6629	7028	9 351 6 22
18′	109	04. 7426	7825	8223	8620	9017	9414	9811	0207	0602	0998	7 26
	110	1393	1787	2182	2576	2969	3362	3755	4148	4540	4932	8 30
20″	111	5323	5714	6105	6495	6885	7275	7664	8053	8442	8830	370 9 34
	112	05. 9218	9606	9993	0380	0766	1153	1538	1924	2309	2694	1 37
40″	113	3078	3463	3846	4230	4613	4996	5378	5760	6142	6524	2 74
	114	06. 6905	7286	7666	8046	8426	8805	9185	9563	9942	0320	3 111 36
19′	115	0698	1075	1452	1829	2206	2582	2958	3333	3709	4083	4 148 1 3
	116	4458	4832	5206	5580	5953	6326	6699	7071	7443	7815	5 185 2 7
20″	117	07. 8186	8557	8928	9298	9668	0038	0407	0776	1145	1514	6 222 3 10
	118	1882	2250	2617	2985	3352	3718	4085	4451	4816	5182	7 259 4 14
40″	119	5547	5912	6276	6640	7004	7368	7731	8094	8457	8819	8 296 5 18
												9 333 6 21
												7 25
												8 28
												9 32

Digitized by Google

0h.	N°	Log. 0	1	2	3	4	5	6	7	8	9
20′	120	07. 9181	9543	9904	0266	0626	0987	1347	1707	2067	2426
	121	08. 2785	3144	3503	3861	4219	4576	4934	5291	5647	6004
20″	122	6360	6716	7071	7426	7781	8136	8490	8845	9198	9552
	123	09. 9905	0258	0611	0963	1315	1667	2018	2370	2721	3071
40″	124	3422	3772	4122	4471	4820	516,	5518	5866	6215	6562
	125	10. 6910	7257	7604	7951	8298	8644	8990	9335	9681	0026
21′	126	0371	0715	1059	1403	1747	2091	2434	2777	3119	3462
	127	3804	4146	4487	4828	5169	551c	5851	6191	6531	6871
20″	128	11. 7210	7549	7888	8227	8565	8903	9241	9579	9916	0253
	129	0590	0926	1263	1599	1934	2270	2605	2940	3275	3609
40″	130	3943	4277	4611	4944	5278	5611	5943	6276	6608	6940
	131	12. 7271	7603	7934	8265	8595	8926	9256	9586	9915	0245
22′	132	0574	0903	1231	1560	1888	2216	2544	2871	3198	3525
	133	3852	4178	4504	4830	5156	5481	5806	6131	6456	6781
20″	134	13. 7105	7429	7753	8076	8399	8722	9045	9368	9690	0012
	135	0334	0655	0977	1298	1619	1939	2260	2580	2900	3219
40″	136	3539	3858	4177	4496	4814	5133	5451	5769	6086	6403
	137	6721	7037	7354	7671	7987	8303	8618	8934	9249	9564
23′	138	14. 9879	0194	0508	0822	1136	1450	1763	2076	2389	2702
	139	3015	3327	3639	3951	4263	4574	4885	5196	5507	5818
20″	140	6128	6438	6748	7058	7367	7676	7985	8294	8603	8911
	141	15. 9219	9527	9835	0142	0449	0756	1063	1370	1676	1982
40″	142	2288	2594	2900	3205	3510	3815	4120	4424	4728	5032
	143	5336	5640	5943	6246	6549	6852	7154	7457	7759	8061
24′	144	16. 8362	8664	8965	9266	9567	9868	0168	0469	0769	1068
	145	1368	1667	1967	2266	2564	2863	3161	3460	3758	4055
20″	146	4353	4650	4947	5244	5541	5838	6134	6430	6726	7022
	147	7317	7613	7908	8203	8497	8792	9086	9380	9674	9968
40″	148	17. 0262	0555	0848	1141	1434	1726	2019	2311	2603	2895
	149	3186	3478	3769	4060	4351	4641	4932	5222	5512	5802
25′	150	6091	6381	6670	6959	7248	7536	7825	8113	8401	8689
	151	18. 8977	9264	9552	9839	0126	0413	0699	0986	1272	1558
20″	152	1844	2129	2415	2700	2985	3270	3555	3839	4123	4407
	153	4691	4975	5259	5542	5825	6108	6391	6674	6956	7239
40″	154	19. 7521	7803	8084	8366	8647	8928	9209	9490	9771	0051
	155	0332	0612	0892	1171	1451	1730	2010	2289	2567	2846
26′	156	3125	3403	3681	3959	4237	4514	4792	5069	5346	5623
	157	5900	6176	6453	6729	7005	7281	7556	7832	8107	8382
20″	158	20. 8657	8932	9206	9481	9755	0029	0303	0577	0850	1124
	159	1397	1670	1943	2216	2488	2761	3033	3305	3577	3848
40″	160	4120	4391	4663	4934	5204	5475	5746	6016	6286	6556
	161	6826	7096	7365	7634	7904	8173	8441	8710	8979	9247
27′	162	21. 9515	9783	0051	0319	0586	0853	1121	1388	1654	1921
	163	2188	2454	2720	2986	3252	3518	3783	4049	4314	4579
20″	164	4844	5109	5373	5638	5902	6166	6430	6694	6957	7221
	165	7484	7747	8010	8273	8536	8798	9060	9323	9585	9846
40″	166	22. 0108	0370	0631	0892	1153	1414	1675	1936	2196	2456
	167	2716	2976	3236	3496	3755	4015	4274	4533	4792	5051
28′	168	5309	5568	5826	6084	6342	6600	6858	7115	7372	7630
	169	7887	8144	8400	8657	8913	9170	9426	9682	9938	0193
20″	170	23. 0449	0704	0960	1215	1470	1724	1979	2234	2488	2742
	171	2996	3250	3504	3757	4011	4264	4517	4770	5023	5276
40″	172	5528	5781	6033	6285	6537	6789	7041	7292	7544	7795
	173	24. 8046	8297	8548	8799	9049	9299	9550	9800	0050	0300
29′	174	0549	0799	1048	1297	1546	1795	2044	2293	2541	2790
	175	3038	3286	3534	3782	4030	4277	4525	4772	5019	5266
20″	176	5513	5759	6006	6252	6499	6745	6991	7237	7482	7728
	177	25. 7973	8219	8464	8709	8954	9198	9443	9687	9932	0176
40″	178	0420	0664	0908	1151	1395	1638	1881	2125	2368	2610
	179	2853	3096	3338	3580	3822	4064	4306	4548	4790	5031

Diff.									
360									
1	36								
2	72	3							
3	108	1							
4	144	2							
5	180	3							
6	216	4							
7	252	5							
8	288	6							
9	324	7							
		8							
340		9							
1	34								
2	68	3							
3	102	1							
4	136	2							
5	170	3							
6	204	4							
7	238	5							
8	272	6							
9	306	7							
		8							
320		9							
1	32								
2	64	3							
3	96	1							
4	128	2							
5	160	3							
6	192	4							
7	224	5							
8	256	6							
9	288	7							
		8							
300		9							
1	30								
2	60	2							
3	90	1							
4	120	2							
5	150	3							
6	180	4							
7	210	5							
8	240	6							
9	270	7							
		8							
280		9							
1	28								
2	56	2							
3	84	1							
4	112	2							
5	140	3							
6	168	4							
7	196	5							
8	224	6							
9	252	7							
		8							
260		9							
1	26								
2	52	2							
3	78	1							
4	104	2							
5	130	3							
6	156	4							
7	182	5							
8	208	6							
9	234	7							
		8							
		9							

77
78
79

25.2-

Digitized by Google

0°.	N°	Log.0	1	2	3	4	5	6	7	8	9
30′	180	25.5273	5514	5755	5996	6237	6477	6718	6958	7198	7439
	181	7679	7918	8158	8398	8637	8877	9116	9355	9594	9833
20″	182	26.0071	0310	0548	0787	1025	1263	1501	1739	1976	2214
	183	2451	2688	2925	3162	3399	3636	3873	4109	4346	4582
40″	184	4818	5054	5290	5525	5761	5996	6232	6467	6702	6937
	185	7172	7406	7641	7875	8110	8344	8578	8812	9046	9279
31′	186	27.9513	9746	9980	0213	0446	0679	0912	1144	1377	1609
	187	1842	2074	2306	2538	2770	3001	3233	3464	3696	3927
20″	188	4158	4389	4620	4850	5081	5311	5542	5772	6002	6232
	189	6462	6692	6921	7151	7380	7609	7838	8067	8296	8525
40″	190	28.8754	8982	9211	9439	9667	9895	0123	0351	0578	0806
	191	1033	1261	1488	1715	1942	2169	2396	2622	2849	3075
32′	192	3301	3527	3753	3979	4205	4431	4656	4882	5107	5332
	193	5557	5782	6007	6232	6456	6681	6905	7130	7354	7578
20″	194	7802	8026	8249	8473	8696	8920	9143	9366	9589	9812
	195	29.0035	0257	0480	0702	0925	1147	1369	1591	1813	2034
40″	196	2256	2478	2699	2920	3141	3363	3584	3804	4025	4246
	197	4466	4687	4907	5127	5347	5567	5787	6007	6226	6446
33′	198	6665	6884	7104	7323	7542	7761	7979	8198	8416	8635
	199	8853	9071	9289	9507	9725	9943	0161	0378	0595	0813
20″	200	30.1030	1247	1464	1681	1898	2114	2331	2547	2764	2980
	201	3196	3412	3628	3844	4059	4275	4491	4706	4921	5136
40″	202	5351	5566	5781	5996	6211	6425	6639	6854	7068	7282
	203	7496	7710	7924	8137	8351	8564	8778	8991	9204	9417
34′	204	9630	9843	0056	0268	0481	0693	0906	1118	1330	1542
	205	31.1754	1966	2177	2389	2600	2812	3023	3234	3445	3656
20″	206	3867	4078	4289	4499	4710	4920	5130	5340	5551	5760
	207	5970	6180	6390	6599	6809	7018	7227	7436	7646	7854
40″	208	8063	8272	8481	8689	8898	9106	9314	9522	9730	9938
	209	32.0146	0354	0562	0769	0977	1184	1391	1598	1805	2012
35′	210	2219	2426	2633	2839	3046	3252	3458	3665	3871	4077
	211	4282	4488	4694	4899	5105	5310	5516	5721	5926	6131
20″	212	6336	6541	6745	6950	7155	7359	7563	7767	7972	8176
	213	8380	8583	8787	8991	9194	9398	9601	9805	0008	0211
40″	214	33.0414	0617	0819	1022	1225	1427	1630	1832	2034	2236
	215	2438	2640	2842	3044	3246	3447	3649	3850	4051	4253
36′	216	4454	4655	4856	5057	5257	5458	5658	5859	6059	6260
	217	6460	6660	6860	7060	7260	7459	7659	7858	8058	8257
20″	218	8456	8656	8855	9054	9253	9451	9650	9849	0047	0246
	219	34.0444	0642	0841	1039	1237	1435	1632	1830	2028	2225
40″	220	2423	2620	2817	3014	3212	3409	3606	3802	3999	4196
	221	4392	4589	4785	4981	5178	5374	5570	5766	5962	6157
37′	222	6353	6549	6744	6939	7135	7330	7525	7720	7915	8110
	223	8305	8500	8694	8889	9083	9278	9472	9666	9860	0054
20″	224	35.0248	0442	0636	0829	1023	1216	1410	1603	1796	1989
	225	2183	2375	2568	2761	2954	3147	3339	3532	3724	3916
40″	226	4108	4301	4493	4685	4876	5068	5260	5452	5643	5834
	227	6026	6217	6408	6599	6790	6981	7172	7363	7554	7744
38′	228	7935	8125	8316	8506	8696	8886	9076	9266	9456	9646
	229	36.9835	0025	0215	0404	0593	0783	0972	1161	1350	1539
20″	230	1728	1917	2105	2294	2482	2671	2859	3048	3236	3424
	231	3612	3800	3988	4176	4363	4551	4739	4926	5113	5301
40″	232	5488	5675	5862	6049	6236	6423	6610	6796	6983	7169
	233	7356	7542	7729	7915	8101	8287	8473	8659	8845	9030
39′	234	37.9216	9401	9587	9772	9958	0143	0328	0513	0698	0883
	235	1068	1253	1437	1622	1806	1991	2175	2360	2544	2728
20″	236	2912	3096	3280	3464	3647	3831	4015	4198	4382	4565
	237	4748	4932	5115	5298	5481	5664	5846	6029	6212	6394
40″	238	6577	6759	6942	7124	7306	7488	7670	7852	8034	8216
	239	38.8398	8580	8761	8943	9124	9306	9487	9668	9849	0030

Diff.									
240									
1	24								
2	48								
3	72	230							
4	96	1	23						
5	120	2	46						
6	144	3	69						
7	168	4	92						
8	192	5	115						
9	216	6	138						
		7	161						
		8	184						
		9	207						
220									
1	22								
2	44								
3	66	210							
4	88	1	21						
5	110	2	42						
6	132	3	63						
7	154	4	84						
8	176	5	105						
9	198	6	126						
		7	147						
		8	168						
		9	189						
205									
1	21								
2	41								
3	62	200							
4	82	1	20						
5	103	2	40						
6	123	3	60						
7	144	4	80						
8	164	5	100						
9	185	6	120						
		7	140						
		8	160						
		9	180						
195									
1	20								
2	39								
3	59	190							
4	78	1	19						
5	98	2	38						
6	117	3	57						
7	136	4	76						
8	156	5	95						
9	176	6	114						
		7	133						
		8	152						
		9	171						
185									
1	18								
2	37								
3	55	180							
4	74	1	18						
5	93	2	36						
6	111	3	54						
7	130	4	72						
8	148	5	90						
9	167	6	108						
		7	126						
		8	144						
		9	162						

Digitized by Google

0h.	N°	Log. 0	1	2	3	4	5	6	7	8	9	Diff.
40′	240	38. 0211	0392	0573	0754	0934	1115	1296	1476	1656	1837	
	241	2017	2197	2377	2557	2737	2917	3097	3277	3456	3636	
20″	242	3815	3995	4174	4353	4533	4712	4891	5070	5249	5428	
	243	5606	5785	5964	6142	6321	6499	6677	6856	7034	7212	175
40″	244	7390	7568	7746	7923	8101	8279	8456	8634	8811	8989	1 18
	245	9166	9343	9520	9698	9875						2 35
		39.					0051	0228	0405	0582	0759	3 53
41′	246	0935	1112	1288	1464	1641	1817	1993	2169	2345	2521	4 70
	247	2697	2873	3048	3224	3400	3575	3751	3926	4101	4277	5 88
20″	248	4452	4627	4802	4977	5152	5326	5501	5676	5850	6025	6 105
	249	6199	6374	6548	6722	6896	7071	7245	7419	7592	7766	7 123
40″	250	7940	8114	8287	8461	8634	8808	8981	9154	9328	9501	8 140
	251	9674	9847									9 158
		40.		0020	0192	0365	0538	0711	0883	1056	1228	
42′	252	1401	1573	1745	1917	2089	2261	2433	2605	2777	2949	
	253	3121	3292	3464	3635	3808	3978	4149	4320	4492	4663	
20″	254	4834	5005	5176	5346	5517	5688	5858	6029	6199	6370	
	255	6540	6710	6881	7051	7221	7391	7561	7731	7901	8070	
40″	256	8240	8410	8579	8749	8918	9087	9257	9426	9595	9764	
	257											
		41.	9933	0102	0271	0440	0609	0777	0946	1114	1283	1451
43′	258	1620	1788	1956	2124	2293	2461	2629	2796	2964	3132	165
	259	3300	3467	3635	3803	3970	4137	4305	4472	4639	4806	1 17
20″	260	4973	5140	5307	5474	5641	5808	5974	6141	6308	6474	2 33
	261	6641	6807	6973	7139	7306	7472	7638	7804	7970	8135	3 50
40″	262	8301	8467	8633	8798	8964	9129	9295	9460	9625	9791	4 66
	263											5 83
		42.	9956	0121	0286	0451	0616	0781	0945	1110	1275	1439
44′	264	1604	1768	1933	2097	2261	2426	2590	2754	2918	3082	6 99
	265	3246	3410	3574	3737	3901	4065	4228	4392	4555	4718	7 116
20″	266	4882	5045	5208	5371	5534	5697	5860	6023	6186	6349	8 132
	267	6511	6674	6836	6999	7161	7324	7486	7648	7811	7973	9 149
40″	268	8135	8297	8459	8621	8783	8944	9106	9268	9429	9591	
	269											
		43.	9752	9914	0075	0236	0398	0559	0720	0881	1042	1203
45′	270	1364	1525	1685	1846	2007	2167	2328	2488	2649	2809	
	271	2969	3130	3290	3450	3610	3770	3930	4090	4249	4409	
20″	272	4569	4729	4888	5048	5207	5367	5526	5685	5844	6004	
	273	6163	6322	6481	6640	6799	6957	7116	7275	7433	7592	155
40″	274	7751	7909	8067	8226	8384	8542	8701	8859	9017	9175	1 16
	275	9333	9491	9648	9806	9964						2 31
		44.					0122	0279	0437	0594	0752	3 47
46′	276	0909	1066	1224	1381	1538	1695	1852	2009	2166	2323	4 62
	277	2480	2637	2793	2950	3106	3263	3419	3576	3732	3889	5 78
20″	278	4045	4201	4357	4513	4669	4825	4981	5137	5293	5449	6 93
	279	5604	5760	5915	6071	6226	6382	6537	6692	6848	7003	7 109
40″	280	7158	7313	7468	7623	7778	7933	8088	8242	8397	8552	8 124
	281	8706	8861	9015	9170	9324	9478	9633	9787	9941		9 140
		45.									0095	
47′	282	0249	0403	0557	0711	0865	1018	1172	1326	1479	1633	
	283	1786	1940	2093	2247	2400	2553	2706	2859	3012	3165	
20″	284	3318	3471	3624	3777	3930	4082	4235	4387	4540	4692	
	285	4845	4997	5150	5302	5454	5606	5758	5910	6062	6214	
40″	286	6366	6518	6670	6821	6973	7125	7276	7428	7579	7731	
	287	7882	8033	8184	8336	8487	8638	8789	8940	9091	9242	
48′	288											
		46.	9392	9543	9694	9845	9995					
								0146	0296	0447	0597	0748
	289	0898	1048	1198	1348	1499	1649	1799	1948	2098	2248	145
20″	290	2398	2548	2697	2847	2997	3146	3296	3445	3594	3744	1 15
	291	3893	4042	4191	4340	4490	4639	4788	4936	5085	5234	2 29
40″	292	5383	5532	5680	5829	5977	6126	6274	6423	6571	6719	3 44
	293	6868	7016	7164	7312	7460	7608	7756	7904	8052	8200	4 58
49′	294	8347	8495	8643	8790	8938	9085	9233	9380	9527	9675	5 73
	295											6 87
		47.	9822	9969	0116	0263	0410	0557	0704	0851	0998	1145
20″	296	1292	1438	1585	1732	1878	2025	2171	2318	2464	2610	7 102
	297	2756	2903	3049	3195	3341	3487	3633	3779	3925	4071	8 116
40″	298	4216	4362	4508	4653	4799	4944	5090	5235	5381	5526	9 131
	299	5671	5816	5962	6107	6252	6397	6542	6687	6832	6976	

Digitized by Google

0′.	N°	Log. 0	1	2	3	4	5	6	7	8	9	Diff.
50′	300	47.7121	7266	7411	7555	7700	7844	7989	8133	8278	8422	140
	301	8566	8711	8855	8999	9143	9287	9431	9575	9719	9863	1 14
20″	302	48.0007	0151	0294	0438	0582	0725	0869	1012	1156	1299	2 28
	303	1443	1586	1729	1872	2016	2159	2302	2445	2588	2731	3 42
40″	304	2874	3016	3159	3302	3445	3587	3730	3872	4015	4157	4 56 13
	305	4300	4442	4585	4727	4869	5011	5153	5295	5437	5579	5 70 1 1
51′	306	5721	5863	6005	6147	6289	6430	6572	6714	6855	6997	6 84 2 2
	307	7138	7280	7421	7563	7704	7845	7986	8127	8269	8410	7 98 3 4
20″	308	8551	8692	8833	8974	9114	9255	9396	9537	9677	9818	8 112 4 5
	309	49.9958	0099	0239	0380	0520	0661	0801	0941	1081	1222	9 126 5 6
40″	310	1362	1502	1642	1782	1922	2062	2201	2341	2481	2621	6 8
	311	2760	2900	3040	3179	3319	3458	3597	3737	3876	4015	7 9
52′	312	4155	4294	4433	4572	4711	4850	4989	5128	5267	5406	136 8 11
	313	5544	5683	5822	5960	6099	6238	6376	6515	6653	6791	1 14 9 12
20″	314	6930	7068	7206	7344	7483	7621	7759	7897	8035	8173	2 27
	315	8311	8448	8586	8724	8862	8999	9137	9275	9412	9550	3 41
40″	316	50.9687	9824	9962	0099	0236	0374	0511	0648	0785	0922	4 54
	317	1059	1196	1333	1470	1607	1744	1880	2017	2154	2291	5 68 13
53′	318	2427	2564	2700	2837	2973	3109	3246	3382	3518	3655	6 82 1 1
	219	3791	3927	4063	4199	4335	4471	4607	4743	4878	5014	7 95 2 2
20″	320	5150	5286	5421	5557	5693	5828	5964	6099	6234	6370	8 109 3 4
	321	6505	6640	6776	6911	7046	7181	7316	7451	7586	7721	9 122 4 5
40″	322	7856	7991	8126	8260	8395	8530	8664	8799	8934	9068	5 6
	323	51.9203	9337	9471	9606	9740	9874	0009	0143	0277	0411	6 8
54′	324	0545	0679	0813	0947	1081	1215	1349	1482	1616	1750	132 7 9
	325	1883	2017	2151	2284	2418	2551	2684	2818	2951	3084	1 13 8 10
20″	326	3218	3351	3484	3617	3750	3883	4016	4149	4282	4415	2 26 9 12
	327	4548	4681	4813	4946	5079	5211	5344	5476	5609	5741	3 40
40″	328	5874	6006	6139	6271	6403	6535	6668	6800	6932	7064	4 53
	329	7196	7328	7460	7592	7724	7855	7987	8119	8251	8382	5 66
55′	330	8514	8646	8777	8909	9040	9171	9303	9434	9566	9697	6 79 13
	331	52.9828	9959	0090	0221	0353	0484	0615	0745	0876	1007	7 92 1 1
20″	332	1138	1269	1400	1530	1661	1792	1922	2053	2183	2314	8 106 2 2
	333	2444	2575	2705	2835	2966	3096	3226	3356	3486	3616	9 119 3 3
40″	334	3746	3876	4006	4136	4266	4396	4526	4656	4785	4915	4 5
	335	5045	5174	5304	5434	5563	5693	5822	5951	6081	6210	5 6
56′	336	6339	6469	6598	6727	6856	6985	7114	7243	7372	7501	128 6 7
	337	7630	7759	7888	8016	8145	8274	8402	8531	8660	8788	1 13 7 9
20″	338	8917	9045	9174	9302	9430	9559	9687	9815	9943	0072	2 26 8 10
	339	53.0200	0328	0456	0584	0712	0840	0968	1096	1223	1351	3 38 9 11
40″	340	1479	1607	1734	1862	1990	2117	2245	2372	2500	2627	4 51
	341	2754	2882	3009	3136	3264	3391	3518	3645	3772	3899	5 64
57′	342	4026	4153	4280	4407	4534	4661	4787	4914	5041	5167	6 77
	343	5294	5421	5547	5674	5800	5927	6053	6180	6306	6432	7 90 12
20″	344	6558	6685	6811	6937	7063	7189	7315	7441	7567	7693	8 102 1 1
	345	7819	7945	8071	8197	8322	8448	8574	8699	8825	8951	9 115 2 2
40″	346	54.9076	9202	9327	9452	9578	9703	9829	9954	0079	0204	3 3
	347	0329	0455	0580	0705	0830	0955	1080	1205	1330	1454	4 5
58′	348	1579	1704	1829	1953	2078	2203	2327	2452	2576	2701	5 6
	349	2825	2950	3074	3199	3323	3447	3571	3696	3820	3944	124 6 7
20″	350	4068	4192	4316	4440	4564	4688	4812	4936	5060	5183	1 12 7 8
	351	5307	5431	5555	5678	5802	5925	6049	6172	6296	6419	2 25 8 10
40″	352	6543	6666	6789	6913	7036	7159	7282	7405	7529	7652	3 37 9 11
	353	7775	7898	8021	8144	8267	8389	8512	8635	8758	8881	4 50
59′	354	55.9003	9126	9249	9371	9494	9616	9739	9861	9984	0106	5 62
	355	0228	0351	0473	0595	0717	0840	0962	1084	1206	1328	6 74
20″	356	1450	1572	1694	1816	1938	2060	2181	2303	2425	2547	7 87
	357	2668	2790	2911	3033	3155	3276	3398	3519	3640	3762	8 99
40″	358	3883	4004	4126	4247	4368	4489	4610	4731	4852	4973	9 111
	359	5094	5215	5336	5457	5578	5699	5820	5940	6061	6182	

Digitized by Google

1h.	N°	Log. 0	1	2	3	4	5	6	7	8	9	Diff.
0′	360	55.6303	6423	6544	6664	6785	6905	7026	7146	7267	7387	120
	361	7507	7627	7748	7868	7988	8108	8228	8349	8469	8589	1 12
20″	362	8709	8829	8948	9068	9188	9308	9428	9548	9667	9787	118 2 24
	363	56.9907	0026	0146	0265	0385	0504	0624	0743	0863	0982	3 36
40″	364	1101	1221	1340	1459	1578	1698	1817	1936	2055	2174	2 24 4 48
	365	2293	2412	2531	2650	2769	2887	3006	3125	3244	3362	3 35 5 60
1′	366	3481	3600	3718	3837	3955	4074	4192	4311	4429	4548	4 47 6 72
	367	4666	4784	4903	5021	5139	5257	5376	5494	5612	5730	5 59 7 84
20″	368	5848	5966	6084	6202	6320	6437	6555	6673	6791	6909	6 71 8 96
	369	7026	7144	7262	7379	7497	7614	7732	7849	7967	8084	7 83 9 108
40″	370	8202	8319	8436	8554	8671	8788	8905	9023	9140	9257	8 94
	371	57.9374	9491	9608	9725	9842	9959	0076	0193	0309	0426	9 106
2′	372	0543	0660	0776	0893	1010	1126	1243	1359	1476	1592	116
	373	1709	1825	1942	2058	2174	2291	2407	2523	2639	2755	1 12
20″	374	2872	2988	3104	3220	3336	3452	3568	3684	3800	3915	2 23
	375	4031	4147	4263	4379	4494	4610	4726	4841	4957	5072	3 35
40″	376	5188	5303	5419	5534	5650	5765	5880	5996	6111	6226	114 4 46
	377	6341	6457	6572	6687	6802	6917	7032	7147	7262	7377	1 11 5 58
3′	378	7492	7607	7722	7836	7951	8066	8181	8295	8410	8525	2 23 6 70
	379	8639	8754	8868	8983	9097	9212	9326	9441	9555	9669	3 34 7 81
20″	380	58.9784	9898	0012	0126	0241	0355	0469	0583	0697	0811	4 46 8 93
	381	0925	1039	1153	1267	1381	1495	1608	1722	1836	1950	5 57 9 104
40″	382	2063	2177	2291	2404	2518	2631	2745	2858	2972	3085	6 68
	383	3199	3312	3426	3539	3652	3765	3879	3992	4105	4218	7 80
4′	384	4331	4444	4557	4670	4783	4896	5009	5122	5235	5348	8 91
	385	5461	5574	5686	5799	5912	6024	6137	6250	6362	6475	9 103 112
20″	386	6587	6700	6812	6925	7037	7149	7262	7374	7486	7599	1 11
	387	7711	7823	7935	8047	8160	8272	8384	8496	8608	8720	2 22
40″	388	8832	8944	9056	9167	9279	9391	9503	9615	9726	9838	3 34
	389	59.9950	0061	0173	0284	0396	0507	0619	0730	0842	0953	4 45
5′	390	1065	1176	1287	1399	1510	1621	1732	1843	1955	2066	5 56 110
	391	2177	2288	2399	2510	2621	2732	2843	2954	3064	3175	6 67 1 11
20″	392	3286	3397	3508	3618	3729	3840	3950	4061	4171	4282	7 78 2 22
	393	4393	4503	4614	4724	4834	4945	5055	5165	5276	5386	8 90 3 33
40″	394	5496	5606	5717	5827	5937	6047	6157	6267	6377	6487	9 101 4 44
	395	6597	6707	6817	6927	7037	7146	7256	7366	7476	7586	5 55
6′	396	7695	7805	7914	8024	8134	8243	8353	8462	8572	8681	6 66
	497	8791	8900	9009	9119	9228	9337	9446	9556	9665	9774	7 77
20″	398	60.9883	9992	0101	0210	0319	0428	0537	0646	0755	0864	8 88 108
	399	0973	1082	1191	1299	1408	1517	1625	1734	1843	1951	9 99 1 11
40″	400	2060	2169	2277	2386	2494	2603	2711	2819	2928	3036	2 22
	401	3144	3253	3361	3469	3577	3686	3794	3902	4010	4118	3 32
7′	402	4226	4334	4442	4550	4658	4766	4874	4982	5089	5197	4 43
	403	5305	5413	5521	5628	5736	5844	5951	6059	6166	6274	5 54 106
20″	404	6381	6489	6596	6704	6811	6919	7026	7133	7241	7348	6 65 1 11
	405	7455	7562	7669	7777	7884	7991	8098	8205	8312	8419	7 76 2 21
40″	406	8526	8633	8740	8847	8954	9061	9167	9274	9381	9488	8 86 3 32
	407	61.9594	9701	9808	9914	0021	0128	0234	0341	0447	0554	9 97 4 42
8′	408	0660	0767	0873	0979	1086	1192	1298	1405	1511	1617	5 53
	409	1723	1829	1936	2042	2148	2254	2360	2466	2572	2678	6 64
20″	410	2784	2890	2996	3102	3207	3313	3419	3525	3630	3736	7 74
	411	3842	3947	4053	4159	4264	4370	4475	4581	4686	4792	8 85 104
40″	412	4897	5003	5108	5213	5319	5424	5529	5634	5740	5845	9 95 1 10
	413	5950	6055	6160	6265	6370	6476	6581	6686	6790	6895	2 21
9′	414	7000	7105	7210	7315	7420	7525	7629	7734	7839	7943	3 31
	415	8048	8153	8257	8362	8466	8571	8676	8780	8884	8989	4 42
20″	416	62.9093	9198	9302	9406	9511	9615	9719	9824	9928	0032	5 52
	417	0136	0240	0344	0448	0552	0656	0760	0864	0968	1072	6 62
40″	418	1176	1280	1384	1488	1592	1695	1799	1903	2007	2110	7 73
	419	2214	2318	2421	2525	2628	2732	2835	2939	3042	3146	8 83
												9 94

Digitized by Google

h.	N°	Log. 0	1	2	3	4	5	6	7	8	9	Diff.
10′	420	62. 3249	3353	3456	3559	3663	3766	3869	3973	4076	4179	103
	421	4282	4385	4488	4591	4695	4798	4901	5004	5107	5210	101 1 10
20″	422	5312	5415	5518	5621	5724	5827	5929	6032	6135	6238	1 10 2 20
	423	6340	6443	6546	6648	6751	6853	6956	7058	7161	7263	2 20 3 31
40″	424	7366	7468	7571	7673	7775	7878	7980	8082	8185	8287	3 30 4 41
	425	8389	8491	8593	8695	8797	8900	9002	9104	9206	9308	4 40 5 51
11′	426	63. 9410	9512	9613	9715	9817	9919	0021	0123	0224	0326	5 51 6 61
	427	0428	0530	0631	0733	0835	0936	1038	1139	1241	1342	6 61 7 71
20″	428	1444	1545	1647	1748	1849	1951	2052	2153	2255	2356	7 71 8 82
	429	2457	2559	2660	2761	2862	2963	3064	3165	3266	3367	8 81 9 92
40″	430	3468	3569	3670	3771	3872	3973	4074	4175	4276	4376	9 91
	431	4477	4578	4679	4779	4880	4981	5081	5182	5283	5383	100
12′	432	5484	5584	5685	5785	5886	5986	6087	6187	6287	6388	99 1 10
	433	6488	6588	6688	6789	6889	6989	7089	7189	7290	7390	1 10 2 20
20″	434	7490	7590	7690	7790	7890	7990	8090	8190	8290	8389	2 20 3 30
	435	8489	8589	8689	8789	8888	8988	9088	9188	9287	9387	3 30 4 40
40″	436	64. 9486	9586	9686	9785	9885	9984	0084	0183	0283	0382	4 40 5 50
	437	0481	0581	0680	0779	0879	0978	1077	1177	1276	1375	5 50 6 60
13′	438	1474	1573	1672	1771	1871	1970	2069	2168	2267	2366	6 59 7 70
	439	2465	2563	2662	2761	2860	2959	3058	3156	3255	3354	7 69 8 80
20″	440	3453	3551	3650	3749	3847	3946	4044	4143	4242	4340	8 79 9 90
	441	4439	4537	4636	4734	4832	4931	5029	5127	5226	5324	9 89
40″	442	5422	5521	5619	5717	5815	5913	6011	6110	6208	6306	98
	443	6404	6502	6600	6698	6796	6894	6992	7089	7187	7285	97 1 10
14′	444	7383	7481	7579	7676	7774	7872	7969	8067	8165	8262	1 10 2 19
	445	8360	8458	8555	8653	8750	8848	8945	9043	9140	9237	2 19 3 29
20″	446	65. 9335	9432	9530	9627	9724	9821	9919	0016	0113	0210	3 29 4 39
	447	0308	0405	0502	0599	0696	0793	0890	0987	1084	1181	4 39 5 49
40″	448	1278	1375	1472	1569	1666	1762	1859	1956	2053	2150	5 49 6 59
	449	2246	2343	2440	2536	2633	2730	2826	2923	3019	3116	6 58 7 69
15′	450	3213	3309	3405	3502	3598	3695	3791	3888	3984	4080	7 68 8 78
	451	4177	4273	4369	4465	4562	4658	4754	4850	4946	5042	8 78 9 88
20″	452	5138	5235	5331	5427	5523	5619	5715	5810	5906	6002	9 87
	453	6098	6194	6290	6386	6482	6577	6673	6769	6864	6960	96
40″	454	7056	7152	7247	7343	7438	7534	7629	7725	7820	7916	95 1 10
	455	8011	8107	8202	8297	8393	8488	8584	8679	8774	8870	1 10 2 19
16′	456	8965	9060	9155	9250	9346	9441	9536	9631	9726	9821	2 19 3 29
	457	66. 9916	0011	0106	0201	0296	0391	0486	0581	0676	0771	3 29 4 38
20″	458	0865	0960	1055	1150	1245	1339	1434	1529	1623	1718	4 38 5 48
	459	1813	1907	2002	2096	2191	2286	2380	2475	2569	2663	5 48 6 58
40″	460	2758	2852	2947	3041	3135	3230	3324	3418	3512	3607	6 57 7 67
	461	3701	3795	3889	3983	4078	4172	4266	4360	4454	4548	7 67 8 77
17′	462	4642	4736	4830	4924	5018	5112	5206	5299	5393	5487	8 76 9 86
	463	5581	5675	5769	5862	5956	6050	6143	6237	6331	6424	9 86
20″	464	6518	6612	6705	6799	6892	6986	7079	7173	7266	7360	94
	465	7453	7546	7640	7733	7826	7920	8013	8106	8199	8293	93 1 9
40″	466	8386	8479	8572	8665	8759	8852	8945	9038	9131	9224	2 19 3 28
	467	67. 9317	9410	9503	9596	9689	9782	9875	9967	0060	0153	4 38 5 47
18′	468	0246	0339	0431	0524	0617	0710	0802	0895	0988	1080	5 47 6 56
	469	1173	1265	1358	1451	1543	1636	1728	1821	1913	2005	6 56 7 66
20″	470	2098	2190	2283	2375	2467	2560	2652	2744	2836	2929	7 65 8 75
	471	3021	3113	3205	3297	3390	3482	3574	3666	3758	3850	8 74 9 85
40″	472	3942	4034	4126	4218	4310	4402	4494	4586	4677	4769	9 84
	473	4861	4953	5045	5137	5228	5320	5412	5503	5595	5687	92
19′	474	5778	5870	5962	6053	6145	6236	6328	6419	6511	6602	91 1 9
	475	6694	6785	6876	6968	7059	7151	7242	7333	7424	7516	2 18 3 27
20″	476	7607	7698	7789	7881	7972	8063	8154	8245	8336	8427	3 27 4 36
	477	8518	8609	8700	8791	8882	8973	9064	9155	9246	9337	4 36 5 46
40″	478	68. 9428	9519	9610	9700	9791	9882	9973	0063	0154	0245	5 46 6 55
	479	0336	0426	0517	0607	0698	0789	0879	0970	1060	1151	6 55 7 64
												7 64 8 73
												8 73 9 82

Digitized by Google

1°.	N°	Log. 0	1	2	3	4	5	6	7	8	9	D
												90
20′	480	68. 1241	1332	1422	1513	1603	1693	1784	1874	1964	2055	1 9
	481	2145	2235	2326	2416	2506	2596	2686	2777	2867	2957	2 18
20″	482	3047	3137	3227	3317	3407	3497	3587	3677	3767	3857	3 27
	483	3947	4037	4127	4217	4307	4396	4486	4576	4666	4756	4 36
40″	484	4845	4935	5025	5114	5204	5294	5383	4473	5563	5652	5 45
	485	5742	5831	5921	6010	6100	6189	6279	6368	6458	6547	6 54
21′	486	6636	6726	6815	6904	6994	7083	7172	7261	7351	7440	7 63
	487	7529	7618	7707	7796	7886	7975	8064	8153	8242	8331	8 72
20″	488	8420	8509	8598	8687	8776	8865	8953	9042	9131	9220	9 81
	489	9309	9398	9486	9575	9664	9753	9841	9930	0019	0107	
		69.										
40″	490	0196	0285	0373	0462	0550	0639	0728	0816	0905	0993	88
	491	1081	1170	1258	1347	1435	1524	1612	1700	1789	1877	1 9
22′	492	1965	2053	2142	2230	2318	2406	2494	2583	2671	2759	2 18
	493	2847	2935	3023	3111	3199	3287	3375	3463	3551	3639	3 26
20″	494	3727	3815	3903	3991	4078	4166	4254	4342	4430	4517	4 35
	495	4605	4693	4781	4868	4956	5044	5131	5219	5307	5394	5 44
40″	496	5482	5569	5657	5744	5832	5919	6007	6094	6182	6269	6 53
	497	6356	6444	6531	6618	6706	6793	6880	6968	7055	7142	7 62
23′	498	7229	7317	7404	7491	7578	7665	7752	7839	7926	8014	8 70
	499	8101	8188	8275	8362	8449	8535	8622	8709	8796	8883	9 79
20″	500	8970	9057	9144	9231	9317	9404	9491	9578	9664	9751	
	501	9838	9924	0011	0098	0184	0271	0358	0444	0531	0617	
		70.										86
40″	502	0704	0790	0877	0963	1050	1136	1222	1309	1395	1482	1 9
	503	1568	1654	1741	1827	1913	1999	2086	2172	2258	2344	2 17
24′	504	2431	2517	2603	2689	2775	2861	2947	3033	3119	3205	3 26
	505	3291	3377	3463	3549	3635	3721	3807	3893	3979	4065	4 34
20″	506	4151	4236	4322	4408	4494	4579	4665	4751	4837	4922	5 43
	507	5008	5094	5179	5265	5350	5436	5522	5607	5693	5778	6 52
40″	508	5864	5949	6035	6120	6206	6291	6376	6462	6547	6632	7 60
	509	6718	6803	6888	6974	7059	7144	7229	7315	7400	7485	8 69
25′	510	7570	7655	7740	7826	7911	7996	8081	8166	8251	8336	9 77
	511	8421	8506	8591	8676	8761	8846	8931	9015	9100	9185	
20″	512	9270	9355	9440	9524	9609	9694	9779	9863	9948	0033	84
		71.										1 8
	513	0117	0202	0287	0371	0456	0540	0625	0710	0794	0879	2 17
40″	514	0963	1048	1132	1217	1301	1385	1470	1554	1639	1723	3 25
	515	1807	1892	1976	2060	2144	2229	2313	2397	2481	2566	4 34
26′	516	2650	2734	2818	2902	2986	3070	3154	3238	3323	3407	5 42
	517	3491	3575	3659	3742	3826	3910	3994	4078	4162	4246	6 50
20″	518	4330	4414	4497	4581	4665	4749	4833	4916	5000	5084	7 59
	519	5167	5251	5335	5418	5502	5586	5669	5753	5836	5920	8 67
40″	520	6003	6087	6170	6254	6337	6421	6504	6588	6671	6754	9 76
	521	6838	6921	7004	7088	7171	7254	7338	7421	7504	7587	82
27′	522	7671	7754	7837	7920	8003	8086	8169	8253	8336	8419	1 8
	523	8502	8585	8668	8751	8834	8917	9000	9083	9165	9248	2 16
20″	524	9331	9414	9497	9580	9663	9745	9828	9911	9994	0077	3 25
		72.										4 33
	525	0159	0242	0325	0407	0490	0573	0655	0738	0821	0903	5 41
40″	526	0986	1068	1151	1233	1316	1398	1481	1563	1646	1728	6 49
	527	1811	1893	1975	2058	2140	2222	2305	2387	2469	2552	7 57
28′	528	2634	2716	2798	2881	2963	3045	3127	3209	3291	3374	8 56
	529	3456	3538	3620	3702	3784	3866	3948	4030	4112	4194	9 74
20″	530	4276	4358	4440	4522	4604	4685	4767	4849	4931	5013	
	531	5095	5176	5258	5340	5422	5503	5585	5667	5748	5830	80
40″	532	5912	5993	6075	6156	6238	6320	6401	6483	6564	6646	1 8
	533	6727	6809	6890	6972	7053	7134	7216	7297	7379	7460	2 16
29′	534	7541	7623	7704	7785	7866	7948	8029	8110	8191	8273	3 24
	535	8354	8435	8516	8597	8678	8759	8841	8922	9003	9084	4 32
20″	536	9165	9246	9327	9408	9489	9570	9651	9732	9813	9893	5 40
	537	9974										6 48
		73.	0055	0136	0217	0298	0378	0459	0540	0621	0702	7 56
40″	538	0782	0863	0944	1024	1105	1185	1265	1347	1428	1508	8 64
	539	1589	1669	1750	1830	1911	1991	2072	2152	2233	2313	9 72

Digitized by Google

1h.	N°	Log. 0	1	2	3	4	5	6	7	8	9
30′	540	73.2394	2474	2555	2635	2715	2796	2876	2956	3037	3117
	541	3197	3278	3358	3438	3518	3598	3679	3759	3839	3919
20′′	542	3999	4079	4160	4240	4320	4400	4480	4560	4640	4720
	543	4800	4880	4960	5040	5120	5200	5279	5359	5439	5519
40′′	544	5599	5679	5759	5838	5918	5998	6078	6157	6237	6317
	545	6397	6476	6556	6635	6715	6795	6874	6954	7034	7113
31′	546	7193	7272	7352	7431	7511	7590	7670	7749	7829	7908
	547	7987	8067	8146	8225	8305	8384	8463	8543	8622	8701
20′′	548	8781	8860	8939	9018	9097	9177	9256	9335	9414	9493
	549	9572	9651	9731	9810	9889	9968				
								0047	0126	0205	0284
40′′	550	74.0363	0442	0521	0600	0678	0757	0836	0915	0994	1073
	551	1152	1230	1309	1388	1467	1546	1624	1703	1782	1860
32′	552	1939	2018	2096	2175	2254	2332	2411	2489	2568	2647
	553	2725	2804	2882	2961	3039	3118	3196	3275	3353	3431
20′′	554	3510	3588	3667	3745	3823	3902	3980	4058	4136	4215
	555	4293	4371	4449	4528	4606	4684	4762	4840	4919	4997
40′′	556	5075	5153	5231	5309	5387	5465	5543	5621	5699	5777
	557	5855	5933	6011	6089	6167	6245	6323	6401	6479	6556
33′	558	6634	6712	6790	6868	6945	7023	7101	7179	7256	7334
	559	7412	7489	7567	7645	7722	7800	7878	7955	8033	8110
20′′	560	8188	8266	8343	8421	8498	8576	8653	8731	8808	8885
	561	8963	9040	9118	9195	9272	9350	9427	9504	9582	9659
40′′	562	9736	9814	9891	9968						
						0045	0123	0200	0277	0354	0431
	563	75.0508	0586	0663	0740	0817	0894	0971	1048	1125	1202
34′	564	1279	1356	1433	1510	1587	1664	1741	1818	1895	1972
	565	2048	2125	2202	2279	2356	2433	2509	2586	2663	2740
20′′	566	2816	2893	2970	3047	3123	3200	3277	3353	3430	3506
	567	3583	3660	3736	3813	3889	3966	4042	4119	4195	4272
40′′	568	4348	4425	4501	4578	4654	4730	4807	4883	4960	5036
	569	5112	5189	5265	5341	5417	5494	5570	5646	5722	5799
35′	570	5875	5951	6027	6103	6180	6256	6332	6408	6484	6560
	571	6636	6712	6788	6864	6940	7016	7092	7168	7244	7320
20′′	572	7396	7472	7548	7624	7700	7775	7851	7927	8003	8079
	573	8155	8230	8306	8382	8458	8533	8609	8685	8761	8836
40′′	574	8912	8988	9063	9139	9214	9290	9366	9441	9517	9592
	575	9668	9743	9819	9894	9970					
							0045	0121	0196	0272	0347
36′	576	76.0422	0498	0573	0649	0724	0799	0875	0950	1025	1101
	577	1176	1251	1326	1402	1477	1552	1627	1702	1778	1853
20′′	578	1928	2003	2078	2153	2228	2303	2378	2453	2529	2604
	579	2679	2754	2829	2904	2978	3053	3128	3203	3278	3353
40′′	580	3428	3503	3578	3653	3727	3802	3877	3952	4027	4101
	581	4176	4251	4326	4400	4475	4550	4624	4699	4774	4848
37′	582	4923	4998	5072	5147	5221	5296	5370	5445	5520	5594
	583	5669	5743	5818	5892	5966	6041	6115	6190	6264	6338
20′′	584	6413	6487	6562	6636	6710	6785	6859	6933	7007	7082
	585	7156	7230	7304	7379	7453	7527	7601	7675	7749	7823
40′′	586	7898	7972	8046	8120	8194	8268	8342	8416	8490	8564
	587	8638	8712	8786	8860	8934	9008	9082	9156	9230	9303
38′	588	9377	9451	9525	9599	9673	9746	9820	9894	9968	
											0042
	589	77.0115	0189	0263	0336	0410	0484	0557	0631	0705	0778
20′′	590	0852	0926	0999	1073	1146	1220	1293	1367	1440	1514
	591	1587	1661	1734	1808	1881	1955	2028	2102	2175	2248
40′′	592	2322	2395	2468	2542	2615	2688	2762	2835	2908	2981
	593	3055	3128	3201	3274	3348	3421	3494	3567	3640	3713
39′	594	3786	3860	3933	4006	4079	4152	4225	4298	4371	4444
	595	4517	4590	4663	4736	4809	4882	4955	5028	5100	5173
20′′	596	5246	5319	5392	5465	5538	5610	5683	5756	5829	5902
	597	5974	6047	6120	6193	6265	6338	6411	6483	6556	6629
40′′	598	6701	6774	6846	6919	6992	7064	7137	7209	7282	7354
	599	7427	7499	7572	7644	7717	7789	7862	7934	8006	8079

Diff.

79
1 8
2 16
3 24
4 32
5 39
6 47
7 55
8 62
9 70

78
1 8
2 16
3 23
4 31
5 39
6 47
7 55
8 62
9 70

77
1 8
2 15
3 23
4 31
5 38
6 46
7 54
8 62
9 69

76
1 8
2 15
3 23
4 30
5 38
6 46
7 53
8 61
9 68

75
1 7
2 15
3 22
4 30
5 37
6 45
7 52
8 60
9 67

74
1 7
2 15
3 22
4 30
5 37
6 44
7 52
8 59
9 67

73
1 7
2 15
3 22
4 29
5 36
6 44
7 51
8 58
9 66

72
1 7
2 14
3 22
4 29
5 36
6 43
7 50
8 58
9 65

Digitized by Google

′	N°	Log. 0	1	2	3	4	5	6	7	8	9	Dif.
40′	600	77. 8151	8224	8296	8368	8441	8513	8585	8658	8730	8802	72
	601	8874	8947	9019	9091	9163	9236	9308	9380	9452	9524	1 7
20″	602	9596	9669	9741	9813	9885	9957	0029	0101	0173	0245	2 14
	603	78. 0317	0389	0461	0533	0605	0677	0749	0821	0893	0965	3 22
40″	604	1037	1109	1181	1253	1324	1396	1468	1540	1612	1684	4 29
	605	1755	1827	1899	1971	2042	2114	2186	2258	2329	2401	5 36
41′	606	2473	2544	2616	2688	2759	2831	2902	2974	3046	3117	6 43
	607	3189	3260	3332	3403	3475	3546	3618	3689	3761	3832	7 50
20″	608	3904	3975	4046	4118	4189	4261	4332	4403	4475	4546	8 58
	609	4617	4689	4760	4831	4902	4974	5045	5116	5187	5259	9 65
40″	610	5330	5401	5472	5543	5615	5686	5757	5828	5899	5970	71
	611	6041	6112	6183	6254	6325	6396	6467	6538	6609	6680	1 7
42′	612	6751	6822	6893	6964	7035	7106	7177	7248	7319	7390	2 14
	613	7460	7531	7602	7673	7744	7815	7885	7956	8027	8098	3 21
20″	614	8168	8239	8310	8381	8451	8522	8593	8663	8734	8804	4 28
	615	8875	8946	9016	9087	9157	9228	9299	9369	9440	9510	5 35
40″	616	9581	9651	9722	9792	9863	9933	0004	0074	0144	0215	6 42
	617	79. 0285	0356	0426	0496	0567	0637	0707	0778	0848	0918	7 50
43′	618	0988	1059	1129	1199	1269	1340	1410	1480	1550	1620	8 57
	619	1691	1761	1831	1901	1971	2041	2111	2181	2252	2322	9 64
20″	620	2392	2462	2532	2602	2672	2742	2812	2882	2952	3022	70
	621	3092	3162	3231	3301	3371	3441	3511	3581	3651	3721	1 7
40″	622	3790	3860	3930	4000	4070	4139	4209	4279	4349	4418	2 14
	623	4488	4558	4627	4697	4767	4836	4906	4976	5045	5115	3 21
44′	624	5185	5254	5324	5393	5463	5532	5602	5672	5741	5811	4 28
	625	5880	5949	6019	6088	6158	6227	6297	6366	6436	6505	5 35
20″	626	6574	6644	6713	6782	6852	6921	6990	7060	7129	7198	6 42
	627	7268	7337	7406	7475	7545	7614	7683	7752	7821	7890	7 49
40″	628	7960	8029	8098	8167	8236	8305	8374	8443	8513	8582	8 56
	629	8651	8720	8789	8858	8927	8996	9065	9134	9203	9272	9 63
45′	630	9341	9409	9478	9547	9616	9685	9754	9823	9892	9961	69
	631	80. 0029	0098	0167	0236	0305	0373	0442	0511	0580	0648	1 7
20″	632	0717	0786	0854	0923	0992	1061	1129	1198	1266	1335	2 14
	633	1404	1472	1541	1609	1678	1747	1815	1884	1952	2021	3 21
40″	634	2089	2158	2226	2295	2363	2432	2500	2568	2637	2705	4 28
	635	2774	2842	2910	2979	3047	3116	3184	3252	3321	3389	5 34
46′	636	3457	3525	3594	3662	3730	3798	3867	3935	4003	4071	6 41
	637	4139	4208	4276	4344	4412	4480	4548	4616	4685	4753	7 48
20″	638	4821	4889	4957	5025	5093	5161	5229	5297	5365	5433	8 54
	639	5501	5569	5637	5705	5773	5841	5908	5976	6044	6112	9 61
40″	640	6180	6248	6316	6384	6451	6519	6587	6655	6723	6790	68
	641	6858	6926	6994	7061	7129	7197	7264	7332	7400	7467	1 7
47′	642	7535	7603	7670	7738	7806	7873	7941	8008	8076	8143	2 14
	643	8211	8279	8346	8414	8481	8549	8616	8684	8751	8818	3 20
20″	644	8886	8953	9021	9088	9156	9223	9290	9358	9425	9492	4 27
	645	9560	9627	9694	9762	9829	9896	9964	0031	0098	0165	5 34
40″	646	81. 0233	0300	0367	0434	0501	0569	0636	0703	0770	0837	6 41
	647	0904	0971	1039	1106	1173	1240	1307	1374	1441	1508	7 48
48′	648	1575	1642	1709	1776	1843	1910	1977	2044	2111	2178	8 54
	649	2245	2312	2379	2445	2512	2579	2646	2713	2780	2847	9 61
20″	650	2913	2980	3047	3114	3181	3247	3314	3381	3448	3514	67
	651	3581	3648	3714	3781	3848	3914	3981	4048	4114	4181	1 7
40″	652	4248	4314	4381	4447	4514	4581	4647	4714	4780	4847	2 13
	653	4913	4980	5046	5113	5179	5246	5312	5378	5445	5511	3 20
49′	654	5578	5644	5711	5777	5843	5910	5976	6042	6109	6175	4 27
	655	6241	6308	6374	6440	6506	6573	6639	6705	6771	6838	5 33
20″	656	6904	6970	7036	7102	7169	7235	7301	7367	7433	7499	6 40
	657	7565	7631	7698	7764	7830	7896	7962	8028	8094	8160	7 46
40″	658	8226	8292	8358	8424	8490	8556	8622	8688	8754	8820	8 53
	659	8885	8951	9017	9083	9149	9215	9281	9346	9412	9478	9 59

Digitized by Google

	N	Log. 0	1	2	3	4	5	6	7	8	9	L
50′	660	81. 9544	9610	9676	9741	9807	9873	9939	0004	0070	0136	
	661	82. 0201	0267	0333	0399	0464	0530	0595	0661	0727	0792	
20″	662	0858	0924	0989	1055	1120	1186	1251	1317	1382	1448	
	663	1514	1579	1645	1710	1775	1841	1906	1972	2037	2103	66
40″	664	2168	2233	2299	2364	2430	2495	2560	2626	2691	2756	1 7
	665	2822	2887	2952	3018	3083	3148	3213	3279	3344	3409	2 13
51′	666	3474	3539	3605	3670	3735	3800	3865	3930	3996	4061	3 20
	667	4126	4191	4256	4321	4386	4451	4516	4581	4646	4711	4 26
20″	668	4776	4841	4906	4971	5036	5101	5166	5231	5296	5361	5 33
	669	5426	5491	5556	5621	5686	5751	5815	5880	5945	6010	6 40
40″	670	6075	6140	6204	6269	6334	6399	6464	6528	6593	6658	7 46
	671	6723	6787	6852	6917	6981	7046	7111	7175	7240	7305	8 53
52′	672	7369	7434	7499	7563	7628	7692	7757	7821	7886	7951	9 59
	673	8015	8080	8144	8209	8273	8338	8402	8467	8531	8595	
20″	674	8660	8724	8789	8853	8918	8982	9046	9111	9175	9239	
	675	9304	9368	9432	9497	9561	9625	9690	9754	9818	9882	
40″	676	9947	0011	0075	0139	0204	0268	0332	0396	0460	0525	
	677	83. 0589	0653	0717	0781	0845	0909	0973	1037	1102	1166	
53′	678	1230	1294	1358	1422	1486	1550	1614	1678	1742	1806	64
	679	1870	1934	1998	2062	2126	2189	2253	2317	2381	2445	1 6
20″	680	2509	2573	2637	2700	2764	2828	2892	2956	3020	3083	2 13
	681	3147	3211	3275	3338	3402	3466	3530	3593	3657	3721	3 19
40″	682	3784	3848	3912	3975	4039	4103	4166	4230	4294	4357	4 26
	683	4421	4484	4548	4611	4675	4739	4802	4866	4929	4993	5 32
54′	684	5056	5120	5183	5247	5310	5373	5437	5500	5564	5627	6 38
	685	5691	5754	5817	5881	5944	6007	6071	6134	6197	6261	7 45
20″	686	6324	6387	6451	6514	6577	6641	6704	6767	6830	6894	8 51
	687	6957	7020	7083	7146	7210	7273	7336	7399	7462	7525	9 58
40″	688	7588	7652	7715	7778	7841	7904	7967	8030	8093	8156	
	689	8219	8282	8345	8408	8471	8534	8597	8660	8723	8786	
55′	690	8849	8912	8975	9038	9101	9164	9227	9289	9352	9415	
	691	9478	9541	9604	9667	9729	9792	9855	9918	9981	0043	
20″	692	84. 0106	0169	0232	0294	0357	0420	0482	0545	0608	0671	
	693	0733	0796	0859	0921	0984	1046	1109	1172	1234	1297	62
40″	694	1359	1422	1485	1547	1610	1672	1735	1797	1860	1922	1 6
	695	1985	2047	2110	2172	2235	2297	2360	2422	2484	2547	2 12
56′	696	2609	2672	2734	2796	2859	2921	2983	3046	3108	3170	3 19
	697	3233	3295	3357	3420	3482	3544	3606	3669	3731	3793	4 25
20″	698	3855	3918	3980	4042	4104	4166	4229	4291	4353	4415	5 31
	699	4477	4539	4601	4664	4726	4788	4850	4912	4974	5036	6 37
40″	700	5098	5160	5222	5284	5346	5408	5470	5532	5594	5656	7 43
	701	5718	5780	5842	5904	5966	6028	6090	6151	6213	6275	8 50
57′	702	6337	6399	6461	6523	6585	6646	6708	6770	6832	6894	9 56
	703	6955	7017	7079	7141	7202	7264	7326	7388	7449	7511	
20″	704	7573	7634	7696	7758	7819	7881	7943	8004	8066	8128	
	705	8189	8251	8312	8374	8435	8497	8559	8620	8682	8743	
40″	706	8805	8866	8928	8989	9051	9112	9174	9235	9297	9358	
	707	9419	9481	9542	9604	9665	9726	9788	9849	9911	9972	
58′	708	85. 0033	0095	0156	0217	0279	0340	0401	0462	0524	0585	60
	709	0646	0707	0769	0830	0891	0952	1014	1075	1136	1197	1 6
20″	710	1258	1320	1381	1442	1503	1564	1625	1686	1747	1809	2 12
	711	1870	1931	1992	2053	2114	2175	2236	2297	2358	2419	3 18
40″	712	2480	2541	2602	2663	2724	2785	2846	2907	2968	3029	4 24
	713	3090	3150	3211	3272	3333	3394	3455	3516	3577	3637	5 30
59′	714	3698	3759	3820	3881	3941	4002	4063	4124	4185	4245	6 36
	715	4306	4367	4428	4488	4549	4610	4670	4731	4792	4852	7 42
20″	716	4913	4974	5034	5095	5156	5216	5277	5337	5398	5459	8 48
	717	5519	5580	5640	5701	5761	5822	5882	5943	6003	6064	9 54
40″	718	6124	6185	6245	6306	6366	6427	6487	6548	6608	6668	
	719	6729	6789	6850	6910	6970	7031	7091	7152	7212	7272	

Digitized by Google

2n.	N°	Log. 0	1	2	3	4	5	6	7	8	9	Diff.
0′	720	85. 7332	7393	7453	7513	7574	7634	7694	7755	7815	7875	
	721	7935	7995	8056	8116	8176	8236	8297	8357	8417	8477	
20″	722	8537	8597	8657	8718	8778	8838	8898	8958	9018	9078	
	723	9138	9198	9258	9318	9379	9439	9499	9559	9619	9679	
40″	724	9739	9799	9859	9918	9978						
							0038	0098	0158	0218	0278	
	725	86. 0338	0398	0458	0518	0578	0637	0697	0757	0817	0877	
1′	726	0937	0996	1056	1116	1176	1236	1295	1355	1415	1475	60
	727	1534	1594	1654	1714	1773	1833	1893	1952	2012	2072	1 6
												2 12
20″	728	2131	2191	2251	2310	2370	2430	2489	2549	2608	2668	3 18
	729	2728	2787	2847	2906	2966	3025	3085	3144	3204	3263	4 24
40″	730	3323	3382	3442	3501	3561	3620	3680	3739	3799	3858	5 30
	731	3917	3977	4036	4096	4155	4214	4274	4333	4392	4452	6 36
												7 42
2′	732	4511	4570	4630	4689	4748	4808	4867	4926	4985	5045	8 48
	733	5104	5163	5222	5282	5341	5400	5459	5519	5578	5637	9 54
20″	734	5696	5755	5814	5874	5933	5992	6051	6110	6169	6228	
	735	6287	6346	6405	6465	6524	6583	6642	6701	6760	6819	
40″	736	6878	6937	6996	7055	7114	7173	7232	7291	7350	7409	
	737	7467	7526	7585	7644	7703	7762	7821	7880	7939	7998	
3′	738	8056	8115	8174	8233	8292	8350	8409	8468	8527	8586	
	739	8644	8703	8762	8821	8879	8938	8997	9056	9114	9173	
20″	740	9232	9290	9349	9408	9466	9525	9584	9642	9701	9760	
	741	9818	9877	9935	9994							
						0053	0111	0170	0228	0287	0345	
40″	742	87. 0404	0462	0521	0579	0638	0696	0755	0813	0872	0930	
	743	0989	1047	1106	1164	1223	1281	1339	1398	1456	1515	
4′	744	1573	1631	1690	1748	1806	1865	1923	1981	2040	2098	
	745	2156	2215	2273	2331	2389	2448	2506	2564	2622	2681	
20″	746	2739	2797	2855	2913	2972	3030	3088	3146	3204	3262	
	747	3321	3379	3437	3495	3553	3611	3669	3727	3785	3844	58
40″	748	3902	3960	4018	4076	4134	4192	4250	4308	4366	4424	1 6
												2 12
	749	4482	4540	4598	4656	4714	4772	4830	4888	4945	5003	3 17
5′	750	5061	5119	5177	5235	5293	5351	5409	5466	5524	5582	4 23
	751	5640	5698	5756	5813	5871	5929	5987	6045	6102	6160	5 29
20″	752	6218	6276	6333	6391	6449	6507	6564	6622	6680	6737	6 35
	753	6795	6853	6910	6968	7026	7083	7141	7199	7256	7314	7 41
												8 46
40″	754	7371	7429	7487	7544	7602	7659	7717	7774	7832	7889	9 52
	755	7947	8004	8062	8119	8177	8234	8292	8349	8407	8464	
6′	756	8522	8579	8637	8694	8752	8809	8866	8924	8981	9039	
	757	9096	9153	9211	9268	9325	9383	9440	9497	9555	9612	
20″	758	9669	9726	9784	9841	9898	9956					
								0013	0070	0127	0185	
	759	88. 0242	0299	0356	0413	0471	0528	0585	0642	0699	0756	
40″	760	0814	0871	0928	0985	1042	1099	1156	1213	1271	1328	
	761	1385	1442	1499	1556	1613	1670	1727	1784	1841	1898	
7′	762	1955	2012	2069	2126	2183	2240	2297	2354	2411	2468	
	763	2525	2581	2638	2695	2752	2809	2866	2923	2980	3037	
20″	764	3093	3150	3207	3264	3321	3377	3434	3491	3548	3605	
	765	3661	3718	3775	3832	3888	3945	4002	4059	4115	4172	
40″	766	4229	4285	4342	4399	4455	4512	4569	4625	4682	4739	
	767	4795	4852	4909	4965	5022	5078	5135	5192	5248	5305	56
8′	768	5361	5418	5474	5531	5587	5644	5700	5757	5813	5870	1 6
												2 11
	769	5926	5983	6039	6096	6152	6209	6265	6321	6378	6434	3 17
20″	770	6491	6547	6604	6660	6716	6773	6829	6885	6942	6998	4 22
	771	7054	7111	7167	7223	7280	7336	7392	7449	7505	7561	5 28
40″	772	7617	7674	7730	7786	7842	7898	7955	8011	8067	8123	6 34
												7 39
	773	8179	8236	8292	8348	8404	8460	8516	8573	8629	8685	8 45
9′	774	8741	8797	8853	8909	8965	9021	9077	9134	9190	9246	9 50
	775	9302	9358	9414	9470	9526	9582	9638	9694	9750	9806	
20″	776	9862	9918	9974								
					0030	0086	0141	0197	0253	0309	0365	
	777	89. 0421	0477	0533	0589	0645	0700	0756	0812	0868	0924	
40″	778	0980	1035	1091	1147	1203	1259	1314	1370	1426	1482	
	779	1537	1593	1649	1705	1760	1816	1872	1928	1983	2039	

Digitized by Google

9h.	N°	Log. 0	1	2	3	4	5	6	7	8	9	Diff.
10′	780	89.2095	2150	2206	2262	2317	2373	2429	2484	2540	2595	
	781	2651	2707	2762	2818	2873	2929	2985	3040	3096	3151	
20″	782	3207	3262	3318	3373	3429	3484	3540	3595	3651	3706	56
	783	3762	3817	3873	3928	3984	4039	4094	4150	4205	4261	1 6
40″	784	4316	4371	4427	4482	4538	4593	4648	4704	4759	4814	2 11
												3 17
	785	4870	4925	4980	5036	5091	5146	5201	5257	5312	5367	4 22
11′	786	5423	5478	5533	5588	5644	5699	5754	5809	5864	5920	5 28
	787	5975	6030	6085	6140	6195	6251	6306	6361	6416	6471	6 34
20″	788	6526	6581	6636	6692	6747	6802	6857	6912	6967	7022	7 39
	789	7077	7132	7187	7242	7297	7352	7407	7462	7517	7572	8 45
												9 50
40″	790	7627	7682	7737	7792	7847	7902	7957	8012	8067	8122	55
	791	8176	8231	8286	8341	8396	8451	8506	8561	8615	8670	1 5
12′	792	8725	8780	8835	8890	8944	8999	9054	9109	9164	9218	2 11
	793	9273	9328	9383	9437	9492	9547	9602	9656	9711	9766	3 16
20″	794	9821	9875	9930	9985	0039	0094	0149	0203	0258	0312	4 22
		90.										5 27
	795	0367	0422	0476	0531	0586	0640	0695	0749	0804	0859	6 33
40″	796	0913	0968	1022	1077	1131	1186	1240	1295	1349	1404	7 38
	797	1458	1513	1567	1622	1676	1731	1785	1840	1894	1948	8 44
13′	798	2003	2057	2112	2166	2221	2275	2329	2384	2438	2492	9 49
	799	2547	2601	2655	2710	2764	2818	2873	2927	2981	3036	
20″	800	3090	3144	3199	3253	3307	3361	3416	3470	3524	3578	
	801	3633	3687	3741	3795	3849	3904	3958	4012	4066	4120	54
40″	802	4174	4229	4283	4337	4391	4445	4499	4553	4607	4661	1 5
	803	4716	4770	4824	4878	4932	4986	5040	5094	5148	5202	2 11
												3 16
14′	804	5256	5310	5364	5418	5472	5526	5580	5634	5688	5742	4 22
	805	5796	5850	5904	5958	6012	6066	6119	6173	6227	6281	5 27
20″	806	6335	6389	6443	6497	6551	6604	6658	6712	6766	6820	6 32
	807	6874	6927	6981	7035	7089	7143	7196	7250	7304	7358	7 38
40″	808	7411	7465	7519	7573	7626	7680	7734	7787	7841	7895	8 43
												9 49
	809	7949	8002	8056	8110	8163	8217	8270	8324	8378	8431	
15′	810	8485	8539	8592	8646	8699	8753	8807	8860	8914	8967	
	811	9021	9074	9128	9181	9235	9289	9342	9396	9449	9503	53
20″	812	9556	9610	9663	9716	9770	9823	9877	9930	9984		1 5
											0037	2 11
	813	91. 0091	0144	0197	0251	0304	0358	0411	0464	0518	0571	3 16
40″	814	0624	0678	0731	0784	0838	0891	0944	0998	1051	1104	4 21
	815	1158	1211	1264	1317	1371	1424	1477	1530	1584	1637	5 26
16′	816	1690	1743	1797	1850	1903	1956	2009	2063	2116	2169	6 32
	817	2222	2275	2328	2381	2435	2488	2541	2594	2647	2700	7 37
												8 42
20″	818	2753	2806	2859	2913	2966	3019	3072	3125	3178	3231	9 48
	819	3284	3337	3390	3443	3496	3549	3602	3655	3708	3761	
40″	820	3814	3867	3920	3973	4026	4079	4132	4184	4237	4290	
	821	4343	4396	4449	4502	4555	4608	4660	4713	4766	4819	52
17′	822	4872	4925	4977	5030	5083	5136	5189	5241	5294	5347	1 5
												2 10
	823	5400	5453	5505	5558	5611	5664	5716	5769	5822	5875	3 16
20″	824	5927	5980	6033	6085	6138	6191	6243	6296	6349	6401	4 21
	825	6454	6507	6559	6612	6664	6717	6770	6822	6875	6927	5 26
40″	826	6980	7033	7085	7138	7190	7243	7295	7348	7400	7453	6 31
	827	7506	7558	7611	7663	7716	7768	7820	7873	7925	7978	7 36
												8 42
18′	828	8030	8083	8135	8188	8240	8293	8345	8397	8450	8502	9 47
	829	8555	8607	8659	8712	8764	8816	8869	8921	8973	9026	
20″	830	9078	9130	9183	9235	9287	9340	9392	9444	9496	9549	51
	831	9601	9653	9706	9758	9810	9862	9914	9967	0019	0071	1 5
												2 10
40″	832	92. 0123	0176	0228	0280	0332	0384	0436	0489	0541	0593	3 15
	833	0645	0697	0749	0801	0853	0906	0958	1010	1062	1114	4 20
19′	834	1166	1218	1270	1322	1374	1426	1478	1530	1582	1634	5 25
	835	1686	1738	1790	1842	1894	1946	1998	2050	2102	2154	6 31
												7 36
20″	836	2206	2258	2310	2362	2414	2466	2518	2570	2622	2674	8 41
	837	2725	2777	2829	2881	2933	2985	3037	3089	3140	3192	9 46
40″	838	3244	3296	3348	3399	3451	3503	3555	3607	3658	3710	
	839	3762	3814	3865	3917	3969	4021	4072	4124	4176	4228	

Digitized by Google

1°	Log. 0	1	2	3	4	5	6	7	8	9	Diff.
840	92.4279	4331	4383	4434	4486	4538	4589	4641	4693	4744	
841	4796	4848	4899	4951	5003	5054	5106	5157	5209	5261	
842	5312	5364	5415	5467	5518	5570	5621	5673	5725	5776	
843	5828	5879	5931	5982	6034	6085	6137	6188	6240	6291	
844	6342	6394	6445	6497	6548	6600	6651	6702	6754	6805	
845	6857	6908	6959	7011	7062	7114	7165	7216	7268	7319	
846	7370	7422	7473	7524	7576	7627	7678	7730	7781	7832	52
847	7883	7935	7986	8037	8088	8140	8191	8242	8293	8345	1 5
848	8396	8447	8498	8549	8601	8652	8703	8754	8805	8857	2 10
849	8908	8959	9010	9061	9112	9163	9215	9266	9317	9368	3 16
850	9419	9470	9521	9572	9623	9674	9725	9776	9827	9879	4 21
851	9930	9981	0032	0083	0134	0185	0236	0287	0338	0389	5 26
852	93.0440	0491	0542	0592	0643	0694	0745	0796	0847	0898	6 31
853	0949	1000	1051	1102	1153	1204	1254	1305	1356	1407	7 36
854	1458	1509	1560	1610	1661	1712	1763	1814	1865	1915	8 42
855	1966	2017	2068	2118	2169	2220	2271	2322	2372	2423	9 47
856	2474	2524	2575	2626	2677	2727	2778	2829	2879	2930	
857	2981	3031	3082	3133	3183	3234	3285	3335	3386	3437	51
858	3487	3538	3589	3639	3690	3740	3791	3841	3892	3943	1 5
859	3993	4044	4094	4145	4195	4246	4296	4347	4397	4448	2 10
860	4498	4549	4599	4650	4700	4751	4801	4852	4902	4953	3 15
861	5003	5054	5104	5154	5205	5255	5306	5356	5406	5457	4 20
862	5507	5558	5608	5658	5709	5759	5809	5860	5910	5960	5 25
863	6011	6061	6111	6162	6212	6262	6313	6363	6413	6463	6 31
864	6514	6564	6614	6665	6715	6765	6815	6865	6916	6966	7 36
865	7016	7066	7117	7167	7217	7267	7317	7367	7418	7468	8 41
866	7518	7568	7618	7668	7718	7769	7819	7869	7919	7969	9 46
867	8019	8069	8119	8169	8219	8269	8320	8370	8420	8470	
868	8520	8570	8620	8670	8720	8770	8820	8870	8920	8970	50
869	9020	9070	9120	9170	9220	9270	9320	9369	9419	9469	1 5
870	9519	9569	9619	9669	9719	9769	9819	9869	9918	9968	2 10
871	94.0018	0068	0118	0168	0218	0267	0317	0367	0417	0467	3 15
872	0516	0566	0616	0666	0716	0765	0815	0865	0915	0964	4 20
873	1014	1064	1114	1163	1213	1263	1313	1362	1412	1462	5 25
874	1511	1561	1611	1660	1710	1760	1809	1859	1909	1958	6 30
875	2008	2058	2107	2157	2207	2256	2306	2355	2405	2455	7 35
876	2504	2554	2603	2653	2702	2752	2801	2851	2901	2950	8 40
877	3000	3049	3099	3148	3198	3247	3297	3346	3396	3445	9 45
878	3495	3544	3593	3643	3692	3742	3791	3841	3890	3939	
879	3989	4038	4088	4137	4186	4236	4285	4335	4384	4433	49
880	4483	4532	4581	4631	4680	4729	4779	4828	4877	4927	1 5
881	4976	5025	5074	5124	5173	5222	5272	5321	5370	5419	2 10
882	5469	5518	5567	5616	5665	5715	5764	5813	5862	5912	3 15
883	5961	6010	6059	6108	6157	6207	6256	6305	6354	6403	4 20
884	6452	6501	6551	6600	6649	6698	6747	6796	6845	6894	5 24
885	6943	6992	7041	7090	7140	7189	7238	7287	7336	7385	6 29
886	7434	7483	7532	7581	7630	7679	7728	7777	7826	7875	7 34
887	7924	7973	8022	8070	8119	8168	8217	8266	8315	8364	8 39
888	8413	8462	8511	8560	8609	8657	8706	8755	8804	8853	9 44
889	8902	8951	8999	9048	9097	9146	9195	9244	9292	9341	
890	9390	9439	9488	9536	9585	9634	9683	9731	9780	9829	48
891	9878	9926	9975	0024	0073	0121	0170	0219	0267	0316	1 5
892	95.0365	0414	0462	0511	0560	0608	0657	0706	0754	0803	2 10
893	0851	0900	0949	0997	1046	1095	1143	1192	1240	1289	3 14
894	1338	1386	1435	1483	1532	1580	1629	1677	1726	1775	4 19
895	1823	1872	1920	1969	2017	2066	2114	2163	2211	2260	5 24
896	2308	2356	2405	2453	2502	2550	2599	2647	2696	2744	6 29
897	2792	2841	2889	2938	2986	3034	3083	3131	3180	3228	7 34
898	3276	3325	3373	3421	3470	3518	3566	3615	3663	3711	8 38
899	3760	3808	3856	3905	3953	4001	4049	4098	4146	4194	9 43

Digitized by Google

2h.	N°	Log. 0	1	2	3	4	5	6	7	8	9	D.
30′	900	95. 4243	4291	4339	4387	4435	4484	4532	4580	4628	4677	
	901	4725	4773	4821	4869	4918	4966	5014	5062	5110	5158	
20″	902	5207	5255	5303	5351	5399	5447	5495	5543	5592	5640	
	903	5688	5736	5784	5832	5880	5928	5976	6024	6072	6120	48
40″	904	6168	6216	6265	6313	6361	6409	6457	6505	6553	6601	1 5
	905	6649	6697	6745	6793	6840	6888	6936	6984	7032	7080	2 10
31′	906	7128	7176	7224	7272	7320	7368	7416	7464	7512	7559	3 14
	907	7607	7655	7703	7751	7799	7847	7894	7942	7990	8038	4 19
20″	908	8086	8134	8181	8229	8277	8325	8373	8421	8468	8516	5 24
	909	8564	8612	8659	8707	8755	8803	8850	8898	8946	8994	6 29
40″	910	9041	9089	9137	9185	9232	9280	9328	9375	9423	9471	7 34
	911	9518	9566	9614	9661	9709	9757	9804	9852	9900	9947	8 38
32′	912	9995	0042	0090	0138	0185	0233	0280	0328	0376	0423	9 43
	913	96. 0471	0518	0566	0613	0661	0709	0756	0804	0851	0899	
20″	914	0946	0994	1041	1089	1136	1184	1231	1279	1326	1374	
	915	1421	1469	1516	1563	1611	1658	1706	1753	1801	1848	
40″	916	1895	1943	1990	2038	2085	2132	2180	2227	2275	2322	
	917	2369	2417	2464	2511	2559	2606	2653	2701	2748	2795	
33′	918	2843	2890	2937	2985	3032	3079	3126	3174	3221	3268	47
	919	3316	3363	3410	3457	3504	3552	3599	3646	3693	3741	1 5
20″	920	3788	3835	3882	3929	3977	4024	4071	4118	4165	4212	2 9
	921	4260	4307	4354	4401	4448	4495	4542	4590	4637	4684	3 14
40″	922	4731	4778	4825	4872	4919	4966	5013	5061	5108	5155	4 19
	923	5202	5249	5296	5343	5390	5437	5484	5531	5578	5625	5 23
34′	924	5672	5719	5766	5813	5860	5907	5954	6001	6048	6095	6 28
	925	6142	6189	6236	6283	6329	6376	6423	6470	6517	6564	7 33
20″	926	6611	6658	6705	6752	6799	6845	6892	6939	6986	7033	8 38
	927	7080	7127	7173	7220	7267	7314	7361	7408	7454	7501	9 42
40″	928	7548	7595	7642	7688	7735	7782	7829	7875	7922	7969	
	929	8016	8062	8109	8156	8203	8249	8296	8343	8390	8436	
35′	930	8483	8530	8576	8623	8670	8716	8763	8810	8856	8903	
	931	8950	8996	9043	9090	9136	9183	9229	9276	9323	9369	
20″	932	9416	9463	9509	9556	9602	9649	9695	9742	9789	9835	
	933	9882	9928	9975	0021	0068	0114	0161	0207	0254	0300	
40″	934	97. 0347	0393	0440	0486	0533	0579	0626	0672	0719	0765	46
	935	0812	0858	0904	0951	0997	1044	1090	1137	1183	1229	1 5
36′	936	1276	1322	1369	1415	1461	1508	1554	1601	1647	1693	2 9
	937	1740	1786	1832	1879	1925	1971	2018	2064	2110	2157	3 14
20″	938	2203	2249	2295	2342	2388	2434	2481	2527	2573	2619	4 18
	939	2666	2712	2758	2804	2851	2897	2943	2989	3035	3082	5 23
40″	940	3128	3174	3220	3266	3313	3359	3405	3451	3497	3543	6 28
	941	3590	3636	3682	3728	3774	3820	3866	3913	3959	4005	7 32
37′	942	4051	4097	4143	4189	4235	4281	4327	4374	4420	4466	8 37
	943	4512	4558	4604	4650	4696	4742	4788	4834	4880	4926	9 41
20″	944	4972	5018	5064	5110	5156	5202	5248	5294	5340	5386	
	945	5432	5478	5524	5570	5616	5662	5707	5753	5799	5845	
40″	946	5891	5937	5983	6029	6075	6121	6167	6212	6258	6304	
	947	6350	6396	6442	6488	6533	6579	6625	6671	6717	6763	
38′	948	6808	6854	6900	6946	6992	7037	7083	7129	7175	7220	
	949	7266	7312	7358	7403	7449	7495	7541	7586	7632	7678	45
20″	950	7724	7769	7815	7861	7906	7952	7998	8043	8089	8135	1 4
	951	8181	8226	8272	8317	8363	8409	8454	8500	8546	8591	2 9
40″	952	8637	8683	8728	8774	8819	8865	8911	8956	9002	9047	3 13
	953	9093	9138	9184	9230	9275	9321	9366	9412	9457	9503	4 18
39′	954	9548	9594	9639	9685	9730	9776	9821	9867	9912	9958	5 22
	955	98. 0003	0049	0094	0140	0185	0231	0276	0322	0367	0412	6 27
20″	956	0458	0503	0549	0594	0640	0685	0730	0776	0821	0867	7 31
	957	0912	0957	1003	1048	1093	1139	1184	1229	1275	1320	8 36
40″	958	1366	1411	1456	1501	1547	1592	1637	1683	1728	1773	9 40
	959	1819	1864	1909	1954	2000	2045	2090	2135	2181	2226	

Digitized by Google

n.	Log. 0	1	2	3	4	5	6	7	8	9	Diff.
960	98. 2271	2316	2362	2407	2452	2497	2543	2588	2633	2678	
961	2723	2769	2814	2859	2904	2949	2994	3040	3085	3130	
962	3175	3220	3265	3310	3356	3401	3446	3491	3536	3581	
963	3626	3671	3716	3762	3807	3852	3897	3942	3987	4032	
964	4077	4122	4167	4212	4257	4302	4347	4392	4437	4482	
965	4527	4572	4617	4662	4707	4752	4797	4842	4887	4932	45
966	4977	5022	5067	5112	5157	5202	5247	5292	5337	5382	1 | 4
967	5426	5471	5516	5561	5606	5651	5696	5741	5786	5830	2 | 9
968	5875	5920	5965	6010	6055	6100	6144	6189	6234	6279	3 | 13
969	6324	6369	6413	6458	6503	6548	6593	6637	6682	6727	4 | 18
970	6772	6817	6861	6906	6951	6996	7040	7085	7130	7175	5 | 22
971	7219	7264	7309	7353	7398	7443	7488	7532	7577	7622	6 | 27
972	7666	7711	7756	7800	7845	7890	7934	7979	8024	8068	7 | 31
973	8113	8157	8202	8247	8291	8336	8381	8425	8470	8514	8 | 36
974	8559	8604	8648	8693	8737	8782	8826	8871	8916	8960	9 | 40
975	9005	9049	9094	9138	9183	9227	9272	9316	9361	9405	
976	9450	9494	9539	9583	9628	9672	9717	9761	9806	9850	
977	9895	9939	9983	0028	0072	0117	0161	0206	0250	0294	
978	99. 0339	0383	0428	0472	0516	0561	0605	0650	0694	0738	
979	0783	0827	0871	0916	0960	1004	1049	1093	1137	1182	44
980	1226	1270	1315	1359	1403	1448	1492	1536	1580	1625	1 | 4
981	1669	1713	1758	1802	1846	1890	1935	1979	2023	2067	2 | 9
982	2111	2156	2200	2244	2288	2333	2377	2421	2465	2509	3 | 13
983	2554	2598	2642	2686	2730	2774	2819	2863	2907	2951	4 | 18
984	2995	3039	3083	3127	3172	3216	3260	3304	3348	3392	5 | 22
985	3436	3480	3524	3568	3613	3657	3701	3745	3789	3833	6 | 26
986	3877	3921	3965	4009	4053	4097	4141	4185	4229	4273	7 | 31
987	4317	4361	4405	4449	4493	4537	4581	4625	4669	4713	8 | 35
988	4757	4801	4845	4889	4933	4977	5021	5065	5108	5152	9 | 40
989	5196	5240	5284	5328	5372	5416	5460	5504	5547	5591	
990	5635	5679	5723	5767	5811	5854	5898	5942	5986	6030	
991	6074	6117	6161	6205	6249	6293	6337	6380	6424	6468	
992	6512	6555	6599	6643	6687	6731	6774	6818	6862	6906	43
993	6949	6993	7037	7080	7124	7168	7212	7255	7299	7343	1 | 4
994	7386	7430	7474	7517	7561	7605	7648	7692	7736	7779	2 | 9
995	7823	7867	7910	7954	7998	8041	8085	8129	8172	8216	3 | 13
996	8259	8303	8347	8390	8434	8477	8521	8564	8608	8652	4 | 17
997	8695	8739	8782	8826	8869	8913	8956	9000	9043	9087	5 | 21
998	9131	9174	9218	9261	9305	9348	9392	9435	9479	9522	6 | 26
999	9565	9609	9652	9696	9739	9783	9826	9870	9913	9957	7 | 30
1000	00. 0000	0043	0087	0130	0174	0217	0261	0304	0347	0391	8 | 34
01	0434	0477	0521	0564	0608	0651	0694	0738	0781	0824	9 | 39
02	0868	0911	0954	0998	1041	1084	1128	1171	1214	1258	
03	1301	1344	1388	1431	1474	1517	1561	1604	1647	1690	
04	1734	1777	1820	1863	1907	1950	1993	2036	2080	2123	
05	2166	2209	2252	2296	2339	2382	2425	2468	2512	2555	
06	2598	2641	2684	2727	2771	2814	2857	2900	2943	2986	42
07	3029	3073	3116	3159	3202	3245	3288	3331	3374	3417	1 | 4
08	3461	3504	3547	3590	3633	3676	3719	3762	3805	3848	2 | 8
09	3891	3934	3977	4020	4063	4106	4149	4192	4235	4278	3 | 13
10	4321	4364	4407	4450	4493	4536	4579	4622	4665	4708	4 | 17
11	4751	4794	4837	4880	4923	4966	5009	5052	5095	5138	5 | 21
12	5181	5223	5266	5309	5352	5395	5438	5481	5524	5567	6 | 25
13	5609	5652	5695	5738	5781	5824	5867	5909	5952	5995	7 | 29
14	6038	6081	6124	6166	6209	6252	6295	6338	6380	6423	8 | 34
15	6466	6509	6552	6594	6637	6680	6723	6765	6808	6851	9 | 38
16	6894	6936	6979	7022	7065	7107	7150	7193	7236	7278	
17	7321	7364	7406	7449	7492	7534	7577	7620	7662	7705	
18	7748	7790	7833	7876	7918	7961	8004	8046	8089	8132	
19	8174	8217	8259	8302	8345	8387	8430	8472	8515	8558	

Digitized by Google

	N°.	Log. 0	1	2	3	4	5	6	7	8	9	Diff
2h.												
50′	1020	00 .8600	8643	8685	8728	8770	8813	8856	8898	8941	8983	
	21	9026	9068	9111	9153	9196	9238	9281	9323	9366	9408	
20″	22	9451	9493	9536	9578	9621	9663	9706	9748	9791	9833	
	23	01. 9876	9918	9961	0003	0045	0088	0130	0173	0215	0258	
40″	24	0300	0342	0385	0427	0470	0512	0554	0597	0639	0681	
	25	0724	0766	0809	0851	0893	0936	0978	1020	1063	1105	
51′	26	1147	1190	1232	1274	1317	1359	1401	1444	1486	1528	
	27	1570	1613	1655	1697	1740	1782	1824	1866	1909	1951	42
20″	28	1993	2035	2078	2120	2162	2204	2247	2289	2331	2373	1 4 2 8 3 13 4 17 5 21 6 25 7 29 8 34 9 38
	29	2415	2458	2500	2542	2584	2626	2669	2711	2753	2795	
40″	1030	2837	2879	2922	2964	3006	3048	3090	3132	3174	3217	
	31	3259	3301	3343	3385	3427	3469	3511	3553	3596	3638	
52′	32	3680	3722	3764	3806	3848	3890	3932	3974	4016	4058	
	33	4100	4142	4184	4226	4268	4310	4353	4395	4437	4479	
20″	34	4521	4563	4605	4647	4689	4730	4772	4814	4856	4898	
	35	4940	4982	5024	5066	5108	5150	5192	5234	5276	5318	
40″	36	5360	5402	5444	5486	5527	5569	5611	5653	5695	5737	
	37	5779	5821	5863	5904	5946	5988	6030	6072	6114	6156	
53′	38	01. 6197	6239	6281	6323	6365	6407	6448	6490	6532	6574	
	39	6616	6657	6699	6741	6783	6824	6866	6908	6950	6992	
20″	1040	7033	7075	7117	7159	7200	7242	7284	7326	7367	7409	
	41	7451	7492	7534	7576	7618	7659	7701	7743	7784	7826	
40″	42	7868	7909	7951	7993	8034	8076	8118	8159	8201	8243	
	43	8284	8326	8368	8409	8451	8492	8534	8576	8617	8659	
54′	44	8701	8742	8784	8825	8867	8908	8950	8992	9033	9075	
	45	9116	9158	9199	9241	9283	9324	9366	9407	9449	9490	
20″	46	9532	9573	9615	9656	9698	9739	9781	9822	9864	9905	41
	47	9947	9988	0030	0071	0113	0154	0195	0237	0278	0320	1 4 2 8 3 12 4 16 5 21 6 25 7 29 8 33 9 37
40″	48	02. 0361	0403	0444	0486	0527	0568	0610	0651	0693	0734	
	49	0775	0817	0858	0900	0941	0982	1024	1065	1107	1148	
55′	1050	1189	1231	1272	1313	1355	1396	1437	1479	1520	1561	
	51	1603	1644	1685	1727	1768	1809	1851	1892	1933	1974	
20″	52	2016	2057	2098	2140	2181	2222	2263	2305	2346	2387	
	53	2428	2470	2511	2552	2593	2635	2676	2717	2758	2799	
40″	54	2841	2882	2923	2964	3005	3047	3088	3129	3170	3211	
	55	3252	3294	3335	3376	3417	3458	3499	3541	3582	3623	
56′	56	3664	3705	3746	3787	3828	3870	3911	3952	3993	4034	
	57	4075	4116	4157	4198	4239	4280	4321	4363	4404	4445	
20″	58	4486	4527	4568	4609	4650	4691	4732	4773	4814	4855	
	59	4896	4937	4978	5019	5060	5101	5142	5183	5224	5265	
40″	1060	5306	5347	5388	5429	5470	5511	5552	5593	5634	5674	
	61	5715	5756	5797	5838	5879	5920	5961	6002	6043	6084	
57′	62	02 6125	6165	6206	6247	6288	6329	6370	6411	6452	6492	
	63	6533	6574	6615	6656	6697	6737	6778	6819	6860	6901	
20″	64	6942	6982	7023	7064	7105	7146	7186	7227	7268	7309	
	65	7350	7390	7431	7472	7513	7553	7594	7635	7676	7716	
40″	66	7757	7798	7839	7879	7920	7961	8002	8042	8083	8124	40
	67	8164	8205	8246	8287	8327	8368	8409	8449	8490	8531	1 4 2 8 3 12 4 16 5 20 6 24 7 28 8 32 9 36
58′	68	8571	8612	8653	8693	8734	8775	8815	8856	8896	8937	
	69	8978	9018	9059	9100	9140	9181	9221	9262	9303	9343	
20″	1070	9384	9424	9465	9506	9546	9587	9627	9668	9708	9749	
	71	03. 9789	9830	9871	9911	9952	9992	0033	0073	0114	0154	
40″	72	0195	0235	0276	0316	0357	0397	0438	0478	0519	0559	
	73	0600	0640	0681	0721	0762	0802	0843	0883	0923	0964	
59′	74	1004	1045	1085	1126	1166	1206	1247	1287	1328	1368	
	75	1408	1449	1489	1530	1570	1610	1651	1691	1732	1772	
20″	76	1812	1853	1893	1933	1974	2014	2054	2095	2135	2175	
	77	2216	2256	2296	2337	2377	2417	2458	2498	2538	2578	
40″	78	2619	2659	2699	2740	2780	2820	2860	2901	2941	2981	
	79	3021	3062	3102	3142	3182	3223	3263	3303	3343	3384	
3h.	1080	03. 3424	3464	3504	3544	3585	3625	3665	3705	3745	3786	

In Nat. Num. read 397.

ERRATA.—In Log. of Num. 4847. for 4473, read 5473.

Digitized by Google

TABLE II. Sexages. Logs. of the seconds and tenths of minutes, or minutes and tenths of hours. Useful for finding the nat. or log. sine, tangent, &c. for any given second, or the nearest second for any given sine, &c. when the minutes and differences for one minute are given.

		,1	,2	,3	,4	,5	,6	,7	,8	,9
1	8.2218									
2	5229									
3	6990									
4	8239									
5	8.9208	,1	,2	,3	,4	,5	,6	,7	,8	,9
6	9.0000	072	142	212	280	348	414	479	544	607
7	669	731	792	852	911	969				
	9.1						027	083	139	195
8	249	303	357	409	461	513	563	614	663	712
9	761	809	856	903	950	996				
	9.2						041	086	131	175
10	218	262	304	347	389	430	472	512	553	593
11	632	672	711	749	788	825	863	900	937	974
12	9.3010	046	082	118	153	188	222	257	291	324
13	358	391	424	457	490	522	554	586	617	649
14	680	711	741	772	802	832	862	892	921	950
15	979									
	9.4	008	037	065	094	122	150	177	205	232
16	Index 260	287	314	340	367	393	420	446	472	497
17	523	548	574	599	624	649	674	698	723	747
18	771	795	819	843	867	890	914	937	960	983
19	9.5006	029	051	074	097	119	141	163	185	207
20	Index 229	250	272	293	315	336	357	378	399	420
21	441	461	482	502	523	543	563	583	603	623
22	643	662	682	702	721	740	760	779	798	817
23	836	855	873	892	911	929	948	966	984	
	9.6									002
24	021	039	057	075	092	110	128	145	163	180
25	198	215	232	250	267	284	301	318	335	351
26	368	385	402	418	435	451	467	484	500	516
27	9.6532	548	564	580	596	612	628	643	659	675
28	690	706	721	736	752	767	782	797	812	827
29	842	857	872	887	902	917	931	946	961	975
30	990									
	9.7	004	019	033	047	061	076	090	104	118
31	132	146	160	174	188	202	215	229	243	256
32	270	284	297	311	324	337	351	364	377	390
33	404	417	430	443	456	469	482	495	507	520
34	Index 7533	546	559	571	584	597	609	622	634	647
35	659	672	684	696	709	721	733	745	757	769
36	782	794	806	818	830	841	853	865	877	889
37	901	912	924	936	947	959	970	982	993	
	9.8									005
38	016	028	039	050	062	073	084	096	107	118
39	129	140	151	162	173	183	195	206	217	228
40	239	250	261	272	282	293	304	314	325	336
41	346	357	367	378	388	399	409	420	430	441
42	451	461	472	482	492	502	513	523	533	543
43	9.8553	563	573	583	593	603	613	623	633	643
44	653	663	673	683	692	702	712	722	731	741
45	Index 751	760	770	779	789	799	808	818	827	837
46	846	855	865	874	884	893	902	912	921	930
47	939	949	958	967	976	985	995			
	9.9							004	013	022
48	031	040	049	058	067	076	085	094	103	112
49	120	129	138	147	156	165	173	182	191	199
50	208	217	226	234	243	251	260	269	277	286
51	294	303	311	320	328	337	345	353	362	370
52	9.9379	387	395	404	412	420	428	437	445	453
53	461	469	478	486	494	502	510	518	526	534
54	542	550	558	566	574	582	590	598	606	614
55	622	630	638	646	654	661	669	677	685	693
56	9.9700	708	716	724	731	739	747	754	762	770
57	777	785	792	800	808	815	823	830	838	845
58	853	860	868	875	883	890	897	905	912	920
59	927	934	942	949	956	964	971	978	985	993

EXAMPLE I.

To find the log. sine of 12° 14' 24",6

Arc preceding 12° 14' 0" - - - - - - - - Log. sine 9.326117

Tab. L. to num. *582 (diff. for 1") 0.9868

Tab. L. to - - - - - 24",6 - - 9.6128

Sum - - - 0.5996 Prop. part $238\frac{1}{18}$

Log. sine of 12° 14' 24",6 - - - - - - - - - - - - - - - - 9.326355$\frac{12}{18}$

EXAMPLE II.

To find the arc to log. sine - - - - - - - - - - - - - - - - 9.326355$\frac{12}{18}$

Arc preceding 12° 14' 0" - - - - - - - - - - log. sine 9.326117

Tabular log. - - - - - - - - - - - - - - - -

TABLE III. shewing the Proportional Parts for any number of seconds wher the minutes and differences for one minute are given less than 300.

diff.									diff.								
60"	50"	40"	30"	20"	10"	9"	8"	7"	60"	50"	40"	30"	20"	10"	9"	8"	7"
1	0.8	0.7	0.5	0.3	0.2	0.2	0.1	0.1	150	125	100	75	50	25	22.5	20	17.5
3	2.5	2	1.5	1	0.5	0.5	0.4	0.4	153	127.5	102	76.5	51	25.5	23	20.4	17 9
6	5	4	3	2	1	0.9	0.8	0.7	156	130	104	78	52	26	23.4	20.8	18.2
9	7.5	6	4.5	3	1.5	1.4	1.2	1.1	159	132.5	106	79.5	53	26.5	23.9	21.2	18.6
12	10	8	6	4	2	1,8	1.6	1.4	162	135	108	81	54	27	24.3	21.6	18.9
15	12.5	10	7.5	5	2.5	2.3	2.0	1 8	165	137.5	110	82.5	55	27.5	24.8	22	19.3
18	15	12	9	6	3	2.7	2.4	2.1	168	140	112	84	56	28	25.2	22.4	19.6
21	17.5	14	10.5	7	3.5	3.2	2.8	2.5	171	142.5	114	85.5	57	28.5	25 7	22.8	20
24	20	16	12	8	4	3.6	3.2	2.8	174	145	116	87	58	29	26.1	23.2	20.3
27	22.5	18	13.5	9	4.5	4.1	3.6	3.2	177	147.5	118	88.5	59	29.5	26.6	23.6	20.7
30	25	20	15	10	5	4.5	4.0	3.5	180	150	120	90	60	30	27	24	21
33	27.5	22	16.5	11	5.5	5.0	4.4	3.9	183	152.5	122	91.5	61	30.5	27.5	24.4	21.4
36	30	24	18	12	6	5.4	4.8	4.2	186	155	124	93	62	31	27.9	24.8	21.7
39	32.5	26	19.5	13	6.5	5.9	5.2	4.6	189	157.5	126	94.5	63	31.5	28.4	25.2	22.1
42	35	28	21	14	7	6.3	5.6	4.9	192	160	128	96	64	32	28.8	25.6	22 4
45	37.5	30	22.5	15	7.5	6.8	6.0	5.3	195	162.5	130	97.5	65	32 5	29.3	26	22.8
48	40	32	24	16	8	7.2	6.4	5.6	198	165	132	99	66	33	29,7	26 4	23.1
51	42.5	34	25.5	17	8.5	7.7	6.8	6	201	167.5	134	100.5	67	33.5	30.2	26.8	23.5
54	45	36	27	18	9	8.1	7.2	6.3	204	170	136	102	68	34	30,6	27.2	23.8
57	47.5	38	28.5	19	9.5	8.6	7.6	6.7	207	172.5	138	103.5	69	34.5	31.1	27.6	24.2
60	50	40	30	20	10	9	8.0	7	210	175	140	105	70	35	31.5	28	24.5
63	52.5	42	31.5	21	10.5	9.5	8.4	7.4	213	177.5	142	106.5	71	35.5	32	28.4	24.9
66	55	44	33	22	11	9.9	8.8	7.7	216	180	144	108	72	36	32.4	28.8	25.2
69	57.5	46	34.5	23	11.5	10.4	9.2	8.1	219	182.5	146	109.5	73	36.5	32.9	29.2	25.6
72	60	48	36	24	12	10.8	9.6	8.4	222	185	148	111	74	37	33.3	29.6	25.9
75	62.5	50	37.5	25	12.5	11.3	10.0	8.8	225	187.5	150	112.5	75	37.5	33.8	30	20.3
78	65	52	39	26	13	11.7	10.4	9.1	228	190	152	114	76	38	34.2	30.4	26 6
81	67.5	54	40.5	27	13.5	12.2	10.8	9.5	231	192.5	154	115.5	77	38.5	34.7	30.8	27
84	70	56	42	28	14	12.6	11.2	9.8	234	195	156	117	78	39	35.1	31.2	27.3
87	72.5	58	43.5	29	14,5	13.1	11.6	10.2	237	197.5	158	118.5	79	39.5	35.6	31.6	27.7
90	75	60	45	30	15	13.5	12	10.5	240	200	160	120	80	40	36	32	28
93	77.5	62	46.5	31	15.5	14	12.4	10.9	243	202.5	162	121.5	81	40.5	36.5	32.4	28.4
96	80	64	48	32	16	14.4	12.8	11.2	246	205	164	123	82	41	36.9	32.8	28.7
99	82.5	66	49.5	33	16.5	14.9	13.2	11 6	249	207.5	166	124.5	83	41.5	37.4	33.2	29.1
102	85	68	51	34	17	15.3	13.6	11.9	252	210	168	126	84	42	37.8	33.6	29.4
105	87.5	70	52.5	35	17.5	15.8	14	12.3	255	212.5	170	127.5	85	42.5	38.3	34	29.8
108	90	72	54	36	18	16.2	14.4	12.6	258	215	172	129	86	43	38.7	34.4	30.1
111	92.5	74	55.5	37	18.5	16,7	14.8	13	261	217.5	174	130,5	87	43.5	39.2	34.8	30.5
114	95	76	57	38	19	17.1	15.2	13.3	264	220	176	132	88	44	39.6	35.2	30.8
117	97.5	78	58.5	39	19.5	17.6	15.6	13.7	267	222.5	178	133.5	89	44.5	40.1	35.6	31.2
120	100	80	60	40	20	18	16	14	270	225	180	135	90	45	40.5	36	31.5
123	102.5	82	61.5	41	20.5	18.5	16.4	14.4	273	227.5	182	136.5	91	45.5	41	36.4	31.9
126	105	84	63	42	21	18.9	16.8	14.7	276	230	184	138	92	46	41.4	36.8	32.2
129	107.5	86	64.5	43	21.5	19.4	17.2	15.1	279	232.5	186	139.5	93	46.5	41,9	37.2	32.6
132	110	88	66	34	22	19.8	17.6	15.4	282	235	188	141	94	47	42 3	37.6	32.9
135	112.5	90	67.5	45	22.5	20.3	18	15.8	285	237.5	190	142.5	95	47.5	42.8	38	33.3
138	115	92	69	46	23	20.7	18.4	16.1	288	240	192	144	96	48	43.2	38.4	33.6
141	117.5	94	70.5	47	23.5	21.2	18.8	16 5	291	242.5	194	145.5	97	48.5	43.7	38.8	34
144	120	96	72	48	24	21.6	19.2	16.8	294	245	196	147	98	49	44.1	39.2	34.
147	122.5	98	73.5	49	24,5	22.1	19.6	17.2	297	247.5	198	148.5	99	49.5	44.6	39.6	34.

The above table of the proportional parts for seconds requires no explanation, may be used instead of table II when the difference of one minute is less than 300.

N. B. Should the exact difference not be found in the table, take the nearest, ar add or subtract $\frac{1}{60}$ of the number of seconds.

Digitized by Google

M	N."	L. Sine	S—"	L Tan.	T—"	L.Cos	D	N. Sin.	d"	N Cos	D	M
0	0	Inf. Neg.	75	Inf. Neg.	75		0		291		0	60
1	60	6.463726	75	6.463726	75	10.0000	0	0000		10.0000	0	
2	120	6.764756	75	6.764756	75		0	0291	5		0	59
3	180	6.940847	75	6.940848	75		0	.00 0582	10		0	58
4	240	7.065786	75	7.065786	75		0	0873	15		0	57
							0	1164	20		0	56
5	300	7.162696	75	7.162696	75		1				1	
6	360	241877	75	241878	75	9.9999	0	1454	24		0	55
7	420	308824	74	308825	75	9.9999	1	1745	29		1	54
8	480	366816	74	366817	76	9.9999	0	.00 2036	34	9.9999	0	53
9	540	417968	74	417970	76	9.9999	0	2327	39		1	52
						9.9999	0	2618	44		0	51
10	600	7.463726	74	7.463727	76		1				1	
11	660	505118	74	505120	76	9.9999	0	2909	49		1	50
12	720	542907	74	542909	77	9.9999	1	.00 3200	53	9.9999	0	49
13	780	577668	74	577672	77	9.9999	0	3491	58		1	48
14	840	609853	74	609857	77	9.9999	1	3782	63		1	47
						9.9999	0	4072	68		1	46
15	900	7.639816	73	7.639820	78		1				2	
16	960	607845	73	697849	78	9.9999	0	4363	73		1	45
17	1020	674173	73	694177	78	9.9999	1	4654	78		2	44
18	1080	718997	73	719003	79	9.9999	1	.00 4945	83	9.9999	1	43
19	1140	742478	73	742484	79	9.9999	1	5236	87		2	42
						9.9999	0	5527	92		1	41
20	1200	7.764754	72	7.764701	80		1				2	
21	1260	785943	72	785951	80	9.9999	1	5818	97		2	40
22	1320	806146	72	806155	81	9.9999	1	6109	102		1	39
23	1380	825451	72	825460	81	9.9999	1	.00 6400	107	9.9999	2	38
24	1440	843934	71	843944	82	9.9999	1	6690	112		2	37
						9.9999	0	6981	116		2	36
25	1500	7.861662	71	7.861674	82		1				3	
26	1560	878695	71	878708	83	9.9999	1	7272	121		2	35
27	1620	895085	70	895099	84	9.9999	1	7563	126		2	34
28	1680	910879	70	910894	84	9.9999	1	.00 7854	131	9.9999	2	33
29	1740	926119	70	926134	85	9.9999	1	8145	136		3	32
						9.9999	1	8436	141		2	31
30	1800	7.940842	69	7.940858	86		2				2	
31	1860	955082	69	955100	87	9.9999	1	8727	146		3	30
32	1920	968870	69	968889	87	9.9999	1	9018	150		2	29
33	1980	982233	68	982253	88	9.9999	1	.00 9308	155	9.9999	3	28
34	2040	995198	68	995219	89	9.9999	1	9599	160		3	27
						9.9999	1	9890	165		3	26
35	2100	8.007787	67	8.007809	90		2				3	
36	2160	020021	67	020045	91	9.9999	1	0181	170		3	25
37	2220	031920	67	031945	92	9.9999	1	0472	175		3	24
38	2280	043501	66	043527	93	9.9999	2	.01 0763	180	9.9999	3	23
39	2340	054781	66	054809	94	9.9999	1	1054	184		3	22
						9.9999	2	1344	189		3	21
40	2400	8.065778	65	8.065806	95		1	1635	194		4	20
41	2460	076500	65	076531	96	9.9999	2	1926	199		3	19
42	2520	086965	64	086997	97	9.9999	2	.01 2217	204	9.9999	4	18
43	2580	097183	64	097217	98	9.9999	2	2508	209		3	17
44	2640	107167	63	107203	99	9.9999	2	2799	213		4	16
						9.9999	1				4	
45	2700	8.116926	62	8.116963	00		2	3090	218		4	15
46	2760	126471	62	126510	01	9.9999	2	3381	223		3	14
47	2820	135810	61	135851	02	9.9999	2	.01 3671	228	9.9999	4	13
48	2880	144953	61	144996	03	9.9999	2	3962	233		4	12
49	2940	153908	60	153952	04	9.9999	2	4253	238		4	11
						9.9999	2				5	
50	3000	8.162681	60	8.162727	05		2	4544	243		4	10
51	3060	171280	59	171328	07	9.9999	2	4835	247		4	9
52	3120	179713	58	179763	08	9.9999	2	.01 5126	252	9.9999	4	8
53	3180	187985	58	188036	09	9.9999	2	5417	257		5	7
54	3240	196102	57	196156	11	9.9999	2	5707	262		4	6
						9.9999	2				5	
55	3300	8.204070	56	8.204126	12		2	5998	267		5	5
56	3360	211895	56	211953	13	9.9999	2	6289	272		5	4
57	3420	219581	55	219641	15	9.9999	2	.01 6580	277	9.9999	4	3
58	3480	227134	54	227195	16	9.9999	2	6871	282		5	2
59	3540	234557	54	234621	18	9.9999	2	7162	287		5	1
M		L.Cos.		LCotan		L.Sin.	D	N. Cos.		Nat. S	D	M

Digitized by Google

M	N″	L.Sine.	S—″	L.Tang.	T—″	L.Cos.	D.	N. Sine	a″	N. Cos.	D.
0	3600	8.241855		8.241922	19	34	2	.017452	291	848	5
1	3660	249033	53	249102	21	32	3	7743	5	843	6
2	3720	256094	52	256165	22	29	2	8034	10	837	5
3	3780	263042	51	263115	24	27	2	8325	15	832	5
4	3840	269881	51	269956	25	25		8616	19	827	6
5	3900	8.276614	50	8.276691	27	22	3	.018907	24	821	5
6	3960	283243	49	283323	28	20	2	9197	29	816	6
7	4020	289773	48	289856	30	18	2	9488	34	810	6
8	4080	296207	47	296292	32	15	3	9779	39	804	6
9	4140	302546	46	302634	33	13	2	.020070	44	799	5
10	4200	8.308794	46	8.308884	35	10	3	0361	49	793	6
11	4260	314954	45	315046	37	07	3	0652	53	787	6
12	4320	321027	44	321122	38	05	2	0942	58	781	6
13	4380	327016	43	327114	40	02	3	1233	63	775	6
14	4440	332924	42	333025	42	00	3	1524	68	768	7
15	4500	8.338753	41	8.338856	44	9.9998	2	.021815	73	762	6
16	4560	344504	40	344611	46	97	3	2106	78	756	6
17	4620	350181	40	350290	48	94	3	2397	83	749	7
18	4680	355783	39	355895	49	91	3	2687	87	743	6
19	4740	361315	38	361430	51	88	3	2978	92	736	7
20	4800	8.366777	37	8.366895	53	85	3	.023269	97	729	7
21	4860	372171	36	372292	55	82	3	3560	102	722	7
22	4920	377499	35	377622	57	79	3	3851	107	716	6
23	4980	382762	34	382889	59	76	3	4141	112	709	7
24	5040	387962	33	388092	61	73	3	4432	116	702	7
25	5100	8.393101	32	8.393234	63	70	3	.024723	121	694	8
26	5160	398179	31	398315	65	67	3	5014	126	687	7
27	5220	403199	30	403338	68	64	3	5305	131	680	7
28	5280	408161	29	408304	70	61	3	5595	136	672	8
29	5340	413068	27	413213	72	58	4	5886	141	665	7
30	5400	8.417919	26	8.418068	74	54	3	.026177	146	657	8
31	5460	422717	25	422869	76	51	3	6468	150	650	7
32	5520	427462	24	427618	79	48	3	6759	155	642	8
33	5580	432156	23	432315	81	45	4	7049	160	634	8
34	5640	436800	22	436962	83	41	3	7340	165	626	8
35	5700	8.441394	21	8.441560	85	38	3	.027631	170	618	8
36	5760	445941	20	446110	88	34	4	7922	175	610	8
37	5820	450440	18	450613	90	31	3	8212	180	602	8
38	5880	454893	17	455070	92	27	4	8503	184	594	9
39	5940	459301	16	459481	95	24	3	8794	189	585	8
40	6000	8.463665	15	8.463849	97	20	4	.029085	194	577	9
41	6060	467985	14	468173	00	16	4	9376	199	568	8
42	6120	472263	12	472454	02	13	3	9666	204	560	9
43	6180	476498	11	476693	05	09	4	9957	209	551	9
44	6240	480693	10	480892	07	05	4	.030248	213	542	9
45	6300	8.484848	09	8.485051	10	01	4	0539	218	534	8
46	6360	488963	07	489170	13	9.9997	4	0829	223	525	9
47	6420	493040	06	493250	15	94	3	1120	228	516	9
48	6480	497078	05	497293	18	90	4	1411	233	507	9
49	6540	501080	03	501298	21	86	4	1702	238	497	10
50	6600	8.505045	02	8.505267	23	82	4	.031992	243	488	9
51	6660	508974	01	509200	26	78	4	2283	247	479	9
52	6720	512867	00	513098	29	74	4	2574	252	469	10
53	6780	516726	98	516961	31	70	4	2864	257	460	9
54	6840	520551	97	520790	34	65	5	3155	262	450	10
55	6900	8.524343	95	8.524586	37	61	4	.033446	267	441	9
56	6960	528102	94	528349	40	57	4	3737	272	431	10
57	7020	531828	93	532080	43	53	4	4027	277	421	10
58	7080	535523	91	535779	45	48	5	4318	281	411	10
59	7140	539186	90	539447	48	44	4	4609	286	401	10
M		Lo.Cos.	88	L.Cotang		L.Sine	D.	N. Cos.		N. Sine.	D.

4.6854 4.6854 98 97 95 94 93 91 90 88 — 4.6857 4.6857 40 43 45 48 — 4.6857 4.6857 26 29 31 34 37 — 9.9997 9.9997 9.9997 9.9997 9.9997 — 4.6856 4.6856 4.6856 4.6856 4.6856 4.6856 — 9.9998 9.9998 9.9998 9.9998 9.9998 — 4.6855 4.6855 4.6855 4.6855 4.6855 4.6855 — 9.9999 9.9999 9.9999 9.9999 9.9999 — 4.6855 4.6855 4.6855 4.6855 4.6855 4.6855 — 4.6857 4.6857 4.6857 4.6857 — 4.6857 4.6857 4.6857 4.6857 4.6857 4.6857 — .999 .999 .999 .999 .999 .999 — .999 .999 .999 .999 .999 .999 —

In the page opposite for the Nat. Cosine of 0° to 4° for 10. write 1. and from 5° to 59° expunge the 9 before the decimal point.

Digitized by Google

°.′	L. Sine.	S—″	L.Tang.	T.—″	L.Cos.	D.	N. Sine	d.″	N. Cos.	D.	M.
7200	8.542819	87	8.543084	751	735						60
7260	546422	85	546691	754	731	4	.034900	291	391	10	59
7320	549995	84	550268	757	727	4	5190	5	381	11	58
7380	553539	4.6854 82	553817	4.6853 760	9.999 722	5	5481	10	.999 370	10	57
7440	557054	81	557336	763	717	5	5772	15	360	10	56
						4	6062	19	350	11	
7500	8.560540	79	8.560828	766	713		.036353	24	339	11	55
7560	563999	78	564291	769	708	5	6644	29	328	10	54
7620	567431	76	567727	772	704	4	6934	34	.999 318	11	53
7680	570836	4.6854 75	571137	4.6853 776	9.999 699	5	7225	39	307	11	52
7740	574214	73	574520	779	694	5	7516	44	296	11	51
						5	.037807	49	285	11	50
7800	8.577566	71	8.577877	782	689	4	8097	53	274	11	49
7860	580892	70	581208	785	685	5	8388	58	.999 263	11	48
7920	584193	68	584514	4.6853 788	9.999 680	5	8679	63	252	12	47
7980	587469	4.6854 67	587795	792	675	5	8969	68	240	11	46
8040	590721	65	591051	795	670						
						5	.039260	73	229	11	45
8100	8.593948	63	8.594283	798	665	5	9551	78	218	12	44
8160	597152	62	597492	802	660	5	9841	83	.999 206	12	43
8220	600332	60	600677	4.6853 805	9.999 655	5	.040132	87	194	11	42
8280	603489	4.6854 58	603839	808	650	5	0422	92	183	12	41
8340	606623	57	606978	812	645						40
8400	8.609734	55	8.610094	815	640	5	0713	97	171	12	39
8460	612824	53	613189	818	635	5	1004	102	.999 159	12	38
8520	615891	51	616262	4.6853 822	9.999 629	6	1294	107	147	12	37
8580	618937	4.6854 50	619313	825	624	5	1585	112	135	12	36
8640	621962	48	622343	829	619	5	1876	116	123	12	
						5	.042166	121	111	13	35
8700	8.624965	46	8.625352	833	614	6	2457	126	.999 098	12	34
8760	627948	44	628340	836	608	5	2748	131	086	13	33	
8820	630911	43	631308	4.6853 840	9.999 603	6	3038	136	073	12	32
8880	633854	4.6854 41	634256	843	597	5	3329	141	061	13	31
8940	636776	39	637185	847	592						30
						5	.043619	146	048	12	29
9000	8.639680	37	8.640093	851	587	6	3910	150	.999 036	13	28
9060	642563	35	642983	854	581	6	4201	155	023	13	27
9120	645428	33	645853	4.6853 858	9.999 575	5	4491	160	010	13	26
9180	648274	32	648704	862	570	6	4782	165	997	13	
9240	651102	30	651538	866	564						25
						6	.045072	170	984	13	24
9300	8.653911	28	8.654352	869	558	5	5363	175	.998 971	13	23
9360	656702	26	657149	4.6853 873	9.999 553	6	5654	180	957	14	22
9420	659475	24	659928	877	547	6	5944	184	944	13	21
9480	662230	22	662689	4.6853 881	9.999 541	6	6235	189	931	13	
9540	664968	20	665433	885	535						20
						5	.046525	194	917	14	19
9600	8.667689	18	8.668160	889	530	6	6816	199	.998 904	13	18
9660	670393	16	670870	4.6853 893	9.999 524	6	7107	204	890	14	17
9720	673080	14	673563	896	518	6	7397	209	876	14	16
9780	675751	12	676239	900	512	6	7688	213	862	14	
9840	678405	10	678900	904	506						15
						6	.047978	218	848	14	14
9900	8.681043	08	8.681544	4.6853 909	500	6	8269	223	.998 834	14	13
9960	683665	06	684172	913	9.999 494	7	8559	228	820	14	12
0020	686272	4.6854 04	686784	4.6853 917	487	6	8850	233	806	14	11
0080	688863	02	689381	921	9.999 481	6	9140	238	792	14	
0140	691438	00	691963	925	475	6	9431	243	778	14	10
						6	9721	247	763	15	9
0200	8.693998	98	8.694527	929	469	7	.050012	252	.998 749	14	8
0260	696543	96	697081	4.6853 933	9.999 463	6	0302	257	734	15	7
0320	699073	94	699617	937	456	6	0593	262	719	15	6
0380	701589	4.6853 92	702139	4.6853 942	9.999 450						
0440	704090	90	704647	946	444	7	.050884	267	705	14	5
						6	1174	272	690	15	4
0500	8.706577	87	8.707140	950	437	7	1465	277	.998 675	15	3
0560	709049	85	709619	4.6853 955	9.999 431	6	1755	281	660	15	2
0620	711508	83	712083	960	424	7	2046	286	645	15	1
0680	713952	4.6853 81	714535	4.6853 964	9.999 418						
0740	716383	79	716972	969	411						
	L.Cosin.		L.Cotan.		L.Sine	D.	N. Cos.		N. Sine	D.	M.

Digitized by Google

M.	N°.''	L. Sine.	S.—'	L.Tang	T—''	L.Cos.	D.	N.Sine.	d.''	N.Cos.	D
0	10800	8.718800	376	8.719396	972	404	6	.052336	290	629	15
1	10860	721204	685 374	721806	976	9.999 398	7	2626	5	998. 614	15
2	10920	723595	372	724204	981	391	7	2917	10	599	15
3	10980	725972	4 685 370	726588	985 4.685	384	6	3207	15	584	16
4	11040	728337	368	728959	990	378		3498	19	568	16
5	11100	8.730688	365	8.731317	994	371	7	.053788	24	552	15
6	11160	733027	363	733663	999	364	7	4079	29	998. 537	16
7	11220	735354	4.685 361	735996	004 4.686	357	7	4369	34	521	16
8	11280	737668	358	738317	008	350	7	4660	39	505	16
9	11340	739969	356	740626	013	343	7	4950	44	489	16
10	11400	8.742259	354	8.742922	017	336	7	.055241	48	473	16
11	11460	744536	4.685 351	745207	022 4.686	329	7	5531	53	998. 457	16
12	11520	746802	349	747479	027	322	7	5822	58	441	16
13	11580	749055	347	749740	032	315	7	6112	63	425	17
14	11640	751297	344	751989	036	308	7	6402	68	408	16
15	11700	8.753528	342	8.754227	041	301	7	.056693	73	392	17
16	11760	755747	4.685 340	756453	046 4.686	294	7	6983	77	998. 375	16
17	11820	757955	337	758668	051	287	8	7274	82	359	17
18	11880	760151	4.685 335	760872	056	279	7	7564	87	342	17
19	11940	762337	332	763065	060	272	7	7854	92	325	17
20	12000	8.764511	330	8.765246	065	265	8	.058145	97	308	17
21	12060	766675	4.685 328	767417	070 4.686	257	7	8435	102	998. 291	17
22	12120	768828	325	769578	075	250	8	8726	106	274	17
23	12180	770970	4.685 323	771727	080	242	7	9016	111	257	17
24	12240	773101	320	773866	085	235	8	9306	116	240	17
25	12300	8.775223	318	8.775995	090	227	7	9597	121	223	18
26	12360	777333	4 685 315	778114	095 4.686	220	8	9887	126	998. 205	17
27	12420	779434	313	780222	100	212	7	.060178	131	188	18
28	12480	781524	4 310	782320	105 4.686	205	8	0468	135	170	17
29	12540	783605	307	784408	110	197	8	0758	140	153	18
30	12600	8.785675	305	8.786486	116	189	8	.061049	145	135	18
31	12660	787736	4.663 302	788554	121	181	8	1339	150	998. 117	18
32	12720	789787	300	790613	126 4.686	174	7	1629	155	099	18
33	12780	791828	4.297	792662	131	166	8	1920	160	081	18
34	12840	793859	294	794701	136	158	8	2210	164	063	18
35	12900	8.795881	292	8.796731	142	150	8	.062500	169	045	18
36	12960	797894	4.685 289	798752	147 4.686	142	8	2791	174	998. 027	19
37	13020	799897	286	800763	152	134	8	3081	179	008	18
38	13080	801892	4.685 284	802765	158	126	8	3371	184	990	18
39	13140	803876	281	804758	163	118		3661	189	972	19
40	13200	8.805852	278	8.806742	168	110	8	.063952	193	953	19
41	13260	807819	4.685 276	808717	174 4.686	102	8	4242	198	998. 934	18
42	13320	809777	273	810683	179	094	8	4532	203	916	19
43	13380	811726	4.685 270	812641	185	086	8	4823	208	897	19
44	13440	813667	268	814589	190	077	9	5113	213	878	19
45	13500	8.815599	265	8.816529	196	069	8	.065403	218	859	19
46	13560	817522	4.685 262	818461	201 4.686	061	8	5693	222	998. 840	19
47	13620	819436	259	820384	207	053	8	5984	227	821	19
48	13680	821343	4.685 256	822298	212 4.686	044	9	6274	232	998. 802	19
49	13740	823240	254	824205	218	036	8	6564	237	782	20
50	13800	8.825130	251	8.826103	224	027	9	.066854	242	763	19
51	13860	827011	4.685 248	827992	229 4.686	019	8	7145	247	998. 743	20
52	13920	828884	245	829874	235	010	9	7435	251	724	19
53	13980	830749	4.685 242	831748	241 4.686	002	8	7725	256	998. 704	20
54	14040	832607	240	833613	246	993	9	8015	261	684	20
55	14100	8.834456	237	8.835471	252	984	9	.068306	266	665	19
56	14160	836297	4.685 234	837321	258 4.686	976	9	8596	271	998. 645	20
57	14220	838130	231	839163	264	967	9	8886	276	625	20
58	14280	839956	4 685 228	840998	270 4.686	958	9	9176	280	998. 605	20
59	14340	841774	225	842825	275	950	8	9466	285	584	21
M.		Lo. Cos		L.Cotan		.Sine	D	N. Cos.	d.''	N. Sine	D

Digitized by Google

I.	N°.″	L. Sine.	S —″	L. Tang.	T—″	L. Cos	D.	N. Sine	d.″	V. Co	D.	M.
0	14400	8.843585	222	8.844644	281	941		.069757	290	564	20	60
1	14460	845387	4.685 219	846455	4.686 287	9.999 932	9	.070047	5	544	21	59
2	14520	847183	216	848269	293	923	9	0337	10	523	20	58
3	14580	848971	213	850057	299	914	9	0627	15	503	21	57
4	14640	850751	210	851846	305	905	9	0917	19	482	20	56
5	14700	8.852525	207	8.853628	311	896	9	.071207	24	462	21	55
6	14760	854291	4.685 204	855403	4.686 317	9.999 887	9	1497	29	441	21	54
7	14820	856049	201	857171	323	878	9	1783	34	420	21	53
8	14880	857801	198	858932	329	869	9	2073	39	399	21	52
9	14940	859546	195	860686	335	860	9	2368	44	378	21	51
10	15000	8.861283	192	8.862433	341	851	9	.072658	48	357	21	50
11	15060	863014	4.685 189	864173	4.686 348	9.999 841	10	2948	53	336	21	49
12	15120	864738	186	865906	354	832	9	3238	58	315	22	48
13	15180	866455	183	867632	360	823	9	3528	63	293	21	47
14	15240	868165	180	869351	366	813	10	3818	68	272	21	46
15	15300	8.869868	177	8.871064	372	804	9	.074109	73	250	22	45
16	15360	871565	4.685 174	872770	4.686 379	9.999 795	9	4399	77	229	21	44
17	15420	873255	170	874469	385	785	10	4689	82	207	22	43
18	15480	874938	167	876162	4.686 391	776	9	4979	87	185	22	42
19	15540	876615	164	877849	398	766	10	5269	92	163	22	41
20	15600	8.878285	161	8.879529	404	757	9	.075559	97	141	22	40
21	15660	879949	4.685 158	881202	4.686 410	9.999 747	10	5849	102	119	22	39
22	15720	881607	154	882869	417	738	9	6139	106	097	22	38
23	15780	883258	151	884530	4.686 423	728	10	6429	111	075	22	37
24	15840	884903	148	886185	430	718	10	6719	116	053	22	36
25	15900	8.886542	145	8.887833	436	708	10	.077009	121	030	23	35
26	15960	888174	4.685 141	889476	4.686 443	9.999 699	9	7299	126	008	22	34
27	16020	889801	138	891112	449	689	10	7589	131	985	23	33
28	16080	891421	135	892742	4.686 456	679	10	7879	135	963	22	32
29	16140	893035	132	894366	463	669	10	8169	140	940	23	31
30	16200	8.894643	128	8.895984	469	659	10	.078459	145	917	23	30
31	16260	896246	4.685 125	897596	4.686 476	9.999 649	10	8749	150	895	22	29
32	16320	897842	122	899203	483	639	10	9039	155	872	23	28
33	16380	899432	118	900803	4.686 489	629	10	9329	160	849	23	27
34	16440	901017	115	902398	496	619	10	9619	164	825	24	26
35	16500	8.902596	112	8.903987	503	609	10	9909	169	802	23	25
36	16560	904169	4.685 108	905570	4.686 509	9.999 599	10	.080199	174	779	23	24
37	16620	905736	105	907147	516	589	11	0489	179	756	23	23
38	16680	907297	102	908719	4.686 523	578	10	0779	184	732	24	22
39	16740	908853	098	910285	530	568	10	1069	189	709	23	21
40	16800	8.910404	095	8.911846	537	558	10	.081359	193	685	24	20
41	16860	911949	4.685 091	913401	4.686 544	9.999 548	10	1649	198	661	24	19
42	16920	913488	088	914951	551	537	11	1939	203	637	24	18
43	16980	915022	4.685 084	916495	4.686 557	9.999 527	10	2228	208	614	23	17
44	17040	916550	081	918034	564	516	11	2518	213	590	24	16
45	17100	8.918073	077	8.919568	571	506	10	.082808	218	566	24	15
46	17160	919591	4.685 074	921096	4.686 578	9.999 495	11	3098	222	541	25	14
47	17220	921103	070	922619	585	485	10	3388	227	517	24	13
48	17280	922610	4.685 067	924136	4.686 593	9.999 474	11	3678	232	493	24	12
49	17340	924112	063	925649	600	464	10	3968	237	469	24	11
50	17400	8.925609	060	8.927156	607	453	11	.084258	242	444	25	10
51	17460	927100	4.685 056	928658	4.686 614	9.999 442	11	4547	247	420	24	9
52	17520	928587	4.685 053	930155	621	431	11	4837	251	395	25	8
53	17580	930068	049	931647	628	421	10	5127	256	370	25	7
54	17640	931544	045	933134	635	410	11	5417	261	345	25	6
55	17700	8.933015	042	8.934616	643	399	11	.085707	266	320	25	5
56	17760	634481	4.685 038	936093	4.686 650	9.999 388	11	5997	271	295	25	4
57	17820	935942	4.685 035	937565	657	377	11	6286	276	270	25	3
58	17880	937398	4.685 031	939032	4.686 665	9.999 366	11	6576	280	245	25	2
59	17940	938850	027	940494	672	355	11	6866	285	220	25	1
		L. Cos.		L. Cotan.		L. Sine	D.	N Cos.		N. Sin.	D.	M.

Digitized by Google

M.	N."	L.Sine.	S.—"	L. Tang.	T—"	L.Cos	D.	N. Sine	d."	N. Cos.	d"
0	18000	8.940296	024	8.941952	679	344		.087156	289	195	28
1	18060	941738	020	943404	687	333	11	7445	5	169	1
2	18120	943174	016	944852	694	322	11	7735	10	.996 144	1
3	18180	944606	013	946295	702	311	11	8025	15	118	1
4	18240	946034	4.685 009	947734	709	300	11	8315	19	093	2
5	18300	8.947456	005	8.949168	717	289	11	.088605	24	067	2
6	18360	948874	001	950597	724	277	12	8894	29	.996 041	3
7	18420	950287	998	952021	732	266	11	9184	34	015	3
8	18480	951696	4.684 994	953441	4.686 739	255	11	9474	39	989	4
9	18540	953100	4.990	954856	747	243	12	9763	43	963	4
10	18600	8.954499	986	8.956267	754	232	11	.090053	48	937	5
11	18660	955894	982	957674	762	220	12	0343	53	.995 911	5
12	18720	957284	4.684 979	959075	4.686 770	209	11	0633	58	884	6
13	18780	958670	975	960473	777	197	12	0922	63	858	6
14	18840	960052	971	961866	785	186	11	1212	67	831	7
15	18900	8.961429	967	8.963255	793	174	11	.091502	72	805	7
16	18960	962801	4.684 963	964639	4.686 800	163	11	1791	77	.995 778	8
17	19020	964170	959	966019	808	151	12	2081	82	751	8
18	19080	965534	4.684 955	967394	4.686 816	139	12	2371	87	725	8
19	19140	966893	951	968766	824	128	11	2660	92	698	9
20	19200	8.968249	948	8.970133	832	116	12	.092950	96	671	9
21	19260	969600	944	971496	4.686 840	104	12	3239	101	.995 644	10
22	19320	970947	4.684 940	972855	848	092	12	3529	106	616	10
23	19380	972289	936	974209	4.686 855	080	12	3819	111	589	11
24	19440	973628	932	975560	863	068	12	4108	116	562	11
25	19500	8.974962	928	8.976906	871	056	12	.094398	120	534	12
26	19560	976293	924	978248	4.686 879	044	12	4687	125	.995 507	12
27	19620	977619	4.684 920	979586	887	032	12	4977	130	479	13
28	19680	978941	916	980921	4.686 895	020	12	5267	135	452	13
29	19740	980259	912	982251	904	008	12	5556	140	424	14
30	19800	8.981573	908	8.983577	912	996	12	.095846	145	396	14
31	19860	982883	4.684 904	984899	4.686 920	9.997 984	12	6135	149	.995 368	15
32	19920	984189	900	986217	928	972	12	6425	154	340	15
33	19980	985491	4.684 896	987532	936	959	13	6714	159	312	15
34	20040	986789	891	988842	944	947	12	7004	164	284	16
35	20100	8.988083	887	8.990149	953	935	12	.097293	169	256	16
36	20160	989374	4.684 883	991451	4.686 961	9.997 922	13	7583	173	.995 227	17
37	20220	990660	879	992750	969	910	12	7872	178	199	17
38	20280	991943	4.684 875	994045	977	897	13	8162	183	170	18
39	20340	993222	871	995337	4.686 986	885	12	8451	188	142	18
40	20400	8.994497	867	8.996624	994	872	13	098741	193	113	19
41	20460	995768	4.684 863	997908	4.687 002	9.997 860	13	9030	198	.995 084	19
42	20520	997036	858	999188	011	847	13	9320	202	056	20
43	20580	998299	4.684 854	9.000465	019	835	13	9609	207	027	20
44	20640	999560	850	001738	028	822	13	9899	212	998	21
45	20700	9.000816	846	003007	036	809	13	.100188	217	968	21
46	20760	002069	4.684 842	004272	4.687 045	9.997 797	12	0477	222	.994 939	22
47	20820	003318	837	005534	053	784	13	0767	226	910	22
48	20880	004563	4.684 833	006792	4.687 062	9.997 771	13	1056	231	881	22
49	20940	005805	829	008047	071	758	13	1346	236	851	23
50	21000	9.007044	824	9.009298	079	745	13	.101635	241	822	23
51	21060	008278	4.684 820	010546	4.687 088	9.997 732	13	1924	246	.994 792	24
52	21120	009510	816	011790	096	719	13	2214	251	762	24
53	21180	010737	4.684 811	013031	4.687 105	9.997 706	13	2503	255	733	25
54	21240	011962	807	014268	113	693	13	2792	260	703	25
55	21300	9.013182	803	9.015502	122	680	13	.103082	265	673	26
56	21360	014400	4.684 798	016732	4.687 131	9.997 667	13	3371	270	.994 643	26
57	21420	015613	794	017959	140	654	13	3660	275	613	27
58	21480	016824	4.684 790	019183	4.687 149	9.997 641	13	3950	279	582	27
59	21540	018031	785	020403	158	628	13	4239	284	552	28
M.		Lo.Cos.		L.Cotang		L.Sine	D.	N. Cos.		N.Sine	

Digitized by Google

M.	N.″	L. Sine.	S.—″	L. Tang.	T—″	L. Cos.	D.	N. Sine	d.″	N. Cos.	d.″	M.
0	21600	9.019235	781	9.021620	166	614		.104528	289	522		60
1	21660	020435	776	022834	175	601	13	4818	5	491	33	59
2	21720	021632	772	024044	184	588	13	5107	10	461	.994	58
3	21780	022825	768	025251	193	574	14	5396	15	430	1	57
4	21840	024016	763	026455	202	561	13	5686	19	400	2	56
5	21900	9.025203	759	9.027655	211	547	14	.105975	24	369	2	55
6	21960	026386	754	028852	220	534	13	6264	29	338	3	54
7	22020	027567	750	030046	229	520	14	6553	34	307	.994	53
8	22080	028744	745	031237	238	507	13	6842	39	276	4	52
9	22140	029918	741	032425	247	493	14	7132	43	245	5	51
10	22200	9.031089	736	9.033609	256	480	13	.107421	48	214	6	50
11	22260	032257	732	034791	265	466	14	7710	53	182	6	49
12	22320	033421	727	035969	275	452	14	7999	58	151	7	48
13	22380	034582	722	037144	284	439	13	8288	63	119	.994	47
14	22440	035741	718	038316	293	425	14	8578	67	088	8	46
15	22500	9.036896	713	9.039485	302	411	14	.108867	72	056	8	45
16	22560	038048	709	040651	312	397	14	9156	77	025	9	44
17	22620	039197	704	041813	321	383	14	9445	82	993	9	43
18	22680	040342	699	042973	330	369	14	9734	87	961	10	42
19	22740	041485	695	044130	339	355	14	.110023	92	929	11	41
20	22800	9.042625	690	9.045284	349	341	14	0313	96	897	11	40
21	22860	043762	686	046434	358	327	14	0602	101	865	12	39
22	22920	044895	681	047582	368	313	14	0891	106	833	12	38
23	22980	046026	676	048727	377	299	14	1180	111	800	13	37
24	23040	047154	671	049869	386	285	14	1469	116	768	13	36
25	23100	9.048279	667	9.051008	396	271	14	.111758	120	735	14	35
26	23160	049400	662	052144	405	257	14	2047	125	703	14	34
27	23220	050519	657	053277	415	242	15	2336	130	679	15	33
28	23280	051635	652	054407	425	228	14	2625	135	637	15	32
29	23340	052749	648	055535	434	214	14	2914	140	605	16	31
30	23400	9.053859	643	9.056659	444	199	15	.113203	145	572	17	30
31	23460	054966	638	057781	453	185	14	3492	149	539	17	29
32	23520	056071	633	058900	463	170	15	3781	154	506	18	28
33	23580	057172	629	060016	473	156	14	4070	159	473	18	27
34	23640	058271	624	061130	482	141	15	4359	164	439	19	26
35	23700	9.059367	619	9.062240	492	127	14	.114648	169	406	19	25
36	23760	060460	614	063348	502	112	15	4937	173	373	20	24
37	23820	061551	609	064453	512	098	14	5226	178	339	20	23
38	23880	062639	604	065556	521	083	15	5515	183	306	21	22
39	23940	063724	600	066655	531	068	15	5804	188	272	22	21
40	24000	9.064806	595	9.067752	541	053	15	.116093	193	238	22	20
41	24060	065885	590	068846	551	039	14	6382	198	204	23	19
42	24120	066962	585	069938	561	024	15	6671	202	171	23	18
43	24180	068036	580	071027	571	009	15	6960	207	137	24	17
44	24240	069107	575	072113	581	994	15	7248	212	103	24	16
45	24300	9.070176	570	9.073197	591	979	15	.117537	217	068	25	15
46	24360	071242	565	074278	601	964	15	7826	222	034	25	14
47	24420	072306	560	075356	611	949	15	8115	226	000	26	13
48	24480	073366	555	076432	621	934	15	8404	231	965	26	12
49	24540	074424	550	077505	631	919	15	8693	236	931	27	11
50	24600	9.075480	545	9.078576	641	904	15	.118982	241	896	28	10
51	24660	076533	540	079644	651	889	15	9270	246	862	28	9
52	24720	077583	535	080710	661	874	15	9559	251	827	29	8
53	24780	078631	530	081773	671	858	16	9848	255	792	29	7
54	24840	079676	525	082833	682	843	15	.120137	260	757	30	6
55	24900	9.080719	520	9.083891	692	828	15	0426	265	722	30	5
56	24960	081759	515	084947	702	812	16	0714	270	687	31	4
57	25020	082797	509	086000	712	797	15	1003	275	652	31	3
58	25080	083832	504	087050	723	782	15	1292	279	617	32	2
59	25140	084864	499	088098	733	765	16	1581	284	582	33	1
M.		L. Cosin		L. Cotan		L. Sine	D.	N. Cos.		N. Sine		M.

Digitized by Google

M.	N°."	L. Sine.	S.—"	L.Tang	T—"	L.Cos.	D.	N. Sine.	d."	N. Cos.	d."	M.
0	25200	9.085894	494	9.089144	743	751	16	.121869	289	546	38	60
1	25260	086922	489	090187	754	735	15	2158	5	511	1	59
2	25320	087947	484	091228	764	720	16	2447	10	.992 475	1	58
3	25380	088970	478	092266	774	704	16	2735	15	439	2	57
4	25440	089990	473	093302	785	688		3024	19	404	3	56
5	25500	9.091008	468	9.094336	795	673	15	.123313	24	368	3	55
6	25560	092024	463	095367	806	657	16	3601	29	.992 332	4	54
7	25620	093037	458	096395	816	641	15	3890	34	296	4	53
8	25680	094047	452	097422	827	625	16	4179	39	260	5	52
9	25740	095056	447	098446	837	610	15	4467	43	224	6	51
10	25800	9.096062	442	9.099468	848	594	16	.124756	48	187	6	50
11	25860	097065	437	100487	859	578	16	5045	53	151	7	49
12	25920	098066	431	101504	869	562	16	5333	58	.992 115	8	48
13	25980	099065	426	102519	880	546	16	5622	63	078	8	47
14	26040	100062	421	103532	891	530		5910	67	042	9	46
15	26100	9.101056	415	9.104542	902	514	16	.126199	72	005	10	45
16	26160	102048	410	105550	912	498	16	6487	77	968	10	44
17	26220	103037	405	106556	923	482	16	6776	82	.991 931	11	43
18	26280	104025	399	107559	934	465	17	7065	87	894	11	42
19	26340	105010	394	108560	945	449	16	7353	92	857	12	41
20	26400	9.105992	389	9.109559	956	433	16	.127642	96	820	13	40
21	26460	106973	383	110556	966	417	17	7930	101	783	13	39
22	26520	107951	378	111551	977	400	16	8219	106	.991 746	14	38
23	26580	108927	372	112543	988	384	16	8507	111	709	15	37
24	26640	109901	367	113533	999	368		8796	116	671	15	36
25	26700	9.110873	361	9.114521	010	351	17	.129084	120	634	16	35
26	26760	111842	356	115507	021	335	16	9372	125	596	17	34
27	26820	112809	350	116491	032	318	17	9661	130	.991 558	17	33
28	26880	113774	345	117472	043	302	16	9949	135	521	18	32
29	26940	114737	340	118452	054	285	17	.130238	140	483	18	31
30	27000	9.115698	334	9.119429	065	269	16	0526	145	445	19	30
31	27060	116656	328	120404	077	252	17	0815	149	407	20	29
32	27120	117613	323	121377	088	235	17	1103	154	.991 369	20	28
33	27180	118567	317	122348	099	219	16	1391	159	331	21	27
34	27240	119519	312	123317	110	202	17	1680	164	292	22	26
35	27300	9.120469	306	9.124284	121	185	17	.131968	169	254	22	25
36	27360	121417	301	125249	133	168	17	2256	173	215	23	24
37	27420	122362	295	126211	144	151	17	2545	178	177	23	23
38	27480	123306	289	127172	155	134	17	2833	183	.991 138	24	22
39	27540	124248	284	128130	166	117	17	3121	188	100	25	21
40	27600	9.125187	278	9.129087	178	100	17	.133410	193	061	25	20
41	27660	126125	273	130041	189	083	17	3698	198	022	26	19
42	27720	127060	267	130994	201	066	17	3986	202	.990 983	27	18
43	27780	127993	261	131944	212	049	17	4274	207	944	27	17
44	27840	128925	255	132893	223	032	17	4563	212	905	28	16
45	27900	9.129854	250	9.133839	235	015	17	.134851	217	866	29	15
46	27960	130781	244	134784	246	9.995 998	18	5139	222	827	29	14
47	28020	131706	238	135726	258	980	17	5427	226	.990 787	30	13
48	28080	132630	233	136667	270	963	17	5716	231	748	30	12
49	28140	133551	227	137605	281	946	17	6004	236	708	31	11
50	28200	9.134470	221	9.138542	293	928	18	.136292	241	669	32	10
51	28260	135387	215	139476	304	911	17	6580	246	629	32	9
52	28320	136303	210	140409	316	894	17	6868	251	.990 589	33	8
53	28380	137216	204	141340	328	876	18	7156	255	549	34	7
54	28440	138128	198	142269	339	859	17	7444	260	509	34	6
55	28500	9.139037	192	9.143196	351	841	18	.137733	265	469	35	5
56	28560	139944	186	144121	363	823	18	8021	270	429	36	4
57	28620	140850	181	145044	375	806	17	8309	275	.990 389	36	3
58	28680	141754	175	145966	386	788	18	8597	279	349	37	2
59	28740	142655	169	146885	398	771	17	8885	284	308	37	1
M.		Lo. Cos.		L.Cotan.		L. Sine	D.	N. Cos.		N. Sine		M.

Digitized by Google

I.	N°.″	L. Sine.	S — ″	L. Tang.	T — ″	L. Cos.	D.	N. Sine	d. ″	N Cos	d. ″	M.
0	28800	9.143555	163	9.147803	410	753	18	.139173	287	268	43	60
1	28860	144453	157	148718	422	735	18	9461	5	227	1	59
2	28920	145349	4.684 152	149632	4.688 434	717	18	9749	10	187	1	58
3	28980	146243	145	150544	446	699	18	.140037	14	146	2	57
4	29040	147136	139	151454	458	681	17	0325	19	105	3	56
5	29100	9.148026	133	9.152363	470	664	18	0613	24	065	4	55
6	29160	148915	127	153269	482	646	18	0901	29	024	4	54
7	29220	149802	4.684 121	154174	4.688 494	628	18	1189	34	983	5	53
8	29280	150686	115	155077	506	610	18	1477	38	941	6	52
9	29340	151569	109	155978	518	591	19	1765	43	900	7	51
10	29400	9.152451	103	9.156877	530	573	18	.142053	48	859	7	50
11	29460	153330	4.684 097	157775	4.688 542	555	18	2341	53	818	8	49
12	29520	154208	091	158671	554	537	18	2629	57	776	9	48
13	29580	155083	085	159565	566	519	18	2917	62	735	9	47
14	29640	155957	079	160457	579	501	19	3205	67	693	10	46
15	29700	9.156830	073	9.161347	591	482	18	.143493	72	651	11	45
16	29760	157700	4.684 067	162236	4.688 603	464	18	3780	77	610	12	44
17	29820	158569	061	163123	615	446	19	4068	81	568	12	43
18	29880	159435	4.684 055	164008	4.688 628	427	18	4356	86	526	13	42
19	29940	160301	049	164892	640	409	19	4644	91	484	14	41
20	30000	9.161164	043	9.165774	652	390	18	.144932	96	442	14	40
21	30060	162025	037	166654	4.688 665	372	19	5220	101	399	15	39
22	30120	162885	030	167532	677	353	19	5507	105	357	16	38
23	30180	163743	4.684 024	168409	4.688 690	334	18	5795	110	315	17	37
24	30240	164600	018	169284	702	316	19	6083	115	272	17	36
25	30300	9.165454	012	9.170157	715	297	19	.146371	120	230	18	35
26	30360	166307	006	171029	727	278	18	6658	124	187	19	34
27	30420	167159	4.683 999	171899	4.688 740	260	19	6946	129	144	19	33
28	30480	168008	993	172767	752	241	19	7234	134	102	20	32
29	30540	168856	987	173634	765	222	19	7522	139	059	21	31
30	30600	9.169702	981	9.174499	777	203	19	.147809	144	016	22	30
31	30660	170547	974	175362	790	184	19	8097	148	973	22	29
32	30720	171389	4.683 968	176224	4.688 803	165	19	8385	153	930	23	28
33	30780	172230	962	177084	815	146	19	8672	158	886	24	27
34	30840	173070	956	177942	828	127	19	8960	163	843	24	26
35	30900	9.173908	949	9.178799	841	108	19	.149248	167	800	25	25
36	30960	174744	4.683 943	179655	4.688 854	089	19	9535	172	756	26	24
37	31020	175578	937	180508	866	070	19	9823	177	713	27	23
38	31080	176411	4.683 930	181360	4.688 879	051	19	.150111	182	669	27	22
39	31140	177242	924	182211	892	032	19	0398	187	625	28	21
40	31200	9.178072	918	9.183059	905	013	20	0686	191	582	29	20
41	31260	178900	911	183907	918	993	19	0973	196	538	29	19
42	31320	179726	4.683 905	184752	4.688 931	974	19	1261	201	494	30	18
43	31380	180551	898	185597	944	955	20	1548	206	450	31	17
44	31440	181374	892	186439	957	935	19	1836	211	406	32	16
45	31500	9.182196	885	9.187280	970	916	20	.152123	215	361	32	15
46	31560	183016	4.683 879	188120	4.688 983	896	19	2411	220	317	33	14
47	31620	183834	873	188958	996	877	20	2698	225	273	34	13
48	31680	184651	4.683 866	189794	4.689 009	857	20	2986	230	228	34	12
49	31740	185466	860	190620	022	838	19	3273	234	184	35	11
50	31800	9.186280	853	9.191442	4.689 035	818	20	.153561	239	139	36	10
51	31860	187092	4.683 847	192294	048	798	20	3848	244	094	37	9
52	31920	187903	840	193124	061	779	20	4136	249	050	37	8
53	31980	188712	4.683 834	193953	075	759	20	4423	254	005	38	7
54	32040	189519	827	194780	088	739	20	4710	258	960	39	6
55	32100	9.190325	820	9.195606	101	719	20	.154998	263	915	39	5
56	32160	191130	4.683 814	196430	114	700	20	5285	268	870	40	4
57	32220	191933	807	197253	4.689 128	680	20	5572	273	824	41	3
58	32280	192734	4.683 801	198074	141	660	20	5860	277	779	42	2
59	32340	193534	794	198894	154	640	20	6147	282	734	42	1
I.		L. Cos.		L. Cotan		L. Sine	D.	N. Co.		N. Sin.		M.

Digitized by Google

M.	L.Sine.	D.	L. Tang.	D.	L. Cotan.	L.Cos	D.	N. Sine	d."	N. Cos	d."	M
0	9.194332		9.199713		10.800287	620		.156434	287	688	48	60
1	195129	797	200529	816	799471	9.994 600	20	6722	5	643	1	59
2	195925	796	201345	816	798655	580	20	7009	10	.987 597	2	58
3	196719	794	202159	814	797841	560	20	7296	14	551	2	57
4	197511	792	202971	812	797029	540	20	7584	19	506	3	56
5	9.198302	791	9.203782	811	10.796218	519	21	.157871	24	460	4	55
6	199091	789	204592	810	795408	499	20	8158	29	414	5	54
7	199879	788	205400	808	794600	9.994 479	20	8445	34	.987 368	6	53
8	200666	787	206207	807	793793	459	20	8732	38	322	6	52
9	201451	785	207013	806	792987	438	21	9020	43	275	7	51
10	9.202234	783	9.207817	804	10.792183	418	20	.159307	48	229	8	50
11	203017	783	208619	802	791381	398	20	9594	53	183	9	49
12	203797	780	209420	801	790580	9.994 377	21	9881	57	.987 136	10	48
13	204577	780	210220	800	789780	357	20	.160168	62	090	10	47
14	205354	777	211018	798	788982	336	21	0455	67	043	11	46
15	9.206131	777	9.211815	797	10.788185	316	20	.160743	72	996	12	45
16	206906	775	212611	796	787389	295	21	1030	77	950	13	44
17	207679	773	213405	794	786595	9.994 274	21	1317	81	.986 903	14	43
18	208452	773	214198	793	785802	254	20	1604	86	856	14	42
19	209222	770	214989	791	785011	233	21	1891	91	809	15	41
20	9.209992	770	9.215780	791	10.784220	212	21	.162178	96	761	16	40
21	210760	768	216568	788	783432	191	21	2465	101	714	17	39
22	211526	766	217356	788	782644	9.994 171	20	2752	105	.986 667	18	38
23	212291	765	218142	786	781858	150	21	3039	110	620	18	37
24	213055	764	218926	784	781074	129	21	3326	115	572	19	36
25	9.213818	763	9.219710	784	10.780290	108	21	.163613	120	525	20	35
26	214579	761	220492	782	779508	087	21	3900	124	.986 477	21	34
27	215338	759	221272	780	778728	9.994 066	21	4187	129	429	22	33
28	216097	759	222052	780	777948	045	21	4474	134	381	22	32
29	216854	757	222830	778	777170	024	21	4761	139	334	23	31
30	9.217609	755	9.223607	777	10.776393	003	21	.165048	144	286	24	30
31	218363	754	224382	775	775618	9.993 982	21	5334	148	237	25	29
32	219116	753	225156	774	774844	960	21	5621	153	.986 189	26	28
33	219868	752	225929	773	774071	9.993 939	21	5908	158	141	26	27
34	220618	750	226700	771	773300	918	21	6195	163	093	27	26
35	9.221367	749	9.227471	771	10.772529	897	21	.166482	167	044	28	25
36	222115	748	228239	768	771761	9.993 875	22	6769	172	996	29	24
37	222861	746	229007	768	770993	854	21	7056	177	.985 947	30	23
38	223606	745	229773	766	770227	9.993 832	22	7342	182	899	30	22
39	224349	743	230539	766	769461	811	21	7629	187	850	31	21
40	9.225092	743	9.231302	763	10.768698	789	22	.167916	191	801	32	20
41	225833	741	232065	763	767935	9.993 768	21	8203	196	.985 752	33	19
42	226573	740	232826	761	767174	746	22	8489	201	703	34	18
43	227311	738	233586	760	766414	9.993 725	21	8776	206	654	34	17
44	228048	737	234345	759	765655	703	22	9063	211	605	35	16
45	9.228784	736	9.235103	758	10.764897	681	22	.169349	215	556	36	15
46	229518	734	235859	756	764141	9.993 660	21	9636	220	.985 507	37	14
47	230252	734	236614	755	763386	9.993 638	22	9923	225	457	38	13
48	230984	732	237368	754	762632	9.993 616	22	.170209	230	400	38	12
49	231715	731	238120	752	761880	594	22	0496	234	358	39	11
50	9.232444	729	9.238872	752	10.761128	572	22	.170783	239	309	40	10
51	233172	728	239622	750	760378	9.993 550	22	1069	244	259	41	9
52	233899	727	240371	749	759629	528	22	1356	249	209	42	8
53	234625	726	241118	747	758882	9.993 506	22	1642	254	.985 159	42	7
54	235349	724	241865	747	758135	484	22	1929	258	109	43	6
55	9.236073	724	9.242610	745	10.757390	462	22	.172216	263	059	44	5
56	236795	722	243354	744	756646	9.993 440	22	2502	268	009	45	4
57	237515	720	244097	743	755903	418	22	2789	273	.984 959	46	3
58	238235	720	244839	742	755161	9.993 396	22	3075	277	909	46	2
59	238953	718	245579	740	754421	374	22	3362	282	.858	47	1
M.	Lo Cos.	D.	L.Cotan.	D.	L. Tang.	L.Sine	D.	N. Cos.		N. Sin		M

Digitized by Google

M.	L. Sine.	D.	L. Tang.	D.	L. Cotan.	L. Cos.	D.	N. Sine	d.	N. Cos	d.	M.
0	9.239670	716	9.246319	738	10.753681	351	22	.173648	286	808	53	60
1	240386	715	247057	737	752943	9.993 329	22	3935	5	.984 757	1	59
2	241101	713	247794	736	752206	307	23	4221	10	707	2	58
3	241814	712	248530	734	751470	284	22	4507	14	656	3	57
4	242526	711	249264	734	750736	262	22	4794	19	605	4	56
5	9.243237	710	9.249998	732	10.750002	240	23	.175080	24	554	4	55
6	243947	709	250730	731	749270	9.993 217	22	5367	29	.984 503	5	54
7	244656	707	251461	730	748539	195	23	5653	33	452	6	53
8	245363	706	252191	729	747809	9.993 172	23	5939	38	401	7	52
9	246069	706	252920	728	747080	149	22	6226	43	350	8	51
10	9.246775	703	9.253648	726	10.746352	127	23	.176512	48	298	9	50
11	247478	703	254374	726	745626	104	23	6798	52	.984 247	10	49
12	248181	702	255100	724	744900	9.993 081	22	7085	57	196	11	48
13	248883	700	255824	723	744176	059	23	7371	62	144	12	47
14	249583	699	256547	722	743453	9.993 036	23	7657	67	092	12	46
15	9.250282	698	9.257269	721	10.742731	013	23	.177943	72	041	13	45
16	250980	697	257990	720	742010	9.992 990	23	8230	76	.983 989	14	44
17	251677	696	258710	719	741290	967	23	8516	81	937	15	43
18	252373	694	259429	717	740571	944	23	8802	86	885	16	42
19	253067	694	260146	717	739854	9.992 921	23	9088	91	833	17	41
20	9.253761	692	9.260863	715	10.739137	898	23	.179375	95	781	18	40
21	254453	691	261578	714	738422	9.992 875	23	9661	100	.983 729	19	39
22	255144	690	262292	713	737708	852	23	9947	105	676	19	38
23	255834	689	263005	712	736995	9.992 829	23	.180233	110	.624	20	37
24	256523	688	263717	711	736283	806	23	0519	114	571	21	36
25	9.257211	687	9.264428	710	10.735572	783	23	.180805	119	519	22	35
26	257898	685	265138	709	734862	9.992 759	24	1091	124	.983 466	23	34
27	258583	685	265847	708	734153	736	23	1377	129	414	24	33
28	259268	683	266555	706	733445	9.992 713	25	1663	134	361	25	32
29	259951	682	267261	706	732739	690	23	1949	138	308	26	31
30	9.260633	681	9.267967	704	10.732033	666	24	.182235	143	255	27	30
31	261314	680	268671	704	731329	9.992 643	23	2521	148	.983 202	27	29
32	261994	679	269375	702	730625	619	24	2807	153	149	28	28
33	262673	678	270077	702	729923	9.992 596	23	3093	157	095	29	27
34	263351	676	270779	700	729221	572	24	3379	162	042	30	26
35	9.264027	676	9.271479	699	10.728521	549	23	.183665	167	.982 989	31	25
36	264703	674	272178	698	727822	9.992 525	24	3951	172	935	32	24
37	265377	674	272876	697	727124	501	24	4237	176	882	33	23
38	266051	672	273573	696	726427	9.992 478	23	4523	181	828	34	22
39	266723	672	274269	695	725731	454	24	4809	186	774	35	21
40	9.267395	670	9.274964	694	10.725036	430	24	.185095	191	721	35	20
41	268065	669	275658	693	724342	9.992 406	24	5381	195	.982 667	36	19
42	268734	668	276351	692	723649	382	24	5667	200	613	37	18
43	269402	667	277043	691	722957	9.992 359	23	5952	205	559	38	17
44	270069	666	277734	690	722266	335	24	6238	210	505	39	16
45	9.270735	665	9.278424	689	10.721576	311	24	.186524	215	450	40	15
46	271400	664	279113	688	720887	9.992 287	24	6810	219	.982 396	41	14
47	272064	662	279801	687	720199	263	24	7096	224	342	42	13
48	272726	662	280488	686	719512	9.992 239	24	7381	229	.287	42	12
49	273388	661	281174	684	718826	214	25	7667	234	233	43	11
50	9.274049	659	9.281858	684	10.718141	190	24	.187953	238	178	44	10
51	274708	659	282542	683	717458	9.992 166	24	8238	243	.982 123	45	9
52	275367	658	283225	682	716775	142	24	8524	248	069	46	8
53	276025	656	283907	681	716093	9.992 118	24	8810	253	014	47	7
54	276681	656	284588	680	715412	093	25	9005	257	.981 959	48	6
55	9.277337	654	9.285268	679	10.714732	9.992 069	24	.189381	262	904	49	5
56	277991	654	285947	677	714053	044	25	9667	267	848	50	4
57	278645	652	286624	677	713375	9.991 020	24	9952	272	793	50	3
58	279297	651	287301	676	712699	996	24	.190238	277	738	51	2
59	279948		287977		712022	971	25	0523	281	683	52	1
M.	L. Cosin	D.	L. Cotan	D.	L. Tang.	L. Sine	D.	N. Cos.		N. Sin		M

Digitized by Google

M.	L. Sine.	D.	L. Tang.	D.	L. Cotan.	L. Cos.	D.	N. Sine.	d.	N. Cos.	d.	M.
0	9.280599	649	9.288652	674	10.711348	947	25	.190809	285	627	58	60
1	281248	649	289326	673	710674	9.999 922	25	1094	5	.981 572	1	59
2	281897	647	289999	672	710001	897	24	1380	10	516	2	58
3	282544	646	290671	671	709329	873	25	1666	14	460	3	57
4	283190	646	291342	671	708658	848	25	1951	19	404	4	56
5	9.283836	644	9.292013	669	10.707987	823	25	.192236	24	349	5	55
6	284480	644	292682	668	707318	799	24	2522	29	293	6	54
7	285124	642	293350	667	706650	774	25	2807	33	.981 237	7	53
8	285766	642	294017	667	705983	749	25	3093	38	180	8	52
9	286408	640	294684	665	705316	724	25	3378	43	124	9	51
10	9.287048	640	9.295349	664	10.704651	699	25	.193664	48	068	10	50
11	287688	638	296013	664	703987	9.999 674	25	3949	52	012	11	49
12	288326	638	296677	662	703323	649	25	4234	57	.980 955	12	48
13	288964	636	297339	662	702661	624	25	4520	62	899	13	47
14	289600	636	298001	661	701999	599	25	4805	67	.842	14	46
15	9.290236	634	9.298662	660	10.701338	574	25	.195090	71	785	15	45
16	290870	634	299322	658	700678	9.999 549	25	5376	76	.980 728	16	44
17	291504	633	299980	658	700020	524	26	5661	81	672	16	43
18	292137	631	300638	657	699362	9.998 498	25	5946	86	615	17	42
19	292768	631	301295	656	698705	473	25	6231	90	558	18	41
20	9.293399	630	9.301951	656	10.698049	448	26	.196517	95	500	19	40
21	294029	629	302607	654	697393	9.999 422	25	6802	100	.980 443	20	39
22	294658	628	303261	653	696739	397	25	7087	105	386	21	38
23	295286	627	303914	653	696086	9.998 372	26	7372	109	329	22	37
24	295913	626	304567	651	695433	346	25	7657	114	271	23	36
25	9.296539	625	9.305218	651	10.694782	321	26	.197942	119	214	24	35
26	297164	624	305869	650	694131	9.999 295	25	8228	124	.980 156	25	34
27	297788	624	306519	649	693481	270	26	8513	128	098	26	33
28	298412	622	307168	647	692832	9.998 244	26	8798	133	040	27	32
29	299034	621	307815	648	692185	218	25	9083	138	983	28	31
30	9.299655	621	9.308463	646	10.691537	193	26	.199368	143	925	29	30
31	300276	619	309109	645	690891	9.999 167	26	9653	147	.979 867	30	29
32	300895	619	309754	645	690246	141	26	9938	152	809	31	28
33	301514	618	310399	643	689602	9.998 115	25	.200223	157	750	32	27
34	302132	616	311042	643	688958	090	26	0508	162	692	33	26
35	9.302748	616	9.311685	642	10.688315	9.999 064	26	.200793	166	634	34	25
36	303364	615	312327	641	687673	038	26	1078	171	.979 575	35	24
37	303979	614	312968	640	687032	9.998 012	26	1363	176	517	36	23
38	304593	614	313608	639	686392	986	26	1648	181	458	37	22
39	305207	612	314247	638	685753	960	26	1933	185	399	38	21
40	9.305819	611	9.314885	638	10.685115	9.999 934	26	.202218	190	341	39	20
41	306430	611	315523	636	684477	908	26	2502	195	.979 282	40	19
42	307041	609	316159	636	683841	882	27	2787	200	223	41	18
43	307650	609	316795	635	683205	855	26	3072	204	164	42	17
44	308259	608	317430	634	682570	829	26	3357	209	105	43	16
45	9.308867	607	9.318064	633	10.681936	9.999 803	26	.203642	214	.978 045	44	15
46	309474	606	318697	633	681303	777	27	3926	219	986	45	14
47	310080	605	319330	631	680670	9.998 750	26	4211	223	927	45	13
48	310685	604	319961	631	680039	724	27	4496	228	867	46	12
49	311289	604	320592	630	679408	697	26	4781	233	808	47	11
50	9.311893	602	9.321222	629	10.678778	9.999 671	26	.205065	238	748	48	10
51	312495	602	321851	628	678149	645	27	5350	242	.978 689	49	
52	313097	601	322479	627	677521	9.998 618	27	5635	247	629	50	
53	313698	600	323106	627	676894	591	26	5919	252	569	51	
54	314298	599	323733	625	676267	565	27	6204	257	509	52	
55	9.314897	598	9.324358	625	10.675642	9.999 538	27	.206489	261	449	53	
56	315495	597	324983	624	675017	511	26	6773	266	.978 389	54	
57	316092	597	325607	624	674393	9.998 485	27	7058	271	329	55	
58	316689	595	326231	622	673769	458	27	7343	276	268	56	
59	317284		326853		673147	431	27	7627	280	208	57	
M.	Lo. Cos	D.	L. Cotan	D.	L. Tang	L. Sine	D.	N. Cos.		N. Sine		M

Digitized by Google

M.	L. Sine.	D.	L. Tang.	D.	L. Cotang.	L Cos.	D.	N. Sine	d.	N. Cos	d	M
0	9.317879		9.327474	621	10.672525	404	26	.20791	284	148	62	60
1	318473	594	328095	620	671905	378	27	8196	5	087	1	59
2	319066	593	328715	619	671285	9.990 351	27	8481	10	.978 026	2	58
3	319658	592	329334	619	670666	324	27	8765	14	566	3	57
4	320249	591	329953	617	670047	297	27	9050	19	905	4	56
5	9.320840	591	9.330570	617	10.669430	270	27	.209334	24	844	5	55
6	321430	590	331187	616	668813	243	27	9619	28	.977 783	6	54
7	322019	589	331803	615	668197	9.990 215	28	9903	33	722	7	53
8	322607	588	332418	615	667582	188	27	.210187	38	661	8	52
9	323194	587	333033	613	666967	161	27	0472	43	600	10	51
10	9.323780	586	9.333646	613	10.666354	134	27	.210756	47	539	11	50
11	324366	585	334259	612	665741	107	27	1040	52	477	12	49
12	324950	585	334871	611	665129	9.990 079	28	1325	57	.977 416	13	48
13	325534	584	335482	611	664518	052	27	1609	62	354	14	47
14	326117	583	336093	609	663907	025	27	1893	66	293	15	46
15	9.326700	583	9.336702	609	10.663298	997	28	.212178	71	231	16	45
16	327281	581	337311	608	662689	9.989 970	27	2462	76	169	17	44
17	327862	581	337919	608	662081	942	28	2746	81	.977 107	18	43
18	328442	570	338527	606	661473	915	27	3030	85	046	19	42
19	329021	579	339133	606	660867	887	28	3315	90	984	20	41
20	9.329599	578	9.339739	605	10.660261	860	27	.213599	95	921	21	40
21	330176	577	340344	604	659656	9.989 832	28	3883	99	.976 859	22	39
22	330753	577	340948	604	659052	804	28	4167	104	797	23	38
23	331329	576	341552	603	658448	9.989 777	27	4451	109	735	24	37
24	331903	574	342155	602	657845	749	27	4735	114	672	25	36
25	9.332478	575	9.342757	601	10.657243	721	28	.215019	118	610	26	35
26	333051	573	343358	600	656642	9.989 693	28	5303	123	.976 547	27	34
27	333624	572	343958	600	656042	665	28	5588	128	484	28	33
28	334195	571	344558	599	655442	9.989 637	28	5872	133	.422	29	32
29	334767	572	345157	598	654843	610	27	6156	137	359	30	31
30	9.335337	560	9.345755	598	10.654245	582	28	.216440	142	296	31	30
31	335906	569	346353	596	653647	9.989 553	29	6724	147	233	32	29
32	336475	569	346949	596	653051	525	28	7008	152	.976 170	33	28
33	337043	568	347545	596	652455	9.989 497	28	7291	156	107	34	27
34	337610	567	348141	594	651859	469	28	7575	161	043	35	26
35	9.338176	566	9.348735	594	10.651265	441	28	.217859	166	980	36	25
36	338742	565	349329	593	650671	9.989 413	28	8143	170	917	37	24
37	339307	564	349922	592	650078	385	28	8427	175	.975 853	38	23
38	339871	563	350514	592	649486	9.989 356	28	8711	180	790	39	22
39	340434	562	351106	591	648894	328	29	8995	185	726	40	21
40	9.340996	562	9.351697	590	10.648303	300	28	.219279	189	662	41	20
41	341558	561	352287	589	647713	9.989 271	29	9562	194	.975 598	42	19
42	342119	560	352876	589	647124	243	28	9846	199	534	43	18
43	342679	560	353465	588	646535	9.989 214	29	.220130	204	471	44	17
44	343239	559	354053	587	645947	186	29	0414	208	406	45	16
45	9.343797	558	9.354640	587	10.645360	157	28	.220697	213	342	46	15
46	344355	558	355227	586	644773	9.989 128	29	0981	218	.975 278	47	14
47	344912	557	355813	585	644187	100	29	1265	223	214	48	13
48	345469	557	356398	584	643602	9.989 071	28	1548	227	.149	49	12
49	346024	555	356982	584	643018	042	29	1832	232	085	50	11
50	9.346579	555	9.357566	583	10.642434	014	28	.222116	237	020	51	10
51	347134	555	358149	582	641851	9.988 985	29	2399	241	.974 956	52	9
52	347687	553	358731	582	641269	956	29	2683	246	891	53	8
53	348240	553	359313	580	640687	9.988 927	29	2967	251	.826	54	7
54	348792	552	359893	581	640107	898	29	3250	256	761	55	6
55	9.349343	551	9.360474	579	10.639526	869	29	.223534	260	696	56	5
56	349893	550	361053	579	638947	9.988 840	29	3817	265	.974 631	57	4
57	350443	550	361632	578	638368	811	29	4101	270	566	58	3
58	350992	549	362210	577	637790	9.988 782	29	4384	275	501	59	2
59	351540	548	362787		637213	753	29	4668	279	435	60	1
M	L. Cos.	D.	L. Cotan.	D.	L. Tang	L. Sine	D.	N. Cos.		N. Sine		M

Digitized by Google

M.	L. Sine.	D.	L Tang.	D.	L. Cotan.	L. Cos	D.	N. Sine	d."	N. Cos	d."	M.
0	9.352088		9.363364		10.636636	724		.224951	283	4370	68	60
1	352635	547	363940	576	636060	695	29	5234	5	4305	1	59
2	353181	546	364515	575	635485	666	29	5518	9	4239	2	58
3	353726	545	365090	575	634910	636	30	5801	14	4173	3	57
4	354271	545	365664	574	634336	607	29	6085	19	4108	5	56
5	9.354815	544	9.366237	573	10.633763	578	29	.226368	24	4042	6	55
6	355358	543	366810	573	633190	548	30	6651	28	3976	7	54
7	355901	543	367382	572	632618	519	29	6935	33	3910	8	53
8	356443	542	367953	571	632047	489	30	7218	38	3844	9	52
9	356984	541	368524	571	631476	460	29	7501	43	3778	10	51
10	9.357524	540	9.369094	570	10 630906	430	30	.227784	47	3712	11	50
11	358064	540	369663	569	630337	401	29	8068	52	3645	13	49
12	358603	539	370231	568	629769	371	30	8351	57	3579	14	48
13	359141	538	370799	568	629201	342	29	8634	61	3512	15	47
14	359678	537	371367	568	628633	312	30	8917	66	3446	16	46
15	9.360215	537	9.371933	566	10.628067	282	30	.229200	71	3379	17	45
16	360752	537	372499	566	627501	252	30	9483	76	3312	18	44
17	361287	535	373064	565	626936	223	29	9767	80	3246	19	43
18	361822	535	373629	565	626371	193	30	.230050	85	3179	20	42
19	362356	534	374193	564	625807	163	30	0333	90	3112	22	41
20	9.362889	533	9.374756	563	10.625244	133	30	.230616	94	3045	23	40
21	363422	533	375319	563	624681	103	30	0899	99	2978	24	39
22	363954	532	375881	562	624119	073	30	1182	104	2910	25	38
23	364485	531	376442	561	623558	043	30	1465	109	2843	26	37
24	365016	531	377003	561	622997	013	30	1748	113	2776	27	36
25	9.365546	530	9.377563	560	10.622437	983	30	.232031	118	2708	28	35
26	366075	529	378122	559	621878	953	30	2314	123	2641	30	34
27	366604	529	378681	559	621319	922	31	2597	127	2573	31	33
28	367132	528	379239	558	620761	892	30	2880	132	2506	32	32
29	367659	527	379797	558	620203	862	30	3162	137	2438	33	31
30	9.368185	526	9.380354	557	10.619646	832	30	.233445	142	2370	34	30
31	368711	526	380910	556	619090	801	31	3728	146	2302	35	29
32	369236	525	381466	556	618534	771	30	4011	151	2234	36	28
33	369761	525	382021	555	617979	740	31	4294	156	2166	37	27
34	370285	524	382575	554	617425	710	30	4577	160	2098	39	26
35	9.370808	523	9.383129	554	10.616871	679	31	.234859	165	2029	40	25
36	371330	522	383682	553	616318	649	30	5142	170	1961	41	24
37	371852	522	384234	552	615766	618	31	5425	175	1893	42	23
38	372373	521	384786	552	615214	588	30	5707	179	1824	43	22
39	372894	521	385337	551	614663	557	31	5990	184	1755	44	21
40	9.373414	520	9.385888	551	10.614112	526	31	.236273	189	1687	45	20
41	373933	519	386438	550	613562	496	30	6555	193	1618	47	19
42	374452	519	386987	549	613013	465	31	6838	198	1549	48	18
43	374970	518	387536	549	612464	434	31	7121	203	1480	49	17
44	375487	517	388084	548	611916	403	31	7403	208	1411	50	16
45	9.376003	516	9.388631	547	10.611369	372	31	.237686	212	1342	51	15
46	376519	516	389178	547	610822	341	31	7968	217	1273	52	14
47	377035	516	389724	546	610276	310	31	8251	222	1204	53	13
48	377549	514	390270	546	609730	279	31	8533	226	1134	54	12
49	378063	514	390815	545	609185	248	31	8816	231	1065	56	11
50	9.378577	514	9.391360	545	10.608640	217	31	.239098	236	0995	57	10
51	379089	512	391903	543	608097	186	31	9381	241	0926	58	9
52	379601	512	392447	544	607553	155	31	9663	245	0856	59	8
53	380113	512	392989	542	607011	124	31	9946	250	0786	60	7
54	380624	511	393531	542	606469	092	32	.240228	255	0716	61	6
55	9.381134	510	9.394073	542	10.605927	061	31	.240510	259	0647	62	5
56	381643	509	394614	541	605386	030	31	0793	264	0577	64	4
57	382152	509	395154	540	604846	998	32	1075	269	0506	65	3
58	382661	509	395694	540	604306	967	31	1357	274	0436	66	2
59	383168	507	396233	539	603767	936	31	1640	278	0366	67	1
M.	Lo Cos.	D.	L.Cotan.	D.	L Tang.	L.Sine	D.	N. Cos.		N. Sin.		M.

Digitized by Google

M.	L. Sine.	D.	L. Tang.	D.	L. Cotang.	L. Cos.	D.	N. Sine	d. "	N. Cos.	d "	M
0	9 383675		9·396771		10.603229	904		.241922	282	0296	72	60
1	384182	507	397309	538	602691	9.986 873	31	2204	5	0225	1	59
2	384687	505	397846	537	602154	841	32	2486	9	.97 0155	2	58
3	385192	505	398383	537	601617	809	32	2768	14	0084	4	57
4	385697	505	398919	536	601081	778	31	3051	19	0014	5	56
5	9·386201	504	9·399455	536	10.600545	746	32	.243333	24	9943	6	55
6	386704	503	399990	535	600010	9.986 714	32	3615	28	9872	7	54
7	387207	503	400524	534	599476	683	31	3897	33	.96 9801	8	53
8	387709	502	401058	534	598942	651	32	4179	38	9730	10	52
9	388210	501	401591	533	598409	619	31	4461	42	9659	11	51
10	9·388711	501	9·402124	533	10.597876	587	32	.244743	47	9588	12	50
11	389211	500	402656	532	597344	9.986 555	32	5025	52	9517	13	49
12	389711	500	403187	531	596813	523	32	5307	56	.96 9445	14	48
13	390210	499	403718	531	596282	491	32	5589	61	9374	16	47
14	390708	498	404249	531	595751	459	32	5871	66	9302	17	46
15	9·391206	498	9·404778	529	10.595222	427	32	.246153	71	9231	18	45
16	391703	497	405308	530	594692	9.986 395	32	6435	75	9159	19	44
17	392199	496	405836	528	594164	363	32	6717	80	.96 9087	20	43
18	392695	496	406364	528	593636	331	32	6999	85	9016	21	42
19	393191	496	406892	528	593108	299	32	7281	89	8944	23	41
20	9·393685	494	9·407419	527	10.592581	266	33	.247563	94	8872	24	40
21	394179	494	407945	526	592055	9.986 234	32	7844	99	8800	25	39
22	394673	494	408471	526	591529	202	32	8126	103	.96 8728	26	38
23	395166	493	408996	525	591004	169	33	8408	108	8655	28	37
24	395658	492	409521	525	590479	137	32	8690	113	8583	29	36
25	9·396150	492	9·410045	524	10.589955	104	33	.248972	118	8511	30	35
26	396641	491	410569	524	589431	9.986 072	32	9253	122	8438	31	34
27	397132	491	411092	523	588908	039	33	9535	127	.96 8366	32	33
28	397622	490	411615	523	588385	007	32	9817	132	8293	34	32
29	398111	489	412137	522	587863	974	33	·250098	136	8220	35	31
30	9·398600	489	9·412658	521	10.587342	942	32	.250380	141	8148	36	30
31	399088	488	413179	521	586821	9.985 909	33	0662	146	8075	37	29
32	399575	487	413699	520	586301	876	33	0943	150	.96 8002	38	28
33	400062	487	414219	520	585781	843	33	1225	155	7929	40	27
34	400549	487	414738	519	585262	811	32	1506	160	7856	41	26
35	9·401035	486	9·415257	519	10.584743	778	33	.251788	165	7782	42	25
36	401520	485	415775	518	584225	9.985 745	33	2069	169	7709	43	24
37	402005	485	416293	518	583707	712	33	2351	174	.96 7636	44	23
38	402489	484	416810	517	583190	679	33	2632	179	7562	46	22
39	402972	483	417326	516	582674	646	33	2914	183	7489	47	21
40	9·403455	483	9·417842	516	10.582158	613	33	.253195	188	7415	48	20
41	403938	483	418358	516	581642	9.985 580	33	3477	193	7341	49	19
42	404420	482	418873	515	581127	547	33	3758	197	.96 7268	50	18
43	404901	481	419387	514	580613	514	33	4039	202	7194	52	17
44	405382	481	419901	514	580099	480	34	4321	207	7120	53	16
45	9·405862	480	9·420415	512	10.579585	447	33	.254602	212	7046	54	15
46	406341	479	420927	513	579073	9.985 414	33	4883	216	6972	55	14
47	406820	479	421440	512	578560	381	33	5164	221	.96 6898	56	13
48	407299	479	421952	511	578048	347	34	5446	226	6823	58	12
49	407777	478	422463		577537	314	33	5727	230	6749	59	11
50	9·408254	477	9·422974	511	10.577026	280	34	.256008	235	6675	60	10
51	408731	477	423484	510	576516	9.985 247	33	6289	240	6600	61	9
52	409207	476	423993	509	576007	213	34	6570	244	.96 6525	62	8
53	409682	475	424503	510	575497	180	33	6852	249	6451	64	7
54	410157	475	425011	508	574989	146	34	7133	254	6376	65	6
55	9·410632	475	9·425519	508	10.574481	5113	33	.257414	259	6301	66	5
56	411106	474	426027	507	573973	9.98 5079	34	7695	263	6226	67	4
57	411579	473	426534	507	573466	5045	34	7976	268	.96 6151	68	3
58	412052	473	427041	506	572959	5011	34	8257	273	6076	70	2
59	412524	472	427547		572453	4978	33	8538	277	6001	71	1
M.	L. Cos.	D.	L. Cotan.	D.	L. Tang.	L. Sine	D.	N. Cos.		N. Sin.		M

Digitized by Google

M.	L. Sine.	D.	L.Tang.	D.	L. Cotan	L.Cos.	D	N.Sine.	d.'	N.Cos.	d.'	M
0	9.412096		9.428052		10.571948	944	34	.258819	280	5926	78	0
1	413467	471	428558	506	571442	9.984 910	34	9100	5	5850	1	5
2	413938	471	429062	504	570938	876	34	9381	9	.96 5775	3	5
3	414408	470	429566	504	570434	842	34	9662	14	5700	4	5
4	414878	470	430070	504	569930	808	34	9943	19	5624	5	5
5	9.415347	469	9.430573	503	10.569427	774	34	.260224	23	5548	7	5
6	415815	468	431075	502	568925	9.984 740	34	0504	28	5473	8	5
7	416283	468	431577	502	568423	706	34	0785	33	.96 5397	9	5
8	416751	468	432079	502	567921	672	34	1066	37	5321	10	5
9	417217	466	432580	501	567420	638	34	1347	42	5245	12	5
10	9.417684	467	9.433080	500	10.566920	603	35	.261628	47	5169	13	5
11	418150	466	433580	500	566420	9.984 569	34	1908	51	5093	14	4
12	418615	465	434080	500	565920	535	34	2189	56	.96 5016	16	4
13	419079	464	434579	499	565421	9.984 500	35	2470	61	4940	17	4
14	419544	465	435078	499	564922	466	34	2751	65	4864	18	4
15	9.420007	463	9.435576	498	10.564424	432	34	.263031	70	4787	20	4
16	420470	463	436073	497	563927	9.984 397	35	3312	75	4711	21	4
17	420933	463	436570	497	563430	363	34	3592	79	.96 4634	22	4
18	421395	462	437067	497	562933	9.984 328	35	3873	84	4557	23	4
19	421857	462	437563	496	562437	294	34	4154	89	4481	25	4
20	9.422318	461	9.438059	496	10.561941	259	35	.264434	93	4404	26	4
21	422778	460	438554	495	561446	9.984 224	35	4715	98	4327	27	3
22	423238	460	439048	494	560952	190	34	4995	103	.96 4250	29	3
23	423697	459	439543	495	560457	9 155	35	5276	107	4173	30	3
24	424156	459	440036	493	559964	120	35	5556	112	4095	31	3
25	9.424615	459	9.440529	493	10.559471	9.984 085	35	.265837	117	4018	33	3
26	425073	458	441022	493	558978	050	35	6117	121	3941	34	3
27	425530	457	441514	492	558486	9.983 015	35	6397	126	.96 3863	35	3
28	425987	457	442006	492	557994	981	34	6678	131	3786	36	3
29	426443	456	442497	491	557503	946	35	6958	135	3708	38	3
30	9.426899	456	9.442988	491	10.557012	911	35	.267238	140	3630	39	3
31	427354	455	443479	491	556521	9.983 875	36	7519	145	3553	40	2
32	427809	455	443969	490	556031	840	35	7799	149	.96 3475	42	2
33	428263	454	444458	489	555542	805	35	8079	154	3397	43	2
34	428717	454	444947	489	555053	770	35	8359	159	3319	44	2
35	9.429170	453	9.445435	488	10.554565	735	35	.268640	163	3241	46	2
36	429623	453	445923	488	554077	9.983 700	35	8920	168	3163	47	2
37	430075	452	446411	488	553589	664	36	9200	173	.96 3084	48	2
38	430527	452	446898	487	553102	9.983 629	35	9480	177	3006	49	2
39	430978	451	447384	486	552616	594	35	9760	182	2927	51	2
40	9.431429	451	9.447870	486	10.552130	558	36	.270040	187	2849	52	2
41	431879	450	448356	486	551644	9.983 523	35	0320	191	2770	53	1
42	432329	450	448841	485	551159	487	35	0600	196	.96 2692	55	1
43	432778	449	449326	485	550674	9.983 452	35	0880	201	2613	56	1
44	433226	448	449810	484	550190	416	36	1160	205	2534	57	1
45	9.433675	449	9.450294	484	10.549706	381	35	.271440	210	2455	59	1
46	434122	447	450777	483	549223	9.983 345	36	1720	215	2376	60	1
47	434569	447	451260	483	548740	309	36	2000	219	.96 2297	61	1
48	435016	447	451743	483	548257	9.983 273	36	2280	224	2218	62	1
49	435462	446	452225	482	547775	238	35	2560	229	2139	64	1
50	9.435908	446	9.452706	481	10.547294	202	36	.272840	233	2059	65	1
51	436353	445	453187	481	546813	9.983 166	36	3120	238	1980	66	9
52	436798	444	453668	481	546332	130	36	3400	243	.96 1900	68	8
53	437242	444	454148	480	545852	9.983 094	36	3679	247	1821	69	7
54	437686	443	454628	480	545372	058	36	3959	252	1741	70	6
55	9.438129	443	9.455107	479	10.544893	022	36	.274239	257	1662	72	5
56	438572	442	455586	479	544414	9.982 986	36	4519	261	1582	73	4
57	439014	442	456064	478	543936	950	36	4798	266	.96 1502	74	3
58	439456	441	456542	478	543458	914	36	5078	271	1422	75	2
59	439897		457019	477	542981	878	36	5358	275	1342	77	1
M.	Lo. Cos	D.	L.Cotan	D.	L.Tang	L.Sine	D.	N. Cos.		N.Sine		M.

Digitized by Google

M.	L. Sine.	D.	L.Tang	D.	L.Cotan	L.Cos.	D.	N. Sine	d.″	N Cos	d ″	M
0	9.440335		7496		2504	842		.275637	279	1262	82	60
1	440778	440	7973	477	2027	805	37	5917	5	1181	1	59
2	441218	440	8449	476	1551	769	36	6196	9	1101	3	58
3	441658	440	8925	476	1075	733	36	6476	14	1021	4	57
4	442097	439	9400	475	0600	696	37	6756	19	0940	6	56
5	9.442535	438	9875	475	0125	660	36	.277035	23	0860	7	55
6	442973	438	0349	474	9651	624	36	7315	28	0779	8	54
7	443410	437	0823	474	9177	587	37	7594	33	0698	10	53
8	443847	437	1297	474	8703	551	36	7874	37	0618	11	52
9	444284	437	1770	473	8230	514	37	8153	42	0537	12	51
10	9.444720	436	2242	472	7758	477	37	.278432	47	0456	14	50
11	445155	435	2714	472	7286	441	36	8712	51	0375	15	49
12	445590	435	3186	472	6814	404	37	8991	56	0294	16	48
13	446025	485	3658	472	6342	367	37	9270	61	0212	18	47
14	446459	434	4129	471	5871	331	36	9550	65	0131	19	46
15	9.446893	434	4599	470	5401	294	37	.279829	70	0050	21	45
16	447326	433	5069	470	4931	257	37	.280108	74	9968	22	44
17	447759	433	5539	470	4461	220	37	0387	79	9887	23	43
18	448191	432	6008	469	3992	183	37	0667	84	9805	25	42
19	448623	432	6477	469	3523	146	37	0946	88	9724	26	41
20	9.449054	431	6945	468	3055	109	37	.281225	93	9642	27	40
21	449485	431	7413	468	2587	072	37	1504	98	9560	29	39
22	449915	430	7880	467	2120	035	37	1783	102	9478	30	38
23	450345	430	8347	467	1653	998	37	2062	107	9396	31	37
24	450775	430	8814	467	1186	961	37	2341	112	9314	33	36
25	9.451204	429	9280	466	0720	924	37	.282620	116	9232	34	35
26	451632	428	9746	466	0254	886	38	2899	121	9150	36	34
27	452060	428	0211	465	9789	849	37	3178	126	9067	37	33
28	452488	428	0676	465	9324	812	37	3457	130	8985	38	32
29	452915	427	1141	465	8859	774	38	3736	135	8902	40	31
30	9.453342	427	1605	464	8395	737	37	.284015	140	8820	41	30
31	453768	426	2069	464	7931	700	37	4294	144	8737	42	29
32	454194	426	2532	463	7468	662	38	4573	149	8654	44	28
33	454619	425	2995	463	7005	625	37	4852	154	8571	45	27
34	455044	425	3457	462	6543	587	38	5131	158	8489	47	26
35	9.455469	425	3919	462	6081	549	38	.285410	163	8406	48	25
36	455893	424	4381	462	5619	512	37	5688	167	8323	49	24
37	456316	423	4842	461	5158	474	38	5967	172	8239	51	23
38	456739	423	5303	461	4697	436	38	6246	177	8156	52	22
39	457162	423	5763	460	4237	399	37	6525	181	8073	53	21
40	9.457584	422	6223	460	3777	361	38	.286803	186	7989	55	20
41	458006	422	6683	460	3317	323	38	7082	191	7906	56	19
42	458427	421	7142	459	2858	285	38	7360	195	7822	57	18
43	458848	421	7601	459	2399	247	38	7639	200	7739	59	17
44	459268	420	8059	458	1941	209	38	7918	205	7655	60	16
45	9.459688	420	8517	458	1483	171	38	.288196	209	7571	62	15
46	460108	420	8975	458	1025	133	38	8475	214	7487	63	14
47	460527	419	9432	457	0568	095	38	8753	219	7403	64	13
48	460946	419	9889	457	0111	057	38	9032	223	7319	66	12
49	461364	418	0345	456	9655	019	38	9310	228	7235	67	11
50	9.461782	418	0801	456	9199	981	38	.289589	233	7151	68	10
51	462199	417	1257	455	8743	942	39	9867	237	7067	70	9
52	462616	417	1712	455	8288	904	38	.290145	242	6982	71	8
53	463032	416	2167	454	7833	866	38	0424	247	6898	72	7
54	463448	416	2621	454	7379	827	39	0702	251	6814	74	6
55	9.463864	415	3075	454	6925	789	38	.290980	256	6729	75	5
56	464279	415	3528	454	6471	750	39	1259	260	6644	77	4
57	464694	415	3982	453	6018	712	38	1537	265	6559	78	3
58	465108	414	4435	453	5565	673	39	1815	270	6475	79	2
59	465522	414	4887	452	5113	635	38	2093	274	6390	81	1
M.	L.Cosin	D.	L.Cotan	D.	L. Tang.	L.Sine	D.	N. Cos.		N.Sin.		M.

Digitized by Google

M.	L. Sine.	D.	L. Tang	D.	L. Cotan	L. Cos.	D.	N. Sine	d."	N. Cos.	d'
0	9.465935		9.485339		14661			.292372	278	.956305	87
1	466348	413	485791	452	14209	596	38	2650	5	6220	2
2	466761	413	486242	451	13758	9.980 558	39	2928	9	6134	3
3	467173	412	486693	451	13307	519	39	3206	14	6049	4
4	467585	412	487143	450	12857	480	38	3484	19	5964	6
5	9.467996	411	9.487593	450	12407	442		.293762	23	.955878	7
6	468407	411	488043	450	11957	403	39	4040	28	5793	9
7	468817	410	488492	449	11508	9.980 364	39	4318	32	5707	10
8	469227	410	488941	449	11059	325	39	4596	37	5622	12
9	469637	410	489390	449	10610	286	39	4874	42	5536	13
10	9.470046	409	9.489838	448	10162	247	39	.295152	46	.955450	15
11	470455	409	490286	448	09714	208	39	5430	51	5364	16
12	470863	409	490733	447	09267	169	39	5708	56	5278	17
13	471271	408	491180	447	08820	9.980 130	39	5986	60	5192	19
14	471679	408	491627	447	08373	091	39	6264	65	5106	20
15	9.472086	407	9.492073	446	07927	052	40	.296542	70	.955020	22
16	472492	406	492519	446	07481	012	39	6819	74	4934	23
17	472898	406	492965	446	07035	973	39	7097	79	4847	25
18	473304	406	493410	445	06590	9.979 934	39	7375	83	4761	26
19	473710	406	493854	444	06146	895	40	7653	88	4674	28
20	9.474115	405	9.494299	445	05701	855	39	.297930	93	.954588	29
21	474519	404	494743	444	05257	816	40	8208	97	4501	31
22	474923	404	495186	443	04814	776	39	8486	102	4414	32
23	475327	404	495630	444	04370	9.979 737	40	8763	107	4327	33
24	475730	403	496073	443	03927	697	39	9041	111	4240	35
25	9.476133	403	9.496515	442	03485	658	40	.299318	116	.954153	36
26	476536	403	496957	442	03043	618	39	9596	121	4066	38
27	476938	402	497399	442	02601	579	40	9873	125	3979	39
28	477340	402	497841	441	02159	9.979 539	40	.300151	130	3892	41
29	477741	401	498282	440	01718	499	40	0428	134	3804	42
30	9.478142	401	.9498722	441	01278	459	39	.300706	139	.953717	44
31	478542	400	499163	440	00837	420	40	0983	144	3629	45
32	478942	400	499603	439	00397	9.979 380	40	1261	148	3542	46
33	479342	400	500042	439	99958	340	40	1538	153	3454	48
34	479741	399	500481	439	99519	300	40	1815	158	3366	49
35	9.480140	399	9.500920	439	99080	260	40	.302093	162	.953279	51
36	480539	399	501359	438	98641	220	40	2370	167	3191	52
37	480937	398	501797	438	98203	180	40	2647	171	3103	54
38	481334	397	502235	437	97765	9.979 140	40	2924	176	3015	55
39	481731	397	502672	437	97328	100	41	3202	181	2926	57
40	9.482128	397	9.503109	437	96891	059	40	.303479	185	.952838	58
41	482525	397	503546	436	96454	019	40	3756	190	2750	60
42	482921	396	503982	436	96018	9.978 979	40	4033	195	2661	61
43	483316	395	504418	436	95582	939	41	4310	199	2573	62
44	483712	396	504854	435	95146	898	40	4587	204	2484	64
45	9.484107	395	9.505289	435	94711	858	41	.304864	209	.952396	65
46	484501	394	505724	435	94276	817	40	5141	213	2307	67
47	484895	394	506159	434	93841	9.978 777	40	5418	218	2218	68
48	485289	394	506593	434	93407	737	41	5695	222	2129	70
49	485682	393	507027	433	92973	696	41	5972	227	2040	71
50	9.486075	393	9.507460	433	92540	655	40	.306249	232	.951951	73
51	486467	392	507893	433	92107	615	41	6526	236	1862	74
52	486860	393	508326	435	91674	9 978 574	41	6803	241	1773	75
53	487251	391	508759	432	91241	533	40	7080	246	1684	77
54	487643	392	509191	431	90809	493	41	7357	250	1594	78
55	9.488034	391	.9509622	432	90378	452	41	.307633	255	.951505	80
56	488424	390	510054	431	89946	411	41	7910	260	1415	81
57	488814	390	510485	431	89515	9.978 370	41	8187	264	1326	83
58	489204	390	510916	430	89084	329	41	8464	269	1236	84
59	489593	389	511346		88654	288	41	8740	273	1146	86
M.	L. Cos.	D.	L. Cotan.	D.	L. Tang.	L. Sine	D.	N. Cos.		N. Sin.	

Digitized by Google

M.	L. Sine.	D.	L. Tang.	D.	L. Cotan.	L. Cos	D.	N. Sine	d.	N. Cos.	d.	M.
0	·9489982		·9511776		86224			·309017		·951056		60
1	490371	389	512206	430	87794	206	41	9294	276	0967	92	59
2	490759	388	512635	429	87365	165	41	9570	5	0877	2	58
3	491147	388	513064	429	86936	124	41	9847	9	0786	3	57
4	491535	388	513493	429	86507	083	41	·310123	14	0696	5	56
5	·9491922	387	·9513921	428	86079	042	41	·310400	18	·950606	6	55
6	492308	386	514349	428	85651	001	42	0676	23	0516	8	54
7	492695	387	514777	428	85223	959	41	0953	28	0425	9	53
8	493081	386	515204	427	84796	918	41	1229	32	0335	11	52
9	493466	385	515631	427	84369	877	42	1506	37	0244	12	51
10	·9493851	385	·9516057	426	83943	835	41	·311782	41	·950154	14	50
11	494236	385	516484	427	83516	794	42	2059	46	0063	15	49
12	494621	385	516910	426	83090	752	42	2335	51	·949972	17	48
13	495005	384	517335	425	82665	711	41	2611	55	9881	18	47
14	495388	383	517761	426	82239	669	42	2887	60	9790	20	46
15	·9495772	384	·9518186	425	81814	628	41	·313164	64	·949699	22	45
16	496154	382	518610	424	81390	586	42	3440	69	9608	23	44
17	496537	383	519034	424	80966	544	42	3716	74	9517	25	43
18	496919	382	519458	424	80542	503	42	3992	78	9425	26	43
19	497301	382	519882	424	80118	461	42	4269	83	9334	28	42
20	·9497682	381	·9520305	423	79695	419	42	·314545	87	·949243	29	41
21	498064	382	520728	423	79272	377	42	4821	92	9151	31	40
22	498444	380	521151	423	78849	335	42	5097	97	9059	32	39
23	498825	381	521573	422	78427	293	42	5373	101	8968	34	38
24	499204	379	521995	422	78005	251	42	5649	106	8876	35	37
25	·9499584	380	·9522417	422	77583	209	42	·315725	110	·948784	37	36
26	499963	379	522838	421	77162	167	42	6201	115	8692	38	35
27	500342	379	523259	421	76741	125	42	6477	120	8600	40	34
28	500721	379	523680	421	76320	083	42	6753	124	8508	41	33
29	501099	378	524100	420	75900	041	42	7029	129	8416	43	32
30	·9501476	377	·9524520	420	75480	999	42	·317305	133	·948324	45	31
31	501854	378	524940	420	75060	957	42	7580	138	8231	46	30
32	502231	377	525359	419	74641	914	43	7856	143	8139	48	29
33	502607	376	525778	419	74222	872	42	8132	147	8046	49	28
34	502984	377	526197	419	73803	830	42	8408	152	7954	51	27
35	·9503360	376	·9526615	418	73385	787	43	·318684	156	·947861	52	26
36	503735	375	527033	418	72967	745	42	8959	161	7768	54	25
37	504110	375	527451	418	72549	702	43	9235	166	7676	55	24
38	504485	375	527868	417	72132	660	42	9511	170	7583	57	23
39	504860	375	528285	417	71715	617	43	9786	175	7490	58	22
40	·9505234	374	·9528702	417	71298	574	43	·320062	179	·947397	60	21
41	505608	374	529119	417	70881	532	43	0337	184	7303	61	20
42	505981	373	529535	415	70465	489	43	0613	189	7210	63	19
43	506354	373	529951	416	70049	446	42	0888	193	7117	64	18
44	506727	373	530366	415	69634	404	43	1164	198	7024	66	17
45	·9507099	372	·9530781	415	69219	361	43	·321439	202	·946930	68	16
46	507471	372	531196	415	68804	318	43	1715	207	6837	69	15
47	507843	372	531611	414	68389	275	43	1990	212	6743	71	14
48	508214	372	532025	414	67975	232	43	2266	216	6649	72	13
49	508585	371	532432	414	67561	189	43	2541	221	6555	74	12
50	·9508956	371	·9532853	414	67147	146	43	·322816	225	·946462	75	11
51	509326	370	533266	413	66734	103	43	3092	230	6368	77	10
52	509696	370	533679	413	66321	060	43	3367	235	6274	78	9
53	510065	369	534092	413	65908	017	43	3642	239	6179	80	8
54	510434	369	534504	412	65496	974	44	3917	244	6085	81	7
55	·9510803	369	·9534916	412	65084	930	43	·324193	248	·945991	83	6
56	511172	368	535328	412	64672	887	43	4468	253	5897	84	5
57	511540	368	535739	411	64261	844	44	4743	258	5802	86	4
58	511907	367	536150	411	63850	800	43	5018	262	5708	87	3
59	512275	368	536561	411	63439	757	43	5293	267	5613	89	2
						714			271		91	1
M.	L. Cos.	D.	L. Cotan.	D.	L. Tang.	L. Sine	D.	N. Cos.		N. Sine		M.

Digitized by Google

M.	L.Sine.	D.	L.Tang.	D.	L.Cotan.	L Cos.	D.	N.Sine.	d	N. Cos.	d
●	9 5120420	367	9.536972	410	63028	670	43	.325568	274	.945519	98
1	513009	366	537382	410	62618	627	44	5843	5	5424	2
2	513375	366	537792	410	62208	583	44	6118	9	5329	3
3	513741	366	538202	409	61798	539	43	6393	14	5234	5
4	514107	365	538611	409	61389	496	44	6668	18	5139	7
5	9.514472	365	9.539020	409	60980	452	44	.326943	23	.945044	8
6	514837	365	539429	408	60571	408	43	7218	27	4949	10
7	515202	364	539837	408	60163	365	44	7493	32	4854	11
8	515566	364	540245	408	59755	321	44	7768	37	4758	13
9	515930	364	540653	408	59347	277	44	8042	41	4663	15
10	9.516294	363	9.541061	407	58939	233	44	.328317	46	.944567	16
11	516657	363	541468	407	58532	189	44	8592	50	4472	18
12	517020	362	541875	406	58125	145	44	8867	55	4376	20
13	517382	363	542281	407	57719	101	44	9141	59	4281	21
14	517745	362	542688	406	57312	057	44	9416	64	4185	23
15	9.518107	361	9.543094	405	56906	013	44	.329691	69	.944089	25
16	518468	361	543499	406	56501	969	44	9965	73	3993	26
17	518829	361	543905	405	56095	925	45	.330240	78	3897	28
18	519190	361	544310	405	55690	880	44	0514	82	3801	29
19	519551	360	544715	404	55285	836	44	0789	87	3705	31
20	9.519911	360	9.545119	405	54881	792	44	.331063	91	.943608	33
21	520271	360	545524	404	54476	748	44	1338	96	3512	34
22	520631	359	545928	403	54072	703	45	1612	101	3416	36
23	520990	359	546331	404	53669	659	44	1887	105	3319	38
24	521349	358	546735	403	53265	614	45	2161	110	3223	39
25	9.521707	359	9.547138	402	52862	570	44	.332435	114	.943126	41
26	522066	358	547540	403	52460	525	45	2710	119	3029	43
27	522424	357	547943	402	52057	481	44	2984	123	2932	44
28	522781	357	548345	402	51655	436	45	3258	128	2835	46
29	523138	357	548747	402	51253	391	45	3533	132	2739	47
30	9.523495	357	9.549149	401	50851	347	44	.333807	137	.942641	49
31	523852	356	549550	401	50450	302	45	4081	142	2544	51
32	524208	356	549951	401	50049	257	45	4355	146	2447	52
33	524564	356	550352	400	49648	212	45	4629	151	2350	54
34	524920	355	550752	400	49248	167	45	4903	155	2252	56
35	9.525275	355	9.551152	400	48848	122	45	.335177	160	.942155	57
36	525630	354	551552	400	48448	077	45	5452	164	2057	59
37	525984	355	551952	399	48048	032	45	5726	169	1960	60
38	526339	354	552351	399	47649	987	45	6000	174	1862	62
39	526693	353	552750	399	47250	942	45	6273	178	1764	64
40	9.527046	354	9.553149	399	46851	897	45	.336547	183	.941666	65
41	527400	353	553548	398	46452	852	45	6821	187	1569	67
42	527753	352	553946	398	46054	807	45	7095	192	1470	69
43	528105	353	554344	397	45656	761	46	7369	196	1372	70
44	528458	352	554741	398	45259	716	45	7643	201	1274	72
45	9.528810	352	9.555139	397	44861	671	45	.337917	206	.941176	74
46	529161	352	555536	397	44464	625	46	8190	210	1078	75
47	529513	351	555933	396	44067	580	45	8464	215	0979	77
48	529864	351	556329	396	43671	535	45	8738	219	0881	78
49	530215	350	556725	396	43275	489	44	9012	224	0782	80
50	9.530565	350	9.557121	396	42879	444	45	.339285	228	.940683	82
51	530915	350	557517	396	42483	398	44	9559	233	0585	83
52	531265	349	557913	396	42087	352	46	9832	238	0486	85
53	531614	349	558308	395	41692	307	45	.340106	242	0387	87
54	531963	349	558703	395	41297	261	46	0380	247	0288	88
55	.9532312	349	.9559097	394	40903	215	46	.340653	251	.940189	90
56	532661	348	559491	394	40509	169	44	0926	256	0090	92
57	533009	348	559885	394	40115	124	45	1200	260	.939991	93
58	533357	347	560279	394	39721	078	46	1473	265	9891	95
59	533704		560673		39327	032	46	1747	269	9792	96
M.	L. Cos.	D.	L.Cotan.	D.	L. Tang.	L.Sine.	D.	N. Cos.		N. Sine	

Digitized by Google

M.	L. Sine.	D.	L. Tang	D	L. Cotan	L.Cos.	D.	N. Sine.	d.	N. Cos.	d.	M
0	9·534052		9·561065		38734	986		·342020		·939693		60
1	534399	347	561459	393	38541	940	46	2293	272	9593	102	59
2	534745	346	561851	392	38149	9·972 894	46	2567	5	9493	2	58
3	535092	347	562244	393	37756	848	46	2840	9	9394	3	57
4	535438	346	562636	392	37364	802	46	3113	14	9294	5	56
5	9·535783	345	9·563028	392	36972	755	47	·343386	18	·939194	7	55
6	536129	346	563419	391	36581	9·972 709	46	3660	23	9094	9	54
7	536474	345	563811	392	36189	663	46	3933	27	8994	10	53
8	536818	344	564202	391	35798	617	46	4206	32	8894	12	52
9	537163	345	564593	391	35407	570	47	4479	36	8794	14	51
10	9·537507	344	9·564983	390	35017	524	46	·344752	41	·938694	15	50
11	537851	344	565373	390	34627	9·972 478	46	5025	45	8593	17	49
12	538194	343	565763	390	34237	431	47	5298	50	8493	19	48
13	538538	344	566153	390	33847	385	46	5571	54	8392	20	47
14	538880	342	566542	389	33458	338	47	5844	59	8292	22	46
15	9·539223	343	9·566932	390	33068	291	47	·346117	64	·938191	24	45
16	539565	342	567320	388	32680	245	46	6390	68	8091	26	44
17	539907	342	567709	389	32291	9·972 198	47	6663	73	7990	27	43
18	540249	342	568098	389	31902	151	47	6936	77	7889	29	42
19	540590	341	568486	388	31514	105	46	7208	82	7788	31	41
20	9·540931	341	9·568873	387	31127	058	47	·347481	86	·937687	32	40
21	541272	341	569261	388	30739	011	47	7754	91	7586	34	39
22	541613	341	569648	387	30352	9·971 964	47	8027	95	7485	36	38
23	541953	340	570035	387	29965	917	47	8299	100	7383	37	37
24	542293	340	570422	387	29578	870	47	8572	104	7282	39	36
25	9·542632	339	9·570809	387	29191	823	47	·348845	109	·937181	41	35
26	542971	339	571195	386	28805	776	47	9117	113	7079	43	34
27	543310	339	571581	386	28419	9·971 729	47	9390	118	6977	44	33
28	543649	339	571967	386	28033	682	47	9662	122	6876	46	32
29	543987	338	572352	385	27648	635	47	9935	127	6774	48	31
30	9·544325	338	9·572738	386	27262	588	47	·350207	132	·936672	49	30
31	544663	338	573123	385	26877	9·971 540	48	0480	136	6570	51	29
32	545000	337	573507	384	26493	493	47	0752	141	6468	53	28
33	545338	338	573892	385	26108	446	47	1025	145	6366	54	27
34	545674	336	574276	384	25724	398	48	1297	150	6264	56	26
35	9·546011	337	9·574660	384	25340	351	47	·351569	154	·936162	58	25
36	546347	336	575044	384	24956	9·971 303	48	1842	159	6059	60	24
37	546683	336	575427	383	24573	256	47	2114	163	5957	61	23
38	547019	336	575810	383	24190	208	48	2386	168	5855	63	22
39	547354	335	576193	383	23807	161	47	2658	172	5752	65	21
40	9·547689	335	9·576576	383	23424	113	48	·352931	177	·935649	66	20
41	548024	335	576959	383	23041	9·971 066	47	3203	181	5547	68	19
42	548359	334	577341	382	22659	018	48	3475	186	5444	70	18
43	548693	334	577723	382	22277	970	48	3747	190	5341	71	17
44	549027	334	578104	381	21896	922	48	4019	195	5238	73	16
45	9·549360	333	9·578486	382	21514	874	48	·354291	200	·935135	75	15
46	549693	333	578867	381	21133	9·970 827	47	4563	204	5032	77	14
47	550026	333	579248	381	20752	779	48	4835	209	4929	78	13
48	550359	333	579629	381	20371	731	48	5107	213	4826	80	12
49	550692	333	580007	380	19991	683	48	5379	218	4722	82	11
50	9·551024	332	9·580389	382	19611	635	48	·355651	222	·934619	83	10
51	551356	332	580769	380	19231	9·970 586	49	5923	227	4515	85	9
52	551687	331	581149	380	18851	538	48	6194	231	4412	87	8
53	552018	331	581528	379	18472	490	48	6466	236	4308	88	7
54	552349	331	581907	379	18093	442	48	6738	240	4204	90	6
55	9·552680	331	9·582286	379	17714	394	48	·357010	245	·934101	92	5
56	553010	330	582665	379	17335	9·970 345	49	7281	249	3997	94	4
57	553341	331	583044	379	16956	297	48	7553	254	3893	95	3
58	553670	329	583422	378	16578	249	48	7825	258	3789	97	2
59	554000	330	583800	378	16200	200	49	8006	263	3685	99	1
M.	Lo. Cos.	D.	L.Cotan.	D.	L.Tang	L.Sine	D.	N. Cos.	268	N. Sine	100	M.

Digitized by Google

M.	L. Sine.	D.	L.Tang	D.	L.Cotan.		L.Cos.	D.	N.Sine.	d."	N.Cos
0	9·554329		9·584177	378	15823		0152	49	·358368	270	·93358
1	554658	329	584555	377	15445	10·4	9·97 0103	48	8639	5	347
2	554987	329	584932	377	15068		0055	49	8911	9	337
3	555315	328	585309	377	14691		0006	49	9182	14	326
4	555643	328	585686	377	14314		9957	49	9454	18	316
5	9·555971	328	9·586062	376	13938		9909	48	·359725	23	·93305
6	556299	328	586439	377	13561	10·4	9·96 9860	49	9997	27	295
7	556626	327	586815	376	13185		9811	49	·360268	32	284
8	556953	327	587190	375	12810		9762	49	0539	36	274
9	557280	327	587566	376	12434		9714	48	0811	41	263
10	9·557606	326	9·587941	375	12059		9665	49	·361082	45	·93253
11	557932	326	588316	375	11684	10·4	9·96 9616	49	1353	50	242
12	558258	326	588691	375	11309		9567	49	1625	54	232
13	558583	325	589066	374	10934		9518	49	1896	59	221
14	558909	326	589440	374	10560		9469	49	2167	63	211
15	9·559234	325	9·589814	374	10186		9420	50	·362438	68	·93200
16	559558	324	590188	374	09812	10·4	9·96 9370	49	2709	72	190
17	559883	325	590562	374	09438		9321	49	2980	77	179
18	560207	324	590935	373	09065		9272	49	3251	81	169
19	560531	324	591308	373	08692		9223	49	3522	86	158
20	9·560855	324	9·591681	373	08319		9173	50	·363793	90	·93148
21	561178	323	592054	373	07946	10·4	9·96 9124	49	4004	95	137
22	561501	323	592426	372	07574		9075	49	4335	99	126
23	561824	323	592799	373	07201		9025	50	4606	104	116
24	562146	322	593171	372	06829		8976	49	4877	108	105
25	9·562468	322	9·593542	371	06458		8926	50	·365148	113	·93095
26	562790	322	593914	372	06086	10·4	9·96 8877	49	5418	117	084
27	563112	322	594285	371	05715		8827	50	5689	122	073
28	563433	321	594656	371	05344		8777	50	5960	126	063
29	563755	322	595027	371	04973		8728	49	6231	131	052
30	9·564075	320	9·595398	370	04602		8678	50	·366501	135	·93041
31	564396	321	595768	370	04232	10·4	9·96 8628	50	6772	140	031
32	564716	320	596138	370	03862		8578	50	7042	144	020
33	565036	320	596508	370	03492		8528	50	7313	149	009
34	565356	320	596878	369	03122		8479	49	7584	153	·92999
35	9·565676	319	9·597247	369	02753		8429	50	·367854	158	·92988
36	565995	319	597616	369	02384	10·4	9·96 8379	50	8125	162	977
37	566314	318	597985	369	02015		8329	50	8395	167	966
38	566632	319	598354	368	01646		8278	51	8665	171	956
39	566951	317	598722	369	01278		8228	50	8936	176	945
40	9·567269	318	9·599091	368	00909		8178	50	·369206	180	·92934
41	567587	317	599459	368	00541	10·4	9·96 8128	50	9476	185	924
42	567904	318	599827	367	00173		8078	50	9747	189	913
43	568222	317	600194	368	99806		8027	51	·370017	194	902
44	568539	317	600562	367	99438		7977	50	0287	198	891
45	9·568856	316	9·600929	367	99071		7927	50	·370557	203	·92881
46	569172	316	601296	367	98704	10·3	9·96 7876	51	0828	207	870
47	569488	316	601663	366	98337		7826	50	1098	212	859
48	569804	316	602029	366	97971		7775	51	1368	216	848
49	570120	315	602395	366	97605		7725	50	1638	221	837
50	9·570435	316	9·602761	366	97239		7674	51	·371908	225	·92827
51	570751	315	603127	366	96873	10·3	9·96 7624	50	2178	230	816
52	571066	314	603493	365	96507		7573	51	2448	234	805
53	571380	315	603858	365	96142		7522	51	2718	239	794
54	571695	314	604223	365	95777		7471	51	2988	243	783
55	9·572009	314	9·604588	365	95412		7421	50	·373258	248	·92772
56	572323	313	604953	364	95047	10·3	9·96 7370	51	3527	252	761
57	572636	314	605317	365	94683		7319	51	3797	257	751
58	572950	313	605682	364	94318		7268	51	4067	261	740
59	573263		606046		93954		7217	51	4337	266	729
M.	Lo. Cos.	D.	L.Cotan.	D.	L.Tang.		L.Sine	D.	N. Cos.		N.Sine

Digitized by Google

M.	L.Sine.	D.	L. Tang	D.	L.Cotan	L. Cos.	D	N. Sine.	d "	N Cos.	d "	M
0	9.573575		9.606410			93590	7166					60
1	573888	313	606773	363		93227	7115	.374607	268	.927184	112	59
2	574200	312	607137	364	10.3	92863	7064	4876	5	7075	2	58
3	574512	312	607500	363		92500	7013	5146	9	6966	4	57
4	574824	312	607863	365		92137	6961	5416	13	6857	6	56
5	9.575136	311	9.608225	362		91775	6910	5685	18	6747	8	55
6	575447	311	608588	363	10.3	91412	6859	.375955	22	.926638	9	54
7	575758	311	608950	362		91050	6808	6224	27	6529	11	53
8	576069	310	609312	362		90688	6756	6494	31	6419	13	52
9	576379	310	609674	362		90326	6705	6763	36	6310	15	51
10	9.576689	310	9.610036	362		89964	6653	7033	40	6200	17	50
11	576999	310	610397	361	10.3	89603	6602	.377302	45	.926090	19	49
12	577309	309	610759	362		89241	6550	7571	49	5980	21	48
13	577618	309	611120	361		88880	6499	7841	54	5871	22	47
14	577927	309	611480	360		88520	6447	8110	58	5761	24	46
15	9.578236	309	9.611841	361		88159	6395	8379	63	5651	26	45
16	578545	309	612201	360	10.3	87799	6344	.378649	67	.925540	28	44
17	578853	308	612561	360		87439	6292	8918	72	5430	30	43
18	579162	309	612921	360		87079	6240	9187	76	5320	32	42
19	579470	308	613281	360		86719	6188	9456	80	5210	34	41
20	9.579777	307	9.613641	360		86359	6136	9725	85	5099	36	40
21	580085	308	614000	359	10.3	86000	6085	.379994	89	.924989	37	39
22	580392	307	614359	359		85641	6033	.380263	94	4878	39	38
23	580699	307	614718	359		85282	5981	0532	98	4768	41	37
24	581005	306	615077	359		84923	5929	0801	103	4657	43	36
25	9.581312	307	9.615435	358		84565	5876	1070	107	4546	45	35
26	581618	306	615793	358	10.3	84207	5824	.381339	112	.924435	47	34
27	581924	306	616151	358		83849	5772	1608	116	4324	49	33
28	582229	305	616509	358		83491	5720	1877	121	4213	50	32
29	582535	306	616867	358		83133	5668	2146	125	4102	52	31
30	9.582840	305	9.617224	357		82776	5615	2415	130	3991	54	30
31	583145	305	617582	358	10.3	82418	5563	.382683	134	.923879	56	29
32	583449	304	617939	357		82061	5511	2952	139	3768	58	28
33	583754	305	618295	356		81705	5458	3221	143	3657	60	27
34	584058	304	618652	357		81348	5406	3489	147	3545	62	26
35	9.584361	303	9.619008	356		80992	5353	3758	152	3434	64	25
36	584665	304	619364	356	10.3	80636	5301	.384027	156	.923322	65	24
37	584968	303	619720	356		80280	5248	4295	161	3210	67	23
38	585272	304	620076	356		79924	5195	4564	165	3098	69	22
39	585574	302	620432	356		79568	5143	4832	170	2986	71	21
40	9.585877	303	9.620787	355		79213	5090	5101	174	2874	73	20
41	586179	302	621142	355	10.3	78858	5037	.385369	179	.922762	75	19
42	586482	303	621497	355		78503	4984	5638	183	2650	77	18
43	586783	301	621852	355		78148	4931	5906	188	2538	78	17
44	587085	302	622207	355		77793	4879	6174	192	2426	80	16
45	9.587386	301	9.622561	354		77439	4826	6443	197	2313	82	15
46	587688	302	622915	354	10.3	77085	4773	.386711	201	.922201	84	14
47	587989	301	623269	354		76731	4720	6979	206	2088	86	13
48	588289	300	623623	354		76377	4666	7247	210	1976	88	12
49	588590	301	623976	353		76024	4613	7516	214	1863	90	11
50	9.588890	300	9.624330	354		75670	4560	7784	219	1750	92	10
51	589190	300	624683	353	10.3	75317	4507	.388052	223	.921637	93	9
52	589489	299	625036	353		74964	4454	8320	228	1525	95	8
53	589789	300	625388	352		74612	4400	8588	232	1412	97	7
54	590088	299	625741	353		74259	4347	8856	237	1299	99	6
55	9.590387	299	9.626093	352		73907	4294	9124	241	1185	101	5
56	590686	299	626445	352	10.3	73555	4240	.389392	246	.921072	103	4
57	590984	298	626797	352		73203	4187	9660	250	0959	105	3
58	591282	298	627149	352		72851	4133	9928	255	0845	106	2
59	591580	298	627501	352		72499	4080	.390195	259	0732	108	1
M.	L. Cos.	D.	L.Cotan.	D.	L.Tang.	L.Sine	D.	N. Cos.		N. Sine		M

Digitized by Google

M	L.Sine.	D.	L.Tang.	D.	L.Cotan.	L.Cos.	D.	N. Sine	d."	N.Cos.	d."	M
0	9.591878		9.627852		72148	4026		·390731	267	·920505	116	60
1	592175	297	628203	351	71797	3972	54	0999	5	0391	2	59
2	592473	298	628554	351	71446	3919	53	1267	9	0277	4	58
3	592770	297	628905	351	71095	3865	54	1534	13	0163	6	57
4	593067	297	629255	350	70745	3811	54	1802	18	0050	8	56
		296		351			54					
5	9.593363	296	9.629606	350	70394	3757	53	·392069	22	·919936	10	55
6	593659	296	629956	350	70044	3704	54	2337	27	9821	12	54
7	593955	296	630306	350	69694	3650	54	2605	31	9707	14	53
8	594251	296	630656	349	69344	3596	54	2872	36	9593	16	52
9	594547		631005		68995	3542		3140	40	9479	17	51
10	9.594842	295	9.631355	350	68645	3488	54	·393407	45	·919364	19	50
11	595137	295	631704	349	68296	3434	54	3674	49	9250	21	49
12	595432	295	632053	349	67947	3379	55	3942	53	9135	23	48
13	595727	295	632402	349	67598	3325	54	4209	58	9021	25	47
14	596021	294	632750	348	67250	3271	54	4477	62	8906	27	46
		294		349			54					
15	9.596315	294	9.633099	348	66901	3217	54	·394744	67	·918791	29	45
16	596609	294	633447	348	66553	3163	54	5011	71	8676	31	44
17	596903	293	633795	348	66205	3108	55	5278	76	8561	33	43
18	597196	294	634143	347	65857	3054	54	5545	80	8446	35	42
19	597490		634490		65510	2999	55	5813	85	8331	37	41
20	9.597783	293	9.634838	348	65162	2945	54	·396080	89	·918216	39	40
21	598075	292	635185	347	64815	2890	55	6347	94	8101	41	39
22	598368	293	635532	347	64468	2836	54	6614	98	7985	43	38
23	598660	292	635879	347	64121	2781	55	6881	102	7870	45	37
24	598952	292	636226	346	63774	2727	54	7148	107	7755	46	36
25	9.599244	292	9.636572	347	63428	2672	55	·397415	111	·917639	48	35
26	599536	292	636919	346	63081	2617	55	7682	116	7523	50	34
27	599827	291	637265	346	62735	2562	54	7949	120	7408	52	33
28	600118	291	637611	345	62389	2508	55	8215	125	7292	54	32
29	600409	291	637956	346	62044	2453	55	8482	129	7176	56	31
30	9.600700	291	9.638302	345	61698	2398	55	·398749	134	·917060	58	30
31	600990	290	638647	345	61353	2342	55	9016	138	6944	60	29
32	601280	290	638992	345	61008	2288	55	9282	142	6828	62	28
33	601570	290	639337	345	60663	2233	55	9549	147	6712	64	27
34	601860	290	639682	345	60318	2178	55	9816	151	6595	66	26
35	9.602150	290	9.640027	345	59973	2123	55	·400082	156	·916479	68	25
36	602439	289	640371	344	59629	2067	56	0349	160	6363	70	24
37	602728	289	640716	345	59284	2012	55	0616	165	6246	72	23
38	603017	289	641060	344	58940	1957	55	0882	169	6130	74	22
39	603305	288	641404	344	58596	1902	55	1149	174	6013	75	21
40	9.603594	289	9.641747	343	58253	1846	56	·401415	178	·915896	77	20
41	603882	288	642091	344	57909	1791	55	1681	183	5779	79	19
42	604170	288	642434	343	57566	1735	56	1948	187	5663	81	18
43	604457	287	642777	343	57223	1680	55	2214	191	5546	83	17
44	604745	288	643120	343	56880	1624	56	2480	196	5429	85	16
45	9.605032	287	9.643463	343	56537	1569	55	·402747	200	·915311	87	15
46	605319	287	643806	343	56194	1513	56	3013	205	5194	89	14
47	605606	287	644148	342	55852	1458	55	3279	209	5077	91	13
48	605892	286	644490	342	55510	1402	56	3545	214	4960	93	12
49	606179	287	644832	342	55168	1346	56	3811	218	4842	95	11
50	9.606465	286	9.645174	342	54826	1290	56	·404077	223	·914725	97	10
51	606751	286	645516	342	54484	1235	55	4344	227	4607	99	9
52	607036	285	645857	341	54143	1179	56	4610	231	4489	101	8
53	607322	286	646199	342	53801	1123	56	4876	236	4372	103	7
54	607607	285	646540	341	53460	1067	56	5142	240	4254	104	6
55	9.607892	285	9.646881	341	53119	1011	56	·405407	245	·914136	106	5
56	608177	285	647222	341	52778	0955	56	5673	249	4018	108	4
57	608461	284	647562	340	52438	0899	56	5939	254	3900	110	3
58	608745	284	647903	341	52097	0843	56	6205	258	3782	112	2
59	609029	284	648243	340	51757	0786	57	6471	263	3664	114	1
M.	Lo.Cos.	D.	L.Cotan.	D.	L.Tang.	L.Sine	D.	N. Cos.		N.Sine		M

Digitized by Google

M.	L. Sine	D.	L. Tang.	D.	L. Cotan.	L. Cos.	D.	N. Sine	d."	N. Cos.	d."	M
0	9.609313		9.648583		51417	0730		.406737	265	.913545	121	60
1	609597	284	648923	340	51077	0674	56	7002	4	3427	2	59
2	609880	283	649263	340	50737	0618	56	7268	9	3309	4	58
3	610164	284	649602	339	50398	0561	57	7534	13	3190	6	57
4	610447	283	649942	340	50058	0505	56	7799	18	3072	8	56
5	9.610729	282	9.650281	339	49719	0448	57	.408065	22	.912953	10	55
6	611012	283	650620	339	49380	0392	56	8330	27	2834	12	54
7	611294	282	650959	339	49041	0335	57	8596	31	2715	14	53
8	611576	282	651297	338	48703	0279	56	8861	35	2596	16	52
9	611858	282	651636	339	48364	0222	57	9127	40	2477	18	51
10	9.612140	282	9.651974	338	48026	0165	57	.409392	44	.912358	20	50
11	612421	281	652312	338	47688	0109	56	9658	49	2239	22	49
12	612702	281	652650	338	47350	0052	57	9923	53	2120	24	48
13	612983	281	652988	338	47012	9995	57	.410188	57	2001	26	47
14	613264	281	653326	338	46674	9938	57	0454	62	1881	28	46
15	9.613545	281	9 653663	337	46337	9882	56	.410719	66	.911762	30	45
16	613825	280	654000	337	46000	9825	57	0984	71	,1642	32	44
17	614105	280	654337	337	45663	9768	57	1249	75	1523	34	43
18	614385	280	654674	337	45326	9711	57	1514	80	1403	36	42
19	614665	280	655011	337	44989	9654	57	1779	84	1283	38	41
20	9.614944	279	9.655348	337	44652	9596	58	.412044	88	.911164	40	40
21	615223	279	655684	336	44316	9539	57	2310	93	1044	42	39
22	615502	279	656020	336	43980	9482	57	2574	97	0924	44	38
23	615781	279	656356	336	43644	9425	57	2839	102	0804	46	37
24	616060	279	656692	336	43308	9368	57	3104	106	0684	48	36
25	9.616338	278	9.657028	336	42972	9310	58	.413369	110	.910563	50	35
26	616616	278	657364	336	42636	9253	57	3634	115	0443	52	34
27	616894	278	657699	335	42301	9195	58	3899	119	0323	55	33
28	617172	278	658034	335	41966	9138	57	4164	124	0202	57	32
29	617450	278	658369	335	41631	9080	58	4428	128	0082	59	31
30	9.617727	277	9.658704	335	41296	9023	57	.414693	133	.909961	61	30
31	618004	277	659039	335	40961	8965	58	4958	137	9841	63	29
32	618281	277	659373	334	40627	8908	57	5223	141	9720	65	28
33	618558	277	659708	335	40292	8850	58	5487	146	9599	67	27
34	618834	276	660042	334	39958	8792	58	5752	150	9478	69	26
35	9.619110	276	9.660370	334	39624	8734	57	.416016	155	.909357	71	25
36	619386	276	660710	334	39290	8677	58	6281	159	9236	73	24
37	619662	276	661043	333	38957	8619	58	6545	163	9115	75	23
38	619938	276	661377	334	38623	8561	58	6810	168	8994	77	22
39	620213	275	661710	333	38290	8503	58	7074	172	8872	79	21
40	9.620488	275	9.662043	333	37957	8445	58	.417338	177	.908751	81	20
41	620763	275	662376	333	37624	8387	58	7603	181	8630	83	19
42	621038	275	662709	333	37291	8329	58	7867	186	8508	85	18
43	621313	275	663042	333	36958	8271	58	8131	190	8387	87	17
44	621587	274	663375	333	36625	8213	58	8396	194	8265	89	16
45	9.621861	274	9.663707	332	36293	8154	59	.418660	199	.908143	91	15
46	622135	274	664039	332	35961	8096	58	8924	203	8021	93	14
47	622409	274	664371	332	35629	8038	58	9188	208	7899	95	13
48	622682	273	664703	332	35297	7979	59	9452	212	7777	97	12
49	622956	274	665035	332	34965	7921	58	9716	216	7655	99	11
50	9.623229	273	9.665300	331	34634	7863	58	.419980	221	.907533	101	10
51	623502	273	665698	332	34302	7804	59	.420244	225	7411	103	9
52	623774	272	666029	331	33971	7746	58	0508	230	7289	105	8
53	624047	273	666360	331	33640	7687	59	0772	234	7166	107	7
54	624319	272	666691	331	33309	7628	59	1036	239	7044	109	6
55	9.624591	272	9.667021	330	32979	7570	58	.421300	243	.906921	111	5
56	624863	272	667352	331	32648	7511	59	1563	247	6799	113	4
57	625135	272	667682	330	32318	7452	59	1827	252	6676	115	3
58	625406	271	668013	331	31987	7393	59	2091	256	6553	117	2
59	625677	271	668343	330	31657	7335	58	2355	261	6431	119	1
M.	L. Cos.	D.	L. Cotan.	D.	L. Tang.	L. Sine	D.	N. Cos.		N. Sin.		M

Digitized by Google

M.	L. Sine	D.	L. Tang.	D.	L. Cotan		L. Cos.	D.	N. Sine	d."	N. Cos.	d."	M.
0	9.625948		9.668673		31327		7276	59	.422618	263	.906308	125	60
1	626219	271	669002	329	30998	10.3	7217	59	2882	4	6185	2	59
2	626490	271	669332	330	30668	10.3	7158	59	3145	9	6062	4	58
3	626760	270	669661	329	30339	9.95	7099	59	3409	13	5939	6	57
4	627030	270	669991	330	30009		7040	59	3672	18	5815	8	56
5	9.627300	270	9.670320	329	29680		6981	59	.423936	22	.906692	10	55
6	627570	270	670649	329	29351	10.3	6921	60	4199	26	5569	13	54
7	627840	270	670977	328	29023	10.3	6862	59	4463	31	5445	15	53
8	628109	269	671306	329	28694	9.95	6803	59	4726	35	5322	17	52
9	628378	269	671635	329	28365		6744	59	4989	40	5198	19	51
10	9.628647	269	9.671963	328	28037		6684	60	.425253	44	.905075	21	50
11	628916	269	672291	328	27709	10 3	6625	59	5516	48	4951	23	49
12	629185	269	672619	328	27381	10 3	6566	59	5779	53	4827	25	48
13	629453	268	672947	328	27053	9.95	6506	60	6042	57	4703	27	47
14	629721	268	673274	327	26726		6447	59	6306	61	4579	29	46
15	9.629989	268	9.673602	328	26398		6387	60	.426569	66	.904455	31	45
16	630257	268	673929	337	26071	10.3	6327	60	6832	70	4331	33	44
17	630524	267	674257	328	25743	10.3	6268	59	7095	75	4207	35	43
18	630792	268	674584	327	25416	9.95	6208	60	7358	79	4082	38	42
19	631059	267	674911	327	25089		6148	60	7621	83	3958	40	41
20	9.631326	267	9.675237	326	24763		6089	59	.427884	88	.903834	42	40
21	631593	267	675564	327	24436	10.3	6029	60	8147	92	3709	44	39
22	631859	266	675890	326	24110	10.3	5969	60	8409	96	3585	46	38
23	632125	266	676217	327	23783	9.95	5909	60	8672	101	3460	48	37
24	632392	267	676543	326	23457		5849	60	8935	105	3335	50	36
25	9.632658	266	9.676869	326	23131		5789	60	.429198	110	.903210	52	35
26	632923	265	677194	325	22806	10 3	5729	60	9461	114	3086	54	34
27	633189	266	677520	326	22480	10 3	5669	60	9723	118	2961	56	33
28	633454	265	677846	326	22154	9.95	5609	60	9986	123	2836	58	32
29	633719	265	678171	325	21829		5548	61	.430248	127	2710	60	31
30	9.633984	265	9.678496	325	21504		5488	60	.430511	132	.902585	63	30
31	634249	265	678821	325	21179	10.3	5428	60	0774	136	2460	65	29
32	634514	264	679146	325	20854	10.3	5368	61	1036	140	2335	67	28
33	634778	264	679471	324	20529	9.95	5307	60	1299	145	2209	69	27
34	635042	264	679795	325	20205		5247	61	1561	149	2084	71	26
35	9.635306	264	9.680120	324	19880		5186	60	.431823	153	.901958	73	25
36	635570	264	680444	324	19556	10.3	5126	61	2086	158	1832	75	24
37	635834	263	680768	324	19232	10.3	5065	60	2348	162	1707	77	23
38	636097	263	681092	324	18908	9.95	5005	61	2610	167	1581	79	22
39	636360	263	681416	324	18584		4944	61	2873	171	1455	81	21
40	9.636623	263	9.681740	324	18260		4883	60	.433135	175	.901329	83	20
41	636886	262	682063	323	17937	10.3	4823	61	3397	180	1203	85	19
42	637148	263	682387	324	17613	10.3	4762	61	3659	184	1077	88	18
43	637411	262	682710	323	17290	9.95	4701	61	3921	189	0951	90	17
44	637673	262	683033	323	16967		4640	61	4183	193	0825	92	16
45	9.637935	262	9.683356	323	16644		4579	61	.434445	197	.900698	94	15
46	638197	261	683679	323	16321	10.3	4518	61	4707	202	0572	96	14
47	638458	262	684001	322	15999	9.95	4457	61	4969	206	0445	98	13
48	638720	261	684324	323	15676	9.95	4396	61	5231	210	0319	100	12
49	638981	261	684646	322	15354		4335	61	5493	215	0192	102	11
50	9.639242	261	9.684968	322	15032		4274	61	.435755	219	.900065	104	10
51	639503	261	685290	322	14710	10 3	4213	61	6017	224	.899939	106	9
52	639764	260	685612	322	14388	9 95	4152	62	6278	228	9812	108	8
53	640024	260	685934	322	14066	9 95	4090	61	6540	232	9685	110	7
54	640284	260	686255	321	13745		4029	61	6802	237	9558	113	6
55	9.640544	260	9.686577	322	13423		3968	62	.437063	241	.899431	115	5
56	640804	260	686898	321	13102	10.3	3906	61	7325	246	9303	117	4
57	641064	260	687219	321	12781	10.3	3845	62	7587	250	9176	119	3
58	641324	260	687540	321	12460	9.95	3783	61	7848	254	9049	121	2
59	641583	259	687861	321	12139		3722	62	8110	259	8921	123	1
M.	L. Cos.	D.	L. Cotan.	D.	L. Tang.		L. Sine	D.	N. Cos.		N. Sin.	d."	M.

Digitized by Google

	L. Sine.	D	L. Tang	D.	L. Cotan	L. Cos.	D.	N. Sine.	d."	N. Cos.	d."	M.
	9.641842	259	9.688182	320	11818	3660	61	.438371	261	.898794	130	60
	642101	259	688502	321	10.3 11498	3599	62	8633	4	8666	2	59
	642360	258	688823	320	11177	9.95 3537	62	8894	9	8539	4	58
	642618	259	689143	320	10857	3475	62	9155	13	8411	7	57
	642877	258	689463	320	10537	3413	61	9417	17	8283	9	56
	9.643135	258	9.689783	320	10217	3352	62	.439678	22	.898155	11	55
	643393	257	690103	320	10.3 09897	3290	62	9939	26	8028	13	54
	643650	258	690423	320	09577	9.95 3228	62	.440200	31	7900	15	53
	643908	257	690742	319	09258	3166	62	0461	35	7771	17	52
	644165	258	691062	320	08938	3104	62	0723	39	7643	20	51
	9.644423	257	9.691381	319	08619	3042	62	.440984	44	.897515	22	50
	644680	256	691700	319	10.3 08300	9.95 2980	62	1245	48	7387	24	49
	644936	257	692019	319	07981	2918	63	1506	52	7258	26	48
	645193	257	692338	319	07662	2855	62	1767	57	7130	28	47
	645450	256	692656	318	07344	2793	62	2028	61	7001	30	46
	9.645706	256	9.692975	319	07025	2731	62	.442289	65	.896873	33	45
	645962	256	693293	318	10.3 06707	2669	63	2550	70	6744	35	44
	646218	256	693612	319	06388	9.95 2606	62	2810	74	6615	37	43
	646474	255	693930	318	06070	2544	63	3071	78	6486	39	42
	646729	255	694248	318	05752	2481	62	3332	83	6357	41	41
	9.646984	256	9.694566	317	05434	2419	63	.443593	87	.896228	43	40
	647240	254	694883	318	10.8 05117	2356	62	3853	91	6099	46	39
	647494	255	695201	317	04799	9.95 2294	63	4114	96	5970	48	38
	647749	255	695518	318	04482	2231	63	4375	100	5841	50	37
	648004	254	695836		04164	2168	63	4635	104	5712	52	36
	9.648258	254	9.696153	317	03847	2106	62	.444896	109	.895582	54	35
	648512	254	696470	317	10.3 03530	2043	63	5156	113	5453	56	34
	648766	254	696787	317	03213	9.95 1980	63	5417	118	5323	59	33
	649020	254	697103	316	02897	1917	63	5677	122	5194	61	32
	649274	253	697420	317	02580	1854	63	5937	126	5064	63	31
	9.649527	253	9.697736	316	02264	1791	63	.446198	131	.894934	65	30
	649781	253	698053	317	10.3 01947	1728	63	6458	135	4804	67	29
	650034	253	698369	316	01631	9.95 1665	63	6718	139	4675	69	28
	650287	252	698685	316	01315	1602	63	6979	144	4545	72	27
	650539	253	699001	316	00999	1539	63	7239	148	4415	74	26
	9.650792	252	9.699316	315	00684	1476	63	.447499	152	.894284	76	25
	651044	253	699632	316	10.3 00368	1412	64	7759	157	4154	78	24
	651297	252	699947	315	00053	9.95 1349	63	8019	161	4024	80	23
	651549	252	700263	316	99737	1286	63	8279	165	3894	82	22
	651800	251	700578	315	99422	1222	64	8539	170	3763	85	21
	9.652052	252	9.700893	315	99107	1159	63	.448799	174	.893633	87	20
	652304	252	701208	315	10.2 98792	1096	63	9059	178	3502	89	19
	652555	251	701523	314	98477	9.95 1032	64	9319	183	3371	91	18
	652806	251	701837	315	98163	0968	63	9579	187	3241	93	17
	653057	251	702152	314	97848	0905	63	9839	191	3110	95	16
	9.653308	250	9.702466	315	97534	0841	64	.450098	196	.892979	98	15
	653558	250	702781	314	10.2 97219	0778	63	0358	200	2848	100	14
	653808	251	703095	314	96905	9.95 0714	64	0618	205	2717	102	13
	654059	250	703409	313	96591	0650	64	0877	209	2586	104	12
	654309	249	703722		96278	0586	64	1137	213	2455	106	11
	9.654558	250	9.704036	314	95964	0522	64	.451397	218	.892323	108	10
	654808	250	704350	314	10.2 95650	0458	64	1656	222	2192	111	9
	655058	249	704663	313	95337	9.95 0394	64	1916	226	2061	113	8
	655307	249	704976	313	95024	0330	64	2175	231	1929	115	7
	655556	249	705290	314	94710	0266	64	2435	235	1797	117	6
	9.655805	249	9.705603	313	94397	50202	64	.452694	239	.891666	119	5
	656054	248	705916	313	94084	50138	64	2953	244	1534	121	4
	656302	248	706228	312	10.2 93772	9.9 50074	64	3213	248	1402	124	3
	656551	249	706541	313	93459	50010	64	3472	252	1270	126	2
	656799		706854	313	93146	49945	65	3731	257	1138	128	1
M.	Lo. Cos	D.	L.Cotan.	D.	L. Tang.	L.Sine.	D.	N. Cos.		N. Sine		M.

Digitized by Google

M.	L.Sine.	D.	L. Tang	D.	L.Cotan.	L.Cos.	D.	N.Sine.	d.″	N. Cos.	d.″	M
0	9.657047		9.707166		92834	9881		.453990	258	.891006	134	60
1	657295	248	707478	312	92522	9816	65	4250	4	0874	2	59
2	657542	247	707790	312	92210	9752	64	4509	9	0742	5	58
3	657790	248	708102	312	91898	9688	64	4768	13	0610	7	57
4	658037	247	708414	312	91586	9623	65	5027	17	0478	9	56
5	9.658284	247	9.708726	312	91274	9558	65	.455286	22	.890345	11	55
6	658531	247	709037	311	90963	9494	64	5545	26	0213	13	54
7	658778	247	709349	312	90651	9429	65	5804	30	0080	16	53
8	659025	247	709660	311	90340	9364	65	6063	34	.889948	18	52
9	659271	246	709971	311	90029	9300	64	6322	39	9815	20	51
10	9.659517	246	9.710282	311	89718	9235	65	.456580	43	.889682	22	50
11	659763	246	710593	311	89407	9170	65	6839	47	9549	25	49
12	660009	246	710904	311	89096	9105	65	7098	52	9416	27	48
13	660255	246	711215	310	88785	9040	65	7357	56	9283	29	47
14	660501	245	711525	311	88475	8975	65	7615	60	9150	31	46
15	9.660746	245	9.711836	310	88164	8910	65	.457874	65	.889017	34	45
16	660991	245	712146	310	87854	8845	65	8132	69	8884	36	44
17	661236	245	712456	310	87544	8780	65	8391	73	8751	38	43
18	661481	245	712766	310	87234	8715	65	8650	77	8617	40	42
19	661726	244	713076	310	86924	8650	65	8908	82	8484	42	41
20	9.661970	244	9.713386	310	86614	8584	66	.459166	86	.888350	45	40
21	662214	244	713696	310	86304	8519	65	9425	90	8217	47	39
22	662459	245	714005	309	85995	8454	65	9683	95	8083	49	38
23	662703	244	714314	309	85686	8388	66	9941	99	7949	51	37
24	662946	243	714624	310	85376	8323	65	.460200	103	7815	54	36
25	9.663190	244	9.714933	309	85067	8257	66	.460458	108	.887681	56	35
26	663433	243	715242	309	84758	8192	65	0716	112	7547	58	34
27	663677	244	715551	309	84449	8126	66	0974	116	7413	60	33
28	663920	243	715860	309	84140	8060	66	1232	120	7279	63	32
29	664163	243	716168	308	83832	7995	65	1491	125	7145	65	31
30	9.664406	243	9.716477	309	83523	7929	66	.461749	129	.887011	67	30
31	664648	242	716785	308	83215	7863	66	2007	133	6876	69	29
32	664891	243	717093	308	82907	7797	66	2265	138	6742	72	28
33	665133	242	717401	308	82599	7731	66	2522	142	6607	74	27
34	665375	242	717709	308	82291	7665	66	2780	146	6473	76	26
35	9.665617	242	9.718017	308	81983	7600	65	.463038	151	.886338	78	25
36	665859	241	718325	308	81675	7533	67	3296	155	6204	80	24
37	666100	242	718633	307	81367	7467	66	3554	159	6069	83	23
38	666342	241	718940	308	81060	7401	66	3811	163	5934	85	22
39	666583	241	719248	307	80752	7335	66	4069	168	5799	87	21
40	9.666824	241	9.719555	307	80445	7269	66	.464327	172	.885664	89	20
41	667065	240	719862	307	80138	7203	67	4584	176	5529	92	19
42	667305	241	720169	307	79831	7136	66	4842	181	5394	94	18
43	667546	240	720476	307	79524	7070	66	5100	185	5258	96	17
44	667786	241	720783	306	79217	7004	67	5357	189	5123	98	16
45	9.668027	240	9.721089	307	78911	6937	66	.465614	194	.884988	101	15
46	668267	239	721396	306	78604	6871	67	5872	198	4852	103	14
47	668506	240	721702	307	78298	6804	66	6129	202	4717	105	13
48	668746	240	722009	306	77991	6738	67	6387	206	4581	107	12
49	668986	239	722315	306	77685	6671	67	6644	211	4445	109	11
50	9.669225	239	9.722621	306	77379	6604	67	.466901	215	.884309	112	10
51	669464	239	722927	305	77073	6538	66	7158	219	4174	114	9
52	669703	239	723232	306	76768	6471	67	7416	224	4038	116	8
53	669942	239	723538	306	76462	6404	67	7673	228	3902	118	7
54	670181	238	723844	305	76156	6337	67	7930	232	3766	121	6
55	9.670419	239	9.724149	305	75851	6270	67	.468187	237	.883629	123	5
56	670658	238	724454	306	75546	6203	67	8444	241	3493	125	4
57	670896	238	724760	305	75240	6136	67	8701	245	3357	127	3
58	671134	238	725065	305	74935	6069	67	8958	249	3221	130	2
59	671372		725370		74630	6002		9215	254	3084	132	1
M.	L. Cos.	D.	L.Cotan.	D.	L.Tang.	L. Sine	D.	N. Cos.		N.Sine		M

Digitized by Google

M	L.Sine.	D.	L. Tang.	D.	L.Cotan.	L.Cos.	D.	N. Sine	d."	N.Cos.	d."	M
0	9.671609	238	9.725674	305	74326	5935	67	.469472	256	882948	139	60
1	671847	237	725979	305	10.2 74021	9.94 5868	68	9728	4	2811	2	59
2	672084	237	726284	304	73716	5800	67	9985	9	2674	5	58
3	672321	237	726588	304	73412	5733	67	.470242	13	2538	7	57
4	672558	237	726892	304	73108	5666	68	0499	17	2401	9	56
5	9 672795	237	9.727197	305	72803	5598	67	.470755	21	.882264	12	55
6	673032	236	727501	304	10.2 72499	9.94 5531	67	1012	26	2127	14	54
7	673268	237	727805	304	72195	5464	68	1268	30	1990	16	53
8	673505	236	728109	303	71891	5396	68	1525	34	1853	19	52
9	673741	236	728412	304	71588	5328	67	1781	38	1715	21	51
10	9.673977	236	9.728716	304	71284	5261	68	.472038	43	.881578	23	50
11	674213	235	729020	303	10.2 70980	9.94 5193	68	2294	47	1441	26	49
12	674448	236	729323	303	70677	5125	67	2551	51	1303	28	48
13	674684	235	729626	303	70374	5058	68	2807	56	1166	30	47
14	674919	236	729929	303	70071	4990	68	3063	60	1028	32	46
15	9.675155	235	9.730232	303	69767	4922	68	.473320	64	.880891	35	45
16	675390	234	730535	303	10.2 69465	9.94 4854	68	3576	68	0753	37	44
17	675624	235	730838	303	69162	4786	68	3832	73	0615	39	43
18	675859	235	731141	303	68859	4718	68	4088	77	0477	42	42
19	676094	234	731444	303	68556	4650	68	4344	81	0339	44	41
20	9.676328	234	9.731746	302	68254	4582	68	.474600	85	.880201	46	40
21	676562	234	732048	302	10.2 67952	9.94 4514	68	4856	90	0063	49	39
22	676796	234	732351	303	67649	4446	68	5112	94	.879925	51	38
23	677030	234	732653	302	67347	4377	69	5368	98	9787	53	37
24	677264	234	732955	302	67045	4309	68	5624	102	9649	56	36
25	9.677498	234	9.733257	302	66743	4241	68	.475880	107	.879510	58	35
26	677731	233	733558	301	10.2 66442	9.94 4172	69	6136	111	9372	60	34
27	677964	233	733860	302	66140	4104	68	6392	115	9233	63	33
28	678197	233	734162	302	65838	4036	68	6647	120	9095	65	32
29	678430	233	734463	301	65537	3967	69	6903	124	8956	67	31
30	9.678663	233	9.734764	301	65236	3899	68	.477159	128	.878817	70	30
31	678895	232	735066	302	10.2 64934	9.94 3830	69	7414	132	8678	72	29
32	679128	233	735367	301	64633	3761	69	7670	137	8539	74	28
33	679360	232	735668	301	64332	3693	68	7925	141	8400	77	27
34	679592	232	735969	301	64031	3624	69	8181	145	8261	79	26
35	9.679824	232	9.736269	300	63731	3555	69	.478436	149	.878122	81	25
36	680056	232	736570	301	10.2 63430	9.94 3486	69	8692	154	7983	83	24
37	680288	232	736870	300	63130	3417	69	8947	158	7844	86	23
38	680519	231	737171	301	62829	3348	69	9203	162	7704	88	22
39	680750	231	737471	300	62529	3279	69	9458	166	7565	90	21
40	9.680982	232	9.737771	300	62229	3210	69	.479713	171	.877425	93	20
41	681213	231	738071	300	10 2 61929	9.94 3141	69	9968	175	7286	95	19
42	681443	230	738371	300	61629	3072	69	.480223	179	7146	97	18
43	681674	231	738671	300	61329	3003	69	0479	184	7006	100	17
44	681905	231	738971	300	61029	2934	69	0734	188	6867	102	16
45	9.682135	230	9.739271	300	60729	2864	70	.480989	192	.876727	104	15
46	682365	230	739570	299	60430	9.94 2795	69	1244	196	6587	107	14
47	682595	230	739870	300	10.2 60130	2726	69	1499	201	6447	109	13
48	682825	230	740169	299	59831	2656	70	1754	205	6307	111	12
49	683055	230	740468	299	59532	2587	69	2009	209	6166	114	11
50	9.683284	229	9.740767	299	59233	2517	70	.482263	213	.876026	116	10
51	683514	230	741066	299	10 2 58934	9.94 2448	69	2518	218	5886	118	9
52	683743	229	741365	299	58635	2378	70	2773	222	5745	121	8
53	683972	229	741664	299	58336	2308	70	3028	226	5605	123	7
54	684201	229	741962	298	58038	2239	69	3282	230	5464	125	6
55	9.684430	228	9.742261	299	57739	2169	70	.483537	235	.875324	127	5
56	684658	229	742559	298	10.2 57441	9.94 2099	70	3792	239	5183	130	4
57	684887	228	742858	299	57142	2029	70	4046	243	5042	132	3
58	685115	228	743156	298	56844	1959	70	4301	248	4902	134	2
59	685343		743454	298	56546	1889	70	4555	252	4761	137	1
M.	Lo Cos.	D.	L.Cotan.	D.	L. Tang.	L.Sine	D.	N. Cos.		N. Sine		M

Digitized by Google

M.	L.Sine.	D.	L.Tang.	D.	L.Cotan.	L.Cos	D	N. Sine	d."	N.Cos	d."	M
0	9.683571	228	9.743752	298	56248	1819	70	.484810	253	.874620	143	60
1	685799	228	744050	298	55950	1749	70	5064	4	4479	2	59
2	686027	227	744348	297	55652	1679	70	5318	8	4337	5	58
3	686254	228	744645	298	55355	1609	70	5573	13	4196	7	57
4	686482		744943		55057	1539	70	5827	17	4055	10	56
5	9 686709	227	9.745240	297	54760	1469	70	.486081	21	.873914	12	55
6	686936	227	745538	298	54462	1398	71	6335	25	3772	14	54
7	687163	227	745835	297	54165	1328	70	6589	30	3631	17	53
8	687389	226	746132	297	53868	1258	70	6844	34	3489	19	52
9	687616	227	746429	297	53571	1187	71	7098	38	3347	22	51
10	9.687843	227	9.746726	297	53274	1117	70	.487352	42	.873206	24	50
11	688069	226	747023	297	52977	1046	71	7606	46	3064	26	49
12	688295	226	747319	296	52681	0975	71	7860	51	2922	29	48
13	688521	226	747616	297	52384	0905	70	8114	55	2780	31	47
14	688747		747913	297	52087	0834	71	8367	59	2638	33	46
15	9.688972	225	9.748209	296	51791	0763	71	.488621	63	.872496	36	45
16	689198	226	748505	296	51495	0693	70	8875	68	2354	38	44
17	689423	225	748801	296	51199	0622	71	9129	72	2212	41	43
18	689648	225	749097	296	50903	0551	71	9382	76	2069	43	42
19	689873		749393		50607	0480	71	9636	80	1927	45	41
20	9.690098	225	9.749689	296	50311	0409	71	.489890	84	.871784	48	40
21	690323	225	749985	296	50015	0338	71	.490143	89	1642	50	39
22	690548	225	750281	296	49719	0267	71	0397	93	1499	52	38
23	690772	224	750576	295	49424	0196	71	0650	97	1357	55	37
24	690996	224	750872	296	49128	0125	71	0904	101	1214	57	36
25	9.691220	224	9.751167	295	48833	0054	71	.491157	105	.871071	60	35
26	691444	224	751462	295	48538	9982	72	1410	110	0928	62	34
27	691668	224	751757	295	48243	9911	71	1664	114	0785	64	33
28	691892	224	752052	295	47948	9840	71	1917	118	0642	67	32
29	692115	223	752347		47653	9768	72	2170	122	0499	69	31
30	9.692339	224	9.752642	295	47358	9697	71	.492424	127	.870356	72	30
31	692562	223	752937	295	47063	9625	72	2677	131	0212	74	29
32	692785	223	753231	294	46769	9554	71	2930	135	0069	76	28
33	693008	223	753526	295	46474	9482	72	3183	139	.869926	79	27
34	693231		753820	294	46180	9410	72	3436	143	9782	81	26
35	9.693453	222	9.754115	295	45885	9339	71	.493689	148	.869639	83	25
36	693676	223	754409	294	45591	9267	72	3942	152	9495	86	24
37	693898	222	754703	294	45297	9195	72	4195	156	9351	88	23
38	694120	222	754997	294	45003	9123	72	4448	160	9207	91	22
39	694342	222	755291	294	44709	9052	71	4700	165	9064	93	21
40	9.694564	222	9.755585	294	44415	8980	72	.494953	169	.868920	95	20
41	694786	221	755878	293	44122	8908	72	5206	173	8776	98	19
42	695007	222	756172	294	43828	8836	72	5459	177	8631	100	18
43	695229	221	756465	293	43535	8763	73	5711	181	8487	103	17
44	695450		756759	294	43241	8691	72	5964	186	8343	105	16
45	9.695671	221	9.757052	293	42948	8619	72	.496216	190	.868199	107	15
46	695892	221	757345	293	42655	8547	72	6469	194	8054	110	14
47	696113	221	757638	293	42362	8475	72	6721	198	7910	112	13
48	696334	220	757931	293	42069	8402	73	6974	202	7765	114	12
49	696554		758224	293	41776	8330	72	7226	207	7621	117	11
50	9.696775	221	9.758517	293	41483	8258	72	.497479	211	.867476	119	10
51	696995	220	758810	293	41190	8185	73	7731	215	7331	122	9
52	697215	220	759102	292	40898	8113	72	7983	219	7187	124	8
53	697435	220	759395	293	40605	8040	73	8235	224	7042	126	7
54	697654		759687	292	40313	7967	73	8488	228	6897	129	6
55	9.697874	220	9.759979	292	40021	7895	72	.498740	232	.866752	131	5
56	698094	220	760272	293	39728	7822	73	8992	236	6607	134	4
57	698313	219	760564	292	39436	7749	73	9244	240	6461	136	3
58	698532	219	760856	292	39144	7676	73	9496	245	6316	138	2
59	698751	219	761148	292	38852	7604	72	9748	249	6171	141	1
M.	L.Cos.	D.	L.Cotan.	D.	L.Tang.	L.Sine	D.	N. Cos.		N. Sine		M

Digitized by Google

M.	L. Sine	D.	L. Tang.	D.	L. Cotan.	L. Cos.	D.	N. Sine	d."	N. Cos.	d."	M.
0	9.698770	219	9.761439	292	38561	7531		.500000	251	.8660-5	148	60
1	699189	218	761731	292	38269	7458	73	0252	4	5880	3	59
2	699407	219	762023	291	37977	7385	73	0504	8	5734	5	58
3	699626	218	762314	292	37686	7312	73	0756	13	5589	7	57
4	699844	218	762606	291	37394	7238	74	1007	17	5443	10	56
5	9.700062	218	9.762897	291	37103	7165	73	.501259	21	.865297	12	55
6	700280	218	763188	291	36812	7092	73	1511	25	5151	15	54
7	700498	218	763479	291	36521	7019	73	1762	29	5005	17	53
8	700716	217	763770	291	36230	6946	73	2014	34	4859	20	52
9	700933	218	764061	291	35939	6872	74	2265	38	4713	22	51
10	9.701151	217	9.764352	291	35648	6799	73	.502517	42	.864567	25	50
11	701368	217	764643	290	35357	6725	74	2768	46	4421	27	49
12	701585	217	764933	291	35067	6652	73	3020	50	4275	30	48
13	701802	217	765224	290	34776	6578	74	3271	54	4128	32	47
14	702019	217	765514	291	34486	6505	73	3523	59	3982	35	46
15	9.702236	216	9.765805	290	34195	6431	74	.503774	63	.863835	37	45
16	702452	217	766095	290	33905	6357	74	4025	67	3689	40	44
17	702669	216	766385	290	33615	6284	73	4276	71	3542	42	43
18	702885	216	766675	290	33325	6210	74	4528	75	3396	44	42
19	703101	216	766965	290	33035	6136	74	4779	80	3249	47	41
20	9.703317	216	9.767255	290	32745	6062	74	.505030	84	.863102	49	40
21	703533	216	767545	289	32455	5988	74	5281	88	2955	52	39
22	703749	215	767834	290	32166	5914	74	5532	92	2808	54	38
23	703964	215	768124	290	31876	5840	74	5783	96	2661	57	37
24	704179	216	768414	289	31586	5766	74	6034	100	2514	59	36
25	9.704395	215	9.768703	289	31297	5692	74	.506285	105	.862366	62	35
26	704610	215	768992	289	31008	5618	74	6535	109	2219	64	34
27	704825	215	769281	289	30719	5543	75	6786	113	2072	67	33
28	705040	214	769571	290	30429	5469	74	7037	117	1924	69	32
29	705254	215	769860	289	30140	5395	74	7288	121	1777	72	31
30	9.705469	214	9.770140	288	29852	5320	75	.507538	126	.861629	74	30
31	705683	214	770437	289	29563	5246	74	7789	130	1481	77	29
32	705898	215	770726	289	29274	5171	75	8040	134	1334	79	28
33	706112	214	771015	289	28985	5097	74	8290	138	1186	81	27
34	706326	214	771303	288	28697	5022	75	8541	142	1038	84	26
35	9.706539	213	9.771592	289	28408	4948	74	508789	146	.860890	86	25
36	706753	214	771880	288	28120	4873	75	9041	151	0742	89	24
37	706967	213	772168	288	27832	4798	75	9292	155	0594	91	23
38	707180	213	772457	289	27543	4723	74	9542	159	0446	94	22
39	707393		772745	288	27255	4649	74	9792	163	0297	96	21
40	9.707606	213	9.773033	288	26967	4574	75	.510043	167	.860149	99	20
41	707819	213	773321	288	26679	4499	75	0293	172	0001	101	19
42	708032	213	773608	287	26392	4424	75	0543	176	.859852	104	18
43	708245	213	773896	288	26104	4349	75	0793	180	9704	106	17
44	708458	213	774184	288	25816	4274	75	1043	184	9555	109	16
45	9.708670	212	9.774471	287	25529	4199	75	.511293	188	.859406	111	15
46	708882	212	774759	288	25241	4123	76	1543	192	9258	114	14
47	709094	212	775046	287	24954	4048	75	1793	197	9109	116	13
48	709306	212	775333	287	24667	3973	75	2043	201	8960	118	12
49	709518	212	775621	288	24379	3898	75	2293	205	8811	121	11
50	9.709730	211	9.775908	287	24092	3822	76	512542	209	.858662	123	10
51	709941	212	776195	287	23805	3747	75	2792	213	8513	126	9
52	710153	211	776482	287	23518	3671	76	3042	218	8363	128	8
53	710364	211	776768	286	23232	3596	75	3292	222	8214	131	7
54	710575	211	777055	287	22945	3520	76	3541	226	8065	133	6
55	9.710786	211	9.777342	287	22658	3445	75	.513791	230	.857915	136	5
56	710997	211	777628	286	22372	3369	76	4040	234	7766	138	4
57	711208	211	777915	287	22085	3293	76	4290	239	7616	141	3
58	711419	210	778201	286	21799	3217	76	4539	243	7467	143	2
59	711629	211	778488	287	21512	3141	76	4789	247	7317	146	1
M.	L. Cos	D.	L. Cotan.	D.	L. Tang.	L. Sine	D.	N. Cos.		N. Sine		M

Digitized by Google

M.	L. Sine.	D.	L. Tang	D	L. Cotan	L. Cos.	D	N. Sine.	d.	N. Cos.	d.	M.
0	9.711839	211	9.778774	286	21226	3066	76	.515038	48	.857167	15	60
1	712050	210	779060	286	10.2 20940	9.93 2990	76	5287	4	7017	3	59
2	712260	209	779346	286	20654	2914	76	5537	8	6867	5	58
3	712469	210	779632	286	20368	2838	76	5786	12	6717	8	57
4	712679	210	779918	285	20082	2762	76	6035	17	6567	10	56
5	9.712889	209	9.780203	286	19797	2685	77	.516284	21	.856417	13	55
6	713098	210	780489	286	10.2 19511	9.93 2609	76	6533	25	6267	15	54
7	713308	209	780775	285	19225	2533	76	6782	29	6117	18	53
8	713517	209	781060	286	18940	2457	77	7031	33	5966	20	52
9	713726	209	781346	285	18654	2380	76	7280	37	5816	23	51
10	9.713935	209	9.781631	285	18369	2304	76	.517529	41	.855665	25	50
11	714144	208	781916	285	10.2 18084	9.93 2228	77	7778	46	5515	28	49
12	714352	209	782201	285	17799	2151	76	8027	50	5364	30	48
13	714561	208	782486	285	17514	2075	77	8276	54	5213	33	47
14	714769	209	782771	285	17229	1998	77	8525	58	5063	36	46
15	9.714978	208	9.783056	285	16944	1921	77	.518773	62	.854912	38	45
16	715186	208	783341	285	10.2 16659	9.93 1845	76	9022	66	4761	41	44
17	715394	208	783626	285	16374	1768	77	9270	70	4610	43	43
18	715602	207	783910	284	16090	1691	77	9519	74	4459	46	42
19	715809	208	784195	285	15805	1614	77	9768	79	4308	48	41
20	9.716017	207	9.784479	284	15521	1537	77	.520016	83	.854156	51	40
21	716224	208	784764	285	10.2 15236	9.93 1460	77	0265	87	4005	53	39
22	716432	207	785048	284	14952	1383	77	0513	91	3854	56	38
23	716639	207	785332	284	14668	1306	77	0761	95	3702	58	37
24	716846	207	785616	284	14384	1229	77	1010	99	3551	61	36
25	9.717053	206	9.785900	284	14100	1152	77	.521258	103	.853399	63	35
26	717259	207	786184	284	10.2 13816	9.93 1075	77	1506	108	3247	66	34
27	717466	207	786468	284	13532	0998	77	1754	112	3096	68	33
28	717673	206	786752	284	13248	0921	78	2002	116	2944	71	32
29	717879	206	787036	283	12964	0843	77	2250	120	2792	74	31
30	9.718085	206	9.787319	284	12681	0766	78	.522499	124	.852640	76	30
31	718291	206	787603	283	10.2 12397	9.93 0688	77	2747	128	2488	79	29
32	718497	206	787886	284	12114	0611	78	2994	132	2336	81	28
33	718703	206	788170	283	11830	0533	77	3242	136	2184	84	27
34	718909	205	788453	283	11547	0456	78	3490	141	2032	86	26
35	9.719114	206	9.788736	283	11264	0378	78	.523738	145	.851879	89	25
36	719320	205	789019	283	10.2 10981	9.93 0300	78	3986	149	1727	91	24
37	719525	205	789302	283	10698	0223	77	4234	153	1574	94	23
38	719730	205	789585	283	10415	0145	78	4481	157	1422	96	22
39	719935	205	789868	283	10132	0067	78	4729	161	1269	99	21
40	9.720140	205	9.790151	283	09849	9989	78	.524977	165	.851117	101	20
41	720345	204	790434	282	10.2 09566	9.92 9911	78	5224	170	0964	104	19
42	720549	205	790716	283	092[illegible]	9833	78	5472	174	0811	106	18
43	720754	204	790999	282	09[illegible]	9755	78	5719	178	0658	109	17
44	720958	204	791281	282	08[illegible]	0677	78	5966	182	0505	112	16
45	9.721162	204	9.791563	283	084[illegible]	9599	78	.526214	186	.850352	114	15
46	721366	204	791846	282	0815[illegible]	9521	78	6461	190	0199	117	14
47	721570	204	792128	282	10.2 07872	9.92 9442	79	6708	194	0046	119	13
48	721774	204	792410	282	07590	9364	78	6956	198	.849893	122	12
49	721978	203	792692	282	07308	9286	78	7203	203	9739	124	11
50	9.722181	204	9.792974	282	07026	9207	79	.527450	207	.849586	127	10
51	722385	203	793256	282	10.2 06744	9.92 9129	78	7697	211	9432	129	9
52	722588	203	793538	281	06462	9050	79	7944	215	9279	132	8
53	722791	203	793819	282	06181	8972	78	8191	219	9125	134	7
54	722994	203	794101	282	05899	8893	79	8438	223	8972	137	6
55	9.723197	203	9.794383	281	05617	8815	78	.528685	227	.848818	139	5
56	723400	203	794664	282	10.2 05336	9.92 8736	79	8932	232	8664	142	4
57	723603	202	794946	281	05054	8657	79	9179	236	8510	144	3
58	723805	202	795227	281	04773	9.92 8578	79	9426	240	8356	147	2
59	724007		795508		04492	8499		9673	244	8202	150	1
M.	Lo. Cos	D.	L. Cotan.	D.	L. Tang	L. Sine.	D.	N. Cos.		N. Sine		M.

Digitized by Google

M.	L.Sine.	D.	L. Tang	D.	L.Cotan	L Cos.	D.	N.Sine.	d.″	N. Cos.	d.″	M
0	9·724210	202	9·795789	281	04211	8420	78	·529919	246	·848048	156	60
1	724412	202	796070	281	10.2 03930	9.92 8342	79	·530166	4	7894	3	59
2	724614	202	796351	281	03649	8263	80	0412	8	7740	5	58
3	724816	201	796632	281	03368	8183	79	0659	12	7585	8	57
4	725017	202	796913	281	03087	8104	79	0906	16	7431	10	56
5	9·725219	201	9·797194	280	02806	8025	79	·531152	21	·847276	13	55
6	725420	202	797474	281	10.2 02526	9.92 7946	79	1399	25	7122	16	54
7	725622	201	797755	281	02245	7867	80	1645	29	6967	18	53
8	725823	201	798036	280	01964	7787	79	1891	33	6813	21	52
9	726024	201	798316	280	01684	7708	79	2138	37	6658	23	51
10	9·726225	201	9·798596	281	01404	7629	80	·532384	41	·846503	26	50
11	726426	200	798877	280	10.2 01123	9.92 7549	79	2630	45	6348	29	49
12	726626	201	799157	280	00843	7470	80	2876	49	6193	31	48
13	726827	200	799437	280	00563	7390	80	3122	53	6038	34	47
14	727027	201	799717	280	00283	7310	79	3368	57	5883	36	46
15	9·727228	200	9·799997	280	00003	7231	80	·533614	62	·845728	39	45
16	727428	200	800277	280	99723	7151	80	3860	66	5573	42	44
17	727628	200	800557	279	10.1 99443	9.92 7071	80	4106	70	5417	44	43
18	727828	199	800836	280	99164	6991	80	4352	74	5262	47	42
19	728027	200	801116	280	98884	6911	80	4598	78	5106	49	41
20	9·728227	200	9·801396	279	98604	6831	80	·534844	82	·844951	52	40
21	728427	199	801675	280	98325	6751	80	5090	86	4795	55	39
22	728626	199	801955	279	10.1 98045	9.92 6671	80	5335	90	4639	57	38
23	728825	199	802234	279	97766	6591	80	5581	94	4484	60	37
24	729024	199	802513	279	97487	6511	80	5827	98	4328	62	36
25	9·729223	199	9·802792	279	97208	6431	80	·536072	103	·844172	65	35
26	729422	199	803072	280	96928	6351	80	6318	107	4016	68	34
27	729621	199	803351	279	10.1 96649	9.92 6270	81	6563	111	3860	70	33
28	729820	199	803630	279	96370	6190	80	6809	115	3704	73	32
29	730018	198	803909	279	96091	6110	80	7054	119	3548	75	31
30	9·730217	199	9·804187	278	95813	6029	81	·537300	123	·843391	78	30
31	730415	198	804466	279	95534	5949	80	7545	127	3235	81	29
32	730613	198	804745	279	10.1 95255	9.92 5868	81	7790	131	3079	83	28
33	730811	198	805023	278	94977	5788	80	8035	135	2922	86	27
34	731009	197	805302	279	94698	5707	81	8281	139	2766	88	26
35	9·731206	198	9·805580	278	94420	5626	81	·538526	144	·842609	91	25
36	731404	198	805859	279	94141	5545	80	8771	148	2452	94	24
37	731602	198	806137	278	10.1 93863	9.92 5465	81	9016	152	2296	96	23
38	731799	197	806415	278	93585	5384	81	9261	156	2139	99	22
39	731996	197	806693	278	93307	5303	81	9506	160	1982	101	21
40	9·732193	197	9·806971	278	93029	5222	81	·539751	164	·841825	104	20
41	732390	197	807249	278	92751	5141	81	9995	168	1668	107	19
42	732587	197	807527	278	1.01 92473	9.92 5060	81	·540240	172	1511	109	18
43	732784	197	807805	278	92195	4979	82	0485	176	1354	112	17
44	732980	196	808083	278	91917	4897	81	0730	180	1196	114	16
45	9·733177	197	9·808361	278	91639	4816	81	·540974	185	·841039	117	15
46	733373	196	808638	277	91362	4735	81	1219	189	0882	120	14
47	733569	196	808916	278	10.1 91084	9.92 4654	82	1464	193	0724	122	13
48	733765	196	809193	277	90807	4572	81	1708	197	0567	125	12
49	733961	196	809471	278	90529	4491	82	1953	201	0409	127	11
50	9·734157	196	9·809748	277	90252	4409	81	·542197	205	·840251	130	10
51	734353	195	810025	277	10.1 89975	9.92 4328	82	2441	209	0094	133	9
52	734548	196	810302	278	89698	4246	82	2686	213	·839936	135	8
53	734744	195	810580	277	89420	4164	81	2930	217	9778	138	7
54	734939	196	810857	277	89143	4083	82	3174	221	9620	140	6
55	9·735135	195	9·811134	277	88866	4001	82	·543419	226	·839462	143	5
56	735330	195	811410	276	88590	3919	82	3663	230	9304	146	4
57	735525	195	811687	277	10.1 88313	9.92 3837	82	3907	234	9145	148	3
58	735719	194	811964	277	88036	3755	82	4151	238	8987	151	2
59	735914	195	812241	277	87759	3673	82	4395	242	8829	153	1
M.	L. Cos.	D.	L.Cotan	D.	L. Tang.	L Sine	D.	N. Cos.		N.Sine		M

Digitized by Google

M.	L.Sine.	D.	L. Tang	D.	L.Cotan	L Cos.	D	N.Sine.	d″	N. Cos.	d″	M
0	9.736109		9.812517		87483	3591		·544639	243	·838671	160	60
1	736303	194	812794	277	87206	3509	82	4883	4	8512	3	59
2	736498	195	813070	276	86930	3427	82	5127	8	8354	5	58
3	736692	194	813347	277	86653	3345	82	5371	12	8195	8	57
4	736886	194	813623	276	86377	3263	82	5614	16	8036	11	56
5	9.737080	194	9.813899	276	86101	3181	83	·545858	20	·837877	13	55
6	737274	194	814176	277	85824	3098	82	6102	24	7719	16	54
7	737467	193	814452	276	85548	3016	83	6346	28	7560	19	53
8	737661	194	814728	276	85272	2933	82	6589	32	7401	21	52
9	737855	194	815004	276	84996	2851	83	6833	37	7242	24	51
10	9.738048	193	9.815280	275	84720	2768	82	·547076	41	·837083	27	50
11	738241	193	815555	276	84445	2686	83	7320	45	6924	29	49
12	738434	193	815831	276	84169	2603	83	7563	49	6764	32	48
13	738627	193	816107	275	83893	2520	82	7807	53	6605	35	47
14	738820	193	816382	276	83618	2438	83	8050	57	6446	37	46
15	9.739013	193	9.816658	275	83342	2355	83	·548293	61	·836286	40	45
16	739206	193	816933	276	83067	2272	83	8536	65	6127	43	44
17	739398	192	817209	275	82791	2189	83	8780	69	5967	45	43
18	739590	192	817484	275	82516	2106	83	9023	73	5807	48	42
19	739783	193	817759	276	82241	2023	83	9266	77	5648	51	41
20	9.739975	192	9.818035	275	81965	1940	83	·549509	81	·835488	53	40
21	740167	192	818310	275	81690	1857	83	9752	85	5328	56	39
22	740359	192	818585	275	81415	1774	83	·549995	89	5168	59	38
23	740550	191	818860	275	81140	1691	83	·550238	93	5008	61	37
24	740742	192	819135	275	80865	1607	84	0481	97	4848	64	36
25	9.740934	191	9.819410	274	80590	1524	83	·550724	101	·834688	67	35
26	741125	191	819684	275	80316	1441	84	0966	105	4527	69	34
27	741316	191	819959	275	80041	1357	83	1209	109	4367	72	33
28	741508	192	820234	274	79766	1274	84	1452	113	4207	75	32
29	741699	191	820508	275	79492	1190	83	1694	118	4046	77	31
30	9.741889	190	9.820783	274	79217	1107	84	·551937	122	·833886	80	30
31	742080	191	821057	275	78943	1023	84	2179	126	3725	83	29
32	742271	191	821332	274	78668	0939	83	2422	130	3565	85	28
33	742462	191	821606	274	78394	0856	84	2664	134	3404	88	27
34	742652	190	821880	274	78120	0772	84	2907	138	3243	91	26
35	9.742842	190	9.822154	275	77846	0688	84	·553149	142	·833082	93	25
36	743033	191	822429	274	77571	0604	84	3391	146	2921	96	24
37	743223	190	822703	274	77297	0520	84	3634	150	2760	99	23
38	743413	190	822977	274	77023	0436	84	3876	154	2599	101	22
39	743602	189	823251	274	76749	0352	84	4118	158	2438	104	21
40	9.743792	190	9.823524	273	76476	0268	84	·554360	162	·832277	107	20
41	743982	190	823798	274	76202	0184	84	4602	166	2115	109	19
42	744171	189	824072	274	75928	0099	85	4844	170	1954	112	18
43	744361	190	824345	273	75655	0015	84	5086	174	1793	115	17
44	744550	189	824619	274	75381	9931	84	5328	178	1631	117	16
45	9.744739	189	9.824893	273	75107	9846	85	·555570	182	·831470	120	15
46	744928	189	825166	273	74834	9762	84	5812	186	1308	123	14
47	745117	189	825439	274	74561	9677	85	6054	190	1146	125	13
48	745306	188	825713	273	74287	9593	84	6296	194	0984	128	12
49	745494	189	825986	273	74014	9508	85	6537	199	0823	131	11
50	9.745683	188	9.826259	273	73741	9424	84	·556779	203	·830661	133	10
51	745871	189	826532	273	73468	9339	85	7021	207	0499	136	9
52	746060	188	826805	273	73195	9254	85	7262	211	0337	139	8
53	746248	188	827078	273	72922	9169	84	7504	215	0174	141	7
54	746436	188	827351	273	72649	9085	85	7745	219	830012	144	6
55	9.746624	188	9.827624	273	72376	9000	85	·557986	223	·829850	147	5
56	746812	187	827897	273	72103	8915	85	8228	227	9688	149	4
57	746999	188	828170	272	71830	8830	85	8469	231	9525	152	3
58	747187	187	828442	273	71558	8745	86	8710	235	9363	155	2
59	747374		828715		71285	8659		8952	239	9200	157	1
M.	L. Cos.	D.	L.Cotan	D.	L.Tang.	L.Sine	D	N. Cos.		N. Sine		M

Digitized by Google

M.	L. Sine.	D.	L. Tang.	D.	L.Cotan.	L.Cos.	D.	N. Sine	d."	N.Cos	d."	M
0	9.747562	187	9.828987	273	71013	8574	85	.559193	240	.829038	165	60
1	747749	187	829260	272	10.1 70740	8489	85	9434	4	8875	3	59
2	747936	187	829532	273	70468	9.9 8404	86	9675	8	8712	6	58
3	748123	187	829805	272	70195	8318	85	.559916	12	8549	8	57
4	748310	187	830077	272	69923	8233	86	.560157	16	8386	11	56
5	9.748497	186	9.830349	272	69651	8147	85	.560398	20	.828223	14	55
6	748683	187	830621	272	10.1 69379	9.9 8062	86	0639	24	8060	17	54
7	748870	186	830893	272	69107	7976	85	0880	28	7897	19	53
8	749056	187	831165	272	68835	7891	86	1121	32	7734	22	52
9	749243	186	831437	272	68563	7805	86	1361	36	7571	25	51
10	9.749429	186	9.831709	272	68291	7719	85	.561602	40	.827407	28	50
11	749615	186	831981	272	10.1 68019	9.9 7634	86	1843	44	7244	30	49
12	749801	186	832253	272	67747	7548	86	2083	48	7081	33	48
13	749987	185	832525	271	67475	7462	86	2324	52	6917	36	47
14	750172	186	832796	272	67204	7376	86	2564	56	6753	39	46
15	9.750358	185	9.833068	271	66932	7290	86	.562805	60	.826590	41	45
16	750543	186	833339	272	10.1 66661	9.9 7204	86	3045	64	6426	44	44
17	750729	185	833611	271	66389	7118	86	3286	68	6262	47	43
18	750914	185	833882	272	66118	7032	86	3526	72	6098	50	42
19	751099	185	834154	272	65846	6946	86	3766	76	5934	52	41
20	9.751284	185	9.834425	271	65575	6859	87	.564007	80	.825770	55	40
21	751469	185	834696	271	10.1 65304	9.9 6773	86	4247	84	5606	58	39
22	751654	185	834967	271	65033	6687	87	4487	88	5442	61	38
23	751839	184	835238	271	64762	6600	86	4727	92	5278	63	37
24	752023	185	835509	271	64491	6514	87	4967	96	5113	66	36
25	9.752208	184	9.835780	271	64220	6427	86	.565207	100	.824949	69	35
26	752392	184	836051	271	10.1 63949	9.9 6341	87	5447	104	4785	72	34
27	752576	184	836322	271	63678	6254	87	5687	108	4620	74	33
28	752760	184	836593	271	63407	6167	86	5927	112	4456	77	32
29	752944	184	836864	270	63136	6081	87	6166	116	4291	80	31
30	9.753128	184	9.837134	271	62866	5994	87	.566406	120	824126	83	30
31	753312	185	837405	270	10.1 62595	9.9 5907	87	6646	124	3961	85	29
32	753495	184	837675	271	62325	5820	87	6886	128	3796	88	28
33	753679	183	837946	270	62054	5733	87	7125	132	3632	91	27
34	753862	184	838216	271	61784	5646	87	7365	136	3467	94	26
35	9.754046	183	9.838487	270	61513	5559	87	.567604	140	.823301	96	25
36	754229	183	838757	270	10.1 61243	9.9 5472	87	7844	144	3136	99	24
37	754412	183	839027	270	60973	5385	88	8083	148	2971	102	23
38	754595	183	839297	271	60703	5297	87	8322	152	2806	105	22
39	754778	182	839568	270	60432	5210	87	8562	156	2640	107	21
40	9.754960	183	9.839838	270	60162	5123	88	.568801	160	.822475	110	20
41	755143	183	840108	270	10.1 59892	9.9 5035	87	9040	164	2310	113	19
42	755326	182	840378	270	59622	4948	88	9279	168	2144	116	18
43	755508	182	840648	269	59352	4860	87	9519	172	1978	118	17
44	755690	182	840917	270	59083	4773	88	9758	176	1813	121	16
45	9.755872	182	9.841187	270	58813	4685	87	.569997	180	.821647	124	15
46	756054	182	841457	270	10.1 58543	9.9 4598	88	.570236	184	1481	127	14
47	756236	182	841727	269	58273	4510	88	0475	188	1315	129	13
48	756418	182	841996	270	58004	4422	88	0714	192	1149	132	12
49	756600	182	842266	269	57734	4334	88	0952	196	0983	135	11
50	9.756782	181	9.842535	270	57465	4246	88	.571191	200	.820817	138	10
51	756963	181	842805	269	10.1 57195	9.9 4158	88	1430	204	0651	140	9
52	757144	182	843074	269	56926	4070	88	1669	208	0485	143	8
53	757326	181	843343	269	56657	3982	88	1907	212	0318	146	7
54	757507	181	843612	269	56388	3894	88	2146	216	.820152	149	6
55	9.757688	181	9.843882	270	56118	3806	88	.572384	220	.819985	151	5
56	757869	181	844151	269	10.1 55849	9.9 3718	88	2623	224	9819	154	4
57	758050	180	844420	269	55580	3630	89	2861	228	9652	157	3
58	758230	181	844689	269	55311	3541	88	3100	232	9486	160	2
59	758411		844958		55042	3453		3338	236	9319	162	1
M.	Lo Cos.	D.	L.Cotan.	D.	L Tang.	.Sine	D.	N. Cos.		N.Sine		M

Digitized by Google

M.	L. Sine	D.	L. Tang.	D.	L. Cotan.	L. Cos.	D.	N. Sine	d.	N. Cos.	d.	M.
0	9.758591	181	9.845227	269	54773	3365	89	.573576	237	.819152	169	60
1	758772	180	845496	268	54504	3276	89	3815	4	8985	3	59
2	758952	180	845764	269	54236	3187	88	4053	8	8818	0	58
3	759132	180	846033	269	53967	3099	89	4291	12	8651	9	57
4	759312	180	846302	268	53698	3010	89	4529	16	8484	11	56
5	9.759492	180	9.846570	269	53430	2922	88	.574767	20	.818317	14	55
6	759672	180	846839	269	53161	2833	89	5005	24	8150	17	54
7	759852	179	847108	268	52892	2744	89	5243	28	7982	20	53
8	760031	180	847376	268	52624	2655	89	5481	32	7815	23	52
9	760211	179	847644	269	52356	2566	89	5719	36	7648	25	51
10	9.760390	179	9.847913	268	52087	2477	89	.575957	40	.817480	28	50
11	760569	179	848181	268	51819	2388	89	6195	44	7312	31	49
12	760748	179	848449	268	51551	2299	89	6432	47	7145	34	48
13	760927	179	848717	269	51283	2210	89	6670	51	6977	37	47
14	761106	179	848986	268	51014	2121	90	6908	55	6809	39	46
15	9.761285	179	9.849254	268	50746	2031	89	.577145	59	.816642	42	45
16	761464	178	849522	268	50478	1942	89	7383	63	6474	45	44
17	761642	179	849790	268	50210	1853	90	7620	67	6306	48	43
18	761821	178	850057	267	49942	1763	89	7858	71	6138	51	42
19	761999	178	850325	268	49675	1674	90	8095	75	5969	54	41
20	9.762177	179	9.850593	268	49407	1584	89	.578332	79	.815801	56	40
21	762356	178	850861	268	49139	1495	90	8570	83	5633	59	39
22	762534	178	851129	268	48871	1405	90	8807	87	5465	62	38
23	762712	177	851396	267	48604	1315	90	9044	91	5296	65	37
24	762889	178	851664	268	48336	1226	89	9281	95	5128	68	36
25	9.763067	178	9.851931	267	48069	1136	90	.579518	99	.814959	70	35
26	763245	177	852199	268	47801	1046	90	9755	103	4791	73	34
27	763422	178	852466	267	47534	0956	90	.579992	107	4622	76	33
28	763600	177	852733	267	47267	0866	90	.580229	111	4453	79	32
29	763777	177	853001	268	46999	0776	90	0466	115	4284	82	31
30	9.763954	177	9.853268	267	46732	0686	90	.580703	119	.814115	85	30
31	764131	177	853535	267	46465	0596	90	0940	123	3947	87	29
32	764308	177	853802	267	46198	0506	90	1176	126	3777	90	28
33	764485	177	854069	267	45931	0415	91	1413	130	3608	93	27
34	764662	177	854336	267	45664	0325	90	1650	134	3439	96	26
35	9.764838	176	9.854603	267	45397	0235	90	.581886	138	.813270	99	25
36	765015	177	854870	267	45130	0144	91	2123	142	3101	101	24
37	765191	176	855137	267	44863	0054	90	2359	146	2931	104	23
38	765367	176	855404	267	44596	9963	91	2596	150	2762	107	22
39	765544	177	855671	267	44329	9873	90	2832	154	2592	110	21
40	9.765720	176	9.855938	266	44062	9782	91	.583069	158	.812423	113	20
41	765896	176	856204	267	43796	9691	91	3305	162	2253	116	19
42	766072	176	856471	266	43529	9601	90	3541	166	2083	118	18
43	766247	175	856737	267	43263	9510	91	3777	170	1914	121	17
44	766423	176	857004	266	42996	9419	91	4014	174	1744	124	16
45	9.766598	175	9.857270	267	42730	9328	91	.584250	178	.811574	127	15
46	766774	176	857537	266	42463	9237	91	4486	182	1404	130	14
47	766949	175	857803	266	42197	9146	91	4722	186	1234	132	13
48	767124	175	858069	267	41931	9055	91	4958	190	1064	135	12
49	767300	176	858336	266	41664	8964	91	5194	194	0894	138	11
50	9.767475	175	9.858602	266	41398	8873	92	.585429	198	.810723	141	10
51	767649	174	858868	266	41132	8781	91	5665	202	0553	144	9
52	767824	175	859134	266	40866	8690	91	5901	205	0383	147	8
53	767999	175	859400	266	40600	8599	92	6137	209	0212	149	7
54	768173	174	859666	266	40334	8507	91	6372	213	.810042	152	6
55	9.768348	175	9.859932	266	40068	8416	92	.586608	217	.809871	155	5
56	768522	174	860198	266	39802	8324	91	6843	221	9700	158	4
57	768697	175	860464	266	39536	8233	92	7079	225	9530	161	3
58	768871	174	860730	265	39270	8141	92	7314	229	9359	163	2
59	769045	174	860995		39005	8049	92	7550	233	9188	166	1
M.	L. Cos.	D.	L. Cotan.	D.	L. Tang.	L. Sine	D.	N. Cos.		N. Sine		M.

Digitized by Google

M.	L. Sine.	D.	L.Tang	D	L.Cotan	L.Cos.	D.	N. Sine.	d.''	N. Cos.	d.''	M.
0	9·769219	174	9.861261	266	38739	7958	92	·587785	234	·809017	173	60
1	769393	173	861527	265	10.1 38473	9.99 7866	92	8021	4	8846	3	59
2	769566	174	861792	266	38208	7774	92	8256	8	8675	6	58
3	769740	173	862058	265	37942	7682	92	8491	12	8504	9	57
4	769913	174	862323	266	37677	7590	92	8726	16	8332	12	56
5	9·770087	173	9.862589	265	37411	7498	92	·588961	20	·808161	14	55
6	770260	173	862854	265	10.1 37146	9.99 7406	92	9196	23	7990	17	54
7	770433	173	863119	266	36881	7314	92	9431	27	7818	20	53
8	770606	173	863385	265	36615	7222	93	9666	31	7647	23	52
9	770779	173	863650	265	36350	7129	92	·589901	35	7475	26	51
10	9·770952	173	9.863915	265	36085	7037	92	·590136	39	·807304	29	50
11	771125	173	864180	265	10.1 35820	9.99 6945	93	0371	43	7132	32	49
12	771298	172	864445	265	35555	6852	92	0606	47	6960	35	48
13	771470	173	864710	265	35290	6760	93	0840	51	6788	38	47
14	771643	172	864975	265	35025	6667	92	1075	55	6617	40	46
15	9·771815	172	9.865240	265	34760	6575	93	·591310	59	·806445	43	45
16	771987	172	865505	265	10.1 34495	9.99 6482	93	1544	62	6273	46	44
17	772159	172	865770	265	34230	6389	93	1779	66	6100	49	43
18	772331	172	866035	265	33965	6296	93	2013	70	5928	52	42
19	772503	172	866300	264	33700	6204	92	2248	74	5756	55	41
20	9·772675	172	9.866564	265	33436	6111	93	·592482	78	·805584	58	40
21	772847	171	866829	265	10.1 33171	9.99 6018	93	2716	82	5411	61	39
22	773018	172	867094	264	32906	5925	93	2950	86	5239	64	38
23	773190	171	867358	265	32642	9.99 5832	93	3185	90	5066	66	37
24	773361	172	867623	264	32377	5739	93	3419	94	4894	69	36
25	9·773533	171	9.867887	265	32113	5645	94	·593653	98	·804721	72	35
26	773704	171	868152	264	10.1 31848	9.99 5552	93	3887	101	4548	75	34
27	773875	171	868416	264	31584	5459	93	4121	105	4376	78	33
28	774046	171	868680	265	31320	9.99 5366	93	4355	109	4203	81	32
29	774217	171	868945	264	31055	5272	94	4589	113	4030	84	31
30	9·774388	170	9.869209	264	30791	5179	93	·594823	117	·803857	87	30
31	774558	171	869473	264	10 1 30527	9.99 5085	94	5057	121	3684	89	29
32	774729	170	869737	264	30263	4992	93	5290	125	3511	92	28
33	774899	171	870001	264	29999	9.99 4898	94	5524	129	3337	95	27
34	775070	170	870265	264	29735	4804	94	5758	133	3164	98	26
35	9·775240	170	9.870529	264	29471	4711	93	·595991	137	·802991	101	25
36	775410	170	870793	264	10.1 29207	9.99 4617	94	6225	140	2817	104	24
37	775580	170	871057	264	28943	4523	94	6458	144	2644	107	23
38	775750	170	871321	264	28679	9.99 4429	94	6692	148	2470	110	22
39	775920	170	871585	264	28415	4335	94	6925	152	2297	113	21
40	9·776090	169	9.871849	264	28151	4241	94	·597159	156	·802123	115	20
41	776259	170	872112	263	10.1 27888	9.99 4147	94	7392	160	1949	118	19
42	776429	169	872376	264	27624	4053	94	7625	164	1776	121	18
43	776598	170	872640	264	27360	9.99 3959	94	7858	168	1602	124	17
44	776768	169	872903	263	27097	3864	95	8091	172	1428	127	16
45	9·776937	169	9.873167	264	26833	3770	94	·598325	176	·801254	130	15
46	777106	169	873430	263	10.1 26570	9.99 3676	94	8558	179	1080	133	14
47	777275	169	873694	264	26306	3581	95	8791	183	0906	136	13
48	777444	169	873957	263	26043	9.99 3487	94	9024	187	0731	138	12
49	777613	168	874220	263	25780	3392	95	9256	191	0557	141	11
50	9·777781	169	9 874484	264	25516	3298	94	·599489	195	·800383	144	10
51	777950	169	874747	263	10.1 25253	9.99 3203	95	9722	199	0208	147	9
52	778119	168	875010	263	24990	3108	95	·599955	203	·800034	150	8
53	778287	168	875273	264	24727	9.99 3014	94	·600188	207	·799859	153	7
54	778455	169	875537	263	24463	2919	95	0420	211	9685	156	6
55	9·778624	168	9.875800	263	24200	2824	95	·600653	215	·799510	159	5
56	778792	168	876063	263	10.1 23937	9.99 2729	95	0885	218	9335	162	4
57	778960	168	876326	263	23674	2634	95	1118	222	9160	164	3
58	779128	167	876589	263	23411	9.99 2539	95	1350	226	8985	167	2
59	779295		876852		23148	2444	95	1583	230	8810	170	1
M.	Lo. Cos.	D.	L.Cotan.	D.	L.Tang.	L.Sine.	D.	N. Cos.		N. Sine		M.

Digitized by Google

M.	L. Sine.	D.	L.Tang	D.	L.Cotan	L.Cos.	D.	N. Sine.	d."	N. Cos.	d."	M
0	9.779403	168	9.877114	263	22886	2349	96	.601815	230	.798635	177	60
1	779631	167	877377	263	22623	2253	95	2047	4	8460	3	59
2	779798	168	877640	263	22360	2158	95	2279	8	8285	6	58
3	779966	167	877903	262	22097	2063	95	2512	12	8110	9	57
4	780133		878165		21835	1967	96	2744	15	7935	12	56
5	9.780300	167	9.878428	263	21572	1872	95	.60 2976	19	.797759	15	55
6	780467	167	878691	262	21309	1776	96	3208	23	7584	18	54
7	780634	167	878953	263	21047	1681	95	3440	27	7408	21	53
8	780801	167	879216	262	20784	1585	96	3672	31	7233	24	52
9	780968	167	879478		20522	1490	95	3904	35	7057	27	51
10	9.781134	166	9.879741	263	20259	1394	96	.604136	38	.796881	30	50
11	781301	167	880003	262	19997	1298	96	4367	42	6706	33	49
12	781468	167	880265	263	19735	1202	96	4599	46	6530	35	48
13	781634	166	880528	262	19472	1106	96	4831	50	6354	38	47
14	781800	166	880790		19210	1010	96	5062	54	6178	41	46
15	9.781966	166	9.881052	262	18948	0914	96	.605294	58	.796002	44	45
16	782132	166	881314	262	18686	0818	96	5525	61	5826	47	44
17	782298	166	881577	263	18423	0722	96	5757	65	5650	50	43
18	782464	166	881839	262	18161	0626	96	5988	69	5473	53	42
19	782630	166	882101	262	17899	0529	97	6220	73	5297	56	41
20	9.782796	165	9.882363	262	17637	0433	96	.606451	77	.795121	59	40
21	782961	166	882625	262	17375	0337	96	6682	81	4944	62	39
22	783127	165	882887	261	17113	0240	97	6914	84	4768	65	38
23	783292	166	883148	262	16852	0144	96	7145	88	4591	68	37
24	783458	165	883410	262	16590	0047	97	7376	92	4415	71	36
25	9.783623	165	9.883672	262	16328	9951	96	.607607	96	.794238	74	35
26	783788	165	883934	262	16066	9854	97	7838	100	4061	77	34
27	783953	165	884196	261	15804	9757	97	8069	104	3884	80	33
28	784118	164	884457	262	15543	9660	97	8300	107	3707	83	32
29	784282	165	884719	261	15281	9564	96	8531	111	3530	86	31
30	9.784447	165	9.884980	262	15020	9467	97	.608761	115	.793353	89	30
31	784612	164	885242	262	14758	9370	97	8992	119	3176	92	29
32	784776	166	885504	261	14496	9273	97	9223	123	2999	94	28
33	784941	164	885765	261	14235	9176	97	9453	127	2822	97	27
34	785105	164	886026	262	13974	9078	98	9684	130	2644	100	26
35	9.785269	164	9.886288	261	13712	8981	97	.609915	134	.792467	103	25
36	785433	164	886549	262	13451	8884	97	.610145	138	2290	106	24
37	785597	164	886811	261	13189	8787	97	0376	142	2112	109	23
38	785761	164	887072	261	12928	8689	99	0606	146	1934	112	22
39	785925	164	887333	261	12667	8592	97	0836	150	1757	115	21
40	9.786089	163	9.887594	261	12406	8494	98	.611067	153	.791579	118	20
41	786252	164	887855	261	12145	8397	97	1297	157	1401	121	19
42	786416	163	888116	262	11884	8299	98	1527	161	1223	124	18
43	786579	163	888378	261	11622	8202	97	1757	165	1046	127	17
44	786742	164	888639	261	11361	8104	98	1987	169	0868	130	16
45	9.786906	163	9.888900	261	11100	8006	98	.612217	173	.790690	133	15
46	787069	163	889161	260	10839	7908	98	2447	176	0511	136	14
47	787232	163	889421	261	10579	7810	98	2677	180	0333	139	13
48	787395	162	889682	261	10318	7712	98	2907	184	.790155	142	12
49	787557	163	889943	261	10057	7614	98	3137	188	.789977	145	11
50	9.787720	163	9 890204	261	09796	7516	98	.613367	192	.789798	148	10
51	787883	162	890465	260	09535	7418	98	3596	196	9620	151	9
52	788045	163	890725	261	09275	7320	98	3826	199	9441	153	8
53	788208	162	890986	261	09014	7222	98	4056	203	9263	156	7
54	788370	162	891247	260	08753	7123	99	4285	207	9084	159	6
55	9.788532	162	9.891507	261	08493	7025	98	.614515	211	.788905	162	5
56	788694	162	891768	260	08232	6926	99	4744	215	8727	165	4
57	788856	162	892028	261	07972	6828	98	4974	219	8548	168	3
58	789018	162	892289	260	07711	6729	99	5203	222	8369	171	2
59	789180		892549		07451	6631	99	5432	226	8190	174	1
M.	Lo. Cos.	D.	L.Cotan.	D.	L.Tang.	L Sine.	D.	N. Cos.		N. Sine		M

Digitized by Google

M.	L.Sine.	D.	L. Tang	D.	L. Cotan	L.Cos.	D.	N.Sine.	d.″	N. Cos.	d.″	M
0	9 789342	162	9.892810	260	07190	6532	99	.615661	228	.788011	181	60
1	789504	161	893070	261	06930	6433	98	5891	4	7832	3	59
2	789665	162	893331	260	06669	6335	99	6120	8	7652	6	58
3	789827	161	893591	260	06409	6236	99	6349	11	7473	9	57
4	789988	161	893851	260	06149	6137	99	6578	15	7294	12	56
5	9·790149	161	9.894111	261	05889	6038	99	.616807	19	.787114	15	55
6	790310	161	894372	260	05628	5939	99	7036	23	6935	18	54
7	790471	161	894632	260	05368	5840	99	7265	27	6755	21	53
8	790632	161	894892	260	05108	5741	99	7494	30	6576	24	52
9	790793	161	895152	260	04848	5641	100	7722	34	6396	27	51
10	9·790954	161	9.895412	260	04588	5542	99	.617951	38	.786216	30	50
11	791115	160	895672	260	04328	5443	99	8180	42	6037	33	49
12	791275	161	895932	260	04068	5343	100	8408	46	5857	36	48
13	791436	160	896192	260	03808	5244	99	8637	49	5677	39	47
14	791596	161	896452	260	03548	5145	99	8865	53	5497	42	46
15	9·791757	160	9.896712	259	03288	5045	100	.619094	57	.785317	45	45
16	791917	160	896971	260	03029	4945	100	9322	61	5137	48	44
17	792077	160	897231	260	02769	4846	99	9551	65	4957	51	43
18	792237	160	897491	260	02509	4746	100	.619779	68	4776	54	42
19	792397	160	897751	260	02249	4646	100	.620007	72	4596	57	41
20	9·792557	159	9.898010	259	01990	4546	100	.620235	76	.784416	60	40
21	792716	160	898270	260	01730	4446	100	9464	80	4235	63	39
22	792876	159	898530	260	01470	4346	100	0692	84	4055	66	38
23	793035	160	898789	259	01211	4246	100	0920	87	3874	69	37
24	793195	159	899049	260	00951	4146	100	1148	91	3693	72	36
25	9·793354	160	9.899308	259	00692	4046	100	.621376	95	.783513	75	35
26	793514	159	899568	260	00432	3946	100	1604	99	3332	78	34
27	793673	159	899827	259	00173	3846	101	1831	103	3151	82	33
28	793832	159	900086	259	99913	3745	100	2059	106	2970	85	32
29	793991	159	900346	260	99654	3645	101	2287	110	2789	88	31
30	9·794150	158	9.900605	259	99395	3544	100	.622515	114	.782608	91	30
31	794308	159	900864	259	99136	3444	101	2742	118	2427	94	29
32	794467	159	901124	259	98876	3343	100	2970	122	2246	97	28
33	794626	158	901383	259	98617	3243	101	3197	125	2065	100	27
34	794784	158	901642	259	98358	3142	101	3425	129	1883	103	26
35	9·794942	159	9.901901	259	98099	3041	101	.623652	133	.781702	106	25
36	795101	158	902160	260	97840	2940	101	3880	137	1520	109	24
37	795259	158	902420	259	97580	2839	100	4107	141	1339	112	23
38	795417	158	902679	259	97321	2739	101	4334	144	1157	115	22
39	795575	158	902938	259	97062	2638	102	4561	148	0976	118	21
40	9·795733	158	9.903197	259	96803	2536	101	.624788	152	.780794	121	20
41	795891	158	903456	258	96544	2435	101	5016	156	0612	124	19
42	796049	157	903714	259	96286	2334	101	5243	160	0430	127	18
43	796206	158	903973	259	96027	2233	101	5470	163	0248	130	17
44	796364	157	904232	259	95768	2132	102	5697	167	.780066	133	16
45	9·796521	158	9.904491	259	95509	2030	101	.625923	171	.779884	136	15
46	796679	157	904750	258	95250	1929	102	6150	175	9702	139	14
47	796836	157	905008	259	94991	1827	101	6377	179	9520	142	13
48	796993	157	905267	259	94733	1726	102	6604	182	9338	145	12
49	797150	157	905526	259	94474	1624	101	6830	186	9156	148	11
50	9·797307	157	9.905785	258	94215	1523	102	.627057	190	.778973	151	10
51	797464	157	906043	259	93957	1421	102	7284	194	8791	154	9
52	797621	156	906302	258	93698	1319	101	7510	198	8608	157	8
53	797777	157	906560	259	93440	1217	102	7737	201	8426	160	7
54	797934	157	906819	259	93181	1115	102	7963	205	8243	163	6
55	9·798091	156	9.907077	258	92923	1013	102	.628189	209	.778060	166	5
56	798247	156	907336	259	92664	0911	102	8416	213	7878	169	4
57	798403	157	907594	258	92406	0809	102	8642	217	7695	172	3
58	798560	156	907853	259	92147	0707	102	8868	220	7512	175	2
59	798716	156	908111	258	91889	0605	102	9094	224	7329	178	1
M.	L. Cos.	D.	L.Cotan	D.	L.Tang.	L. Sine	D.	N. Cos.		N. Sine		M

Digitized by Google

M.	L. Sine	D.	L. Tang.	D.	L. Cotan	L. Cos.	D.	N. Sine	d."	N. Cos.	d."	M
0	9.798872		9.908369		91631	0503		,629320	225	·777146	185	60
1	799028	156	908628	259	91372	0400	103	9546	4	6963	3	59
2	799184	156	908886	258	91114	0298	102	9772	8	6780	6	58
3	799339	155	909144	258	90856	0195	103	.629998	11	6596	9	57
4	799495	156	909402	258	90598	0093	102	.630224	15	6413	12	56
5	9.799651	156	9.909660	258	90340	9990	103	,630450	19	·776230	15	55
6	799806	155	909918	258	90082	9888	102	0676	23	6046	19	54
7	799962	156	910177	259	89823	9785	103	9901	26	5863	22	53
8	800117	155	910435	258	89565	9682	103	1127	30	5679	25	52
9	800272	155	910693	258	89307	9579	103	1353	34	5496	28	51
10	9.800427	155	9.910951	258	89049	9477	102	,631578	38	·775312	31	50
11	800582	155	911209	258	88791	9374	103	1804	41	5128	34	49
12	800737	155	911467	258	88533	9271	103	2029	45	4944	37	48
13	800892	155	911725	257	88275	9168	103	2255	49	4761	40	47
14	801047	155	911982		88018	9064	104	2480	53	4577	43	46
15	9.801201	154	9.912240	258	87760	8961	103	.632705	56	·774393	46	45
16	801356	155	912498	258	87502	8858	103	2931	60	4209	49	44
17	801511	155	912756	258	87244	8755	103	3156	64	4024	52	43
18	801665	154	913014	258	86986	8651	104	3381	68	3840	56	42
19	801819	154	913271	257	86729	8548	103	3606	71	3656	59	41
20	9.801973	154	9.913529	258	86471	8444	104	.633831	75	·773472	62	40
21	802128	155	913787	258	86213	8341	103	4056	79	3287	65	39
22	802282	154	914044	257	85956	8237	104	4281	83	3103	68	38
23	802436	154	914302	258	85698	8134	103	4506	86	2918	71	37
24	802589	153	914560	258	85440	8030	104	4730	90	2734	74	36
25	9.802743	154	9.914817	257	85183	7926	104	.634955	94	·772549	77	35
26	802897	154	915075	258	84925	7822	104	5180	98	2364	80	34
27	803050	153	915332	257	84668	7718	104	5405	101	2179	83	33
28	803204	154	915590	258	84410	7614	104	5629	105	1994	86	32
29	803357	153	915847	257	84153	7510	104	5854	109	1810	89	31
30	9.803511	154	9.916104	257	83896	7406	104	.636078	113	·771625	93	30
31	803664	153	916362	258	83638	7302	104	6303	116	1439	96	29
32	803817	153	916619	257	83381	7198	104	6527	120	1254	99	28
33	803970	153	916877	258	83123	7093	105	6751	124	1069	102	27
34	804123	153	917134	257	82866	6989	104	6976	128	0884	105	26
35	9.804276	153	9.917391	257	82609	6885	104	.637200	131	·770699	108	25
36	804428	152	917648	257	82352	6780	105	7424	135	0513	111	24
37	804581	153	917906	258	82094	6676	104	7648	139	0328	114	23
38	804734	153	918163	257	81837	6571	105	7872	143	·770142	117	22
39	804886	152	918420	257	81580	6466	105	8096	146	·769957	120	21
40	9.805039	153	9.918677	257	81323	6362	104	.638320	150	·769771	123	20
41	805191	152	918934	257	81066	6257	105	8544	154	9585	126	19
42	805343	152	919191	257	80809	6152	105	8768	158	9400	130	18
43	805495	152	919448	257	80552	6047	105	8992	161	9214	133	17
44	805647	152	919705	257	80295	5942	105	9215	165	9028	136	16
45	9.805799	152	9.919962	257	80038	5837	105	.639439	169	·768842	139	15
46	805951	152	920219	257	79781	5732	105	9663	173	8656	142	14
47	806103	152	920476	257	79524	5627	105	.639886	176	8470	145	13
48	806254	151	920733	257	79267	5522	105	.640110	180	8283	148	12
49	806406	152	920990	257	79010	5416	106	0333	184	8097	151	11
50	9.806557	151	9.921247	257	78753	5311	105	.640557	188	·767911	154	10
51	806709	152	921503	256	78497	5205	106	0780	191	7725	157	9
52	806860	151	921760	257	78240	5100	105	1003	195	7538	160	8
53	807011	151	922017	257	77983	4994	106	1226	199	7352	163	7
54	807163	152	922274	257	77726	4889	105	1450	203	7165	167	6
55	9.807314	151	9.922530	256	77470	4783	106	.641673	206	·766978	170	5
56	807465	151	922787	257	77213	4677	106	1896	210	6792	173	4
57	807615	150	923044	257	76956	4572	105	2119	214	6605	176	3
58	807766	151	923300	256	76700	4466	106	2342	218	6418	179	2
59	807917	151	923557	257	76443	4360	106	2565	221	6231	182	1
M.	L. Cos	D.	L. Cotan.	D.	L. Tang.	L. Sine.	D.	N. Cos.		N. Sine		M

Digitized by Google

M.	L. Sine.	D.	L. Tang.	D.	L. Cotan.	L. Cos.	D.	N. Sine	d.	N. Cos	d.	M
0	9.808067		9.923814									
		151		256	76186	4254	106	.642788	221	.766044	139	60
1	808218	150	924070	257	10.0 75930	4148	106	3010	4	5857	3	59
2	808368	151	924327	256	75673	9.88 4042	106	3233	7	5670	6	58
3	808519	150	924583	257	75417	3936	107	3456	11	5483	10	57
4	808669		924840		75160	3829		3678	15	5296	13	56
		150		256			106					
5	9.808819	150	9.925096	256	74904	3723	106	.643901	18	.765109	16	55
6	808969	150	925352	256	10.0 74648	3617	107	4124	22	4921	19	54
7	809119	150	925609	257	74391	9.88 3510	106	4346	26	4734	22	53
8	809269	150	925865	256	74135	3404	107	4568	30	4546	25	52
9	809419	150	926122	257	73878	3297	106	4791	33	4359	28	51
		150		256			107					
10	9.809569	149	9.926378	256	73622	3191	107	.645013	37	.764171	32	50
11	809718	150	926634	256	10.0 73366	9.88 3084	107	5235	41	3984	35	49
12	809868	149	926890	257	73110	2977	106	5458	44	3796	38	48
13	810017	150	927147	256	72853	2871	107	5680	48	3608	41	47
14	810167		927403		72597	2764		5902	52	3420	44	46
		149		256			107					
15	9.810316	149	9.927659	256	72341	2657	107	.646124	55	.763232	47	45
16	810465	149	927915	256	10.0 72085	2550	107	6346	59	3044	50	44
17	810614	149	928171	256	71829	9.88 2443	107	6568	63	2856	54	43
18	810763	149	928427	257	71573	2336	107	6790	66	2668	57	42
19	810912		928684		71316	2229		7012	70	2480	60	41
		149		256			108					
20	9.811061	149	9.928940	256	71060	2121	107	.647233	74	.762292	63	40
21	811210	148	929196	256	10 0 70804	2014	107	7455	77	2104	66	39
22	811358	149	929452	256	70548	9.88 1907	108	7677	81	1915	69	38
23	811507	148	929708	256	70292	1799	107	7898	85	1727	73	37
24	811655		929964		70036	1692		8120	88	1538	76	36
		149		256			108					
25	9.811804	148	9.930220	255	69780	1584	107	.648341	92	.761350	79	35
26	811952	148	930475	256	10.0 69525	9.88 1477	108	8563	96	1161	82	34
27	812100	148	930731	256	69269	1369	108	8784	100	0972	85	33
28	812248	148	930987	256	69013	1261	108	9006	103	0784	88	32
29	812396		931243		68757	1153		9227	107	0595	91	31
		148		256			107					
30	9.812544	148	9.931499	256	68501	1046	108	.649448	111	.760406	95	30
31	812692	148	931755	255	10.0 68245	0938	108	9669	114	0217	98	29
32	812840	148	932010	256	67990	9.88 0830	108	.649890	118	.760028	101	28
33	812988	147	932266	256	67734	0722	109	.650111	122	.759839	104	27
34	813135		932522		67478	0613		0332	125	9650	107	26
		148		256			108					
35	9.813283	147	9.932778	255	67222	0505	108	.650553	129	.759461	110	25
36	813430	148	933033	256	10.0 66967	0397	108	0774	133	9271	113	24
37	813578	147	933289	256	66711	9.88 0289	109	0995	136	9082	117	23
38	813725	147	933545	255	66455	0180	108	1216	140	8893	120	22
39	813872		933800		66200	0072		1437	144	8703	123	21
		147		256			109					
40	9.814019	147	9.934056	255	65944	9963	108	.651657	147	.758514	126	20
41	814166	147	934311	256	10 0 65689	9855	109	1878	151	8324	129	19
42	814313	147	934567	255	65433	9.87 9746	109	2098	155	8134	132	18
43	814460	147	934822	256	65178	9637	109	2319	158	7945	136	17
44	814607		935078		64922	9529	108	2529	162	7755	139	16
		146		255			109					
45	9.814753	147	9.935333	256	64667	9420	109	.652760	166	.757565	142	15
46	814900	146	935589	255	10.0 64411	9311	109	2980	169	7375	145	14
47	815046	147	935844	256	64156	9.87 9202	109	3200	173	7185	148	13
48	815193	146	936100	255	63900	9093	109	3421	177	6995	151	12
49	815339		936355		63645	8984		3641	181	6805	154	11
		146		256			109					
50	9.815485	147	9.936611	255	63389	8875	109	.653861	184	.756615	158	10
51	815632	146	936866	255	10 0 63134	8766	110	4081	188	6425	161	9
52	815778	146	937121	256	62879	9.87 8656	109	4301	192	6234	164	8
53	815924	145	937377	255	62623	8547	109	4521	195	6044	167	7
54	816069		937632		62368	8438		4741	199	5853	170	6
		146		255			110					
55	9.816215	146	9 937887	255	62113	8328	109	.654961	203	.755663	173	5
56	816361	146	938142	256	10.0 61858	8219	110	5180	206	5472	176	4
57	816507	145	938398	255	61602	9.87 8109	110	5400	210	5282	180	3
58	816652	146	938653	255	61347	7999	110	5620	214	5091	183	2
59	816798		938908		61092	7890	109	5839	217	4900	186	1
M.	Lo Cos.	D.	L. Cotan.	D.	L. Tang.	L. Sine	D.	N. Cos.		N. Sine		M

Digitized by Google

M.	L. Sine.	D.	L. Tang.	D.	L. Cotan.	L. Cos	D.	N. Sine	d."	N. Cos	d."	
0	9 816943	145	9·939163	255	60837	7780	110	·656059	218	·754710	193	60
1	817088	145	939418	255	60582	10.0 9.87 7670	110	6278	4	4519	3	59
2	817233	146	939673	255	60327	7560	110	6498	7	4328	6	58
3	817379	145	939928	255	60072	7450	110	6717	11	4137	10	57
4	817524	144	940183	256	59817	7340	110	6937	15	3946	13	56
5	9.817668	145	9 940439	255	59561	7230	110	·657156	18	·753755	16	55
6	817813	145	940694	255	59306	10.0 7120	110	7375	22	3563	19	54
7	817958	145	940949	255	59051	9.87 7010	111	7594	25	3372	23	53
8	818103	145	941204	255	58796	6899	110	7813	29	3181	26	52
9	818247	144	941459	255	58541	6789	111	8033	33	2989	29	51
10	9·818392	145	9·941713	254	58287	6678	110	·658252	36	·752798	32	50
11	818536	144	941968	255	58032	10.0 9.87 6568	111	8471	40	2606	35	49
12	818681	145	942223	255	57777	6457	110	8689	44	2415	39	48
13	818825	144	942478	255	57522	6347	111	8908	47	2223	42	47
14	818969	144	942733	255	57267	6236	111	9127	51	2032	45	46
15	9.819113	144	9·942988	255	57012	6125	111	·659346	55	·751840	48	45
16	819257	144	943243	255	56757	10.0 9.87 6014	110	9564	58	1648	52	44
17	819401	144	943498	255	56502	5904	111	·659783	62	1456	55	43
18	819545	144	943752	254	56248	5793	111	·660002	65	1264	58	42
19	819689	143	944007	255	55993	5682	111	0220	69	1072	61	41
20	9.819832	144	9·944262	255	55738	5571	111	·660439	73	·750880	64	40
21	819976	144	944517	255	55483	10 0 9.87 5459	112	0657	76	0688	68	39
22	820120	143	944771	254	55229	5348	111	0875	80	0496	71	38
23	820263	143	945026	255	54974	5237	111	1094	84	0303	74	37
24	820406	144	945281	255	54719	5126	112	1312	87	·750111	77	36
25	9.820550	143	9·945535	254	54465	5014	111	·661530	91	·749919	80	35
26	820693	143	945790	255	54210	10.0 9.87 4903	112	1748	95	9726	84	34
27	820836	143	946045	255	53955	4791	112	1966	98	9534	87	33
28	820979	143	946299	254	53701	4680	111	2184	102	9341	90	32
29	821122	143	946554	255	53446	4568	112	2402	105	9148	93	31
30	9.821265	143	9·946808	254	53192	4456	112	·662620	109	·748956	97	30
31	821407	142	947063	255	52937	10 0 9.87 4344	112	2838	113	8763	100	29
32	821550	143	947318	255	52682	4232	112	3056	116	8570	103	28
33	821693	143	947572	254	52428	4121	111	3273	120	8377	106	27
34	821835	142	947827	255	52173	4009	112	3491	124	8184	109	26
35	9.821977	142	9·948081	254	51919	3896	113	·663709	127	·747991	113	25
36	822120	143	948335	254	51665	10.0 9.87 3784	112	3926	131	7798	116	24
37	822262	142	948590	255	51410	3672	112	4144	134	7605	119	23
38	822404	142	948844	254	51156	3560	112	4361	138	7412	122	22
39	822546	142	949099	255	50901	3448	112	4578	142	7218	126	21
40	9.822688	142	9·949353	254	50647	3335	113	·664796	145	·747025	129	20
41	822830	142	949608	255	50392	10 0 9.87 3223	112	5013	149	6832	132	19
42	822972	142	949862	254	50138	3110	113	5230	153	6638	135	18
43	823114	141	950116	254	49884	2998	112	5447	156	6445	138	17
44	823255	142	950371	255	49629	2885	113	5665	160	6251	142	16
45	9.823397	142	9·950625	254	49375	2772	113	·665882	164	·746057	145	15
46	823539	141	950879	254	49121	10.0 9.87 2659	113	6099	167	5864	148	14
47	823680	141	951133	254	48867	2547	112	6316	171	5670	151	13
48	823821	142	951388	255	48612	2434	113	6532	174	5476	154	12
49	823963	141	951642	254	48358	2321	113	6749	178	5282	158	11
50	9.824104	141	9·951896	254	48104	2208	113	·666966	182	·745088	161	10
51	824245	141	952150	254	47850	10 0 9.87 2095	113	7183	185	4894	164	9
52	824386	141	952405	255	47595	1981	114	7399	189	4700	167	8
53	824527	141	952659	254	47341	1868	113	7616	193	4506	171	7
54	824668	140	952913	254	47087	1755	113	7833	196	4311	174	6
55	9.824808	141	9·953167	254	46833	1641	114	·668049	200	·744117	177	5
56	824949	141	953421	254	46579	10.0 9.87 1528	113	8265	204	3923	180	4
57	825090	140	953675	254	46325	1414	114	8482	207	3728	183	3
58	825230	141	953929	254	46071	1301	113	8698	211	3534	187	2
59	825371		954183		45817	1187	114	8914	214	3339	190	1
M.	Lo Cos.	D.	L. Cotan.	D.	L Tang.	L. Sine	D.	N. Cos.		N. Sine		M

Digitized by Google

M.	L. Sine	D	L. Tang	D	L. Cotan	L. Cos	D	N. Sine.	d."	N. Cos.	d."	M
0	9·8255[illegible]		9·954437	254	45503	1073		·669131	214	·743145	197	60
1	825651	140	954691	255	45309	0960	113	9347	4	2950	3	59
2	825791	140	954946	254	45054	0846	114	9563	7	2755	7	58
3	825931	140	955200	254	44800	0732	114	9779	11	2561	10	57
4	826071	140	955454	254	44546	0618	114	669995	14	2366	13	56
5	9·826211	140	9·955708	253	44292	0504	114	·670211	18	·742171	16	55
6	826351	140	955961	254	44039	0390	114	0427	21	1976	20	54
7	826491	140	956215	254	43785	0276	114	0642	25	1781	23	53
8	826631	140	956469	254	43531	0161	115	0858	27	1586	26	52
9	826770	139	956723	254	43277	0047	114	1074	32	1390	30	51
10	9·826910	140	9·956977	254	43023	9·99 33	114	·671128	36	·741195	33	50
11	827049	139	957231	254	42769	9818	115	1505	39	1000	36	49
12	827189	140	957485	254	42515	9704	114	1721	43	0805	39	48
13	827328	139	9·957739	254	42261	9589	115	1936	46	0609	43	47
14	827467	139	957993	254	42007	9474	115	2151	50	0414	46	46
15	9·827606	139	9·958247	253	41753	9360	114	·672367	54	·740218	49	45
16	827745	139	958500	254	41500	9245	115	2582	57	·740022	53	44
17	827884	139	958754	254	41246	9130	115	2797	61	·739827	56	43
18	828023	139	959008	254	40992	9015	115	3012	64	9631	59	42
19	828162	139	959262	254	40738	8900	115	3228	68	9435	62	41
20	9·828301	139	9·959516	253	40484	8785	115	·673443	71	·739239	66	40
21	828439	138	959769	254	40231	8670	115	3658	75	9043	69	39
22	828578	139	960023	254	39977	8555	115	3873	79	8847	72	38
23	828716	138	960277	253	39723	8440	115	4088	82	8651	76	37
24	828855	139	960530	254	39470	8324	116	4302	86	8455	79	36
25	9·828993	138	9·960784	254	39216	8209	115	·674517	89	·738259	82	35
26	829131	138	961038	254	38962	8093	116	4732	93	8063	85	34
27	829269	138	961292	253	38708	7978	115	4947	96	7867	89	33
28	829407	138	961545	254	38455	7862	116	5161	100	7670	92	32
29	829545	138	961799	253	38201	7747	115	5376	103	7474	95	31
30	9·829683	138	9·962052	254	37948	7631	116	·675590	107	·737277	99	30
31	829821	138	962306	254	37694	7515	116	5805	111	7081	102	29
32	829959	138	962560	253	37440	7399	116	6019	114	6884	105	28
33	830097	138	962813	254	37187	7283	116	6233	118	6687	108	27
34	830234	137	963067	253	36933	7167	116	6448	121	6491	112	26
35	9·830372	138	9·963320	254	36680	7051	116	·676662	125	·736294	115	25
36	830509	137	963574	254	36426	6935	116	6876	128	6097	118	24
37	830646	137	963828	253	36172	6819	116	7090	132	5900	122	23
38	830784	138	964081	254	35919	6703	116	7304	136	5703	125	22
39	830921	137	964335		35665	6586	117	7518	139	5506	128	21
40	9·831058	137	9·964588	253	35412	6470	116	·677732	143	·735309	131	20
41	831195	137	964842	254	35158	6353	117	7946	146	5112	135	19
42	831332	137	965095	253	34905	6237	116	8160	150	4915	138	18
43	831469	137	965349	254	34651	6120	117	8373	153	4717	141	17
44	831606	136	965602	253	34398	6004	116	8587	157	4520	145	16
45	9·831742	137	9·965855	253	34145	5887	117	·678801	161	·734322	148	15
46	831879	136	966109	254	33891	5770	117	9014	164	4125	151	14
47	832015	137	966362	253	33638	5653	117	9228	168	3927	154	13
48	832152	136	966616	254	33384	5536	117	9441	171	3730	158	12
49	832288	137	966869	253	33131	5419	117	9655	175	3532	161	11
50	9·832425	136	9·967123	254	32877	5302	117	·679868	178	·733334	164	10
51	832561	136	967376	253	32624	5185	117	·680081	182	3137	168	9
52	832697	136	967629	253	32371	5068	117	0295	186	2939	171	8
53	832833	136	967883	254	32117	4950	118	0508	189	2741	174	7
54	832969	136	968136	253	31864	4833	117	0721	193	2543	177	6
55	9·833105	136	9·968389	253	31611	4716	117	·680934	196	·732345	181	5
56	833241	136	968643	254	31357	4598	118	1147	200	2147	184	4
57	833377	135	968896	253	31104	4481	117	1360	203	1949	187	3
58	833512	136	969149	253	30851	4363	118	1573	207	1750	190	2
59	833648	136	969403	254	30597	4245	118	1786	211	1552	194	1
M.	Lo. Cos.	D.	L. Cotan.	D.	L. Tang.	L. Sine.	D.	N. Cos.		N. Sine		M

Digitized by Google

M.	L. Sine.	D.	L. Tang.	D.	L Cotan.	L. Cos.	D.	N. Sine.	d."	N. Cos.	d."	M
0	9 833783		9·969659		30344	4127		·681998		·731354		60
1	833919	136	969909	253	30091	4010	117	2211	211	1155	201	59
2	834054	135	970162	253	29838	3892	118	2424	4	0957	3	58
3	834189	135	970416	254	29584	3774	118	2636	7	0758	7	57
4	834325	136	970669	253	29331	3656	118	2849	11	0560	10	56
5	9·834460	135	9·970922	253	29078	3538	118	·683061	14	·730361	13	55
6	834595	135	971175	253	28825	3419	119	3274	18	·730162	17	54
7	834730	135	971429	254	28571	3301	118	3486	21	·729963	20	53
8	834865	135	971682	253	28318	3183	118	3698	25	9765	24	52
9	834999	134	971935	253	28065	3064	119	3911	28	9566	27	51
10	9·835134	135	9·972188	253	27812	2946	118	·684123	32	·729367	30	50
11	835269	135	972441	253	27559	2827	119	4335	35	9168	34	49
12	835403	134	972695	254	27305	2709	118	4547	39	8969	37	48
13	835538	135	972948	253	27052	2590	119	4759	42	8769	40	47
14	835672	134	973201	253	26799	2471	119	4971	46	8570	44	46
15	9·835807	135	9·973454	253	26546	2353	118	·685183	49	·728371	47	45
16	835941	134	973707	253	26293	2234	119	5395	53	8172	50	44
17	836075	134	973960	253	26040	2115	119	5607	56	7972	54	43
18	836209	134	974213	253	25787	1996	119	5818	60	7773	57	42
19	836343	134	974466	253	25534	1877	119	6030	63	7573	60	41
20	9·836477	134	9·974720	254	25280	1758	119	·686242	67	·727374	64	40
21	836611	134	974973	253	25027	1638	120	6453	70	7174	67	39
22	836745	134	975226	253	24774	1519	119	6665	74	6974	70	38
23	836878	133	975479	253	24521	1400	119	6876	77	6774	74	37
24	837012	134	975732	253	24268	1280	120	7087	81	6575	77	36
25	9·837146	133	9·975985	253	24015	1161	119	·687299	84	·726375	80	35
26	837279	133	976238	253	23762	1041	120	7510	88	6175	84	34
27	837412	133	976491	253	23509	0922	119	7721	91	5975	87	33
28	837546	134	976744	253	23256	0802	120	7932	95	5775	91	32
29	837679	133	976997	253	23003	0682	120	8143	99	5575	94	31
30	9·837812	133	9·977250	253	22750	0562	120	·688355	102	·725374	97	30
31	837945	133	977503	253	22497	0442	120	8565	106	5174	101	29
32	838078	133	977756	253	22244	0322	120	8776	109	4974	104	28
33	838211	133	978009	253	21991	0202	120	8987	113	4773	107	27
34	838344	133	978262	253	21738	0082	120	9198	116	4573	111	26
35	9·838477	133	9·978515	253	21485	9902	120	·689409	120	·724372	114	25
36	838610	132	978768	253	21232	9842	120	9619	123	4172	117	24
37	838742	133	979021	253	20979	9721	121	·689830	127	3971	121	23
38	838875	132	979274	253	20726	9601	120	·690041	130	3770	124	22
39	839007	133	979527	253	20473	9480	121	0251	134	3570	127	21
40	9·839140	132	9·979780	253	20220	9360	120	·690462	137	·723369	131	20
41	839272	132	980033	253	19967	9239	121	0672	141	3168	134	19
42	839404	132	980286	253	19714	9119	120	0882	144	2967	137	18
43	839536	132	980538	252	19462	8998	121	1093	148	2766	141	17
44	839668	132	980791	253	19209	8877	121	1303	151	2565	144	16
45	9·839800	132	9·981044	253	18956	8756	121	·691513	155	·722364	147	15
46	839932	132	981297	253	18703	8635	121	1723	158	2163	151	14
47	840064	132	981550	253	18450	8514	121	1933	162	1961	154	13
48	840196	132	981803	253	18197	8393	121	2143	165	1760	158	12
49	840328	131	982056		17944	8272	121	2353	169	1559	161	11
50	9·840459	132	9·982309	253	17691	8151	121	·692563	172	·721357	164	10
51	840591	131	982562	253	17438	8029	122	2773	176	1156	168	9
52	840722	132	982814	252	17186	7908	121	2982	179	0954	171	8
53	840854	131	983067	253	16933	7786	122	3192	183	0753	174	7
54	840985	131	983320	253	16680	7665	121	3402	186	0551	178	6
55	9·841116	131	9·983573	253	16427	7543	122	·693611	190	·720349	181	5
56	841247	131	983826	253	16174	7422	121	3821	193	·720148	184	4
57	841378	131	984079	253	15921	7300	122	4030	197	·719946	188	3
58	841509	131	984332	252	15668	7178	122	4240	201	9744	191	2
59	841640		984584		15416	7056	122	4449	204	9542	194	1
M.	L. Cos.	D.	L. Cotan	D.	L. Tang.	L. Sine	D.	N. Cos.	208	N. Sine	198	M

Digitized by Google

M.	L. Sine	D.	L. Tang.	D.	L. Cotan	L. Cos.	D.	N. Sine	d.	N. Cos.	d.	M
0	9.698970	219	9.761439	292	38561	7531	73	.500000	251	.866025	148	60
1	699189	218	761731	292	10.2 38269	9.93 7458	73	0252	4	5880	3	59
2	699407	219	762023	291	37977	7385	73	0504	8	5734	5	58
3	699626	218	762314	292	37686	7312	73	0756	13	5589	7	57
4	699844	218	762606	291	37394	7238	74	1007	17	5443	10	56
5	9.700062	218	9.762897	291	37103	7165	73	.501259	21	.865297	12	55
6	700280	218	763188	291	10.2 36812	9.93 7092	73	1511	25	5151	15	54
7	700498	218	763479	291	36521	7019	73	1762	29	5005	17	53
8	700716	217	763770	291	36230	6946	73	2014	34	4859	20	52
9	700933	218	764061	291	35939	6872	74	2265	38	4713	22	51
10	9.701151	217	9.764352	291	35648	6799	73	.502517	42	.864567	25	50
11	701368	217	764643	290	10.2 35357	9.93 6725	74	2768	46	4421	27	49
12	701585	217	764933	291	35067	6652	73	3020	50	4275	30	48
13	701802	217	765224	290	34776	6578	73	3271	54	4128	32	47
14	702019	217	765514	291	34486	6505	73	3523	59	3982	35	46
15	9.702236	216	9.765805	290	34195	6431	74	.503774	63	.863835	37	45
16	702452	217	766095	290	10.2 33905	9.93 6357	74	4025	67	3689	40	44
17	702669	216	766385	290	33615	6284	74	4276	71	3542	42	43
18	702885	216	766675	290	33325	6210	74	4528	75	3396	44	42
19	703101	216	766965	290	33035	6136	74	4779	80	3249	47	41
20	9.703317	216	9.767255	290	32745	6062	74	.505030	84	.863102	49	40
21	703533	216	767545	289	10.2 32455	9.93 5988	74	5281	88	2955	52	39
22	703749	215	767834	290	32166	5914	74	5532	92	2808	54	38
23	703964	215	768124	290	31876	5840	74	5783	96	2661	57	37
24	704179	216	768414	289	31586	5766	74	6034	100	2514	59	36
25	9.704395	215	9.768703	289	31297	5692	74	.506285	105	.862366	62	35
26	704610	215	768992	289	10.2 31008	9.93 5618	74	6535	109	2219	64	34
27	704825	215	769281	289	30719	5543	75	6786	113	2072	67	33
28	705040	214	769571	290	30429	5469	74	7037	117	1924	69	32
29	705254	215	769860	289	30140	5395	74	7288	121	1777	72	31
30	9.705469	214	9.770148	288	29852	5320	75	.507538	126	.861629	74	30
31	705683	215	770437	289	10.2 29563	9.93 5246	74	7789	130	1481	77	29
32	705898	214	770726	289	29274	5171	75	8040	134	1334	79	28
33	706112	214	771015	289	28985	5097	74	8290	138	1186	81	27
34	706326	213	771303	288	28697	5022	75	8541	142	1038	84	26
35	9.706539	214	9.771592	289	28408	4948	74	.508790	146	.860890	86	25
36	706753	214	771880	288	10.2 28120	9.93 4873	75	9041	151	0742	89	24
37	706967	213	772168	288	27832	4798	75	9292	155	0594	91	23
38	707180	213	772457	289	27543	4723	75	9542	159	0446	94	22
39	707393	213	772745	288	27255	4649	74	9792	163	0297	96	21
40	9.707606	213	9.773033	288	26967	4574	75	.510043	167	.860149	99	20
41	707819	213	773321	288	10.2 26679	9.93 4499	75	0293	172	0001	101	19
42	708032	213	773608	287	26392	4424	75	0543	176	.859852	104	18
43	708245	213	773896	288	26104	4349	75	0793	180	9704	106	17
44	708458	213	774184	288	25816	4274	75	1043	184	9555	109	16
45	9.708670	212	9.774471	287	25529	4199	75	.511293	188	.859406	111	15
46	708882	212	774759	288	10.2 25241	9.93 4123	76	1543	192	9258	114	14
47	709094	212	775046	287	24954	4048	75	1793	197	9109	116	13
48	709306	212	775333	287	24667	3973	75	2043	201	8960	118	12
49	709518	212	775621	288	24379	3898	75	2293	205	8811	121	11
50	9.709730	212	9.775908	287	24092	3822	76	.512542	209	.858662	123	10
51	709941	211	776195	287	10.2 23805	9.93 3747	75	2792	213	8513	126	9
52	710153	212	776482	287	23518	3671	76	3042	218	8363	128	8
53	710364	211	776768	286	23232	3596	75	3292	222	8214	131	7
54	710575	211	777055	287	22945	3520	76	3541	226	8065	133	6
55	9.710786	211	9.777342	287	22658	3445	75	.513791	230	.857915	136	5
56	710997	211	777628	286	10.2 22372	9.93 3369	76	4040	234	7766	138	4
57	711208	211	777915	287	22085	3293	76	4290	239	7616	141	3
58	711419	210	778201	286	21799	3217	76	4539	243	7467	143	2
59	711629	210	778488	287	21512	3141	76	4789	247	7317	146	1
M.	L. Cos	D.	L. Cotan.	D.	L. Tang	L. Sine	D	N. Cos.		N. Sine		M

Digitized by Google

M.	L. Sine.	D.	L. Tang	D	L. Cotan	L. Cos.	D	N. Sine.	d.	N. Cos.	d.	M.
0	9.711839	211	9.778774	286	21226	3066	76	.515038	48	.857167	15	60
1	712050	210	779060	286	20940	2990	76	5287	4	7017	3	59
2	712260	209	779346	286	20654	2914	76	5537	8	6867	5	58
3	712469	210	779632	286	20368	2838	76	5786	12	6717	8	57
4	712679	210	779918	285	20082	2762	76	6035	17	6567	10	56
5	9.712889	209	9.780203	286	19797	2685	77	.516284	21	.856417	13	55
6	713098	210	780489	286	19511	2609	76	6533	25	6267	15	54
7	713308	209	780775	285	19225	2533	76	6782	29	6117	18	53
8	713517	209	781060	286	18940	2457	77	7031	33	5966	20	52
9	713726	209	781346	285	18654	2380	76	7280	37	5816	23	51
10	9.713935	209	9.781631	285	18369	2304	76	.517529	41	.855665	25	50
11	714144	208	781916	285	18084	2228	77	7778	46	5515	28	49
12	714352	209	782201	285	17799	2151	76	8027	50	5364	30	48
13	714561	208	782486	285	17514	2075	77	8276	54	5213	33	47
14	714769	209	782771	285	17229	1998	77	8525	58	5063	36	46
15	9.714978	208	9.783056	285	16944	1921	77	.518773	62	.854912	38	45
16	715186	208	783341	285	16659	1845	76	9022	66	4761	41	44
17	715394	208	783626	284	16374	1768	77	9270	70	4610	43	43
18	715602	207	783910	285	16090	1691	77	9519	74	4459	46	42
19	715809	208	784195		15805	1614	77	9768	79	4308	48	41
20	9.716017	207	9.784479	284	15521	1537	77	.520016	83	.854156	51	40
21	716224	208	784764	285	15236	1460	77	0265	87	4005	53	39
22	716432	207	785048	284	14952	1383	77	0513	91	3854	56	38
23	716639	207	785332	284	14668	1306	77	0761	95	3702	58	37
24	716846	207	785616	284	14384	1229	77	1010	99	3551	61	36
25	9.717053	206	9.785900	284	14100	1152	77	.521258	103	.853399	63	35
26	717259	207	786184	284	13816	1075	77	1506	108	3247	66	34
27	717466	207	786468	284	13532	0998	77	1754	112	3096	68	33
28	717673	206	786752	284	13248	0921	78	2002	116	2944	71	32
29	717879	206	787036	284	12964	0843	77	2250	120	2792	74	31
30	9.718085	206	9.787319	283	12681	0766	78	.522499	124	.852640	76	30
31	718291	206	787603	284	12397	0688	77	2747	128	2488	79	29
32	718497	206	787886	283	12114	0611	78	2994	132	2336	81	28
33	718703	206	788170	284	11830	0533	77	3242	136	2184	84	27
34	718909	205	788453	283	11547	0456	78	3490	141	2032	86	26
35	9.719114	206	9.788736	283	11264	0378	78	.523738	145	.851879	89	25
36	719320	205	789019	283	10981	0300	77	3986	149	1727	91	24
37	719525	205	789302	283	10698	0223	78	4234	153	1574	94	23
38	719730	205	789585	283	10415	0145	78	4481	157	1422	96	22
39	719935	205	789868	283	10132	0067	78	4729	161	1269	99	21
40	9.720140	205	9.790151	283	09849	9989	78	.524977	165	.851117	101	20
41	720345	204	790434	283	09566	9911	78	5224	170	0964	104	19
42	720549	205	790716	282	09284	9833	78	5472	174	0811	106	18
43	720754	204	790999	283	09001	9755	78	5719	178	0658	109	17
44	720958	204	791281	282	08719	9677	78	5966	182	0505	112	16
45	9.721162	204	9.791563	282	08437	9599	78	.526214	186	.850352	114	15
46	721366	204	791846	283	08154	9521	78	6461	190	0199	117	14
47	721570	204	792128	282	07872	9442	79	6708	194	0046	119	13
48	721774	204	792410	282	07590	9364	78	6956	198	.849893	122	12
49	721978	203	792692	282	07308	9286	78	7203	203	9739	124	11
50	9.722181	204	9.792974	282	07026	9207	79	.527450	207	.849586	127	10
51	722385	203	793256	282	06744	9129	78	7697	211	9432	129	9
52	722588	203	793538	281	06462	9050	79	7944	215	9279	132	8
53	722791	203	793819	282	06181	8972	78	8191	219	9125	134	7
54	722994	203	794101	282	05899	8893	79	8438	223	8972	137	6
55	9.723197	203	9.794383	281	05617	8815	78	.528685	227	.848818	139	5
56	723400	203	794664	282	05336	8736	79	8932	232	8664	142	4
57	723603	202	794946	281	05054	8657	79	9179	236	8510	144	3
58	723805	202	795227	281	04773	8578	79	9426	240	8356	147	2
59	724007		795508		04492	8499	79	9673	244	8202	150	1
M.	Lo. Cos	D.	L. Cotan.	D.	L. Tang	L. Sine.	D.	N. Cos.		N. Sine		M.

Digitized by Google

M.	L.Sine.	D.	L. Tang	D.	L.Cotan	L Cos.	D.	N.Sine.	d.″	N Cos.	d.″	M
0	9.724210		9.795789		04211	8420		.529919		.848048		60
1	724412	202	796070	281	03930	8342	78	.530166	246	7894	156	59
2	724614	202	796351	281	03649	8263	79	0412	4	7740	3	58
3	724816	202	796632	281	03368	8183	80	0659	8	7585	5	57
4	725017	201	796913	281	03087	8104	79	0906	12	7431	8	56
5	9.725219	202	9.797194	281	02806	8025	79	.531152	16	.847276	10	55
6	725420	201	797474	280	02526	7946	79	1399	21	7122	13	54
7	725622	202	797755	281	02245	7867	79	1645	25	6967	16	53
8	725823	201	798036	281	01964	7787	80	1891	29	6813	18	52
9	726024	201	798316	280	01684	7708	79	2138	33	6658	21	51
10	9.726225	201	9.798596	280	01404	7629	79	.532384	37	.846503	23	50
11	726426	200	798877	281	01123	7549	80	2630	41	6348	26	49
12	726626	201	799157	280	00843	7470	79	2876	45	6193	29	48
13	726827	200	799437	280	00563	7390	80	3122	49	6038	31	47
14	727027	201	799717	280	00283	7310	80	3368	53	5883	34	46
15	9.727228	200	9.799997	280	00003	7231	79	.533614	57	.845728	36	45
16	727428	200	800277	280	99723	7151	80	3860	62	5573	39	44
17	727628	200	800557	280	99443	7071	80	4106	66	5417	42	43
18	727828	199	800836	279	99164	6991	80	4352	70	5262	44	42
19	728027	200	801116	280	98884	6911	80	4598	74	5106	47	41
20	9.728227	200	9.801396	280	98604	6831	80	.534844	78	.844951	49	40
21	728427	199	801675	279	98325	6751	80	5090	82	4795	52	39
22	728626	199	801955	280	98045	6671	80	5335	86	4639	55	38
23	728825	199	802234	279	97766	6591	80	5581	90	4484	57	37
24	729024	199	802513	279	97487	6511	80	5827	94	4328	60	36
25	9.729223	199	9.802792	279	97208	6431	80	.536072	98	.844172	62	35
26	729422	199	803072	280	96928	6351	80	6318	103	4016	65	34
27	729621	199	803351	279	96649	6270	81	6563	107	3860	68	33
28	729820	199	803630	279	96370	6190	80	6809	111	3704	70	32
29	730018	198	803909	279	96091	6110	80	7054	115	3548	73	31
30	9.730217	199	9.804187	278	95813	6029	81	.537300	119	.843391	75	30
31	730415	198	804466	279	95534	5949	80	7545	123	3235	78	29
32	730613	198	804745	279	95255	5868	81	7790	127	3079	81	28
33	730811	198	805023	278	94977	5788	80	8035	131	2922	83	27
34	731009	197	805302	279	94698	5707	81	8281	135	2766	86	26
35	9.731206	198	9.805580	278	94420	5626	81	.538526	139	.842609	88	25
36	731404	198	805859	279	94141	5545	81	8771	144	2452	91	24
37	731602	197	806137	278	93863	5465	80	9016	148	2296	94	23
38	731799	197	806415	278	93585	5384	81	9261	152	2139	96	22
39	731996	197	806693	278	93307	5303	81	9506	156	1982	99	21
40	9.732193	197	9.806971	278	93029	5222	81	.539751	160	.841825	101	20
41	732390	197	807249	278	92751	5141	81	9995	164	1668	104	19
42	732587	197	807527	278	92473	5060	81	.540240	168	1511	107	18
43	732784	197	807805	278	92195	4979	82	0485	172	1354	109	17
44	732980	196	808083	278	91917	4897	81	0730	176	1196	112	16
45	9.733177	197	9.808361	278	91639	4816	81	.540974	180	.841039	114	15
46	733373	196	808638	277	91362	4735	81	1219	185	0882	117	14
47	733569	196	808916	278	91084	4654	82	1464	189	0724	120	13
48	733765	196	809193	277	90807	4572	81	1708	193	0567	122	12
49	733961	196	809471	278	90529	4491	82	1953	197	0409	125	11
50	9.734157	196	9.809748	277	90252	4409	81	.542197	201	.840251	127	10
51	734353	196	810025	277	89975	4328	82	2441	205	0094	130	9
52	734548	195	810302	277	89698	4246	82	2686	209	.839936	133	8
53	734744	196	810580	278	89420	4164	82	2930	213	9778	135	7
54	734939	195	810857	277	89143	4083	81	3174	217	9620	138	6
55	9.735135	196	9.811134	277	88866	4001	82	.543419	221	.839462	140	5
56	735330	195	811410	276	88590	3919	82	3663	226	9304	143	4
57	735525	195	811687	277	88313	3837	82	3907	230	9145	146	3
58	735719	194	811964	277	88036	3755	82	4151	234	8987	148	2
59	735914	195	812241	277	87759	3673	82	4395	238	8829	151	1
M.	L. Cos.	D.	L.Cotan	D.	L. Tang.	L Sine	D.	N. Cos.	242	N.Sine	153	M

Digitized by Google

M.	L.Sine.	D.	L. Tang	D.	L.Cotan	L Cos.	D	N.Sine.	d"	N. Cos.	d"
0	9.736109		9.812517		87483	3591		.544639		.838671	
		194		277			82		243		160
1	736303		812794		87206	3509		4883	4	8512	3
		195		276		9.92	82				
2	736498		813070		86930	3427		5127	8	8354	5
		194		277	10.1		82				
3	736692		813347		86653	3345		5371	12	8195	8
		194		276			82				
4	736886		813623		86377	3263		5614	16	8036	11
		194		276			82				
5	9.737080		9.813899		86101	3181		.545858	20	.837877	13
		194		277			83				
6	737274		814176		85824	3098		6102	24	7719	16
		193		276	10.1	9.92	82				
7	737467		814452		85548	3016		6346	28	7560	19
		194		276			83				
8	737661		814728		85272	2933		6589	32	7401	21
		194		276			82				
9	737855		815004		84996	2851		6833	37	7242	24
		193		276			83				
10	9.738048		9.815280		84720	2768		.547076	41	.837083	27
		193		275			82				
11	738241		815555		84445	2686		7320	45	6924	29
		193		276		9.92	83				
12	738434		815831		84169	2603		7563	49	6764	32
		193		276	10.1		83				
13	738627		816107		83893	2520		7807	53	6605	35
		193		275			82				
14	738820		816382		83618	2438		8050	57	6446	37
		193		276			83				
15	9.739013		9.816658		83342	2355		.548293	61	.836286	40
		193		275			83				
16	739206		816933		83067	2272		8536	65	6127	43
		192		276		9.92	83				
17	739398		817209		82791	2189		8780	69	5967	45
		192		275	10.1		83				
18	739590		817484		82516	2106		9023	73	5807	48
		193		275			83				
19	739783		817759		82241	2023		9266	77	5648	51
		192		276			83				
20	9.739975		9.818035		81965	1940		.549509	81	.835488	53
		192		275			83				
21	740167		818310		81690	1857		9752	85	5328	56
		192		275	10.1	9.92	83				
22	740359		818585		81415	1774		.549995	89	5168	59
		191		275			83				
23	740550		818860		81140	1691		.550238	93	5008	61
		192		275			84				
24	740742		819135		80865	1607		0481	97	4848	64
		192		275			83				
25	9.740934		9.819410		80590	1524		.550724	101	.834688	67
		191		274			83				
26	741125		819684		80316	1441		0966	105	4527	69
		191		275	10.1	9.92	84				
27	741316		819959		80041	1357		1209	109	4367	72
		192		275			83				
28	741508		820234		79766	1274		1452	113	4207	75
		191		274			84				
29	741699		820508		79492	1190		1694	118	4046	77
		190		275			83				
30	9.741889		9.820783		79217	1107		.551937	122	.833886	80
		191		274			84				
31	742080		821057		78943	1023		2179	126	3725	83
		191		275	10.1	9.92	84				
32	742271		821332		78668	0939		2422	130	3565	85
		191		274			83				
33	742462		821606		78394	0856		2664	134	3404	88
		190		274			84				
34	742652		821880		78120	0772		2907	138	3243	91
		190		274			84				
35	9.742842		9.822154		77846	0688		.553149	142	.833082	93
		191		275			84				
36	743033		822429		77571	0604		3391	146	2921	96
		190		274	10.1	9.92	84				
37	743223		822703		77297	0520		3634	150	2760	99
		190		274			84				
38	743413		822977		77023	0436		3876	154	2599	101
		189		274			84				
39	743602		823251		76749	0352		4118	158	2438	104
		190		273			84				
40	9.743792		9.823524		76476	0268		.554360	162	.832277	107
		190		274			84				
41	743982		823798		76202	0184		4602	166	2115	109
		189		274	10.1	9.92	85				
42	744171		824072		75928	0099		4844	170	1954	112
		190		273			84				
43	744361		824345		75655	0015		5086	174	1793	115
		189		274			84				
44	744550		824619		75381	9931		5328	178	1631	117
		189		274			85				
45	9.744739		9.824893		75107	9846		.555570	182	.831470	120
		189		273			84				
46	744928		825166		74834	9762		5812	186	1308	123
		189		273	10.1	9.91	85				
47	745117		825439		74561	9677		6054	190	1146	125
		189		274			84				
48	745306		825713		74287	9593		6296	194	0984	128
		188		273			85				
49	745494		825986		74014	9508		6537	199	0823	131
		189		273			84				
50	9.745683		9.826259		73741	9424		.556779	203	.830661	133
		188		273			85				
51	745871		826532		73468	9339		7021	207	0499	136
		189		273	10.1	9.91	85				
52	746060		826805		73195	9254		7262	211	0337	139
		188		273			85				
53	746248		827078		72922	9169		7504	215	0174	141
		188		273			84				
54	746436		827351		72649	9085		7745	219	829012	144
		188		273			85				
55	9.746624		9.827624		72376	9000		.557986	223	.829850	147
		188		273			85				
56	746812		827897		72103	8915		8228	227	9688	149
		187		273	10.1	9.91	85				
57	746999		828170		71830	8830		8469	231	9525	152
		188		272			85				
58	747187		828442		71558	8745		8710	235	9363	155
		187		273			86				
59	747374		828715		71285	8659		8952	239	9200	157
M.	L. Cos.	D.	L.Cotan	D.	L.Tang.	L.Sine	D	N. Cos.		N.Sine	

Digitized by Google

M.	L. Sine.	D.	L. Tang.	D.	L. Cotan.	L. Cos.	D.	N. Sine	d."	N. Cos	d."	M
0	9.747562	187	9.828987	273	71013	8574	85	.559193	240	.829038	165	60
1	747749	187	829260	272	70740	8489	85	9434	4	8875	3	59
2	747936	187	829532	273	70468	8404	86	9675	8	8712	6	58
3	748123	187	829805	272	70195	8318	85	.559916	12	8549	8	57
4	748310	187	830077	272	69923	8233	86	.560157	16	8386	11	56
5	9.748497	186	9.830349	272	69651	8147	85	.560398	20	.828223	14	55
6	748683	187	830621	272	69379	8062	86	0639	24	8060	17	54
7	748870	186	830893	272	69107	7976	85	0880	28	7897	19	53
8	749056	187	831165	272	68835	7891	86	1121	32	7734	22	52
9	749243	186	831437	272	68563	7805	86	1361	36	7571	25	51
10	9.749429	186	9.831709	272	68291	7719	85	.561602	40	.827407	28	50
11	749615	186	831981	272	68019	7634	86	1843	44	7244	30	49
12	749801	186	832253	272	67747	7548	86	2083	48	7081	33	48
13	749987	185	832525	271	67475	7462	86	2324	52	6917	36	47
14	750172	186	832796	272	67204	7376	86	2564	56	6753	39	46
15	9.750358	185	9.833068	271	66932	7290	86	.562805	60	.826590	41	45
16	750543	186	833339	272	66661	7204	86	3045	64	6426	44	44
17	750729	185	833611	271	66389	7118	86	3286	68	6262	47	43
18	750914	185	833882	272	66118	7032	86	3526	72	6098	50	42
19	751099	185	834154	272	65846	6946	86	3766	76	5934	52	41
20	9.751284	185	9.834425	271	65575	6859	87	.564007	80	.825770	55	40
21	751469	185	834696	271	65304	6773	86	4247	84	5606	58	39
22	751654	185	834967	271	65033	6687	86	4487	88	5442	61	38
23	751839	184	835238	271	64762	6600	87	4727	92	5278	63	37
24	752023	185	835509	271	64491	6514	86	4967	96	5113	66	36
25	9.752208	184	9.835780	271	64220	6427	87	.565207	100	.824949	69	35
26	752392	184	836051	271	63949	6341	86	5447	104	4785	72	34
27	752576	184	836322	271	63678	6254	87	5687	108	4620	74	33
28	752760	184	836593	271	63407	6167	87	5927	112	4456	77	32
29	752944	184	836864	271	63136	6081	86	6166	116	4291	80	31
30	9.753128	184	9.837134	270	62866	5994	87	.566406	120	824126	83	30
31	753312	183	837405	271	62595	5907	87	6646	124	3961	85	29
32	753495	184	837675	270	62325	5820	87	6886	128	3796	88	28
33	753679	183	837946	271	62054	5733	87	7125	132	3632	91	27
34	753862	184	838216	270	61784	5646	87	7365	136	3467	94	26
35	9.754046	183	9.838487	271	61513	5559	87	.567604	140	.823301	96	25
36	754229	183	838757	270	61243	5472	87	7844	144	3136	99	24
37	754412	183	839027	270	60973	5385	87	8083	148	2971	102	23
38	754595	183	839297	270	60703	5297	88	8322	152	2806	105	22
39	754778	183	839568	271	60432	5210	87	8562	156	2640	107	21
40	9.754960	182	9.839838	270	60162	5123	87	.568801	160	.822475	110	20
41	755143	183	840108	270	59892	5035	88	9040	164	2310	113	19
42	755326	183	840378	270	59622	4948	87	9279	168	2144	116	18
43	755508	182	840648	270	59352	4860	88	9519	172	1978	118	17
44	755690	182	840917	269	59083	4773	87	9758	176	1813	121	16
45	9.755872	182	9.841187	270	58813	4685	88	.569997	180	.821647	124	15
46	756054	182	841457	270	58543	4598	87	.570236	184	1481	127	14
47	756236	182	841727	270	58273	4510	88	0475	188	1315	129	13
48	756418	182	841996	269	58004	4422	88	0714	192	1149	132	12
49	756600	182	842266	270	57734	4334	88	0952	196	0983	135	11
50	9.756782	181	9.842535	269	57465	4246	88	.571191	200	.820817	138	10
51	756963	181	842805	270	57195	4158	88	1430	204	0651	140	9
52	757144	182	843074	269	56926	4070	88	1669	208	0485	143	8
53	757326	181	843343	269	56657	3982	88	1907	212	0318	146	7
54	757507	181	843612	269	56388	3894	88	2146	216	.820152	149	6
55	9.757688	181	9.843882	270	56118	3806	88	.572384	220	.819985	151	5
56	757869	181	844151	269	55849	3718	88	2623	224	9819	154	4
57	758050	180	844420	269	55580	3630	89	2861	228	9652	157	3
58	758230	181	844689	269	55311	3541	88	3100	232	9486	160	2
59	758411		844958		55042	3453		3338	236	9319	162	1
M.	Lo Cos.	D.	L. Cotan.	D.	L Tang.	L. Sine	D.	N. Cos.		N. Sine		M

Digitized by Google

M.	L. Sine	D.	L. Tang.	D.	L.Cotan	L.Cos.	D.	N. Sine	d.	N. Cos.	d.	M.
0	9.758591	181	9.845227	269	54773	3365	89	.573576	237	.819152	169	60
1	758772	180	845496	268	54504	3276	89	3815	4	8985	3	59
2	758952	180	845764	269	54236	3187	88	4053	8	8818	6	58
3	759132	180	846033	269	53967	3099	89	4291	12	8651	9	57
4	759312	180	846302	268	53698	3010	89	4529	16	8484	11	56
5	9.759492	180	9.846570	269	53430	2922	88	.574767	20	.818317	14	55
6	759672	180	846839	268	53161	2833	89	5005	24	8150	17	54
7	759852	179	847108	268	52892	2744	89	5243	28	7982	20	53
8	760031	180	847376	268	52624	2655	89	5481	32	7815	23	52
9	760211	179	847644	269	52356	2566	89	5719	36	7648	25	51
10	9.760390	179	9.847913	268	52087	2477	89	.575957	40	.817480	28	50
11	760569	179	848181	268	51819	2388	89	6195	44	7312	31	49
12	760748	179	848449	268	51551	2299	89	6432	47	7145	34	48
13	760927	179	848717	269	51283	2210	89	6670	51	6977	37	47
14	761106	179	848986	268	51014	2121	90	6908	55	6809	39	46
15	9.761285	179	9.849254	268	50746	2031	89	.577145	59	.816642	42	45
16	761464	178	849522	268	50478	1942	89	7383	63	6474	45	44
17	761642	179	849790	268	50210	1853	90	7620	67	6306	48	43
18	761821	178	850057	267	49942	1763	89	7858	71	6138	51	42
19	761999	178	850325	268	49675	1674	90	8095	75	5969	54	41
20	9.762177	179	9.850593	268	49407	1584	89	.578332	79	.815801	56	40
21	762356	178	850861	268	49139	1495	90	8570	83	5633	59	39
22	762534	178	851129	268	48871	1405	90	8807	87	5465	62	38
23	762712	177	851396	267	48604	1315	90	9044	91	5296	65	37
24	762889	178	851664	268	48336	1226	89	9281	95	5128	68	36
25	9.763067	178	9.851931	267	48069	1136	90	.579518	99	.814959	70	35
26	763245	177	852199	268	47801	1046	90	9755	103	4791	73	34
27	763422	178	852466	267	47534	0956	90	.579992	107	4622	76	33
28	763600	177	852733	267	47267	0866	90	.580229	111	4453	79	32
29	763777	177	853001	268	46999	0776	90	0466	115	4284	82	31
30	9.763954	177	9.853268	267	46732	0686	90	.580703	119	.814115	85	30
31	764131	177	853535	267	46465	0596	90	0940	123	3947	87	29
32	764308	177	853802	267	46198	0506	90	1176	126	3777	90	28
33	764485	177	854069	267	45931	0415	91	1413	130	3608	93	27
34	764662	177	854336	267	45664	0325	90	1650	134	3439	96	26
35	9.764838	176	9.854603	267	45397	0235	90	.581886	138	.813270	99	25
36	765015	177	854870	267	45130	0144	91	2123	142	3101	101	24
37	765191	176	855137	267	44863	0054	90	2359	146	2931	104	23
38	765367	176	855404	267	44596	9963	91	2596	150	2762	107	22
39	765544	177	855671	267	44329	9873	90	2832	154	2592	110	21
40	9.765720	176	9.855938	266	44062	9782	91	.583069	158	.812423	113	20
41	765896	176	856204	267	43796	9691	91	3305	162	2253	116	19
42	766072	176	856471	266	43529	9601	90	3541	166	2083	118	18
43	766247	175	856737	267	43263	9510	91	3777	170	1914	121	17
44	766423	176	857004	266	42996	9419	91	4014	174	1744	124	16
45	9.766598	175	9.857270	267	42730	9328	91	.584250	178	.811574	127	15
46	766774	176	857537	266	42463	9237	91	4486	182	1404	130	14
47	766949	175	857803	266	42197	9146	91	4722	186	1234	132	13
48	767124	175	858069	267	41931	9055	91	4958	190	1064	135	12
49	767300	176	858336	266	41664	8964	91	5194	194	0894	138	11
50	9.767475	175	9.858602	266	41398	8873	92	.585429	198	.810723	141	10
51	767649	174	858868	266	41132	8781	91	5665	202	0553	144	9
52	767824	175	859134	266	40866	8690	91	5901	205	0383	147	8
53	767999	175	859400	266	40600	8599	92	6137	209	0212	149	7
54	768173	174	859666	266	40334	8507	91	6372	213	.810042	152	6
55	9.768348	175	9.859932	266	40068	8416	92	.586608	217	.809871	155	5
56	768522	174	860198	266	39802	8324	91	6843	221	9700	158	4
57	768697	175	860464	266	39536	8233	92	7079	225	9530	161	3
58	768871	174	860730	265	39270	8141	92	7314	229	9359	163	2
59	769045	174	860995		39005	8049	92	7550	233	9188	166	1
M.	L. Cos.	D.	L. Cotan.	D.	L. Tang	L. Sine	D.	N. Cos.		N. Sine		M.

Digitized by Google

	L. Sine.	D.	L. Tang.	D.	L.Cotan.	L.Cos.	D.	N. Sine	d.″	N.Cos	d.″	
0	9.747562	187	9.828987	273	71013	8574	85	.559193	240	.829038	165	60
1	747749	187	829260	272	70740	8489	85	9434	4	8875	3	59
2	747936	187	829532	273	70468	8404	86	9675	8	8712	6	58
3	748123	187	829805	272	70195	8318	85	.559916	12	8549	8	57
4	748310	187	830077	272	69923	8233	86	.560157	16	8386	11	56
5	9.748497	186	9.830349	272	69651	8147	85	.560398	20	.828223	14	55
6	748683	187	830621	272	69379	8062	86	0639	24	8060	17	54
7	748870	186	830893	272	69107	7976	85	0880	28	7897	19	53
8	749056	187	831165	272	68835	7891	86	1121	32	7734	22	52
9	749243	186	831437	272	68563	7805	86	1361	36	7571	25	51
10	9.749429	186	9.831709	272	68291	7719	85	.561602	40	.827407	28	50
11	749615	186	831981	272	68019	7634	86	1843	44	7244	30	49
12	749801	186	832253	272	67747	7548	86	2083	48	7081	33	48
13	749987	185	832525	271	67475	7462	86	2324	52	6917	36	47
14	750172	186	832796	272	67204	7376	86	2564	56	6753	39	46
15	9.750358	185	9.833068	271	66932	7290	86	.562805	60	.826590	41	45
16	750543	186	833339	272	66661	7204	86	3045	64	6426	44	44
17	750729	185	833611	271	66389	7118	86	3286	68	6262	47	43
18	750914	185	833882	272	66118	7032	86	3526	72	6098	50	42
19	751099	185	834154	271	65846	6946	86	3766	76	5934	52	41
20	9.751284	185	9.834425	271	65575	6859	87	.564007	80	.825770	55	40
21	751469	185	834696	271	65304	6773	86	4247	84	5606	58	39
22	751654	185	834967	271	65033	6687	86	4487	88	5442	61	38
23	751839	184	835238	271	64762	6600	87	4727	92	5278	63	37
24	752023	185	835509	271	64491	6514	86	4967	96	5113	66	36
25	9.752208	184	9.835780	271	64220	6427	87	.565207	100	.824949	69	35
26	752392	184	836051	271	63949	6341	86	5447	104	4785	72	34
27	752576	184	836322	271	63678	6254	87	5687	108	4620	74	33
28	752760	184	836593	271	63407	6167	87	5927	112	4456	77	32
29	752944	184	836864	270	63136	6081	86	6166	116	4291	80	31
30	9.753128	184	9.837134	271	62866	5994	87	.566406	120	.824126	83	30
31	753312	184	837405	270	62595	5907	87	6646	124	3961	85	29
32	753495	183	837675	271	62325	5820	87	6886	128	3796	88	28
33	753679	184	837946	270	62054	5733	87	7125	132	3632	91	27
34	753862	183	838216	271	61784	5646	87	7365	136	3467	94	26
35	9.754046	184	9.838487	270	61513	5559	87	.567604	140	.823301	96	25
36	754229	183	838757	270	61243	5472	87	7844	144	3136	99	24
37	754412	183	839027	270	60973	5385	88	8083	148	2971	102	23
38	754595	183	839297	271	60703	5297	87	8322	152	2806	105	22
39	754778	182	839568	270	60432	5210	87	8562	156	2640	107	21
40	9.754960	183	9.839838	270	60162	5123	88	.568801	160	.822475	110	20
41	755143	183	840108	270	59892	5035	87	9040	164	2310	113	19
42	755326	182	840378	270	59622	4948	88	9279	168	2144	116	18
43	755508	182	840648	269	59352	4860	87	9519	172	1978	118	17
44	755690	182	840917	270	59083	4773	88	9758	176	1813	121	16
45	9.755872	182	9.841187	270	58813	4685	87	.569997	180	.821647	124	15
46	756054	182	841457	270	58543	4598	88	.570236	184	1481	127	14
47	756236	182	841727	269	58273	4510	88	0475	188	1315	129	13
48	756418	182	841996	270	58004	4422	88	0714	192	1149	132	12
49	756600	182	842266	269	57734	4334	88	0952	196	0983	135	11
50	9.756782	181	9.842535	270	57465	4246	88	.571191	200	.820817	138	10
51	756963	181	842805	269	57195	4158	88	1430	204	0651	140	9
52	757144	182	843074	269	56926	4070	88	1669	208	0485	143	8
53	757326	181	843343	269	56657	3982	88	1907	212	0318	146	7
54	757507	181	843612	269	56388	3894	88	2146	216	.820152	149	6
55	9.757688	181	9.843882	270	56118	3806	88	.572384	220	.819985	151	5
56	757869	181	844151	269	55849	3718	88	2623	224	9819	154	4
57	758050	180	844420	269	55580	3630	89	2861	228	9652	157	3
58	758230	181	844689	269	55311	3541	88	3100	232	9486	160	2
59	758411		844958		55042	3453		3338	236	9319	162	1
M.	Lo Cos.	D.	L.Cotan.	D.	L Tang.	.Sine	D.	N. Cos.		N.Sine		M

Digitized by Google

M.	L. Sine	D.	L. Tang.	D.	L. Cotan	L. Cos.	D.	N. Sine	d.	N. Cos.	d.	M.
0	9.758591	181	9.845227	269	54773	3365	89	.573576	237	.819152	165	60
1	758772	180	845496	268	54504	3276	89	3815	4	8985	3	59
2	758952	180	845764	269	54236	3187	88	4053	8	8818	6	58
3	759132	180	846033	269	53967	3099	89	4291	12	8651	9	57
4	759312	180	846302	268	53698	3010	88	4529	16	8484	11	56
5	9.759492	180	9.846570	269	53430	2922	89	.574767	20	.818317	14	55
6	759672	180	846839	269	53161	2833	89	5005	24	8150	17	54
7	759852	179	847108	268	52892	2744	89	5243	28	7982	20	53
8	760031	180	847376	268	52624	2655	89	5481	32	7815	23	52
9	760211	179	847644	269	52356	2566	89	5719	36	7648	25	51
10	9.760390	179	9.847913	268	52087	2477	89	.575957	40	.817480	28	50
11	760569	179	848181	268	51819	2388	89	6195	44	7312	31	49
12	760748	179	848449	268	51551	2299	89	6432	47	7145	34	48
13	760927	179	848717	269	51283	2210	89	6670	51	6977	37	47
14	761106	179	848986	268	51014	2121	90	6908	55	6809	39	46
15	9.761285	179	9.849254	268	50746	2031	89	.577145	59	.816642	42	45
16	761464	178	849522	268	50478	1942	89	7383	63	6474	45	44
17	761642	179	849790	268	50210	1853	90	7620	67	6306	48	43
18	761821	178	850057	267	49942	1763	89	7858	71	6138	51	42
19	761999	178	850325	268	49675	1674	90	8095	75	5969	54	41
20	9.762177	179	9.850593	268	49407	1584	89	.578332	79	.815801	56	40
21	762356	178	850861	268	49139	1495	90	8570	83	5633	59	39
22	762534	178	851129	267	48871	1405	90	8807	87	5465	62	38
23	762712	177	851396	268	48604	1315	90	9044	91	5296	65	37
24	762889	178	851664	267	48336	1226	89	9281	95	5128	68	36
25	9.763067	178	9.851931	268	48069	1136	90	.579518	99	.814959	70	35
26	763245	177	852199	267	47801	1046	90	9755	103	4791	73	34
27	763422	178	852466	267	47534	0956	90	.579992	107	4622	76	33
28	763600	177	852733	267	47267	0866	90	.580229	111	4453	79	32
29	763777	177	853001	268	46999	0776	90	0466	115	4284	82	31
30	9.763954	177	9.853268	267	46732	0686	90	.580703	119	.814115	85	30
31	764131	177	853535	267	46465	0596	90	0940	123	3947	87	29
32	764308	177	853802	267	46198	0506	90	1176	126	3777	90	28
33	764485	177	854069	267	45931	0415	91	1413	130	3608	93	27
34	764662	177	854336	267	45664	0325	90	1650	134	3439	96	26
35	9.764838	176	9.854603	267	45397	0235	90	.581886	138	.813270	99	25
36	765015	177	854870	267	45130	0144	91	2123	142	3101	101	24
37	765191	176	855137	267	44863	0054	90	2359	146	2931	104	23
38	765367	176	855404	267	44596	9963	91	2596	150	2762	107	22
39	765544	177	855671	267	44329	9873	90	2832	154	2592	110	21
40	9.765720	176	9.855938	266	44062	9782	91	.583069	158	.812423	113	20
41	765896	176	856204	267	43796	9691	91	3305	162	2253	116	19
42	766072	176	856471	266	43529	9601	90	3541	166	2083	118	18
43	766247	175	856737	267	43263	9510	91	3777	170	1914	121	17
44	766423	176	857004	266	42996	9419	91	4014	174	1744	124	16
45	9.766598	175	9.857270	267	42730	9328	91	.584250	178	.811574	127	15
46	766774	176	857537	266	42463	9237	91	4486	182	1404	130	14
47	766949	175	857803	266	42197	9146	91	4722	186	1234	132	13
48	767124	175	858069	267	41931	9055	91	4958	190	1064	135	12
49	767300	176	858336	266	41664	8964	91	5194	194	0894	138	11
50	9.767475	175	9.858602	266	41398	8873	92	.585429	198	.810723	141	10
51	767649	174	858868	266	41132	8781	91	5665	202	0553	144	9
52	767824	175	859134	266	40866	8690	91	5901	205	0383	147	8
53	767999	175	859400	266	40600	8599	92	6137	209	0212	149	7
54	768173	174	859666	266	40334	8507	91	6372	213	.810042	152	6
55	9.768348	175	9.859932	266	40068	8416	92	.586608	217	.809871	155	5
56	768522	174	860198	266	39802	8324	91	6843	221	9700	158	4
57	768697	175	860464	266	39536	8233	92	7079	225	9530	161	3
58	768871	174	860730	265	39270	8141	92	7314	229	9359	163	2
59	769045	174	860995		39005	8049	92	7550	233	9188	166	1
M.	L. Cos.	D.	L. Cotan.	D.	L. Tang	L. Sine	D.	N. Cos.		N. Sine		M.

Digitized by Google

M.	L. Sine.	D.	L.Tang	D	L.Cotan	L.Cos.	D	N. Sine.	d."	N. Cos.	d."	M.
0	9·769219	174	9·861261	266	38739	7958	92	·587785	234	·809017	173	60
1	769393	173	861527	265	10.1 38473	7866	92	8021	4	8846	3	59
2	769566	174	861792	266	38208	9.90 7774	92	8256	8	8675	6	58
3	769740	173	862058	265	37942	7682	92	8491	12	8504	9	57
4	769913	174	862323	266	37677	7590	92	8726	16	8332	12	56
5	9·770087	173	9·862589	265	37411	7498	92	·588961	20	·808161	14	55
6	770260	173	862854	265	10.1 37146	7406	92	9196	23	7990	17	54
7	770433	173	863119	266	36881	9.90 7314	92	9431	27	7818	20	53
8	770606	173	863385	265	36615	7222	92	9666	31	7647	23	52
9	770779	173	863650	265	36350	7129	93	·589901	35	7475	26	51
10	9·770952	173	9·863915	265	36085	7037	92	·590136	39	·807304	29	50
11	771125	173	864180	265	10 1 35820	6945	92	0371	43	7132	32	49
12	771298	172	864445	265	35555	9.90 6852	93	0606	47	6960	35	48
13	771470	173	864710	265	35290	6760	92	0840	51	6788	38	47
14	771643	172	864975	265	35025	6667	93	1075	55	6617	40	46
15	9·771815	172	9·865240	265	34760	6575	92	·591310	59	·806445	43	45
16	771987	172	865505	265	10.1 34495	6482	93	1544	62	6273	46	44
17	772159	172	865770	265	34230	9.90 6389	93	1779	66	6100	49	43
18	772331	172	866035	265	33965	6296	93	2013	70	5928	52	42
19	772503	172	866300	264	33700	6204	92	2248	74	5756	55	41
20	9·772675	172	9·866564	265	33436	6111	93	·592482	78	·805584	58	40
21	772847	171	866829	265	10.1 33171	9.90 6018	93	2716	82	5411	61	39
22	773018	172	867094	264	32906	5925	93	2950	86	5239	64	38
23	773190	171	867358	265	32642	5832	93	3185	90	5066	66	37
24	773361	172	867623	264	32377	5739	93	3419	94	4894	69	36
25	9·773533	171	9·867887	265	32113	5645	94	·593653	98	·804721	72	35
26	773704	171	868152	264	10.1 31848	9.90 5552	93	3887	101	4548	75	34
27	773875	171	868416	264	31584	5459	93	4121	105	4376	78	33
28	774046	171	868680	265	31320	5366	93	4355	109	4203	81	32
29	774217	171	868945	264	31055	5272	94	4589	113	4030	84	31
30	9·774388	170	9·869209	264	30791	5179	93	·594823	117	·803857	87	30
31	774558	171	869473	264	10 1 30527	9.90 5085	94	5057	121	3684	89	29
32	774729	170	869737	264	30263	4992	93	5290	125	3511	92	28
33	774899	171	870001	264	29999	4898	94	5524	129	3337	95	27
34	775070	170	870265	264	29735	4804	94	5758	133	3164	98	26
35	9·775240	170	9·870529	264	29471	4711	93	·595991	137	·802991	101	25
36	775410	170	870793	264	10.1 29207	9.90 4617	94	6225	140	2817	104	24
37	775580	170	871057	264	28943	4523	94	6458	144	2644	107	23
38	775750	170	871321	264	28679	4429	94	6692	148	2470	110	22
39	775920	170	871585	264	28415	4335	94	6925	152	2297	113	21
40	9·776090	169	9·871849	263	28151	4241	94	·597159	156	·802123	115	20
41	776259	170	872112	264	10.1 27888	4147	94	7392	160	1949	118	19
42	776429	169	872376	264	27624	9.90 4053	94	7625	164	1776	121	18
43	776598	170	872640	263	27360	3959	94	7858	168	1602	124	17
44	776768	169	872903	264	27097	3864	95	8091	172	1428	127	16
45	9·776937	169	9·873167	263	26833	3770	94	·598325	176	·801254	130	15
46	777106	169	873430	264	10.1 26570	3676	94	8558	179	1080	133	14
47	777275	169	873694	263	26306	9.90 3581	95	8791	183	0906	136	13
48	777444	169	873957	263	26043	3487	94	9024	187	0731	138	12
49	777613	168	874220	264	25780	3392	95	9256	191	0557	141	11
50	9·777781	169	9 874484	263	25516	3298	94	·599489	195	·800383	144	10
51	777950	169	874747	263	10.1 25253	3203	95	9722	199	0208	147	9
52	778119	168	875010	263	24990	9.90 3108	95	·599955	203	·800034	150	8
53	778287	168	875273	264	24727	3014	94	·600188	207	·799859	153	7
54	778455	169	875537	263	24463	2919	95	0420	211	9685	156	6
55	9·778624	168	9·875800	263	24200	2824	95	·600653	215	·799510	159	5
56	778792	168	876063	263	10.1 23937	2729	95	0885	218	9335	162	4
57	778960	168	876326	263	23674	9.90 2634	95	1118	222	9160	164	3
58	779128	167	876589	263	23411	2539	95	1350	226	8985	167	2
59	779295		876852		23148	2444	95	1583	230	8810	170	1
M.	Lo. Cos.	D.	L.Cotan.	D.	L. Tang.	L.Sine.	D.	N. Cos.		N. Sine		M.

Digitized by Google

M.	L. Sine.	D.	L. Tang	D.	L. Cotan		L. Cos.	D.	N. Sine.	d."	N. Cos.	d."	M.
0	9.779463	168	9.877114	263	22886		2349	96	.601815	230	.798635	177	60
1	779631	167	877377	263	22623	10.1	2253	95	2047	4	8460	3	59
2	779798	168	877640	263	22360	9.90	2158	95	2279	8	8285	6	58
3	779966	167	877903	262	22097		2063	95	2512	12	8110	9	57
4	780133		878165		21835		1967	96	2744	15	7935	12	56
5	9.780300	167	9.878428	263	21572		1872	95	.60 2976	19	.797759	15	55
6	780467	167	878691	263	21309	10.1	1776	96	3208	23	7584	18	54
7	780634	167	878953	262	21047	9.90	1681	95	3440	27	7408	21	53
8	780801	167	879216	263	20784		1585	96	3672	31	7233	24	52
9	780968	166	879478	262	20522		1490	95	3904	35	7057	27	51
10	9.781134	167	9.879741	263	20259		1394	96	.604136	38	.796881	30	50
11	781301	167	880003	262	19997	10.1	1298	96	4367	42	6706	33	49
12	781468	166	880265	262	19735	9.90	1202	96	4599	46	6530	35	48
13	781634	166	880528	263	19472		1106	96	4831	50	6354	38	47
14	781800	166	880790	262	19210		1010	96	5062	54	6178	41	46
15	9.781966	166	9.881052	262	18948		0914	96	.605294	58	.796002	44	45
16	782132	166	881314	262	18686	10.1	0818	96	5525	61	5826	47	44
17	782298	166	881577	263	18423	9.90	0722	96	5757	65	5650	50	43
18	782464	166	881839	262	18161		0626	96	5988	69	5473	53	42
19	782630	166	882101	262	17899		0529	97	6220	73	5297	56	41
20	9.782796	165	9.882363	262	17637		0433	96	.606451	77	.795121	59	40
21	782961	166	882625	262	17375	10.1	0337	96	6682	81	4944	62	39
22	783127	165	882887	261	17113	9.90	0240	97	6914	84	4768	65	38
23	783292	166	883148	262	16852		0144	96	7145	88	4591	68	37
24	783458	165	883410	262	16590		0047	97	7376	92	4415	71	36
25	9.783623	165	9.883672	262	16328		9951	96	.607607	96	.794238	74	35
26	783788	165	883934	262	16066	10.1	9854	97	7838	100	4061	77	34
27	783953	165	884196	261	15804	9.89	9757	97	8069	104	3884	80	33
28	784118	164	884457	262	15543		9660	97	8300	107	3707	83	32
29	784282	165	884719	261	15281		9564	96	8531	111	3530	86	31
30	9.784447	165	9.884980	262	15020		9467	97	.608761	115	.793353	89	30
31	784612	164	885242	262	14758	10.1	9370	97	8992	119	3176	92	29
32	784776	166	885504	261	14496	9.89	9273	97	9223	123	2999	94	28
33	784941	164	885765	261	14235		9176	97	9453	127	2822	97	27
34	785105	164	886026	262	13974		9078	98	9684	130	2644	100	26
35	9.785269	164	9.886288	261	13712		8981	97	.609915	134	.792467	103	25
36	785433	164	886549	262	13451	10.1	8884	97	.610145	138	2290	106	24
37	785597	164	886811	261	13189	9.89	8787	97	0376	142	2112	109	23
38	785761	164	887072	261	12928		8689	99	0606	146	1934	112	22
39	785925	164	887333	261	12667		8592	97	0836	150	1757	115	21
40	9.786089	163	9.887594	261	12406		8494	98	.611067	153	.791579	118	20
41	786252	164	887855	261	12145	10.1	8397	97	1297	157	1401	121	19
42	786416	163	888116	262	11884	9.89	8299	98	1527	161	1223	124	18
43	786579	163	888378	261	11622		8202	97	1757	165	1046	127	17
44	786742	164	888639	261	11361		8104	98	1987	169	0868	130	16
45	9.786906	163	9.888900	261	11100		8006	98	.612217	173	.790690	133	15
46	787069	163	889161	260	10839	10.1	7908	98	2447	176	0511	136	14
47	787232	163	889421	261	10579	9.89	7810	98	2677	180	0333	139	13
48	787395	162	889682	261	10318		7712	98	2907	184	.790155	142	12
49	787557	163	889943	261	10057		7614	98	3137	188	.789977	145	11
50	9.787720	163	9.890204	261	09796		7516	98	.613367	192	.789798	148	10
51	787883	162	890465	261	09535	10.1	7418	98	3596	196	9620	151	9
52	788045	163	890725	260	09275	9.89	7320	98	3826	199	9441	153	8
53	788208	162	890986	261	09014		7222	98	4056	203	9263	156	7
54	788370	162	891247	261	08753		7123	99	4285	207	9084	159	6
55	9.788532	162	9.891507	260	08493		7025	98	.614515	211	.788905	162	5
56	788694	162	891768	261	08232	10.1	6926	99	4744	215	8727	165	4
57	788856	162	892028	260	07972	9.89	6828	98	4974	219	8548	168	3
58	789018	162	892289	261	07711		6729	99	5203	222	8369	171	2
59	789180		892549	260	07451		6631	99	5432	226	8190	174	1
M.	Lo. Cos.	D.	L. Cotan.	D.	L. Tang.		L. Sine.	D.	N. Cos.		N. Sine		M.

Digitized by Google

M.	L.Sine.	D.	L. Tang	D.	L.Cotan	L.Cos.	D.	N.Sine.	d.″	N. Cos.	d.″	M
0	9 789342		9.892810		07190	6532		.615661	228	.788011	181	60
1	789504	162	893070	260	06930	6433	99	5891	4	7832	3	59
2	789665	161	893331	261	06669	6335	98	6120	8	7652	6	58
3	789827	162	893591	260	06409	6236	99	6349	11	7473	9	57
4	789988	161	893851	260	06149	6137	99	6578	15	7294	12	56
5	9.790149	161	9.894111	260	05889	6038	99	.616807	19	.787114	15	55
6	790310	161	894372	261	05628	5939	99	7036	23	6935	18	54
7	790471	161	894632	260	05368	5840	99	7265	27	6755	21	53
8	790632	161	894892	260	05108	5741	99	7494	30	6576	24	52
9	790793	161	895152	260	04848	5641	100	7722	34	6396	27	51
10	9.790954	161	9.895412	260	04588	5542	99	.617951	38	.786216	30	50
11	791115	161	895672	260	04328	5443	99	8180	42	6037	33	49
12	791275	160	895932	260	04068	5343	100	8408	46	5857	36	48
13	791436	161	896192	260	03808	5244	99	8637	49	5677	39	47
14	791596	160	896452	260	03548	5145	99	8865	53	5497	42	46
15	9.791757	161	9.896712	260	03288	5045	100	.619094	57	.785317	45	45
16	791917	160	896971	259	03029	4945	100	9322	61	5137	48	44
17	792077	160	897231	260	02769	4846	99	9551	65	4957	51	43
18	792237	160	897491	260	02509	4746	100	.619779	68	4776	54	42
19	792397	160	897751	260	02249	4646	100	620007	72	4596	57	41
20	9.792557	160	9.898010	259	01990	4546	100	.620235	76	.784416	60	40
21	792716	159	898270	260	01730	4446	100	9464	80	4235	63	39
22	792876	160	898530	260	01470	4346	100	0692	84	4055	66	38
23	793035	159	898789	259	01211	4246	100	0920	87	3874	69	37
24	793195	160	899049	260	00951	4146	100	1148	91	3693	72	36
25	9.793354	159	9.899308	259	00692	4046	100	.621376	95	.783513	75	35
26	793514	160	899568	260	00432	3946	100	1604	99	3332	78	34
27	793673	159	899827	259	00173	3846	100	1831	103	3151	82	33
28	793832	159	900086	259	99913	3745	101	2059	106	2970	85	32
29	793991	159	900346	260	99654	3645	100	2287	110	2789	88	31
30	9.794150	159	9.900605	259	99395	3544	101	.622515	114	.782608	91	30
31	794308	158	900864	259	99136	3444	100	2742	118	2427	94	29
32	794467	159	901124	260	98876	3343	101	2970	122	2246	97	28
33	794626	159	901383	259	98617	3243	100	3197	125	2065	100	27
34	794784	158	901642	259	98358	3142	101	3425	129	1883	103	26
35	9.794942	158	9.901901	259	98099	3041	101	.623652	133	.781702	106	25
36	795101	159	902160	259	97840	2940	101	3880	137	1520	109	24
37	795259	158	902420	260	97580	2839	101	4107	141	1339	112	23
38	795417	158	902679	259	97321	2739	100	4334	144	1157	115	22
39	795575	158	902938	259	97062	2638	101	4561	148	0976	118	21
40	9.795733	158	9.903197	259	96803	2536	102	.624788	152	.780794	121	20
41	795891	158	903456	258	96544	2435	101	5016	156	0612	124	19
42	796049	157	903714	259	96286	2334	101	5243	160	0430	127	18
43	796206	157	903973	259	96027	2233	101	5470	163	0248	130	17
44	796364	158	904232		95768	2132	101	5697	167	.780066	133	16
45	9.796521	157	9.904491	259	95509	2030	102	.625923	171	.779884	136	15
46	796679	158	904750	259	95250	1929	101	6150	175	9702	139	14
47	796836	157	905008	258	94991	1827	102	6377	179	9520	142	13
48	796993	157	905267	259	94733	1726	101	6604	182	9338	145	12
49	797150	157	905526	259	94474	1624	102	6830	186	9156	148	11
50	9.797307	157	9.905785	259	94215	1523	101	.627057	190	.778973	151	10
51	797464	157	906043	258	93957	1421	102	7284	194	8791	154	9
52	797621	157	906302	259	93698	1319	102	7510	198	8608	157	8
53	797777	156	906560	258	93440	1217	101	7737	201	8426	160	7
54	797934	157	906819	259	93181	1115	102	7963	205	8243	163	6
55	9.798091	157	9.907077	258	92923	1013	102	.628189	209	.778060	166	5
56	798247	156	907336	259	92664	0911	102	8416	213	7878	169	4
57	798403	156	907594	258	92406	0809	102	8642	217	7695	172	3
58	798560	157	907853	259	92147	0707	102	8868	220	7512	175	2
59	798716	156	908111	258	91889	0605	102	9094	224	7329	178	1
M.	L. Cos.	D.	L.Cotan	D.	L.Tang.	L Sine	D.	N. Cos.		N. Sine		M

Digitized by Google

M.	L. Sine	D.	L. Tang.	D.	L.Cotan	L.Cos.	D.	N. Sine	d.'	N. Cos.	d.'	M
0	9.798872		9.908369		91631	0503		,629320		.777146		60
1	799028	156	908628	259	91372	0400	103	9546	225	6963	185	59
2	799184	156	908886	258	10.0 91114	9.89 0298	102	9772	4	6780	3	58
3	799339	155	909144	258	90856	0195	103	.629998	8	6596	6	57
4	799495	156	909402	258	90598	0093	102	.630224	11	6413	9	56
5	9.799651	156	9.909660	258	90340	9990	103	,630450	15	.776230	12	55
6	799806	155	909918	258	10.0 90082	9.88 9888	102	0676	19	6046	15	54
7	799962	156	910177	259	89823	9785	103	9901	23	5863	19	53
8	800117	155	910435	258	89565	9682	103	1127	26	5679	22	52
9	800272	155	910693	258	89307	9579	103	1353	30	5496	25	51
10	9.800427	155	9.910951	258	89049	9477	102	,631578	34	.775312	28	50
11	800582	155	911209	258	88791	9374	103	1804	38	5128	31	49
12	800737	155	911467	258	10.0 88533	9.88 9271	103	2029	41	4944	34	48
13	800892	155	911725	257	88275	9168	103	2255	45	4761	37	47
14	801047	155	911982	258	88018	9064	104	2480	49	4577	40	46
15	9.801201	154	9.912240	258	87760	8961	103	.632705	53	.774393	43	45
16	801356	155	912498	258	87502	8858	103	2931	56	4209	46	44
17	801511	155	912756	258	10.0 87244	9.88 8755	103	3156	60	4024	49	43
18	801665	154	913014	258	86986	8651	104	3381	64	3840	52	42
19	801819	154	913271	257	86729	8548	103	3606	68	3656	56	41
20	9.801973	154	9.913529	258	86471	8444	104	.633831	71	.773472	59	40
21	802128	155	913787	258	86213	8341	103	4056	75	3287	62	39
22	802282	154	914044	257	10.0 85956	9.88 8237	104	4281	79	3103	65	38
23	802436	154	914302	258	85698	8134	103	4506	83	2918	68	37
24	802589	153	914560	258	85440	8030	104	4730	86	2734	71	36
25	9.802743	154	9.914817	257	85183	7926	104	.634955	90	.772549	74	35
26	802897	154	915075	258	84925	7822	104	5180	94	2364	77	34
27	803050	153	915332	257	10.0 84668	9.88 7718	104	5405	98	2179	80	33
28	803204	154	915590	258	84410	7614	104	5629	101	1994	83	32
29	803357	153	915847	257	84153	7510	104	5854	105	1810	86	31
30	9.803511	154	9.916104	257	83896	7406	104	.636078	109	.771625	89	30
31	803664	153	916362	258	83638	7302	104	6303	113	1439	93	29
32	803817	153	916619	257	10.0 83381	9.88 7198	104	6527	116	1254	96	28
33	803970	153	916877	258	83123	7093	105	6751	120	1069	99	27
34	804123	153	917134	257	82866	6989	104	6976	124	0884	102	26
35	9.804276	153	9.917391	257	82609	6885	104	.637200	128	.770699	105	25
36	804428	152	917648	257	82352	6780	105	7424	131	0513	108	24
37	804581	153	917906	258	10.0 82094	9.88 6676	104	7648	135	0328	111	23
38	804734	153	918163	257	81837	6571	105	7872	139	.770142	114	22
39	804886	152	918420	257	81580	6466	105	8096	143	.769957	117	21
40	9.805039	153	9.918677	257	81323	6362	104	.638320	146	.769771	120	20
41	805191	152	918934	257	81066	6257	105	8544	150	9585	123	19
42	805343	152	919191	257	10.0 80809	9.88 6152	105	8768	154	9400	126	18
43	805495	152	919448	257	80552	6047	105	8992	158	9214	130	17
44	805647	152	919705	257	80295	5942	105	9215	161	9028	133	16
45	9.805799	152	9.919962	257	80038	5837	105	.639439	165	.768842	136	15
46	805951	152	920219	257	79781	5732	105	9663	169	8656	139	14
47	806103	152	920476	257	10.0 79524	9.88 5627	105	.639886	173	8470	142	13
48	806254	151	920733	257	79267	5522	105	.640110	176	8283	145	12
49	806406	152	920990	257	79010	5416	106	0333	180	8097	148	11
50	9.806557	151	9.921247	257	78753	5311	105	.640557	184	.767911	151	10
51	806709	152	921503	256	78497	5205	106	0780	188	7725	154	9
52	806860	151	921760	257	10.0 78240	9.88 5100	105	1003	191	7538	157	8
53	807011	151	922017	257	77983	4994	106	1226	195	7352	160	7
54	807163	152	922274	257	77726	4889	105	1450	199	7165	163	6
55	9.807314	151	9.922530	256	77470	4783	106	.641673	203	.766978	167	5
56	807465	151	922787	257	77213	4677	106	1896	206	6792	170	4
57	807615	150	923044	257	10.0 76956	9.88 4572	105	2119	210	6605	173	3
58	807766	151	923300	256	76700	4466	106	2343	214	6418	176	2
59	807917	151	923557	257	76443	4360	106	2565	218	6231	179	1
M.	L. Cos	D.	L. Cotan.	D.	L.Tang.	L.Sine.	D.	N. Cos.	221	N. Sine	182	M

Digitized by Google

M.	L. Sine.	D.	L. Tang.	D.	L.Cotan.	L.Cos.	D.	N. Sine	d."	N.Cos	l."	M
0	9 808067	151	9.923814	256	76186	4254	106	.642788	221	.766044	139	60
1	808218	150	924070	257	10.0 75930	9.88 4148	106	3010	4	5857	3	59
2	808368	151	924327	256	75673	4042	106	3233	7	5670	6	58
3	808519	150	924583	257	75417	3936	107	3456	11	5483	10	57
4	808669	150	924840	256	75160	3829	106	3678	15	5296	13	56
5	9.808819	150	9.925096	256	74904	3723	106	.643901	18	.765109	16	55
6	808969	150	925352	256	10.0 74648	9.88 3617	107	4124	22	4921	19	54
7	809119	150	925609	257	74391	3510	106	4346	26	4734	22	53
8	809269	150	925865	256	74135	3404	107	4568	30	4546	25	52
9	809419	150	926122	257	73878	3297	106	4791	33	4359	28	51
10	9.809569	150	9.926378	256	73622	3191	107	.645013	37	.764171	32	50
11	809718	149	926634	256	73366	3084	107	5235	41	3984	35	49
12	809868	150	926890	256	10.0 73110	9.88 2977	106	5458	44	3796	38	48
13	810017	149	927147	257	72853	2871	107	5680	48	3608	41	47
14	810167	150	927403	256	72597	2764	107	5902	52	3420	44	46
15	9.810316	149	9.927659	256	72341	2657	107	.646124	55	.763232	47	45
16	810465	149	927915	256	72085	2550	107	6346	59	3044	50	44
17	810614	149	928171	256	10.0 71829	9.88 2443	107	6568	63	2856	54	43
18	810763	149	928427	257	71573	2336	107	6790	66	2668	57	42
19	810912	149	928684	256	71316	2229	107	7012	70	2480	60	41
20	9.811061	149	9.928940	256	71060	2121	108	.647233	74	.762292	63	40
21	811210	149	929196	256	70804	2014	107	7455	77	2104	66	39
22	811358	148	929452	256	10.0 70548	9.88 1907	107	7677	81	1915	69	38
23	811507	149	929708	256	70292	1799	108	7898	85	1727	73	37
24	811655	148	929964	256	70036	1692	107	8120	88	1538	76	36
25	9.811804	149	9.930220	256	69780	1584	108	.648341	92	.761350	79	35
26	811952	148	930475	255	69525	1477	107	8563	96	1161	82	34
27	812100	148	930731	256	10.0 69269	9.88 1369	108	8784	100	0972	85	33
28	812248	148	930987	256	69013	1261	108	9006	103	0784	88	32
29	812396	148	931243	256	68757	1153	108	9227	107	0595	91	31
30	9.812544	148	9.931499	256	68501	1046	107	.649448	111	.760406	95	30
31	812692	148	931755	255	10.0 68245	9.88 0938	108	9669	114	0217	98	29
32	812840	148	932010	256	67990	0830	108	.649890	118	.760028	101	28
33	812988	147	932266	256	67734	0722	109	.650111	122	.759839	104	27
34	813135	148	932522	256	67478	0613	108	0332	125	9650	107	26
35	9.813283	147	9.932778	255	67222	0505	108	.650553	129	.759461	110	25
36	813430	148	933033	256	10.0 66967	9.88 0397	108	0774	133	9271	113	24
37	813578	147	933289	256	66711	0289	109	0995	136	9082	117	23
38	813725	147	933545	255	66455	0180	108	1216	140	8893	120	22
39	813872	147	933800	256	66200	0072	108	1437	144	8703	123	21
40	9.814019	147	9.934056	255	65944	9963	109	.651657	147	.758514	126	20
41	814166	147	934311	256	10.0 65689	9.87 9855	108	1878	151	8324	129	19
42	814313	147	934567	255	65433	9746	109	2098	155	8134	132	18
43	814460	147	934822	256	65178	9637	109	2319	158	7945	136	17
44	814607	146	935078	255	64922	9529	108	2539	162	7755	139	16
45	9.814753	147	9.935333	256	64667	9420	109	.652760	166	.757565	142	15
46	814900	146	935589	255	10.0 64411	9.87 9311	109	2980	169	7375	145	14
47	815046	147	935844	256	64156	9202	109	3200	173	7185	148	13
48	815193	146	936100	255	63900	9093	109	3421	177	6995	151	12
49	815339	146	936355	256	63645	8984	109	3641	181	6805	154	11
50	9.815485	147	9.936611	255	63389	8875	109	.653861	184	.756615	158	10
51	815632	146	936866	255	10.0 63134	9.87 8766	109	4081	188	6425	161	9
52	815778	146	937121	256	62879	8656	110	4301	192	6234	164	8
53	815924	145	937377	255	62623	8547	109	4521	195	6044	167	7
54	816069	146	937632	255	62368	8438	109	4741	199	5853	170	6
55	9.816215	146	9 937887	255	62113	8328	110	.654961	203	.755663	173	5
56	816361	146	938142	255	10.0 61858	9.87 8219	109	5180	206	5472	176	4
57	816507	145	938398	256	61602	8109	110	5400	210	5282	180	3
58	816652	146	938653	255	61347	7999	110	5620	214	5091	183	2
59	816798		938908	255	61092	7890	109	5839	217	4900	186	1
M.	Lo Cos.	D.	L.Cotan.	D.	L Tang.	L.Sine	D.	N. Cos.		N. Sine		M

Digitized by Google

M.	L. Sine.	D.	L. Tang.	D.	L.Cotan.	L.Cos	D.	N. Sine	d."	N.Cos	d."	
0	9.816943		9.939163		60837	7780		.656059	218	.754710	193	60
1	817088	145	939418	255	60582	7670	110	6278	4	4519	3	59
2	817233	145	939673	255	10.0 60327	9.87 7560	110	6498	7	4328	6	58
3	817379	146	939928	255	60072	7450	110	6717	11	4137	10	57
4	817524	145	940183	255	59817	7340	110	6937	15	3946	13	56
5	9.817668	144	9 940439	256	59561	7230	110	.657156	18	.753755	16	55
6	817813	145	940694	255	59306	7120	110	7375	22	3563	19	54
7	817958	145	940949	255	10.0 59051	9.87 7010	111	7594	25	3372	23	53
8	818103	145	941204	255	58796	6899	110	7813	29	3181	26	52
9	818247	144	941459	255	58541	6789	111	8033	33	2989	29	51
10	9.818392	145	9.941713	254	58287	6678	110	.658252	36	.752798	32	50
11	818536	144	941968	255	58032	6568	111	8471	40	2606	35	49
12	818681	145	942223	255	10.0 57777	9.87 6457	110	8689	44	2415	39	48
13	818825	144	942478	255	57522	6347	111	8908	47	2223	42	47
14	818969	144	942733	255	57267	6236	111	9127	51	2032	45	46
15	9.819113	144	9.942988	255	57012	6125	111	.659346	55	.751840	48	45
16	819257	144	943243	255	56757	6014	110	9564	58	1648	52	44
17	819401	144	943498	255	10.0 56502	9.87 5904	111	.659783	62	1456	55	43
18	819545	144	943752	254	56248	5793	111	.660002	65	1264	58	42
19	819689	143	944007	255	55993	5682	111	0220	69	1072	61	41
20	9.819832	144	9.944262	255	55738	5571	112	.660439	73	.750880	64	40
21	819976	144	944517	255	55483	5459	111	0657	76	0688	68	39
22	820120	143	944771	254	10 0 55229	9.87 5348	111	0875	80	0496	71	38
23	820263	143	945026	255	54974	5237	111	1094	84	0303	74	37
24	820406	144	945281	255	54719	5126	112	1312	87	.750111	77	36
25	9.820550	143	9.945535	254	54465	5014	111	.661530	91	.749919	80	35
26	820693	143	945790	255	54210	4903	112	1748	95	9726	84	34
27	820836	143	946045	255	10.0 53955	9.87 4791	112	1966	98	9534	87	33
28	820979	143	946299	254	53701	4680	111	2184	102	9341	90	32
29	821122	143	946554	255	53446	4568	112	2402	105	9148	93	31
30	9.821265	142	9.946808	254	53192	4456	112	.662620	109	.748956	97	30
31	821407	143	947063	255	52937	4344	112	2838	113	8763	100	29
32	821550	143	947318	255	10 0 52682	9.87 4232	112	3056	116	8570	103	28
33	821693	143	947572	254	52428	4121	111	3273	120	8377	106	27
34	821835	142	947827	255	52173	4009	112	3491	124	8184	109	26
35	9.821977	142	9.948081	254	51919	3896	113	.663709	127	.747991	113	25
36	822120	143	948335	254	10.0 51665	9.87 3784	112	3926	131	7798	116	24
37	822262	142	948590	255	51410	3672	112	4144	134	7605	119	23
38	822404	142	948844	254	51156	3560	112	4361	138	7412	122	22
39	822546	142	949099	255	50901	3448	112	4578	142	7218	126	21
40	9.822688	142	9.949353	254	50647	3335	113	.664796	145	.747025	129	20
41	822830	142	949608	255	10 0 50392	9.87 3223	112	5013	149	6832	132	19
42	822972	142	949862	254	50138	3110	113	5230	153	6638	135	18
43	823114	141	950116	254	49884	2998	112	5447	156	6445	138	17
44	823255	142	950371	255	49629	2885	113	5665	160	6251	142	16
45	9.823397	142	9.950625	254	49375	2772	113	.665882	164	.746057	145	15
46	823539	141	950879	254	10.0 49121	9.87 2659	113	6099	167	5864	148	14
47	823680	141	951133	255	48867	2547	112	6316	171	5670	151	13
48	823821	141	951388	254	48612	2434	113	6532	174	5476	154	12
49	823963	142	951642	254	48358	2321	113	6749	178	5282	158	11
50	9.824104	141	9.951896	254	48104	2208	113	.666966	182	.745088	161	10
51	824245	141	952150	254	10 0 47850	9.87 2095	113	7183	185	4894	164	9
52	824386	141	952405	255	47595	1981	114	7399	189	4700	167	8
53	824527	141	952659	254	47341	1868	113	7616	193	4506	171	7
54	824668	141	952913	254	47087	1755	113	7833	196	4311	174	6
55	9.824808	140	9.953167	254	46833	1641	114	.668049	200	.744117	177	5
56	824949	141	953421	254	10.0 46579	9.87 1528	113	8265	204	3923	180	4
57	825090	141	953675	254	46325	1414	114	8482	207	3728	183	3
58	825230	140	953929	254	46071	1301	113	8698	211	3534	187	2
59	825371	141	954183	254	45817	1187	114	8914	214	3339	190	1
M.	Lo Cos.	D.	L.Cotan.	D.	L Tang.	L.Sine	D.	N. Cos.		N.Sine		M

Digitized by Google

M.	L. Sine	D	L. Tang	D	L. Cotan	L. Cos.	D	N. Sine.	d."	N. Cos.	d."	M
0	9·825511		9·954437	254	45563	1073	112	·669131	214	·743145	197	60
1	825651	140	954691	255	45309	9·9·6960	114	9347	4	2950	3	59
2	825791	140	954946	254	45054	0846	114	9563	7	2755	7	58
3	825931	140	955200	254	44800	0732	114	9779	11	2561	10	57
4	826071	140	955454	254	44546	0618	114	669995	14	2366	13	56
5	9·826211	140	9·955708	253	44292	0504	114	·670211	18	·742171	16	55
6	826351	140	955961	254	44039	9·9·0390	114	0427	21	1976	20	54
7	826491	140	956215	254	43785	0276	115	0642	25	1781	23	53
8	826631	140	956469	254	43531	0161	114	0858	27	1586	26	52
9	826770	139	956723	254	43277	0047	114	1074	32	1390	30	51
10	9·826910	140	9·956977	254	43023	9·9·9933	114	·671289	36	·741195	33	50
11	827049	139	957231	254	42769	9818	115	1505	39	1000	36	49
12	827189	140	957485	254	42515	9704	114	1721	43	0805	39	48
13	827328	139	957739	254	42261	9589	115	1936	46	0609	43	47
14	827467	139	957993	254	42007	9474	115	2151	50	0414	46	46
15	9·827606	139	9·958247	253	41753	9360	114	·672367	54	·740218	49	45
16	827745	139	958500	254	41500	9245	115	2582	57	·740022	53	44
17	827884	139	958754	254	41246	9·9·9130	115	2797	61	·739827	56	43
18	828023	139	959008	254	40992	9015	115	3012	64	9631	59	42
19	828162	139	959262	254	40738	8900	115	3228	68	9435	62	41
20	9·828301	139	9·959516	253	40484	8785	115	·673443	71	·739239	66	40
21	828439	138	959769	254	40231	9·9·8670	115	3658	75	9043	69	39
22	828578	139	960023	254	39977	8555	115	3873	79	8847	72	38
23	828716	138	960277	253	39723	8440	115	4088	82	8651	76	37
24	828855	139	960530	254	39470	8324	116	4302	86	8455	79	36
25	9·828993	138	9·960784	254	39216	8209	115	·674517	89	·738259	82	35
26	829131	138	961038	254	38962	9·9·8093	116	4732	93	8063	85	34
27	829269	138	961292	253	38708	7978	115	4947	96	7867	89	33
28	829407	138	961545	254	38455	7862	116	5161	100	7670	92	32
29	829545	138	961799	253	38201	7747	115	5376	103	7474	95	31
30	9·829683	138	9·962052	254	37948	7631	116	·675590	107	·737277	99	30
31	829821	138	962306	254	37694	9·9·7515	116	5805	111	7081	102	29
32	829959	138	962560	253	37440	7399	116	6019	114	6884	105	28
33	830097	138	962813	254	37187	7283	116	6233	118	6687	108	27
34	830234	137	963067	253	36933	7167	116	6448	121	6491	112	26
35	9·830372	138	9·963320	254	36680	7051	116	·676662	125	·736294	115	25
36	830509	137	963574	254	36426	9·9·6935	116	6876	128	6097	118	24
37	830646	137	963828	253	36172	6819	116	7090	132	5900	122	23
38	830784	138	964081	254	35919	6703	116	7304	136	5703	125	22
39	830921	137	964335	253	35665	6586	117	7518	139	5506	128	21
40	9·831058	137	9·964588	254	35412	6470	116	·677732	143	·735309	131	20
41	831195	137	964842	253	35158	9·9·6353	117	7946	146	5112	135	19
42	831332	137	965095	254	34905	6237	116	8160	150	4915	138	18
43	831469	137	965349	253	34651	6120	117	8373	153	4717	141	17
44	831606	136	965602	253	34398	6004	116	8587	157	4520	145	16
45	9·831742	137	9·965855	254	34145	5887	117	·678801	161	·734322	148	15
46	831879	136	966109	253	33891	9·9·5770	117	9014	164	4125	151	14
47	832015	137	966362	254	33638	5653	117	9228	168	3927	154	13
48	832152	136	966616	253	33384	5536	117	9441	171	3730	158	12
49	832288	137	966869	253	33131	5419	117	9655	175	3532	161	11
50	9·832425	136	9·967123	254	32877	5302	117	·679868	178	·733334	164	10
51	832561	136	967376	253	32624	9·9·5185	117	·680081	182	3137	168	9
52	832697	136	967629	253	32371	5068	117	0295	186	2939	171	8
53	832833	136	967883	254	32117	4950	118	0508	189	2741	174	7
54	832969	136	968136	253	31864	4833	117	0721	193	2543	177	6
55	9·833105	136	9·968389	253	31611	4716	117	·680934	196	·732345	181	5
56	833241	136	968643	254	31357	9·9·4598	118	1147	200	2147	184	4
57	833377	136	968896	253	31104	4481	117	1360	203	1949	187	3
58	833512	135	969149	253	30851	4363	118	1573	207	1750	190	2
59	833648	136	969403	254	30597	4245	118	1786	211	1552	194	1
M.	Lo. Cos.	D.	L. Cotan.	D.	L. Tang.	L. Sine.	D.	N. Cos.		N. Sine		M

Digitized by Google

M.	L.Sine.	D.	L. Tang.	D.	L Cotan.		L.Cos.	D.	N.Sine.	d.″	N. Cos.	d.″
0	9 833783	136	9·969656	253	30344		4127	117	.681998	211	.731354	201
1	833919	135	969909	253	30091	10.0	4010	118	2211	4	1155	3
2	834054	135	970162	254	29838		3892	118	2424	7	0957	7
3	834189	136	970416	253	29584	9.86	3774	118	2636	11	0758	10
4	834325		970669		29331		3656		2849	14	0560	13
5	9.834460	135	9·970922	253	29078		3538	118	.683001	18	.730361	17
6	834595	135	971175	253	28825	10.0	3419	119	3274	21	.730162	20
7	834730	135	971429	254	28571		3301	118	3486	25	.729963	24
8	834865	134	971682	253	28318	9.86	3183	119	3698	28	9765	27
9	834999		971935	253	28065		3064		3911	32	9566	30
10	9.835134	135	9·972188	253	27812		2946	118	.684123	35	.729367	34
11	835269	135	972441	253	27559	10 0	2827	119	4335	39	9168	37
12	835403	134	972695	254	27305		2709	118	4547	42	8969	40
13	835538	135	972948	253	27052	9.86	2590	119	4759	46	8769	44
14	835672	134	973201	253	26799		2471	119	4971	49	8570	47
15	9.835807	135	9·973454	253	26546		2353	118	.685183	53	.728371	50
16	835941	134	973707	253	26293	10.0	2234	119	5395	56	8172	54
17	836075	134	973960	253	26040		2115	119	5607	60	7972	57
18	836209	134	974213	253	25787	9.86	1996	119	5818	63	7773	60
19	836343	134	974466	253	25534		1877	119	6030	67	7573	64
20	9.836477	134	9·974720	254	25280		1758	119	.686242	70	.727374	67
21	836611	134	974973	253	25027	10.0	1638	120	6453	74	7174	70
22	836745	134	975226	253	24774		1519	119	6665	77	6974	74
23	836878	133	975479	253	24521	9.86	1400	119	6876	81	6774	77
24	837012	134	975732	253	24268		1280	120	7087	84	6575	80
25	9.837146	133	9·975985	253	24015		1161	119	.687299	88	.726375	84
26	837279	133	976238	253	23762	10.0	1041	120	7510	91	6175	87
27	837412	133	976491	253	23509		0922	119	7721	95	5975	91
28	837546	134	976744	253	23256	9.86	0802	120	7932	99	5775	94
29	837679	133	976997	253	23003		0682	120	8143	102	5575	97
30	9.837812	133	9·977250	253	22750		0562	120	.688355	106	.725374	101
31	837945	133	977503	253	22497	10.0	0442	120	8565	109	5174	104
32	838078	133	977756	253	22244		0322	120	8776	113	4974	107
33	838211	133	978009	253	21991	9.86	0202	120	8987	116	4773	111
34	838344	133	978262	253	21738		0082	120	9198	120	4573	114
35	9.838477	133	9·978515	253	21485		9902	120	.689409	123	.724372	117
36	838610	132	978768	253	21232	10.0	9842	120	9619	127	4172	121
37	838742	133	979021	253	20979		9721	121	.689830	130	3971	124
38	838875	132	979274	253	20726	9.85	9601	120	.690041	134	3770	127
39	839007	133	979527	253	20473		9480	121	0251	137	3570	131
40	9.839140	132	9·979780	253	20220		9360	120	.690462	141	.723369	134
41	839272	132	980033	253	19967	10.0	9239	121	0672	144	3168	137
42	839404	132	980286	252	19714		9119	120	0882	148	2967	141
43	839536	132	980538	253	19462	9.85	8998	121	1093	151	2766	144
44	839668	132	980791	253	19209		8877	121	1303	155	2565	147
45	9.839800	132	9·981044	253	18956		8756	121	.691513	158	.722364	151
46	839932	132	981297	253	18703	10.0	8635	121	1723	162	2163	154
47	840064	132	981550	253	18450		8514	121	1933	165	1961	158
48	840196	132	981803	253	18197	9.85	8393	121	2143	169	1760	161
49	840328	131	982056	253	17944		8272	121	2353	172	1559	164
50	9.840459	132	9·982309	253	17691		8151	121	692563	176	.721357	168
51	840591	131	982562	253	17438	10.0	8029	122	2773	179	1156	171
52	840722	132	982814	252	17186		7908	121	2982	183	0954	174
53	840854	131	983067	253	16933	9.85	7786	122	3192	186	0753	178
54	840985	131	983320	253	16680		7665	121	3402	190	0551	181
55	9.841116	131	9·983573	253	16427		7543	122	.693611	193	.720349	184
56	841247	131	983826	253	16174	10.0	7422	121	3821	197	.720148	188
57	841378	131	984079	253	15921		7300	122	4030	201	.719946	191
58	841509	131	984332	253	15668	9.85	7178	122	4240	204	9744	194
59	841640	131	984584	252	15416		7056	122	4449	208	9542	198
M.	L. Cos.	D.	L.Cotan	D.	L. Tang.		L. Sine	D.	N. Cos.		N. Sine	

Digitized by Google

M.	L. Sine.	D.	L. Tang.	D.	L. Cotan	L. Cos.	D.	N. Sine	d."	N Cos.	d"	M
0	9.841771		9.984837		15163	6934		.694658	207	.719340	204	60
1	841902	131	985090	253	14910	6812	122	4868	4	9138	3	59
2	842033	131	985343	253	14657	6690	122	5077	7	8935	7	58
3	842163	130	985596	253	14404	6568	122	5286	10	8733	10	57
4	842294	131	985848	252	14152	6446	122	5495	14	8531	14	56
5	9.842424	130	9.986101	253	13899	6323	123	.695704	17	.718329	17	55
6	842555	131	986354	253	13646	6201	122	5913	21	8126	20	54
7	842685	130	986607	253	13393	6078	123	6122	24	7924	24	53
8	842815	130	986860	253	13140	5956	122	6330	28	7721	27	52
9	842946	131	987112	252	12888	5833	123	6530	31	7519	31	51
10	9.843076	130	9.987365	253	12635	5711	122	.696748	35	.717316	34	50
11	843206	130	987618	253	12382	5588	123	6956	38	7113	37	49
12	843336	130	987871	253	12129	5465	123	7165	41	6911	41	48
13	843466	130	988123	252	11877	5342	123	7374	45	6708	44	47
14	843595	129	988376	253	11624	5219	123	7582	48	6505	48	46
15	9.843725	130	9.988629	253	11371	5096	123	.697790	52	.716302	51	45
16	843855	130	988882	253	11118	4973	123	7999	55	6099	54	44
17	843984	129	989134	252	10866	4850	123	8207	59	5896	58	43
18	844114	130	989387	253	10613	4727	124	8415	62	5693	61	42
19	844243	129	989640	253	10360	4603	123	8623	66	5489	65	41
20	9.844372	129	9.989893	253	10107	4480	124	.698831	69	.715286	68	40
21	844502	130	990145	252	09855	4356	123	9040	73	5083	71	39
22	844631	129	990398	253	09602	4233	124	9248	76	4880	75	38
23	844760	129	990651	253	09349	4109	123	9455	79	4676	78	37
24	844889	129	990903	252	09097	3986	124	9663	83	4473	82	36
25	9.845018	129	9.991156	253	08844	3862	124	.699871	86	.714269	85	35
26	845147	129	991409	253	08591	3738	124	.700079	90	4065	88	34
27	845276	129	991662	253	08338	3614	124	0287	93	3862	92	33
28	845405	128	991914	252	08086	3490	124	0494	97	3658	95	32
29	845533	129	992167	253	07833	3366	124	0702	100	3454	99	31
30	9.845662	128	9.992420	253	07580	3242	124	.700909	104	.713250	102	30
31	845790	129	992672	252	07328	3118	124	1117	107	3046	105	29
32	845919	128	992925	253	07075	2994	125	1324	110	2843	109	28
33	846047	128	993178	253	06822	2869	124	1531	114	2638	112	27
34	846175	129	993431	253	06569	2745	125	1739	117	2434	116	26
35	9.846304	128	9.993683	252	06317	2620	124	.701946	121	.712230	119	25
36	846432	128	993936	253	06064	2496	125	2153	124	2026	122	24
37	846560	128	994189	253	05811	2371	124	2360	128	1822	126	23
38	846688	128	994441	252	05559	2247	125	2567	131	1617	129	22
39	846816	128	994694	253	05306	2122	125	2774	135	1413	133	21
40	9.846944	127	9.994947	253	05053	1997	125	.702981	138	.711209	136	20
41	847071	128	995199	252	04801	1872	125	3188	142	1004	139	19
42	847199	128	995452	253	04548	1747	125	3395	145	0799	143	18
43	847327	127	995705	253	04295	1622	125	3601	148	0595	146	17
44	847454	128	995957	252	04043	1497	125	3808	152	0390	150	16
45	9.847582	127	9.996210	253	03790	1372	126	.704015	155	.710185	153	15
46	847709	127	996463	253	03537	1246	125	4221	159	.709981	156	14
47	847836	128	996715	252	03285	1121	125	4428	162	9776	160	13
48	847964	127	996968	253	03032	0996	126	4634	166	9571	163	12
49	848091	127	997221	253	02779	0870	125	4841	169	9366	167	11
50	9.848218	127	9.997473	252	02527	0745	126	.705047	173	.709161	170	10
51	848345	127	997726	253	02274	0619	126	5253	176	8956	173	9
52	848472	127	997979	253	02021	0493	125	5459	179	8750	177	8
53	848599	127	998231	252	01769	0368	126	5665	183	8545	180	7
54	848726	127	998484	253	01516	0242	126	5872	186	8340	184	6
55	9.848852	126	9.998737	253	01263	0116	126	.706078	190	.708134	187	5
56	848979	127	998989	252	01011	9990	126	6283	193	7929	190	4
57	849106	127	999242	253	00758	9864	126	6489	197	7724	194	3
58	849232	126	999495	253	00505	9738	126	6695	200	7518	197	2
59	849359	127	9.999747	252	00253	9611	127	6901	204	7312	201	1
60	849485	126	10.00000	253	00000	9485	126	7107	207	7107	204	0
M.	L. Cos.	D.	L. Cotan.	D.	L. Tang.	L. Sine.	D.	N. Cos.		N. Sine		M

Digitized by Google

TABLE V. PROP. LOG. of 3 or 12 Degrs. or Hours

	O.H	0 M	4 M	8 M	12 M	16 M	20 M	24 M	28 M	32 M
M S	°	0′	1′	2′	3′	4′	5′	6′	7′	8′
0	0″	Infinite	2.25527	1.95424	1.77815	1.65321	1.55630	1.47712	1.41017	1.3521
4	1	4.03342	24809	95064	77575	65141	55486	47592	40914	3512
8	2	3.73239	24103	94706	77335	64961	55342	47472	40811	3503
12	3	55630	23408	94352	77097	64782	55198	47352	40708	3494
16	4	43136	22724	94000	76861	64603	55055	47232	40606	3485
* 20	5	3.33445	2.22051	1.93651	1.76625	1.64426	1.54912	1.47113	1.40503	1.3476
24	6	25527	21388	93305	76391	64249	54770	46994	40401	3467
28	7	18833	20735	92962	76158	64073	54629	46876	40300	3458
32	8	13033	20091	92621	75927	63897	54487	46758	40198	3450
36	9	07918	19457	92283	75696	63722	54347	46640	40097	3441
* 40	10	3.03342	2.18833	1.91948	1.75467	1.63548	1.54206	1.46522	1.39996	1.3432
44	11	2.99203	18217	91615	75239	63375	54066	46405	39895	3423
48	12	95424	17609	91285	75012	63202	53927	46288	39794	3414
52	13	91946	17010	90957	74787	63030	53788	46171	39694	3405
M 56	14	88730	16419	90632	74562	62859	53649	46055	39593	3397
1 0	15	2.85733	2.15836	1.90309	1.74339	1.62688	1.53511	1.45939	1.39493	1.3388
4	16	82930	15261	89988	74117	62518	53374	45824	39394	3379
8	17	80297	14693	89670	73896	62349	53236	45708	39294	3370
12	18	77815	14133	89354	73676	62180	53100	45593	39195	3361
16	19	75467	13580	89041	73457	62012	52963	45478	39096	3353
* 20	20	2.73239	2.13033	1.88730	1.73239	1.61845	1.52827	1.45364	1.38997	1.3344
24	21	71120	12494	88420	73023	61678	52692	45250	38899	3335
28	22	69100	11961	88114	72807	61512	52557	45136	38800	3327
32	23	67170	11435	87809	72593	61347	52422	45022	38702	3318
36	24	65321	10914	87506	72379	61182	52288	44909	38604	3309
* 40	25	2.63548	2.10400	1.87206	1.72167	1.61018	1.52154	1.44796	1.38506	1.3301
44	26	61845	09893	86907	71956	60854	52021	44684	38409	3292
48	27	60206	09390	86611	71745	60691	51888	44571	38312	3284
52	28	58627	08894	86316	71536	60529	51755	44459	38215	3275
M 56	29	57103	08403	86024	71328	60367	51623	44347	38118	3267
2 0	30	2.55630	2.07918	1.85733	1.71120	1.60206	1.51491	1.44236	1.38021	1.32585
4	31	54206	07438	85445	70914	60045	51360	44125	37925	32500
8	32	52827	06964	85158	70709	59885	51229	44014	37829	32415
12	33	51491	06494	84873	70504	59726	51098	43903	37733	32331
16	34	50194	06030	84590	70301	59567	50968	43793	37637	32246
* 20	35	2.48936	2.05570	1.84309	1.70099	1.59409	1.50838	1.43683	1.37541	1.32162
24	36	47712	05115	84030	69897	59251	50708	43573	37446	32077
28	37	46522	04665	83752	69696	59094	50579	43463	37351	31993
32	38	45364	04220	83477	69497	58938	50451	43354	37256	31909
36	39	44236	03779	83203	69298	58782	50322	43245	37161	31826
* 40	40	2.43136	2.03342	1.82930	1.69100	1.58627	1.50194	1.43136	1.37067	1.31742
44	41	42064	02910	82660	68903	58472	50067	43028	36972	31659
48	42	41017	02482	82391	68707	58317	49940	42920	36878	31575
52	43	39996	02060	82124	68512	58164	49813	42812	36784	31492
M 56	44	38997	01639	81858	68318	58011	49687	42704	36691	31409
3 0	45	2.38021	2.01223	1.81594	1.68124	1.57858	1.49560	1.42597	1.36597	1.31326
4	46	37067	00812	81332	67932	57706	49435	42490	36504	31244
8	47	36133	00404	81071	67740	57554	49309	42383	36411	31161
12	48	35218	00000	80811	67549	57403	49184	42276	36318	31079
16	49	34323	1.99600	80554	67359	57253	49060	42170	36225	30997
* 20	50	2.33445	1.99203	1.80297	1.67170	1.57103	1.48936	1.42064	1.36133	1.30915
24	51	32585	98810	80043	66981	56953	48812	41958	36040	30833
28	52	31742	98421	79790	66794	56804	48688	41853	35948	30751
32	53	30915	98035	79538	66607	56656	48565	41747	35856	30670
36	54	30103	97652	79287	66421	56508	48442	41642	35765	30588
40	55	2.29306	1.97273	1.79039	1.66236	1.56360	1.48320	1.41538	1.35673	1.30507
44	56	28524	96897	78791	66051	56213	48197	41433	35582	30426
48	57	27755	96524	78545	65868	56067	48076	41329	35491	30345
52	58	27000	96154	78300	65685	55921	47954	41225	35400	30264
56	59	26257	95788	78057	65503	55775	47833	41121	35309	30183

Digitized by Google

TABLE V. PROP. LOG. of 3 or 12 Degrs. or Hours.

O.H		36M	40M	44M	48M	52M	56M	I.H	4M	8M
M S	O°	9′	10′	11′	12′	13′	14′	15′	16′	17′
0	0′′	1.30103	1.25527	1.21388	1.17609	1.14133	1.10914	1.07918	1.05115	1.02492
4	1	30023	25455	21322	17547	14077	10863	07870	05070	02440
8	2	29942	25383	21257	17489	14022	10811	07822	05025	02397
12	3	29862	25311	21191	17429	13966	10760	07774	04981	02355
16	4	29782	25239	21126	17369	13911	10708	07726	04936	02312
* 20	5	1.29703	1.25167	1.21060	1.17309	1.13855	1.10657	1.07678	1.04890	1.02270
24	6	29623	25095	20995	17249	13800	10605	07630	04845	02228
28	7	29544	25024	20930	17189	13745	10554	07582	04800	02185
32	8	29464	24952	20865	17129	13690	10503	07534	04755	02143
36	9	29385	24881	20800	17070	13635	10452	07486	04710	02101
* 40	10	1.29306	1.24809	1.20735	1.17010	1.13580	1.10400	1.07438	1.04665	1.02059
44	11	29227	24738	20670	16951	13525	10349	07391	04620	02017
48	12	29148	24667	20605	16891	13470	10298	07343	04576	01974
52	13	29070	24596	20541	16832	13415	10247	07295	04531	01932
M 56	14	28991	24526	20476	16773	13360	10197	07248	04486	01890
1 0	15	1.28913	1.24455	1.20412	1.16714	1.13306	1.10146	1.07200	1.04442	1.01848
4	16	28835	24384	20348	16655	13251	10095	07153	04397	01806
8	17	28757	24314	20284	16596	13197	10044	07105	04353	01764
12	18	28679	24244	20219	16537	13142	09994	07058	04308	01723
16	19	28601	24173	20155	16478	13088	09943	07011	04264	01681
* 20	20	1.28524	1.24103	1.20091	1.16419	1.13033	1.09893	1.06964	1.04220	1.01639
24	21	28446	24033	20028	16361	12979	09842	06916	04175	01597
28	22	28369	23963	19964	16302	12925	09792	06869	04131	01556
32	23	28292	23894	19900	16243	12871	09741	06822	04087	01514
36	24	28214	23824	19837	16185	12817	09691	06775	04043	01472
* 40	25	1.28138	1.23754	1.19773	1.16127	1.12763	1.09641	1.06728	1.03999	1.01431
44	26	28061	23685	19710	16068	12709	09591	06681	03955	01389
48	27	27984	23616	19647	16010	12655	09540	06634	02911	01348
52	28	27908	23546	19584	15952	12601	09490	06588	03867	01306
M 56	29	27831	23477	19520	15894	12548	09440	06541	03823	01265
2 0	30	1.27755	1.23408	1.19457	1.15836	1.12494	1.09390	1.06494	1.03779	1.01223
4	31	27679	23339	19395	15778	12440	09341	06447	03735	01182
8	32	27603	23271	19332	15721	12387	09291	06401	03691	01141
12	33	27527	23202	19269	15663	12333	09241	06354	03647	01100
16	34	27451	23133	19206	15605	12280	09191	06308	03604	01058
* 20	35	1.27376	1.23065	1.19144	1.15548	1.12227	1.09142	1.06261	1.03560	1.01017
24	36	27300	22997	19081	15490	12173	09092	06215	03516	00976
28	37	27225	22928	19019	15433	12120	09042	06168	03473	00935
32	38	27150	22860	18957	15375	12067	08993	06122	03429	00894
36	39	27075	22792	18895	15318	12014	08943	06076	03386	00853
* 40	40	1.27000	1.22724	1.18833	1.15261	1.11961	1.08894	1.06030	1.03342	1.00812
44	41	26925	22657	18771	15204	11908	08845	05983	03299	00771
48	42	26850	22589	18709	15147	11855	08796	05937	03256	00730
52	43	26776	22521	18647	15090	11802	08746	05891	03212	00689
M 56	44	26701	22454	18585	15033	11750	08697	05845	03169	00648
3 0	45	1.26627	1.22387	1.18523	1.14976	1.11697	1.08648	1.05799	1.03126	1.00607
4	46	26553	22319	18462	14919	11644	08599	05753	03083	00567
8	47	26479	22252	18400	14863	11592	08550	05707	03039	00526
12	48	26405	22185	18339	14806	11539	08501	05662	02996	00485
16	49	26331	22118	18278	14750	11487	08452	05616	02953	00445
* 20	50	1.26257	1.22051	1.18217	1.14693	1.11435	1.08403	1.05570	1.02910	1.00404
24	51	26184	21984	18155	14637	11382	08355	05524	02867	00363
28	52	26110	21918	18094	14581	11330	08306	05479	02824	00323
32	53	26037	21851	18033	14524	11278	08257	05433	02781	00282
36	54	25964	21785	17973	14468	11226	08209	05388	02739	00242
* 40	55	1.25891	1.21718	1.17912	1.14412	1.11174	1.08160	1.05342	1.02696	1.00202
44	56	25818	21652	17851	14356	11122	08112	05297	02653	00161
48	57	25745	21586	17790	14300	11070	08063	05251	02610	00121
52	58	25672	21520	17730	14244	11018	08015	05206	02568	00080
56	59	25600	21454	17669	14189	10966	07966	05161	02525	00040
60	60									1.00000

Digitized by Google

TABLE V. PROP. LOG. of 3 or 12 Degrs. or Hours.

I.H	12M	16M	20M	24M	28M	32M	36M	40M	44M	48M	52M
M S	O°	18′	19′	20′	21′	22′	23′	42′	25′	26′	27′	28′
0	0″	99999	97652	95424	93305	91285	89354	87506	85733	84030	82391	80811
4	1	960	614	388	271	252	323	476	704	002	364	786
8	2	920	576	352	236	219	292	446	675	83974	337	760
12	3	880	538	316	202	186	260	416	646	946	311	734
16	4	839	500	280	168	154	229	386	618	919	284	708
* 20	5	99799	97462	95244	93133	91121	89197	87356	85589	83891	82257	80683
24	6	759	424	208	099	088	166	326	560	863	230	657
28	7	719	386	172	065	055	135	296	531	835	204	631
32	8	679	348	136	030	023	103	266	502	808	177	605
36	9	640	310	100	92996	90990	072	236	473	780	150	579
* 40	10	99600	97273	95064	92962	90957	89041	87206	85445	83752	82124	80554
44	11	560	235	028	928	925	010	176	416	725	097	528
48	12	520	197	94992	894	892	88978	146	387	697	070	502
52	13	480	159	956	860	859	947	116	358	670	044	477
M 56	14	441	122	921	825	827	916	086	330	642	017	451
1 0	15	99401	97084	94885	92791	90794	88885	87055	85301	83614	81991	80425
4	16	361	047	849	757	762	854	026	272	587	964	400
8	17	322	009	813	723	729	823	86996	244	559	938	374
12	18	282	96972	778	689	697	792	967	215	532	911	349
16	19	243	934	742	655	664	761	937	187	504	884	323
* 20	20	99203	96897	94706	92621	90632	88730	86907	85158	83477	81858	80297
24	21	164	859	671	587	599	699	877	129	449	832	272
28	22	124	822	635	554	567	668	848	101	422	805	246
32	23	085	784	600	520	535	637	818	072	394	779	221
36	24	045	747	564	486	502	606	788	044	367	752	195
* 40	25	99006	96710	94529	92452	90470	88575	86759	85015	83339	81726	80170
44	26	98967	673	493	418	438	544	729	84987	312	699	144
48	27	928	635	458	385	406	513	699	958	285	673	119
52	28	888	598	423	351	373	482	670	930	257	647	094
M 56	29	849	561	387	317	341	451	640	902	230	620	068
2 0	30	98810	96524	94352	92283	90309	88420	86611	84873	83203	81594	80043
4	31	771	487	317	250	277	390	581	845	175	568	017
8	32	732	450	281	216	245	359	552	816	148	541	79992
12	33	693	413	246	183	213	328	522	788	121	515	967
16	34	654	376	211	149	181	297	493	760	094	489	941
* 20	35	98615	96339	94176	92115	90148	88267	86463	84732	83066	81463	79916
24	36	576	302	141	082	116	236	434	703	039	436	891
28	37	537	265	105	048	084	205	404	675	012	410	865
32	38	498	228	070	015	052	175	375	647	82985	384	840
36	39	459	191	035	91981	020	144	346	619	958	358	815
* 40	40	98421	96154	94000	91948	89988	88114	86316	84590	82930	81332	79790
44	41	382	117	93965	915	957	083	287	562	903	305	764
48	42	343	081	930	881	925	052	258	534	876	279	739
52	43	304	044	895	848	893	022	228	506	849	253	714
M 56	44	266	007	860	815	861	87991	199	478	822	227	689
3 0	45	98227	95971	93825	91781	89829	87961	86170	84450	82795	81201	79663
4	46	189	934	791	748	797	930	140	421	768	175	638
8	47	150	897	756	715	766	900	111	393	741	149	613
12	48	111	861	721	682	734	870	082	365	714	123	588
16	49	073	824	686	648	702	839	053	337	687	097	563
* 20	50	98035	95788	93651	91615	89670	87809	86024	84309	82660	81071	79538
24	51	97996	751	617	582	639	778	85995	281	633	045	513
28	52	958	715	582	549	607	748	965	253	606	019	488
32	53	919	678	547	516	575	718	936	225	579	80993	463
36	54	881	642	513	483	544	687	907	197	552	967	437
* 40	55	97843	95606	93478	91450	89512	87657	85878	84169	82525	80941	79412
44	56	805	569	443	417	481	627	849	141	498	915	387
48	57	766	533	409	384	449	597	820	114	471	889	362
52	58	728	497	374	351	417	566	791	086	445	863	337
56	59	690	460	340	318	386	536	762	058	418	837	312
		d.35	d.37	d.35	d.34	d.32	d.31	d.30	d.29	l.28	d.27	d.25
		10 1	9 1	9 1	8 1	8 1	8 1	7 1	7 1	7 1	7 1	6 1
		20 2	18 2	18 2	17 2	16 2	16 2	14 2	14 2	14 2	14 2	12 2
		29 3	28 3	26 3	26 3	24 3	23 3	21 3	22 3	21 3	20 3	18 3

Digitized by Google

M.	L.Sine.	D.	L. Tang	D.	L. Cotan	L.Cos.	D.	N. Sine.	d.″	N. Cos.	d.″	M
0	9 789342	162	9.892810	260	07190	6532		.615661	228	.788011	181	60
1	789504	161	893070	261	06930	6433	99	5891	4	7832	3	59
2	789665	162	893331	260	06669	6335	98	6120	8	7652	6	58
3	789827	161	893591	260	06409	6236	99	6349	11	7473	9	57
4	789988	161	893851	260	06149	6137	99	6578	15	7294	12	56
5	9.790149	161	9.894111	261	05889	6038	99	.616807	19	.787114	15	55
6	790310	161	894372	260	05628	5939	99	7036	23	6935	18	54
7	790471	161	894632	260	05368	5840	99	7265	27	6755	21	53
8	790632	161	894892	260	05108	5741	99	7494	30	6576	24	52
9	790793	161	895152	260	04848	5641	100	7722	34	6396	27	51
10	9.790954	161	9.895412	260	04588	5542	99	.617951	38	.786216	30	50
11	791115	160	895672	260	04328	5443	99	8180	42	6037	33	49
12	791275	161	895932	260	04068	5343	100	8408	46	5857	36	48
13	791436	160	896192	260	03808	5244	99	8637	49	5677	39	47
14	791596	161	896452	260	03548	5145	99	8865	53	5497	42	46
15	9.791757	160	9.896712	259	03288	5045	100	.619094	57	.785317	45	45
16	791917	160	896971	260	03029	4945	100	9322	61	5137	48	44
17	792077	160	897231	260	02769	4846	99	9551	65	4957	51	43
18	792237	160	897491	260	02509	4746	100	.619779	68	4776	54	42
19	792397	160	897751	260	02249	4646	100	.620007	72	4596	57	41
20	9.792557	159	9.898010	259	01990	4546	100	.620235	76	.784416	60	40
21	792716	160	898270	260	01730	4446	100	9464	80	4235	63	39
22	792876	159	898530	260	01470	4346	100	0692	84	4055	66	38
23	793035	160	898789	259	01211	4246	100	0920	87	3874	69	37
24	793195	159	899049	260	00951	4146	100	1148	91	3693	72	36
25	9.793354	160	9.899308	259	00692	4046	100	.621376	95	.783513	75	35
26	793514	159	899568	260	00432	3946	100	1604	99	3332	78	34
27	793673	159	899827	259	00173	3846	100	1831	103	3151	82	33
28	793832	159	900086	259	99913	3745	101	2059	106	2970	85	32
29	793991	159	900346	260	99654	3645	100	2287	110	2789	88	31
30	9.794150	159	9.900605	259	99395	3544	101	.622515	114	.782608	91	30
31	794308	158	900864	259	99136	3444	100	2742	118	2427	94	29
32	794467	159	901124	260	98876	3343	101	2970	122	2246	97	28
33	794626	159	901383	259	98617	3243	100	3197	125	2065	100	27
34	794784	158	901642	259	98358	3142	101	3425	129	1883	103	26
35	9.794942	158	9.901901	259	98099	3041	101	.623652	133	.781702	106	25
36	795101	159	902160	259	97840	2940	101	3880	137	1520	109	24
37	795259	158	902420	260	97580	2839	101	4107	141	1339	112	23
38	795417	158	902679	259	97321	2739	100	4334	144	1157	115	22
39	795575	158	902938	259	97062	2638	101	4561	148	0976	118	21
40	9.795733	158	9.903197	259	96803	2536	102	.624788	152	.780794	121	20
41	795891	158	903456	258	96544	2435	101	5016	156	0612	124	19
42	796049	157	903714	259	96286	2334	101	5243	160	0430	127	18
43	796206	158	903973	259	96027	2233	101	5470	163	0248	130	17
44	796364	157	904232	259	95768	2132	101	5697	167	.780066	133	16
45	9.796521	158	9.904491	259	95509	2030	102	.625923	171	.779884	136	15
46	796679	157	904750	259	95250	1929	101	6150	175	9702	139	14
47	796836	157	905008	258	94991	1827	102	6377	179	9520	142	13
48	796993	157	905267	259	94733	1726	101	6604	182	9338	145	12
49	797150	157	905526	259	94474	1624	102	6830	186	9156	148	11
50	9.797307	157	9.905785	259	94215	1523	101	.627057	190	.778973	151	10
51	797464	157	906043	258	93957	1421	102	7284	194	8791	154	9
52	797621	157	906302	259	93698	1319	102	7510	198	8608	157	8
53	797777	156	906560	258	93440	1217	101	7737	201	8426	160	7
54	797934	157	906819	259	93181	1115	102	7963	205	8243	163	6
55	9.798091	157	9.907077	258	92923	1013	102	.628189	209	.778060	166	5
56	798247	156	907336	259	92664	0911	102	8416	213	7878	169	4
57	798403	156	907594	258	92406	0809	102	8642	217	7695	172	3
58	798560	157	907853	259	92147	0707	102	8868	220	7512	175	2
59	798716	156	908111	258	91889	0605	102	9094	224	7329	178	1
M.	L. Cos.	D.	L.Cotan	D.	L.Tang.	L Sine	D.	N. Cos.		N. Sine		M

Digitized by Google

M.	L. Sine	D.	L. Tang.	D.	L. Cotan	L. Cos.	D.	N. Sine	d.	N. Cos.	d.	M.
0	9.798872		9.908369		91631	0503		,629320	225	.777146	185	60
1	799028	156	908628	259	91372	0400	103	9546	4	6963	3	59
2	799184	156	908886	258	91114	0298	102	9772	8	6780	6	58
3	799339	155	909144	258	90856	0195	103	.629998	11	6596	9	57
4	799495	156	909402	258	90598	0093	102	.630224	15	6413	12	56
5	9.799651	156	9.909660	258	90340	9990	103	,630450	19	.776230	15	55
6	799806	155	909918	258	90082	9888	102	0676	23	6046	19	54
7	799962	156	910177	259	89823	9785	103	9901	26	5863	22	53
8	800117	155	910435	258	89565	9682	103	1127	30	5679	25	52
9	800272	155	910693	258	89307	9579	103	1353	34	5496	28	51
10	9.800427	155	9.910951	258	89049	9477	102	,631578	38	.775312	31	50
11	800582	155	911209	258	88791	9374	103	1804	41	5128	34	49
12	800737	155	911467	258	88533	9271	103	2029	45	4944	37	48
13	800892	155	911725	257	88275	9168	103	2255	49	4761	40	47
14	801047	155	911982	258	88018	9064	104	2480	53	4577	43	46
15	9.801201	154	9.912240	258	87760	8961	103	.632705	56	.774393	46	45
16	801356	155	912498	258	87502	8858	103	2931	60	4209	49	44
17	801511	155	912756	258	87244	8755	103	3156	64	4024	52	43
18	801665	154	913014	258	86986	8651	104	3381	68	3840	56	42
19	801819	154	913271	257	86729	8548	103	3606	71	3656	59	41
20	9.801973	154	9.913529	258	86471	8444	104	.633831	75	.773472	62	40
21	802128	155	913787	258	86213	8341	103	4056	79	3287	65	39
22	802282	154	914044	257	85956	8237	104	4281	83	3103	68	38
23	802436	154	914302	258	85698	8134	103	4506	86	2918	71	37
24	802589	153	914560	258	85440	8030	104	4730	90	2734	74	36
25	9.802743	154	9.914817	257	85183	7926	104	.634955	94	.772549	77	35
26	802897	154	915075	258	84925	7822	104	5180	98	2364	80	34
27	803050	153	915332	257	84668	7718	104	5405	101	2179	83	33
28	803204	154	915590	258	84410	7614	104	5629	105	1994	86	32
29	803357	153	915847	257	84153	7510	104	5854	109	1810	89	31
30	9.803511	154	9.916104	257	83896	7406	104	.636078	113	.771625	93	30
31	803664	153	916362	258	83638	7302	104	6303	116	1439	96	29
32	803817	153	916619	257	83381	7198	104	6527	120	1254	99	28
33	803970	153	916877	258	83123	7093	105	6751	124	1069	102	27
34	804123	153	917134	257	82866	6989	104	6976	128	0884	105	26
35	9.804276	153	9.917391	257	82609	6885	104	.637200	131	.770699	108	25
36	804428	152	917648	257	82352	6780	105	7424	135	0513	111	24
37	804581	153	917906	258	82094	6676	104	7648	139	0328	114	23
38	804734	153	918163	257	81837	6571	105	7872	143	.770142	117	22
39	804886	152	918420	257	81580	6466	105	8096	146	.769957	120	21
40	9.805039	153	9.918677	257	81323	6362	104	.638320	150	.769771	123	20
41	805191	152	918934	257	81066	6257	105	8544	154	9585	126	19
42	805343	152	919191	257	80809	6152	105	8768	158	9400	130	18
43	805495	152	919448	257	80552	6047	105	8992	161	9214	133	17
44	805647	152	919705	257	80295	5942	105	9215	165	9028	136	16
45	9.805799	152	9.919962	257	80038	5837	105	.639439	169	.768842	139	15
46	805951	152	920219	257	79781	5732	105	9663	173	8656	142	14
47	806103	152	920476	257	79524	5627	105	.639886	176	8470	145	13
48	806254	151	920733	257	79267	5522	105	.640110	180	8283	148	12
49	806406	152	920990	257	79010	5416	106	0333	184	8097	151	11
50	9.806557	151	9.921247	257	78753	5311	105	.640557	188	.767911	154	10
51	806709	152	921503	256	78497	5205	106	0780	191	7725	157	9
52	806860	151	921760	257	78240	5100	105	1003	195	7538	160	8
53	807011	151	922017	257	77983	4994	106	1226	199	7352	163	7
54	807163	152	922274	257	77726	4889	105	1450	203	7165	167	6
55	9.807314	151	9.922530	256	77470	4783	106	.641673	206	.766978	170	5
56	807465	151	922787	257	77213	4677	106	1896	210	6792	173	4
57	807615	150	923044	257	76956	4572	105	2119	214	6605	176	3
58	807766	151	923300	256	76700	4466	106	2343	218	6418	179	2
59	807917	151	923557	257	76443	4360	106	2565	221	6231	182	1
M.	L. Cos	D.	L. Cotan.	D.	L. Tang.	L. Sine.	D.	N. Cos.		N. Sine		M.

Digitized by Google

M.	L. Sine.	D.	L. Tang.	D.	L. Cotan.	L. Cos.	D.	N. Sine	d."	N. Cos	l."	M
0	9.808067	151	9.923814	256	76186	4254	106	.642788	221	.766044	139	60
1	808218	150	924070	257	75930	4148	106	3010	4	5857	3	59
2	808368	151	924327	256	75673	4042	106	3233	7	5670	6	58
3	808519	150	924583	257	75417	3936	107	3456	11	5483	10	57
4	808669	150	924840	256	75160	3829	106	3678	15	5296	13	56
5	9.808819	150	9.925096	256	74904	3723	106	.643901	18	.765109	16	55
6	808969	150	925352	257	74648	3617	107	4124	22	4921	19	54
7	809119	150	925609	256	74391	3510	106	4346	26	4734	22	53
8	809269	150	925865	257	74135	3404	107	4568	30	4546	25	52
9	809419	150	926122	256	73878	3297	106	4791	33	4359	28	51
10	9.809569	149	9.926378	256	73622	3191	107	.645013	37	.764171	32	50
11	809718	150	926634	256	73366	3084	107	5235	41	3984	35	49
12	809868	149	926890	257	73110	2977	106	5458	44	3796	38	48
13	810017	150	927147	256	72853	2871	107	5680	48	3608	41	47
14	810167	149	927403	256	72597	2764	107	5902	52	3420	44	46
15	9.810316	149	9.927659	256	72341	2657	107	.646124	55	.763232	47	45
16	810465	149	927915	256	72085	2550	107	6346	59	3044	50	44
17	810614	149	928171	256	71829	2443	107	6568	63	2856	54	43
18	810763	149	928427	257	71573	2336	107	6790	66	2668	57	42
19	810912	149	928684	256	71316	2229	107	7012	70	2480	60	41
20	9.811061	149	9.928940	256	71060	2121	108	.647233	74	.762292	63	40
21	811210	149	929196	256	70804	2014	107	7455	77	2104	66	39
22	811358	148	929452	256	70548	1907	107	7677	81	1915	69	38
23	811507	149	929708	256	70292	1799	108	7898	85	1727	73	37
24	811655	148	929964		70036	1692	107	8120	88	1538	76	36
25	9.811804	149	9.930220	256	69780	1584	108	.648341	92	.761350	79	35
26	811952	148	930475	255	69525	1477	107	8563	96	1161	82	34
27	812100	148	930731	256	69269	1369	108	8784	100	0972	85	33
28	812248	148	930987	256	69013	1261	108	9006	103	0784	88	32
29	812396	148	931243	256	68757	1153	108	9227	107	0595	91	31
30	9.812544	148	9.931499	256	68501	1046	107	.649448	111	.760406	95	30
31	812692	148	931755	255	68245	0938	108	9669	114	0217	98	29
32	812840	148	932010	256	67990	0830	108	.649890	118	.760028	101	28
33	812988	147	932266	256	67734	0722	108	.650111	122	.759839	104	27
34	813135	148	932522		67478	0613	109	0332	125	9650	107	26
35	9.813283	147	9.932778	256	67222	0505	108	.650553	129	.759461	110	25
36	813430	148	933033	255	66967	0397	108	0774	133	9271	113	24
37	813578	147	933289	256	66711	0289	108	0995	136	9082	117	23
38	813725	147	933545	256	66455	0180	109	1216	140	8893	120	22
39	813872	147	933800	255	66200	0072	108	1437	144	8703	123	21
40	9.814019	147	9.934056	256	65944	9963	109	.651657	147	.758514	126	20
41	814166	147	934311	255	65689	9855	108	1878	151	8324	129	19
42	814313	147	934567	256	65433	9746	109	2098	155	8134	132	18
43	814460	147	934822	255	65178	9637	109	2319	158	7945	136	17
44	814607	147	935078	256	64922	9529	108	2539	162	7755	139	16
45	9.814753	146	9.935333	255	64667	9420	109	.652760	166	.757565	142	15
46	814900	147	935589	256	64411	9311	109	2980	169	7375	145	14
47	815046	146	935844	255	64156	9202	109	3200	173	7185	148	13
48	815193	147	936100	256	63900	9093	109	3421	177	6995	151	12
49	815339	146	936355	255	63645	8984	109	3641	181	6805	154	11
50	9.815485	147	9.936611	256	63389	8875	109	.653861	184	.756615	158	10
51	815632	146	936866	255	63134	8766	109	4081	188	6425	161	9
52	815778	146	937121	255	62879	8656	110	4301	192	6234	164	8
53	815924	146	937377	256	62623	8547	109	4521	195	6044	167	7
54	816069	145	937632	255	62368	8438	109	4741	199	5853	170	6
55	9.816215	146	9.937887	255	62113	8328	110	.654961	203	.755663	173	5
56	816361	146	938142	255	61858	8219	109	5180	206	5472	176	4
57	816507	146	938398	256	61602	8109	110	5400	210	5282	180	3
58	816652	145	938653	255	61347	7999	110	5620	214	5091	183	2
59	816798	146	938908	255	61092	7890	109	5839	217	4900	186	1
M.	Lo Cos.	D.	L. Cotan.	D.	L. Tang.	L. Sine	D.	N. Cos.		N. Sine		M

Digitized by Google

M.	L. Sine.	D.	L. Tang.	D.	L.Cotan.	L.Cos	D.	N. Sine	d."	N.Cos	d."	
0	9 816943		9·939163		60837	7780		.656059	218	.754710	193	60
1	817088	145	939418	255	60582	7670	110	6278	4	4519	3	59
2	817233	145	939673	255	60327	7560	110	6498	7	4328	6	58
3	817379	146	939928	255	60072	7450	110	6717	11	4137	10	57
4	817524	145	940183	255	59817	7340	110	6937	15	3946	13	56
5	9·817668	144	9 940439	256	59561	7230	110	.657156	18	.753755	16	55
6	817813	145	940694	255	59306	7120	110	7375	22	3563	19	54
7	817958	145	940949	255	59051	7010	111	7594	25	3372	23	53
8	818103	145	941204	255	58796	6899	110	7813	29	3181	26	52
9	818247	144	941459	255	58541	6789	111	8033	33	2989	29	51
10	9·818392	145	9·941713	254	58287	6678	110	.658252	36	.752798	32	50
11	818536	144	941968	255	58032	6568	111	8471	40	2606	35	49
12	818681	145	942223	255	57777	6457	110	8689	44	2415	39	48
13	818825	144	942478	255	57522	6347	111	8908	47	2223	42	47
14	818969	144	942733	255	57267	6236	111	9127	51	2032	45	46
15	9·819113	144	9·942988	255	57012	6125	111	.659346	55	.751840	48	45
16	819257	144	943243	255	56757	6014	110	9564	58	1648	52	44
17	819401	144	943498	255	56502	5904	111	.659783	62	1456	55	43
18	819545	144	943752	254	56248	5793	111	.660002	65	1264	58	42
19	819689	144	944007	255	55993	5682	111	0220	69	1072	61	41
20	9·819832	143	9·944262	255	55738	5571	111	.660439	73	.750880	64	40
21	819976	144	944517	255	55483	5459	112	0657	76	0688	68	39
22	820120	144	944771	254	55229	5348	111	0875	80	0496	71	38
23	820263	143	945026	255	54974	5237	111	1094	84	0303	74	37
24	820406	143	945281	255	54719	5126	111	1312	87	.750111	77	36
25	9·820550	144	9·945535	254	54465	5014	112	.661530	91	.749919	80	35
26	820693	143	945790	255	54210	4903	111	1748	95	9726	84	34
27	820836	143	946045	255	53955	4791	112	1966	98	9534	87	33
28	820979	143	946299	254	53701	4680	111	2184	102	9341	90	32
29	821122	143	946554	255	53446	4568	112	2402	105	9148	93	31
30	9·821265	143	9·946808	254	53192	4456	112	.662620	109	.748956	97	30
31	821407	142	947063	255	52937	4344	112	2838	113	8763	100	29
32	821550	143	947318	255	52682	4232	112	3056	116	8570	103	28
33	821693	143	947572	254	52428	4121	111	3273	120	8377	106	27
34	821835	142	947827	255	52173	4009	112	3491	124	8184	109	26
35	9·821977	142	9·948081	254	51919	3896	113	.663709	127	.747991	113	25
36	822120	143	948335	254	51665	3784	112	3926	131	7798	116	24
37	822262	142	948590	255	51410	3672	112	4144	134	7605	119	23
38	822404	142	948844	254	51156	3560	112	4361	138	7412	122	22
39	822546	142	949099	255	50901	3448	112	4578	142	7218	126	21
40	9·822688	142	9·949353	254	50647	3335	113	.664796	145	.747025	129	20
41	822830	142	949608	255	50392	3223	112	5013	149	6832	132	19
42	822972	142	949862	254	50138	3110	113	5230	153	6638	135	18
43	823114	141	950116	254	49884	2998	112	5447	156	6445	138	17
44	823255	142	950371	255	49629	2885	113	5665	160	6251	142	16
45	9·823397	142	9·950625	254	49375	2772	113	.665882	164	.746057	145	15
46	823539	141	950879	254	49121	2659	113	6099	167	5864	148	14
47	823680	141	951133	254	48867	2547	112	6316	171	5670	151	13
48	823821	141	951388	255	48612	2434	113	6532	174	5476	154	12
49	823963	142	951642	254	48358	2321	113	6749	178	5282	158	11
50	9·824104	141	9·951896	254	48104	2208	113	.666966	182	.745088	161	10
51	824245	141	952150	254	47850	2095	113	7183	185	4894	164	9
52	824386	141	952405	255	47595	1981	114	7399	189	4700	167	8
53	824527	141	952659	254	47341	1868	113	7616	193	4506	171	7
54	824668	141	952913	254	47087	1755	113	7833	196	4311	174	6
55	9·824808	140	9·953167	254	46833	1641	114	.668049	200	.744117	177	5
56	824949	141	953421	254	46579	1528	113	8265	204	3923	180	4
57	825090	141	953675	254	46325	1414	114	8482	207	3728	183	3
58	825230	140	953929	254	46071	1301	113	8698	211	3534	187	2
59	825371	141	954183	254	45817	1187	114	8914	214	3339	190	1
M.	L. Cos.	D.	L. Cotan.	D.	L. Tang.	L. Sine	D.	N. Cos.		N. Sine		M

Digitized by Google

M.	L. Sine	D	L. Tang	D	L. Cotan	L. Cos	D	N. Sine.	d."	N. Cos.	d."	M
0	9·8255[illegible]		9·954437	254	45563	1073		·669131	214	·743145	197	60
1	825651	140	954691	255	45309	0960	113	9347	4	2950	3	59
2	825791	140	954946	254	45054	9·99 0846	114	9563	7	2755	7	58
3	825931	140	955200	254	44800	0732	114	9779	11	2561	10	57
4	826071	140	955454	254	44546	0618	114	669995	14	2366	13	56
5	9·826211	140	9·955708	253	44292	0504	114	·670211	18	·742171	16	55
6	826351	140	955961	254	44039	0·90	114	0427	21	1976	20	54
7	826491	140	956215	254	43785	9·87 0276	115	0642	25	1781	23	53
8	826631	140	956469	254	43531	0161	114	0858	2,	1586	26	52
9	826770	139	956723	254	43277	0047	114	1074	32	1390	30	51
10	9·826910	140	9·956977	254	43023	9·33	114	·671285	36	·741195	33	50
11	827049	139	957231	254	42769	9818	115	1505	39	1000	36	49
12	827189	140	957485	254	42515	9·86 9704	114	1721	43	0805	39	48
13	827328	139	957739	254	42261	9589	115	1936	46	0609	43	47
14	827467	139	957993	254	42007	9474	115	2151	50	0414	46	46
15	9·827606	139	9·958247	253	41753	9360	114	·672367	54	·740218	49	45
16	827745	139	958500	254	41500	9245	115	2582	57	·740022	53	44
17	827884	139	958754	254	41246	9·86 9130	115	2797	61	·739827	56	43
18	828023	139	959008	254	40992	9015	115	3012	64	9631	59	42
19	828162	139	959262	254	40738	8900	115	3228	68	9435	62	41
20	9·828301	139	9·959516	253	40484	8785	115	·673443	71	·739239	66	40
21	828439	138	959769	254	40231	8670	115	3658	75	9043	69	39
22	828578	139	960023	254	39977	9·86 8555	115	3873	79	8847	72	38
23	828716	138	960277	253	39723	8440	115	4088	82	8651	76	37
24	828855	139	960530	254	39470	8324	116	4302	86	8455	79	36
25	9·828993	138	9·960784	254	39216	8209	115	·674517	89	·738259	82	35
26	829131	138	961038	254	38962	80[illegible]	116	4732	93	8063	85	34
27	829269	138	961292	253	38708	9·86 7978	115	4947	96	7867	89	33
28	829407	138	961545	254	38455	7862	116	5161	100	7670	92	32
29	829545	138	961799	253	38201	7747	115	5376	03	7474	95	31
30	9·829683	138	9·962052	254	37948	7631	116	·675590	107	·737277	99	30
31	829821	138	962306	254	37694	9·86 7515	116	5805	111	7081	102	29
32	829959	138	962560	253	37440	7399	116	6019	114	6884	105	28
33	830097	138	962813	254	37187	7283	116	6233	118	6687	108	27
34	830234	137	963067	253	36933	7167	116	6448	121	6491	112	26
35	9·830372	138	9·963320	254	36680	7051	116	·676662	125	·736294	115	25
36	830509	137	963574	254	36426	9·86 6935	116	6876	128	6097	118	24
37	830646	137	963828	253	36172	6819	116	7090	132	5900	122	23
38	830784	138	964081	254	35919	6703	116	7304	136	5703	125	22
39	830921	137	964335	254	35665	6586	117	7518	139	5506	128	21
40	9·831058	137	9·964588	253	35412	6470	116	·677733	143	·735309	131	20
41	831195	137	964842	254	35158	9·86 6353	117	7946	146	5112	135	19
42	831332	137	965095	253	34905	6237	116	8160	150	4915	138	18
43	831469	137	965349	254	34651	6120	117	8373	153	4717	141	17
44	831606	136	965602	253	34398	6004	116	8587	157	4520	145	16
45	9·831742	137	9·965855	253	34145	5887	117	·678801	161	·734322	148	15
46	831879	136	966109	254	33891	9·86 5770	117	9014	164	4125	151	14
47	832015	137	966362	253	33638	5653	117	9228	168	3927	154	13
48	832152	136	966616	254	33384	5536	117	9441	171	3730	158	12
49	832288	137	966869	253	33131	5419	117	9655	175	3532	161	11
50	9·832425	136	9·967123	254	32877	5302	117	·679868	178	·733334	164	10
51	832561	136	967376	253	32624	9·86 5185	117	·680081	182	3137	168	9
52	832697	136	967629	253	32371	5068	117	0295	186	2939	171	8
53	832833	136	967883	254	32117	4950	118	0508	189	2741	174	7
54	832969	136	968136	253	31864	4833	117	0721	193	2543	177	6
55	9·833105	136	9·968389	253	31611	4716	117	·680934	196	·732345	181	5
56	833241	136	968643	254	31357	4598	118	1147	200	2147	184	4
57	833377	135	968896	253	31104	9·86 4481	117	1360	203	1949	187	3
58	833512	136	969149	253	30851	4363	118	1573	207	1759	190	2
59	833648		969403	254	30597	4245		1786	211	1552	194	1
M.	Co. Cos.	D.	L. Cotan.	D.	L. Tang.	L. Sine.	D.	N. Cos.		N. Sine		M

Digitized by Google

M.	L.Sine.	D.	L. Tang.	D.	L Cotan.	L.Cos.	D.	N.Sine.	d.″	N. Cos.	d.″	M
0	9 833783		9.969650		30344	4127		.681978	211	.731354	201	60
1	833919	136	969909	253	30091	4010	117	2211	4	1155	3	59
2	834054	135	970162	253	29838	3892	118	2424	7	0957	7	58
3	834189	135	970416	254	29584	3774	118	2636	11	0758	10	57
4	834325	136	970669	253	29331	3656	118	2849	14	0560	13	56
5	9.834460	135	9.970922	253	29078	3538	119	.683001	18	.730361	17	55
6	834595	135	971175	253	28825	3419	118	3274	21	.730162	20	54
7	834730	135	971429	254	28571	3301	118	3486	25	.729963	24	53
8	834865	134	971682	253	28318	3183	119	3698	28	9765	27	52
9	834999	135	971935	253	28065	3064	118	3911	32	9566	30	51
10	9.835134	135	9.972188	253	27812	2946	119	.684123	35	.729367	34	50
11	835269	134	972441	253	27559	2827	118	4335	39	9168	37	49
12	835403	135	972695	254	27305	2709	119	4547	42	8969	40	48
13	835538	134	972948	253	27052	2590	119	4759	46	8769	44	47
14	835672	135	973201	253	26799	2471	119	4971	49	8570	47	46
15	9.835807	134	9.973454	253	26546	2353	118	.685183	53	.728371	50	45
16	835941	134	973707	253	26293	2234	119	5395	56	8172	54	44
17	836075	134	973960	253	26040	2115	119	5607	60	7972	57	43
18	836209	134	974213	253	25787	1996	119	5818	63	7773	60	42
19	836343	134	974466	253	25534	1877	119	6030	67	7573	64	41
20	9.836477	134	9.974720	254	25280	1758	119	.686242	70	.727374	67	40
21	836611	134	974973	253	25027	1638	120	6453	74	7174	70	39
22	836745	134	975226	253	24774	1519	119	6665	77	6974	74	38
23	836878	133	975479	253	24521	1400	119	6876	81	6774	77	37
24	837012	134	975732	253	24268	1280	120	7087	84	6575	80	36
25	9.837146	134	9.975985	253	24015	1161	119	.687299	88	.726375	84	35
26	837279	133	976238	253	23762	1041	120	7510	91	6175	87	34
27	837412	133	976491	253	23509	0922	119	7721	95	5975	91	33
28	837546	134	976744	253	23256	0802	120	7932	99	5775	94	32
29	837679	133	976997	253	23003	0682	120	8143	102	5575	97	31
30	9.837812	133	9.977250	253	22750	0562	120	.688355	106	.725374	101	30
31	837945	133	977503	253	22497	0442	120	8565	109	5174	104	29
32	838078	133	977756	253	22244	0322	120	8776	113	4974	107	28
33	838211	133	978009	253	21991	0202	120	8987	116	4773	111	27
34	838344	133	978262	253	21738	0082	120	9198	120	4573	114	26
35	9.838477	133	9.978515	253	21485	9902	120	.689409	123	.724372	117	25
36	838610	132	978768	253	21232	9842	120	9619	127	4172	121	24
37	838742	133	979021	253	20979	9721	121	.689830	130	3971	124	23
38	838875	132	979274	253	20726	9601	120	.690041	134	3770	127	22
39	839007	133	979527	253	20473	9480	121	0251	137	3570	131	21
40	9.839140	132	9.979780	253	20220	9360	120	.690462	141	.723369	134	20
41	839272	132	980033	253	19967	9239	121	0672	144	3168	137	19
42	839404	132	980286	252	19714	9119	120	0882	148	2967	141	18
43	839536	132	980538	253	19462	8998	121	1093	151	2766	144	17
44	839668	132	980791	253	19209	8877	121	1303	155	2565	147	16
45	9.839800	132	9.981044	253	18956	8756	121	.691513	158	.722364	151	15
46	839932	132	981297	253	18703	8635	121	1723	162	2163	154	14
47	840064	132	981550	253	18450	8514	121	1933	165	1961	158	13
48	840196	132	981803	253	18197	8393	121	2143	169	1760	161	12
49	840328	131	982056		17944	8272	121	2353	172	1559	164	11
50	9.840459	132	9.982309	253	17691	8151	121	.692563	176	.721357	168	10
51	840591	131	982562	253	17438	8029	122	2773	179	1156	171	9
52	840722	132	982814	252	17186	7908	121	2982	183	0954	174	8
53	840854	131	983067	253	16933	7786	122	3192	186	0753	178	7
54	840985	131	983320	253	16680	7665	121	3402	190	0551	181	6
55	9.841116	131	9.983573	253	16427	7543	122	.693611	193	.720349	184	5
56	841247	131	983826	253	16174	7422	121	3821	197	.720148	188	4
57	841378	131	984079	253	15921	7300	122	4030	201	.719946	191	3
58	841509	131	984332	253	15668	7178	122	4240	204	9744	194	2
59	841640	131	984584	252	15416	7056	122	4449	208	9542	198	1
M.	L. Cos.	D.	L.Cotan	D.	L.Tang.	L. Sine	D.	N. Cos.		N. Sine		M

Digitized by Google

M.	L. Sine.	D.	L. Tang.	D.	L. Cotan	L. Cos.	D.	N. Sine	d″	N Cos.	d″	M
0	9.841771		9.984837		15163	6934		.694658		.719340		60
1	841902	131	985090	253	14910	6812	122	4868	207	9138	204	59
2	842033	131	985343	253	14657	6690	122	5077	4	8935	3	58
3	842163	130	985596	253	14404	6568	122	5286	7	8733	7	57
4	842294	131	985848	252	14152	6446	122	5495	10	8531	10	56
5	9.842424	130	9.986101	253	13899	6323	123	.695704	14	.718329	14	55
6	842555	131	986354	253	13646	6201	122	5913	17	8126	17	54
7	842685	130	986607	253	13393	6078	123	6122	21	7924	20	53
8	842815	130	986860	253	13140	5956	122	6330	24	7721	24	52
9	842946	131	987112	252	12888	5833	123	6530	28	7519	27	51
10	9.843076	130	9.987365	253	12635	5711	122	.696748	31	.717316	31	50
11	843206	130	987618	253	12382	5588	123	6956	35	7113	34	49
12	843336	130	987871	253	12129	5465	123	7165	38	6911	37	48
13	843466	130	988123	252	11877	5342	123	7374	41	6708	41	47
14	843595	129	988376	253	11624	5219	123	7582	45	6505	44	46
15	9.843725	130	9.988629	253	11371	5096	123	.697790	48	.716302	48	45
16	843855	130	988882	253	11118	4973	123	7999	52	6099	51	44
17	843984	129	989134	252	10866	4850	123	8207	55	5896	54	43
18	844114	130	989387	253	10613	4727	124	8415	59	5693	58	42
19	844243	129	989640	253	10360	4603	123	8623	62	5489	61	41
20	9.844372	129	9.989893	253	10107	4480	124	.698831	66	.715286	65	40
21	844502	130	990145	252	09855	4356	124	9040	69	5083	68	39
22	844631	129	990398	253	09602	4233	123	9248	73	4880	71	38
23	844760	129	990651	253	09349	4109	124	9455	76	4676	75	37
24	844889	129	990903	252	09097	3986	123	9663	79	4473	78	36
25	9.845018	129	9.991156	253	08844	3862	124	.699871	83	.714269	82	35
26	845147	129	991409	253	08591	3738	124	.700079	86	4065	85	34
27	845276	129	991662	253	08338	3614	124	0287	90	3862	88	33
28	845405	128	991914	252	08086	3490	124	0494	93	3658	92	32
29	845533	129	992167	253	07833	3366	124	0702	97	3454	95	31
30	9.845662	128	9.992420	253	07580	3242	124	.700909	100	.713250	99	30
31	845790	129	992672	252	07328	3118	124	1117	104	3046	102	29
32	845919	128	992925	253	07075	2994	125	1324	107	2843	105	28
33	846047	128	993178	253	06822	2869	124	1531	110	2638	109	27
34	846175	129	993431	253	06569	2745	125	1739	114	2434	112	26
35	9.846304	128	9.993683	252	06317	2620	124	.701946	117	.712230	116	25
36	846432	128	993936	253	06064	2496	125	2153	121	2026	119	24
37	846560	128	994189	253	05811	2371	124	2360	124	1822	122	23
38	846688	128	994441	252	05559	2247	124	2567	128	1617	126	22
39	846816	128	994694	253	05306	2122	125	2774	131	1413	129	21
40	9.846944	127	9.994947	253	05053	1997	125	.702981	135	.711209	133	20
41	847071	128	995199	252	04801	1872	125	3188	138	1004	136	19
42	847199	128	995452	253	04548	1747	125	3395	142	0799	139	18
43	847327	127	995705	253	04295	1622	125	3601	145	0595	143	17
44	847454	128	995957	252	04043	1497	125	3808	148	0390	146	16
45	9.847582	127	9.996210	253	03790	1372	126	.704015	152	.710185	150	15
46	847709	127	996463	253	03537	1246	125	4221	155	.709981	153	14
47	847836	128	996715	252	03285	1121	125	4428	159	9776	156	13
48	847964	127	996968	253	03032	0996	125	4634	162	9571	160	12
49	848091	127	997221	253	02779	0870	126	4841	166	9366	163	11
50	9.848218	127	9.997473	252	02527	0745	125	.705047	169	.709161	167	10
51	848345	127	997726	253	02274	0619	126	5253	173	8956	170	9
52	848472	127	997979	253	02021	0493	126	5459	176	8750	173	8
53	848599	127	998231	252	01769	0368	125	5665	179	8545	177	7
54	848726	127	998484	253	01516	0242	126	5872	183	8340	180	6
55	9.848852	126	9.998737	253	01263	0116	126	.706078	186	.708134	184	5
56	848979	127	998989	252	01011	9990	126	6283	190	7929	187	4
57	849106	127	999242	253	00758	9864	126	6489	193	7724	190	3
58	849232	126	999495	253	00505	9738	126	6695	197	7518	194	2
59	849359	127	9.999747	252	00253	9611	127	6901	200	7312	197	1
60	849485	126	10.00000	253	00000	9485	126	7107	204	7107	201	0
M.	L. Cos.	D.	L. Cotan.	D.	L. Tang.	L. Sine.	D.	N. Cos.	207	N. Sine	204	M

Digitized by Google

TABLE V. PROP. LOG. of 3 or 12 Degrs. or Hours.

O.H		0M	4M	8M	12M	16M	20M	24M	28M	32M
M S	°	0′	1′	2′	3′	4′	5′	6′	7′	8′
	0	0″	Infinite	2.25527	1.95424	1.77815	1.65321	1.55630	1.47712	1.41017	1.35211
4	1		4.03342	24809	95064	77575	65141	55486	47592	40914	35128
8	2		3.73239	24103	94706	77335	64961	55342	47472	40811	35038
12	3		55630	23408	94352	77097	64782	55198	47352	40708	34948
16	4		43136	22724	94000	76861	64603	55055	47232	40606	34858
* 20	5		3.33445	2.22051	1.93651	1.76625	1.64426	1.54912	1.47113	1.40503	1.34768
24	6		25527	21388	93305	76391	64249	54770	46996	40401	34679
28	7		18833	20735	92962	76158	64073	54629	46876	40300	34589
32	8		13033	20091	92621	75927	63897	54487	46758	40198	34500
36	9		07918	19457	92283	75696	63722	54347	46640	40097	34411
* 40	10		3.03342	2.18833	1.91948	1.75467	1.63548	1.54206	1.46522	1.39996	1.34323
44	11		2.99203	18217	91615	75239	63375	54066	46405	39895	34234
48	12		95424	17609	91285	75012	63202	53927	46288	39794	34146
52	13		91948	17010	90957	74787	63030	53788	46171	39694	34058
M 56	14		88730	16419	90632	74562	62859	53649	46055	39593	33970
1 0	15		2.85733	2.15836	1.90309	1.74339	1.62688	1.53511	1.45939	1.39493	1.33882
4	16		82930	15261	89988	74117	62518	53374	45824	39394	33794
8	17		80297	14693	89670	73896	62349	53236	45708	39294	33707
12	18		77815	14133	89354	73676	62180	53100	45593	39195	33619
16	19		75467	13580	89041	73457	62012	52963	45478	39096	33532
* 20	20		2.73239	2.13033	1.88730	1.73239	1.61845	1.52827	1.45364	1.38997	1.33445
24	21		71120	12494	88420	73023	61678	52692	45250	38899	33359
28	22		69100	11961	88114	72807	61512	52557	45136	38800	33272
32	23		67170	11435	87809	72593	61347	52422	45022	38702	33186
36	24		65321	10914	87506	72379	61182	52288	44909	38604	33099
* 40	25		2.63548	2.10400	1.87206	1.72167	1.61018	1.52154	1.44796	1.38506	1.33013
44	26		61845	09893	86907	71956	60854	52021	44684	38409	32927
48	27		60206	09390	86611	71745	60691	51888	44571	38312	32842
52	28		58627	08894	86316	71536	60529	51755	44459	38215	32756
M 56	29		57103	08403	86024	71328	60367	51623	44347	38118	32671
2 0	30		2.55630	2.07918	1.85733	1.71120	1.60206	1.51491	1.44236	1.38021	1.32585
4	31		54206	07438	85445	70914	60045	51360	44125	37925	32500
8	32		52827	06964	85158	70709	59885	51229	44014	37829	32415
12	33		51491	06494	84873	70504	59726	51098	43903	37733	32331
16	34		50194	06030	84590	70301	59567	50968	43793	37637	32246
* 20	35		2.48936	2.05570	1.84308	1.70099	1.59409	1.50838	1.43683	1.37541	1.32162
24	36		47712	05115	84030	69897	59251	50708	43573	37446	32077
28	37		46522	04665	83752	69696	59094	50579	43463	37351	31993
32	38		45364	04220	83477	69497	58938	50451	43354	37256	31909
36	39		44236	03779	83203	69298	58782	50322	43245	37161	31826
* 40	40		2.43136	2.03342	1.82930	1.69100	1.58627	1.50194	1.43136	1.37067	1.31742
44	41		42064	02910	82660	68903	58472	50067	43028	36972	31659
48	42		41017	02482	82391	68707	58317	49940	42920	36878	31575
52	43		39996	02060	82124	68512	58164	49813	42812	36784	31492
M 56	44		38997	01639	81858	68318	58011	49687	42704	36691	31409
3 0	45		2.38021	2.01223	1.81594	1.68124	1.57858	1.49560	1.42597	1.36597	1.31326
4	46		37067	00812	81332	67932	57706	49435	42490	36504	31244
8	47		36133	00404	81071	67740	57554	49309	42383	36411	31161
12	48		35218	00000	80811	67549	57403	49184	42276	36318	31079
16	49		34323	1.99600	80554	67359	57253	49060	42170	36225	30997
* 20	50		2.33445	1.99203	1.80297	1.67170	1.57103	1.48936	1.42064	1.36133	1.30915
24	51		32585	98810	80043	66981	56953	48812	41958	36040	30833
28	52		31742	98421	79790	66794	56804	48688	41853	35948	30751
32	53		30915	98035	79538	66607	56656	48565	41747	35856	30670
36	54		30103	97652	79287	66421	56508	48442	41642	35765	30588
40	55		2.29306	1.97273	1.79039	1.66236	1.56360	1.48320	1.41538	1.35673	1.30507
44	56		28524	96897	78791	66051	56213	48197	41433	35582	30426
48	57		27755	96524	78545	65868	56067	48076	41329	35491	30345
52	58		27000	96154	78300	65685	55921	47954	41225	35400	30264
56	59		26257	95788	78057	65503	55775	47833	41121	35309	30183

Digitized by Google

TABLE V. PROP. LOG. of 3 or 12 DEGRS. or HOURS.

O.H		36M	40M	44M	48M	52M	56M	I.H	4M	8M
I S	O°	9′	10′	11′	12′	13′	14′	15′	16′	17′
	0	0″ 1.30103	1.25527	1.21388	1.17609	1.14133	1.10914	1.07918	1.05115	1.02492
4	1	30023	25455	21322	17547	14077	10863	07870	05070	02440
8	2	29942	25383	21257	17489	14022	10811	07822	05025	02397
12	3	29862	25311	21191	17429	13966	10760	07774	04980	02355
16	4	29782	25239	21126	17369	13911	10708	07726	04935	02312
* 20	5	1.29703	1.25167	1.21060	1.17309	1.13855	1.10657	1.07678	1.04890	1.02270
24	6	29623	25095	20995	17249	13800	10605	07630	04845	02228
28	7	29544	25024	20930	17189	13745	10554	07582	04800	02185
32	8	29464	24952	20865	17129	13690	10503	07534	04755	02143
36	9	29385	24881	20800	17070	13635	10452	07486	04710	02101
* 40	10	1.29306	1.24809	1.20735	1.17010	1.13580	1.10400	1.07438	1.04665	1.02059
44	11	29227	24738	20670	16951	13525	10349	07391	04620	02017
48	12	29148	24667	20605	16891	13470	10298	07343	04576	01974
52	13	29070	24596	20541	16832	13415	10247	07295	04531	01932
M 56	14	28991	24526	20476	16773	13360	10197	07248	04486	01890
1 0	15	1.28913	1.24455	1.20412	1.16714	1.13300	1.10146	1.07200	1.04442	1.01848
4	16	28835	24384	20348	16655	13251	10095	07153	04397	01806
8	17	28757	24314	20284	16596	13197	10044	07105	04353	01764
12	18	28679	24244	20219	16537	13142	09994	07058	04308	01723
16	19	28601	24173	20155	16478	13088	09943	07011	04264	01681
* 20	20	1.28524	1.24103	1.20091	1.16419	1.13033	1.09893	1.06964	1.04220	1.01639
24	21	28446	24033	20028	16361	12979	09842	06916	04175	01597
28	22	28369	23963	19964	16302	12925	09792	06869	04131	01556
32	23	28292	23894	19900	16243	12871	09741	06822	04087	01514
36	24	28214	23824	19837	16185	12817	09691	06775	04043	01472
* 40	25	1.28138	1.23754	1.19773	1.16127	1.12763	1.09641	1.06728	1.03999	1.01431
44	26	28061	23685	19710	16068	12709	09591	06681	03955	01389
48	27	27984	23616	19647	16010	12655	09540	06634	02911	01348
52	28	27908	23546	19584	15952	12601	09490	06588	03867	01306
M 56	29	27831	23477	19520	15894	12548	09440	06541	03823	01265
2 0	30	1.27755	1.23408	1.19457	1.15836	1.12494	1.09390	1.06494	1.03779	1.01223
4	31	27679	23339	19395	15778	12440	09341	06447	03735	01182
8	32	27603	23271	19332	15721	12387	09291	06401	03691	01141
12	33	27527	23202	19269	15663	12333	09241	06354	03647	01100
16	34	27451	23133	19206	15605	12280	09191	06308	03604	01058
* 20	35	1.27376	1.23065	1.19144	1.15548	1.12227	1.09142	1.06261	1.03560	1.01017
24	36	27300	22997	19081	15490	12173	09092	06215	03516	00976
28	37	27225	22928	19019	15433	12120	09042	06168	03473	00935
32	38	27150	22860	18957	15375	12067	08993	06122	03429	00894
36	39	27075	22792	18895	15318	12014	08943	06076	03386	00853
* 40	40	1.27000	1.22724	1.18833	1.15261	1.11961	1.08894	1.06030	1.03342	1.00812
44	41	26925	22657	18771	15204	11908	08845	05983	03299	00771
48	42	26850	22589	18709	15147	11855	08796	05937	03256	00730
52	43	26776	22521	18647	15090	11802	08746	05891	03212	00689
M 56	44	26701	22454	18585	15033	11750	08697	05845	03169	00648
3 0	45	1.26627	1.22386	1.18523	1.14976	1.11697	1.08648	1.05799	1.03126	1.00607
4	46	26553	22319	18462	14919	11644	08599	05753	03083	00567
8	47	26479	22252	18400	14863	11592	08550	05707	03039	00526
12	48	26405	22185	18339	14806	11539	08501	05662	02996	00485
16	49	26331	22118	18278	14750	11487	08452	05616	02953	00445
* 20	50	1.26257	1.22051	1.18217	1.14693	1.11435	1.08403	1.05570	1.02910	1.00404
24	51	26184	21984	18155	14637	11382	08355	05524	02867	00363
28	52	26110	21918	18094	14581	11330	08306	05479	02824	00323
32	53	26037	21851	18033	14524	11278	08257	05433	02781	00282
36	54	25964	21785	17973	14468	11226	08209	05388	02739	00242
* 40	55	1.25891	1.21718	1.17912	1.14412	1.11174	1.08160	1.05342	1.02696	1.00202
44	56	25818	21652	17851	14356	11122	08112	05297	02653	00161
48	57	25745	21586	17790	14300	11070	08063	05251	02610	00121
52	58	25672	21520	17730	14244	11018	08015	05206	02568	00080
56	59	25600	21454	17669	14189	10966	07966	05161	02525	00040
60	60									1.00000

Digitized by Google

TABLE V. PROP. LOG. of 3 or 12 Degrs. or Hours.

M	S	I.H 0°	12M 18′	16M 19′	20M 20′	24M 21′	28M 22′	32M 23′	36M 42′	40M 25′	44M 26′	48M 27′	52M 28′
	0	0′′	99999	97652	95424	93305	91285	89354	87506	85733	84030	82391	80811
	4	1	960	614	388	271	252	323	476	704	002	364	786
	8	2	920	576	352	236	219	292	446	675	83974	337	760
	12	3	880	538	316	202	186	260	416	646	946	311	734
	16	4	839	500	280	168	154	229	386	618	919	284	708
*	20	5	99799	97462	95244	93133	91121	89197	87356	85589	83891	82257	80683
	24	6	759	424	208	099	088	166	326	560	863	230	657
	28	7	719	386	172	065	055	135	296	531	835	204	631
	32	8	679	348	136	030	023	103	266	502	808	177	605
	36	9	640	310	100	92996	90990	072	236	473	780	150	579
*	40	10	99600	97273	95064	92962	90957	89041	87206	85445	83752	82124	80554
	44	11	560	235	028	928	925	010	176	416	725	097	528
	48	12	520	197	94992	894	892	88978	146	387	697	070	502
	52	13	480	159	956	860	859	947	116	358	670	044	477
M	56	14	441	122	921	825	827	916	086	330	642	017	451
1	0	15	99401	97084	94885	92791	90794	88885	87055	85301	83614	81991	80425
	4	16	361	047	849	757	762	854	026	272	587	964	400
	8	17	322	009	813	723	729	823	86996	244	559	938	374
	12	18	282	96972	778	689	697	792	967	215	532	911	349
	16	19	243	934	742	655	664	761	937	187	504	884	323
*	20	20	99203	96897	94706	92621	90632	88730	86907	85158	83477	81858	80297
	24	21	164	859	671	587	599	699	877	129	449	832	272
	28	22	124	822	635	554	567	668	848	101	422	805	246
	32	23	085	784	600	520	535	637	818	072	394	779	221
	36	24	045	747	564	486	502	606	788	044	367	752	195
*	40	25	99006	96710	94529	92452	90470	88575	86759	85015	83339	81726	80170
	44	26	98967	673	493	418	438	544	729	84987	312	699	144
	48	27	928	635	458	385	406	513	699	958	285	673	119
	52	28	888	598	423	351	373	482	670	930	257	647	094
M	56	29	849	561	387	317	341	451	640	902	230	620	068
2	0	30	98810	96524	94352	92283	90309	88420	86611	84873	83203	81594	80043
	4	31	771	487	317	250	277	390	581	845	175	568	017
	8	32	732	450	281	216	245	359	552	816	148	541	79992
	12	33	693	413	246	183	213	328	522	788	121	515	967
	16	34	654	376	211	149	181	297	493	760	094	489	941
*	20	35	98615	96339	94176	92115	90148	88267	86463	84732	83066	81463	79916
	24	36	576	302	141	082	116	236	434	703	039	436	891
	28	37	537	265	105	048	084	205	404	675	012	410	865
	32	38	498	228	070	015	052	175	375	647	82985	384	840
	36	39	459	191	035	91981	020	144	346	619	958	358	815
*	40	40	98421	96154	94000	91948	89988	88114	86316	84590	82930	81332	79790
	44	41	382	117	93965	915	957	083	287	562	903	305	764
	48	42	343	081	930	881	925	052	258	534	876	279	739
	52	43	304	044	895	848	893	022	228	506	849	253	714
M	56	44	266	007	860	815	861	87991	199	478	822	227	689
3	0	45	98227	95971	93825	91781	89829	87961	86170	84450	82795	81201	79663
	4	46	189	934	791	748	797	930	140	421	768	175	638
	8	47	150	897	756	715	766	900	111	393	741	149	613
	12	48	111	861	721	682	734	870	082	365	714	123	588
	16	49	073	824	686	648	702	839	053	337	687	097	563
*	20	50	98035	95788	93651	91615	89670	87809	86024	84309	82660	81071	79538
	24	51	97996	751	617	582	639	778	85995	281	633	045	513
	28	52	958	715	582	549	607	748	965	253	606	019	488
	32	53	919	678	547	516	575	718	936	225	579	80993	463
	36	54	881	642	513	483	544	687	907	197	552	967	437
*	40	55	97843	95606	93478	91450	89512	87657	85878	84169	82525	80941	79412
	44	56	805	569	443	417	481	627	849	141	498	915	387
	48	57	766	533	409	384	449	597	820	114	471	889	362
	52	58	728	497	374	351	417	566	791	086	445	863	337
	56	59	690	460	340	318	386	536	762	058	418	837	312
			d. 3	d. 37	d. 35	d. 34	d. 32	d. 31	d. 30	d. 29	l. 28	d. 27	d. 25
			10 1	9 1	9 1	8 1	8 1	8 1	7 1	7 1	7 1	7 1	6 1
			20 2	18 2	18 2	17 2	16 2	16 2	14 2	14 2	14 2	14 2	12 2
			29 3	28 3	26 3	26 3	24 3	23 3	21 3	22 3	21 3	20 3	18 3

Digitized by Google

O.H		36M	40M	44M	48M	52M	56M	I.H	4M	8M
I S	O°	9′	10′	11′	12′	13′	14′	15′	16′	17′
0	0″	1.30103	1.25527	1.21388	1.17609	1.14133	1.10914	1.07918	1.05115	1.02492
4	1	30023	25455	21322	17549	14077	10863	07870	05076	02440
8	2	29942	25383	21257	17489	14022	10811	07822	05025	02397
12	3	29862	25311	21191	17429	13966	10760	07774	04980	02355
16	4	29782	25239	21126	17369	13911	10708	07726	04931	02312
* 20	5	1.29703	1.25167	1.21060	1.17309	1.13855	1.10657	1.07678	1.04890	1.02270
24	6	29623	25095	20995	17249	13800	10605	07630	04841	02228
28	7	29544	25024	20930	17189	13745	10554	07582	04800	02185
32	8	29464	24952	20865	17129	13690	10503	07534	04755	02143
36	9	29385	24881	20800	17070	13635	10452	07486	04710	02101
* 40	10	1.29306	1.24809	1.20735	1.17010	1.13580	1.10400	1.07438	1.04665	1.02059
44	11	29227	24738	20670	16951	13525	10349	07391	04620	02017
48	12	29148	24667	20605	16891	13470	10298	07343	04576	01974
52	13	29070	24596	20541	16832	13415	10247	07295	04531	01932
M 56	14	28991	24526	20476	16773	13360	10197	07248	04486	01890
I 0	15	1.28913	1.24455	1.20412	1.16714	1.13306	1.10146	1.07200	1.04442	1.01848
4	16	28835	24384	20348	16655	13251	10095	07153	04397	01806
8	17	28757	24314	20284	16596	13197	10044	07105	04353	01764
12	18	28679	24244	20219	16537	13142	09994	07058	04308	01723
16	19	28601	24173	20155	16478	13088	09943	07011	04264	01681
* 20	20	1.28524	1.24103	1.20091	1.16419	1.13033	1.09893	1.06964	1.04220	1.01639
24	21	28446	24033	20028	16361	12979	09842	06916	04175	01597
28	22	28369	23963	19964	16302	12925	09792	06869	04131	01556
32	23	28292	23894	19900	16243	12871	09741	06822	04087	01514
36	24	28214	23824	19837	16185	12817	09691	06775	04043	01472
* 40	25	1.28138	1.23754	1.19773	1.16127	1.12763	1.09641	1.06728	1.03999	1.01431
44	26	28061	23685	19710	16068	12709	09591	06681	03955	01389
48	27	27984	23616	19647	16010	12655	09540	06634	02911	01348
52	28	27908	23546	19584	15952	12601	09490	06588	03867	01306
M 56	29	27831	23477	19520	15894	12548	09440	06541	03823	01265
2 0	30	1.27755	1.23408	1.19457	1.15836	1.12494	1.09390	1.06494	1.03779	1.01223
4	31	27679	23339	19395	15778	12440	09341	06447	03735	01182
8	32	27603	23271	19332	15721	12387	09291	06401	03691	01141
12	33	27527	23202	19269	15663	12333	09241	06354	03647	01100
16	34	27451	23133	19206	15605	12280	09191	06308	03604	01058
* 20	35	1.27376	1.23065	1.19144	1.15548	1.12227	1.09142	1.06261	1.03560	1.01017
24	36	27300	22997	19081	15490	12173	09092	06215	03516	00976
28	37	27225	22928	19019	15433	12120	09042	06168	03473	00935
32	38	27150	22860	18957	15375	12067	08993	06122	03429	00894
36	39	27075	22792	18895	15318	12014	08943	06076	03386	00853
* 40	40	1.27000	1.22724	1.18833	1.15261	1.11961	1.08894	1.06030	1.03342	1.00812
* 44	41	26925	22657	18771	15204	11908	08845	05983	03299	00771
48	42	26850	22589	18709	15147	11855	08796	05937	03256	00730
52	43	26776	22521	18647	15090	11802	08746	05891	03212	00689
M 56	44	26701	22454	18585	15033	11750	08697	05845	03169	00648
3 0	45	1.26627	1.22386	1.18523	1.14976	1.11697	1.08648	1.05799	1.03126	1.00607
4	46	26553	22319	18462	14919	11644	08599	05753	03083	00567
8	47	26479	22252	18400	14863	11592	08550	05707	03039	00526
12	48	26405	22185	18339	14806	11539	08501	05662	02996	00485
16	49	26331	22118	18278	14750	11487	08452	05616	02953	00445
* 20	50	1.26257	1.22051	1.18217	1.14693	1.11435	1.08403	1.05570	1.02910	1.00404
24	51	26184	21984	18155	14637	11382	08355	05524	02867	00363
28	52	26110	21918	18094	14581	11330	08306	05479	02824	00323
32	53	26037	21851	18033	14524	11278	08257	05433	02781	00282
36	54	25964	21785	17973	14468	11226	08209	05388	02732	00242
* 40	55	1.25891	1.21718	1.17912	1.14412	1.11174	1.08160	1.05342	1.02696	1.00202
44	56	25818	21652	17851	14356	11122	08112	05297	02653	00161
48	57	25745	21586	17790	14300	11070	08063	05251	02610	00121
52	58	25672	21520	17730	14244	11018	08015	05206	02568	00080
56	59	25600	21454	17669	14189	10966	07966	05161	02525	00040
60	60									1.00000

Digitized by Google

TABLE V. PROP. LOG. of 3 or 12 DEGRS. or HOURS.

	I.H	12M	16M	20M	24M	28M	32M	36M	40M	44M	48M	52M
M S	O°	18′	19′	20′	21′	22′	23′	42′	25′	26′	27′	28′
0	0′′	99999	97652	95424	93305	91285	89354	87506	85733	84030	82391	80811
4	1	960	614	388	271	252	323	476	704	002	364	786
8	2	920	576	352	236	219	292	446	675	83974	337	760
12	3	880	538	316	202	186	260	416	646	946	311	734
16	4	839	500	280	168	154	229	386	618	919	284	708
* 20	5	99799	97462	95244	93133	91121	89197	87356	85589	83891	82257	80683
* 24	6	759	424	208	099	088	166	326	560	863	230	657
28	7	719	386	172	065	055	135	296	531	835	204	631
32	8	679	348	136	030	023	103	266	502	808	177	605
36	9	640	310	100	92996	90990	072	236	473	780	150	579
* 40	10	99600	97273	95064	92962	90957	89041	87206	85445	83752	82124	80554
* 44	11	560	235	028	928	925	010	176	416	725	097	528
48	12	520	197	94992	894	892	88978	146	387	697	070	502
52	13	480	159	956	860	859	947	116	358	670	044	477
M 56	14	441	122	921	825	827	916	086	330	642	017	451
1 0	15	99401	97084	94885	92791	90794	88885	87055	85301	83614	81991	80425
4	16	361	047	849	757	762	854	026	272	587	964	400
8	17	322	009	813	723	729	823	86996	244	559	938	374
12	18	282	96972	778	689	697	792	967	215	532	911	349
16	19	243	934	742	655	664	761	937	187	504	884	323
* 20	20	99203	96897	94706	92621	90632	88730	86907	85158	83477	81858	80297
24	21	164	859	671	587	599	699	877	129	449	832	272
28	22	124	822	635	554	567	668	848	101	422	805	246
32	23	085	784	600	520	535	637	818	072	394	779	221
36	24	045	747	564	486	502	606	788	044	367	752	195
* 40	25	99006	96710	94529	92452	90470	88575	86759	85015	83339	81726	80170
* 44	26	98967	673	493	418	438	544	729	84987	312	699	144
48	27	928	635	458	385	406	513	699	958	285	673	119
52	28	888	598	423	351	373	482	670	930	257	647	094
M 56	29	849	561	387	317	341	451	640	902	230	620	068
2 0	30	98810	96524	94352	92283	90309	88420	86611	84873	83203	81594	80043
4	31	771	487	317	250	277	390	581	845	175	568	017
8	32	732	450	281	216	245	359	552	816	148	541	79992
12	33	693	413	246	183	213	328	522	788	121	515	967
16	34	654	376	211	149	181	297	493	760	094	489	941
* 20	35	98615	96339	94176	92115	90148	88267	86463	84732	83066	81463	79916
24	36	576	302	141	082	116	236	434	703	039	436	891
28	37	537	265	105	048	084	205	404	675	012	410	865
32	38	498	228	070	015	052	175	375	647	82985	384	840
36	39	459	191	035	91981	020	144	346	619	958	358	815
* 40	40	98421	96154	94000	91948	89988	88114	86316	84590	82930	81332	79790
* 44	41	382	117	93965	915	957	083	287	562	903	305	764
48	42	343	081	930	881	925	052	258	534	876	279	739
52	43	304	044	895	848	893	022	228	506	849	253	714
M 56	44	266	007	860	815	861	87991	199	478	822	227	689
3 0	45	98227	95971	93825	91781	89829	87961	86170	84450	82795	81201	79663
4	46	189	934	791	748	797	930	140	421	768	175	638
8	47	150	897	756	715	766	900	111	393	741	149	613
12	48	111	861	721	682	734	870	082	365	714	123	588
16	49	073	824	686	648	702	839	053	337	687	097	563
* 20	50	98035	95788	93651	91615	89670	87809	86024	84309	82660	81071	79538
24	51	97996	751	617	582	639	778	85995	281	633	045	513
28	52	958	715	582	549	607	748	965	253	606	019	488
32	53	919	678	547	516	575	718	936	225	579	80993	463
36	54	881	642	513	483	544	687	907	197	552	967	437
* 40	55	97843	95606	93478	91450	89512	87657	85878	84169	82525	80941	79412
* 44	56	805	569	443	417	481	627	849	141	493	915	387
48	57	766	533	409	384	449	597	820	114	471	889	362
52	58	728	497	374	351	417	566	791	086	445	863	337
56	59	690	460	340	318	386	536	762	058	418	837	312
		d. 37	d. 37	d. 35	d. 34	d. 32	d. 31	d. 30	d. 29	d. 28	d. 27	d. 25
		10 1	9 1	9 1	8 1	8 1	8 1	7 1	7 1	7 1	7 1	6 1
		20 2	18 2	18 2	17 2	16 2	16 2	14 2	14 2	14 2	14 2	12 2
		29 3	28 3	26 3	26 3	24 3	23 3	21 3	22 3	21 3	20 3	18 3

Digitized by Google

TABLE V. PROP. LOG. of 5 or 12 Degrs. or Hours.

M	S	I.H 56 M	II.H 4 M	8 M	12 M	16 M	20 M	24 M	28 M	32 M	36 M
		○ / 29′	30′	31′	32′	33′	34′	35′	36′	37′	38′	39′
	c	0′′ 79287	77815	76391	75012	73676	72379	71120	69897	68707	67549	66421
	4	1 262	791	368	74990	654	358	100	877	688	530	402
	8	2 238	767	344	967	631	337	079	857	668	511	384
	12	3 213	743	321	944	610	316	058	837	648	492	365
	16	4 188	719	298	922	588	294	038	817	629	473	347
*	20	5 79163	77695	76274	74899	73566	72273	71017	69797	68609	67454	66328
	24	6 138	671	251	877	544	252	70997	777	590	435	310
	28	7 113	647	228	854	523	231	976	756	570	416	291
	32	8 088	623	205	832	501	209	955	736	551	397	273
	36	9 063	599	181	809	479	188	935	716	531	378	254
*	40	10 79039	77575	76158	74787	73457	72167	70914	69696	68512	67359	66236
	44	11 014	551	135	764	435	146	894	676	492	340	217
	48	12 78989	527	112	742	413	125	873	656	473	321	199
	52	13 964	503	089	719	392	103	852	636	454	302	180
M	56	14 939	479	065	697	370	082	832	616	434	283	162
1	0	15 78915	77455	76042	74674	73348	72061	70811	69596	68415	67264	66143
	4	16 890	431	019	652	326	040	791	576	395	245	125
	8	17 865	407	75996	629	305	019	770	557	376	226	106
	12	18 840	383	973	607	283	71998	750	537	356	207	088
	16	19 816	359	950	585	261	977	729	517	337	188	070
*	20	20 78791	77335	75927	74562	73239	71956	70709	69497	68318	67170	66051
	24	21 766	311	903	540	218	935	688	477	298	151	033
	28	22 742	288	880	517	196	914	668	457	279	132	014
	32	23 717	264	857	495	174	892	647	437	259	113	65996
	36	24 693	240	834	473	153	871	627	417	240	094	978
*	40	25 78668	77216	75811	74450	73131	71850	70606	69397	68221	67075	65
	44	26 643	192	788	428	109	829	586	377	201	056	
	48	27 619	169	765	406	088	808	566	357	182	038	92
	52	28 594	145	742	383	066	787	545	338	163	019	90
M	56	29 570	121	719	361	044	766	525	318	143	000	88
2	0	30 78545	77097	75696	74339	73023	71745	70504	69298	68124	66981	65868
	4	31 521	074	673	317	001	724	484	278	105	962	849
	8	32 496	050	650	294	72980	703	464	258	086	944	831
	12	33 472	026	627	272	958	682	443	239	066	925	813
	16	34 447	002	604	250	936	661	423	219	047	906	794
*	20	35 78423	76979	75581	74228	72915	71641	70403	69199	67028	66887	65776
	24	36 398	955	559	205	893	620	382	179	009	869	758
	28	37 374	931	536	183	872	599	362	159	989	850	739
	32	38 349	908	513	161	850	578	342	140	970	831	721
	36	39 325	884	490	139	829	557	321	120	951	812	703
*	40	40 78300	76861	75467	74117	72807	71536	70301	69100	67932	66794	65685
	44	41 276	837	444	095	786	515	281	080	912	775	666
	48	42 252	813	421	072	764	494	260	061	893	756	648
	52	43 227	790	398	050	743	473	240	041	874	737	630
M	56	44 203	766	376	028	721	453	220	021	855	719	612
3	0	45 78179	76743	75353	74006	72700	71432	70200	69002	67836	66700	65594
	4	46 154	719	330	73984	678	411	179	68982	816	681	575
	8	47 130	696	307	962	657	390	159	962	797	663	557
	12	48 106	672	285	940	636	369	139	942	778	644	539
	16	49 081	649	262	918	614	349	119	923	759	625	521
*	20	50 78057	76625	75239	73896	72593	71328	70099	68903	67740	66607	65503
	24	51 033	602	216	874	571	307	078	884	721	588	484
	28	52 009	578	194	852	550	286	058	864	702	570	466
	32	53 77984	555	171	830	529	265	038	844	682	551	448
	36	54 960	531	148	808	507	245	018	825	663	532	430
*	40	55 77936	76508	75126	73786	72486	71224	69998	68805	67644	66514	65412
	44	56 912	485	103	764	465	203	977	785	625	495	394
	48	57 888	461	080	742	443	183	957	766	606	477	376
	52	58 863	438	058	720	422	162	937	746	587	458	357
	56	59 839	414	035	698	401	141	917	727	568	439	339
		d.24	d.24	d.23	d.22	d.22	d.21	d.20	d.20	d.19	d.19	d.18
		6 1	6 1	6 1	6 1	5 1	5 1	5 1	5 1	5 1	5 1	5 1
		12 2	12 2	12 2	12 2	10 2	10 2	10 2	10 2	10 2	10 2	10 2
		18 3	18 3	17 3	16 3	17 3	16 3	15 3	15 3	14 3	14 3	13 3

Digitized by Google

TABLE V. PROP. LOG. of 3 or 12 Degrs. or Hours.

	II.H	40M	44M	48M	52M	56M	III.H	4M	8M	12M	16M	20M
M	S	O°	40′	41′	42′	43′	44′	45′	46′	47′	48′	49′	50′
	0	0′′	65321	64249	63202	62180	61182	60206	59251	58317	57403	56508	55630
	4	1	303	231	185	164	166	190	236	302	388	493	616
	8	2	285	214	168	147	149	174	220	287	373	478	601
	12	3	267	196	151	130	133	158	204	271	358	463	587
	16	4	249	178	133	113	116	142	189	256	343	449	572
*	20	5	65231	64161	63116	62096	61100	60126	59173	58241	57328	56434	55558
	24	6	213	143	099	080	083	110	157	225	313	419	543
	28	7	195	125	082	063	067	094	141	210	298	404	529
	32	8	177	108	065	046	051	078	126	194	283	390	515
	36	9	159	090	047	029	034	061	110	179	268	375	500
*	40	10	65141	64073	63030	62012	61018	60045	59094	58164	57253	56360	55486
	44	11	123	055	013	61996	001	029	079	148	238	345	471
	48	12	105	038	62996	979	60985	013	063	133	223	331	457
	52	13	087	020	979	962	969	59997	047	118	208	316	442
M	56	14	069	002	962	945	952	981	032	102	193	301	428
	0	15	65051	63985	62945	61929	60936	59965	59016	58087	57178	56287	55414
1	4	16	033	967	927	912	920	949	000	072	163	272	399
	8	17	015	950	910	895	903	933	58985	056	148	257	385
	12	18	64997	932	893	878	887	917	969	041	133	243	370
	16	19	979	915	876	862	871	901	953	026	118	228	356
*	20	20	64961	63897	62859	61845	60854	59885	58938	58011	57103	56213	55342
	24	21	943	880	842	828	838	870	922	57995	088	199	327
	28	22	925	862	825	812	822	854	907	980	073	184	313
	32	23	907	845	808	795	805	838	891	965	058	169	299
	36	24	889	827	791	778	789	822	875	949	043	155	284
*	40	25	64871	63810	62774	61762	60773	59806	58860	57934	57028	56140	55270
	44	26	853	792	757	745	756	790	844	919	013	125	255
	48	27	835	775	739	728	740	774	829	904	56998	111	241
	52	28	818	757	722	712	724	758	813	888	983	096	227
M	56	29	800	740	705	695	708	742	798	873	968	081	212
	0	30	64782	63722	62688	61678	60691	59726	58782	57858	56953	56067	55198
2	4	31	764	705	671	662	675	710	766	843	938	052	184
	8	32	746	688	654	645	659	694	751	827	923	037	169
	12	33	728	670	637	628	642	678	735	812	908	023	155
	16	34	710	653	620	612	626	663	720	797	893	56008	141
*	20	35	64692	63635	62603	61595	60610	59647	58704	57782	56879	55994	55127
	24	36	675	618	586	579	594	631	689	767	864	979	112
	28	37	657	601	569	562	578	615	673	751	849	964	098
	32	38	639	583	552	545	561	599	658	736	834	950	084
	36	39	621	566	535	529	545	583	642	721	819	935	069
*	40	40	64603	63548	62518	61512	60529	59567	58627	57706	56804	55921	55055
	44	41	586	531	501	496	513	551	611	691	789	906	041
	48	42	568	514	485	479	496	536	596	675	774	892	026
	52	43	550	496	468	463	480	520	580	660	759	877	012
M	56	44	532	479	451	446	464	504	565	645	745	862	54998
	0	45	64514	63462	62434	61429	60448	59488	58549	57630	56730	55848	54984
3	4	46	497	444	417	413	432	472	534	615	715	833	969
	8	47	479	427	400	396	416	457	518	600	700	819	955
	12	48	461	410	383	380	399	441	503	584	685	804	941
	16	49	443	392	366	363	383	425	487	569	670	790	927
*	20	50	64426	63375	62349	61347	60367	59409	58472	57554	56656	55775	54912
	24	51	408	358	332	330	351	393	456	539	641	761	898
	28	52	390	340	315	314	335	378	441	524	626	746	884
	32	53	373	323	298	297	319	362	425	509	611	732	870
	36	54	355	306	282	281	303	346	410	494	596	717	855
*	40	55	64337	63289	62265	61264	60286	59330	58395	57479	56582	55703	54841
	44	56	320	271	248	248	270	314	379	463	567	688	827
	48	57	302	254	231	231	254	299	364	448	552	674	813
	52	58	284	237	214	215	238	283	348	433	537	659	799
	56	59	267	220	197	198	222	267	333	418	522	645	784
			d.18	d.18	d.17	d.17	d.16	d.16	d.15	d.15	d.15	d.14	d.14
			1 4		1 4		1 4			1 4		1 4	
			2 9		2 8		2 8			2 8		2 7	
			3 14		3 13		3 12			3 11		3 10	

Digitized by Google

TABLE V. PROP. LOG. of 3 or 12 DEGRS. or HOURS.

III.H		24M	28M	32M	36M	40M	44M	48M	52M	56M	IVH 4M	
M	S O°	51′	52′	53′	54′	55′	56′	57′	58′	59′	I° 0′	1′
	0 0″	54770	53927	53100	52288	51491	50708	49940	49184	48442	47712	46994
	4 1	756	913	086	274	478	696	927	172	430	700	982
	8 2	742	899	072	261	465	683	914	159	418	688	971
	12 3	728	885	059	248	452	670	902	147	405	676	959
	16 4	714	871	045	234	438	657	889	135	393	664	947
*	20 5	54699	53857	3031	52221	51425	50644	49876	49122	48381	47652	46935
	24 6	685	843	018	208	412	631	864	110	369	640	923
	28 7	671	830	004	194	399	618	851	097	356	628	911
	32 8	657	816	2991	181	386	605	838	085	344	616	899
	36 9	643	802	977	167	373	592	826	072	332	604	888
*	40 10	54629	53788	52963	52154	51360	50579	49813	49060	48320	47592	46876
	44 11	614	774	950	141	346	566	800	047	307	580	864
	48 12	600	760	936	127	333	554	788	035	295	568	852
	52 13	586	746	922	114	320	541	775	023	283	556	840
M	56 14	572	732	909	101	307	528	762	010	271	544	828
I	0 15	54558	53717	52895	52087	51294	50515	49750	48998	48258	47532	46817
	4 16	544	705	882	074	281	502	737	985	246	520	805
	8 17	530	691	868	061	268	489	724	973	234	508	793
	12 18	516	677	855	047	255	476	712	960	222	496	781
	16 19	501	663	841	034	242	464	699	948	210	484	769
*	20 20	54487	53649	52827	52021	51229	50451	49687	48936	48197	47472	46758
	24 21	473	636	814	007	215	438	674	923	185	460	746
	28 22	459	622	800	51994	202	425	661	911	173	448	734
	32 23	445	608	787	981	189	412	649	898	161	436	722
	36 24	431	594	773	967	176	399	636	886	149	424	710
*	40 25	54417	53580	52760	51954	51163	50387	49623	48874	48136	47412	46699
	44 26	403	567	746	941	150	374	611	861	124	400	687
	48 27	389	553	732	927	137	361	598	849	112	388	675
	52 28	375	539	719	914	124	348	586	836	100	376	663
M	56 29	361	525	705	901	111	335	573	824	088	364	652
2	0 30	54347	53511	52692	51888	51098	50322	49560	48812	48076	47352	46640
	4 31	332	498	678	874	085	310	548	799	063	340	628
	8 32	318	484	665	861	072	297	535	787	051	328	616
	12 33	304	470	651	848	059	284	523	775	039	316	604
	16 34	290	456	638	835	046	271	510	762	027	304	593
*	20 35	54276	53442	52624	51821	51033	50258	49498	48750	48015	47292	46581
	24 36	262	429	611	808	020	246	485	737	003	280	569
	28 37	248	415	597	795	007	233	472	725	47990	268	557
	32 38	234	401	584	781	50994	220	460	713	978	256	546
	36 39	220	387	570	768	981	207	447	700	966	244	534
*	40 40	54206	53374	52557	51755	50968	50194	49435	48688	47954	47232	46522
	44 41	192	360	543	742	955	182	422	676	942	220	510
	48 42	178	346	530	729	942	169	410	663	930	208	499
	52 43	164	332	516	715	929	156	397	651	918	196	487
M	56 44	150	319	503	702	916	143	385	639	906	185	475
3	0 45	54136	53305	52489	51689	50903	50131	49372	48626	47893	47173	46464
	4 46	122	291	476	676	890	118	360	614	881	161	452
	8 47	108	278	462	662	877	105	347	602	869	149	440
	12 48	094	264	449	649	864	092	334	590	857	137	428
	16 49	080	250	436	636	851	080	322	577	845	125	417
*	20 50	54066	53236	52422	51623	50838	50067	49309	48565	47833	47113	46405
	24 51	052	223	409	610	825	054	297	553	821	101	393
	28 52	038	209	395	596	812	041	284	540	809	089	382
	32 53	024	195	382	583	799	029	272	528	797	077	370
	36 54	011	182	368	570	786	016	259	516	785	066	358
*	40 55	53997	53168	52355	51557	50773	50003	49247	48503	47772	47054	46346
	44 56	983	154	342	544	760	49991	234	491	760	042	335
	48 57	969	141	328	530	747	978	222	479	748	030	323
	52 58	955	127	315	517	734	965	209	467	736	018	311
	56 59	941	113	301	504	721	952	197	454	724	006	300
		d.14	d.14	d.14	d.13	d.13	d.13	d.12	d.12	d.12	d.12	d.11
			1 4		1 3				1 3			1 3
			2 7		2 6				2 6			2 6
			3 10		3 10				3 9			3 8

Digitized by Google

TABLE V. PROP. LOG. of 3 or 12 Degrs. or Hours.

IV.H	8M	12M	16M	20M	24M	28M	32M	36M	40M	44M	48M
M S	1°	2′	3′	4′	5′	6′	7′	8′	9′	10′	11′	12′
0	0″	46288	45593	44909	44236	43573	42920	42276	41642	41017	40401	39794
4	1	276	582	898	225	562	909	266	632	007	391	784
8	2	265	570	887	214	551	898	255	621	40997	381	774
12	3	253	559	875	203	540	887	244	611	986	371	764
16	4	241	547	864	191	529	877	234	600	976	361	754
* 20	5	46230	45536	44853	44180	43518	42866	42223	41590	40966	40350	39744
24	6	218	524	841	169	507	855	213	579	955	340	734
28	7	206	513	830	158	496	844	202	569	945	330	724
32	8	195	501	819	147	485	833	191	559	935	320	714
36	9	183	490	808	136	474	823	181	548	924	310	704
* 40	10	46171	45478	44796	44125	43463	42812	42170	41538	40914	40300	39694
44	11	160	467	785	114	452	801	159	527	904	289	684
48	12	148	456	774	102	441	790	149	517	894	279	674
52	13	137	444	762	091	431	780	138	506	883	269	664
M 56	14	125	433	751	080	420	769	128	496	873	259	653
1 0	15	46113	45421	44740	44069	43409	42758	42117	41485	40863	40249	39643
4	16	102	410	729	058	398	747	106	475	852	239	633
8	17	090	398	717	047	387	737	096	464	842	228	623
12	18	078	387	706	036	376	726	085	454	832	218	613
16	19	067	375	695	025	365	715	075	443	821	208	603
* 20	20	46055	45364	44684	44014	43354	42704	42064	41433	40811	40198	39593
24	21	044	353	672	003	343	693	053	423	801	188	583
28	22	032	341	661	43992	332	683	043	412	791	178	573
32	23	020	330	650	981	321	672	032	402	780	168	563
36	24	009	318	639	969	310	661	022	391	770	157	553
* 40	25	45997	45307	44627	43958	43300	42651	42011	41381	40760	40147	39543
44	26	986	295	616	947	289	640	000	370	749	137	533
48	27	974	284	605	936	278	629	41990	360	739	127	523
52	28	962	273	594	925	267	618	979	350	729	117	513
M 56	29	951	261	583	914	256	608	969	339	719	107	503
2 0	30	45939	45250	44571	43903	43245	42597	41958	41329	40708	40097	39493
4	31	928	238	560	892	234	586	948	318	698	087	483
8	32	916	227	549	881	223	575	937	308	688	076	473
12	33	905	216	538	870	212	565	927	298	678	066	464
16	34	893	204	526	859	202	554	916	287	667	056	454
* 20	35	45881	45193	44515	43848	43191	42543	41905	41277	40657	40046	39444
24	36	870	182	504	837	180	533	895	266	647	036	434
28	37	858	170	493	826	169	522	884	256	637	026	424
32	38	847	159	482	815	158	511	874	246	626	016	414
36	39	835	147	470	804	147	500	863	235	616	006	404
* 40	40	45824	45136	44459	43793	43136	42490	41853	41225	40606	39996	39394
44	41	812	125	448	782	126	479	842	214	596	985	384
48	42	800	113	437	771	115	468	832	204	585	975	374
52	43	789	102	426	760	104	458	821	194	575	965	364
M 56	44	777	091	414	749	093	447	811	183	565	955	354
3 0	45	45766	45079	44403	43738	43082	42436	41800	41173	40555	39945	39344
4	46	754	068	392	727	071	426	789	162	544	935	334
8	47	743	057	381	716	060	415	779	152	534	925	324
12	48	731	045	370	705	050	404	768	142	524	915	314
16	49	720	034	359	694	039	394	758	131	514	905	304
* 20	50	45708	45022	44347	43683	43028	42383	41747	41121	40503	39895	39294
24	51	697	011	336	672	017	372	737	111	493	885	284
28	52	685	000	325	661	006	362	726	100	483	874	274
32	53	674	44988	314	650	42995	351	716	090	473	864	264
36	54	662	977	303	639	985	340	705	080	463	854	254
* 40	55	45651	44966	44292	43628	42974	42330	41695	41069	40452	39844	39245
44	56	639	955	280	617	963	319	684	059	442	834	235
48	57	628	943	269	606	952	308	674	048	432	824	225
52	58	616	932	258	595	941	298	663	038	422	814	215
56	59	605	921	247	584	931	287	653	028	412	804	205
		d.11	d.11	d.11	d.11	d.11	d.11	d.10	d.10	d.10	d.10	d.10
				1 | 3 2 | 6 3 | 9						1 | 3 2 | 5 3 | 8	

Digitized by Google

	IV.H	52M	56M	V.H	4M	8M	12M	16M	20M	24M	28M	32M
M S	1.9	13′	14′	15′	16′	17′	18′	19′	20′	21′	22′	23′
	0	0″	39195	38604	38021	37446	36878	36318	35765	35218	34679	34146	33619
4	1		185	594	011	436	869	309	755	209	670	137	611
8	2		175	585	002	427	859	299	746	200	661	128	602
12	3		165	575	37992	417	850	290	737	191	652	119	593
16	4		155	565	983	408	841	281	728	182	643	111	585
* 20	5	39145	38555	37973	37398	36831	36271	35719	35173	34634	34102	33576
24	6		136	545	963	389	822	262	710	164	625	093	567
28	7		126	536	954	379	812	253	700	155	616	084	558
32	8		116	526	944	370	803	244	691	146	607	075	550
36	9		106	516	934	360	794	234	682	137	598	066	541
* 40	10	39096	38506	37925	37351	36784	36225	35673	35128	34589	34058	33532
44	11		086	497	915	341	775	216	664	119	581	049	524
48	12		076	487	905	332	766	207	655	110	572	040	515
52	13		066	477	896	322	756	197	646	101	563	031	506
M 56	14		056	467	886	313	747	188	636	092	554	022	498
1 0	15	39046	38458	37877	37303	36737	36179	35627	35083	34545	34014	33489
4	16		037	448	867	294	728	170	618	074	536	005	480
8	17		027	438	857	284	719	160	609	065	527	33996	471
12	18		017	428	848	275	709	151	600	056	518	987	463
16	19		007	419	838	265	700	142	591	047	509	978	454
* 20	20	38997	38409	37829	37256	36691	36133	35582	35038	34500	33970	33445
24	21		987	399	819	246	681	123	573	029	491	961	437
28	22		977	389	809	237	672	114	563	020	483	952	428
32	23		968	380	800	227	663	105	554	011	474	943	419
36	24		958	370	790	218	653	096	545	002	465	935	411
* 40	25	38948	38360	37781	37208	36644	36086	35535	34993	34456	33926	33402
44	26		938	351	771	199	634	077	527	984	447	917	393
48	27		928	341	761	189	625	068	518	975	438	908	385
52	28		918	331	752	180	616	059	509	966	429	899	376
M 56	29		908	321	742	171	606	050	500	957	420	891	367
2 0	30	38899	38312	37733	37161	36597	36040	35491	34948	34411	33882	33359
4	31		889	302	723	152	588	031	481	939	403	873	350
8	32		879	292	713	142	578	022	472	930	394	864	341
12	33		869	282	704	133	569	013	463	921	385	856	333
16	34		859	273	694	123	560	003	454	912	376	847	324
* 20	35	38849	38263	37685	37114	36550	35994	35445	34903	34367	33838	33315
24	36		839	253	675	104	541	985	436	894	358	829	307
28	37		830	244	665	095	532	976	427	885	349	820	298
32	38		820	234	656	085	522	967	418	876	340	812	289
36	39		810	224	646	076	513	957	409	867	332	803	281
* 40	40	38800	38215	37637	37067	36504	35948	35400	34858	34323	33794	33272
44	41		790	205	627	057	494	939	391	849	314	785	263
48	42		781	195	618	048	485	930	382	840	305	777	255
52	43		771	186	608	038	476	921	373	831	296	768	246
M 56	44		761	176	599	029	467	911	363	822	287	759	237
3 0	45	38751	38166	37589	37019	36457	35902	35353	34813	34278	33750	33229
4	46		741	156	579	010	448	893	345	804	270	742	220
8	47		731	147	570	001	439	884	336	795	261	733	211
12	48		722	137	560	36991	429	875	327	786	252	724	203
16	49		712	127	551	982	420	865	318	777	243	715	194
* 20	50	38702	38118	37541	36972	36411	35856	35309	34768	34234	33707	33186
24	51		692	108	532	963	401	847	300	759	225	698	177
28	52		682	098	522	953	392	838	291	750	217	689	168
32	53		673	089	513	944	383	829	282	741	208	681	160
36	54		663	079	503	935	374	820	273	732	199	672	151
* 40	55	38653	38069	37494	36925	36364	35810	35264	34723	34190	33663	33142
44	56		643	060	484	916	355	801	254	715	181	654	134
48	57		633	050	474	906	346	792	245	706	172	646	125
52	58		624	040	465	897	336	783	236	697	164	637	117
56	59		614	031	455	888	327	774	227	688	155	628	108
		d.10	d.10	d.9	d.9	d.9	d.9	d.9	d.9	d.9	d.9	d.8
		1,2 / 2,5 / 3,7					1,2 / 2,5 / 3,7					1,2 / 2,4 / 3,6

Digitized by Google

TABLE V. PROP. LOG. of 3 or 12 DEGRS. or HOURS.

	V.H	36M	40M	44M	48M	52M	56M	VIH	4M	8M	12M	16M	20M
M S	I.°	24′	25′	26′	27′	28′	29′	30′	31′	32′	33′	34′	35′
	0″	33099	32585	32077	31575	31079	30588	30103	29623	29148	28679	28214	27755
4	1	091	577	069	567	071	580	095	615	141	671	207	747
8	2	082	568	061	559	063	572	087	607	133	663	199	740
12	3	073	560	052	550	054	564	079	599	125	656	191	732
16	4	065	551	044	542	046	556	071	591	117	648	184	724
* 20	5	33056	32543	32035	31534	31038	30548	30063	29583	29109	28640	28176	27717
24	6	048	534	027	525	030	539	055	575	101	632	168	709
28	7	039	526	019	517	021	531	047	567	093	625	161	702
32	8	030	517	010	509	013	523	039	560	086	617	153	694
36	9	022	509	002	501	005	515	031	552	078	609	145	686
* 40	10	33013	32500	31993	31492	30997	30507	30023	29544	29070	28601	28138	27679
44	11	005	492	985	484	989	499	015	536	062	593	130	671
48	12	32996	483	977	476	980	491	007	528	054	586	122	664
M 52	13	987	475	968	467	972	483	29999	520	046	578	114	656
56	14	979	466	960	459	964	475	991	512	038	570	107	648
1 0	15	32970	32458	31951	31451	30956	30466	29983	29504	29031	28562	28099	27641
4	16	962	449	943	442	948	458	975	496	023	555	091	633
8	17	953	441	935	434	939	450	966	488	015	547	084	626
12	18	944	432	926	426	931	442	958	480	007	539	076	618
16	19	936	424	918	418	923	434	950	472	28999	531	068	610
* 20	20	32927	32415	31909	31409	30915	30426	29942	29464	28991	28524	28061	27603
24	21	919	407	901	401	907	418	934	456	984	516	053	595
28	22	910	398	893	393	898	410	926	448	976	508	045	588
32	23	902	390	884	384	890	402	918	441	968	500	038	580
36	24	893	381	876	376	882	393	910	433	960	493	030	572
* 40	25	32884	32373	31867	31368	30874	30385	29902	29425	28952	28485	28022	27565
44	26	876	365	859	360	866	377	894	417	944	477	015	557
48	27	867	356	851	351	857	369	886	409	937	469	007	550
M 52	28	859	348	842	343	849	361	878	401	929	462	27999	542
56	29	850	339	834	335	841	353	870	393	921	454	992	534
2 0	30	32842	32331	31826	31326	30833	30345	29862	29385	28913	28446	27984	27527
4	31	833	322	817	318	825	337	854	377	905	438	976	519
8	32	824	314	809	310	817	329	846	369	897	431	969	512
12	33	816	305	801	302	808	321	838	361	890	423	961	504
16	34	807	297	792	293	800	313	830	354	882	415	953	497
* 20	35	32799	32288	31784	31285	30792	30305	29822	29346	28874	28407	27946	27489
24	36	790	280	775	277	784	296	814	338	866	400	938	481
28	37	782	271	767	269	776	288	806	330	858	392	930	474
32	38	773	263	759	260	768	280	798	322	851	384	923	466
36	39	765	255	750	252	759	272	790	314	843	376	915	459
* 40	40	32756	32246	31742	31244	30751	30264	29782	29306	28835	28369	27908	27451
44	41	747	238	734	236	743	256	775	298	827	361	900	444
48	42	739	229	725	227	735	248	767	290	819	353	892	436
52	43	730	221	717	219	727	240	759	282	811	346	885	428
M 56	44	722	212	709	211	718	232	751	275	804	338	877	421
3 0	45	32713	32204	31700	31203	30710	30224	29743	29267	28796	28330	27869	27413
4	46	705	195	692	194	702	216	735	259	788	322	862	406
8	47	696	187	684	186	694	208	727	251	780	315	854	398
12	48	688	179	675	178	686	200	719	243	772	307	846	391
16	49	679	170	667	170	678	192	711	235	765	299	839	383
* 20	50	32671	32162	31659	31161	30670	30183	29703	29227	28757	28292	27831	27376
24	51	662	153	650	153	662	175	695	219	749	284	824	368
28	52	654	145	642	145	653	167	687	211	741	276	816	360
32	53	645	136	634	137	645	159	679	204	733	268	808	353
36	54	636	128	625	128	637	151	671	196	726	261	801	345
* 40	55	32628	32120	31617	31120	30629	30143	29663	29188	28718	28253	27793	27338
44	56	619	111	609	112	621	135	655	180	710	245	785	330
48	57	611	103	600	104	613	127	647	172	702	238	778	323
52	58	602	094	592	095	605	119	639	164	795	230	770	315
56	59	594	086	584	087	596	111	631	156	787	222	763	308
		d. 8	d. 8	d. 8	d. 8	d. 8	d. 8	d. 8	d. 8	d. 8	d. 8	d. 8	d. 8

1 2
2 4
3 6

Digitized by Google

TABLE V. PROP. LOG. of 3 or 12 DEGRS. or HOURS.

VI.H	24M	28M	32M	36M	40M	44M	48M	52M	56M	VII.H	4M	8M
M S	I°	36′	37′	38′	39′	40′	41′	42′	43′	44′	45′	46′	47′
	0″	27300	26850	26405	25964	25527	25095	24667	24244	23824	23408	22997	22589
	4 1	293	843	397	956	520	088	660	237	817	401	990	582
	8 2	285	835	390	949	513	081	653	229	810	395	983	575
	12 3	278	828	382	942	506	074	646	222	803	388	976	569
	16 4	270	820	375	934	498	066	639	215	796	381	969	562
*	20 5	27262	26813	26368	25927	25491	25059	24632	24208	23789	23374	22963	22555
	24 6	255	805	360	920	484	052	625	201	782	367	956	548
	28 7	247	798	353	913	477	045	618	194	775	360	949	542
	32 8	240	790	346	905	469	038	610	187	768	353	942	535
	36 9	232	783	338	898	462	031	603	180	761	346	935	528
*	40 10	27225	26775	26331	25891	25455	25024	24596	24173	23754	23339	22928	22521
	44 11	217	768	323	883	448	016	589	166	747	333	922	515
	48 12	210	761	316	876	440	009	582	159	740	326	915	508
	52 13	202	753	309	869	433	002	575	152	734	319	908	501
M	56 14	195	746	301	861	425	24995	568	145	727	312	901	494
1	0 15	27187	26738	26294	25854	25419	24988	24561	24138	23720	23305	22894	22488
	4 16	180	731	287	847	412	981	554	131	713	298	888	481
	8 17	172	723	279	839	404	974	547	124	706	291	881	474
	12 18	165	716	272	832	397	966	540	117	699	284	874	467
	16 19	157	709	265	825	390	959	533	110	692	278	867	461
*	20 20	27150	26701	26257	25818	25383	24952	24526	24103	23685	23271	22860	22454
	24 21	142	694	250	810	376	945	518	096	678	264	854	447
	28 22	135	686	242	803	368	938	511	089	671	257	847	440
	32 23	127	679	235	796	361	931	504	082	664	250	840	434
	36 24	120	671	228	789	354	923	497	075	657	243	833	427
*	40 25	27112	26664	26220	25781	25347	24916	24490	24068	23650	23236	22826	22420
	44 26	105	656	213	774	339	909	483	061	643	229	819	413
	48 27	097	649	206	767	332	902	476	054	636	223	813	407
	52 28	090	642	198	759	325	895	469	047	629	216	806	400
M	56 29	082	634	191	752	318	888	462	040	623	209	799	393
2	0 30	27075	26627	26184	25745	25311	24881	24455	24033	23610	23202	22792	22386
	4 31	067	619	176	738	303	874	448	026	609	195	785	380
	8 32	060	612	169	730	296	866	441	019	602	188	779	373
	12 33	052	605	162	723	289	859	434	012	595	181	772	366
	16 34	045	597	154	716	282	852	427	005	588	175	765	359
*	20 35	27037	26590	26147	25709	25275	24845	24420	23998	23581	23168	22758	22353
	24 36	030	582	140	701	267	838	413	991	574	161	752	346
	28 37	022	575	132	694	260	831	405	984	567	154	745	339
	32 38	015	567	125	687	253	824	398	977	560	147	738	333
	36 39	007	560	118	680	246	817	391	970	553	140	731	326
*	40 40	27000	26553	26110	25672	25239	24809	24384	23963	23546	23133	22724	22319
	44 41	26992	545	103	665	231	802	377	956	539	127	718	312
	48 42	985	538	096	658	224	795	370	949	533	120	711	306
	52 43	977	530	088	650	217	788	363	942	526	113	704	299
M	56 44	970	523	081	643	210	781	356	935	519	106	697	292
3	0 45	26962	26516	26074	25636	25203	24774	24349	23928	23512	23099	22690	22286
	4 46	955	508	066	629	196	767	342	921	505	092	684	279
	8 47	947	501	059	621	188	760	335	914	498	086	677	272
	12 48	940	493	052	614	181	752	328	908	491	079	670	265
	16 49	932	486	044	607	174	745	321	901	484	072	663	259
*	20 50	26925	26479	26037	25600	25167	24738	24314	23894	23477	23065	22657	22252
	24 51	917	471	030	592	160	731	307	887	470	058	650	245
	28 52	910	464	022	585	152	724	300	880	464	051	643	239
	32 53	902	456	015	578	145	717	293	873	457	044	636	232
	36 54	895	449	008	571	138	710	286	866	450	038	629	225
*	40 55	26887	26442	26000	25563	25131	24703	24279	23859	23443	23031	22623	22218
	44 56	880	434	25993	556	124	696	272	852	436	024	616	212
	48 57	872	427	986	549	117	689	265	845	429	017	609	205
	52 58	865	410	978	542	109	681	258	838	422	010	602	198
	56 59	858	412	971	534	102	674	251	831	415	003	596	192
=		d. 7	d. 7	d. 7	d. 7	d. 7	d. 7	d. 7	d. 7	d. 7	d. 7	d. 7	d. 7

1	2
2	4
3	5

Digitized by Google

TABLE V. PROP. LOG. of 3 or 12 Degrs. or Hours

VII.H	12M	16M	20M	24M	28M	32M	36M	40M	44M	48M	52M	56M
M S	1°	48′	49′	50′	51′	52′	53′	54′	55′	56′	57′	58′	59′
0	0′′	22185	21785	21388	20995	20605	20219	19837	19457	19081	18710	18339	17973
4	1	178	778	381	988	599	213	830	451	075	702	333	966
8	2	171	771	375	982	593	207	824	445	069	696	327	960
12	3	165	765	368	975	586	200	818	439	063	690	321	954
16	4	158	758	362	969	580	194	811	432	056	684	315	948
* 20	5	22151	21751	21355	20962	20573	20187	19805	19426	19050	18678	18308	17942
24	6	145	745	349	956	567	181	799	420	044	672	302	936
28	7	138	738	342	949	560	175	792	413	038	665	296	930
32	8	131	732	335	943	554	168	786	407	032	659	290	924
36	9	125	725	329	936	547	162	780	401	025	653	284	918
* 40	10	22118	21718	21322	20930	20541	20155	19773	19395	19019	18647	18278	17912
44	11	111	712	316	923	534	149	767	388	013	641	272	906
48	12	105	705	309	917	528	143	761	382	007	634	266	900
52	13	098	698	303	910	522	136	754	376	000	628	259	894
M 56	14	091	692	296	904	515	130	748	369	18994	622	253	887
1 0	15	22084	21685	21289	20897	20509	20123	19742	19363	18988	18616	18247	17881
4	16	078	678	283	891	502	117	735	357	982	610	241	875
8	17	071	672	276	884	496	111	729	351	976	604	235	869
12	18	064	665	270	878	489	104	723	344	969	597	229	863
16	19	058	659	263	871	483	098	716	338	963	591	223	857
* 20	20	22051	21652	21257	20865	20476	20091	19710	19332	18957	18585	18217	17851
24	21	044	645	250	858	470	085	704	325	951	579	210	845
28	22	038	639	243	852	464	079	697	319	944	573	204	839
32	23	031	632	237	845	457	072	691	313	938	567	198	833
36	24	024	626	230	839	451	066	685	307	932	560	192	827
* 40	25	22018	21619	21224	20832	20444	20060	19678	19300	18926	18554	18186	17821
44	26	011	612	217	826	438	053	672	294	920	548	180	815
48	27	004	606	211	819	431	047	666	288	913	542	174	809
52	28	21998	599	204	813	425	040	659	282	907	536	168	803
M 56	29	991	592	198	806	418	034	653	275	901	530	162	797
2 0	30	21984	21586	21191	20800	20412	20028	19647	19269	18895	18523	18155	17790
4	31	978	579	184	793	406	021	640	263	888	517	149	784
8	32	971	573	178	787	399	015	634	257	882	511	143	778
12	33	964	566	171	780	393	009	628	250	876	505	137	772
16	34	958	559	165	774	386	002	621	244	870	499	131	766
* 20	35	21951	21553	21158	20767	20380	19996	19615	19238	18864	18493	18125	17760
24	36	944	546	152	761	373	989	609	231	857	487	119	754
28	37	938	540	145	754	367	983	602	225	851	480	113	748
32	38	931	533	139	748	361	977	596	219	845	474	107	742
36	39	924	526	132	741	354	970	590	213	839	468	100	736
* 40	40	21918	21520	21126	20735	20348	19964	19584	19206	18833	18462	18094	17730
44	41	911	513	119	728	341	958	577	200	826	456	088	724
48	42	904	507	112	722	335	951	571	194	820	450	082	718
52	43	898	500	106	715	328	945	565	188	814	443	076	712
M 56	44	891	493	099	709	322	938	558	181	808	437	070	706
3 0	45	21884	21487	21093	20702	20316	19932	19552	19175	18802	18431	18064	17700
4	46	878	480	086	696	309	926	546	169	795	425	058	694
8	47	871	474	080	690	303	919	539	163	789	419	052	688
12	48	864	467	073	683	296	913	533	156	783	413	046	682
16	49	858	460	067	677	290	907	527	150	777	407	040	676
* 20	50	21851	21454	21060	20670	20284	19900	19520	19144	18771	18400	18033	17669
24	51	844	447	054	664	277	894	514	138	764	394	027	663
28	52	838	441	047	657	271	888	508	131	758	388	021	657
32	53	831	434	041	651	264	881	502	125	752	382	015	651
36	54	824	427	034	644	258	875	495	119	746	376	009	645
* 40	55	21818	21421	21028	20638	20251	19869	19489	19113	18740	18370	18003	17639
44	56	811	414	021	631	245	862	483	106	733	364	17997	633
48	57	805	408	015	625	239	856	476	100	727	357	991	627
52	58	798	401	008	618	232	849	470	094	721	351	985	621
56	59	791	395	001	612	226	843	464	088	715	345	979	615
		d. 7	d. 7	d. 7	d. 6	d. 6	d. 6	d. 6	d. 6	d. 6	d. 6	d. 6	d. 6
		1 | 2							1 | 2				
		2 | 3							2 | 3				
		3 | 5							3 | 5				

Digitized by Google

TABLE V. PROP. LOG. of 3 or 12 Degrs. or Hours.

VIII.		0M	4M	8M	12M	16M	20M	24M	28M	32M	36M	40M	44M
M	S	11°	0′	1′	2′	3′	4′	5′	6′	7′	8′	9′	10′	11′
	0	0″	17609	17249	16891	16537	16185	15836	15490	15147	14806	14468	14133	13800
	4	1	603	243	885	531	179	830	484	141	801	463	127	795
	8	2	597	237	879	525	173	825	479	135	795	457	122	789
	12	3	591	231	873	519	168	819	473	130	789	451	116	784
	16	4	585	225	868	513	162	813	467	124	784	446	111	778
*	20	5	17579	17219	16862	16507	16156	15807	15461	15118	14778	14440	14105	13773
	24	6	573	213	856	501	150	802	456	113	772	435	100	767
	28	7	567	207	850	496	144	796	450	107	767	429	094	761
	32	8	561	201	844	490	138	790	444	101	761	423	088	756
	36	9	555	195	838	484	133	784	439	096	755	418	083	750
*	40	10	17549	17189	16832	16478	16127	15778	15433	15090	14750	14412	14077	13745
	44	11	543	183	826	472	121	773	427	084	744	407	072	739
	48	12	537	177	820	466	115	767	421	079	738	401	066	734
	52	13	531	171	814	460	109	761	416	073	733	395	061	728
M	56	14	525	165	808	454	103	755	410	067	727	390	055	723
1	0	15	17519	17159	16802	16449	16098	15749	15404	15061	14722	14384	14049	13717
	4	16	513	153	796	443	092	744	398	056	716	379	044	712
	8	17	507	147	791	437	086	738	393	050	710	373	038	706
	12	18	501	141	785	431	080	732	387	044	705	367	033	701
	16	19	495	135	779	425	074	726	381	039	699	362	027	695
*	20	20	17489	17129	16773	16419	16068	15721	15375	15033	14693	14356	14022	13690
	24	21	483	123	767	413	063	715	370	027	688	351	016	684
	28	22	477	117	761	407	057	709	364	022	682	345	011	679
	32	23	471	111	755	402	051	703	358	016	676	339	005	673
	36	24	465	105	749	396	045	697	353	010	671	334	13999	668
*	40	25	17460	17099	16743	16390	16039	15692	15347	15005	14665	14328	13994	13662
	44	26	453	093	737	384	034	686	341	14999	659	323	988	657
	48	27	447	087	731	378	028	680	335	993	654	317	983	651
	52	28	441	082	725	372	022	674	330	988	648	311	977	646
M	56	29	435	076	720	366	016	669	324	982	643	306	972	640
2	0	30	17425	17070	16714	16361	16010	15663	15318	14976	14637	14300	13966	13635
	4	31	423	064	708	355	005	657	312	971	631	295	961	629
	8	32	417	058	702	349	15999	651	307	965	626	289	955	624
	12	33	411	052	696	343	993	646	301	959	620	284	949	618
	16	34	405	046	690	337	987	640	295	954	614	278	944	613
*	20	35	17399	17040	16684	16331	15981	15634	15290	14948	14609	14272	13938	13607
	24	36	393	034	678	325	975	628	284	942	603	267	933	602
	28	37	387	028	672	320	970	623	278	937	598	261	927	596
	32	38	381	022	666	314	964	617	272	931	592	256	922	591
	36	39	375	016	660	308	958	611	267	925	586	250	916	585
*	40	40	17369	17010	16655	16302	15952	15605	15261	14919	14581	14244	13911	13580
	44	41	363	004	649	296	946	599	255	914	575	239	905	574
	48	42	357	16998	643	290	941	594	250	908	569	233	900	569
	52	43	351	992	637	284	935	588	244	902	564	228	894	563
M	56	44	345	986	631	279	929	582	238	897	558	222	889	558
3	0	45	17339	16980	16625	16273	15923	15576	15232	14891	14553	14217	13883	13552
	4	46	333	974	619	267	917	571	227	886	547	211	878	547
	8	47	327	968	613	261	912	565	221	880	541	205	872	541
	12	48	321	963	607	255	906	559	215	874	536	200	866	536
	16	49	315	957	602	249	900	553	210	869	530	194	861	530
	20	50	17309	16951	16596	16243	15894	15548	15204	14863	14524	14189	13855	13525
*	24	51	303	945	590	238	888	542	198	857	519	183	850	519
	28	52	297	939	584	232	883	536	192	852	513	177	844	514
	32	53	291	933	578	226	877	530	187	846	508	172	839	508
	36	54	285	927	572	220	871	525	181	840	502	166	833	503
*	40	55	17279	16921	16566	16214	15865	15519	15175	14835	14496	14161	13828	13497
	44	56	273	915	560	208	859	513	170	829	491	155	822	492
	48	57	267	909	554	203	854	507	164	823	485	150	817	486
	52	58	261	903	549	197	848	502	158	818	480	144	811	481
	56	59	255	897	543	191	842	496	153	812	474	138	806	475
			d. 6	d. 6	d. 6	d. 6	d. 6	d. 6	d. 6	d. 6	d. 6	d. 6	d. 6	d. 6

1 | 2
2 | 3
3 | 4

Digitized by Google

TABLE V. PROP. LOG. of 3 or 12 Degrs. or Hours.

VIII.H	48M	52M	56M	IX.H	4M	8M	12M	16M	20M	24M	28M	32M
M S	II.°	12′	13′	14′	15′	16′	17′	18′	19′	20′	21′	22′	23′
0	0′	13470	13142	12817	12494	12173	11855	11539	11226	10914	10605	10298	09994
4	1	464	137	811	489	168	850	534	221	909	600	293	989
8	2	459	131	806	483	163	845	529	215	904	595	288	984
12	3	453	126	801	478	157	839	524	210	899	590	283	978
16	4	448	120	795	472	152	834	518	205	894	585	278	973
* 20	5	13442	13115	12790	12467	12147	11829	11513	11200	10889	10580	10273	09968
24	6	437	109	784	462	141	824	508	195	883	575	268	963
28	7	431	104	779	456	136	818	503	189	878	569	263	958
32	8	426	099	774	451	131	813	497	184	873	564	258	953
36	9	421	093	768	446	125	808	492	179	868	559	253	948
* 40	10	13415	13088	12763	12440	12120	11802	11487	11174	10863	10554	10247	09943
44	11	410	082	757	435	115	797	482	169	858	549	242	938
48	12	404	077	752	430	110	792	476	163	852	544	237	933
52	13	399	071	747	424	104	787	471	158	847	539	232	928
M 56	14	393	066	741	419	099	781	466	153	842	534	227	923
1 0	15	13388	13061	12736	12414	12094	11776	11461	11148	10837	10528	10222	09918
4	16	382	055	730	408	088	771	456	143	832	523	217	913
8	17	377	050	725	403	083	765	450	137	827	518	212	908
12	18	371	044	720	397	078	760	445	132	821	513	207	903
16	19	366	039	714	392	072	755	440	127	816	508	202	898
* 20	20	13360	13033	12709	12387	12067	11750	11435	11122	10811	10503	10197	09893
24	21	355	028	703	381	062	744	429	117	806	498	192	887
28	22	349	023	698	376	056	739	424	111	801	493	186	882
32	23	344	017	693	371	051	734	419	106	796	487	181	877
36	24	338	012	687	365	046	729	414	101	791	482	176	872
* 40	25	13333	13006	12682	12360	12041	11723	11408	11096	10785	10477	10171	09867
44	26	328	001	677	355	035	718	403	091	780	472	166	862
48	27	322	12995	671	349	030	713	398	086	775	467	161	857
52	28	317	990	666	344	025	708	393	080	770	462	156	852
M 56	29	311	985	660	339	019	702	387	075	765	457	151	847
2 0	30	13306	12979	12655	12333	12014	11697	11382	11070	10760	10452	10146	09842
4	31	300	974	650	328	009	692	377	065	754	447	141	837
8	32	295	968	644	323	003	686	372	059	749	441	136	832
12	33	289	963	639	317	11998	681	367	054	744	436	131	827
16	34	284	957	634	312	993	676	361	049	739	431	126	822
* 20	35	13278	12952	12628	12307	11987	11671	11356	11044	10734	10426	10120	09817
24	36	273	947	623	301	982	665	351	039	729	421	115	812
28	37	267	941	617	296	977	660	346	034	724	416	110	807
32	38	262	936	612	291	972	655	340	028	718	411	105	802
36	39	257	930	607	285	966	650	335	023	713	406	100	797
* 40	40	13251	12925	12601	12280	11961	11644	11330	11018	10708	10400	10095	09792
44	41	246	920	596	275	956	639	325	013	703	395	090	787
48	42	240	914	590	269	950	634	320	008	698	390	085	782
52	43	235	909	585	264	945	629	314	002	693	385	080	777
M 56	44	229	903	580	259	940	623	309	10997	688	380	075	772
3 0	45	13224	12898	12574	12253	11935	11618	11304	10992	10682	10375	10070	09766
4	46	218	892	569	248	929	613	299	987	677	370	065	761
8	47	213	887	564	243	924	608	294	982	672	365	059	756
12	48	207	882	558	237	919	602	288	977	667	360	054	751
16	49	202	876	553	232	913	597	283	971	662	355	049	746
* 20	50	13197	12871	12548	12227	11908	11592	11278	10966	10657	10349	10044	09741
24	51	191	865	542	221	903	587	273	961	652	344	039	736
28	52	186	860	537	216	897	581	267	956	646	339	034	731
32	53	180	855	531	211	892	576	262	951	641	334	029	726
36	54	175	849	526	205	887	571	257	945	636	329	024	721
* 40	55	13169	12844	12521	12200	11882	11566	11252	10940	10631	10324	10019	09716
44	56	164	838	515	195	876	560	247	935	626	319	014	711
48	57	158	833	510	189	871	555	241	930	621	314	009	706
52	58	153	828	505	184	866	550	236	925	616	309	004	701
56	59	148	822	499	179	860	545	231	920	610	304	09999	696
		d. 5	d. 5	d. 5	d. 5	d. 5	d. 5	d. 5	d. 5	90. 5	d. 5	d. 5	d. 5

1	1
2	3
3	4

Digitized by Google

TABLE V. PROP. LOG. of 3 or 12 Degrs. or Hours.

IX.H	36M	40M	44M	48M	52M	56M	XH	4M	8M	12M	16M	20M
M S	11.°	24′	25′	26′	27′	28′	29′	30′	31′	32′	33′	34′	35′
0	0	09691	09590	09492	08796	08501	08209	07918	07630	07343	07058	06775	06494
4	1	686	385	087	791	496	204	913	625	338	053	770	489
8	2	681	380	082	786	491	199	908	620	333	049	766	485
12	3	676	375	077	781	486	194	904	615	329	044	761	480
16	4	671	370	072	776	482	189	899	610	324	039	756	475
* 20	5	09666	09365	09067	08771	08477	08184	07894	07606	07319	07034	06752	06471
24	6	661	360	062	766	472	179	889	601	314	030	747	466
28	7	656	356	057	761	467	175	884	596	310	025	742	461
32	8	651	351	052	756	462	170	880	591	305	020	738	457
36	9	646	346	047	751	457	165	875	586	300	016	733	452
* 40	10	09641	09341	09042	08746	08452	08160	07870	07582	07295	07011	06728	06447
44	11	636	336	037	741	447	155	865	577	291	006	724	443
48	12	631	331	033	736	442	150	860	572	286	001	719	438
52	13	626	326	028	732	438	146	855	567	281	06997	714	433
M 56	14	621	321	023	727	433	141	851	562	276	992	709	429
1 0	15	09616	09316	09018	08722	08426	08136	07846	07558	07272	06987	06705	06424
4	16	611	311	013	717	423	131	841	553	267	982	700	419
8	17	606	306	008	712	418	126	836	548	262	978	695	415
12	18	601	301	003	707	413	121	831	543	257	973	691	410
16	19	596	296	08998	702	408	116	827	539	253	968	686	405
* 20	20	09591	09291	08993	08697	08403	08112	07822	07534	07248	06964	06681	06401
24	21	586	286	988	692	398	107	817	529	243	959	677	396
28	22	581	281	983	687	394	102	812	524	238	954	672	391
32	23	576	276	978	682	389	097	807	519	234	949	667	387
36	24	571	271	973	678	384	092	802	515	229	945	663	382
* 40	25	09566	09266	08968	08673	08379	08087	07798	07510	07224	06940	06658	06377
44	26	561	261	963	668	374	083	793	505	219	935	653	373
48	27	556	256	958	663	369	078	788	500	215	931	648	368
52	28	550	251	953	658	364	073	783	496	210	926	644	364
M 56	29	545	246	948	653	359	068	778	491	205	921	639	359
2 0	30	09540	09241	08943	08648	08355	08063	07774	07486	07200	06916	06634	06354
4	31	535	236	938	643	350	058	769	481	196	912	630	350
8	32	530	231	933	638	345	053	764	476	191	907	625	345
12	33	525	226	929	633	340	049	759	472	186	902	620	340
16	34	520	221	924	628	335	044	754	467	181	898	616	336
* 20	35	09515	09216	08919	08624	08330	08039	07750	07462	07177	06893	06611	06331
24	36	510	211	914	619	325	034	745	457	172	888	606	326
28	37	505	206	909	614	320	029	740	453	167	883	602	322
32	38	500	201	904	609	316	024	735	448	162	879	597	317
36	39	495	196	899	604	311	020	730	443	158	874	592	312
* 40	40	09490	09191	08894	08599	08306	08015	07726	07438	07153	06869	06588	06308
44	41	485	186	889	594	301	010	721	433	148	865	583	303
48	42	480	181	884	589	296	005	716	429	143	860	578	298
52	43	475	176	879	584	291	000	711	424	139	855	574	294
M 56	44	470	171	874	579	286	07995	706	419	134	850	569	289
3 0	45	09465	09166	08869	08575	08282	07991	07702	07414	07129	06846	06564	06284
4	46	460	161	865	570	277	986	697	410	124	841	559	280
8	47	455	156	860	565	272	981	692	405	120	836	555	275
12	48	450	151	855	560	267	976	687	400	115	832	550	271
16	49	445	147	850	555	262	971	682	395	110	827	545	266
* 20	50	09440	09142	08845	08550	08257	07966	07678	07391	07105	06822	06541	06261
24	51	435	137	840	545	252	962	673	386	101	817	536	257
28	52	430	132	835	540	248	957	668	381	096	813	531	252
32	53	425	127	830	535	243	952	663	376	091	808	527	247
36	54	420	122	825	530	238	947	658	371	087	803	522	243
* 40	55	09415	09117	08820	08526	08233	07942	07654	07367	07082	06799	06517	06238
44	56	410	112	815	521	228	937	649	362	077	794	513	233
48	57	405	107	810	516	223	933	644	357	072	789	508	229
52	58	400	102	805	511	218	928	639	352	068	784	503	224
56	59	395	097	800	506	213	923	634	348	063	780	499	219
		d. 5	d. 5	d. 5	d. 5	d. 5	d. 5	d. 4	d. 4	d. 4	d. 4	d. 4	d. 4

1 | 1
2 | 3
3 | 4

1 | 1
2 | 2
3 | 3

Digitized by Google

TABLE V. PROP. LOG. of 3 or 12 DEGRS. or HOURS.

	X.H	24M	28M	32M	36M	40M	44M	48M	52M	56M	XIH	4M	8M
M S	II.°	36′	37′	38′	39′	40′	41′	42′	43′	44′	45′	46′	47′
0	0″	06215	05937	05662	05388	05115	04845	04576	04308	04043	03779	03516	03256
4	1	210	933	657	383	111	840	571	304	038	774	512	251
8	2	206	928	652	378	106	836	567	300	034	770	508	247
12	3	201	923	648	374	102	831	562	295	030	766	503	243
16	4	196	919	643	369	097	827	558	291	025	761	499	238
* 20	5	06192	05914	05639	05365	05093	04822	04553	04286	04021	03757	03495	03234
24	6	187	910	634	360	088	818	549	282	016	753	490	230
28	7	182	905	629	356	084	813	544	277	012	748	486	225
32	8	178	900	625	351	079	809	540	273	008	744	482	221
36	9	173	896	620	347	075	804	536	269	003	739	477	217
* 40	10	06168	05891	05616	05342	05070	04800	04531	04264	03999	03735	03473	03212
44	11	164	887	611	337	066	795	527	260	994	731	469	208
48	12	159	882	607	333	061	791	522	255	990	726	464	204
52	13	155	877	602	328	056	786	518	251	986	722	460	199
M 56	14	150	873	597	324	052	782	513	246	981	717	455	195
1 0	15	06145	05868	05593	05319	05047	04777	04509	04242	03977	03713	03451	03191
4	16	141	864	588	315	043	773	504	237	972	709	447	186
8	17	136	859	584	310	038	768	500	233	968	704	442	182
12	18	131	854	579	306	034	764	495	229	963	700	438	178
16	19	127	850	575	301	029	759	491	224	959	696	434	173
* 20	20	06122	05845	05570	05297	05025	04755	04486	04220	03955	03691	03429	03169
24	21	117	841	565	292	020	750	482	215	950	687	425	165
28	22	113	836	561	288	016	746	478	211	946	682	421	160
32	23	108	831	556	283	011	741	473	206	941	678	416	156
36	24	104	827	552	278	007	737	469	202	937	674	412	152
* 40	25	06099	05822	05547	05274	05002	04732	04464	04198	03933	03669	03408	03147
44	26	094	818	543	269	04998	728	460	193	928	665	403	143
48	27	090	813	538	265	993	723	455	189	924	661	399	139
52	28	085	808	533	260	989	719	451	184	919	656	395	134
M 56	29	080	804	529	256	984	714	446	180	915	652	390	130
2 0	30	06076	05799	05524	05251	04980	04710	04442	04175	03911	03647	03386	03126
4	31	071	795	520	247	975	706	437	171	906	643	381	121
8	32	067	790	515	242	971	701	433	167	902	639	377	117
12	33	062	785	511	238	966	697	429	162	897	634	373	113
16	34	057	781	506	233	962	692	424	158	893	630	368	108
* 20	35	06053	05776	05501	05229	04957	04688	04420	04153	03889	03626	03364	03104
24	36	048	772	497	224	953	683	415	149	884	621	360	100
28	37	043	767	492	219	948	679	411	144	880	617	355	096
32	38	039	762	488	215	944	674	406	140	875	612	351	091
36	39	034	758	483	210	939	670	402	136	871	608	347	087
* 40	40	06030	05753	05479	05206	04935	04665	04397	04131	03867	03604	03342	03083
44	41	025	749	474	201	930	661	393	127	862	599	338	078
48	42	020	744	470	197	926	656	388	122	858	595	334	074
52	43	016	739	465	192	921	652	384	118	853	591	329	070
M 56	44	011	735	460	188	917	647	380	114	849	586	325	065
3 0	45	06006	05730	05456	05183	04912	04643	04375	04109	03845	03582	03321	03061
4	46	002	726	451	179	908	638	371	105	840	578	316	057
8	47	05997	721	447	174	903	634	366	100	836	573	312	052
12	48	993	717	442	170	899	629	362	096	832	569	308	048
16	49	988	712	438	165	894	625	357	091	827	564	303	044
* 20	50	05983	05707	05433	05161	04890	04620	04353	04087	03823	03560	03299	03039
24	51	979	703	429	156	885	616	348	083	818	556	295	035
28	52	974	698	424	151	881	612	344	078	814	551	290	031
32	53	970	694	419	147	876	607	340	074	810	547	286	026
36	54	965	689	415	142	872	603	335	069	805	543	282	022
* 40	55	05960	05684	05410	05138	04867	04598	04331	04065	03801	03538	03277	03018
44	56	956	680	406	133	863	594	326	061	796	534	273	014
48	57	951	675	401	129	858	589	322	056	792	530	269	009
52	58	947	671	397	124	854	585	317	052	788	525	264	005
M 56	59	942	666	392	120	849	580	313	047	783	521	260	001
		d. 4	d. 4	d. 4	d. 4	d. 4	d. 4	d. 4	d. 4	d. 4	d. 4	d. 4	d. 4

1 1
2 2
3 3

Digitized by Google

TABLE V. PROP. LOG. of 3 or 12 DEGRS. or HOURS.

XI.H	12M	16M	20M	24M	28M	32M	36M	40M	44M	48M	52M	56M
1 S	II.°	48′	49′	50′	51′	52′	53′	54′	55′	56′	57′	58′	59′
	0	0″	02996	02739	02482	02228	0197	01723	01472	01223	00976	00730	00485	00242
	4	1	992	734	478	223	970	718	468	219	972	726	481	238
	8	2	988	730	474	219	966	714	464	215	968	722	477	234
	12	3	983	726	470	215	962	710	460	211	964	718	473	230
	16	4	979	721	465	211	958	706	456	207	960	714	469	226
*	20	5	02975	02717	02461	02206	01953	01702	01452	01203	00955	00709	00465	00221
	24	6	970	713	457	202	949	698	447	199	951	705	461	218
	28	7	966	709	453	198	945	693	443	195	947	701	457	214
	32	8	962	704	448	194	941	689	439	190	943	697	453	210
	36	9	958	700	444	190	937	685	435	186	939	693	449	206
*	40	10	02953	02696	02440	02185	01932	01681	01431	01182	00935	00689	00445	00202
	44	11	949	691	436	181	928	677	427	178	931	685	441	197
	48	12	945	687	431	177	924	672	422	174	927	681	436	193
	52	13	940	683	427	173	920	668	418	170	923	677	432	189
M	56	14	936	679	423	168	916	664	414	166	918	673	428	185
1	0	15	02932	02674	02419	02164	01911	01660	01410	01161	00914	00669	00424	00181
	4	16	927	670	414	160	907	656	406	157	910	665	420	177
	8	17	923	666	410	156	903	652	402	153	906	660	416	173
	12	18	919	662	406	152	899	647	398	149	902	656	412	169
	16	19	915	657	402	147	895	643	393	145	898	652	408	165
*	20	20	02910	02653	02397	02143	01890	01639	01389	01141	00894	00648	00404	00161
	24	21	906	649	393	139	886	635	385	137	890	644	400	157
	28	22	902	644	389	135	882	631	381	133	886	640	396	153
	32	23	897	640	385	130	878	627	377	128	882	636	392	149
	36	24	893	636	380	126	874	622	373	124	877	632	388	145
*	40	25	02889	02632	02376	02122	01869	01618	01368	01120	00873	00628	00384	00141
	44	26	884	627	372	118	865	614	364	116	869	624	380	137
	48	27	880	623	368	114	861	610	360	112	865	620	376	133
	52	28	876	619	363	109	857	606	356	108	861	616	372	129
M	56	29	872	615	359	105	853	601	352	104	857	611	367	125
2	0	30	02867	02610	02355	02101	01848	01597	01348	01100	00853	00607	00363	00121
	4	31	863	606	351	097	844	593	344	095	849	603	359	117
	8	32	859	602	346	092	840	589	339	091	845	599	355	113
	12	33	854	598	342	088	836	585	335	087	840	595	351	109
	16	34	850	593	338	084	832	581	331	083	836	591	347	105
*	20	35	02846	02589	02334	02080	01827	01576	01327	01079	00832	00587	00343	00101
	24	36	841	585	329	076	823	572	323	075	828	583	339	097
	28	37	837	580	325	071	819	568	319	071	824	579	335	093
	32	38	833	576	321	067	815	564	315	067	820	575	331	089
	36	39	829	572	317	063	811	560	310	062	816	571	327	085
*	40	40	02824	02568	02312	02059	01806	01556	01306	01058	00812	00567	00323	00080
	44	41	820	563	308	054	802	551	302	054	808	563	319	076
	48	42	816	559	304	050	798	547	298	050	804	559	315	072
	52	43	811	555	300	046	794	543	294	046	799	554	311	068
M	56	44	807	551	295	042	790	53	290	042	795	550	307	064
3	0	45	02803	02546	02291	02038	01785	01535	01286	01038	00791	00546	00303	00060
	4	46	799	542	287	033	781	53	281	034	787	542	299	056
	8	47	794	538	283	029	777	526	277	029	783	538	295	052
	12	48	790	533	278	025	773	52	273	025	779	534	290	048
	16	49	786	529	274	021	769	518	269	021	775	530	286	044
*	20	50	02781	02525	02270	02017	01764	01514	01265	01017	00771	00526	00282	00040
	24	51	777	521	266	012	760	510	261	013	767	522	278	036
	28	52	773	516	262	008	756	506	257	009	763	518	274	032
	32	53	769	512	257	004	752	501	252	005	759	514	270	028
	36	54	764	508	253	000	748	497	248	001	754	510	266	024
*	40	55	02760	02504	02249	01995	01744	01493	01244	00997	00750	00506	00262	00020
	44	56	756	499	245	991	739	489	240	992	746	502	258	016
	48	57	751	495	240	987	735	485	236	988	742	497	254	012
	52	58	747	491	236	983	731	481	232	984	738	493	250	008
	56	59	743	487	232	979	727	477	228	980	734	489	246	004
			d. 4	d. 4	d. 4	d. 4	d. 4	d. 4	d. 4	d. 4	d. 4	d. 4	d. 4	d. 4

1 1
2 2
3 3

Digitized by Google

TABLE VI. To reduce the Longit. Lat. R. A. Dec. Hor. Par. Semid. &c. as given in the Nautical Almanac, to any intermediate Time.

Agr. Ti. af. noon or mid.	Argument. Variation in Twelve Hours.												
	1′	2′	3′	4′	5′	6′	7′	8′	9′	10′	11′	12′	p.p
h. m	/ //	/ //	/ //	/ //	/ //	/ //	/ //	/ //	/ //	/ //	/ //	/ //	
0 12	0 1	0 2	0 3	0 4	0 5	0 6	0 7	0 8	0 9	0 10	0 11	0 12	1
24	0 2	0 4	0 6	0 8	0 10	0 12	0 14	0 16	0 18	0 20	0 22	0 24	2
36	0 3	0 6	0 9	0 12	0 15	0 18	0 21	0 24	0 27	0 30	0 33	0 36	3
48	0 4	0 8	0 12	0 16	0 20	0 24	0 28	0 32	0 36	0 40	0 44	0 48	4
1 0	0 5	0 10	0 15	0 20	0 25	0 30	0 35	0 40	0 45	0 50	0 55	1 0	5
12	0 6	0 12	0 18	0 24	0 30	0 36	0 42	0 48	0 54	1 0	1 6	1 12	6
24	0 7	0 14	0 21	0 28	0 35	0 42	0 49	0 56	1 3	1 10	1 17	1 24	7
36	0 8	0 16	0 24	0 32	0 40	0 48	0 56	1 4	1 12	1 20	1 28	1 36	8
48	0 9	0 18	0 27	0 36	0 45	0 54	1 3	1 12	1 21	1 30	1 39	1 48	9
2 0	0 10	0 20	0 30	0 40	0 50	1 0	1 10	1 20	1 30	1 40	1 50	2 0	10
12	0 11	0 22	0 33	0 44	0 55	1 6	1 17	1 28	1 39	1 50	2 1	2 12	11
24	0 12	0 24	0 36	0 48	1 0	1 12	1 24	1 36	1 48	2 0	2 12	2 24	12
36	0 13	0 26	0 39	0 52	1 5	1 18	1 31	1 44	1 57	2 10	2 23	2 36	13
48	0 14	0 28	0 42	0 56	1 10	1 24	1 38	1 52	2 6	2 20	2 34	2 48	14
3 0	0 15	0 30	0 45	1 0	1 15	1 30	1 45	2 0	2 15	2 30	2 45	3 0	15
12	0 16	0 32	0 48	1 4	1 20	1 36	1 52	2 8	2 24	2 40	2 56	3 12	16
24	0 17	0 34	0 51	1 8	1 25	1 42	1 59	2 16	2 33	2 50	3 7	3 24	17
36	0 18	0 36	0 54	1 12	1 30	1 48	2 6	2 24	2 42	3 0	3 18	3 36	18
48	0 19	0 38	0 57	1 16	1 35	1 54	2 13	2 32	2 51	3 10	3 29	3 48	19
4 0	0 20	0 40	1 0	1 20	1 40	2 0	2 20	2 40	3 0	3 20	3 40	4 0	20
12	0 21	0 42	1 3	1 24	1 45	2 6	2 27	2 48	3 9	3 30	3 51	4 12	21
24	0 22	0 44	1 6	1 28	1 50	2 12	2 34	2 56	3 18	3 40	4 2	4 24	22
36	0 23	0 46	1 9	1 32	1 55	2 18	2 41	3 4	3 27	3 50	4 13	4 36	23
48	0 24	0 48	1 12	1 36	2 0	2 24	2 48	3 12	3 36	4 0	4 24	4 48	24
5 0	0 25	0 50	1 15	1 40	2 5	2 30	2 55	3 20	3 45	4 10	4 35	5 0	25
12	0 26	0 52	1 18	1 44	2 10	2 36	3 2	3 28	3 54	4 20	4 46	5 12	26
24	0 27	0 54	1 21	1 48	2 15	2 42	3 9	3 36	4 3	4 30	4 57	5 24	27
36	0 28	0 56	1 24	1 52	2 20	2 48	3 16	3 44	4 12	4 40	5 8	5 36	28
48	0 29	0 58	1 27	1 56	2 25	2 54	3 23	3 52	4 21	4 50	5 19	5 48	29
6 0	0 30	1 0	1 30	2 0	2 30	3 0	3 30	4 0	4 30	5 0	5 30	6 0	30
12	0 31	1 2	1 33	2 4	2 35	3 6	3 37	4 8	4 39	5 10	5 41	6 12	31
24	0 32	1 4	1 36	2 8	2 40	3 12	3 44	4 16	4 48	5 20	5 52	6 24	32
36	0 33	1 6	1 39	2 12	2 45	3 18	3 51	4 24	4 57	5 30	6 3	6 36	33
48	0 34	1 8	1 42	2 16	2 50	3 24	3 58	4 32	5 6	5 40	6 14	6 48	34
7 0	0 35	1 10	1 45	2 20	2 55	3 30	4 5	4 40	5 15	5 50	6 25	7 0	35
12	0 36	1 12	1 48	2 24	3 0	3 36	4 12	4 48	5 24	6 0	6 36	7 12	36
24	0 37	1 14	1 51	2 28	3 5	3 42	4 19	4 56	5 33	6 10	6 47	7 24	37
36	0 38	1 16	1 54	2 32	3 10	3 48	4 26	5 4	5 42	6 20	6 58	7 36	38
48	0 39	1 18	1 57	2 36	3 15	3 54	4 33	5 12	5 51	6 30	7 9	7 48	39
8 0	0 40	1 20	2 0	2 40	3 20	4 0	4 40	5 20	6 0	6 40	7 20	8 0	40
12	0 41	1 22	2 3	2 44	3 25	4 6	4 47	5 28	6 9	6 50	7 31	8 12	41
24	0 42	1 24	2 6	2 48	3 30	4 12	4 54	5 36	6 18	7 0	7 42	8 24	42
36	0 43	1 26	2 9	2 52	3 35	4 18	5 1	5 44	6 27	7 10	7 53	8 36	43
48	0 44	1 28	2 12	2 56	3 40	4 24	5 8	5 52	6 36	7 20	8 4	8 48	44
9 0	0 45	1 30	2 15	3 0	3 45	4 30	5 15	6 0	6 45	7 30	8 15	9 0	45
12	0 46	1 32	2 18	3 4	3 50	4 36	5 22	6 8	6 54	7 40	8 26	9 12	46
24	0 47	1 34	2 21	3 8	3 55	4 42	5 29	6 16	7 3	7 50	8 37	9 24	47
36	0 48	1 36	2 24	3 12	4 0	4 48	5 36	6 24	7 12	8 0	8 48	9 36	48
48	0 49	1 38	2 27	3 16	4 5	4 54	5 43	6 32	7 21	8 10	8 59	9 48	49
10 0	0 50	1 40	2 30	3 20	4 10	5 0	5 50	6 40	7 30	8 20	9 10	10 0	50
12	0 51	1 42	2 33	3 24	4 15	5 6	5 57	6 48	7 39	8 30	9 21	10 12	51
24	0 52	1 44	2 36	3 28	4 20	5 12	6 4	6 56	7 48	8 40	9 32	10 24	52
36	0 53	1 46	2 39	3 32	4 25	5 18	6 11	7 4	7 57	8 50	9 43	10 36	53
48	0 54	1 48	2 42	3 36	4 30	5 24	6 18	7 12	8 6	9 0	9 54	10 48	54
11 0	0 55	1 50	2 45	3 40	4 35	5 30	6 25	7 20	8 15	9 10	10 5	11 0	55
12	0 56	1 52	2 48	3 44	4 40	5 36	6 32	7 28	8 24	9 20	10 16	11 12	56
24	0 57	1 54	2 51	3 48	4 45	5 42	6 39	7 36	8 33	9 30	10 27	11 24	57
36	0 58	1 56	2 54	3 52	4 50	5 48	6 46	7 44	8 42	9 40	10 38	11 36	58
48	0 59	1 58	2 57	3 56	4 55	5 54	6 53	7 52	8 51	9 50	10 49	11 48	59
12 0	1 0	2 0	3 0	4 0	5 0	6 0	7 0	8 0	9 0	10 0	11 0	12 0	60

Digitized by Google

TABLE VI. To reduce the Longit. Lat. R. A. Dec. Hor. Par. Semid. &c. as given in the Nautical Almanac, to any intermediate Time.

Arg. Ti. af. noon or midn.	Argument. Variation in Twelve Hours.															p.p
	13′	14′	15′	16′	17′	18′	19′	20′	21′	22′	23′	24′				
h. m.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″				
0 12	0 13	0 14	0 15	0 16	0 17	0 18	0 19	0 20	0 21	0 22	0 23	0 24	1			
24	0 26	0 28	0 30	0 32	0 34	0 36	0 38	0 40	0 42	0 44	0 46	0 48	2			
36	0 39	0 42	0 45	0 48	0 51	0 54	0 57	1 0	1 3	1 6	1 9	1 12	3			
48	0 52	0 56	1 0	1 4	1 8	1 12	1 16	1 20	1 24	1 28	1 32	1 36	4			
1 0	1 5	1 10	1 15	1 20	1 25	1 30	1 35	1 40	1 45	1 50	1 55	2 0	5			
12	1 18	1 24	1 30	1 36	1 42	1 48	1 54	2 0	2 6	2 12	2 18	2 24	6			
24	1 31	1 38	1 45	1 52	1 59	2 6	2 13	2 20	2 27	2 34	2 41	2 48	7			
36	1 44	1 52	2 0	2 8	2 16	2 24	2 32	2 40	2 48	2 56	3 4	3 12	8			
48	1 57	2 6	2 15	2 24	2 33	2 42	2 51	3 0	3 9	3 18	3 27	3 36	9			
2 0	2 10	2 20	2 30	2 40	2 50	3 0	3 10	3 20	3 30	3 40	3 50	4 0	10			
12	2 23	2 34	2 45	2 56	3 7	3 18	3 29	3 40	3 51	4 2	4 13	4 24	11			
24	2 36	2 48	3 0	3 12	3 24	3 36	3 48	4 0	4 12	4 24	4 36	4 48	12			
36	2 49	3 2	3 15	3 28	3 41	3 54	4 7	4 20	4 33	4 46	4 59	5 12	13			
48	3 2	3 16	3 30	3 44	3 58	4 12	4 26	4 40	4 54	5 8	5 22	5 36	14			
3 0	3 15	3 30	3 45	4 0	4 15	4 30	4 45	5 0	5 15	5 30	5 45	6 0	15			
12	3 28	3 44	4 0	4 16	4 32	4 48	5 4	5 20	5 36	5 52	6 8	6 24	16			
24	3 41	3 58	4 15	4 32	4 49	5 6	5 23	5 40	5 57	6 14	6 31	6 48	17			
36	3 54	4 12	4 30	4 48	5 6	5 24	5 42	6 0	6 18	6 36	6 54	7 12	18			
48	4 7	4 26	4 45	5 4	5 23	5 42	6 1	6 20	6 39	6 58	7 17	7 36	19			
4 0	4 20	4 40	5 0	5 20	5 40	6 0	6 20	6 40	7 0	7 20	7 40	8 0	20			
12	4 33	4 54	5 15	5 36	5 57	6 18	6 39	7 0	7 21	7 42	8 3	8 24	21			
24	4 46	5 8	5 30	5 52	6 14	6 36	6 58	7 20	7 42	8 4	8 26	8 48	22			
36	4 59	5 22	5 45	6 8	6 31	6 54	7 17	7 40	8 3	8 26	8 49	9 12	23			
48	5 12	5 36	6 0	6 24	6 48	7 12	7 36	8 0	8 24	8 48	9 12	9 36	24			
5 0	5 25	5 50	6 15	6 40	7 5	7 30	7 55	8 20	8 45	9 10	9 35	10 0	25			
12	5 38	6 4	6 30	6 56	7 22	7 48	8 14	8 40	9 6	9 32	9 58	10 24	26			
24	5 51	6 18	6 45	7 12	7 39	8 6	8 33	9 0	9 27	9 54	10 21	10 48	27			
36	6 4	6 32	7 0	7 28	7 56	8 24	8 52	9 20	9 48	10 16	10 44	11 12	28			
48	6 17	6 46	7 15	7 44	8 13	8 42	9 11	9 40	10 9	10 38	11 7	11 36	29			
6 0	6 30	7 0	7 30	8 0	8 30	9 0	9 30	10 0	10 30	11 0	11 30	12 0	30			
12	6 43	7 14	7 45	8 16	8 47	9 18	9 49	10 20	10 51	11 22	11 53	12 24	31			
24	6 56	7 28	8 0	8 32	9 4	9 36	10 8	10 40	11 12	11 44	12 16	12 48	32			
36	7 9	7 42	8 15	8 48	9 21	9 54	10 27	11 0	11 33	12 6	12 39	13 12	33			
48	7 22	7 56	8 30	9 4	9 38	10 12	10 46	11 20	11 54	12 28	13 2	13 36	34			
7 0	7 35	8 10	8 45	9 20	9 55	10 30	11 5	11 40	12 15	12 50	13 25	14 0	35			
12	7 48	8 24	9 0	9 36	10 12	10 48	11 24	12 0	12 36	13 12	13 48	14 24	36			
24	8 1	8 38	9 15	9 52	10 29	11 6	11 43	12 20	12 57	13 34	14 11	14 48	37			
36	8 14	8 52	9 30	10 8	10 46	11 24	12 2	12 40	13 18	13 56	14 34	15 12	38			
48	8 27	9 6	9 45	10 24	11 3	11 42	12 21	13 0	13 39	14 18	14 57	15 36	39			
8 0	8 40	9 20	10 0	10 40	11 20	12 0	12 40	13 20	14 0	14 40	15 20	16 0	40			
12	8 53	9 34	10 15	10 56	11 37	12 18	12 59	13 40	14 21	15 2	15 43	16 24	41			
24	9 6	9 48	10 30	11 12	11 54	12 36	13 18	14 0	14 42	15 24	16 6	16 48	42			
36	9 19	10 2	10 45	11 28	12 11	12 54	13 37	14 20	15 3	15 46	16 29	17 12	43			
48	9 32	10 16	11 0	11 44	12 28	13 12	13 56	14 40	15 24	16 8	16 52	17 36	44			
9 0	9 45	10 30	11 15	12 0	12 45	13 30	14 15	15 0	15 45	16 30	17 15	18 0	45			
12	9 58	10 44	11 30	12 16	13 2	13 48	14 34	15 20	16 6	16 52	17 38	18 24	46			
24	10 11	10 58	11 45	12 32	13 19	14 6	14 53	15 40	16 27	17 14	18 1	18 48	47			
36	10 24	11 12	12 0	12 48	13 36	14 24	15 12	16 0	16 48	17 36	18 24	19 12	48			
48	10 37	11 26	12 15	13 4	13 53	14 42	15 31	16 20	17 9	17 58	18 47	19 36	49			
10 0	10 50	11 40	12 30	13 20	14 10	15 0	15 50	16 40	17 30	18 20	19 10	20 0	50			
12	11 3	11 54	12 45	13 36	14 27	15 18	16 9	17 0	17 51	18 42	19 33	20 24	51			
24	11 16	12 8	13 0	13 52	14 44	15 36	16 28	17 20	18 12	19 4	19 56	20 48	52			
36	11 29	12 22	13 15	14 8	15 1	15 54	16 47	17 40	18 33	19 26	20 19	21 12	53			
48	11 42	12 36	13 30	14 24	15 18	16 12	17 6	18 0	18 54	19 48	20 42	21 36	54			
11 0	11 55	12 50	13 45	14 40	15 35	16 30	17 25	18 20	19 15	20 10	21 5	22 0	55			
12	12 8	13 4	14 0	14 56	15 52	16 48	17 44	18 40	19 36	20 32	21 28	22 24	56			
24	12 21	13 18	14 15	15 12	16 9	17 6	18 3	19 0	19 57	20 54	21 51	22 48	57			
36	12 34	13 32	14 30	15 28	16 26	17 24	18 22	19 20	20 18	21 16	22 14	23 12	58			
48	12 47	13 46	14 45	15 44	16 43	17 42	18 41	19 40	20 39	21 38	22 37	23 36	59			
12 0	13 0	14 0	15 0	16 0	17 0	18 0	19 0	20 0	21 0	22 0	23 0	24 0	60			

Digitized by Google

TABLE VI. To reduce the Longit. Lat. R. A. Dec. Hor. Par. Semid. &c. as given in the Nautical Almanac, to any intermediate Time.

Arg. Ti. af. noon or mid.	Argument. Variation in Twelve Hours.												p.p
	25′	26′	27′	28′	29′	30′	31′	32′	33′	34′	35′	36′	
h. m.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
0 12	0 25	0 26	0 27	0 28	0 29	0 30	0 31	0 32	0 33	0 34	0 35	0 36	1
24	0 50	0 52	0 54	0 56	0 58	1 0	1 2	1 4	1 6	1 8	1 10	1 12	2
36	1 15	1 18	1 21	1 24	1 27	1 30	1 33	1 36	1 39	1 42	1 45	1 48	3
48	1 40	1 44	1 48	1 52	1 56	2 0	2 4	2 8	2 12	2 16	2 20	2 24	4
1 0	2 5	2 10	2 15	2 20	2 25	2 30	2 35	2 40	2 45	2 50	2 55	3 0	5
12	2 30	2 36	2 42	2 48	2 54	3 0	3 6	3 12	3 18	3 24	3 30	3 36	6
24	2 55	3 2	3 9	3 16	3 23	3 30	3 37	3 44	3 51	3 58	4 5	4 12	7
36	3 20	3 28	3 36	3 44	3 52	4 0	4 8	4 16	4 24	4 32	4 40	4 48	8
48	3 45	3 54	4 3	4 12	4 21	4 30	4 39	4 48	4 57	5 6	5 15	5 24	9
2 0	4 10	4 20	4 30	4 40	4 50	5 0	5 10	5 20	5 30	5 40	5 50	6 0	10
12	4 35	4 46	4 57	5 8	5 19	5 30	5 41	5 52	6 3	6 14	6 25	6 36	11
24	5 0	5 12	5 24	5 36	5 48	6 0	6 12	6 24	6 36	6 48	7 0	7 12	12
36	5 25	5 38	5 51	6 4	6 17	6 30	6 43	6 56	7 9	7 22	7 35	7 48	13
48	5 50	6 4	6 18	6 32	6 46	7 0	7 14	7 28	7 42	7 56	8 10	8 24	14
3 0	6 15	6 30	6 45	7 0	7 15	7 30	7 45	8 0	8 15	8 30	8 45	9 0	15
12	6 40	6 56	7 12	7 28	7 44	8 0	8 16	8 32	8 48	9 4	9 20	9 36	16
24	7 5	7 22	7 39	7 56	8 13	8 30	8 47	9 4	9 21	9 38	9 55	10 12	17
36	7 30	7 48	8 6	8 24	8 42	9 0	9 18	9 36	9 54	10 12	10 30	10 48	18
48	7 55	8 14	8 33	8 52	9 11	9 30	9 49	10 8	10 27	10 46	11 5	11 24	19
4 0	8 20	8 40	9 0	9 20	9 40	10 0	10 20	10 40	11 0	11 20	11 40	12 0	20
12	8 45	9 6	9 27	9 48	10 9	10 30	10 51	11 12	11 33	11 54	12 15	12 36	21
24	9 10	9 32	9 54	10 16	10 38	11 0	11 22	11 44	12 0	12 28	12 50	13 12	22
36	9 35	9 58	10 21	10 44	11 7	11 30	11 53	12 16	12 39	13 2	13 25	13 48	23
42	10 0	10 24	10 48	11 12	11 36	12 0	12 24	12 48	13 12	13 36	14 0	14 24	24
5 0	10 25	10 50	11 15	11 40	12 5	12 30	12 55	13 20	13 45	14 10	14 35	15 0	25
12	10 50	11 16	11 42	12 8	12 34	13 0	13 26	13 52	14 18	14 44	15 10	15 36	26
24	11 15	11 42	12 9	12 36	13 3	13 30	13 57	14 24	14 51	15 18	15 45	16 12	27
36	11 40	12 8	12 36	13 4	13 32	14 0	14 28	14 56	15 24	15 52	16 20	16 48	28
48	12 5	12 34	13 3	13 32	14 1	14 30	14 59	15 28	15 57	16 26	16 55	17 24	29
6 0	12 30	13 0	13 30	14 0	14 30	15 0	15 30	16 0	16 30	17 0	17 30	18 0	30
12	12 55	13 26	13 57	14 28	14 59	15 30	16 1	16 32	17 3	17 34	18 5	18 36	31
24	13 20	13 52	14 24	14 56	15 28	16 0	16 32	17 4	17 36	18 8	18 40	19 12	32
36	13 45	14 18	14 51	15 24	15 57	16 30	17 3	17 36	18 9	18 42	19 15	19 48	33
48	14 10	14 44	15 18	15 52	16 26	17 0	17 34	18 8	18 42	19 16	19 50	20 24	34
7 0	14 35	15 10	15 45	16 20	16 55	17 30	18 5	18 40	19 15	19 50	20 25	21 0	35
12	15 0	15 36	16 12	16 48	17 24	18 0	18 36	19 12	19 48	20 24	21 0	21 36	36
24	15 25	16 2	16 39	17 16	17 53	18 30	19 7	19 44	20 21	20 58	21 35	22 12	37
36	15 50	16 28	17 6	17 44	18 22	19 0	19 38	20 16	20 54	21 32	22 10	22 48	38
48	16 15	16 54	17 33	18 12	18 51	19 30	20 9	20 48	21 27	22 6	22 45	23 24	39
8 0	16 40	17 20	18 0	18 40	19 20	20 0	20 40	21 20	22 0	22 40	23 20	24 0	40
12	17 5	17 46	18 27	19 8	19 49	20 30	21 11	21 52	22 33	23 14	23 55	24 36	41
24	17 30	18 12	18 54	19 36	20 18	21 0	21 42	22 24	23 6	23 48	24 30	25 12	42
36	17 55	18 38	19 21	20 4	20 47	21 30	22 13	22 56	23 39	24 22	25 5	25 48	43
48	18 20	19 4	19 48	20 32	21 16	22 0	22 44	23 28	24 12	24 56	25 40	26 24	44
9 0	18 45	19 30	20 15	21 0	21 45	22 30	23 15	24 0	24 45	25 30	26 15	27 0	45
12	19 10	19 56	20 42	21 28	22 14	23 0	23 46	24 32	25 18	26 4	26 50	27 36	46
24	19 35	20 22	21 9	21 56	22 43	23 30	24 17	25 4	25 51	26 38	27 25	28 12	47
36	20 0	20 48	21 36	22 24	23 12	24 0	24 48	25 36	26 24	27 12	28 0	28 48	48
48	20 25	21 14	22 3	22 52	23 41	24 30	25 10	26 8	26 57	27 46	28 35	29 24	49
10 0	20 50	21 40	22 30	23 20	24 10	25 0	25 50	26 40	27 30	28 20	29 10	30 0	50
12	21 15	22 6	22 57	23 48	24 39	25 30	26 21	27 12	28 3	28 54	29 45	30 36	51
24	21 40	22 32	23 24	24 16	25 8	26 0	26 52	27 44	28 36	29 28	30 20	31 12	52
36	22 5	22 58	23 51	24 44	25 37	26 30	27 23	28 16	29 9	30 2	30 55	31 48	53
48	22 30	23 24	24 18	25 12	26 6	27 0	27 54	28 48	29 42	30 36	31 30	32 24	54
11 0	22 55	23 50	24 45	25 40	26 35	27 30	28 25	29 20	30 15	31 10	32 5	33 0	55
12	23 20	24 16	25 12	26 8	27 4	28 0	28 56	29 52	30 48	31 44	32 40	33 36	56
24	23 45	24 42	25 39	26 36	27 33	28 30	29 27	30 24	31 21	32 18	33 15	34 12	57
36	24 10	25 8	26 6	27 4	28 2	29 0	29 58	30 56	31 54	32 52	33 50	34 48	58
48	24 35	25 34	26 33	27 32	28 31	29 30	30 29	31 28	32 27	33 26	34 25	35 24	59
12 0	25 0	26 0	27 0	28 0	29 0	30 0	31 0	32 0	33 0	34 0	35 0	36 0	60

Digitized by Google

TABLE VI. To reduce the Longit. Lat. R. A. Dec. Hor. Par. Semid. &c. as given in the Nautical Almanac, to any intermediate Time.

Arg. Ti. af. noon or mid.	Argument. Variation in Twelve Hours.															p p
	37′	38′	39′	40′	41′	42′	43′	44′	45′	46′	47′	48′				
h. m.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″				
0 12	0 37	0 38	0 39	0 40	0 41	0 42	0 43	0 44	0 45	0 46	0 47	0 48	1			
24	1 14	1 16	1 18	1 20	1 22	1 24	1 26	1 28	1 30	1 32	1 34	1 36	2			
36	1 51	1 54	1 57	2 0	2 3	2 6	2 9	2 12	2 15	2 18	2 21	2 24	3			
48	2 28	2 32	2 36	2 40	2 44	2 48	2 52	2 56	3 0	3 4	3 8	3 12	4			
1 0	3 5	3 10	3 15	3 20	3 25	3 30	3 35	3 40	3 45	3 50	3 55	4 0	5			
12	3 42	3 48	3 54	4 0	4 6	4 12	4 18	4 24	4 30	4 36	4 42	4 48	6			
24	4 19	4 26	4 33	4 40	4 47	4 54	5 1	5 8	5 15	5 22	5 29	5 36	7			
36	4 56	5 4	5 12	5 20	5 28	5 36	5 44	5 52	6 0	6 8	6 16	6 24	8			
48	5 33	5 42	5 51	6 0	6 9	6 18	6 27	6 36	6 45	6 54	7 3	7 12	9			
2 0	6 10	6 20	6 30	6 40	6 50	7 0	7 10	7 20	7 30	7 40	7 50	8 0	10			
12	6 47	6 58	7 9	7 20	7 31	7 42	7 53	8 4	8 15	8 26	8 37	8 48	11			
24	7 24	7 36	7 48	8 0	8 12	8 24	8 36	8 48	9 0	9 12	9 24	9 36	12			
36	8 1	8 14	8 27	8 40	8 53	9 6	9 19	9 32	9 45	9 58	10 11	10 24	13			
48	8 38	8 52	9 6	9 20	9 34	9 48	10 2	10 16	10 30	10 44	10 58	11 12	14			
3 0	9 15	9 30	9 45	10 0	10 15	10 30	10 45	11 0	11 15	11 30	11 45	12 0	15			
12	9 52	10 8	10 24	10 40	10 56	11 12	11 28	11 44	12 0	12 16	12 32	12 48	16			
24	10 29	10 46	11 3	11 20	11 37	11 54	12 11	12 28	12 45	13 2	13 19	13 36	17			
36	11 6	11 24	11 42	12 0	12 18	12 36	12 54	13 12	13 30	13 48	14 6	14 24	18			
48	11 43	12 2	12 21	12 40	12 59	13 18	13 37	13 56	14 15	14 34	14 53	15 12	19			
4 0	12 20	12 40	13 0	13 20	13 40	14 0	14 20	14 40	15 0	15 20	15 40	16 0	20			
12	12 57	13 18	13 39	14 0	14 21	14 42	15 3	15 24	15 45	16 6	16 27	16 48	21			
24	13 34	13 56	14 18	14 40	15 2	15 24	15 46	16 8	16 30	16 52	17 14	17 36	22			
36	14 11	14 34	14 57	15 20	15 43	16 6	16 29	16 52	17 15	17 38	18 1	18 24	23			
48	14 48	15 12	15 36	16 0	16 24	16 48	17 12	17 36	18 0	18 24	18 48	19 12	24			
5 0	15 25	15 50	16 15	16 40	17 5	17 30	17 55	18 20	18 45	19 10	19 35	20 0	25			
12	16 2	16 28	16 54	17 20	17 46	18 12	18 38	19 4	19 30	19 56	20 22	20 48	26			
24	16 39	17 6	17 33	18 0	18 27	18 54	19 21	19 48	20 15	20 42	21 9	21 36	27			
36	17 16	17 44	18 12	18 40	19 8	19 36	20 4	20 32	21 0	21 28	21 56	22 24	28			
48	17 53	18 22	18 51	19 20	19 49	20 18	20 47	21 16	21 45	22 14	22 43	23 12	29			
6 0	18 30	19 0	19 30	20 0	20 30	21 0	21 30	22 0	22 30	23 0	23 30	24 0	30			
12	19 7	19 38	20 9	20 40	21 11	21 42	22 13	22 44	23 15	23 46	24 17	24 48	31			
24	19 44	20 16	20 48	21 20	21 52	22 24	22 56	23 28	24 0	24 32	25 4	25 36	32			
36	20 21	20 54	21 27	22 0	22 33	23 6	23 39	24 12	24 45	25 18	25 51	26 24	33			
48	20 58	21 32	22 6	22 40	23 14	23 48	24 22	24 56	25 30	26 4	26 38	27 12	34			
7 0	21 35	22 10	22 45	23 20	23 55	24 30	25 5	25 40	26 15	26 50	27 25	28 0	35			
12	22 12	22 48	23 24	24 0	24 36	25 12	25 48	26 24	27 0	27 36	28 12	28 48	36			
24	22 49	23 26	24 3	24 40	25 17	25 54	26 31	27 8	27 45	28 22	28 59	29 36	37			
36	23 26	24 4	24 42	25 20	25 58	26 36	27 14	27 52	28 30	29 8	29 46	30 24	38			
48	24 3	24 42	25 21	26 0	26 39	27 18	27 57	28 36	29 15	29 54	30 33	31 12	39			
8 0	24 40	25 20	26 0	26 40	27 20	28 0	28 40	29 20	30 0	30 40	31 20	32 0	40			
12	25 17	25 58	26 39	27 20	28 1	28 42	29 23	30 4	30 45	31 26	32 7	32 48	41			
24	25 54	26 36	27 18	28 0	28 42	29 24	30 6	30 48	31 30	32 12	32 54	33 36	42			
36	26 31	27 14	27 57	28 40	29 23	30 6	30 49	31 32	32 15	32 58	33 41	34 24	43			
48	27 8	27 52	28 36	29 20	30 4	30 48	31 32	32 16	33 0	33 44	34 28	35 12	44			
9 0	27 45	28 30	29 15	30 0	30 45	31 30	32 15	33 0	33 45	34 30	35 15	36 0	45			
12	28 22	29 8	29 54	30 40	31 26	32 12	32 58	33 44	34 30	35 16	36 2	36 48	46			
24	28 59	29 46	30 33	31 20	32 7	32 54	33 41	34 28	35 15	36 2	36 49	37 36	47			
36	29 36	30 24	31 12	32 0	32 48	33 36	34 24	35 12	36 0	36 48	37 36	38 24	48			
48	30 13	31 2	31 51	32 40	33 29	34 18	35 7	35 56	36 45	37 34	38 23	39 12	49			
10 0	30 50	31 40	32 30	33 20	34 10	35 0	35 50	36 40	37 30	38 20	39 10	40 0	50			
12	31 27	32 18	33 9	34 0	34 51	35 42	36 33	37 24	38 15	39 6	39 57	40 48	51			
24	32 4	32 56	33 48	34 40	35 32	36 24	37 16	38 8	39 0	39 52	40 44	41 36	52			
36	32 41	33 34	34 27	35 20	36 13	37 6	37 59	38 52	39 45	40 38	41 31	12 24	53			
48	33 18	34 12	35 6	36 0	36 54	37 48	38 42	39 36	40 30	41 24	42 18	13 12	54			
11 0	33 55	34 50	35 45	36 40	37 35	38 30	39 25	40 20	41 15	42 10	43 5	44 0	55			
12	34 32	35 28	36 24	37 20	38 16	39 12	40 8	41 4	42 0	42 56	43 52	14 48	56			
24	35 9	36 6	37 3	38 0	38 57	39 54	40 51	41 48	42 45	43 42	44 39	45 36	57			
36	35 46	36 44	37 42	38 40	39 38	40 36	41 34	42 32	43 30	44 28	45 26	16 24	58			
48	36 23	37 22	38 21	39 20	40 19	41 18	42 17	43 16	44 15	45 14	46 13	17 12	59			
2 0	37 0	38 0	39 0	40 0	41 0	42 0	43 0	44 0	45 0	46 0	47 0	18 0	60			

Digitized by Google

TABLE VI. To reduce the Longit. Lat. R. A. Dec. Hor. Par. Semid. &c. as given in the Nautical Almanac, to any intermediate Time.

Arg. Ti. at noon or mid.	Argument. 49′	50′	51′	Variation in Twelve Hours 52′	53′	54′	55′	56′	57′	58′	59′	60′	p.
h. m.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
0 12	0 49	0 50	0 51	0 52	0 53	0 54	0 55	0 56	0 57	0 58	0 59	1 0	1
24	1 38	1 40	1 42	1 44	1 46	1 48	1 50	1 52	1 54	1 56	1 58	2 0	2
36	2 27	2 30	2 33	2 36	2 39	2 42	2 45	2 48	2 51	2 54	2 57	3 0	3
48	3 16	3 20	3 24	3 28	3 33	3 36	3 40	3 44	3 48	3 52	3 57	4 0	4
1 0	4 5	4 10	4 15	4 20	4 25	4 30	4 35	4 40	4 45	4 50	4 55	5 0	5
12	4 54	5 0	5 6	5 12	5 18	5 24	5 30	5 36	5 42	5 48	5 55	6 0	6
24	5 43	5 50	5 57	6 4	6 11	6 18	6 25	6 32	6 39	6 46	6 53	7 0	7
36	6 32	6 40	6 48	6 56	7 4	7 12	7 20	7 28	7 36	7 44	7 52	8 0	8
48	7 21	7 30	7 39	7 48	7 57	8 6	8 15	8 24	8 33	8 42	8 51	9 0	9
2 0	8 10	8 20	8 30	8 40	8 50	9 0	9 10	9 20	9 30	9 40	9 50	10 0	10
12	8 59	9 10	9 21	9 32	9 43	9 54	10 5	10 16	10 27	10 38	10 49	11 0	11
24	9 48	10 0	10 12	10 24	10 36	10 48	11 0	11 12	11 24	11 35	11 48	12 0	12
36	10 37	10 50	11 3	11 16	11 29	11 42	11 55	12 8	12 21	12 34	12 47	13 0	13
48	11 26	11 40	11 54	12 8	12 22	12 36	12 50	13 4	13 18	13 32	13 46	14 0	14
3 0	12 15	12 30	12 45	13 0	13 15	13 30	13 45	14 0	14 15	14 30	14 45	15 0	15
12	13 4	13 20	13 36	13 52	14 8	14 24	14 40	14 56	15 12	15 28	15 44	16 0	16
24	13 53	14 10	14 27	14 44	15 1	15 18	15 35	15 52	16 9	16 26	16 43	17 0	17
36	14 42	15 0	15 18	15 36	15 54	16 12	16 30	16 48	17 6	17 24	17 42	18 0	18
48	15 31	15 50	16 9	16 28	16 47	17 6	17 25	17 44	18 3	18 22	18 41	19 0	19
4 0	16 20	16 40	17 0	17 20	17 40	18 0	18 20	18 40	19 0	19 20	19 40	20 0	20
12	17 9	17 30	17 51	18 12	18 33	18 54	19 15	19 36	19 57	20 18	20 39	21 0	21
24	17 58	18 20	18 42	19 4	19 26	19 48	20 10	20 32	20 54	21 16	21 38	22 0	22
36	18 47	19 10	19 33	19 56	20 19	20 42	21 5	21 28	21 51	22 14	22 37	23 0	23
48	19 36	20 0	20 24	20 48	21 12	21 36	22 0	22 24	22 48	23 12	23 36	24 0	24
5 0	20 25	20 50	21 15	21 40	22 5	22 30	22 55	23 20	23 45	24 10	24 35	25 0	25
12	21 14	21 40	22 6	22 32	22 58	23 24	23 50	24 16	24 42	25 8	25 34	26 0	26
24	22 3	22 30	22 57	23 24	23 51	24 18	24 45	25 12	25 39	26 6	26 33	27 0	27
36	22 52	23 20	23 48	24 16	24 44	25 12	25 40	26 8	26 36	27 4	27 32	28 0	28
48	23 41	24 10	24 39	25 8	25 37	26 6	26 35	27 4	27 33	28 2	28 31	29 0	29
6 0	24 30	25 0	25 30	26 0	26 30	27 0	27 30	28 0	28 30	29 0	29 30	30 0	30
12	25 19	25 50	26 21	26 52	27 23	27 54	28 25	28 56	29 27	29 58	30 29	31 0	31
24	26 8	26 40	27 12	27 44	28 16	28 48	29 20	29 52	30 24	30 56	31 28	32 0	32
36	26 57	27 30	28 3	28 36	29 9	29 42	30 15	30 48	31 21	31 54	32 27	33 0	33
48	27 46	28 20	28 54	29 28	30 2	30 36	31 10	31 44	32 18	32 52	33 26	34 0	34
7 0	28 35	29 10	29 45	30 20	30 55	31 30	32 5	32 40	33 15	33 50	34 25	35 0	35
12	29 24	30 0	30 36	31 12	31 48	32 24	33 0	33 36	34 12	34 48	35 24	36 0	36
24	30 13	30 50	31 27	32 4	32 41	33 18	33 55	34 32	35 9	35 46	36 23	37 0	37
36	31 2	31 40	32 18	32 56	33 34	34 12	34 50	35 28	36 6	36 44	37 22	38 0	38
48	31 51	32 30	33 9	33 48	34 27	35 6	35 45	36 24	37 3	37 42	38 21	39 0	39
8 0	32 40	33 20	34 0	34 40	35 20	36 0	36 40	37 20	38 0	38 40	39 20	40 0	40
12	33 29	34 10	34 51	35 32	36 13	36 54	37 35	38 16	38 57	39 38	40 19	41 0	41
24	34 18	35 0	35 42	36 24	37 6	37 48	38 30	39 12	39 54	40 36	41 18	42 0	42
36	35 7	35 50	36 33	37 16	37 59	38 42	39 25	40 8	40 51	41 34	42 17	43 0	43
48	35 56	36 40	37 24	38 8	38 52	39 36	40 20	41 4	41 48	42 32	43 16	44 0	44
9 0	36 45	37 30	38 15	39 0	39 45	40 30	41 15	42 0	42 45	43 30	44 15	45 0	45
12	37 34	38 20	39 6	39 52	40 38	41 24	42 10	42 56	43 42	44 28	45 14	46 0	46
24	38 23	39 10	39 57	40 44	41 31	42 18	43 5	43 52	44 39	45 26	46 13	47 0	47
36	39 12	40 0	40 48	41 36	42 24	43 12	44 0	44 48	45 36	46 24	47 12	48 0	48
48	40 1	40 50	41 39	42 28	43 17	44 6	44 55	45 44	46 33	47 22	48 11	49 0	49
10 0	40 50	41 40	42 30	43 20	44 10	45 0	45 50	46 40	47 30	48 20	49 10	50 0	50
12	41 39	42 30	43 21	44 12	45 3	45 54	46 45	47 36	48 27	49 18	50 9	51 0	51
24	42 28	43 20	44 12	45 4	45 56	46 48	47 40	48 32	49 24	50 16	51 8	52 0	52
36	43 17	44 10	45 3	45 56	46 49	47 42	48 35	49 28	50 21	51 14	52 7	53 0	53
48	44 6	45 0	45 54	46 48	47 42	48 36	49 30	50 24	51 18	52 12	53 6	54 0	54
11 0	44 55	45 50	46 45	47 40	48 35	49 30	50 25	51 20	52 15	53 10	54 5	55 0	55
12	45 44	46 40	47 36	48 32	49 28	50 24	51 20	52 16	53 12	54 8	55 4	56 0	56
24	46 33	47 30	48 27	49 24	50 21	51 18	52 15	53 12	54 9	55 6	56 3	57 0	57
36	47 22	48 20	49 18	50 16	51 14	52 12	53 10	54 8	55 6	56 4	57 2	58 0	58
48	48 11	49 10	50 9	51 8	52 7	53 6	54 5	55 4	56 3	57 2	58 1	59 0	59
12 0	49 0	50 0	51 0	52 0	53 0	54 0	55 0	56 0	57 0	58 0	59 0	60 0	60

Digitized by Google

TABLE VII. TO FIND THE LATITUDE BY DOUBLE ALTS. AND THE ELAPSED TIME.

Arg. HALF ELAPSED TIME. 0 Hour.							Arg. MIDDLE TIME. 0 Hour.						
M.	0″	10″	20″	30″	40″	50″	D.	M	0″	10″	20″	30″	40″	50″
0	Infinite	13833	83730	66121	53627	43936		0	In. Neg.	16270	46373	63982	76476	86167
1	2.36018	29324	23525	18409	13839	09695		1	7.94085	00779	06578	11694	16269	20408
2	05916	02440	99221	96225	93422	90790		2	8.24187	27663	30882	33878	36681	39313
3	1.88307	85959	83732	81613	79593	77663		3	41796	44144	46371	48490	50510	52440
4	75814	74044	72339	70700	69121	67597		4	54289	56061	57764	59403	60982	62506
5	1.66125	64701	63322	61986	60690	59431		5	8.63978	65402	66781	68117	69413	70672
6	58208	57018	55861	54733	53634	52561		6	71895	73085	74242	75370	76469	77542
7	51515	50494	49496	48520	47566	46632		7	78588	79609	80607	81583	82537	83471
8	45718	44823	43946	43086	42243	41417		8	84385	85280	86157	87017	87860	88686
9	40605	39809	39027	38258	37503	36761		9	89498	90294	91076	91845	92600	93341
10	1.36032	35315	34609	33915	33231	32558		10	8.94071	94788	95494	96188	96872	97545
11	31896	31243	30600	29967	29342	28727		11	98207	98860	99503	00136	00761	01376
12	28120	27522	26931	26349	25774	25207		12	9.01983	02581	03172	03754	04329	04896
13	24647	24095	23549	23010	22477	21952		13	05456	06008	06554	07093	07626	08251
14	21432	20919	20412	19910	19415	18925		14	08671	09184	09691	10193	10688	11178
15	1.18440	17961	17487	17018	16554	16096		15	9.11663	12142	12616	13085	13549	14007
16	15642	15192	14748	14307	13872	13440		16	14461	14911	15355	15796	16231	16663
17	13013	12590	12171	11757	11346	10939		17	17090	17513	17932	18346	18757	19164
18	10536	10136	09740	09348	08960	08575		18	19567	19967	20363	20755	21143	21528
19	08193	07814	07439	07067	06698	06333		19	21910	22289	22664	23036	23405	23770
20	1.05970	05610	05254	04901	04550	04202		20	9.24333	24493	24849	25202	25553	25901
21	03857	03515	03175	02838	02504	02172		21	26246	26588	26928	27265	27599	27931
22	01843	01516	01192	00870	00550	00233		22	28260	28587	28911	29233	29553	29870
23	0.99918	99606	99296	98988	98682	98378		23	30185	30497	30807	31115	31421	31725
24	98077	97777	97480	97184	96891	96600		24	32026	32326	32623	32919	33212	33503
25	0.96310	96023	95738	95454	95172	94892		25	9.33793	34080	34365	34649	34931	35211
26	94614	94338	94063	93790	93519	93250		26	35489	35765	36040	36313	36584	30853
27	92982	92716	92452	92189	91928	91669		27	37121	37387	37651	37914	38175	38434
28	91411	91154	90899	90646	90394	90143		28	38692	38949	39204	39457	39709	39960
29	89894	89647	89401	89156	88913	88671		29	40209	40456	40702	40947	41190	41432
30	0.88430	88191	87953	87717	87481	87247	236	30	9.41673	41912	42150	42386	42622	42856
31	87015	6783	6553	6324	6096	5870	229	31	43088	3320	3550	3779	4007	4233
32	85644	5420	5197	4976	4755	4535	222	32	44459	4683	4906	5127	5348	5568
33	84317	4100	3884	3669	3455	3242	215	33	45786	6003	6219	6434	6648	6861
34	83030	2819	2609	2401	2193	1986	208	34	47073	7284	7494	7702	7910	8117
35	0.81780	81576	81372	81169	80967	80767	203	35	9.48323	48527	48731	48934	49136	49336
36	80567	0368	0170	79973	79777	79581	197	36	49536	9735	9933	50130	50326	50522
37	79387	79193	79001	8809	8618	8428	192	37	50716	50910	51102	1294	1485	1675
38	78239	8051	7863	7677	7491	7306	186	38	51864	2052	2240	2426	2612	2797
39	77122	6938	6756	6574	6393	6212	182	39	52981	3165	3347	3529	3710	3891
40	0.76033	75854	75676	75499	75323	75147	177	40	9.54070	54249	54427	54604	54780	54956
41	74972	4797	4624	4451	4279	4107	173	41	55131	5306	5479	5652	5824	5996
42	73937	3767	3597	3429	3261	3093	168	42	56166	6336	6506	6674	6842	7010
43	72926	2760	2595	2430	2266	2103	165	43	57177	7343	7508	7673	7837	8000
44	71940	1778	1616	1455	1295	1135	161	44	58163	8325	8487	8648	8808	8968
45	0.70976	70818	70660	70503	70346	70190	157	45	9.59127	59285	59443	59600	59751	59913
46	70034	69879	69725	69571	69418	69265	154	46	60069	60224	60378	60532	60685	60838
47	69113	8961	8811	8660	8510	8361	151	47	60990	1141	1292	1443	1593	1742
48	68212	8064	7916	7769	7622	7476	147	48	61891	2039	2187	2334	2481	2627
49	67330	7185	7040	6896	6752	6609	144	49	62773	2918	3063	3207	3351	3494
50	0.66466	66324	66182	66041	65900	65760	141	50	9.63637	63779	63921	64062	64203	64343
51	65620	5481	5342	5204	5066	4928	138	51	64483	4622	4761	4899	5037	5175
52	64791	4655	4519	4383	4248	4113	136	52	65312	5448	5584	5720	5855	5990
53	63978	3844	3711	3578	3445	3313	133	53	66125	6259	6392	6525	6658	6790
54	63181	3050	2919	2789	2659	2529	130	54	66922	7053	7184	7314	7444	7574
55	0.62400	62271	62142	62014	61886	61759	128	55	9.67703	67832	67961	68089	68217	68344
56	61632	1506	1380	1254	1129	1004	126	56	64871	8597	8723	8849	8974	9099
57	60879	0755	0631	0508	0385	0262	123	57	69224	9348	9472	9595	9718	9841
58	60140	0018	59896	59775	59654	59534	121	58	69963	70085	70207	70328	70449	70569
59	59414	59294	9175	9056	8937	8818	119	59	70689	0809	0928	1047	1166	1285

Digitized by Google

TABLE VII. TO FIND THE LATITUDE BY DOUBLE ALTS. AND THE ELAPSED TIME.

Arg. HALF ELAPSED TIME. 1 Hour.							Arg. MIDDLE TIME. 1 Hour.							
M.	0″	10″	20″	30″	40″	50″	D.	M.	0″	10″	20″	30″	40″	50″
0	0.58700	58582	58465	58348	58231	58115	117	0	9.71403	71521	71638	71755	71872	71988
1	57999	7883	7768	7653	7538	7424	115	1	72104	2220	2335	2450	2565	2679
2	57310	7196	7083	6970	6857	6745	113	2	72793	2907	3020	3133	3246	3358
3	56633	6521	6409	6298	6187	6076	111	3	73470	3582	3692	3805	3916	4027
4	55966	5856	5746	5637	5528	5419	109	4	74137	4247	4357	4466	4575	4684
5	0.55311	55203	55095	54987	54880	54773	108	5	9.74792	74900	75008	75116	75223	75330
6	54666	4559	4453	4347	4241	4136	106	6	75437	5544	5650	5756	5862	5967
7	54031	3926	3822	3718	3614	3510	104	7	76072	6177	6281	6385	6489	6593
8	53406	3303	3200	3097	2995	2893	103	8	76697	6800	6903	7006	7108	7210
9	52791	2690	2589	2488	2387	2286	101	9	77312	7413	7514	7615	7716	7817
10	0.52186	52086	51986	51886	51787	51688	100	10	9.77917	78017	78117	78217	78316	78415
11	51589	1490	1392	1294	1196	1099	98	11	78514	8613	8711	8809	8907	9004
12	51002	0905	0808	0711	0615	0519	97	12	79101	9198	9295	9392	9488	9584
13	50423	0327	0232	0137	0042	49947	95	13	79680	9776	9871	9966	80061	80156
14	49852	49758	49664	49570	49476	49383	94	14	80251	80345	80439	80533	0627	0720
15	0.49290	49197	49104	49012	48920	48828	92	15	9.80813	80906	80999	81091	81183	81275
16	48736	8644	8553	8462	8371	8280	91	16	81367	1459	1550	1641	1732	1823
17	48189	8099	8009	7919	7829	7739	90	17	81914	2004	2094	2184	2274	2364
18	47650	7561	7472	7383	7295	7207	89	18	82453	2542	2631	2720	2808	2896
19	47119	7031	6943	6856	6769	6682	87	19	82984	3072	3160	3247	3334	3421
20	0.46595	46508	46421	46335	46249	46163	86	20	9.83508	83595	83682	83768	83854	83940
21	46077	5992	5907	5822	5737	5652	85	21	84026	4111	4196	4281	4366	4451
22	45567	5483	5399	5315	5231	5147	84	22	84536	4620	4704	4788	4872	4956
23	45064	4981	4898	4815	4732	4649	83	23	85039	5122	5205	5388	5371	5454
24	44567	4485	4403	4321	4239	4158	82	24	85536	5618	5700	5782	5864	5945
25	0.44077	43996	43915	43834	43753	43673	81	25	9.86026	86107	86188	86269	86350	86430
26	43593	3513	3433	3353	3273	3193	80	26	86510	6590	6670	6750	6830	6910
27	43114	3035	2956	2877	2799	2721	79	27	86989	7068	7147	7226	7304	7382
28	42643	2565	2487	2409	2331	2253	78	28	87460	7538	7616	7694	7772	7850
29	42176	2099	2022	1945	1868	1792	77	29	87927	8004	8081	8158	8235	8311
30	0.41716	41640	41564	41488	41412	41336	76	30	9.88387	88463	8539	88615	88691	88767
31	41261	1186	1111	1036	0961	0886	75	31	88842	8917	8992	9067	9142	9217
32	40812	0738	0664	0590	0516	0442	74	32	89291	9365	9439	9513	9587	9661
33	40368	0295	0222	0149	0076	0003	73	33	89735	9808	9881	9954	90027	90100
34	39930	39857	39785	39713	39641	39569	72	34	90173	90246	90318	90390	0462	0534
35	0.39497	39425	39353	39282	39211	39140	71	35	9.90606	90678	90750	90821	90892	90963
36	39069	8998	8927	8856	8786	8716	70	36	91034	1105	1176	1247	1317	1387
37	38646	8576	8506	8436	8366	8296	70	37	91457	1527	1597	1667	1737	1807
38	38227	8158	8089	8020	7951	7882	69	38	91876	1945	2014	2083	2152	2221
39	37813	7745	7677	7609	7541	7473	68	39	92290	2358	2426	2494	2562	2630
40	0.37405	37337	37269	37202	37135	37068	67	40	9.92698	92766	92834	92901	92968	93035
41	37001	6934	6867	6800	6734	6668	67	41	93102	3169	3236	3303	3369	3435
42	36602	6536	6470	6404	6338	6272	66	42	93501	3567	3633	3699	3765	3831
43	36206	6141	6076	6011	5946	5881	65	43	93897	3962	4027	4092	4157	4222
44	35816	5751	5686	5622	5558	5494	64	44	94287	4352	4417	4481	4545	4609
45	0.35430	35366	35302	35238	35174	35110	64	45	9.94673	94737	94801	94865	94929	94993
46	35047	4984	4921	4858	4795	4732	63	46	95056	5119	5182	5245	5308	5371
47	34669	4606	4544	4482	4420	4358	62	47	95434	5497	5559	5621	5683	5745
48	34296	4234	4172	4110	4048	3986	62	48	95807	5869	5931	5993	6055	6117
49	33925	3864	3803	3742	3681	3620	61	49	96178	6239	6300	6361	6422	6483
50	0.33559	33498	33438	33378	33318	33258	60	50	9.96544	96605	96665	96725	96785	96845
51	33197	3137	3077	3017	2958	2899	60	51	96906	6966	7026	7086	7145	7204
52	32839	2780	2720	2661	2602	2543	59	52	97264	7323	7383	7442	7501	7560
53	32485	2426	2367	2309	2250	2192	58	53	97618	7677	7736	7794	7853	7911
54	32134	2076	2018	1960	1902	1844	58	54	97969	8027	8085	8143	8201	8259
55	0.31787	31729	31672	31614	31557	31500	58	55	9.98316	98374	98431	98489	98546	98603
56	31443	1386	1329	1272	1216	1159	57	56	98660	8717	8774	8831	8887	8944
57	31103	1046	0990	0934	0878	0822	56	57	99000	9057	9113	9169	9225	9281
58	30766	0710	0655	0599	0544	0488	56	58	99337	9393	9448	9504	9559	9615
59	30433	0378	0323	0268	0213	0158	55	59	99670	9725	9780	9835	9890	9945

Digitized by Google

TABLE VII. TO FIND THE LATITUDE BY DOUBLE ALTS. AND THE ELAPSED TIME.

Arg	HALF ELAPSED TIME. 2 Hours.						D.
M	0″	10″	20″	30″	40″	50″	
0	0.30103	30048	29994	29939	29885	29831	55
1	29776	29722	9668	9614	9560	9507	54
2	29453	9399	9346	9293	9239	9186	53
3	29133	9080	9027	8974	8921	8869	53
4	28816	8764	8711	8659	8607	8554	52
5	0.28502	28450	28398	28346	28295	28243	52
6	28191	8140	8089	8037	7986	7935	52
7	27884	7833	7782	7731	7680	7630	51
8	27579	7529	7478	7428	7378	7327	50
9	27277	7227	7177	7127	7077	7028	50
0	0.26978	26929	26879	26830	26781	26731	49
1	26682	6633	6584	6535	6486	6438	49
2	26389	6340	6292	6244	6195	6147	48
3	26099	6051	6003	5955	5907	5859	48
4	25811	5763	5716	5668	5621	5573	48
5	0.25526	25479	25432	25385	25338	25291	47
6	25244	5197	5150	5104	5057	5011	47
7	24964	4918	4872	4825	4779	4733	46
8	24687	4641	4595	4550	4504	4458	46
9	24413	4367	4322	4276	4231	4186	45
0	0.24141	24096	24051	24006	23961	23916	45
1	23871	3827	3782	3738	3693	3649	44
2	23605	3560	3516	3472	3428	3384	44
3	23340	3296	3252	3209	3165	3122	43
4	23078	3035	2991	2948	2905	2862	43
5	0.22819	22775	22732	22690	22647	22604	43
6	22561	2519	2476	2433	2391	2349	42
7	22306	2264	2222	2180	2138	2096	42
8	22054	2012	1970	1928	1887	1845	42
9	21803	1762	1720	1679	1638	1596	41
0	0.21555	21514	21473	21432	21391	21350	41
1	21309	1269	1228	1187	1147	1106	41
2	21066	1025	0985	0945	0905	0864	40
3	20824	0784	0744	0704	0665	0625	40
4	20585	0545	0506	0466	0427	0387	40
5	0.20348	20309	20269	20230	20191	20152	39
6	20113	0074	0035	19996	19957	19919	39
7	19880	19841	19803	9764	9726	9687	39
8	19649	9611	9572	9534	9496	9458	38
9	19420	9382	9344	9306	9269	9231	38
0	0.19193	19156	19118	19081	19043	19006	37
1	18968	8931	8894	8857	8820	8783	37
2	18746	8709	8672	8635	8598	8561	37
3	18525	8488	8451	8415	8378	8342	36
4	18306	8269	8233	8197	8161	8124	36
5	0.18089	18053	18017	17981	17945	17909	36
6	17874	7838	7802	7767	7731	7696	35
7	17660	7625	7590	7554	7519	7484	35
8	17449	7414	7379	7344	7309	7274	35
9	17239	7205	7170	7135	7101	7066	35
0	0.17032	16997	16963	16928	16894	16860	34
1	16826	6792	6758	6724	6690	6656	34
2	16622	6588	6554	6520	6487	6453	34
3	16419	6386	6352	6319	6285	6252	34
4	16219	6186	6152	6119	6086	6053	33
5	0.16020	15987	15954	15920	15888	15856	33
6	15823	5790	5758	5725	5692	5660	33
7	15628	5595	5563	5530	5498	5466	33
8	15434	5402	5370	5338	5306	5274	32
9	15242	5210	5178	5146	5115	5083	32

Arg.	MIDDLE TIME 2 Hours.						D.
M	0″	10″	20″	30″	40″	50″	
0	10.00000	00055	00109	00164	00218	00272	55
1	00327	0381	0435	0489	0543	0596	54
2	00650	0704	0757	0810	0864	0917	53
3	00970	1023	1076	1129	1182	1234	53
4	01287	1339	1392	1444	1496	1549	52
5	10.01601	01653	01705	01757	01808	01860	52
6	01912	1963	2014	2066	2117	2168	52
7	02219	2270	2321	2372	2423	2473	51
8	02524	2574	2625	2675	2725	2776	50
9	02826	2876	2926	2976	3026	3075	50
10	10.03125	03174	03224	03273	03322	03372	49
11	03421	3470	3519	3568	3617	3665	49
12	03714	3763	3811	3859	3908	3956	48
13	04004	4052	4100	4148	4196	4244	48
14	04292	4340	4387	4435	4482	4530	48
15	10.04577	04624	04671	04718	04765	04812	47
16	04859	4906	4953	4999	5046	5092	47
17	05139	5185	5231	5278	5324	5370	46
18	05416	5462	5508	5553	5599	5645	46
19	05690	5736	5781	5827	5872	5917	45
20	10.05962	06007	06052	06097	06142	06187	45
21	06232	6275	6321	6365	6410	6454	44
22	06498	6543	6587	6631	6675	6719	44
23	06763	6807	6851	6894	6938	6981	43
24	07025	7068	7112	7155	7198	7241	43
25	10.07284	07328	07371	07413	07456	07499	43
26	07542	7584	7627	7670	7712	7754	42
27	07797	7839	7881	7923	7965	8007	42
28	08049	8091	8133	8175	8216	8258	42
29	08300	8341	8383	8424	8465	8507	41
30	10.08548	08589	08630	08671	08712	08753	41
31	08794	8834	8875	8916	8956	8997	41
32	09037	9078	9118	9158	9198	9239	40
33	09279	9319	9359	9399	9438	9478	40
34	09518	9558	9597	9637	9676	9716	40
35	10.09755	09794	09834	09873	09912	09951	39
36	09990	10029	10068	10107	10146	10184	39
37	10223	0262	0300	0339	0377	0416	39
38	10454	0492	0531	0569	0607	0645	38
39	10683	0721	0759	0797	0834	0872	38
40	10.10910	10947	10985	11022	11060	11097	37
41	11135	1172	1209	1246	1283	1320	37
42	11357	1394	1431	1468	1505	1542	37
43	11578	1615	1652	1688	1725	1761	36
44	11797	1834	1870	1906	1942	1979	36
45	10.12014	12050	12086	12122	12158	12194	36
46	12229	2265	2301	2336	2372	2407	35
47	12443	2478	2513	2549	2583	2619	35
48	12654	2689	2724	2759	2794	2829	35
49	12864	2898	2933	2968	3002	3037	35
50	10.13071	13106	13140	13175	13209	13243	34
51	13277	3311	3345	3379	3413	3447	34
52	13481	3515	3549	3583	3616	3650	34
53	13684	3717	3751	3784	3818	3851	34
54	13884	3917	3951	3984	4017	4050	33
55	10.14083	14116	14149	14182	14215	14247	33
56	14280	4313	4345	4378	4411	4443	33
57	14475	4508	4540	4573	4605	4637	33
58	14669	4701	4733	4765	4797	4829	32
59	14861	4893	4925	4957	4988	5020	32

Digitized by Google

TABLE VII. TO FIND THE LATITUDE BY DOUBLE ALTS. AND THE ELAPSED TIME.

Arg	HALF ELAPSED TIME. 3 Hours.						D.	Arg.	MIDDLE TIME. 3 Hours.					
M.	0″	10″	20″	30″	40″	50″		M	0″	10″	20″	30″	40″	50″
0	0.15051	15020	14988	14957	14926	14894	31	0	10.15052	15083	15115	15146	15177	15209
1	14863	4832	4800	4769	4738	4707	31	1	15240	5271	5303	5334	5365	5396
2	14676	4645	4614	4583	4552	4521	31	2	15427	5458	5489	5520	5551	5582
3	14490	4460	4429	4398	4368	4337	31	3	15613	5643	5674	5705	5735	5766
4	14307	4276	4246	4215	4185	4155	31	4	15796	5827	5857	5888	5918	5948
5	0.14124	14094	14064	14034	14004	13974	30	5	10.15979	16009	16039	16069	16099	16129
6	13944	3914	3884	3854	3824	3794	30	6	16159	6189	6219	6249	6279	6309
7	13765	3735	3705	3676	3646	3617	30	7	16338	6368	6398	6427	6457	6486
8	13587	3558	3528	3499	3470	3441	29	8	16516	6545	6575	6604	6633	6662
9	13411	3382	3353	3324	3295	3266	29	9	16692	6721	6750	6779	6808	6837
10	0.13237	13208	13179	13150	13121	13093	29	10	10.16866	16895	16924	16953	16982	17010
11	13064	3035	3007	2978	2950	2921	29	11	17039	7068	7096	7125	7153	7182
12	12893	2864	2835	2807	2779	2751	29	12	17210	7239	7267	7296	7324	7352
13	12723	2695	2666	2638	2610	2582	28	13	17380	7408	7437	7465	7493	7521
14	12554	2526	2499	2471	2443	2415	28	14	17549	7577	7604	7632	7660	7688
15	0.12387	12360	12332	12305	12277	12249	28	15	10.17716	17743	17771	17798	17826	17854
16	12222	2195	2167	2140	2113	2085	28	16	17881	7908	7936	7963	7990	8018
17	12058	2031	2004	1977	1949	1922	27	17	18045	8072	8099	8126	8154	8181
18	11895	1868	1842	1815	1788	1761	27	18	18208	8235	8261	8288	8315	8342
19	11734	1708	1681	1654	1628	1601	27	19	18369	8395	8422	8449	8475	8502
20	0.11575	11548	11522	11495	11469	11443	27	20	10.18528	18555	18581	18608	18634	18660
21	11416	1390	1364	1338	1312	1285	26	21	18687	8713	8739	8765	8791	8818
22	11259	1233	1207	1181	1155	1130	26	22	18844	8870	8896	8922	8948	8973
23	11104	1078	1052	1027	1001	0975	26	23	18999	9025	9051	9076	9102	9128
24	10950	0924	0899	0873	0848	0822	26	24	19153	9179	9204	9230	9255	9281
25	0.10797	10772	10746	10721	10696	10671	25	25	10.19306	19331	19357	19382	19407	19432
26	10646	0620	0595	0570	0545	0520	25	26	19457	9483	9508	9533	9558	9583
27	10495	0471	0446	0421	0396	0371	25	27	19608	9632	9657	9682	9707	9732
28	10347	0322	0297	0272	0248	0224	25	28	19756	9781	9806	9831	9855	9879
29	10199	0175	0151	10126	10102	10078	24	29	19904	19928	19952	19977	20001	20025
30	0.10053	10029	10005	09981	09957	09933	24	30	10.20050	20074	20098	20122	20146	20170
31	09909	09885	09861	9837	9813	9789	24	31	20194	0218	0242	0266	0290	0314
32	09765	9741	9718	9694	9670	9647	24	32	20338	0362	0385	0409	0433	0456
33	09623	9599	9576	9552	9529	9506	23	33	20480	0404	0527	0551	0574	0597
34	09482	9459	9435	9412	9389	9366	23	34	20621	0644	0668	0691	0714	0737
35	0.09343	09319	09296	09273	09250	09227	23	35	10.20760	20783	20807	20830	20853	20876
36	09204	9181	9158	9136	9113	9090	23	36	20899	0922	0945	0967	0990	1013
37	09067	9044	9022	8999	8976	8954	22	37	21036	1059	1081	1104	1127	1149
38	08931	8909	8886	8864	8842	8819	22	38	21172	1194	1217	1239	1261	1284
39	08797	8774	8752	8730	8708	8686	22	39	21306	1329	1351	1373	1395	1417
40	0.08664	08641	08619	08597	08575	08553	22	40	10.21439	21462	21484	21506	21528	21550
41	08531	8510	8488	8466	8444	8422	22	41	21572	1593	1615	1637	1659	1681
42	08401	8379	8357	8336	8314	8293	21	42	21702	1724	1746	1767	1789	1810
43	08271	8250	8228	8207	8185	8164	21	43	21832	1853	1875	1896	1918	1939
44	08143	8121	8100	8097	8058	8036	21	44	21960	1982	2003	2024	2045	2067
45	0.08015	07994	07973	07952	07931	07910	21	45	10.22088	22109	22130	22151	22172	22193
46	07889	7868	7848	7827	7806	7785	21	46	22214	2235	2255	2276	2297	2318
47	07765	7744	7723	7703	7682	7661	20	47	22338	2359	2380	2400	2421	2442
48	07641	7620	7600	7579	7559	7539	20	48	22462	2483	2503	2524	2544	2564
49	07518	7498	7478	7458	7437	7417	20	49	22585	2605	2625	2645	2666	2686
50	0.07397	07377	07357	07337	07317	07297	20	50	10.22706	22725	22746	22766	22786	22806
51	07277	7257	7237	7217	7197	7178	20	51	22826	2846	2866	2886	2906	2925
52	07158	7138	7119	7099	7079	7060	20	52	22945	2965	2984	3004	3024	3043
53	07040	7021	7001	6982	6962	6943	20	53	23063	3082	3102	3121	3141	3160
54	06923	6904	6885	6865	6846	6827	19	54	23180	3199	3218	3238	3257	3276
55	0.06808	06789	06770	06751	06731	06712	19	55	10.23295	23314	23333	23352	23371	23391
56	06693	6674	6656	6637	6618	6599	19	56	23410	3429	3447	3466	3485	3504
57	06580	6561	6543	6524	6505	6487	19	57	23523	3542	3560	3579	3598	3616
58	06468	6449	6431	6412	6394	6375	19	58	23635	3654	3672	3691	3709	3728
59	06357	6338	6320	6302	6283	6265	18	59	23746	3765	3785	3801	3820	3838

Digitized by Google

TABLE VII. TO FIND THE LATITUDE BY DOUBLE ALTS. AND THE ELAPSED TIME.

Arg. HALF ELAPSED TIME. — 4 Hours.

M.	0″	10″	20″	30″	40″	50″	D.
0	0.06247	06229	06211	06192	06174	06156	19
1	06138	6120	6102	6084	6066	6048	18
2	06030	6012	5995	5977	5959	5941	18
3	05924	5906	5888	5871	5853	5836	17
4	05818	5801	5783	5766	5748	5731	17
5	0.05714	05696	05679	05662	05645	05627	17
6	05610	5593	5576	5559	5542	5525	17
7	05508	5491	5474	5457	5440	5423	17
8	05406	5389	5373	5356	5340	5323	16
9	05306	5290	5273	5257	5240	5224	16
10	0.05207	05191	05174	05158	05142	05125	16
11	05109	5093	5076	5060	5044	5028	16
12	05012	4996	4980	4964	4948	4932	16
13	04916	4900	4884	4868	4852	4837	15
14	04821	4805	4789	4774	4758	4743	15
15	0.04727	04711	04696	04680	04665	04649	15
16	04634	4619	4603	4588	4573	4557	15
17	04542	4527	4512	4496	4481	4466	15
18	04451	4436	4421	4406	4391	4376	15
19	04361	4346	4332	4317	4302	4287	15
20	0.04272	04258	04243	04228	04214	04199	14
21	04185	4170	4155	4141	4127	4112	14
22	04098	4083	4069	4055	4040	4026	14
23	04012	3998	3983	3969	3955	3941	14
24	03927	3913	3899	3885	3871	3857	14
25	0.03843	03829	03815	03802	03788	03774	13
26	03760	3746	3733	3719	3706	3692	13
27	03678	3665	3651	3638	3624	3611	13
28	03597	3584	3571	3557	3544	3531	13
29	03517	3504	3491	3478	3465	3452	13
30	0.03438	03425	03412	03399	03386	03373	13
31	03360	3348	3335	3322	3309	3296	13
32	03283	3271	3258	3245	3233	3220	13
33	03207	3195	3182	3170	3157	3145	12
34	03132	3120	3107	3095	3083	3070	12
35	0.03058	03046	03034	03021	03009	02997	12
36	02985	2973	2961	2949	2937	2925	12
37	02913	2901	2889	2877	2865	2853	12
38	02841	2829	2818	2806	2794	2783	12
39	02771	2759	2748	2736	2724	2713	12
40	0.02701	02690	02678	02667	02656	02644	11
41	02633	2622	2610	2599	2588	2577	11
42	02565	2554	2543	2532	2521	2510	11
43	02499	2488	2477	2466	2455	2444	11
44	02433	2422	2411	2400	2390	2379	11
45	0.02368	02357	02347	02336	02326	02315	11
46	02304	2294	2283	2273	2262	2252	11
47	02241	2231	2221	2210	2200	2190	11
48	02179	2169	2159	2149	2139	2128	10
49	02118	2108	2098	2088	2078	2068	10
50	0.02058	02048	02038	02028	02018	02009	10
51	01999	1989	1979	1969	1960	1950	10
52	01940	1931	1921	1912	1902	1892	10
53	01883	1873	1864	1854	1845	1836	10
54	01826	1817	1808	1798	1789	1780	10
55	0.01771	01761	01752	01743	01734	01725	9
56	01716	1707	1698	1689	1680	1671	9
57	01662	1653	1644	1635	1626	1618	9
58	01609	1600	1591	1583	1574	1565	9
59	01557	1548	1540	1531	1523	1514	9

Arg. MIDDLE TIME. — 4 Hours.

M	0″	10″	20″	30″	40″	50″
0	10.23856	23874	23892	23911	23929	23947
1	23965	3983	4001	4019	4037	4055
2	24073	4091	4108	4126	4144	4162
3	24179	4197	4215	4232	4250	4267
4	24285	4302	4320	4337	4355	4372
5	10.24389	24407	24424	24441	24458	24476
6	24493	4510	4527	4544	4561	4578
7	24595	4612	4629	4646	4663	4680
8	24697	4714	4730	4747	4763	4780
9	24797	4813	4830	4846	4863	4879
10	10.24896	24912	24929	24945	24961	24978
11	24994	5010	5027	5043	5059	5075
12	25091	5107	5123	5139	5155	5171
13	25187	5203	5219	5235	5251	5266
14	25282	5298	5314	5329	5345	5360
15	10.25376	25392	25407	25423	25438	25454
16	25469	5484	5500	5515	5530	5546
17	25561	5576	5591	5607	5622	5637
18	25652	5667	5682	5697	5712	5727
19	25742	5757	5771	5786	5801	5816
20	10.25831	25845	25860	25875	25889	25904
21	25918	5933	5948	5962	5976	5991
22	26005	6020	6034	6048	6063	6077
23	26091	6105	6120	6134	6148	6162
24	26176	6190	6204	6218	6232	6246
25	10.26260	26274	26288	26301	26315	26329
26	26343	6357	6370	6384	6397	6411
27	26425	6438	6452	6465	6479	6492
28	26506	6519	6532	6546	6559	6572
29	26586	6599	6612	6625	6638	6651
30	10.26665	26678	26691	26704	26717	26730
31	26743	6755	6768	6781	6794	6807
32	26820	6832	6845	6858	6870	6883
33	26896	6908	6921	6933	6946	6958
34	26971	6983	6996	7008	7020	7033
35	10.27045	27057	27069	27082	27094	27106
36	27118	7130	7142	7154	7166	7178
37	27190	7202	7214	7226	7238	7250
38	27262	7274	7285	7297	7309	7320
39	27332	7344	7355	7367	7379	7390
40	10.27402	27413	27425	27436	27447	27459
41	27470	7481	7493	7504	7515	7526
42	27538	7549	7561	7571	7582	7593
43	27604	7615	7626	7637	7648	7659
44	27670	7681	7692	7703	7713	7724
45	10.27735	27746	27756	27767	27777	27788
46	27799	7809	7820	7830	7841	7851
47	27862	7872	7882	7893	7903	7913
48	27924	7934	7944	7954	7964	7975
49	27983	7995	8005	8015	8025	8035
50	10.28045	28055	28065	28075	28085	28094
51	28104	8114	8124	8134	8143	8153
52	28163	8172	8182	8191	8201	8211
53	28220	8230	8239	8249	8258	8267
54	28277	8286	8295	8305	8314	8323
55	10.28332	28341	28351	28360	28369	28378
56	28387	8396	8405	8414	8423	8432
57	28441	8450	8459	8468	8477	8485
58	28494	8503	8512	8520	8529	8538
59	28546	8555	8563	8572	8580	8589

Digitized by Google

TABLE VII. TO FIND THE LATITUDE BY DOUBLE ALTS. AND THE ELAPSED TIME.

Arg. HALF ELAPSED TIME. 5 Hours.

M.	0″	10″	20″	30″	40″	50″	D.
0	0.01506	01497	01489	01480	01472	01464	9
1	01455	1447	1439	1430	1422	1414	9
2	01406	1398	1390	1381	1373	1365	9
3	01357	1349	1341	1333	1325	1317	8
4	01310	1302	1294	1286	1278	1270	8
5	0.01263	01255	01247	01240	01232	01224	8
6	01217	1209	1202	1194	1187	1179	8
7	01172	1164	1157	1150	1142	1135	8
8	01128	1120	1113	1106	1099	1091	7
9	01084	1077	1070	1063	1056	1049	7
10	0.01042	01035	01028	01021	01014	01007	7
11	01000	0993	0987	0980	0973	0966	7
12	00960	0953	0946	0940	0933	0926	7
13	00920	0913	0907	0900	0894	0887	7
14	00881	0874	0868	0862	0855	0839	6
15	0.00843	00836	00830	00824	00818	00811	6
16	00805	0799	0793	0787	0781	0775	6
17	00769	0763	0757	0751	0745	0739	6
18	00733	0728	0721	0716	0710	0704	5
19	00699	0693	0687	0682	0676	0670	5
20	0.00665	00659	00654	00648	00643	00637	5
21	00632	0626	0621	0616	0610	0605	5
22	00600	0594	0589	0584	0579	0574	5
23	00568	0563	0558	0553	0548	0543	5
24	00538	0533	0528	0523	0518	0513	5
25	0.00508	00504	00499	00494	00489	00484	4
26	00480	0475	0470	0466	0461	0456	4
27	00452	0447	0443	0438	0434	0429	4
28	00425	0420	0416	0412	0407	0403	4
29	00399	0394	0390	0386	0382	0377	4
30	0.00373	00369	00365	00361	00357	00353	4
31	00349	0345	0341	0337	0333	0329	4
32	00325	0321	0317	0313	0310	0306	4
33	00302	0298	0295	0291	0287	0284	4
34	00280	0276	0273	0269	0266	0262	4
35	0.00259	00255	00252	00249	00245	00242	3
36	00239	0235	0232	0229	0225	0222	3
37	00219	0216	0213	0210	0207	0203	3
38	00200	0197	0194	0191	0188	0185	3
39	00183	0180	0177	0174	0171	0168	3
40	0.00166	00163	00160	00157	00155	00152	3
41	00149	0147	0144	0142	0139	0137	2
42	00134	0132	0129	0127	0124	0122	2
43	00120	0117	0115	0113	0110	0108	2
44	00106	0104	0102	0099	0097	0095	2
45	0.00093	00091	00089	00087	00085	00083	2
46	00081	0079	0077	0075	0074	0072	2
47	00070	0068	0066	0065	0063	0061	1
48	00060	0058	0056	0055	0053	0052	1
49	00050	0049	0047	0046	0044	0043	1
50	0.00041	00040	00039	00037	00036	00035	1
51	00033	0032	0031	0030	0029	0028	1
52	00026	0025	0024	0023	0022	0021	1
53	00020	0019	0018	0017	0017	0016	1
54	00015	0014	0013	0013	0012	0011	1
55	0.00010	00010	00009	00008	00008	00007	1
56	00007	0006	0006	0005	0005	0004	1
57	00004	0003	0003	0003	0002	0002	0
58	00002	0001	0001	0001	0001	0001	0
59	00000	0000	0000	0000	0000	0000	0

Arg. MIDDLE TIME. 5 Hours.

M.	0″	10″	20″	30″	40″	50″
0	10.28597	28606	28614	28623	28631	28639
1	28648	8656	8664	8673	8681	8689
2	28697	8705	8713	8722	8730	8738
3	28746	8754	8762	8770	8778	8786
4	28793	8801	8809	8817	8825	8833
5	10.28840	28848	28856	28863	28871	28879
6	28886	8894	8901	8909	8916	8924
7	28931	8939	8946	8953	8961	8968
8	28975	8983	8990	8997	9004	9012
9	29019	9026	9033	9040	9047	9054
10	10.29061	29068	29075	29082	29089	29096
11	29103	9110	9116	9123	9130	9137
12	29143	9150	9157	9163	9170	9177
13	29183	9190	9196	9203	9209	9216
14	29222	9229	9235	9241	9248	9254
15	10.29260	29267	29273	29279	29285	29292
16	29298	9304	9310	9316	9322	9328
17	29334	9340	9346	9352	9358	9364
18	29370	9375	9381	9387	9393	9399
19	29404	9410	9416	9421	9427	9433
20	10.29438	29444	29449	29455	29460	29466
21	29471	9477	9482	9487	9493	9498
22	29503	9509	9514	9519	9524	9529
23	29535	9540	9545	9550	9555	9560
24	29565	9570	9575	9580	9585	9590
25	10.29595	29599	29604	29609	29614	29619
26	29623	9628	9633	9637	9642	9647
27	29651	9656	9660	9665	9669	9674
28	29678	9683	9687	9691	9696	9700
29	29704	9709	9713	9717	9721	9726
30	10.29730	29734	29738	29742	29746	29750
31	29754	9758	9762	9766	9770	9774
32	29778	9782	9786	9790	9793	9797
33	29801	9805	9808	9812	9816	9819
34	29823	9827	9830	9834	9837	9841
35	10.29844	29848	29851	29854	29858	29861
36	29864	9868	9871	9874	9878	9881
37	29884	9887	9890	9893	9896	9900
38	29903	9906	9909	9912	9915	9918
39	29920	9923	9926	9929	9932	9935
40	10.29937	29940	29943	29946	29948	29951
41	29954	9956	9959	9961	9964	9966
42	29969	9971	9974	9976	9979	9981
43	29983	9986	29988	29990	29993	29995
44	29997	29999	30001	30004	30006	30008
45	10.30010	30012	30014	30016	30018	30020
46	30022	0024	0026	0028	0029	0031
47	30033	0035	0037	0038	0040	0042
48	30043	0045	0047	0048	0050	0051
49	30053	0054	0056	0057	0059	0060
50	10.30062	30063	30004	30006	30007	30068
51	30070	0071	0072	0073	0074	0075
52	30077	0078	0079	0080	0081	0082
53	30083	0084	0085	0086	0086	0087
54	30088	008	0090	0090	0091	0092
55	10.30093	30093	30094	30095	30095	30096
56	30096	0097	0097	0098	0098	0099
57	30099	0100	0100	0100	0101	0101
58	30101	0102	0102	0102	0102	0102
59	30103	0103	0103	0103	0103	0103

Digitized by Google

TABLE VIII. TO FIND THE LATITUDE BY DOUBLE ALTS. AND THE ELAPSED TIME.

Arg. RISING.

M.	0 Hour. 0″	10″	20″	30″	40″	50″	M	1 Hour. 0″	10″	20″	30″	40″	50″	D.
0	Inf. Neg.	42230	02436	37654	62642	82024	0	8. 53243	53482	53721	53959	54197	54434	238
1	4. 97880	11250	22848	33079	42230	50509	1	54670	54905	55140	55375	55608	55841	235
2	5. 58066	65019	71455	77448	83054	88319	2	56074	56306	56537	56767	56997	57226	230
3	93284	97980	02435	06673	10714	14575	3	57455	57683	57910	58137	58363	58589	227
4	6. 18271	21817	25224	28502	31660	34708	4	58814	59038	59262	59486	59708	59930	224
5	6. 37653	40501	43258	45931	48524	51041	5	8. 60152	60373	60593	60813	61032	61251	220
6	53488	55868	58184	60440	62639	64784	6	61469	61686	61903	62120	62336	62551	217
7	66877	68920	70917	72869	74778	76646	7	62766	62980	63194	63407	63620	63832	213
8	78474	80265	82019	83739	85426	87080	8	64043	64254	64465	64675	64885	65094	210
9	88703	90297	91862	93390	94909	96394	9	65302	65510	65717	65924	66131	66337	207
10	6. 97854	99289	00701	02091	03458	04805	10	8. 66542	66747	66952	67156	67359	67562	204
11	7. 06131	07437	08723	09991	11240	12472	11	67765	67967	68168	68369	68570	68770	201
12	13687	14885	16066	17223	18381	19517	12	68969	69169	69367	69566	69763	69961	198
13	20638	21744	22836	23915	24980	26033	13	70158	70354	70550	70745	70940	71135	195
14	27073	28100	29116	30120	31112	32093	14	71329	71523	71716	71909	72101	72293	193
15	7. 33063	34023	34972	35910	36839	37758	15	8. 72485	72676	72867	73057	73247	73436	190
16	38667	39567	40457	41338	42211	43075	16	73625	73813	74001	74189	74376	74563	188
17	43930	44777	45616	46447	47270	48085	17	74750	74936	75121	75307	75491	75676	186
18	48893	49693	50486	51271	52050	52821	18	75860	76043	76227	76409	76592	76774	182
19	53586	54344	55096	55841	56580	57312	19	76955	77137	77318	77498	77678	77858	180
20	7. 58039	58759	59473	60182	60885	61582	20	8. 78037	78216	78395	78573	78750	78928	178
21	62274	62960	63641	64316	64987	65652	21	79105	79282	79458	79634	79809	79985	176
22	66312	66967	67617	68262	68903	69538	22	80159	80334	80508	80682	80855	81028	174
23	70169	70796	71418	72036	72649	73258	23	81201	81373	81545	81717	81888	82059	172
24	73863	74464	75060	75652	76241	76825	24	82230	82400	82570	82739	82908	83077	169
25	7. 77405	77982	78555	79124	79689	80251	25	8. 83246	83414	83582	83749	83917	84083	167
26	80809	81363	81914	82461	83005	83546	26	84250	84416	84582	84748	84913	85078	166
27	84083	84617	85148	85675	86199	86720	27	85242	85406	85570	85734	85897	86060	164
28	87238	87753	88265	88773	89279	89782	28	86223	86385	86547	86709	86870	87031	162
29	90282	90779	91273	91765	92254	92740	29	87192	87352	87513	87672	87832	87991	159
30	7. 93223	93703	94181	94656	95129	95599	30	8. 88150	88309	88467	88625	88783	88940	158
31	96067	96532	96994	97454	97912	98367	31	89097	89254	89411	89567	89723	89879	156
32	* 98820	99270	99718	00164	00608	01049	32	90034	90189	90344	90498	90653	90807	154
33	8. 01488	01925	02360	02792	03222	03650	33	90960	91114	91267	91420	91572	91724	153
34	04077	04501	04922	05342	05760	06176	34	91876	92028	92179	92331	92482	92632	152
35	8. 06590	07001	07411	07819	08225	08630	35	8. 92782	92932	93082	93232	93381	93530	149
36	09032	09432	09830	10227	10622	11015	36	93679	93827	93975	94123	94271	94418	148
37	11406	11796	12184	12570	12954	13337	37	94566	94712	94859	95005	95151	95297	146
38	13718	14097	14475	14850	15225	15597	38	95443	95588	95733	95878	96023	96167	145
39	15969	16338	16706	17072	17437	17800	39	96311	96455	96599	96742	96885	97028	143
40	8. 18162	18522	18881	19238	19594	19948	40	8. 97170	97313	97455	97597	97738	97880	142
41	20301	20653	21003	21351	21698	22044	41	98021	98162	98302	98443	98583	98723	140
42	22389	22732	23073	23414	23753	24090	42	98862	99002	99141	99280	99419	99557	139
43	24427	24762	25095	25428	25759	26089	43	* 99696	99834	99972	00109	00247	00384	138
44	26418	26745	27072	27396	27720	28042	44	9. 00521	00657	00793	00930	01066	01202	137
45	8. 28363	28683	29002	29320	29637	29952	45	9. 01337	01473	01608	01743	01877	02012	135
46	30266	30579	30891	31202	31512	31820	46	02146	02280	02414	02547	02681	02814	133
47	32128	32434	32739	33044	33347	33649	47	02947	03080	03212	03344	03477	03608	132
48	33950	34250	34549	34847	35144	35439	48	03740	03871	04003	04134	04265	04395	131
49	35734	36028	36321	36613	36903	37193	49	04526	04656	04786	04916	05045	05175	130
50	8. 37482	37770	38057	38343	38628	38912	50	9. 05304	05433	05561	05690	05818	05946	129
51	39195	39477	39759	40039	40318	40597	51	06074	06202	06330	06457	06584	06711	127
52	40875	41151	41427	41702	41976	42250	52	06838	06965	07091	07217	07343	07469	126
53	42523	42794	43064	43334	43603	43871	53	07595	07720	07845	07970	08095	08220	125
54	44138	44404	44670	44935	45199	45462	54	08344	08468	08592	08716	08840	08964	124
55	8. 45724	45986	46247	46507	46765	47024	55	9. 09087	09210	09333	09456	09578	09701	123
56	47282	47539	47795	48050	48305	48558	56	09823	09945	10067	10188	10310	10431	122
57	48811	49064	49315	49566	49816	50066	57	10552	10673	10794	10915	11035	11155	121
58	50314	50562	50809	51056	51301	51547	58	11275	11395	11515	11634	11754	11873	120
59	51791	52035	52278	52520	52761	53002	59	11992	12111	12229	12348	12466	12584	119

Digitized by Google

TABLE VIII. TO FIND THE LATITUDE BY DOUBLE ALTS. AND THE ELAPSED TIME.

Arg. RISING.

M	2 Hours. 0″	10″	20″	30″	40″	50″	D.	M	3 Hours. 0″	10″	20″	30″	40″	50″	D.
0	9.1 2702	2820	2938	3055	3172	3289	117	0	9.4 6671	6747	6823	6899	6975	7051	76
1	3406	3523	3640	3756	3872	3988	116	1	7127	7203	7278	7354	7430	7505	76
2	4104	4220	4336	4451	4566	4682	115	2	7580	7656	7731	7806	7881	7956	75
3	4797	4911	5026	5140	5255	5369	114	3	9.4 8031	8106	8180	8255	8330	8404	75
4	5483	5597	5710	5824	5937	6050	113	4	8479	8553	8627	8701	8776	8850	74
5	9.1 6163	6276	6389	6501	6614	6726	112	5	8924	8998	9071	9145	9219	9293	74
6	6838	6950	7062	7173	7285	7396	111	6	9366	9440	9513	9586	9659	9733	73
7	7507	7618	7729	7839	7950	8060	110	7	9.4 9806	9879	9952				73
8	8171	8281	8391	8500	8610	8719	109	7	9.5			0025	0098	0170	
9	8828	8938	9047	9156	9265	9373	109	8	0243	0316	0388	0461	0533	0605	73
10	9.1 9482	9590	9698	9806	9914		108	9	0677	0750	0822	0894	0966	1038	72
10	9.2					0021		10	1109	1181	1253	1325	1396	1467	72
11	0129	0236	0344	0451	0558	0665	107	11	1539	1610	1681	1753	1824	1895	71
12	0771	0878	0984	1091	1197	1303	106	12	1966	2037	2107	2178	2249	2319	71
13	1409	1514	1620	1725	1831	1936	105	13	2390	2461	2531	2601	2672	2742	70
14	2041	2146	2250	2355	2459	2564	105	14	9.5 2812	2882	2952	3022	3092	3162	70
15	2668	2772	2876	2980	3083	3187	104	15	3231	3301	3371	3440	3510	3579	69
16	3290	3393	3496	3599	3702	3805	103	16	3648	3718	3787	3856	3925	3994	69
17	3907	4010	4112	4214	4316	4418	102	17	4063	4132	4201	4269	4338	4407	69
18	4520	4622	4723	4825	4926	5027	101	18	4475	4544	4612	4680	4749	4817	68
19	5128	5229	5330	5430	5531	5631	100	19	4885	4953	5021	5089	5157	5225	68
20	9.2 5731	5831	5931	6031	6131	6231	100	20	9.5 5293	5360	5428	5496	5563	5630	68
21	6330	6429	6529	6628	6727	6826	99	21	5698	5765	5832	5900	5967	6034	67
22	6924	7023	7121	7220	7318	7416	99	22	6101	6168	6235	6301	6368	6435	67
23	7514	7612	7710	7807	7905	8002	98	23	6501	6568	6634	6701	6767	6834	67
24	8099	8197	8294	8391	8487	8584	97	24	6900	6966	7032	7098	7164	7230	66
25	8680	8777	8873	8969	9065	9161	96	25	7296	7362	7428	7494	7559	7625	66
26	9257	9353	9449	9544	9639	9735	95	26	9.5 7690	7756	7821	7886	7951	8017	65
27	9.2 9830	9925						27	8082	8147	8212	8277	8342	8407	65
27	9.3		0020	0115	0209	0304	95	28	8471	8536	8601	8665	8730	8794	64
28	0398	0493	0587	0681	0775	0869	94	29	8859	8923	8988	9052	9116	9180	64
29	0963	1056	1150	1243	1337	1430	93	30	9244	9308	9372	9436	9500	9564	64
30	1523	1616	1709	1801	1894	1987	93	31	9.5 9627	9691	9755	9818	9882	9945	63
31	2079	2171	2264	2356	2448	2540	92	31							
32	2631	2723	2815	2906	2997	3089	91	32	9.6 0008	0072	0135	0198	0261	0324	63
33	3180	3271	3362	3453	3543	3634	91	33	0387	0450	0513	0576	0639	0701	63
34	3724	3815	3905	3995	4085	4175	90	34	0764	0827	0890	0952	1015	1077	62
35	4265	4355	4444	4534	4623	4713	90	35	1139	1202	1264	1326	1388	1450	62
36	4802	4891	4980	5069	5158	5247	89	36	1512	1574	1636	1698	1760	1822	62
37	5335	5424	5512	5601	5689	5777	89	37	1883	1945	2006	2068	2129	2191	62
38	9.3 5865	5953	6041	6128	6216	6303	87	38	9.6 2252	2313	2375	2436	2497	2558	61
39	6391	6478	6565	6653	6740	6827	87	39	2619	2680	2741	2802	2863	2923	61
40	6913	7000	7087	7173	7260	7346	86	40	2984	3045	3105	3166	3226	3287	61
41	7432	7518	7604	7690	7776	7862	86	41	3347	3407	3468	3528	3588	3648	60
42	7948	8033	8119	8204	8289	8374	85	42	3708	3768	3828	3888	3948	4008	60
43	8459	8544	8629	8714	8799	8884	85	43	4068	4127	4187	4246	4306	4365	59
44	8968	9052	9137	9221	9305	9389	84	44	9.6 4425	4484	4544	4603	4662	4721	59
45	9.3 9473	9557	9641	9725	9808	9892	84	45	4780	4839	4898	4957	5016	5075	59
46	9975							46	5134	5193	5251	5310	5369	5427	59
46	9.4	0058	0142	0225	0308	0391	83	47	5486	5544	5602	5661	5719	5777	58
47	0474	0556	0639	0722	0804	0886	83	48	5836	5894	5952	6010	6068	6126	58
48	0969	1051	1133	1215	1297	1379	82	49	6184	6241	6299	6357	6415	6472	58
49	1461	1542	1624	1706	1787	1868	82	50	9. 66530	6588	6645	6702	6760	6817	57
50	1950	2031	2112	2193	2274	2355	81	51	6874	6932	6989	7046	7103	7160	57
51	2435	2516	2597	2677	2758	2838	80	52	7217	7274	7331	7388	7445	7502	57
52	2918	2998	3078	3158	3238	3318	80	53	7558	7615	7671	7728	7785	7841	57
53	9.4 3398	3477	3557	3636	3716	3795	79	54	7897	7954	8010	8066	8123	8179	56
54	3874	3953	4032	4111	4190	4269	79	55	9.6 8235	8291	8347	8403	8459	8515	56
55	4348	4426	4505	4583	4662	4740	78	56	8571	8627	8682	8738	8794	8849	56
56	4818	4896	4974	5052	5130	5208	78	57	8905	8960	9016	9071	9127	9182	55
57	5286	5363	5441	5518	5596	5673	77	58	9237	9292	9348	9403	9458	9513	55
58	5750	5827	5904	5981	6058	6135	77	59	9568	9623	9678	9733	9787	9842	55
59	6212	6289	6365	6442	6518	6595	77								

W Digitized by Google

Arg. RISING.

4 Hours.

M	0″	10″	20″	30″	40″	50″	D
0	9.0 9897	9952					55
0	9.7		0006	0061	0115	0170	55
1	0224	0297	0333	0387	0422	0496	54
2	0550	0604	0658	0712	0766	0820	54
3	0874	0928	0982	1036	1089	1143	54
4	1197	1250	1304	1357	1411	1464	53
5	1518	1571	1624	1678	1730	1784	53
6	1837	1890	1943	1996	2047	2102	53
7	2155	2208	2260	2313	2366	2418	53
8	9.7 2471	2523	2576	2626	2681	2733	52
9	2785	2838	2890	2942	2994	3046	52
10	3098	3150	3202	3254	3306	3358	52
11	3410	3462	3514	3565	3617	3668	51
12	3720	3772	3823	3874	3926	3977	51
13	4028	4080	4131	4182	4233	4284	51
14	4335	4386	4437	4488	4539	4590	51
15	464:	4692	4742	4793	4844	4894	51
16	9.7 4945	4995	5046	5096	5147	5197	50
17	5247	5298	5348	5398	5448	5498	50
18	5548	5599	5649	5699	5748	5798	50
19	5848	5898	5948	5997	6047	6097	50
20	6146	6196	6245	6295	6344	6394	50
21	6443	6492	6542	6591	6640	6689	49
22	6738	6787	6836	6885	6934	6983	49
23	9.7 7032	7081	7130	7179	7227	7276	49
24	7325	7373	7422	7470	7519	7567	48
25	7616	7664	7713	7761	7809	7857	48
26	7906	7954	8002	8050	8098	8146	48
27	8194	8242	8290	8338	8385	8433	48
28	8481	8529	8576	8624	8671	8719	48
29	8767	8814	8861	8908	8956	9003	47
30	9.7 9051	9098	9145	9192	9240	9287	47
31	9334	9381	9428	9475	9522	9568	47
32	9615	9662	9709	9756	9802	9849	47
33	9.7 9896	9942	9989				47
33	9.8			0035	0082	0128	47
34	0175	0221	0267	0314	0360	0406	46
35	0452	0498	0544	0591	0637	0683	46
36	0729	0775	0820	0866	0912	0958	46
37	1004	1049	1095	1141	1186	1232	46
38	1277	1323	1368	1414	1459	1505	45
39	1550	1595	1641	1686	1731	1776	45
40	9.8 1821	1866	1911	1956	2001	2046	45
41	2091	2136	2181	2226	2271	2315	45
42	2360	2405	2449	2494	2538	2583	45
43	2628	2672	2716	2761	2805	2850	45
44	2894	2938	2982	3026	3071	3115	44
45	3159	3203	3247	3291	3335	3379	44
46	3423	3467	3510	3554	3598	3642	44
47	9.8 3685	3729	3773	3816	3860	3903	44
48	3947	3990	4034	4077	4120	4164	43
49	4207	4250	4293	4337	4380	4423	43
50	4466	4509	4552	4595	4638	4681	43
51	4724	4767	4810	4852	4895	4938	43
52	4981	5023	5066	5108	5151	5194	43
53	5236	5278	5321	5363	5406	5448	42
54	9.8 5490	5533	5575	5617	5659	5701	42
55	5744	5786	5828	5870	5912	5954	42
56	5996	6037	6079	6121	6163	6205	42
57	6246	6288	6330	6372	6413	6455	42
58	6496	6538	6579	6621	6662	6704	42
59	6745	6786	6828	6869	6910	6951	41

5 Hours.

M	0″	10″	20″	30″	40″	50″	D
0	9.8 6992	7034	70.5	7116	7157	7198	41
1	7239	7280	7321	7362	7402	7443	41
2	7484	7525	7566	7606	7647	7688	41
3	7728	7769	7809	7850	7890	7931	41
4	7971	8012	8052	8093	8133	8173	40
5	9.8 8213	8254	8294	8334	8374	8414	40
6	8454	8494	8534	8574	8614	8654	40
7	8694	8734	8774	8814	8853	8893	40
8	8933	8973	9012	9052	9091	9131	40
9	9.8 9171	9210	9250	9289	9328	9368	39
10	9407	9447	9486	9525	9564	9604	39
11	9643	9682	9721	9760	9799	9838	39
12	9.8 9877	9916	9955	9994			39
12	9.9				0033	0072	39
13	0111	0149	0188	0227	0266	0305	39
14	0343	0382	0421	0459	0498	0536	38
15	0575	0613	0652	0690	0728	0767	38
16	0805	0843	0882	0920	0958	0996	38
17	9.9 1034	1073	1111	1149	1187	1225	38
18	1263	1301	1339	1377	1415	1452	38
19	1490	1528	1566	1603	1641	1679	38
20	1716	1754	1792	1830	1867	1904	38
21	1942	1979	2017	2054	2092	2129	37
22	9.9 2166	2203	2241	2278	2315	2352	37
23	2390	2427	2464	2501	2538	2575	37
24	2612	2649	2686	2723	2760	2796	37
25	2833	2870	2907	2944	2980	3017	37
26	3054	3090	3127	3164	3200	3237	37
27	9.9 3273	3310	3346	3383	3419	3455	36
28	3492	3528	3564	3600	3637	3673	36
29	3709	3745	3781	3817	3854	3890	36
30	3926	3962	3998	4034	4069	4105	36
31	4141	4177	4213	4249	4284	4320	36
32	9.9 4356	4392	4427	4463	4498	4534	36
33	4570	4605	4641	4676	4712	4747	35
34	4782	4818	4853	4888	4924	4959	35
35	4994	5029	5065	5100	5135	5170	35
36	5205	5240	5275	5310	5345	5380	35
37	9.9 5415	5450	5485	5520	5555	5589	35
38	5624	5659	5694	5728	5763	5798	35
39	5832	5867	5902	5936	5971	6005	34
40	6040	6074	6109	6143	6177	6212	34
41	6246	6280	6315	6349	6383	6417	34
42	9.9 6451	6486	6520	6554	6588	6622	34
43	6656	6690	6724	6758	6792	6826	34
44	6860	6894	6927	6961	6995	7029	34
45	7062	7096	7130	7163	7197	7231	34
46	7264	7298	7331	7365	7398	7432	33
47	9.9 7465	7499	7532	7565	7599	7632	33
48	7665	7699	7732	7765	7798	7832	33
49	7865	7898	7931	7964	7997	8030	33
50	8063	8096	8129	8162	8195	8228	33
51	8261	8293	8326	8359	8392	8425	33
52	9.9 8457	8490	8523	8555	8588	8620	32
53	8653	8686	8718	8751	8783	8816	32
54	8848	8880	8913	8945	8978	9010	32
55	9042	9074	9107	9139	9171	9203	32
56	9235	9267	9300	9332	9364	9396	32
57	9.9 9428	9460	9492	9524	9556	9587	32
58	9619	9651	9683	9715	9747	9778	32
59	9810	9842	9873	9905	9937	9968	32

Digitized by Google

TABLE VIII. TO FIND THE LATITUDE BY DOUBLE ALTS. AND THE ELAPSED TIME.

Arg. RISING.

6 Hours.

M	0″	10″	20″	30″	40″	50″	D.
0	10.0 0000	0031	0063	0094	0125	0156	31
1	0188	0219	0250	0282	0313	0345	31
2	0376	0407	0438	0469	0501	0532	31
3	0563	0595	0626	0657	0689	0720	31
4	0751	0782	0813	0844	0875	0905	31
5	10.0 0936	0967	0998	1028	1059	1090	31
6	1121	1151	1182	1213	1244	1275	31
7	1305	1336	1367	1398	1428	1459	31
8	1490	1520	1550	1580	1611	1641	30
9	1671	1701	1732	1762	1792	1822	30
10	10.0 1853	1883	1913	1943	1973	2004	30
11	2034	2064	2094	2125	2155	2185	30
12	2215	2245	2275	2304	2334	2364	30
13	2394	2423	2453	2483	2512	2542	30
14	2572	2602	2631	2661	2691	2720	30
15	10 0 2750	2780	2810	2839	2869	2899	30
16	2928	2958	2987	3016	3045	3074	29
17	3104	3133	3162	3191	3220	3250	29
18	3279	3308	3337	3366	3396	3425	29
19	3454	3483	3512	3542	3571	3600	29
20	10.0 3629	3658	3687	3715	3744	3773	29
21	3801	3830	3859	3887	3916	3945	29
22	3974	4002	4031	4060	4088	4117	29
23	4146	4174	4203	4232	4261	4289	29
24	4318	4346	4374	4402	4430	4459	28
25	10.0 4487	4515	4543	4571	4600	4628	28
26	4656	4684	4712	4740	4769	4797	28
27	4825	4853	4881	4910	4938	4966	28
28	4994	5022	5050	5077	5105	5133	28
29	5160	5188	5216	5243	5271	5299	28
30	10.0 5327	5354	5382	5410	5437	5465	28
31	5493	5520	5548	5576	5604	5631	28
32	5659	5686	5713	5740	5768	5795	27
33	5822	5849	5876	5904	5931	5958	27
34	5985	6013	6040	6067	6094	6122	27
35	10.0 6149	6176	6203	6230	6258	6285	27
36	6312	6339	6365	6392	6419	6445	27
37	6472	6499	6526	6553	6579	6606	27
38	6633	6601	6686	6713	6740	6766	27
39	6793	6820	6847	6875	6900	6927	27
40	10.0 6954	6980	7006	7033	7059	7085	27
41	7111	7138	7164	7190	7217	7243	26
42	7269	7295	7322	7348	7374	7400	26
43	7427	7453	7479	7505	7532	7558	26
44	7584	7610	7636	7662	7687	7713	26
45	10.0 7739	7765	7791	7816	7842	7868	26
46	7894	7920	7945	7971	7997	8023	26
47	8049	8074	8100	8126	8152	8178	26
48	8203	8229	8254	8280	8305	8330	26
49	8356	8381	8406	8432	8457	8482	26
50	10.0 8508	8533	8558	8584	8609	8634	25
51	8660	8685	8710	8736	8761	8787	25
52	8812	8837	8862	8887	8911	8936	25
53	8961	8986	9011	9036	9061	9086	25
54	9111	9136	9160	9185	9210	9235	25
55	10.0 9260	9285	9310	9335	9360	9385	25
56	9409	9434	9458	9483	9507	9532	25
57	9556	9581	9605	9629	9654	9678	25
58	9703	9727	9752	9776	9801	9825	25
59	9850	9874	9899	9923	9947	9972	24

7 Hours

M	0″	10″	20″	30″	40″	50″	D.
0	10.0 9996						24
0	10.1	0020	0044	0068	0092	0116	24
1	0140	0164	0188	0212	0236	0260	24
2	0284	0308	0332	0356	0380	0404	24
3	0429	0453	0477	0501	0525	0549	24
4	0573	0596	0620	0643	0667	0691	24
5	10.1 0714	0738	0761	0785	0809	0832	24
6	0856	0879	0903	0926	0950	0974	24
7	0997	1021	1044	1068	1092	1115	24
8	1139	1162	1183	1208	1231	1255	23
9	10.1 1278	1301	1324	1347	1370	1393	23
10	1417	1440	1463	1486	1509	1532	23
11	1556	1579	1602	1625	1648	1671	23
12	1694	1717	1740	1763	1785	1808	23
13	1831	1854	1876	1899	1922	1945	23
14	10.1 1967	1990	2013	2036	2058	2080	23
15	2104	2126	2149	2172	2195	2217	23
16	2240	2263	2285	2307	2329	2352	22
17	2374	2396	2419	2441	2463	2486	22
18	2508	2530	2553	2575	2597	2619	22
19	10.1 2642	2664	2686	2709	2731	2753	22
20	2776	2798	2820	2841	2863	2885	22
21	2907	2929	2951	2973	2995	3017	22
22	3039	3061	3083	3104	3126	3148	22
23	3170	3192	3214	3236	3258	3280	22
24	10.1 3302	3323	3345	3366	3388	3409	21
25	3431	3452	3474	3495	3517	3538	21
26	3560	3581	3603	3624	3646	3667	21
27	3689	3711	3732	3753	3775	3796	21
28	3818	3839	3860	3881	3902	3923	21
29	10.1 3944	3966	3987	4008	4029	4050	21
30	4071	4092	4113	4134	4155	4176	21
31	4198	4219	4240	4261	4282	4303	21
32	4324	4345	4366	4386	4407	4428	21
33	4449	4469	4490	4511	4531	4552	21
34	10.1 4573	4593	4614	4635	4656	4676	21
35	4697	4718	4738	4759	4780	4800	21
36	4821	4842	4862	4882	4902	4923	20
37	4943	4963	4984	5004	5024	5045	20
38	5065	5085	5106	5126	5146	5166	20
39	10.1 5187	5207	5227	5248	5268	5288	20
40	5309	5329	5349	5369	5388	5408	20
41	5428	5448	5468	5488	5508	5528	20
42	5548	5568	5588	5608	5628	5648	20
43	5667	5687	5707	5727	5747	5767	20
44	10.1 5787	5807	5826	5846	5865	5885	20
45	5904	5924	5943	5963	5983	6002	20
46	6022	6041	6061	6080	6100	6119	20
47	6139	6158	6178	6197	6217	6237	20
48	6256	6275	6295	6314	6333	6352	19
49	10.1 6371	6390	6410	6429	6448	6467	19
50	6486	6505	6525	6544	6563	6582	19
51	6601	6620	6640	6659	6678	6697	19
52	6716	6735	6754	6773	6791	6810	19
53	6829	6848	6866	6885	6904	6923	19
54	10.1 6942	6960	6979	6998	7017	7035	19
55	7054	7073	7092	7111	7129	7148	19
56	7167	7185	7204	7222	7241	725	19
57	7277	7296	7314	7333	7351	7369	19
58	7388	7406	7425	7443	7462	748c	19
59	7498	7517	7535	7554	7572	759c	19

Digitized by Google

TABLE VIII. TO FIND THE LAT. BY DOUBLE ALTS. &c.

Arg RISING.

8 Hours.

M	0″	10″	20″	30″	40″	50″	D.
0	10.1 7609	7627	7645	7663	7681	7699	18
1	7717	7735	7753	7772	7790	7808	18
2	7826	7844	7862	7880	7898	7916	18
3	7934	7952	7970	7988	8006	8024	18
4	8042	8060	8078	8095	8113	8131	18
5	10.1 8148	8166	8184	8202	8219	8237	18
6	8255	8272	8290	8308	8325	8343	18
7	8361	8378	8396	8414	8431	8449	18
8	8467	8484	8501	8519	8536	8553	18
9	8571	8588	8605	8623	8640	8657	18
10	10.1 8675	8692	8709	8727	8744	8761	18
11	8779	8796	8813	8831	8848	8865	17
12	8883	8900	8917	8934	8951	8968	17
13	8985	9002	9019	9035	9052	9069	17
14	9086	9103	9120	9137	9154	9171	17
15	10.1 9188	9205	9222	9239	9256	9273	17
16	9290	9307	9323	9340	9356	9373	17
17	9390	9406	9423	9450	9466	9483	17
18	9489	9506	9523	9539	9556	9572	17
19	9589	9606	9622	9639	9656	9672	17
20	10.1 9689	9705	9721	9738	9754	9770	17
21	9786	9803	9819	9835	9851	9868	16
22	9884	9900	9917	9933	9949	9965	16
23	10.1 9982	9998					16
23	10.2		0014	0030	0047	0063	16
24	0079	0095	0111	0127	0143	0159	16
25	0175	0191	0206	0222	0238	0254	16
26	0270	0286	0302	0318	0334	0350	16
27	0366	0382	0398	0413	0429	0445	16
28	0461	0477	0492	0508	0523	0539	16
29	0555	0570	0586	0601	0617	0633	16
30	10.2 0648	0664	0679	0695	0710	0726	16
31	0742	0757	0773	0788	0804	0819	16
32	0835	0850	0865	0881	0896	0911	15
33	0926	0943	0957	0972	0987	1002	15
34	1018	1033	1048	1063	1079	1094	15
35	10.2 1109	1124	1140	1155	1170	1185	15
36	1201	1215	1230	1245	1260	1275	15
37	1290	1305	1320	1335	1350	1364	15
38	1379	1394	1409	1424	1439	1454	15
39	1469	1484	1499	1513	1528	1543	15
40	10.2 1558	1573	1587	1602	1616	1631	15
41	1645	1660	1675	1689	1704	1718	15
42	1733	1747	1762	1777	1791	1806	15
43	1820	1835	1849	1864	1878	1893	15
44	1908	1922	1936	1950	1964	1979	15
45	10.2 1993	2007	2021	2036	2050	2064	14
46	2078	2092	2107	2121	2135	2149	14
47	2164	2178	2192	2206	2221	2235	14
48	2249	2263	2277	2291	2305	2318	14
49	2332	2346	2360	2374	2388	2402	14
50	10.2 2416	2430	2444	2457	2471	2485	14
51	2499	2513	2527	2541	2555	2569	14
52	2583	2596	2610	2623	2637	2650	13
53	2664	2678	2691	2705	2718	2732	13
54	2745	2759	2773	2786	2800	2813	13
55	10.2 2827	2840	2854	2868	2881	2895	13
56	2908	2921	2935	2948	2961	2974	13
57	2988	3001	3014	3027	3040	3054	13
58	3067	3080	3093	3107	3120	3133	13
59	3146	3160	3173	3186	3199	3213	13
60	10.2 3226						

TABLE IX. The Moon's equatorial Semidiam. in Time.

Arg. H.Par	Arg Var in R.A. for 12 h. 5 30	6 0	6 30	7 0	7 30	8 0	Semidiam.
′ ″	S	S	S	S	S	S	′ ″
54 0	60, 8	60, 9	61, 1	61, 3	61, 5	61, 7	14 43
20	61, 2	61, 3	61, 5	61, 6	61, 8	62, 0	14 48
40	61, 6	61, 7	61, 9	62, 0	62, 2	62, 4	14 54
55 0	61, 9	62, 1	62, 3	62, 4	62, 6	62, 8	14 59
20	62, 3	62, 4	62, 6	62, 8	63, 0	63, 1	15 5
40	62, 6	62, 8	63, 0	63, 2	63, 4	63, 5	15 10
56 0	63, 0	63, 2	63, 4	63, 6	63, 8	63, 9	15 16
20	63, 4	63, 5	63, 7	63, 9	64, 1	64, 3	15 21
40	63, 7	63, 9	64, 1	64, 3	64, 5	64, 7	15 26
57 0	64, 1	64, 3	64, 5	64, 7	64, 9	65, 1	15 32
20	64, 5	64, 7	64, 8	65, 0	65, 2	65, 4	15 37
40	64, 9	65, 1	65, 2	65, 4	65, 6	65, 8	15 43
58 0	65, 3	65, 5	65, 6	65, 8	66, 0	66, 2	15 48
20	65, 6	65, 8	66, 0	66, 2	66, 3	66, 5	15 54
40	66, 0	66, 2	66, 4	66, 6	66, 7	66, 9	15 59
59 0	66, 4	66, 6	66, 8	67, 0	67, 1	67, 3	16 4
20	66, 8	66, 9	67, 2	67, 3	67, 5	67, 7	16 10
40	67, 2	67, 3	67, 6	67, 7	67, 9	68, 1	16 16
60 0	67, 5	67, 7	67, 9	68, 1	68, 3	68, 5	16 21
20	67, 9	68, 0	68, 2	68, 4	68, 6	68, 8	16 26
40	68, 2	68, 4	68, 6	68, 8	69, 0	69, 2	16 32
61 0	68, 6	68, 8	69, 0	69, 2	69, 4	69, 6	16 37
20	69, 0	69, 2	69, 4	69, 6	69, 8	70, 0	16 43
40	69, 4	69, 6	69, 8	70, 0	70, 2	70, 4	16 49
62 0	69, 8	70, 0	70, 2	70, 4	70, 6	70, 8	16 54

TABLE X. Increase of he Moon's equatorial Semidiam. in Time.

Moon's Declin.	Moon's equat. Semid. in Time. S 60	S 62	S 64	S 66	S 68	S 70
° ′	S	S	S	S	S	S
3 0	0, 1	0, 1	0, 1	0, 1	0, 1	0, 1
5 0	0, 2	0, 2	0, 2	0, 2	0, 3	0, 3
7 0	0, 5	0, 5	0, 5	0, 5	0, 5	0, 5
9 0	0, 8	0, 8	0, 8	0, 8	0, 8	0, 9
11 0	1, 1	1, 2	1, 2	1, 2	1, 3	1, 3
13 0	1, 5	1, 6	1, 7	1, 7	1, 8	1, 8
14 0	1, 8	1, 9	2 0	2, 0	2, 1	2, 1
15 0	2, 1	2, 2	2, 2	2, 3	2, 4	2, 5
16 0	2, 4	2, 5	2, 6	2, 7	2, 7	2, 8
17 0	2, 7	2, 8	2, 9	3, 0	3, 1	3, 2
18 0	3, 1	3, 2	3, 3	3, 4	3, 5	3, 6
19 0	3, 4	3, 6	3, 7	3, 8	3, 9	4, 0
20 0	3, 8	4, 0	4, 1	4, 2	4, 3	4, 5
21 0	4, 3	4, 4	4, 5	4, 7	4, 8	5, 0
22 0	4, 7	4, 9	5, 0	5, 2	5, 3	5, 5
23 0	5, 1	5, 3	5, 5	5, 7	5, 9	6, 0
24 0	5, 7	5, 9	6, 0	6, 2	6, 4	6, 6
24 30	5, 9	6, 1	6, 3	6, 5	6, 7	6, 9
25 0	6, 2	6, 4	6, 6	6, 8	7, 0	7, 2
25 30	6, 4	6, 7	6, 9	7, 1	7, 3	7, 5
26 0	6, 7	7, 0	7, 2	7, 4	7, 6	7, 8
26 30	7, 0	7, 3	7, 5	7, 8	8, 0	8, 2
27 0	7, 3	7, 6	7, 8	8, 1	8, 3	8, 6
27 30	7, 6	7, 9	8, 2	8, 4	8, 7	8, 9
28 0	7, 9	8, 2	8, 5	8, 7	9, 0	9, 3
28 30	8, 2	8, 5	8, 8	9, 1	9, 4	9, 6
29 0	8, 6	8, 9	9, 2	9, 5	9, 8	10, 0

Digitized by Google

D.	H. M.	D.	H. M.	D.	H. M.	D.	H. M.	D.	H. M.	D.	H. M.
1	0 4	31	2 4	61	4 4	91	6 4	121	8 4	151	10 4
2	0 8	32	2 8	62	4 8	92	6 8	122	8 8	152	10 8
3	0 12	33	2 12	63	4 12	93	6 12	123	8 12	153	10 12
4	0 16	34	2 16	64	4 16	94	6 16	124	8 16	154	10 16
5	0 20	35	2 20	65	4 20	95	6 20	125	8 20	155	10 20
6	0 24	36	2 24	66	4 24	96	6 24	126	8 24	156	10 24
7	0 28	37	2 28	67	4 28	97	6 28	127	8 28	157	10 28
8	0 32	38	2 32	68	4 32	98	6 32	128	8 32	158	10 32
9	0 36	39	2 36	69	4 36	99	6 36	129	8 36	159	10 36
10	0 40	40	2 40	70	4 40	100	6 40	130	8 40	160	10 40
11	0 44	41	2 44	71	4 44	101	6 44	131	8 44	161	10 44
12	0 48	42	2 48	72	4 48	102	6 48	132	8 48	162	10 48
13	0 52	43	2 52	73	4 52	103	6 52	133	8 52	163	10 52
14	0 56	44	2 56	74	4 56	104	6 56	134	8 56	164	10 56
15	1 0	45	3 0	75	5 0	105	7 0	135	9 0	165	11 0
16	1 4	46	3 4	76	5 4	106	7 4	136	9 4	166	11 4
17	1 8	47	3 8	77	5 8	107	7 8	137	9 8	167	11 8
18	1 12	48	3 12	78	5 12	108	7 12	138	9 12	168	11 12
19	1 16	49	3 16	79	5 16	109	7 16	139	9 16	169	11 16
20	1 20	50	3 20	80	5 20	110	7 20	140	9 20	170	11 20
21	1 24	51	3 24	81	5 24	111	7 24	141	9 24	171	11 24
22	1 28	52	3 28	82	5 28	112	7 28	142	9 28	172	11 28
23	1 32	53	3 32	83	5 32	113	7 32	143	9 32	173	11 32
24	1 36	54	3 36	84	5 36	114	7 36	144	9 36	174	11 36
25	1 40	55	3 40	85	5 40	115	7 40	145	9 40	175	11 40
26	1 44	56	3 44	86	5 44	116	7 44	146	9 44	176	11 44
27	1 48	57	3 48	87	5 48	117	7 48	147	9 48	177	11 48
28	1 52	58	3 52	88	5 52	118	7 52	148	9 52	178	11 52
29	1 56	59	3 56	89	5 56	119	7 56	149	9 56	179	11 56
30	2 0	60	4 0	90	6 0	120	8 0	150	10 0	180	12 0

TABLE XII.

To convert parts of the Equat. into M. Time.

D.	H. M. S.	D.	H. M. S.	D.	H. M. S.
′	M. S. T.	′	M. S. T.		
1	0 3 59	31	2 3 39	70	4 39 14
2	0 7 58	32	2 7 39	80	5 19 7
3	0 11 58	33	2 11 38	90	5 59 1
4	0 15 57	34	2 15 38	100	6 38 54
5	0 19 56	35	2 19 37	110	7 18 47
6	0 23 55	36	2 23 36	120	7 58 41
7	0 27 54	37	2 27 36	130	8 38 35
8	0 31 53	38	2 31 35	140	9 18 28
9	0 35 52	39	2 35 34	150	9 58 22
10	0 39 52	40	2 29 33	160	10 38 15
11	0 43 52	41	2 43 32	170	11 18 8
12	0 47 51	42	2 47 32	180	11 58 2
13	0 51 51	43	2 51 31	190	12 37 55
14	0 55 50	44	2 55 30	200	13 17 48
15	0 59 50	45	2 59 30	210	13 57 42
16	1 3 49	46	3 3 29	220	14 37 35
17	1 7 48	47	3 7 28	230	15 17 28
18	1 11 47	48	3 11 27	240	15 57 22
19	1 15 47	49	3 15 27	250	16 37 16
20	1 19 46	50	3 19 27	260	17 17 9
21	1 23 45	51	3 23 26	270	17 57 3
22	1 27 45	52	3 27 25	280	18 36 56
23	1 31 44	53	3 31 24	290	19 16 49
24	1 35 43	54	3 35 24	300	19 56 43
25	1 39 43	55	3 39 23	310	20 36 36
26	1 43 42	56	3 43 23	320	21 16 30
27	1 47 41	57	3 47 23	330	21 56 24
28	1 51 40	58	3 51 22	340	22 36 17
29	1 55 40	59	3 55 22	350	23 16 11
30	1 59 40	60	3 59 21	360	23 56 4

TABLE XIII.

To convert mean time into parts of the Equat.

H.	D. ′ ″	M. S.	D. ′ ″ ‴	M. S.	D. ′ ″ ‴
1	15 2 28	1	0 15 2	31	7 46 16
2	30 4 56	2	0 30 5	32	8 1 19
3	45 7 24	3	0 45 7	33	8 16 21
4	60 9 51	4	1 0 10	34	8 31 24
5	75 12 19	5	1 15 12	35	8 46 26
6	90 14 47	6	1 30 15	36	9 1 29
7	105 17 15	7	1 45 17	37	9 16 31
8	120 19 43	8	2 0 20	38	9 31 34
9	135 22 11	9	2 15 22	39	9 46 36
10	150 24 38	10	2 30 25	40	10 1 39
11	165 27 6	11	2 45 27	41	10 16 41
12	180 29 34	12	3 0 30	42	10 31 43
13	195 32 2	13	3 15 32	43	10 46 46
14	210 34 30	14	3 30 34	44	11 1 48
15	225 36 58	15	3 45 37	45	11 16 51
16	240 39 26	16	4 0 39	46	11 31 53
17	255 41 53	17	4 15 41	47	11 46 56
18	270 44 21	18	4 30 44	48	12 1 58
19	285 46 49	19	4 45 47	49	12 17 1
20	300 49 17	20	5 0 49	50	12 32 3
21	315 51 45	21	5 15 52	51	12 47 6
22	330 54 13	22	5 30 54	52	13 2 8
23	345 56 40	23	5 45 57	53	13 17 11
24	360 59 8	24	6 0 59	54	13 32 13
25	376 1 36	25	6 16 2	55	13 47 16
26	391 4 4	26	6 31 4	56	14 2 18
27	406 6 32	27	6 46 7	57	14 17 21
28	421 9 0	28	7 1 9	58	14 32 23
29	436 11 28	29	7 16 11	59	14 47 26
30	451 13 56	30	7 31 14	60	15 2 28

Digitized by Google

TABLE XIV.

To reduce the Time of the Paſſage of the Moon over the Meridian of Greenwich, to the Time of its Paſſage over any other Meridian.

Arg. T. fr. ☽'s ſouth.	Arg. Daily Retardation of the Moon in paſſing the Meridian. 40′	42′	44′	46′	48′	50′	52′	54′	56′	58′	60′	62′	64′	66′	Arg. Long.
ch o′	o′	o′	o′	o′	o′	o′	o′	o′	o′	o′	o′	o′	o′	o′	o°
0 20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5
0 40	1	1	1	1	1	1	1	1	1	2	2	2	2	2	10
1 0	2	2	2	2	2	2	2	2	2	2	2	2	3	3	15
1 20	2	2	2	2	3	3	3	3	3	3	3	3	3	4	20
1 40	3	3	3	3	3	3	3	4	4	4	4	4	4	4	25
2 0	3	3	4	4	4	4	4	4	4	5	5	5	5	5	30
2 20	4	4	4	4	5	5	5	5	5	5	6	6	6	6	35
2 40	4	4	5	5	5	5	6	6	6	6	6	7	7	7	40
3 0	5	5	5	6	6	6	6	7	7	7	7	7	8	8	45
3 20	5	6	6	6	6	7	7	7	7	8	8	8	9	9	50
3 40	6	6	7	7	7	7	8	8	8	9	9	9	9	10	55
4 0	6	7	7	7	8	8	8	9	9	9	10	10	10	11	60
4 20	7	7	8	8	8	9	9	9	10	10	10	11	11	11	65
4 40	7	8	8	9	9	9	10	10	10	11	11	12	12	12	70
5 0	8	9	9	9	10	10	10	11	11	12	12	12	13	13	75
5 20	9	9	9	10	10	11	11	12	12	12	13	13	14	14	80
5 40	9	10	10	11	11	11	12	12	13	13	14	14	14	15	85
6 0	10	10	11	11	12	12	13	13	13	14	14	15	15	16	90
6 20	10	11	11	12	12	13	13	14	14	15	15	16	16	17	95
6 40	11	11	12	12	13	13	14	14	15	15	16	17	17	18	100
7 0	11	12	12	13	14	14	15	15	16	16	17	17	18	18	105
7 20	12	12	13	14	14	15	15	16	16	17	18	18	19	19	110
7 40	12	13	14	14	15	15	16	17	17	18	18	19	20	20	115
8 0	13	14	14	15	15	16	17	17	18	19	19	20	20	21	120
8 20	13	14	15	15	16	17	17	18	19	19	20	21	21	22	125
8 40	14	15	15	16	17	17	18	19	19	20	21	21	22	23	130
9 0	14	15	16	17	17	18	19	20	20	21	22	22	23	24	135
9 20	15	16	17	17	18	19	20	20	21	22	22	23	24	25	140
9 40	15	16	17	18	19	19	20	21	22	22	23	24	25	25	145
10 0	16	17	18	19	19	20	21	22	22	23	24	25	26	26	150
10 20	16	18	18	19	20	21	22	22	23	24	25	26	26	27	155
10 40	17	18	19	20	21	21	22	23	24	25	26	26	27	28	160
11 0	17	19	20	20	21	22	23	24	25	26	26	27	28	29	165
11 20	18	19	20	21	22	23	24	25	25	26	27	28	29	30	170
11 40	18	20	21	22	23	23	24	25	26	27	28	29	30	31	175
12 0	19	20	21	22	23	24	25	26	27	28	29	30	31	32	180

TABLE XV.

ACCELERATION OF THE FIXED STARS IN MEAN TIME.

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

Digitized by Google

TABLE XVI. EQUATION OF THE TIME OF HIGH WATER.

Ap.time of ☽'s south.	Moon's Horizontal Parallax. 54′	55′	56′	57′	58′	59′	60′	61′	Ap.time of ☽'s south'g	Ap.time of ☽'s south'	Moon's Horizontal Parallax. 54′	55′	56′	57′	58′	59′	60′	61′	Ap. ti. of ☽'s south.
h. m.	add	add	add	add	add	add	add	add	h. m.	h. m.	sub	sub	sub	sub	sub	sub	sub	sub	h. m.
0 0	27′	26′	25′	23′	22′	21′	20′	19′	12 0	6 0	50′	47	45′	43′	41′	39′	37	35′	18 0
10	24	23	22	21	20	19	18	17	10	10	46	44	42	40	38	36	34	32	10
20	21	20	19	18	17	16	15	14	20	20	42	40	38	36	34	32	30	29	20
30	17	17	16	15	14	13	13	12	30	30	36	35	33	31	30	28	27	25	30
40	14	13	13	12	11	11	10	10	40	40	30	29	27	26	25	23	22	21	40
50	10	10	9	9	8	8	8	7	50	50	23	22	21	20	19	18	17	16	50
1 0	7	7	6	6	6	5	5	5	13 0	7 0	16	15	14	14	13	12	12	11	19 0
10	3	3	3	3	3	3′	3	2	10	10	8	8	7	7	7	6	6	6	10
20	sub	sub	sub	sub	sub	sub	sub	sub	20	20	add	add	add	add	add	add	add	add	20
30	3	3	3	3	3	3	3	2	30	30	8	8	7	7	7	6	6	6	30
40	7	7	6	6	6	5	5	5	40	40	16	15	15	14	13	12	12	11	40
50	10	10	9	9	8	8	8	7	50	50	23	22	21	20	19	18	17	16	50
2 0	14	13	13	12	11	11	10	10	14 0	8 0	30	29	27	26	25	23	22	21	20 0
10	17	17	16	15	14	13	13	12	10	10	36	35	33	31	30	28	27	25	10
20	21	20	19	18	17	16	15	14	20	20	42	40	38	36	34	32	30	29	20
30	24	23	22	21	20	19	18	17	30	30	46	44	42	40	38	36	34	32	30
40	27	26	25	23	22	21	20	19	40	40	50	47	45	43	41	39	37	35	40
50	30	29	28	26	25	24	22	21	50	50	53	50	48	45	43	41	39	37	50
3 0	34	32	30	29	27	26	25	23	15 0	9 0	55	52	50	47	45	42	40	38	21 0
10	37	35	33	31	30	28	27	25	10	10	56	54	51	48	46	44	41	39	10
20	40	38	36	34	32	30	29	27	20	20	57	55	52	49	47	44	42	40	20
30	42	40	38	36	34	33	31	29	30	30	58	55	52	50	47	45	42	40	30
40	45	43	41	39	37	35	33	31	40	40	58	55	52	50	47	45	42	40	40
50	47	45	43	41	39	37	35	33	50	50	57	54	52	49	47	44	42	40	50
4 0	49	47	45	43	40	38	36	34	16 0	10 0	56	53	51	48	46	43	41	39	22 0
10	52	49	47	44	42	40	38	36	10	10	55	52	50	17	45	42	40	38	10
20	53	51	48	46	44	41	39	37	20	20	53	51	48	46	44	41	39	37	20
30	55	52	50	47	45	42	40	38	30	30	52	49	47	44	42	40	38	36	30
40	56	53	51	48	46	43	41	39	40	40	49	47	45	43	40	38	36	34	40
50	57	54	52	49	47	44	42	40	50	50	47	45	43	41	39	37	35	33	50
5 0	58	55	52	50	47	45	42	40	17 0	11 0	45	43	41	39	37	35	33	31	23 0
10	58	55	52	50	47	45	42	40	10	10	42	40	38	36	34	33	31	29	10
20	57	55	52	49	47	44	42	40	20	20	40	38	36	34	32	30	29	27	20
30	56	54	51	48	46	44	41	39	30	30	37	35	33	31	30	28	27	25	30
40	55	52	50	47	45	42	40	38	40	40	34	32	30	29	27	26	25	23	40
50	53	50	48	45	43	41	39	37	50	50	30	29	28	26	25	24	22	21	50
6 0	50	47	45	43	41	39	37	35	18 0	12 0	27	26	25	23	22	21	20	19	24 0

TABLE XVII. HEIGHT OF THE TIDES.

☽'s sou. h. m.	☽ in Perigee.	☽ in mean Dist.	☽ in Apogee.	☽'s sou. h. m.
0 0	0.995 A + 0,149 B	0.883 A + 0.117 B	0.795 A + 0.082 B	12 0
0 40	1.104 A + 0.038 B	0.970 A + 0.030 B	0.874 A + 0.021 B	12 40
1 20	1.138 A + 0.000 B	1.000 A + 0.000 B	0.901 A + 0.000 B	13 20
2 0	1.104 A + 0.038 B	0.970 A + 0.030 B	0.874 A + 0.021 B	14 0
2 40	0.995 A + 0.149 B	0.883 A + 0.117 B	0.795 A + 0.082 B	14 40
3 20	0.853 A + 0.319 B	0,750 A + 0.250 B	0.676 A + 0.176 B	15 20
4 0	0.668 A + 0.527 B	0.587 A + 0.413 B	0.529 A + 0.290 B	16 0
4 40	0.460 A + 0.749 B	0.413 A + 0.587 B	0.327 A + 0.412 B	16 40
5 20	0.284 A + 0,958 B	0.250 A + 0.750 B	0.225 A + 0.527 B	17 20
6 0	0.133 A + 1.127 B	0.117 A + 0.883 B	0.105 A + 0.621 B	18 0
6 40	0.034 A + 1.238 B	0.030 A + 0.970 B	0.027 A + 0.682 B	18 40
7 20	0.000 A + 1.277 B	0.000 A + 1.000 B	0.000 A + 0.703 B	19 20
8 0	0,034 A + 1.238 B	0.030 A + 0.970 B	0.027 A + 0.682 B	20 0
8 40	0.133 A + 1.127 B	0.117 A + 0.883 B	0.105 A + 0.621 B	20 40
9 20	0.284 A + 0.958 B	0.250 A + 0.750 B	0.225 A + 0.527 B	21 2
10 0	0.460 A + 0.749 B	0.413 A + 0.587 B	0.372 A + 0.412 B	22 0
10 40	0.668 A + 0 527 B	0 587 A + 0.413 B	0.529 A + 0.290 B	22 40
11 20	0.853 A + 0 319 B	0.750 A + 0.250 B	0.676 A + 0.176 B	23 20
12 0	0.995 A + 0.149 B	0.883 A + 0.117 B	0.795 A + 0.082 B	24 0

Digitized by Google

TABLE XVIII.

DIFFERENCE BETWEEN THE MERIDIAN ALTITUDE OF AN OBJECT, AND ITS ALTITUDE ONE MINUTE BEFORE, OR AFTER THE TIME OF TRANSIT.

Arg. Lat.	Argument. Declination of the Object of the same name with the Latitude.												
	0°	2°	4°	6°	8°	10°	12°	14°	16°	18°	20°	22°	24°
0°	″′	56″2	28″1	18″7	14″0	11″1	9″2	7″9	6″9	6″0	5″4	4″9	4″4
2	56,2	*	56,1	28,0	18,6	13,9	11,1	9,2	7,8	6,8	5,9	5,3	4,8
4	28,1	56,1	*	55,8	27,8	18,5	13,8	11,0	9,1	7,7	6,7	5,9	5,2
6	18,7	28,0	55,8	*	55,4	27,5	18,3	13,6	10,8	8,9	7,6	6,6	5,8
8	14,0	18,6	27,8	55,4	*	54,9	27,3	18,1	13,4	10,7	8,8	7,5	6,4
10	11,1	13,9	18,5	27,6	54,9	*	54,2	26,9	7,8	13,2	10,5	8,6	7,3
12	9,2	11,1	13,8	18,3	27,3	54,2	*	53,4	26,5	17,5	13,0	10,3	8,4
14	7,9	9,2	11,0	13,6	18,1	26,9	53,4	*	52,5	26,0	17,1	12,7	9,8
16	6,9	7,8	9,1	10,8	13,4	17,8	26,5	52,5	*	51,4	25,4	16,7	12,4
18	6,0	6,8	7,7	8,9	10,7	13,2	17,5	26,0	51,4	*	50,3	24,8	16,4
20	5,4	5,9	6,7	7,6	8,8	10,5	13,0	17,1	25,4	50,3	*	49,0	24,2
22	4,9	5,3	5,9	6,6	7,5	8,6	10,3	12,6	16,8	24,8	49,0	*	47,7
24	4,4	4,8	5,2	5,8	6,4	7,3	8,4	10,0	12,4	16,3	24,2	47,7	*
26	4,0	4,3	4,7	5,2	5,7	6,3	7,1	8,2	9,8	12,1	15,9	23,5	46,2
28	3,7	4,0	4,3	4,6	5,0	5,5	6,2	6,9	8,0	9,5	11,7	15,4	22,7
30	3,4	3,6	3,9	4,2	4,5	4,9	5,5	6,0	6,8	7,8	9,2	11,3	14,9
32	3,1	3,3	3,5	3,8	4,1	4,4	4,8	5,2	5,8	6,6	7,5	8,9	10,9
34	2,9	3,1	3,3	3,5	3,7	4,0	4,3	4,6	5,1	5,6	6,3	7,3	8,5
36	2,7	2,8	3,0	3,2	3,4	3,6	3,8	4,1	4,5	4,9	5,4	6,1	7,0
38	2,5	2,6	2,8	2,9	3,0	3,2	3,4	3,6	4,0	4,3	4,7	5,2	6,0
40	2,3	2,4	2,6	2,7	2,8	3,0	3,1	3,1	3,6	3,8	4,1	4,5	5,0
42	2,2	2,3	2,4	2,5	2,6	2,7	2,9	3,0	3,1	3,5	3,6	4,0	4,3
44	2,0	2,1	2,2	2,3	2,4	2,5	2,6	2,7	2,9	3,1	3,3	3,5	3,8
46	1,9	2,0	2,0	2,1	2,2	2,3	2,4	2,5	2,6	2,8	3,0	3,1	3,3
48	1,8	1,8	1,9	2,0	2,0	2,1	2,2	2,3	2,4	2,5	2,6	2,8	3,0
50	1,7	1,7	1,8	1,8	1,9	1,9	2,0	2,1	2,2	2,3	2,4	2,5	2,6
55	1,3	1,4	1,5	1,5	1,5	1,6	1,6	1,7	1,7	1,8	1,9	1,9	2,0
60	1,1	1,2	1,2	1,2	1,2	1,3	1,3	1,3	1,4	1,4	1,4	1,5	1,5
70	0,7	0,7	0,7	0,7	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,9	0,9
80	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4

Arg. Lat.	Argument. Declination of the Object of a contrary name with the Latitude.												
	0°	2°	4°	6°	8°	10°	12°	14°	16°	18°	20°	22°	24°
0°	″′	56″2	28″1	18″7	14″0	11″1	9″2	7″9	6″9	6″0	5″4	4″9	4″4
2	56,2	28,2	18,7	14,0	11,2	9,3	7,9	7,0	6,2	5,5	5,0	4,5	4,1
4	28,1	18,7	14,0	11,2	9,3	8,0	7,0	6,2	5,5	5,0	4,5	4,1	3,8
6	18,7	14,0	11,2	9,3	8,0	6,9	6,1	5,5	4,9	4,5	4,2	3,9	3,6
8	14,0	11,2	9,3	8,0	7,0	6,2	5,6	5,0	4,6	4,2	3,9	3,6	3,4
10	11,1	9,3	8,0	7,0	6,2	5,6	5,0	4,6	4,2	3,9	3,6	3,4	3,2
12	9,2	7,9	7,0	6,2	5,6	5,1	4,6	4,3	3,9	3,7	3,4	3,2	3,0
14	7,9	6,9	6,1	5,5	5,1	4,6	4,2	3,9	3,7	3,4	3,2	3,0	2,8
16	6,9	6,1	5,5	5,0	4,6	4,2	3,9	3,7	3,4	3,2	3,0	2,9	2,7
18	6,0	5,5	4,9	4,6	4,2	3,9	3,6	3,4	3,2	3,0	2,9	2,7	2,6
20	5,4	4,9	4,5	4,2	3,9	3,6	3,4	3,2	3,0	2,9	2,7	2,6	2,4
22	4,9	4,5	4,2	3,9	3,6	3,4	3,2	3,0	2,9	2,7	2,6	2,4	2,3
24	4,4	4,1	3,8	3,6	3,4	3,2	3,0	2,8	2,7	2,6	2,4	2,4	2,2
26	4,0	3,8	3,5	3,3	3,2	3,0	2,8	2,7	2,5	2,4	2,3	2,2	2,1
28	3,7	3,5	3,3	3,1	2,9	2,8	2,6	2,5	2,4	2,3	2,2	2,1	2,0
30	3,4	3,2	3,0	2,9	2,7	2,6	2,5	2,4	2,3	2,2	2,1	2,0	2,0
32	3,1	3,0	2,8	2,7	2,6	2,5	2,4	2,3	2,2	2,1	2,0	1,9	1,8
34	2,9	2,8	2,6	2,5	2,4	2,3	2,2	2,1	2,0	2,0	1,9	1,8	1,8
36	2,7	2,6	2,5	2,4	2,3	2,2	2,1	2,0	1,9	1,9	1,8	1,7	1,7
38	2,5	2,4	2,3	2,2	2,1	2,1	2,0	1,9	1,8	1,8	1,7	1,7	1,6
40	2,3	2,2	2,2	2,1	2,0	2,0	1,9	1,8	1,8	1,7	1,6	1,6	1,5
42	2,2	2,1	2,0	2,0	1,9	1,8	1,8	1,7	1,7	1,6	1,6	1,5	1,5
44	2,0	1,9	1,9	1,8	1,8	1,7	1,7	1,6	1,6	1,5	1,5	1,4	1,4
46	1,9	1,8	1,8	1,7	1,7	1,6	1,6	1,5	1,5	1,4	1,4	1,4	1,3
48	1,8	1,7	1,7	1,6	1,6	1,5	1,5	1,4	1,4	1,4	1,3	1,3	1,3
50	1,7	1,6	1,6	1,5	1,5	1,4	1,4	1,4	1,3	1,3	1,3	1,2	1,2
55	1,3	1,3	1,3	1,3	1,3	1,2	1,2	1,2	1,2	1,1	1,1	1,1	1,0
60	1,1	1,1	1,1	1,1	1,1	1,0	1,0	1,0	1,0	1,0	0,9	0,9	0,9
70	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,6			
80	0,4	0,3	0,3	0,3	0,3								

Digitized by Google

TABLE XIX. TO REDUCE THE NUMBERS IN THE PRECEDING TABLE TO OTHER GIVEN INTERVALS OF TIME FROM NOON.

Argument. Interval between the Instant of Observation and Noon.

"	0′	1′	2′	3′	4′	5′	6′	7′	8′	9′	10′
0	0,0	1,0	4,0	9,0	16,0	25,0	36,0	49,0	64,0	81,0	100,0
1	0,0	1,0	4,1	9,1	16,1	25,2	36,2	49,2	64,3	81,3	100,3
2	0,0	1,1	4,1	9,2	16,2	25,3	36,4	49,5	64,5	81,6	100,7
3	0,0	1,1	4,2	9,3	16,4	25,5	36,6	49,7	64,8	81,9	101,0
4	0,0	1,1	4,3	9,4	16,5	25,7	36,8	49,9	65,1	82,2	101,3
5	0,0	1,2	4,3	9,5	16,7	25,8	37,0	50,2	65,3	82,5	101,7
6	0,0	1,2	4,4	9,6	16,8	26,0	37,2	50,4	65,6	82,8	102,0
7	0,0	1,3	4,5	9,7	16,9	26,2	37,4	50,6	65,9	83,1	102,3
8	0,0	1,3	4,6	9,8	17,1	26,3	37,6	50,9	66,1	83,4	102,7
9	0,0	1,3	4,6	9,9	17,2	26,5	37,8	51,1	66,4	83,7	103,0
10	0,0	1,4	4,7	10,0	17,4	26,7	38,0	51,4	66,7	84,0	103,4
11	0,0	1,4	4,8	10,1	17,5	26,9	38,2	51,6	67,0	84,3	103,7
12	0,0	1,4	4,8	10,2	17,6	27,0	38,4	51,8	67,2	84,6	104,0
13	0,0	1,5	4,9	10,3	17,8	27,2	38,6	52,1	67,5	84,9	104,4
14	0,1	1,5	5,0	10,4	17,9	27,4	38,8	52,3	67,8	85,3	104,7
15	0,1	1,6	5,1	10,6	18,1	27,6	39,0	52,5	68,1	85,6	105,1
16	0,1	1,6	5,1	10,7	18,2	27,7	39,3	52,8	68,3	85,9	105,4
17	0,1	1,6	5,2	10,8	18,3	27,9	39,5	53,1	68,6	86,2	105,7
18	0,1	1,7	5,3	10,9	18,5	28,1	39,7	53,3	68,9	86,5	106,1
19	0,1	1,7	5,4	11,0	18,6	28,3	39,9	53,5	69,2	86,8	106,4
20	0,1	1,8	5,4	11,1	18,8	28,4	40,1	53,8	69,4	87,1	106,8
21	0,1	1,8	5,5	11,2	18,9	28,6	40,3	54,0	69,7	87,4	107,1
22	0,1	1,9	5,6	11,3	19,1	28,8	40,5	54,3	70,0	87,7	107,5
23	0,1	1,9	5,7	11,4	19,2	29,0	40,7	54,5	70,3	88,0	107,8
24	0,2	2,0	5,8	11,6	19,4	29,2	41,0	54,8	70,6	88,4	108,2
25	0,2	2,0	5,8	11,7	19,5	29,3	41,2	55,0	70,8	88,7	108,5
26	0,2	2,1	5,9	11,8	19,7	29,5	41,4	55,3	71,1	89,0	108,9
27	0,2	2,1	6,0	11,9	19,8	29,7	41,6	55,5	71,4	89,3	109,2
28	0,2	2,2	6,1	12,0	19,9	29,9	41,8	55,8	71,7	89,6	109,6
29	0,2	2,2	6,2	12,1	20,1	30,1	42,0	56,0	72,0	89,9	109,9
30	0,3	2,3	6,3	12,3	20,3	30,3	42,3	56,3	72,3	90,3	110,3
31	0,3	2,3	6,3	12,4	20,4	30,4	42,5	56,5	72,5	90,6	110,6
32	0,3	2,4	6,4	12,5	20,5	30,6	42,7	56,7	72,8	90,9	111,0
33	0,3	2,4	6,5	12,6	20,7	30,8	42,9	57,0	73,1	91,2	111,3
34	0,3	2,5	6,6	12,7	20,8	31,0	43,1	57,3	73,4	91,5	111,7
35	0,3	2,5	6,7	12,8	21,0	31,2	43,3	57,5	73,7	91,8	112,0
36	0,4	2,6	6,8	13,0	21,2	31,4	43,6	57,8	74,0	92,2	112,4
37	0,4	2,6	6,9	13,1	21,3	31,5	43,8	58,0	74,3	92,5	112,7
38	0,4	2,7	6,9	13,2	21,5	31,7	44,0	58,3	74,5	92,8	113,1
39	0,4	2,7	7,0	13,3	21,6	31,9	44,2	58,5	74,8	93,1	113,4
40	0,4	2,8	7,1	13,4	21,8	32,1	44,4	58,8	75,1	93,4	113,8
41	0,5	2,8	7,2	13,6	21,9	32,3	44,7	59,0	75,4	93,8	114,1
42	0,5	2,9	7,3	13,7	22,1	32,5	44,9	59,3	75,7	94,1	114,5
43	0,5	2,9	7,4	13,8	22,2	32,7	45,1	59,5	76,0	94,4	114,8
44	0,5	3,0	7,5	13,9	22,4	32,9	45,3	59,8	76,3	94,7	115,2
45	0,6	3,1	7,6	14,1	22,6	33,1	45,5	60,0	76,6	95,1	115,6
46	0,6	3,1	7,7	14,2	22,7	33,3	45,8	60,3	76,8	95,4	115,9
47	0,6	3,2	7,7	14,3	22,9	33,4	46,0	60,6	77,1	95,7	116,3
48	0,6	3,2	7,8	14,4	23,0	33,6	46,2	60,8	77,4	96,0	116,6
49	0,7	3,3	7,9	14,6	23,2	33,8	46,5	61,1	77,7	96,4	117,0
50	0,7	3,4	8,0	14,7	23,4	34,0	46,7	61,4	78,0	96,7	117,4
51	0,7	3,4	8,1	14,8	23,5	34,2	46,9	61,6	78,3	97,0	117,7
52	0,8	3,5	8,2	15,0	23,7	34,4	47,2	61,9	78,6	97,4	118,1
53	0,8	3,5	8,3	15,1	23,8	34,6	47,4	62,1	78,9	97,7	118,4
54	0,8	3,6	8,4	15,2	24,0	34,8	47,6	62,4	79,2	98,0	118,8
55	0,8	3,7	8,5	15,3	24,2	35,0	47,8	62,7	79,5	98,3	119,2
56	0,9	3,7	8,6	15,5	24,3	35,2	48,1	62,9	79,8	98,7	119,5
57	0,9	3,8	8,7	15,6	24,5	35,4	48,3	63,2	80,1	99,0	119,9
58	0,9	3,9	8,8	15,7	24,7	35,6	48,5	63,5	80,4	99,3	120,3
59	1,0	3,9	8,9	15,9	24,8	35,8	48,8	63,7	80,7	99,7	120,6

Digitized by Google

TABLE XX. AMPLITUDES.

DECLINATION.

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

Digitized by Google

TABLE XX. AMPLITUDES.

DECLINATION.

Lat.	13°	14°	15°	16°	17°	18°	19°	20°	21°	22°	23°	23.28
°	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
1	13 0	14 0	15 0	16 0	17 0	18 0	19 0	20 0	21 0	22 0	23 0	23 28
2	13 0	14 1	15 1	16 1	17 1	18 1	19 1	20 1	21 1	22 1	23 1	23 29
3	13 1	14 1	15 1	16 1	17 1	18 2	19 2	20 2	21 2	22 2	23 2	23 30
4	13 2	14 2	15 2	16 2	17 3	18 3	19 3	20 3	21 3	22 3	23 4	23 32
5	13 3	14 3	15 4	16 4	17 4	18 4	19 5	20 5	21 5	22 5	23 6	23 34
6	13 4	14 5	15 5	16 5	17 6	18 6	19 7	20 7	21 7	22 6	23 8	23 36
7	13 6	14 6	15 7	16 7	17 8	18 8	19 9	20 9	21 10	22 10	23 11	23 39
8	13 8	14 8	15 9	16 10	17 10	18 11	19 12	20 12	21 13	22 14	23 14	23 43
9	13 10	14 11	15 11	16 12	17 13	18 14	19 15	20 16	21 16	22 17	23 18	23 47
10	13 12	14 13	15 14	16 15	17 16	18 17	19 18	20 19	21 20	22 21	23 23	23 51
11	13 15	14 16	15 17	16 18	17 20	18 21	19 22	20 23	21 25	22 26	23 27	23 56
12	13 18	14 19	15 21	16 22	17 24	18 25	19 26	20 28	21 30	22 31	23 33	24 1
13	13 21	14 23	15 24	16 26	17 28	18 29	19 31	20 33	21 35	22 37	23 38	24 7
14	13 24	14 26	15 28	16 30	17 32	18 34	19 36	20 38	21 40	22 43	23 45	24 14
15	13 28	14 30	15 33	16 35	17 37	18 39	19 42	20 44	21 47	22 49	23 52	24 21
16	13 32	14 35	15 37	16 40	17 42	18 45	19 48	20 51	21 53	22 56	23 59	24 28
17	13 36	14 39	15 42	16 45	17 48	18 51	19 54	20 57	22 1	23 4	24 7	24 36
18	13 41	14 44	15 47	16 51	17 54	18 58	20 1	21 5	22 8	23 12	24 15	24 45
19	13 46	14 49	15 53	16 57	18 1	19 5	20 8	21 12	22 16	23 20	24 25	24 54
20	13 51	14 55	15 59	17 3	18 8	19 12	20 16	21 21	22 25	23 30	24 34	25 4
21	13 57	15 1	16 6	17 10	18 15	19 20	20 25	21 29	22 34	23 39	24 45	25 15
22	14 2	15 7	16 13	17 18	18 23	19 28	20 33	21 39	22 44	23 50	24 55	25 26
23	14 9	15 14	16 20	17 25	18 31	19 37	20 43	21 49	22 55	24 1	25 7	25 38
24	14 15	15 21	16 27	17 34	18 40	19 46	20 53	21 59	23 0	24 13	25 19	25 51
25	14 22	15 29	16 36	17 42	18 49	19 56	21 3	22 10	23 18	24 25	25 32	26 4
26	14 30	15 37	16 44	17 52	18 59	20 7	21 14	22 22	23 30	24 38	25 40	26 18
27	14 37	15 45	16 53	18 1	19 9	20 18	21 26	22 34	23 43	24 52	26 1	26 33
28	14 46	15 54	17 3	18 11	19 20	20 29	21 38	22 47	23 57	25 6	26 16	26 48
29	14 54	16 3	17 13	18 22	19 32	20 41	21 51	23 1	24 11	25 22	26 32	27 5
30	15 3	16 13	17 23	18 34	19 44	20 54	22 5	23 16	24 27	25 38	26 49	27 23
31	15 13	16 24	17 34	18 45	19 57	21 8	22 19	23 31	24 43	25 55	27 7	27 41
32	15 23	16 34	17 46	18 58	20 10	21 22	22 35	23 47	25 0	26 13	27 26	28 0
33	15 34	16 46	17 59	19 11	20 24	21 37	22 51	24 4	25 18	26 32	27 46	28 21
34	15 45	16 58	18 11	19 25	20 39	21 53	23 7	24 22	25 37	26 52	28 7	28 42
35	15 56	17 11	18 25	19 40	20 55	22 10	23 25	24 41	25 57	27 13	28 29	29 5
36	16 9	17 24	18 39	19 55	21 11	22 27	23 44	25 1	26 18	27 35	28 53	29 29
37	16 22	17 38	18 55	20 11	21 28	22 46	24 3	25 21	26 40	27 58	29 17	29 55
38	16 35	17 53	19 10	20 28	21 47	23 5	24 24	25 43	27 3	28 23	29 44	30 21
39	16 50	18 8	19 27	20 46	22 6	23 26	24 46	26 7	27 28	28 49	30 11	30 49
40	17 5	18 25	19 45	21 5	22 26	23 47	25 9	26 31	27 54	29 17	30 40	31 19
41	17 20	18 42	20 3	21 25	22 48	24 10	25 33	26 57	28 21	29 46	31 11	31 51
42	17 37	19 0	20 23	21 46	23 10	24 34	25 59	27 24	28 50	30 16	31 43	32 24
43	17 55	19 19	20 44	22 8	23 34	25 0	26 26	27 53	29 20	30 49	32 18	32 59
44	18 13	19 39	21 5	22 32	23 59	25 26	26 55	28 23	29 53	31 23	32 54	33 37
45	18 33	20 0	21 28	22 57	24 25	25 55	27 25	28 56	30 27	31 59	33 33	34 16
46	18 54	20 23	21 53	23 23	24 53	26 25	27 57	29 30	31 3	32 38	34 14	34 59
47	19 16	20 47	22 18	23 50	25 23	26 57	28 31	30 6	31 42	33 19	34 57	35 43
48	19 39	21 12	22 45	24 20	25 55	27 30	29 7	30 44	32 23	34 3	35 44	36 31
49	20 3	21 38	23 14	24 51	26 28	28 6	29 45	31 25	33 7	34 49	36 33	37 22
50	20 29	22 7	23 45	25 24	27 3	28 44	30 26	32 9	33 53	35 39	37 26	38 17
51	20 57	22 36	24 17	25 59	27 41	29 25	31 9	32 55	34 43	36 32	38 23	39 15
52	21 25	23 8	24 52	26 36	28 21	30 8	31 56	33 45	35 36	37 29	39 24	40 18
53	21 57	23 42	25 28	27 16	29 4	30 54	32 45	34 38	36 33	38 30	40 29	41 26
54	22 30	24 18	26 7	27 58	29 50	31 43	33 38	35 35	37 34	39 36	41 40	42 39
55	23 5	24 57	26 49	28 43	30 39	32 36	34 35	36 36	38 40	40 47	42 56	43 53
56	23 43	25 38	27 34	29 32	31 31	33 33	35 36	37 42	39 51	42 4	44 20	45 24
57	24 24	26 22	28 22	30 24	32 28	34 34	36 43	38 54	41 9	43 27	45 50	46 59
58	25 7	27 10	29 14	31 21	33 29	35 40	37 54	40 12	42 33	44 59	47 30	48 43
59	25 54	28 1	30 10	32 21	34 35	36 52	39 12	41 37	44 6	46 40	49 21	50 38
60	26 44	28 56	31 10	33 27	35 47	38 10	40 38	43 10	45 47	48 31	51 24	52 47

Digitized by Google

TABLE XXI. VARIATIONS OF AMPLITUDES,

Answering to a change of one hundred Minutes in the Sun's Altitude.

Lat.	Amplitude towards the elevated Pole.						Lat.	Amplitude towards the depressed Pole.					
	0°	10°	20°	30°	40°	50°		0°	10°	20°	30°	40°	50°
°	′	′	′	′	′	′	°	′	′	′	′	′	′
1	2	2	2	2	2	3	1	2	2	2	2	2	3
2	3	3	3	4	4	5	2	3	3	3	4	5	6
3	5	5	5	6	6	8	3	5	5	5	6	7	9
4	6	6	7	8	8	11	4	6	6	7	8	9	12
5	8	8	9	10	10	14	5	8	8	9	10	12	15
6	10	10	11	12	12	16	6	10	10	11	12	14	17
7	12	12	13	14	14	19	7	12	12	13	14	16	19
8	14	14	15	16	17	21	8	14	14	15	17	19	22
9	16	16	17	18	19	24	9	16	16	17	19	22	25
10	18	18	19	20	22	27	10	18	18	20	22	25	28
11	19	20	21	22	24	29	11	19	20	22	24	27	31
12	21	22	23	24	26	32	12	21	22	24	26	29	34
13	23	24	25	26	28	34	13	23	24	26	28	31	37
14	25	26	27	28	30	37	14	25	26	28	30	33	40
15	27	28	29	30	33	40	15	27	28	30	32	35	43
16	29	29	30	32	35	43	16	29	30	32	34	37	46
17	31	31	32	34	38	46	17	31	32	34	36	39	49
18	33	33	34	37	41	49	18	33	34	36	38	41	52
19	35	35	37	40	44	52	19	35	36	38	40	45	55
20	37	37	39	42	47	55	20	37	38	40	43	48	58
21	39	39	41	44	49	58	21	39	40	42	45	50	61
22	41	41	43	46	51	62	22	41	42	44	47	53	64
23	43	43	45	48	54	65	23	43	44	46	50	56	68
24	45	45	47	50	57	68	24	45	46	48	52	59	72
25	47	48	50	53	60	72	25	47	48	51	55	62	75
26	49	50	52	55	63	75	26	49	50	52	57	65	78
27	51	52	54	57	66	78	27	51	52	55	59	68	81
28	53	54	56	60	69	81	28	53	54	57	62	71	85
29	55	56	59	62	72	84	29	55	56	59	65	74	88
30	58	59	62	65	75	88	30	58	59	62	68	77	92
31	60	61	64	68	78	91	31	60	61	64	70	80	96
32	62	63	66	71	81	95	32	62	63	66	73	83	100
33	65	66	69	74	84	99	33	65	66	69	76	86	104
34	67	68	71	77	87	103	34	67	69	73	79	89	108
35	70	71	74	80	90	107	35	70	72	76	82	93	112
36	72	74	77	83	93	111	36	72	74	78	85	96	116
37	75	77	80	86	97	115	37	75	77	81	88	100	120
38	77	80	83	89	100	119	38	77	79	83	91	104	124
39	80	83	87	93	104	123	39	80	82	86	94	108	128
40	83	86	90	97	108	128	40	83	85	90	98	112	133
41	87	89	93	100	112	133	41	87	89	94	102	115	138
42	90	92	96	103	115	137	42	90	92	96	105	120	143
43	93	96	99	107	120	142	43	93	95	101	108	123	148
44	97	99	102	110	125	147	44	97	99	104	112	128	153
45	100	102	106	115	128	152	45	100	102	107	117	132	160
46	103	106	110	118	133	158	46	103	105	111	122	137	165
47	107	109	113	123	138	163	47	107	109	115	125	142	172
48	112	114	118	127	143	168	48	112	113	119	130	147	177
49	115	117	122	132	148	175	49	115	117	124	135	153	183
50	120	122	127	137	153	182	50	120	121	127	140	158	190
51	123	126	131	142	158	187	51	123	125	132	145	163	196
52	128	131	136	147	165	192	52	128	130	137	150	170	205
53	133	136	141	152	170	200	53	133	135	142	155	177	212
54	138	141	146	157	177	208	54	138	140	147	162	183	220
55	143	146	151	163	183	217	55	143	145	152	167	190	228
56	148	152	157	168	190	225	56	148	151	159	173	197	238
57	153	157	162	175	197	233	57	153	156	164	180	205	247
58	160	164	170	183	205	242	58	160	163	171	187	213	257
59	167	171	177	190	213	252	59	167	170	178	195	222	268
60	173	177	183	198	222	262	60	173	177	186	203	232	278

Digitized by Google

TAB. XXII. Time in Seconds, answering to a change of 100′ of Alt. near the Hor.

Arg. Lat.	Arg. Declination North or South.															
	0°	3°	6°	9°	12°	13°	14°	15°	16°	17°	18°	19°	20°	21°	22°	23°	24°
2°	400	400	402	405	408	410	413	415	417	418	420	423	426	429	432	435	438
4	400	402	403	405	410	412	414	416	418	420	422	425	428	431	434	437	439
6	402	403	405	407	412	414	416	418	420	422	424	427	430	433	436	439	440
8	403	405	407	409	414	416	418	420	422	424	426	429	432	435	438	443	443
10	405	407	410	412	416	418	420	422	424	427	429	432	434	437	440	443	446
12	408	410	412	415	419	421	423	425	427	430	433	435	437	440	443	451	450
14	412	413	415	418	422	424	426	428	430	433	437	439	441	444	447	455	455
16	416	417	419	422	426	428	430	432	434	437	441	443	445	449	452	460	460
18	420	422	423	427	431	433	435	437	439	442	446	448	451	455	458	466	467
20	425	427	428	432	437	439	441	443	445	448	452	455	458	462	465	473	474
22	431	433	435	438	443	445	447	450	452	455	458	462	465	468	472	481	482
24	438	439	442	445	450	452	455	458	460	463	466	470	473	477	480	490	490
26	445	446	449	452	458	460	463	466	468	472	475	479	482	487	490	500	500
28	453	455	457	460	467	469	472	475	479	482	485	489	493	498	502	512	512
30	462	464	466	470	477	479	482	485	487	492	496	500	504	510	513	525	525
32	472	474	477	480	488	490	493	496	499	503	508	512	517	523	527	540	540
34	483	485	488	492	500	503	506	509	512	517	522	527	532	537	543	557	557
36	495	496	499	505	513	516	520	523	527	532	537	542	547	553	560	575	575
38	508	510	513	518	527	530	534	538	543	548	553	558	565	572	578	595	595

Arg. Lat.	Arg. Declination of the same name as the Latitude.																
	0°	3°	6°	9°	12°	13°	14°	15°	16°	17°	18°	19°	20°	21°	22°	23°	24°
40°	522	524	527	533	542	545	549	553	558	563	568	574	581	588	595	603	613
41	530	532	535	542	551	554	558	563	568	573	578	585	592	600	608	616	626
42	538	540	544	551	560	564	568	573	578	583	589	597	604	612	620	630	640
43	547	549	553	560	569	574	579	583	588	594	601	608	616	625	633	643	654
44	557	558	563	570	579	584	589	594	600	606	614	621	629	638	647	658	669
45	567	568	573	580	589	594	599	605	612	619	628	635	643	652	663	674	685
46	577	578	583	590	600	605	610	617	624	632	640	648	658	668	679	691	703
47	587	588	593	601	612	618	623	630	638	646	655	664	673	685	697	710	723
48	598	600	605	612	625	631	637	644	652	660	670	680	690	703	716	731	746
49	610	612	617	624	638	643	650	659	668	677	687	697	709	722	736	752	771
50	622	624	630	638	654	659	666	675	684	694	705	716	729	744	759	777	797
51	635	638	634	653	670	676	683	692	702	713	724	736	750	766	784	804	825
52	648	652	658	669	687	694	702	712	722	733	745	759	774	792	812	833	855
53	663	667	675	686	705	713	722	733	744	755	768	783	800	820	822	864	889
54	680	684	692	704	723	732	742	754	766	779	793	810	829	850	873	900	928
55	697	701	709	723	742	752	763	775	788	803	820	839	860	882	907	937	972
56	715	719	728	743	763	774	786	798	813	830	850	871	894	918	948	982	1023
57	735	739	749	764	786	798	810	824	841	860	882	904	930	960	993	1033	1080
58	755	760	770	789	811	823	837	853	871	892	917	943	973	1008	1047	1093	1148

Arg. Lat.	Arg. Declination of a contrary name to the Latitude.																
	0°	3°	6°	9°	12°	13°	14°	15°	16°	17°	18°	19°	20°	21°	22°	23°	24°
40°	522	524	527	535	543	547	552	557	562	567	573	580	587	594	602	610	620
41	530	532	535	543	552	557	562	567	572	577	583	590	597	605	613	622	633
42	538	540	545	552	562	567	572	577	582	588	595	602	609	617	626	636	647
43	547	549	553	562	572	577	582	587	593	600	607	614	622	630	639	650	662
44	557	559	563	572	582	587	593	598	605	612	618	626	635	644	654	666	679
45	567	569	573	582	593	598	604	610	617	624	632	640	649	660	671	683	697
46	577	579	584	593	605	610	616	623	631	638	646	655	665	677	688	702	717
47	587	589	595	604	618	623	629	637	646	653	661	671	683	695	708	722	738
48	598	600	606	616	632	637	643	652	661	670	679	688	701	714	728	743	760
49	610	612	618	629	647	651	658	668	678	687	697	707	720	735	751	767	785
50	622	625	631	643	661	667	675	684	695	705	716	728	742	758	775	793	813
51	635	638	645	658	677	683	692	703	713	724	736	751	765	783	801	820	843
52	648	652	660	674	694	701	710	722	733	745	758	774	791	810	830	851	877
53	663	667	676	691	712	720	730	742	756	768	781	798	817	839	862	887	915
54	680	684	693	709	731	740	751	763	776	791	806	825	847	871	896	925	955
55	697	702	711	728	752	763	775	787	800	816	835	857	880	905	934	968	1003
56	715	720	730	748	775	787	800	814	830	848	867	890	917	945	979	1018	1059
57	735	740	750	770	800	812	826	843	863	880	902	928	957	990	1030	1078	1131
58	755	760	772	793	827	840	855	874	896	915	941	970	1005	1043	1090	1144	1211

Digitized by Google

TABLE XXIII.

TO FIND THE TIME OF RISING AND SETTING OF A CELESTIAL OBJECT.

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

Google

TABLE XXIII.

TO FIND THE TIME OF RISING AND SETTING OF A CELESTIAL OBJECT.

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

Digitized by Google

TABLE XXIV.

FOR COMPUTING THE EQUATION OF EQUAL ALTITUDES.

Arg.	Arg. Interval between the Observations.														
t. of ace.	h.m. 3 20	h.m. 4 0	h.m. 4 40	h.m 5 20	h.m. 6 0	h.m. 6 40	h.m. 7 20	h.m. 8 0	h.m. 8 40	h.m. 9 20	h.m. 10 0	h m. 10 40	h. m. 11 20	h. m. 12 0
1°	19	19	20	20	21	21	22	22	23	24	25	26	28	29
2	38	39	39	40	41	42	43	45	46	48	50	52	55	58
3	57	58	59	60	62	63	65	67	69	72	75	79	83	87
4	77	78	79	80	82	84	87	90	93	96	100	105	110	116
5	96	97	99	100	103	106	108	112	116	120	126	132	138	145
6	115	116	118	120	123	127	130	134	139	144	151	158	166	174
7	134	136	138	140	144	148	152	157	162	168	176	184	194	204
8	154	156	158	161	165	169	174	180	186	193	202	211	221	233
9	173	176	179	182	186	191	196	203	210	218	228	238	250	263
10	193	196	200	203	207	213	219	226	234	243	254	265	279	293
11	213	216	220	224	228	234	240	248	256	268	280	290	306	323
12	232	236	240	245	250	257	264	273	282	293	306	320	336	354
13	253	257	261	266	272	279	287	296	307	318	332	347	365	385
14	273	277	282	287	294	301	310	320	331	344	358	375	394	415
15	293	298	303	309	316	324	333	344	356	370	385	403	423	446
16	314	319	324	330	338	347	357	368	381	396	412	431	453	478
17	335	340	345	352	360	369	380	392	406	422	440	460	483	509
18	356	361	367	374	383	393	404	417	432	448	467	489	513	541
19	377	383	389	397	406	416	428	442	457	475	495	518	544	574
20	399	404	411	419	429	440	453	467	483	502	523	548	575	607
21	421	427	434	442	452	464	477	492	510	530	552	577	607	640
22	443	449	456	466	476	488	502	518	537	557	581	608	638	673
23	465	472	480	489	500	513	528	544	564	585	610	638	671	707
24	488	495	503	513	525	538	554	571	591	614	640	670	704	742
25	511	518	527	537	550	564	580	598	619	643	670	701	737	777
26	534	542	551	562	575	589	606	626	648	673	701	734	771	813
27	558	566	576	587	600	616	634	654	677	702	733	766	805	849
28	582	591	601	613	627	643	661	682	706	733	765	800	840	986
29	607	616	626	639	653	670	689	711	736	765	797	834	876	924
30	632	641	652	665	680	698	718	741	767	796	830	868	912	962
31	658	668	679	692	708	726	747	771	798	829	864	904	949	1001
32	685	694	706	720	736	755	777	802	830	862	898	940	987	1041
33	711	722	734	748	765	785	808	833	862	896	934	977	1026	1082
34	739	750	762	777	795	815	839	865	896	930	970	1015	1066	1124
35	767	778	791	807	825	846	871	898	930	966	1007	1053	1106	1167
36	796	807	821	837	856	878	903	932	965	1002	1045	1093	1148	1211
37	825	837	852	868	888	911	937	968	1001	1039	1083	1133	1191	1256
38	856	868	883	900	921	944	971	1002	1038	1078	1123	1175	1235	1302
39	887	900	915	933	954	979	1007	1039	1075	1117	1164	1218	1280	1350
40	919	932	948	967	989	1014	1043	1077	1114	1157	1206	1262	1326	1398
41	952	966	982	1002	1024	1051	1081	1115	1155	1199	1250	1308	1374	1449
42	986	1000	1018	1038	1061	1088	1120	1155	1196	1242	1295	1354	1423	1500
43	1022	1036	1054	1075	1099	1127	1160	1197	1238	1287	1341	1403	1474	1554
44	1058	1073	1091	1113	1138	1167	1201	1239	1282	1332	1387	1453	1426	1609
45	1096	1111	1130	1152	1178	1209	1243	1283	1328	1380	1438	1504	1580	1666
46	1134	1151	1170	1193	1220	1252	1288	1329	1375	1429	1489	1558	1636	1726
47	1175	1192	1212	1236	1264	1296	1333	1376	1424	1479	1542	1613	1695	1787
48	1217	1234	1255	1280	1309	1343	1381	1425	1475	1532	1597	1671	1755	1851
49	1260	1278	1300	1326	1350	1390	1430	1476	1528	1587	1654	1730	1818	1917
50	1306	1324	1347	1373	1404	1440	1482	1529	1583	1644	1714	1793	1883	1986
51	1353	1372	1396	1423	1455	1492	1535	1584	1640	1703	1775	1857	1951	2058
52	1402	1422	1447	1475	1508	1547	1592	1642	1700	1766	1849	1925	2023	2133
53	1454	1475	1500	1529	1564	1604	1650	1703	1762	1831	1908	1996	2097	2212
54	1508	1529	1555	1586	1622	1664	1711	1766	1828	1900	1979	2071	2175	2294
55	1565	1587	1614	1646	1683	1726	1776	1832	1897	1970	2054	2148	2257	2380
56	1624	1647	1675	1709	1747	1792	1843	1902	1969	2045	2132	2230	2343	2471
57	1687	1711	1740	1775	1815	1861	1915	1976	2045	2124	2214	2316	2433	2566
58	1753	1778	1808	1844	1886	1934	1990	2053	2125	2207	2301	2407	2529	2667
59	1823	1849	1881	1919	1961	2011	2069	2135	2210	2296	2393	2503	2630	2773
60	1898	1925	1957	1996	2041	2094	2154	2222	2300	2389	2491	2605	2737	2887

Digitized by Google

TABLE XXIV. Part Second.

FOR COMPUTING THE EQUATION OF EQUAL ALTITUDES.

Arg. Decl. of the Sun.	Arg. Interval between the Observations.												
	h.m. 3 20	h.m. 4 0	h.m. 4 40	h.m. 5 20	h.m. 6 0	h.m. 6 40	h.m. 7 20	h.m. 8 0	h.m. 8 40	h.m. 9 20	h.m. 10 0	h.m. 10 40	h.m. 11 20
0°20	6	6	5	5	5	4	4	4	3	3	2	2	1
0 40	12	11	11	10	10	9	8	7	6	5	4	3	2
1 0	17	17	16	15	14	13	12	11	10	8	6	5	2
1 20	23	22	22	21	19	18	17	15	13	11	9	6	3
1 40	29	28	27	26	24	22	21	19	16	14	11	8	4
2 0	35	33	32	31	29	27	25	22	19	16	13	9	5
2 20	40	39	38	36	34	32	29	26	23	19	15	11	6
2 40	46	45	43	41	39	36	33	30	26	22	17	12	6
3 0	52	50	48	46	44	41	37	34	29	25	19	14	7
3 20	58	56	54	51	49	45	42	37	33	27	22	15	8
3 40	64	62	59	57	53	50	46	41	36	30	24	17	9
4 0	69	67	65	62	58	54	50	45	39	33	26	18	10
4 20	75	73	70	67	63	59	54	49	42	36	28	20	10
4 40	81	78	76	72	68	63	58	52	46	39	30	21	11
5 0	87	84	81	77	73	68	62	56	49	41	32	23	12
5 20	93	90	86	82	78	73	67	60	52	44	35	24	13
5 40	98	95	92	87	83	77	71	64	56	47	37	26	14
6 0	104	101	97	92	87	82	75	67	59	50	39	27	14
6 20	110	106	102	98	92	86	79	71	62	52	41	29	15
6 40	116	112	108	103	97	91	83	75	65	55	43	30	16
7 0	122	118	113	108	102	95	87	79	69	58	46	32	17
7 20	128	124	119	113	107	100	92	82	72	61	48	33	18
7 40	134	129	124	118	112	104	96	86	75	63	50	35	18
8 0	140	135	130	124	117	109	100	90	79	66	52	36	19
8 20	145	140	135	129	122	114	104	94	82	69	54	38	20
8 40	151	146	141	134	127	118	109	98	85	72	57	39	21
9 0	157	152	146	139	132	123	113	102	89	76	59	41	22
9 20	163	158	152	144	137	128	118	106	92	78	61	43	23
9 40	169	164	158	150	142	132	122	110	95	80	63	44	23
10 0	175	170	163	155	147	137	126	113	99	83	65	46	24
10 20	181	175	168	160	152	141	130	117	102	86	67	47	25
10 40	187	181	174	166	157	146	134	120	106	89	70	49	26
11 0	193	186	179	171	162	151	138	124	109	92	72	50	27
11 20	199	192	185	177	167	156	142	128	112	95	75	52	27
11 40	205	198	191	182	172	161	146	132	116	98	77	54	28
12 0	211	204	197	188	177	165	152	136	120	101	79	56	29
12 30	220	213	205	196	184	172	158	142	125	105	82	58	30
13 0	229	222	214	204	192	179	164	148	130	109	86	60	32
13 30	238	231	222	212	200	187	171	154	135	114	89	63	33
14 0	247	240	231	220	208	194	178	160	140	118	93	65	34
14 30	257	249	240	228	215	201	184	166	145	122	96	67	35
15 0	266	257	248	236	223	208	191	172	150	126	100	70	37
15 30	275	267	257	245	231	215	197	178	156	131	103	72	38
16 0	285	276	265	253	239	223	204	184	161	136	106	75	39
16 30	294	285	274	262	247	230	211	190	166	140	110	77	41
17 0	303	294	283	270	255	237	218	196	172	144	114	80	42
17 30	313	303	292	278	263	245	225	202	176	149	118	82	43
18 0	322	313	301	287	271	252	232	208	182	154	121	85	45
18 30	332	322	310	295	279	260	239	215	188	158	124	87	46
19 0	342	331	319	304	287	268	246	221	193	162	128	90	47
19 30	351	341	328	313	295	275	253	227	198	167	132	92	49
20 0	361	350	337	321	303	283	260	233	204	172	135	95	50
20 30	371	360	346	330	312	291	267	240	210	177	139	97	51
21 0	381	369	355	339	320	298	274	246	215	181	142	100	53
21 30	391	379	365	348	328	306	281	253	221	185	146	102	54
22 0	401	389	374	357	337	314	288	259	227	191	150	105	55
22 30	411	399	384	366	345	322	295	265	232	195	154	108	57
23 0	421	408	393	375	354	330	303	272	238	200	158	110	58
23 30	431	418	401	383	362	337	310	278	244	205	162	113	60

Digitized by Google

TABLE XXV.

CORRECTION OF EQUAL ALTITUDES, SUFFICIENTLY ACCURATE FOR SEA PURPOSES.

Declination of the same name with the Latitude.

Decl.	Lat. 10 deg. Hrs. bet. obs.			Lat. 20 deg. Hrs. bet obs.			Lat. 30 deg. Hrs. bet. obs.			Lat. 40 deg. Hrs. bet obs.			Lat. 50 deg. Hrs. bet. obs.			Lat 60 deg Hrs bet. obs			Decl.
°	6	5	4	6	5	4	6	5	4	6	5	4	6	5	4	6	5	4	°
	lec.	lec.	lec.	lec	lec	lec.	ec	lec	lec	lec.	lec	lec.	lec	lec	lec.	lec	lec.	lec	
0	3	3	3	6	5	5	9	9	8	14	13	13	20	19	18	28	28	27	0
1	3	3	3	5	5	5	9	9	8	14	13	12	19	19	18	28	27	27	1
2	2	2	2	5	5	5	9	8	8	13	13	12	19	18	18	28	27	26	2
3	2	2	2	5	5	5	8	8	7	13	12	12	18	18	17	28	27	26	3
4	2	2	2	5	5	4	8	8	7	13	12	12	18	17	17	27	26	25	4
5	1	1	1	5	4	4	8	7	7	12	12	11	18	17	17	27	26	25	5
6	1	1	1	5	4	4	8	7	6	12	11	11	17	17	16	27	25	24	6
7	1	1	1	5	4	4	7	7	6	12	11	11	17	16	16	26	25	24	7
8	1	1	1	4	4	3	7	7	6	11	11	10	17	16	16	26	24	23	8
9	1	1	1	4	4	3	7	6	6	11	10	10	16	15	15	25	23	23	9
10	1	1	0	4	3	3	7	6	5	11	10	10	16	15	15	24	23	22	10
11	1	0	0	4	3	3	6	6	5	10	10	9	15	15	14	23	22	22	11
12	0	0	0	3	3	2	6	6	5	10	9	9	15	14	14	22	21	21	12
13	0	0	0	3	2	2	6	5	5	9	9	8	14	14	13	21	21	20	13
14	0	0	0	3	2	2	5	5	5	9	8	8	13	13	12	20	20	19	14
15	1	0	0	3	2	2	5	5	4	8	8	7	13	12	12	19	19	18	15
16	1	1	0	2	2	1	5	4	4	8	7	7	12	12	11	18	18	17	16
17	1	1	0	2	2	1	4	4	3	7	7	6	11	11	10	17	17	16	17
18	1	1	1	1	1	1	4	3	3	6	6	5	10	10	9	16	15	15	18
19	1	1	1	1	1	1	3	3	2	6	5	5	9	9	8	15	14	13	19
20	1	1	1	1	1	0	3	2	2	5	5	4	8	8	7	14	13	12	20
21	1	1	1	1	0	0	2	2	1	4	3	3	7	6	6	12	11	10	21
22	1	1	1	0	0	0	1	1	0	3	2	2	5	5	5	8	8	8	22
23	1	1	0	0	0	0	0	0	0	2	1	0	3	2	2	5	5	4	23

Declination of a contrary name with the Latitude.

Declin.	Lat. 10 deg. Hrs. bet obs.			Lat 20 deg. Hrs. bet obs.			Lat. 30 deg Hrs. bet. obs.			Lat. 40 deg. Hrs. bet. obs.			Lat. 50 deg Hrs. bet. obs.			Lat. 60 deg. Hrs. bet. obs.			Declin.
°	6	5	4	6	5	4	6	5	4	6	5	4	6	5	4	6	5	4	°
	lec	lec	lec.	lec.	lec	lec	lec	lec.	lec.	lec	lec.	lec.	lec.	lec.	lec	lec	lec.	lec.	
0	3	3	3	6	5	5	9	9	8	14	13	13	20	19	18	28	28	27	0
1	3	3	3	6	6	6	9	9	9	14	13	13	20	19	18	29	28	27	1
2	3	3	3	6	6	6	9	9	9	14	14	13	20	19	18	29	28	27	2
3	3	3	4	6	6	6	10	9	9	14	14	13	20	19	18	29	28	27	3
4	4	4	4	6	6	6	10	10	9	14	14	13	20	19	19	29	29	28	4
5	4	4	4	6	7	6	10	10	10	15	14	14	20	19	19	29	29	28	5
6	4	4	4	7	7	7	10	10	10	15	14	14	20	20	19	29	29	28	6
7	4	4	4	7	7	7	10	10	10	15	14	14	20	20	19	29	28	27	7
8	4	4	4	7	7	7	10	10	10	15	14	14	20	20	19	29	28	27	8
9	4	4	4	7	7	7	10	10	10	15	15	14	20	20	19	28	28	27	9
10	5	5	5	7	7	7	10	10	10	15	15	14	20	19	19	28	28	27	10
11	5	5	5	7	7	7	10	10	10	14	14	14	19	19	18		27	27	11
12	5	5	5	7	7	7	10	10	10	14	14	14	19	19	18		27	26	12
13	5	5	5	7	7	7	10	10	9	14	14	14	19	19	18		26	26	13
14	5	5	5	7	7	7	10	9	9	14	14	14	18	18	17		25	25	14
15	5	5	5	7	7	7	9	9	9	14	14	13	18	18	17			24	15
16	5	5	5	6	6	6	9	9	9	13	13	13	17	17	17			23	16
17	5	5	5	6	6	6	9	9	8	12	12	12	16	16	16			22	17
18	4	4	4	6	6	6	9	8	8	12	12	12	15	15	15			21	18
19	4	4	4	6	6	6	8	8	8	11	11	11	14	14	14			19	19
20	4	4	4	5	5	5	8	7	7	10	10	10	13	13	13			17	20
21	4	4	4	5	5	5	7	7	7	9	9	9		11	11			14	21
22	3	3	3	4	4	4	6	6	5	7	7	7		9	9			11	22
23	2	2	2	2	2	2	3	3	3	4	4	4		5	5			7	23

This correction is subtractive when the *change* of Declination between the Observations increases the Sun's Altitudes, or approaches the observer; and additive when it lessens the Altitudes, or recedes from the observer.

Digitized by Google

TABLE XXVI.

ERROR OF OBSERVATION, ARISING FROM AN ERROR IN THE LINE OF COLLIMATION.

Arg. observ. angle	Arg. Error of the Line of Collimation.																							
	10	20	30	36	42	48	54	1 0	1 6	1 12	1 18	1 24	1 30	1 36	1 48	2 0	3 0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	1	1	1	0	2	0	2	0	3	0	3	0	4	0	5	0	5	0	6	0	7	0	9	0	11	0	24
10	0	1	1	2	3	0	4	0	4	0	6	0	7	0	8	0	9	0	11	0	12	0	14	0	18	0	22	0	49
12	0	1	2	2	3	0	4	0	5	0	7	0	8	0	9	0	11	0	13	0	15	0	17	0	21	0	26	0	59
14	0	1	2	3	4	0	5	0	6	0	8	0	9	0	11	0	13	0	15	0	17	0	20	0	25	0	31	1	9
16	0	1	2	3	4	0	6	0	7	0	9	0	11	0	13	0	15	0	17	0	20	0	23	0	29	0	35	1	19
18	0	1	3	4	5	0	6	0	8	0	10	0	12	0	14	0	17	0	19	0	22	0	25	0	32	0	40	1	30
20	0	1	3	4	5	0	7	0	9	0	11	0	13	0	16	0	19	0	22	0	25	0	28	0	36	0	44	1	40
22	0	1	3	4	6	0	8	0	10	0	12	0	15	0	18	0	21	0	24	0	27	0	31	0	39	0	49	1	50
24	0	1	3	5	7	0	9	0	11	0	13	0	16	0	19	0	23	0	26	0	30	0	34	0	43	0	54	2	0
26	0	2	4	5	7	0	9	0	12	0	15	0	18	0	21	0	25	0	28	0	33	0	37	0	47	0	58	2	10
28	0	2	4	6	8	0	10	0	13	0	16	0	19	0	23	0	27	0	31	0	35	0	40	0	51	1	3	2	21
30	1	2	4	6	8	0	11	0	14	0	17	0	20	0	24	0	28	0	33	0	38	0	43	0	55	1	8	2	31
32	1	2	5	6	9	0	12	0	15	0	18	0	22	0	26	0	30	0	35	0	40	0	46	0	58	1	12	2	42
34	1	2	5	7	9	0	12	0	16	0	19	0	23	0	28	0	33	0	38	0	43	0	49	1	2	1	17	2	53
36	1	2	5	7	10	0	13	0	17	0	20	0	25	0	29	0	35	0	40	0	46	0	52	1	6	1	22	3	4
38	1	2	6	8	11	0	14	0	18	0	22	0	26	0	31	0	37	0	42	0	49	0	55	1	10	1	27	3	15
40	1	3	6	8	11	0	15	0	19	0	23	0	28	0	33	0	39	0	45	0	51	0	59	1	14	1	32	3	26
42	1	3	6	9	12	0	15	0	20	0	24	0	29	0	35	0	41	0	47	0	54	1	2	1	18	1	37	3	37
44	1	3	7	9	12	0	16	0	21	0	25	0	31	0	37	0	43	0	50	0	57	1	5	1	22	1	42	3	48
46	1	3	7	10	13	0	17	0	22	0	27	0	32	0	38	0	45	0	52	1	0	1	8	1	26	1	47	4	0
48	1	3	7	10	14	0	18	0	23	0	28	0	34	0	40	0	47	0	55	1	3	1	12	1	30	1	52	4	12
50	1	3	8	11	14	0	19	0	24	0	29	0	35	0	42	0	50	0	57	1	6	1	15	1	35	1	57	4	24
52	1	3	8	11	15	0	20	0	25	0	31	0	37	0	44	0	52	1	0	1	9	1	19	1	39	2	3	4	36
54	1	4	8	12	16	0	20	0	26	0	32	0	39	0	46	0	54	1	3	1	12	1	22	1	44	2	8	4	48
56	1	4	9	12	16	0	21	0	27	0	33	0	41	0	48	0	57	1	5	1	15	1	25	1	48	2	14	5	0
58	1	4	9	13	17	0	22	0	28	0	35	0	42	0	50	0	59	1	8	1	18	1	29	1	53	2	19	5	13
60	1	4	9	13	18	0	23	0	29	0	36	0	44	0	52	1	1	1	11	1	21	1	33	1	58	2	25	5	27
62	1	4	10	14	18	0	24	0	31	0	38	0	46	0	54	1	4	1	14	1	25	1	37	2	2	2	31	5	40
64	1	4	10	14	19	0	25	0	32	0	39	0	48	0	56	1	7	1	17	1	28	1	41	2	7	2	38	5	53
66	1	4	10	15	20	0	26	0	33	0	41	0	50	0	59	1	9	1	20	1	32	1	45	2	12	2	44	6	7
68	1	4	11	15	21	0	27	0	34	0	43	0	52	1	1	1	12	1	23	1	35	1	49	2	17	2	50	6	21
70	1	5	11	16	21	0	28	0	36	0	44	0	53	1	3	1	14	1	26	1	39	1	53	2	23	2	56	6	36
72	1	5	12	16	22	0	29	0	37	0	46	0	55	1	6	1	17	1	29	1	42	1	57	2	28	3	3	6	51
74	2	5	12	17	23	0	30	0	38	0	47	0	57	1	8	1	20	1	33	1	46	2	1	2	33	3	10	7	6
76	2	5	13	18	24	0	31	0	40	0	49	1	0	1	11	1	23	1	36	1	50	2	6	2	39	3	17	7	22
78	2	6	13	18	25	0	33	0	41	0	51	1	2	1	13	1	26	1	40	1	54	2	10	2	45	3	24	7	38
80	2	6	13	19	26	0	34	0	43	0	53	1	4	1	16	1	29	1	43	1	58	2	15	2	51	3	31	7	54
82	2	6	14	20	27	0	35	0	44	0	55	1	6	1	19	1	32	1	47	2	3	2	20	2	57	3	39	8	12
84	2	6	14	20	28	0	36	0	46	0	57	1	8	1	22	1	36	1	51	2	7	2	25	3	3	3	46	8	29
86	2	7	15	21	29	0	37	0	47	0	59	1	11	1	25	1	39	1	55	2	12	2	30	3	10	3	55	8	47
88	2	7	15	22	30	0	39	0	49	1	1	1	14	1	27	1	43	1	59	2	17	2	36	3	17	4	3	9	6
90	2	7	16	23	31	0	40	0	51	1	3	1	16	1	30	1	46	2	3	2	21	2	41	3	24	4	11	9	25
92	2	7	17	23	32	0	42	0	53	1	5	1	19	1	34	1	50	2	7	2	26	2	47	3	31	4	20	9	45
94	2	8	17	24	33	0	43	0	55	1	8	1	22	1	37	1	54	2	12	2	31	2	53	3	38	4	30	10	6
96	2	8	18	25	34	0	45	0	57	1	10	1	25	1	40	1	58	2	17	2	37	2	59	3	46	4	40	10	28
98	2	8	18	26	35	0	46	0	59	1	12	1	28	1	44	2	2	2	22	2	43	3	5	3	54	4	50	10	50
100	2	8	19	27	37	0	48	1	1	1	15	1	31	1	48	2	7	2	27	2	49	3	12	4	3	5	0	11	14
102	2	9	20	28	38	0	50	1	3	1	18	1	34	1	52	2	11	2	32	2	55	3	19	4	11	5	11	11	38
104	3	9	20	29	39	0	51	1	5	1	21	1	37	1	56	2	16	2	38	3	1	3	26	4	21	5	22	12	4
106	3	9	21	30	41	0	53	1	8	1	24	1	41	2	0	2	21	2	43	3	8	3	33	4	30	5	34	12	30
108	3	10	22	31	42	0	55	1	10	1	27	1	45	2	5	2	26	2	49	3	14	3	41	4	40	5	46	12	58
110	3	10	22	32	44	0	57	1	13	1	30	1	49	2	9	2	32	2	56	3	21	3	50	4	51	5	59	13	27
112	3	10	23	34	46	1	0	1	15	1	33	1	53	2	14	2	37	3	3	3	29	3	58	5	5	6	13	13	58
114	3	11	24	35	48	1	2	1	18	1	37	1	57	2	19	2	43	3	10	3	37	4	8	5	14	6	27	14	30
116	3	11	25	36	49	1	4	1	22	1	41	2	2	2	25	2	50	3	17	3	46	4	17	5	26	6	43	15	5
118	3	12	26	38	51	1	7	1	25	1	45	2	7	2	31	2	57	3	25	3	55	4	28	5	39	7	0	15	41
120	3	12	27	39	53	1	10	1	28	1	49	2	12	2	37	3	4	3	33	4	5	4	39	5	53	7	16	16	19

Digitized by Google

TABLE XXVII. For correcting the Latitude computed from the Latitude by Account, two observed Altitudes of the Sun, and the Interval of Time between them.

The Sum or Difference of Unity, and the Number found by this Table must be taken: The Sum, when the Declination and Latitude are of different Names, and the Difference when of the same; except ⊙ under Pole, take the Sum.

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

Or the Numbers may be found by dividing the Natural Tangent of the Declination by the Natural Tangent of the Latitude.

Digitized by Google

TABLE XXVII. For correcting the Latitude computed from the Latitude by Account, two observed Altitudes of the Sun, and the Interval of Time between them.

The Sum or Difference of Unity, and the Number found by this Table must be taken: The Sum, when the Declination and Latitude are of different Names, and the Difference when of the same; except ⊙ under Pole, take the Sum.

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

Or the Numbers may be found by dividing the Natural Tangent of the Declination by the Natural Tangent of the Latitude.

Digitized by Google

TABLE XXVIII. For correcting the Latitude computed from two Altitudes of the Sun, &c. and the Interval of Time between them.

To be used when the Observations are on the *same* Side of Noon.

Arg. Mid. Time.	Arg. TIME NEAREST NOON.														
	h m 0 10	h.m. 0 20	h. m. 0 30	h..m 0 40	h.m. 0 50	h. m. 1 0	h.m. 1 10	h. m 1 20	h·m 1 30	h. m. 1 40	h. m. 1 50	h. m. 2 0	h. m. 2 10	h. m 2 20
h. m.														
0 10														
20	,003													
30	,005	,008												
0 40	,007	,012	,014											
50	,009	,016	,020	,023										
1 0	,011	,020	,026	,031	,034									
1 10	,013	,024	,033	,040	,045	,048								
20	,015	,028	,039	,048	,055	,060	,063							
30	,017	,032	,045	,057	,066	,073	,078	,081						
1 40	,019	,037	,053	,066	,077	,087	,094	,099	,102					
50	,022	,042	,059	,075	,089	,101	,116	,118	,123	,126				
2 0	,024	,047	,067	,085	,101	,115	,127	,137	,145	,150	,154			
2 10	,027	,052	,074	,095	,114	,131	,145	,158	,168	,176	,181	,185		
20	,030	,057	,083	,106	,128	,147	,164	,179	,192	,202	,210	,216	,220	
30	,033	,063	,092	,118	,142	,165	,185	,202	,218	,231	,241	,250	,256	
2 40	,036	,069	,101	,130	,158	,183	,206	,227	,245	,261	,274	,286	,294	
50	,039	,076	,111	,144	,175	,203	,229	,253	,275	,294	,310	,324	,336	
3 0	,043	,083	,122	,158	,193	,225	,254	,282	,307	,329	,349	,366	,381	
3 10		,091	,134	,174	,212	,248	,282	,313	,342	,367	,391	,412	,430	
20			,147	,192	,234	,274	,312	,347	,380	,410	,437	,462	,484	,503
30				,211	,258	,303	,346	,386	,423	,457	,489	,518	,544	,567
	h. m. 2 30	h. m	h. m											
30	,597	2 40	h. m	h. m.										
3 40	,663	,684	2 50	3 0	,285	,336	,383	,428	,470	,510	,546	,580	,611	,638
50	,749	,775	,797			,372	,425	,477	,525	,570	,612	,651	,687	,719
4 0	,847	,880	,907	,932			,474	,532	,587	,638	,687	,732	,774	,812
4 10	,961	1,001	1,035	1,065				,597	,659	,718	,774	,826	,876	,920
20	1,089	1,144	1,18	1,224					,745	,818	,877	,938	,996	1,049
30	1,263	1,317	1,368	1,414						,927	1,002	1,073	1,140	1,203

To be used when the Observations are on *different* Sides of Noon.

Arg. Mid. Time.	Arg. TIME NEAREST NOON.													
	h. m. 0 10	h. m. 0 20	h.m. 0 30	h. m. 0 40	h. m. 0 50	h·m. 1 0	h.m. 1 10	h.m. 1 20	h.m, 1 30	h. m. 1 40	h,m. 1 50	h.m. 2 0	h.m. 2 10
h. m													
0 10	,003	,008	,014	,023	,033	,045	,059	,075	,093	,112	,133	,156	,180
20	,005	,011	,020	,030	,043	,057	,073	,090	,110	,131	,158	,178	,204
30	,007	,015	,026	,038	,052	,068	,086	,105	,126	,149	,174	,200	
0 40	,009	,019	,032	,046	,062	,080	,099	,121	,144	,168	,194		
50	,011	,023	,03[illegible]	,054	,072	,091	,113	,136	,161	,187			
1 0	,013	,027	,044	,062	,082	,103	,127	,152	,179				
1 10	,015	,031	,050	,070	,092	,116	,141	,168					
20	,017	,036	,056	,078	,102	,128	,156						
30	,01[illegible]	,040	,063	,087	,113	,141							
1 40	,021	,044	,069	,096	,125								
50	,024	,049	,077	,106									
2 0	,026	,054	,084										
10	,029	,059											

Divide the Sum, or Difference of Unity, and the Number found in Table XXVII, by the Number from this Table.

Digitized by Google

TABLE XXIX.

FOR COMPUTING THE FINAL EFFECT OF PARALLAX ON THE DISTANCE BETWEEN THE MOON AND THE SUN, OR A FIXED STAR.

Arg. APPARENT DISTANCE.

Arg. Par. in Alt. or Dist. — Add the Difference of the two Numbers taken out of this Table, if the Apparent Distance is less than 90°, and Subtract it if above.

Arg.	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°	85°
											120	115	110	105	100	95
Min.	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″
5	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
8	3	2	2	1	1	1	1	1	0	0	0	0	0	0	0	0
10	5	3	2	2	2	1	1	1	1	1	1	0	0	0	0	0
11	6	4	3	2	2	2	1	1	1	1	1	1	0	0	0	0
12	7	5	3	3	2	2	1	1	1	1	1	1	1	0	0	0
13	8	6	4	3	3	2	2	1	1	1	1	1	1	1	0	0
14	10	6	5	4	3	2	2	2	1	1	1	1	1	1	0	0
15	11	7	5	4	3	3	2	2	2	1	1	1	1	1	0	0
16	13	8	6	5	4	3	3	2	2	2	1	1	1	1	0	0
17	14	9	7	5	4	4	3	3	2	2	1	1	1	1	0	0
18	16	11	8	6	5	4	3	3	2	2	2	1	1	1	1	0
19	18	12	9	7	5	4	4	3	3	2	2	1	1	1	1	0
20	20	13	10	7	6	5	4	3	3	2	2	2	1	1	1	0
21	22	14	11	8	7	5	5	4	3	3	2	2	1	1	1	0
22	24	16	12	9	7	6	5	4	4	3	2	2	2	1	1	0
23	26	17	13	10	8	7	6	5	4	3	3	2	2	1	1	0
24	28	19	14	11	9	7	6	5	4	4	3	2	2	1	1	0
25	31	20	15	12	9	8	6	5	5	4	3	3	2	2	1	1
26	33	22	16	13	10	8	7	6	5	4	3	3	2	2	1	1
27	36	24	17	13	11	9	8	6	5	4	4	3	2	2	1	1
28	89	26	19	15	12	10	8	7	6	5	4	3	2	2	1	1
29	42	27	20	16	13	10	9	7	6	5	4	3	3	2	1	1
30	45	29	22	17	14	11	9	8	7	5	5	4	3	2	1	1
31	48	31	23	18	15	12	10	8	7	6	5	4	3	2	2	1
32	51	33	25	19	15	13	11	9	7	6	5	4	3	2	2	1
33	54	35	26	20	16	14	11	10	8	7	5	4	3	3	2	1
34	57	38	28	22	17	14	12	10	8	7	6	5	4	3	2	1
35	61	40	29	23	19	15	13	11	9	7	6	5	4	3	2	1
36	64	42	31	24	20	16	13	11	9	8	7	5	4	3	2	1
37	68	45	33	26	21	17	14	12	10	8	7	6	4	3	2	1
38	71	47	35	27	22	18	15	13	11	9	7	6	5	3	2	1
39	75	50	36	28	23	19	16	13	11	9	8	6	5	4	2	1
40	79	52	38	30	24	20	17	14	12	10	8	7	5	4	2	1
41	83	55	40	31	25	21	17	15	12	10	8	7	5	4	3	1
42	87	57	42	33	27	22	18	15	13	11	9	7	6	4	3	1
43	91	60	44	35	28	23	19	16	14	11	9	8	6	5	3	1
44	96	63	46	36	29	24	20	17	14	12	10	8	6	5	3	2
45	100	66	49	38	31	25	21	18	15	12	10	8	6	5	3	2
46	105	69	51	40	32	26	22	18	15	13	11	9	7	5	3	2
47	109	72	53	41	33	28	23	19	16	13	11	9	7	5	3	2
48	114	75	55	43	35	29	24	20	17	14	12	9	7	5	4	2
49	119	78	58	45	36	30	25	21	18	15	12	10	8	6	4	2
50	124	81	60	47	38	31	26	22	18	15	13	10	8	6	4	2
51	128	85	62	49	39	32	27	23	19	16	13	11	8	6	4	2
52	134	88	65	51	41	34	28	24	20	17	14	11	9	6	4	2
53	139	91	67	53	42	35	29	25	21	17	14	11	9	7	4	2
54	144	95	70	55	44	36	30	25	21	18	15	12	9	7	4	2
55	149	98	72	57	46	38	31	26	22	18	15	12	10	7	5	2
56	155	102	75	59	47	39	33	27	23	19	16	13	10	7	5	2
57	160	106	78	61	49	40	34	28	24	20	16	13	10	8	5	2
58	166	109	81	63	51	42	35	29	25	21	17	14	11	8	5	2
59	172	113	83	65	53	43	36	30	25	21	18	14	11	8	6	2
60	178	117	86	67	54	45	37	31	26	22	18	15	11	8	6	2
61	184	121	89	70	56	46	39	32	27	23	19	15	12	9	6	2
62	190	125	92	72	58	48	40	34	28	23	19	16	12	9	6	2

Digitized by Google

TABLE XXX.

RIGHT ASCENSIONS AND DECLINATIONS OF THE PRINCIPAL FIXED STARS, ADAPTED TO THE BEGINNING OF THE YEAR 1805.

Names of Stars.		Mag.	Rt. Ascension in time	Ann. Var.	Declination.	Ann. Var.
γ Pegasi	Algenib	2	oh. 3m. 12s.	3.s.06	14°5′ 55″ N	+ 20.″0
α Cassiopeiæ	Sehedar	3	0 29 30	3.31	55 27 58 N	+ 19.9
α Ursæ Minoris	Alruccabah. p.S	2.3	0 53 25	12.89	88 16 3 N	+ 19.6
β Andromedæ	Miracb	2	0 58 50	3.30	34 35 10 N	+ 19.4
α Eridani	Achernar	1	1 30 26	2.25	58 18 10 S	— 18.5
γ Andromedæ	Almach	2	1 51 59	3.61	41 23 17 N	+ 17.7
α Arietis *		2.3	1 56 12	3.33	22 32 8 N	+ 17.5
α Ceti	Menkar	2	2 52 6	3.12	3 20 11 N	+ 14.6
β Persei	Algol	Vari.	2 55 31	3.85	40 11 44 N	+ 14.4
η Pleiadum	Alcyone	3	3 35 35	3.54	23 20 36 N	+ 11.7
α Tauri *	Aldebaran	1	4 24 44	3.42	16 6 24 N	+ 8.1
α Aurigæ	Capella	1	5 2 18	4.41	45 47 16 N	+ 5.0
β Orionis	Rigel	1	5 5 9	2.87	8 26 10 S	— 4.8
β Tauris		2	5 13 58	3.78	28 25 50 N	+ 4.0
γ Orionis	Bellatrix	2	5 14 41	3.21	6 9 43 N	+ 4.0
δ Orionis		2	5 22 3	3.06	0 28 9 S	— 3.3
ε Orionis		2	5 26 19	3.04	1 20 7 S	— 3.0
ζ Orionis		2	5 30 56	3.02	2 3 19 S	— 2.6
α Columbæ		2	5 32 36	2.17	34 11 3 S	— 2.4
α Orionis	Betelguese	1	5 44 37	3.24	7 21 34 N	+ 1.4
α Navis	Canopus	1	6 19 38	1.33	52 35 36 S	+ 1.7
α Canis Majoris	Sirius	1	6 36 32	2.65	16 27 26 S	+ 4.3
α Geminorum	Castor	1.2	7 22 8	3.85	32 18 15 N	— 6.9
α Canis Minoris	Procyon	1.2	7 29 6	3.14	5 43 34 N	— 7.5
β Geminorum *	Pollux	2.3	7 33 21	3.69	28 29 0 N	— 7.9
ε Navis		2	8 18 31	1.25	58 53 15 S	+ 11.4
α 2 Canori	Acubens	4.3	8 47 48	3.29	12 36 26 N	— 13.2
α Hydræ	Alphard	2	9 18 0	2.93	7 49 10 S	+ 15.2
α Leonis *	Regulus	1	9 57 58	3.20	12 54 55 N	— 17.2
β Ursæ Majoris		2	10 49 59	3.71	57 25 36 N	— 19.1
α Ursæ Majoris	Dubhe	2.1	10 51 35	3.85	62 48 21 N	— 19.2
β Leonis	Deneb	2.1	11 39 5	3.06	15 39 49 N	— 19.9
γ Corvi	Algorab	3	12 5 47	3.08	16 27 30 S	+ 20.0
α Crucis		1	12 15 53	3.24	62 1 6 S	+ 20.0
γ Crucis		2	12 20 26	3.24	56 1 2 S	+ 20.0
ε Ursæ Majoris	Alioth	2	12 45 24	2.40	57 1 17 N	— 19.7
ε Virginis	Vindemiatrix	3	12 52 28	3.00	12 0 41 N	— 19.5
α Virginis *	Spica Virginis	1	13 14 56	3.13	10 8 15 S	+ 18.9
η Ursæ Majoris	Benetnach	2	13 39 51	2.39	50 17 32 N	— 18.1
α Bootis	Arcturus	1	14 6 46	2.72	20 12 10 N	— 19.1
γ Bootis	Seginus	3	14 24 13	2.43	39 10 1 N	— 16.2
α Centauri		1	14 26 54	4.45	60 1 57 S	+ 16.1
α 2 Libræ	Zubenesch	2.3	14 40 6	3.29	15 13 16 S	+ 15.3
α Coronæ Borealis	Alphacca	2	15 26 26	2.53	27 22 53 N	— 12.4
β Scorpii		2	15 54 7	3.47	19 15 34 S	+ 10.5
α Scorpii *	Antares	1	16 17 28	3.64	25 59 5 S	+ 8.7
α Herculis	Ras Algethi	2.3	17 5 46	2.73	14 37 22 N	— 4.7
λ Scorpii	Lesath	3.2	17 20 23	4.06	36 36 45 S	+ 3.5
α Ophiuchi	Ras Alhague	2	17 26 43	2.77	12 42 52 N	— 3.0
γ Draconis	Rastaben	3	17 52 5	1.39	51 31 2 N	— 0.7
α Lyræ	Vega	1	18 30 20	2.03	38 36 27 N	+ 2.6
β Cygni	Albireo	3	19 22 51	2.42	27 33 30 N	+ 7.1
α Aquilæ *	Atair	1.2	19 41 16	2.92	8 21 39 N	+ 8.5
α Pavonis		1.2	20 10 8	4.84	57 22 28 S	— 10.7
α Cygni	Deneb	1.2	20 34 47	2.03	44 35 22 N	+ 12.5
α Cephei	Alderaimin	3	21 13 54	1.43	61 45 46 N	+ 15.0
α Gruis		2	21 55 52	3.85	44 53 43 S	— 17.1
α Pisc. Australis *	Fomalhaut	1	22 46 51	3.33	30 39 7 S	— 19.0
β Pegasi	Scheat	2	22 54 19	2.87	27 1 33 N	+ 19.2
α Pegasi *	Markab	2	22 55 3	2.96	14 9 34 N	+ 19.2
α Andromedæ	Alpheratz	2	23 58 19	3.06	28. 0 53 N	+ 20.0

Digitized by Google

TABLE XXXI. PART FIRST
OF PRECESSION IN RIGHT ASCENSION, FOR COMPLETE YEARS.

Y.	Precefs.	Y.	Precefs.	Y.	Precefs.	Y.	Precefs.	Y.	Precefs.	Y.	Precefs.
1	0′46″.0	11	8′26″.5	21	16′ 7″.0	31	23′47″.5	41	31′28″.0	55	0°42′12″.6
2	1 32.1	12	9 12.6	22	16 53.1	32	24 33.5	42	32 14.0	60	0 46 2.9
3	2 18.1	13	9 58.6	23	17 39.1	33	25 19.6	43	33 0.1	65	0 49 53.1
4	3 4.2	14	10 44.7	24	18 25.2	34	26 5.6	44	33 46.1	70	0 53 43.4
5	3 50.2	15	11 30.7	25	19 11.2	35	26 51.7	45	34 32.2	75	0 57 33.6
6	4 36.3	16	12 16.8	26	19 57.2	36	27 37.7	46	35 18.2	80	1 1 23.8
7	5 22.3	17	13 2.8	27	20 43.3	37	28 23.8	47	39 4.3	85	1 5 14.1
8	6 8.4	18	13 48.9	28	21 29.3	38	29 9.8	48	36 50.3	90	1 9 4.3
9	6 54.4	19	14 34.9	29	22 15.4	39	29 55.9	49	37 36.4	95	1 12 54.6
10	7 40.5	20	15 21.0	30	23 1.4	40	30 41.9	50	38 22.4	100	1 16 44.8

TABLE XXXII. TO FIND PART SECOND
OF PRECESSION IN RT. ASCENSION; & THE PRECESSION IN DECLIN.

Arg. Right Af. Star.		Arg. Complete Years.												Arg. Rt Af. Star.	
		1	2	3	4	5	6	7	8	9	10	20	50		
+	—	″	″	″	″	″	″	″	″	″	″	″	″	+°	—°
0°	180°	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	180	360
1	181	0.3	0.7	1.0	1.4	1.7	2.1	2.4	2.8	3.1	3.5	7.0	17.4	179	359
2	182	0.7	1.4	2.1	2.8	3.5	4.2	4.9	5.6	6.3	7.0	14.0	34.9	178	358
3	183	1.0	2.1	3.1	4.2	5.2	6.3	7.3	8.4	9.4	10.5	20.9	52.3	177	357
4	184	1.4	2.8	4.2	5.6	7.0	8.4	9.8	11.2	12.6	13.9	27.9	69.7	176	356
5	185	1.7	3.5	5.2	7.0	8.7	10.5	12.2	13.9	15.7	17.4	34.8	87.1	175	355
6	186	2.1	4.2	6.3	8.4	10.4	12.5	14.6	16.7	18.8	20.9	41.8	104.5	174	354
7	187	2.4	4.9	7.3	9.7	12.2	14.6	17.1	19.5	21.9	24.4	48.7	121.8	173	353
8	188	2.8	5.6	8.3	11.1	13.9	16.7	19.5	22.3	25.0	27.8	55.6	139.1	172	352
9	189	3.1	6.3	9.4	12.5	15.6	18.8	21.9	25.0	28.1	31.3	62.5	156.4	171	351
10	190	3.5	6.9	10.4	13.9	17.4	20.8	24.3	27.8	31.2	34.7	69.4	173.6	170	350
11	191	3.8	7.6	11.4	15.3	19.1	22.9	26.7	30.5	34.3	38.1	76.3	190.7	169	349
12	192	4.2	8.3	12.5	16.6	20.8	24.9	29.1	33.2	37.4	41.6	83.1	207.8	168	348
13	193	4.5	9.0	13.5	18.0	22.5	27.0	31.5	36.0	40.5	45.0	89.9	224.8	167	347
14	194	4.8	9.7	14.5	19.3	24.2	29.0	33.9	38.7	43.5	48.4	96.7	241.8	166	346
15	195	5.2	10.3	15.5	20.7	25.9	31.0	36.2	41.4	46.6	51.7	103.5	258.7	165	345
16	196	5.5	11.0	16.5	22.0	27.5	33.1	38.6	44.1	49.6	55.1	110.2	275.5	164	344
17	197	5.8	11.7	17.5	23.4	29.2	35.1	40.9	46.8	52.6	58.4	116.9	292.2	163	343
18	198	6.2	12.4	18.5	24.7	30.9	37.1	43.2	49.4	55.6	61.8	123.5	308.9	162	342
19	199	6.5	13.0	19.5	26.0	32.5	39.0	45.6	52.1	58.6	65.1	130.1	325.4	161	341
20	200	6.8	13.7	20.5	27.3	34.2	41.0	47.9	54.7	61.5	68.4	136.7	341.9	160	340
21	201	7.2	14.3	21.5	28.7	35.8	43.0	50.1	57.3	64.5	71.6	143.3	358.2	159	339
22	202	7.5	15.0	22.5	30.0	37.4	44.9	52.4	59.9	67.4	74.9	149.8	374.4	158	338
23	203	7.8	15.6	23.4	31.2	39.1	46.9	54.7	62.5	70.3	78.1	156.2	390.5	157	337
24	204	8.1	16.3	24.4	32.5	40.7	48.8	56.9	65.0	73.2	81.3	162.2	406.5	156	336
25	205	8.4	16.9	25.3	33.8	42.2	50.7	59.1	67.6	76.0	84.5	169.0	422.4	155	335
26	206	8.8	17.5	26.3	35.1	43.8	52.6	61.3	70.1	78.9	87.6	175.3	438.2	154	334
27	207	9.1	18.2	27.2	36.3	45.4	54.5	63.5	72.6	81.7	90.7	181.5	453.7	153	333
28	208	9.4	18.8	28.2	37.5	46.9	56.3	65.7	75.1	84.5	93.8	187.7	469.2	152	332
29	209	9.7	19.4	29.1	38.8	48.5	58.1	67.8	77.5	87.2	96.0	193.8	484.6	151	331
30	210	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	199.9	499.8	150	330
31	211	10.3	20.6	30.9	41.2	51.5	61.8	72.1	82.4	92.7	103.0	205.9	514.8	149	329
32	212	10.6	21.2	31.8	42.4	53.0	63.6	74.2	84.7	95.3	105.9	211.9	529.7	148	328
33	213	10.9	21.8	32.7	43.6	54.5	65.3	76.2	87.1	98.0	108.9	217.8	544.6	147	327
34	214	11.2	22.4	33.5	44.7	55.9	67.1	78.2	89.4	100.6	111.8	223.6	558.9	146	326
35	215	11.5	22.9	34.4	45.9	57.3	68.8	80.3	91.7	103.2	114.7	229.3	573.3	145	325
36	216	11.8	23.5	35.3	47.0	58.7	70.5	82.3	94.0	105.8	117.5	235.0	587.5	144	324
37	217	12.0	24.1	36.1	48.1	60.2	72.2	84.2	96.2	108.3	120.3	240.6	601.5	143	323
38	218	12.3	24.6	36.9	49.2	61.5	73.8	86.2	98.5	110.8	123.1	246.1	615.4	142	322
39	219	12.6	25.2	37.7	50.3	62.9	75.5	88.1	100.6	113.2	125.8	251.6	629.0	141	321
40	220	12.8	25.7	38.5	51.4	64.2	77.1	89.9	102.8	115.6	128.5	257.0	642.5	140	320
41	221	13.1	26.2	39.3	52.5	65.6	78.7	91.8	104.9	118.0	131.1	262.3	655.7	139	319
42	222	13.4	26.8	40.1	53.5	66.9	80.3	93.6	107.0	120.4	133.8	267.5	668.8	138	318
43	223	13.6	27.3	40.9	54.5	68.2	81.8	95.4	109.1	122.7	136.3	272.7	681.7	137	317
44	224	13.9	27.8	41.7	55.5	69.4	83.3	97.2	111.1	125.0	138.9	277.7	694.3	136	316
45	225	14.1	28.3	42.4	56.5	70.7	84.8	98.9	113.1	127.2	141.4	282.7	706.8	135	315

Digitized by Google

TABLE XXXII. Continued.

Arg. Af.	Rt. Star.	Arg. Complete Years 1	2	3	4	5	6	7	8	9	10	20	50	Arg. Af.	Rt. Star.
+	—	//	//	//	//	//	//	//	//	//	//	//	//	+	—
46°	226°	14.4	28.8	43.1	57.5	71.9	86.3	100.7	115.0	129.4	143.8	287.6	719.0	134°	314°
47	227	14.6	29.2	43.9	58.5	73.1	87.7	102.3	117.0	131.6	146.2	292.4	731.0	133	313
48	228	14.9	29.7	44.6	59.4	74.3	89.1	104.0	118.8	133.7	148.6	297.1	742.8	132	312
49	229	15.1	30.2	45.3	60.3	75.4	90.5	105.6	120.7	135.8	150.9	301.7	754.3	131	311
50	230	15.3	30.6	45.9	61.2	76.6	91.9	107.2	122.5	137.8	153.1	306.3	765.7	130	310
51	231	15.5	31.1	46.6	62.1	77.7	93.2	108.7	124.3	139.8	155.4	310.7	776.8	129	309
52	232	15.8	31.5	47.3	63.0	78.8	94.5	110.3	126.0	141.8	157.5	315.1	787.6	128	308
53	233	16.0	31.9	47.9	63.9	79.8	95.8	111.8	127.7	143.7	159.6	319.3	798.2	127	307
54	234	16.2	32.3	48.5	64.7	80.9	97.0	113.2	129.4	145.6	161.7	323.5	808.6	126	306
55	235	16.4	32.8	49.1	65.5	81.9	98.2	114.6	131.0	147.4	163.8	327.5	818.8	125	305
56	236	16.6	33.1	49.7	66.3	82.9	99.4	116.0	132.6	149.2	165.7	331.5	828.6	124	304
57	237	16.8	33.5	50.3	67.1	83.8	100.6	117.4	134.1	150.9	167.7	335.3	838.3	123	303
58	238	17.0	33.9	50.9	67.8	84.8	101.7	118.7	135.6	152.6	169.5	339.1	847.6	122	302
59	239	17.1	34.3	51.4	68.5	85.7	102.8	119.9	137.1	154.2	171.4	342.7	856.8	121	301
60	240	17.3	34.6	51.9	69.2	86.6	103.9	121.2	138.5	155.8	173.1	346.2	865.6	120	300
61	241	17.5	35.0	52.4	69.9	87.4	104.9	122.4	139.9	157.4	174.8	349.7	874.2	119	299
62	242	17.6	35.3	52.9	70.6	88.3	105.9	123.6	141.2	158.9	176.5	353.0	882.5	118	298
63	243	17.8	35.6	53.4	71.2	89.1	106.9	124.7	142.5	160.3	178.1	356.2	890.6	117	297
64	244	18.0	35.9	53.9	71.9	89.8	107.8	125.8	143.7	161.7	179.7	359.3	898.4	116	296
65	245	18.1	36.2	54.4	72.5	90.6	108.7	126.8	144.9	163.1	181.2	362.3	905.9	115	295
66	246	18.3	36.5	54.8	73.0	91.3	109.6	127.8	146.1	164.4	182.6	365.2	913.1	114	294
67	247	18.4	36.8	55.2	73.6	92.0	110.4	128.8	147.2	165.6	184.0	368.0	920.1	113	293
68	248	18.5	37.1	55.6	74.1	92.7	111.2	129.7	148.3	166.8	185.3	370.7	926.7	112	292
69	249	18.7	37.3	56.0	74.6	93.3	112.0	130.6	149.3	168.0	186.6	373.3	933.1	111	291
70	250	18.8	37.6	56.4	75.1	93.9	112.7	131.5	150.3	169.1	187.8	375.7	939.2	110	290
71	251	18.9	37.8	56.7	75.6	94.5	113.4	132.3	151.2	170.1	189.0	378.0	945.1	109	289
72	252	19.0	38.0	57.0	76.0	95.1	114.1	133.1	152.1	171.1	190.1	380.2	950.6	108	288
73	253	19.1	38.2	57.3	76.5	95.6	114.7	133.8	152.9	172.1	191.2	382.3	955.8	107	287
74	254	19.2	38.4	57.6	76.9	96.1	115.3	134.5	153.7	172.9	192.2	384.3	960.8	106	286
75	255	19.3	38.6	57.9	77.2	96.5	115.9	135.2	154.5	173.8	193.1	386.2	965.5	105	285
76	256	19.4	38.8	58.2	77.6	97.0	116.4	135.8	155.2	174.6	194.0	387.9	969.8	104	284
77	257	19.5	39.0	58.4	77.9	97.4	116.9	136.3	155.8	175.3	194.8	389.6	973.9	103	283
78	258	19.6	39.1	58.7	78.2	97.8	117.3	136.9	156.4	176.0	195.5	391.1	977.7	102	282
79	259	19.6	39.2	58.9	78.5	98.1	117.7	137.4	157.0	176.6	196.2	392.5	981.2	101	281
80	260	19.7	39.4	59.1	78.7	98.4	118.1	137.8	157.5	177.2	196.9	393.7	984.3	100	280
82	262	19.8	39.6	59.4	79.2	99.0	118.8	138.6	158.4	178.2	198.0	395.9	989.8	98	278
84	264	19.9	39.8	59.6	79.5	99.4	119.3	139.2	159.0	178.9	198.8	397.6	994.0	96	276
86	266	19.9	39.9	59.8	79.8	99.7	119.7	139.6	159.5	179.5	199.4	398.8	997.1	94	274
88	268	20.0	40.0	59.9	79.9	99.9	119.9	139.8	159.8	179.8	199.8	399.6	998.9	92	272
90	270	20.0	40.0	60.0	80.0	100.0	119.9	139.9	159.9	179.9	199.9	399.8	999.5	90	270

TABLE XXXIII. Decimal Numbers for multiplying the Annual Precess. of a Star in Rt. Ascen.

M.	D.	Dec	M.	D.	Dec	M.	D.	Dec.	M.	D.	Dec	M.	D.	Dec	M.	D.	Dec
	1	.01		2	.18		16	.35		5	.52		4	.69		18	.86
	3	.02		7	.19		19	.36		8	.53		9	.70		21	.87
	6	.03	March.	12	.20	May.	22	.37	July.	11	.54	September.	14	.71	Nov.	24	.88
	9	.04		17	.21		25	.38		14	.55		19	.72		27	.89
	12	.05		22	.22		28	.39		17	.56		24	.73		30	.90
	15	.06		27	.23		31	.40		20	.57		29	.74		3	.91
	19	.07		1	.24					23	.58		4	.75		6	.92
	22	.08		6	.25		3	.41		27	.59		9	.76		9	.93
	25	.09	April.	11	.26	June.	6	.42	August.	30	.60	October.	14	.77	December.	12	.94
January.	28	.10		15	.27		9	.43					18	.78		15	.95
	1	.11		20	.28		12	.44		3	.61		23	.79		18	.96
	4	.12		24	.29		15	.45		6	.62		27	.80		21	.97
	8	.13		28	.30		18	.46		10	.63		31	.81		23	.98
	12	.14		2	.31		21	.47		14	.64		4	.82		26	.99
	16	.15	May.	5	.32		24	.48		18	.65		8	.83		29	1.00
	21	.16		9	.33		27	.49		22	.66		11	.84		31	1.01
	25	.17		12	.34		29	.50		26	.67		15	.85			
							2	.51		30	.68						

TABLE XXXIV. Semi-Annual Solar Equa of Northern Stars in De

Ar. twice lon. ☉	R. A.			
D.	o. vi.	i. vii.	ii. viii	
	— +	— +	— +	
0	0′′.0	0′′.2	0′′.4	
3	0.0	0.3	0.4	
6	0.1	0.3	0.4	
9	0.1	0.3	0.4	
12	0.1	0.3	0.5	
15	0.1	0.3	0.5	
18	0.1	0.4	0.5	
21	0.2	0.4	0.5	
24	0.2	0.4	0.5	
27	0.2	0.4	0.5	
30	0.2	0.4	0.5	
	+ —	+ —	+ —	
	xi. v.	x. iv.	ix. iii	

If declin. S. change sig

Digitized by Google

TABLES

FOR COMPUTING THE NUTATION OF A STAR IN RIGHT ASCENSION AND DECLINATION.

TABLE XXXIV.
or,
TAB. I. OF NUTATION.

Argument.
For the Nutation in R. A.
R.A.Star—Lon. Moon's node.
For the Nutation in Declin.
R.A. Star + 3 signs — Long. Moon's Node.

D.	o. vi.	i. vii.	ii. viii	
	− +	− +	− +	
	"	"	"	
0	8.33	7.21	4.16	30
1	8.33	7.14	4.04	29
2	8.33	7.06	3.91	28
3	8.32	6.99	3.78	27
4	8.31	6.91	3.65	26
5	8.30	6.82	3.52	25
6	8.28	6.74	3.39	24
7	8.27	6.65	3.26	23
8	8.25	6.56	3.12	22
9	8.23	6.47	2.98	21
10	8.20	6.38	2.85	20
11	8.18	6.29	2.71	19
12	8.15	6.19	2.57	18
13	8.12	6.09	2.43	17
14	8.08	5.99	2.29	16
15	8.05	5.89	2.15	15
16	8.01	5.78	2.01	14
17	7.97	5.68	1.87	13
18	7.92	5.57	1.73	12
19	7.88	5.46	1.59	11
20	7.83	5.35	1.45	10
21	7.78	5.24	1.30	9
22	7.72	5.13	1.16	8
23	7.67	5.01	1.01	7
24	7.61	4.90	0.87	6
25	7.55	4.78	0.73	5
26	7.49	4.66	0.58	4
27	7.42	4.53	0.44	3
28	7.35	4.41	0.29	2
29	7.28	4.29	0.15	1
30	7.21	4.16	0.00	0
	− +	− +	− +	D.
	xi. v.	x. iv.	ix. iii.	

TABLE XXXV.
or,
TAB. II. OF NUTATION.

Argument.
For the Nutation in R. A.
R.A.Star—Lon. Moon's node.
For the Nutation in Declin.
R.A. Star + 3 signs + Lon. Moon's node.

D.	o. vi.	i. vii.	ii. viii	
	− +	− +	− +	
	"	"	"	
0	1.22	1.06	0.61	30
1	1.22	1.05	0.59	29
2	1.22	1.03	0.57	28
3	1.22	1.02	0.55	27
4	1.22	1.01	0.53	26
5	1.21	1.00	0.52	25
6	1.21	0.99	0.50	24
7	1.21	0.97	0.48	23
8	1.21	0.96	0.46	22
9	1.20	0.95	0.44	21
10	1.20	0.93	0.42	20
11	1.20	0.92	0.40	19
12	1.19	0.91	0.38	18
13	1.19	0.89	0.36	17
14	1.18	0.88	0.34	16
15	1.18	0.86	0.32	15
16	1.17	0.85	0.29	14
17	1.17	0.83	0.27	13
18	1.16	0.82	0.25	12
19	1.15	0.80	0.23	11
20	1.15	0.78	0.21	10
21	1.14	0.77	0.19	9
22	1.13	0.75	0.17	8
23	1.12	0.73	0.15	7
24	1.11	0.72	0.13	6
25	1.11	0.70	0.11	5
26	1.10	0.68	0.08	4
27	1.09	0.66	0.06	3
28	1.08	0.65	0.04	2
29	1.07	0.63	0.02	1
30	1.06	0.61	0.00	0
	− +	− +	− +	D.
	xi. v.	x. iv.	ix. iii.	

TABLE XXXVI.
EQUAT. OF EQUINOXES. IN RIGHT ASCENSION.

Argument.
Longitude of the Moon's Node.

D.	o. vi.	i. vii.	ii. viii	
	− +	− +	− +	
	"	"	"	
0	0.0	8.2	14.2	30
1	0.3	8.4	14.3	29
2	0.6	8.7	14.5	28
3	0.9	8.9	14.6	27
4	1.1	9.2	14.7	26
5	1.4	9.4	14.8	25
6	1.7	9.6	15.0	24
7	2.0	9.8	15.1	23
8	2.3	10.1	15.2	22
9	2.6	10.3	15.3	21
10	2.8	10.5	15.4	20
11	3.1	10.7	15.5	19
12	3.4	11.0	15.6	18
13	3.7	11.2	15.7	17
14	4.0	11.4	15.7	16
15	4.2	11.6	15.8	15
16	4.5	11.8	15.9	14
17	4.8	12.0	16.0	13
18	5.1	12.2	16.0	12
19	5.3	12.4	16.1	11
20	5.6	12.5	16.1	10
21	5.9	12.7	16.2	9
22	6.1	12.9	16.2	8
23	6.4	13.1	16.2	7
24	6.7	13.2	16.3	6
25	6.9	13.4	16.3	5
26	7.2	13.6	16.3	4
27	7.4	13.7	16.3	3
28	7.7	13.9	16.4	2
29	7.9	14.0	16.4	1
30	8.2	14.2	16.4	0
	+ −	+ −	+ −	D.
	xi. v.	x. iv.	ix. iii.	

To find the Nutation of a Star in Right Ascension.

To the Log. of the sum or difference of the Equations from Tables XXXIV. XXXV. answering to their proper arguments, add the log. tangent of the star's declination; the sum will be the log. of part first of Nutation, and if the declination be south, change the signs to which apply the equation from Table XXXVI. answering to the longitude of the Moon's node, and the sum or difference will be the Nutation in Right Ascension.

To find the Nutation of a Star in Declination.

Increase the arguments of Tables XXXIV and XXXV. each by three signs, and the sum or difference of the corresponding equations will be the Nutation in Declination.

Digitized by Google

TABLES

FOR COMPUTING THE ABERRATION OF A STAR IN RIGHT ASCENSION AND DECLINATION.

TABLE XXXVII.
or,
TABLE I. OF ABERRATION.

Argument.
For the Aberration in R. A.
R. A. Star — Long. Sun.
For the Aberration in declin.
R. A. Star + 3 signs — Sun's long.

D.	o. vi.	i. vii.	ii. viii.	
	− +	− +	− +	
	//	//	//	
0	19.17	16.60	9.59	30
1	19.17	16.43	9.30	29
2	19.16	16.26	9.00	28
3	19.15	16.08	8.70	27
4	19.13	15.89	8.40	26
5	19.10	15.71	8.10	25
6	19.07	15.51	7.80	24
7	19.03	15.31	7.49	23
8	18.99	15.11	7.19	22
9	18.94	14.90	6 87	21
10	18.88	14.69	6.56	20
11	18.82	14.47	6.24	19
12	18.75	14.25	5.93	18
13	18.68	14.02	5.61	17
14	18.60	13.79	5.28	16
15	18.52	13.56	4.96	15
16	18.43	13.32	4.64	14
17	18.33	13.08	4.31	13
18	18.23	12.83	3.99	12
19	18.13	12.58	3.66	11
20	18.02	12.32	3.33	10
21	17.90	12.07	3.00	9
22	17.78	11.80	2.67	8
23	17.65	11.54	2.34	7
24	17.52	11.27	2.00	6
25	17.38	11.00	1.67	5
26	17.23	10.72	1.34	4
27	17.08	10.44	1.00	3
28	16.93	10.16	0.67	2
29	16.77	9.87	0.33	1
30	16.60	9.59	0.00	0
	− +	− +	− +	D.
	xi. v.	x. iv.	ix. iii.	

TABLE XXXVIII.
or,
TABLE II. OF ABERRATION.

Argument.
For the Aberration in R. A.
R. A. Star + Sun's long.
For the Aberration in declin.
R. A. Star + 3 signs + Sun's Long.

D.	o. vi.	i. vii.	ii. viii.	
	+ −	+ −	+ −	
	//	//	//	
0	0.83	0.72	0.41	30
1	0.83	0.71	0.40	29
2	0.82	0.70	0.39	28
3	0.82	0.69	0.38	27
4	0.82	0.68	0.37	26
5	0.82	0.67	0.35	25
6	0.82	0.67	0.33	24
7	0.82	0.66	0.32	23
8	0.82	0.65	0.30	22
9	0.82	0.64	0.29	21
10	0.82	0.63	0.28	20
11	0.82	0.62	0.27	19
12	0.82	0.61	0.25	18
13	0.81	0.60	0.24	17
14	0.81	0.59	0.23	16
15	0.80	0.58	0.22	15
16	0.80	0.57	0.20	14
17	0.80	0.56	0.19	13
18	0.79	0.55	0.17	12
19	0.78	0.54	0.15	11
20	0.78	0.53	0.14	10
21	0.77	0.52	0.12	9
22	0.76	0.51	0.11	8
23	0.76	0.50	0.10	7
24	0.75	0.49	0.09	6
25	0.75	0.47	0.07	5
26	0.75	0.46	0.06	4
27	0.74	0.45	0.05	3
28	0.73	0.44	0.03	2
29	0.72	0.43	0.02	1
30	0.72	0.41	0.00	0
	+ −	+ −	+ −	D.
	xi. v.	x. iv.	ix. iii.	

TABLE XXXIX.
or,
TAB. III. OF ABERRATION.

Argument.
For part 2d of Aber. in decl.
Sun's Long. + Star's decl.
For part 3d of Aber. in decl.
Sun's Long. + Star's decl.

D.	o. vi.	i. vii.	ii. viii.	
	− +	− +	− +	
	//	//	//	
0	3.98	3.45	1.99	30
1	3.98	3.42	1.93	29
2	3.98	3.38	1.87	28
3	3.98	3.34	1.81	27
4	3.97	3.30	1.75	26
5	3.97	3.26	1.68	25
6	3.96	3.22	1.62	24
7	3.95	3.18	1.56	23
8	3.94	3.14	1.49	22
9	3.93	3.10	1.43	21
10	3.92	3.05	1.36	20
11	3.91	3.01	1.30	19
12	3.90	2.97	1.23	18
13	3.89	2.92	1.17	17
14	3.87	2.87	1.10	16
15	3.85	2.82	1.03	15
16	3.83	2.77	0.97	14
17	3.81	2.72	0.90	13
18	3.79	2.67	0.83	12
19	3.77	2.62	0.76	11
20	3.74	2.56	0.69	10
21	3.72	2.51	0.63	9
22	3.70	2.46	0.56	8
23	3.67	2.40	0.49	7
24	3.64	2.34	0.42	6
25	3.61	2.28	0.35	5
26	3.58	2.23	0.28	4
27	3.55	2.17	0.21	3
28	3.52	2.11	0.14	2
29	3.49	2.05	0.07	1
30	3.45	1.99	0.00	0
	− +	− +	− +	D.
	xi. v.	x. iv.	ix. iii.	

To find the Aberration of a Star in Right Ascension.

To the log. of the sum or difference of the equations from Tables XXXVII. XXXVIII. answering to their arguments, add the log. secant of the Star's Declination, the sum will be the log. of the Aberration in Right Ascension.

To find the Aberration of a Star in Declination.

Find the sum or difference of the equations answering to the former arguments, increased by 3 signs, to the log. of which add the log. sign of the Star's Declination; the sum will be the log. of part first of the Aberration. Take parts second and third of Aberration from Table *XXXIX.* which applied to the former will give the Aberration in Declination. If the Star's Declination is south, change the sign of parts second and third.

Digitized by Google

TABLE XL.

THE LONGITUDES AND LATITUDES OF STARS, CHIEFLY ZODIACAL; ADAPTED TO THE BEGINNING OF THE YEAR 1800.

Names of Stars.	Mag.	Longitude.	Ann part of sec. var.	Latitude.	Ann. par of sec va
γ Pegasi . . *Algenib*	2	0s. 6°22′ 6	—0″.26	12° 33′ 40″ N	+0″.1
♪ Piſcium . . .	4	0 11 21 15	—0.17	2 10 25 N	+0.16
♪ Andromedæ *Alpheratz*	2	0 11 31 26	—0.37	25 41 4 N	+0.16
ε Piſcium . . .	4	0 14 44 42	—0.16	1 5 49 N	+0.38
μ Piſcium . . .	5	0 20 19 33	—0.13	3 3 53 S	—0.22
η Piſcium . . .	4·3	0 24 1 27	—0.12	5 21 57 N	+0.22
ξ Ceti . . .	4	1 1 15 4	—0.13	4 16 56 S	—0.30
α Arietis . . * .	2·3	1 4 51 48	—0.22	9 57 42 N	+0.33
μ Ceti . . .	4	1 9 7 52	—0.12	5 34 37 S	—0.35
♪ Ceti . . *Menkar*	2	1 11 31 32	—0.08	12 31 51 S	—0.37
♪ Arietis . . .	4	1 18 2 56	—0.16	1 48 26 N	+0.40
h Pleiadum . *Electra*	5	1 26 37 3	—0.17	4 10 11 N	+0.43
g Pleiadum . *Celeno*	6·7	1 26 38 29	—0.17	4 20 46 N	+0.43
♪ Pleiadum . *Taygeta*	5	1 26 46 13	—0.17	4 29 56 N	+0.43
c Pleiadum . *Maia*	6	1 26 53 9	—0.17	4 22 16 N	+0.43
d Pleiadum . *Merope*	5	1 26 54 21	—0.17	4 56 14 N	+0.43
k Pleiadum . *Asterope*	7	1 26 56 43	—0.17	4 33 0 N	+0.43
η Pleiadum . *Alcyone*	3	1 27 11 51	—0.17	4 1 54 N	+0.43
f Pleiadum . *Atlas*	5·6	1 27 33 40	—0.17	3 53 52 N	+0.43
l Pleiadum . *Pleione*	6·7	1 27 35 4	—0.17	3 58 44 N	+0.43
γ Tauri . . .	3	2 3 0 8	—0.14	5 45 10 S	—0.45
♪ Tauri . . .	4	2 4 4 7	—0.14	3 59 25 S	—0.45
ε Tauri . . .	3·4	2 5 39 49	—0.15	2 35 15 S	—0.46
α Tauri . . * *Aldebaran*	1	2 6 59 33	—0.17	5 28 46 S	—0.46
ι Tauri . . .	4	2 13 59 24	—0.15	1 13 18 S	—0.47
β Orionis . . *Rigel*	1	2 14 2 1	—0.11	31 8 53 S	—0.47
α Aurigæ . . *Capella*	1	2 19 3 41	—0.16	22 52 2 N	+0.48
♪ Orionis . . .	2	2 19 34 11	—0.14	23 34 44 S	—0.48
β Tauri . . .	2	2 19 46 52	—0.15	5 22 16 N	+0.48
ι Orionis . . .	2	2 20 40 17	—0.15	24 31 53 S	—0.48
ζ Orionis . . .	2	2 21 53 20	—0.15	25 19 6 S	—0.48
ζ Tauri . . .	3	2 21 59 26	—0.15	2 13 10 S	—0.48
α Orionis . *Betelgueſe*	1	2 25 57 36	—0.16	16 3 14 S	—0.48
H Geminorum . *Propus*	4·5	2 28 9 10	—0.15	0 11 26 S	—0.48
η Geminorum , . .	3·4	3 0 38 48	—0.15	0 54 43 S	—0.48
μ Geminorum . . ,	3	3 2 30 8	—0.15	0 50 13 S	—0.47
♪ Geminorum . . .	4	3 4 0 30	—0.16	3 4 46 S	—0.47
γ Geminorum . . .	2·3	3 6 18 29	—0.17	6 45 50 S	—0.47
ε Geminorum . . .	3	3 7 8 40	—0.15	2 2 46 N	+0.46
α Canis Majoris . *Sirius*	1	3 11 10 52	—0.28	39 22 40 S	—0.45
ζ Geminorum . . .	3·4	3 12 11 46	—0.16	2 3 45 S	—0.45
δ Geminorum . . .	5	3 14 6 16	—0.15	2 31 1 N	+0.45
♪ Geminorum . . .	3	3 15 43 37	—0.15	0 12 3 S	—0.44
α Geminorum . *Castor*	1·2	3 17 27 18	—0.12	10 4 51 N	+0.43
β Geminorum * *Pollux*	2	3 20 27 43	—0.13	6 40 19 N	+0.42
ι Geminorum . . .	4·5	3 20 52 23	—0.14	3 3 32 N	+0.42
α Canis Minoris . *Procyon*	1·2	3 23 2 6	—0.03	15 57 55 S	—0.41
Ψ 2 Cancri . . .	4	3 26 26 54	—0.13	5 19 17 N	+0.40
ζ Cancri, double	5	3 28 32 33	—0.16	2 16 52 S	—0.39
	5	3 28 32 34	—0.16	2 16 49 S	—0.39
γ Cancri . . .	4	4 4 45 1	—0.16	3 10 32 N	+0.35
δ Cancri . . .	4	4 5 55 29	—0.15	0 4 27 N	+0.35
α 1 Cancri . . .	4·5	4 10 18 35	—0.19	5 29 39 S	—0.32
α 2 Cancri . *Acubens*	4·3	4 11 50 46	—0.19	5 5 44 S	—0.32
ι Cancri . . .	4·5	4 13 22 42	—0.19	5 35 8 S	—0.30
ξ Leonis . . .	4	4 18 51 32	—0.18	3 9 45 S	—0.26
o Leonis . . .	5·4	4 21 27 46	—0.18	3 45 52 S	—0.25
α Hydræ . . *Alphard*	2	4 24 29 50	—0.33	22 23 42 S	—0.22
η Leonis . . .	3·4	4 25 6 33	—0.12	4 51 15 N	+0.22
π Leonis . . .	4	4 26 31 19	—0.18	3 55 15 S	—0.21
α Leonis . . * *Regulus*	1	4 27 3 2	—0.15	0 27 35 N	+0.21

Digitized by Google

TABLE XL.

THE LONGITUDES AND LATITUDES OF STARS, CHIEFLY ZODICAL; ADAPTED TO THE BEGINNING OF THE YEAR 1800.

Names of Stars.	Mag.	Longitude.	Ann. part of sec. var.	Latitude.	Ann. part of sec. var.
χ Leonis	4	5s 11° 44′ 9	—0″.14	1°20′ 55 N	+0.″09
σ Leonis	4-5	5 15 55 8	—0.14	1 41 56 N	+0.05
τ Leonis	4	5 18 43 9	—0.15	0 33 14 S	—0.03
μ Leonis *Deneb*	1.2	5 18 50 45	—0.05	12 17 10 N	+0.03
Leonis	4	5 22 14 52	—0.15	3 2 48 S	0.00
β Virginis	3	5 24 19 10	—0.15	0 41 32 N	—0.02
η Virginis	4-3	6 2 2 36	—0.14	1 22 25 N	—0.08
γ Virginis	3	6 7 22 58	—0.13	2 48 46 N	—0.12
θ Virginis	4	6 15 26 47	—0.14	1 45 28 N	—0.19
ι Virginis * *Spicæ Virginis*	1	6 21 3 2	—0.17	2 2 17 S	+0.23
ι Bootis *Arcturus*	1	6 21 26 41	+0.10	30 54 5 N	—0.24
κ Virginis	4	7 1 42 10	—0.13	2 55 19 N	—0.31
λ Virginis	4	7 4 9 36	—0.15	0 30 31 N	—0.32
ι Coronæ Borealis *Alphacca*	2.3	7 9 28 17	+0.11	44 26 53 N	—0.35
α 2 Libræ *Zubenesch*	2.3	7 12 17 42	—0.15	0 21 30 N	—0.37
υ Libræ	4	7 15 58 45	—0.15	1 13 18 N	—0.39
ι Libri	4	7 18 12 47	—0.16	1 49 21 S	+0.40
α Serpentis	2.3	7 19 15 59	—0.03	25 31 39 N	—0.40
ζ Libræ	4	7 21 6 17	—0.14	4 7 18 N	—0.41
γ Libræ	3.4	7 22 20 21	—0.13	4 24 32 N	—0.41
Libræ	4	7 24 33 27	—0.14	4 1 42 N	—0.42
κ Libræ	4	7 24 57 54	—0.15	0 0 48 N	—0.43
θ Libræ	4	7 27 4 23	—0.14	3 29 14 N	—0.43
λ Libræ	4	7 27 40 55	—0.15	0 6 47 N	—0.43
b Scorpii	2.3	7 28 19 54	—0.17	5 27 36 S	+0.44
δ Scorpii	3.2	7 29 46 38	—0.16	1 57 29 S	+0.44
π Scorpii	3	8 0 8 43	—0.17	5 26 50 S	+0.44
β Scorpii	2	8 0 23 43	—0.15	1 2 6 N	—0.45
ρ Scorpii	4	8 1 51 2	—0.14	1 39 41 N	—0.45
σ Scorpii	4	8 5 0 22	—0.16	4 0 32 S	+0.46
α Scorpii * *Antares*	1	8 6 58 9	—0.16	4 32 31 S	+0.46
ρ Ophiuchi	4	8 18 5 41	—0.15	2 3 32 N	—0.48
θ Ophiuchi	3	8 18 36 4	—0.15	1 48 51 S	+0.48
α Ophiuchi *Ras Alhague*	2	8 19 38 39	—0.14	35 52 36 N	—0.48
μ 1 Sagittarii	4	9 0 25 14	—0.16	2 22 10 N	—0.47
μ 2 Sagittarii	4	9 0 46 3	—0.16	2 41 29 N	—0.47
λ Sagittarii	4	9 3 31 33	—0.15	2 5 46 S	+0.47
Φ Sagittarii	4	9 7 22 59	—0.14	3 55 38 S	+0.46
σ Sagittarii	3	9 9 35 25	—0.14	3 25 9 S	+0.46
ζ Sagittarii	4	9 10 39 22	—0.16	1 41 21 N	—0.46
τ Sagittarii	4	9 12 2 44	—0.14	5 2 47 S	+0.45
ο Sagittarii	4	9 12 11 47	—0.16	0 53 25 N	—0.45
α Lyræ *Vega*	1	9 12 30 41	—0.46	61 44 35 N	—0.45
π Sagittarii	3-4	9 13 27 34	—0.16	1 27 55 N	—0.45
γ Aquilæ	3	9 28 9 7	—0.32	31 15 51 N	—0.39
α Aquilæ * *Atair*	1.2	9 28 56 40	—0.32	29 18 25 N	—0.38
β Aquilæ	3	9 29 38 32	—0.31	26 42 40 N	—0.38
α 1 Capricorni	4	10 0 58 38	—0.20	7 0 35 N	—0.37
α 2 Capricorni	3	10 1 3 47	—0.20	6 57 6 N	—0.37
β Capricorni	3	11 1 15 9	—0.18	4 36 39 N	—0.37
ε Capricorni	4	10 17 24 18	—0.10	4 57 35 S	+0.27
λ Capricorni	4-3	10 18 59 19	—0.14	2 32 10 S	+0.26
δ Capricorni	3	10 20 44 23	—0.14	2 33 44 S	+0.25
ι Aquarii	4	10 25 55 31	—0.14	2 8 49 S	+0.21
θ Aquarii	4	11 0 27 56	—0.18	2 43 18 N	—0.18
α Aquarii	3	11 0 33 54	—0.24	10 40 20 N	—0.18
α Pisc. Australis * *Fomalhaut*	1	11 1 2 27	+0.02	21 6 28 S	+0.18
α Cygni *Deneb*	1.2	11 2 34 48	—0.93	59 55 0 N	—0.16
γ Aquarii	4	11 8 46 56	—0.15	0 22 54 S	+0.11
α Pegasi * *Markab*	2	11 20 41 55	—0.32	19 24 41 N	—0.01
λ Piscium	5	11 23 48 39	—0.18	3 25 23 N	+0.01

Digitized by Google

TABLE XLI. PRECESSION OF THE EQUINOCTIAL POINTS IN LONGITUDE, FOR COMPLETE YEARS.

Y.	Precefs.	Y.	Precefs.	Y.	Precefs.	Y.	Precefs.	Y.	Precefs.	Y.	Precefs.
	′ ″		′ ″		′ ″		′ ″		′ ″		° ′ ″
1	0 50.2	11	9 12.2	21	17 34.2	31	25 56.2	41	34 18.2	55	0 46 1.0
2	1 40.4	12	10 2.4	22	18 24.4	32	26 46.4	42	35 8.4	60	0 50 12.0
3	2 30.6	13	10 52.6	23	19 14.6	33	27 36.6	43	35 58.6	65	0 54 23.0
4	3 20.8	14	11 42.8	24	20 4.8	34	28 26.8	44	36 48.8	70	0 58 34.0
5	4 11.0	15	12 33.0	25	20 55.0	35	29 17.0	45	37 39.0	75	1 2 45.0
6	5 1.2	16	13 23.2	26	21 45.2	36	30 7.2	46	38 29.2	80	1 6 56.0
7	5 51.4	17	14 13.4	27	22 35.4	37	30 57.4	47	39 19.4	85	1 11 7.0
8	6 41.6	18	15 3.6	28	23 25.6	38	31 47.6	48	40 9.6	90	1 15 18.0
9	7 31.8	19	15 53.8	29	24 15.8	39	32 37.8	49	40 59.8	95	1 19 29.0
10	8 22.0	20	16 44.0	30	25 6.0	40	33 28.0	50	41 50.0	100	1 23 40.0

TABLE XLII. PRECESSION OF THE EQUINOCTIAL POINTS IN LONGITUDE, FOR MONTHS AND DAYS.

Days.	Jan.	Feb.	Mar.	Apr	May.	June.	July	Aug.	Sep.	Oct.	Nov.	Dec.
1	0″6	5″8	9″0	12″1	15″5	20″2	25″5	30″5	34″4	37″4	40″9	45″4
3	1.0	5 8	9.2	12.3	15.8	20.6	25.8	30.8	34.6	37.6	41.2	45.8
5	1.3	6 1	9.4	12.5	16.1	20.9	26.2	31.1	34.8	37.8	41.4	46.1
7	1.6	6.4	9.6	12.7	16.3	21.3	26.5	31.3	35.0	38.0	41.7	46.4
9	2.0	6.7	9.8	12.9	16.6	21.6	26.8	31.6	35.3	38.3	42.0	46.8
11	2.3	6.9	10.0	13.1	16.9	22.0	27.2	31.9	35.5	38.5	42.3	47.1
13	2.6	7.2	10.2	13.4	17.2	22.3	27.5	32.2	35.7	38.7	42.6	47.5
15	3.0	7.4	10.4	13.6	17.5	22.7	27.8	32.4	35.9	38.9	42.9	47.8
17	3.3	7.6	10.6	13.8	17.8	23.0	28.2	32.7	36.1	39.1	43.2	48.2
19	3.6	7.9	10.8	14.0	18.1	23.4	28.5	32.9	36.3	39.3	43.5	48.6
21	3.9	8.1	11.0	14.3	18.4	23.7	28.8	33.2	36.5	39.6	43.8	48.9
23	4.2	8.3	11.2	14.5	18.8	24.1	29.1	33.4	36.7	39.8	44.1	49.3
25	4.5	8.6	11.4	14.8	19.1	24.4	29.4	33.6	36.9	40.0	44.4	49.6
27	4.8	8.8	11.6	15.0	19.4	24.8	29.7	33.9	37.1	40.3	44.8	50.0
29	5.1		11.8	15.3	19.7	25.1	30.0	34.1	37.2	40.5	45.1	50.4
31	5.4		12.0		20.1		30.3	34.3		40.8		50.7

In January and Feb. Leap Year, take the Precession for the day preceding the given day.

TABLE XLIII. SECULAR VARIAT. of Stars.

D.	Arg. Longitude of Star. 0 + vi.	i. + vii	ii. + viii.	iii. — ix.	iv. — x.	v. — xi.
	″	″	″	″	″	″
0	47.5	37.8	18.0	6.7	29.5	44.5
2	47.3	36.7	16.4	8.4	30.8	45.1
4	47.0	35.6	14.8	10.0	32.1	45.6
6	46.6	34.5	13.2	11.6	33.4	46.1
8	46.1	33.3	11.6	13.2	34.5	46.5
10	45.6	32.1	10.0	14.8	35.7	46.9
12	45.1	30.8	8.4	16.4	36.8	47.3
14	44.5	29.5	6.7	18.0	37.8	47.5
16	43.8	28.2	5.0	19.5	38.8	47.7
18	43.2	26.8	3.3	21.0	39.8	47.8
20	42.4	25.4	1.6	22.3	40.7	47.9
22	41.5	24.0	0.0	24.0	41.5	48.0
24	40.7	22.3	1.7	25.4	42.4	48.0
26	39.7	21.0	3.4	26.8	43.1	47.9
28	38.8	19.5	5.0	28.2	43.8	47.8
30	37.8	18.0	6.7	29.5	44.5	47.5

For var. in lon. multiply by tan. of lat. For var in lat. add 3 signs to the Argument.

In either case if the latitude be south, change the sign.

TABLE XLIV. Equation of the Equinoxes in Longitude.

D.	Arg Log. of ☽'s node. 0. + vi.	i. + vii.	ii + viii	
	″	″	″	
0	0.0	8.9	15.5	30
2	0.6	9.5	15.8	28
4	1.2	10.0	16.1	26
6	1.9	10.5	16.3	24
8	2.5	11.0	16.6	22
10	3.1	11.5	16.8	20
12	3.7	12.0	17.0	18
14	4.3	12.1	17.2	16
16	4.9	12.8	17.3	14
18	5.5	13.3	17.5	12
20	6.1	13.7	17.6	10
22	6.7	14.1	17.7	8
24	7.3	14.5	17.8	6
26	7.8	14.8	17.8	4
28	8.4	15.1	17.9	2
30	8.9	15.5	17.9	0
	v. — xi.	iv. — x.	iii. — ix.	D.

TABLE XLV. Aberrat. in Longitude.

D.	Arg. Lon ☉ — Lon ☌ 0 + vi.	i. + vii.	ii. + viii.	
	″	″	″	
0	20.0	17.3	10.0	30
2	20.0	17.0	9.4	28
4	20.0	16.6	8.8	26
6	19.9	16.2	8.1	24
8	19.8	15.8	7.5	22
10	19.7	15.3	6.8	20
12	19.6	14.9	6.2	18
14	19.4	14.4	5.5	16
16	19.2	13.9	4.8	14
18	19.0	13.4	4.2	12
20	18.8	12.9	3.5	10
22	18.5	12.3	2.8	8
24	18.3	11.8	2.1	6
26	18.0	11.2	1.4	4
28	17.7	10.6	0.7	2
30	17.3	10.0	0.0	0
	v. — xi.	iv. — x.	iii. — ix.	D.

Digitized by Google

TABLE XLVI. ABERRATION OF THE PLANETS IN LONGITUDE.

Arg. Elongation	Mercury. Aphl.	M Dist.	Perih.
	—	—	—
Sup Conju.	46′	51½″	59½″
5°	45	51	58½
10	44	48	52
15	41	43	41
20	36	33	
25	29		
Greatest El	18	18	19
25	7		
20	1	4	
	+	+	+
15	2	4	2
10	4	8	13
5	6	11	18
Inf. Conj	6	11½	10½

Arg Elongation.	Venus.
	—
Sup. Conju.	43½″
15°	41
30	34
45	19
Greatest El	14
45	9
30	0
	+
15	3
Inf. Conj.	3½

Arg. Elongation	Mars	Jup.	Sat.	Geor. Plan.
	—	—	—	—
o. Conj. oc	36″	29″	27″	25″
15	35	28	26	24
I. XI. o	32	26	24	22
15	28	23	21	19
II. X. o	23	19	16	15
15	18	14	12	10
III. IX. o	12	9	6	5
15	7	4	1	0
		+	+	+
IV. VIII. o	3	1	4	5
15	+	5	8	9
V. VII. o	2	9	11	13
15	3	10	12	15
VI. Opp. o	4	11	13	15

TAB. XLVII. FOR COMPUTING THE RT. ASCEN. OF A PLANET IN TIME.

Part. I. Ar. Geo. Lon. of a Pl.

	o. vi.	i. vii.	ii. viii.	
	—	—	—	
0°	0′0	8′4	8′8	30°
3	1.0	8.9	8.7	27
6	2.0	9.3	7.5	24
9	2.9	9.6	6.8	21
12	3.9	9.8	6.0	18
15	4.8	9.9	5.1	15
18	5.6	9.9	4.2	12
21	6.4	9.7	3.2	9
24	7.1	9.5	2.1	6
27	7.8	9.2	1.0	3
30	8.4	8.9	0.0	0
	+	+	+	
	xi. v.	x. iv.	ix. iii.	

Part II. Arg. Longitude in Time corrected.

	oh xiih.	h. xiih.	iih. xiv.h	iiih. xvh.	ivh. xvih.	vh. xviih	
	— +	— +	— +	— +	— +	— +	
0′	1′.60	1′.54	1′.39	1′.13	0.′80	0.′41	60
10	1.60	1.53	1.35	1.08	0.74	0.35	50
20	1.60	1.51	1.30	1.03	0.68	0.28	40
30	1.59	1.48	1.26	0.97	0.61	0.21	30
40	1.57	1.45	1.21	0.92	0.54	0.14	20
50	1.56	1.42	1.17	0.86	0.49	0.07	10
60	1.54	1.39	1.13	0.80	0.41	0.00	0
	— +	— +	— +	— +	— +	— +	
	xxiiihxih	xxiih. xh.	xxih. ix.	xxh. viii	xixhviih	xviihvi	

Part III. Arg. Declination of Planet.

0°	.00	15°	.03	19°	.06	22°	.08	25°	.10	28°	.13	31°	.17
10	.01	17	.04	20	.06	23	.09	26	.11	29	.14	32	.18
12	.02	18	.05	21	.07	24	.09	27	.12	30	.15	33	.19

TABLE XLVIII. TO FIND THE AUGMENTATION OF THE MOON'S SEMIDIAM. BY THE NONAGESIMAL, THE MOON'S SEMIDIAMETER BEING SUPPOSED 16′

PART I.

Ar. Alt non. + ap.dis. ☽ fr.non.
Alt.non — ap.dis. ☽ fr.non

	o. vi	i.vii	ii.viii	
	+ —	+ —	+ —	
0°	0″′00	4″′10	7″′10	30°
3	0.43	4.46	7.30	27
6	0.86	4.82	7.48	24
9	1.28	5.16	7.65	21
12	1.70	5.49	7.79	18
15	2.12	5.80	7.92	15
18	2.53	6.09	8.02	12
21	2.94	6.36	8.09	9
24	3.33	6.63	8.15	6
27	3.72	6.87	8.18	3
30	4.10	7.10	8.19	0
	— +	— +	— +	
	xi. v.	x. iv.	ix. iii.	

PART II.

Arg. Aggreg fr. Par. I.	Cor. +
2″	0″′.00
3	0.01
4	0.02
5	0.03
6	0.04
7	0.05
8	0.06
9	0.08
10	0.10
11	0.12
12	0.14
13	0.17
14	0.20
15	0.23
16	0.26

PART III.

Arg. True Lat. of the Moon.	Argument. Parallax of the ☽ in Lat. 0′	10′	20	30′	40′	50′	60′
	—	—	—	—	—	—	—
South Lat.	″	″	″	″	″	″	″
6° 0′	0.00	0.29	0.59	0.90	1.22	1.54	1.88
5 0	0.00	0.24	0.49	0.76	1.02	1.30	1.59
4 0	0.00	0.19	0.40	0.61	0.83	1.06	1.30
3 0	0.00	0.14	0.30	0.47	0.64	0.82	1.01
2 0	0.00	0.10	0.21	0.33	0.45	0.58	0.72
1 0	0.00	0.05	0.11	0.18	0.26	0.34	0.43
0 0	0.00	0.00	0.02	0.04	0.06	0.10	0 14
North La	+	+	+	+	+	+	+
1 0	0.00	0.05	0.08	0.11	0.13	0.14	0.15
2 0	0.00	0.10	0.18	0.25	0.32	0.38	0.44
3 0	0.00	0.14	0.27	0.39	0.51	0.62	0 72
4 0	0.00	0.19	0.37	0.54	0.70	0.86	1.01
5 0	0.00	0.24	0.46	0.68	0.90	1.10	1.30
6 0	0.00	0.29	0.56	0.83	1.09	1.34	1.59
	—	+	+	+	+	+	+
	0′	10′	20′	30′	40′	50′	60′

Parallax of the Moon in Lat.

PART IV. VAR. for 1′ of ☽'s Semid.

Arg. Sum of preceding equations.

″	″	″	″	″	″	″	″
1	0.13	5	0.62	9	1.13	13	1.62
2	0.25	6	0.75	10	1.25	14	1.75
3	0.37	7	0.87	11	1.37	15	1.87
4	0.50	8	1.00	12	1.50	16	2.00

Digitized by Google

A. Names of Places.	Continent.	Coast, Sea, or Country.	Latitude.				Longitude In Degrees.				In Time.				H. W.	
			°	′	″		°	′	″		h.	m.	s.		h.	m.
Aalborg	Europe	Denmark	57	2	57	N	9	56	30	E	0	39	46	E		
Aahuus	Europe	Denmark	56	9	35	N	10	14	0	E	0	40	56	E		
Aberdeen	Europe	Scotland	57	5	0	N	2	21	30	W	0	9	26	W	0	45
Abbeville	Europe	France	50	7	4	N	1	49	45	E	0	7	19	E	10	30
Abo	Europe	Finland	60	27	7	N	22	15	0	E	1	29	0	E		
Acheen Head	Asia	Sumatra	5	22	0	N	95	26	0	E	6	21	44	E		
Adventure Bay	Asia	N. Holland	43	21	20	S	147	31	40	E	9	50	7	E	4	36
Adventure Isle	America	Pacific Ocean	17	5	15	S	144	17	45	W	9	37	11	W		
Aerschot	Europe	Netherlands	50	59	15	N	4	49	31	E	0	19	18	E		
Agde	Europe	France	43	18	43	N	3	27	55	E	0	13	52	E		
Agen	Europe	France	44	12	22	N	0	36	20	E	0	2	25	E		
Agimere	Asia	Agimere	26	35	0	N	75	20	0	E	5	1	20	E		
St. Agnes (Lights)	Europe	Scillies	49	53	47	N	6	20	30	W	0	25	22	W	3	45
Agra	Asia	India	27	12	30	N	78	17	0	E	5	13	8	E		
Agria	Europe	Hungary	47	53	54	N	20	22	0	E	1	21	28	E		
Aguada (Point)	Asia	India	15	28	55	N	73	48	39	E	4	55	15	E		
Aire	Europe	France	43	41	52	N	0	15	45	W	0	1	3	W		
Aix	Europe	France	43	31	48	N	5	26	30	E	0	21	46	E		
Aix (Isle)	Europe	France	46	1	38	N	1	11	0	W	0	4	44	W		
Akerman	Europe	Türkey	46	11	58	N	30	43	45	E	2	2	55	E		
Alais	Europe	France	44	7	22	N	0	35	50	E	0	2	23	E		
Albano	Europe	Italy	41	43	50	N	12	38	0	E	0	50	32	E		
Albany	Amer.	New Wales	52	14	41	N	81	52	50	W	5	27	31	W		
Albi	Europe	France	43	55	36	N	2	8	18	E	0	8	33	E		
Alkmaer	Europe	Holland	52	38	34	N	4	38	0	E	0	18	32	E		
Aleppo	Asia	Turkey	36	11	25	N	37	10	0	E	2	28	40	E		
Alexandretta	Asia	Syria	36	34	47	N	36	14	45	E	2	24	59	E		
Alexandria	Africa	Egypt	31	11	20	N	30	10	15	E	2	0	41	E		
Alez	Europe	France	42	59	50	N	2	15	0	E	0	9	0	E		
Algiers	Africa	Algiers	36	49	30	N	2	12	45	E	0	8	51	E		
Aloft	Europe	Netherlands	50	56	18	N	4	1	58	E	0	16	8	E		
Altengaard	Europe	Lapland	69	55	0	N	23	4	0	E	1	32	16	E		
Ambrym (Isle)	Asia	Pacific Ocean	16	9	30	S	168	12	30	E	11	12	50	E		
Amesbury	Europe	England	51	10	19	N	1	46	37	W	0	7	6	W		
Amiens	Europe	France	49	53	38	N	2	17	56	E	0	9	12	E		
Amsterdam	Europe	Holland	52	21	56	N	4	51	30	E	0	19	26	E	3	0
Amsterdam (Har.)	Amer.	Curazao	12	8	0	N	68	20	30	W	4	33	22	W		
Amsterdam (Isle)	Asia	Indian Ocean	37	51	0	S	77	44	0	E	5	10	56	E		
Anadirskoi Nofs	Asia	Beering's Str.	64	14	30	N	173	31	0	W	11	34	4	W		
Ancona	Europe	Italy	43	37	54	N	13	30	30	E	0	54	2	E		
Andaman (Little)	Asia	Bengal Bay	10	40	0	N	92	24	0	E	6	9	36	E		
Anderson's Island	Amer.	Beering's Str.	63	4	0	N	167	38	0	W	11	10	32	W		
Anger Point	Asia	Java	6	3	17	S	106	1	57	E	7	4	8	E		
Angers	Europe	France	47	28	8	N	0	33	52	W	0	2	15	W		
Angoulême	Europe	France	45	39	3	N	0	8	47	E	0	0	35	E		
Angra	Europe	Tercera	38	39	7	N	27	12	42	W	1	48	51	W	2	20
C. Angra Pequena	Africa	Caffraria	26	36	50	S	15	16	30	E	1	1	6	E		
Anholt (Lights)	Europe	Categat	56	44	20	N	11	40	0	E	0	46	40	E	0	0
Angenga	Asia	India	8	39	25	N	76	50	4	E	5	7	20	E		
St. Ann (Cape)	Africa	Sierra Leone	7	7	30	N	12	22	0	W	0	49	28	W		
Annamaboe	Africa	Gold Coast	5	9	52	N	1	39	4	W	0	6	36	W		
Annamocka	Asia	Pacific Ocean	20	15	20	S	174	45	0	W	11	39	0	W	6	0
Annobona	Africa	Atlantic Ocean	1	25	0	S	5	45	0	E	0	23	0	E		
St. Anthony's (Cape)	Amer.	Staten Land	54	46	45	S										
Antibes	Europe	France	43	34	43	N	7	7	20	E	0	28	29	E		
Antigua (St. John's)	Amer.	Carib Sea	17	4	30	N	62	9	0	W	4	8	36	W		
Anton. Gill's Bay	Africa	Madagascar	15	27	23	S	50	23	15	E	3	21	33	E		
Antwerp	Europe	Flanders	51	13	18	N	4	24	15	E	0	17	37	E	6	0
Aor (Pulo)	Asia	Chinese Seas	2	45	0	N	104	40	20	E	6	58	41	E		

Digitized by Google

Names of Places	Continent	Coast, Sea, or Country.	Latitude.				Longitude In Degrees				In Time				H.W
			°	′	″		°	′	″		h.	m.	s.		h. m.
Apæ (Isle)	Asia	Pacific Ocean	16	46	15	S	168	27	30	E	11	13	50	E	
Appenrade	Europe	Denmark	55	2	57	N	9	26	4	E	0	37	44	E	
C. Appollonia	Africa	Gold Coaſt	4	59	12	N	3	10	11	W	0	12	41	W	
F. Appollonia	Africa	Gold Coaſt	4	59	14	N	3	4	37	W	0	12	18	W	
Apt	Europe	France	43	52	29	N	5	23	37	E	0	21	34	E	
Aracta	Asia	Turkey	36	1	0	N	38	50	0	E	2	35	20	E	
Arakootai Iſle	Amer.	Pacific Ocean	20	1	30	S	158	14	30	W	10	32	58	W	
Archangel	Europe	Ruſſia	64	34	0	N	38	54	30	E	2	35	38	E	6 0
Arcot	Asia	Arcot	12	51	24	N	79	28	4	E	5	17	52	E	
Arenſburg	Europe	Baltic	58	15	9	N	22	13	15	E	1	28	53	E	
Arica	Amer.	Peru	18	26	40	S	71	13	0	W	4	44	52	W	
Arles	Europe	France	43	40	28	N	4	37	24	E	0	18	30	E	
Arras	Europe	France	50	17	37	N	2	45	41	E	0	11	3	E	
Aruba (W. End)	Amer.	Leeward Iſles	12	35	30	N	69	29	45	W	4	37	59	W	
Aſcenſion (Iſle)	Africa	S. Atl. Ocean	7	56	30	S	14	21	15	W	0	57	25	W	
Aſſiſi	Europe	Italy	43	4	22	N	12	35	13	E	0	50	21	E	
Aſtracan	Aſia	Siberia	46	21	12	N	48	2	45	E	3	12	11	E	
Ath	Europe	Netherlands	50	42	17	N	3	46	17	E	0	15	5	E	
Athens	Europe	Turkey	38	5	0	N	23	52	30	E	1	35	30	E	
Atooi	Amer.	Sandwich Iſles	21	57	0	N	159	39	30	W	10	38	38	W	
Auch	Europe	France	43	38	39	N	0	34	30	E	0	2	18	E	
St. Auguſtin (Bay)	Africa	Madagaſcar	23	27	52	S	44	9	0	E	2	56	36	E	
Aurillac	Europe	France	44	55	10	N	2	27	0	W	0	9	48	W	
Aurora (Iſle)	Aſia	Pacific Ocean	15	8	0	S	168	17	0	E	11	13	8	E	
Autun	Europe	France	46	56	48	N	4	17	44	E	0	17	11	E	
Auxerre	Europe	France	47	47	57	N	3	34	6	E	0	14	16	E	
Aveiro	Europe	Portugal	40	38	17	N	8	29	15	W	0	33	57	W	
Avignon	Europe	France	43	56	58	N	4	48	10	E	0	19	13	E	
Avranches	Europe	France	48	41	21	N	1	21	51	W	0	5	27	W	6 0
Awatſcha	Aſia	Kamtchatka	53	0	37	N	158	44	30	E	10	34	58	E	4 36
B.															
Babee, Pulo	Aſia	Str. of Sunda	5	45	0	N	106	20	30	E	7	5	22	E	
Babylon, Ancient	Aſia	Meſopotamia	33	0	0	N	42	46	30	E	2	51	6	E	
Bagdad	Aſia	Meſopotamia	33	19	40	N	44	22	15	E	2	57	29	E	
Ballaſore,	Aſia	India	21	20	0	N	87	1	26	E	5	48	6	E	10 0
Ballabea, Iſle	Aſia	N. Caledonia	20	7	0	S	164	22	0	E	10	57	28	E	6 0
Banana, Big	Africa	Sierra Leone	8	5	30	N	13	5	0	W	0	52	20	W	
Bancoot	Aſia	India	17	56	40	N	73	7	54	E	4	52	32	E	
Bangalore	Aſia	Myſore	13	0	0	N	77	37	10	E	5	10	29	E	
Banguey, Peak	Aſia	Malacca	7	18	0	N	117	17	30	E	7	49	10	E	
Bank's Iſle	Aſia	New Zeeland	43	43	0	S	173	3	55	E	11	32	16	E	
Bantead	Europe	England	51	19	25	N	0	11	20	W	0	0	45	W	
Bantam Point	Aſia	Java	5	50	20	S	106	9	3	E	7	4	36	E	
Barbas, Cape	Africa	Sanhaga	22	15	30	N	16	40	0	W	1	6	40	W	
Barbuda, Iſle	Amer.	Atlantic Ocean	17	49	45	N	61	50	0	W	4	7	20	W	
Barcelona	Europe	Spain	41	26	0	N	2	13	0	E	0	8	52	E	
Barfleur, Cape	Europe	France	49	40	21	N	1	15	36	W	0	5	2	W	7 30
Barlingues	Europe	Portugal	39	26	0	N	9	35	20	W	0	38	21	W	
Barnevelt's, Iſle	Amer.	Ter. del Fuego	55	49	0	S	66	58	0	W	4	27	52	W	
Barren Iſle	Aſia	Bay of Bengal	12	14	0	N	93	42	0	E	6	14	48	E	
St. Barthoſomew, Iſle	Aſia	N. Hebrides	15	42	0	S	167	17	30	E	11	9	10	E	
Baſle	Europe	Switzerland	47	33	34	N	7	35	12	E	0	30	21	E	
Baſſe Terre	Amer.	Guadaloupe	15	59	45	N	62	0	45	W	4	8	3	W	
Baſſeen, Fort	Aſia	India	19	19	0	N	72	55	24	E	4	51	42	E	
Baſſes, Great	Aſia	Ceylon	6	7	30	N	81	42	50	E	5	26	51	E	
Batavia	Aſia	Java	6	11	0	S	106	50	0	E	7	7	20	E	
Bath	Europe	England	51	22	30	N	2	21	30	W	0	9	26	W	
Batterſea	Europe	England	51	28	36	N	0	10	24	W	0	0	42	W	
Bauld, Cape	Amer.	Newfoundland	51	39	45	N	55	27	50	W	3	41	51	W	
Bayeux	Europe	France	49	16	34	N	0	42	11	W	0	2	49	W	
Bayonne	Europe	France	43	29	15	N	1	28	41	W	0	5	55	W	2 30

Digitized by Google

Names of Places	Continent.	Coast, Sea, or Country.	Latitude.			Longitude In Degrees.				Longitude In Time				H. W.	
			°	′	″	°	′	″		h.	m.	s.		h.	m.
Bazas	Europe	France	44	26	0 N	0	13	17	W	0	0	53	W		
Beachy Head	Europe	England	50	44	24 N	0	15	12	E	0	1	1	E	10	30
Bear, Isle	Amer.	Hudson's Bay	54	34	0 N	79	56	0	W	5	19	44	W	12	0
Beauvais	Europe	France	49	26	0 N	2	4	41	E	0	8	19	E		
Beering's Island	Asia	Beering's Str.	55	36	0 N	167	46	0	E	11	11	4	E		
Belle Isle	Europe	France	47	17	17 N	3	5	0	W	0	12	20	W	1	30
Bellev	Europe	France	45	45	29 N	5	41	4	E	0	22	44	E		
Bembridge Point	Europe	Isle of Wight	50	40	59 N	1	3	26	W	0	4	14	W		
Bencoolen	Asia	Sumatra	3	49	9 S	102	2	25	E	6	48	10	E		
Bender	Europe	Turkey	46	50	29 N	29	36	0	E	1	58	24	E		
Berg River	Africa	St. Helen's Bay	32	50	47 S	18	12	0	E	1	12	48	E		
Bergen	Europe	Norway	60	23	40 N	5	11	30	E	0	20	46	E	1	30
Bergen-op-zoom	Europe	Holland	51	29	46 N	4	16	57	E	0	17	8	E		
Berlin	Europe	Germany	52	31	30 N	13	23	0	E	0	53	32	E		
Bermudas, Isle	Amer.	Atlantic Ocean	32	35	0 N	63	28	0	W	4	13	52	W	7	0
Bernaul	Asia	Siberia	53	19	59 N	82	12	15	E	5	28	49	E		
St. Bertrand	Europe	France	43	1	27 N	0	34	4	E	0	2	16	E		
Besanson	Europe	France	47	14	12 N	6	2	46	E	0	24	11	E		
Besselted	Europe	Iceland	64	6	9 N	21	53	45	W	1	27	35	W		
Bexhill	Europe	England	50	50	47 N	0	28	43	E	0	1	55	E		
Beziers	Europe	France	43	20	23 N	3	12	24	E	0	12	50	E		
Bird Island	Amer.	Pacific Ocean	17	49	0 S	142	43	24	W	9	30	54	W		
Bitche	Europe	Lorrain	49	2	21 N	7	26	20	E	0	29	45	E		
Blanco, Cape	Africa	Negroland	20	55	30 N	17	10	0	W	1	8	40	W	9	45
Blanco, Cape	Amer.	Patagonia	47	20	0 S	64	42	0	W	4	18	48	W		
Blanco, Cape	Amer.	Pacific Ocean	43	12	0 N	124	7	30	W	8	16	30	W		
Bligh's Cape	Asia	Kergulen's L.	48	29	30 S	68	38	45	E	4	34	35	E		
Blois	Europe	France	47	35	20 N	1	20	1	E	0	5	20	E		
Boddam's Isle	Asia	Indian Ocean	5	22	0 S	72	15	0	E	4	49	0	E		
Bojador, Cape	Africa	Negroland	26	12	30 N	14	27	0	W	0	57	48	W	0	0
Bolabola, Isle	Amer.	Pacific Ocean	16	32	30 S	151	52	0	W	10	7	28	W		
Bologna	Europe	Italy	44	29	36 N	11	20	25	E	0	45	22	E		
Bolcheretsk	Asia	Kamtchatka	52	54	30 N	156	56	40	E	10	27	47	E		
Bolt Head	Europe	England	50	17	0 N	3	53	30	W	0	15	34	W		
Bombay	Asia	India	18	55	42 N	72	54	24	E	4	51	38	E		
Bombay, Light-ho.	Asia	India	18	53	0 N	72	52	54	E	4	51	32	E		
Bonavista, Isle	Africa	Cape Verd	16	3	40 N	22	45	32	W	1	31	2	W		
Borcheleon	Europe	Netherlands	50	48	17 N	5	20	18	E	0	21	21	E		
Boscawen's Isle	Asia	Pacific Ocean	15	50	0 S	174	7	40	W	11	36	31	W		
Bolton	Amer.	New England	42	25	0 N	70	37	15	W	4	42	29	W	11	25
Botany, Island	Asia	N. Caledonia	22	26	40 S	167	16	45	E	11	9	7	E	10	30
Botauy Bay	Asia	N. Holland	34	6	0 S	151	15	0	E	10	5	0	E	8	0
Boulogne	Europe	France	50	43	33 N	1	36	33	E	0	6	26	E	11	0
Bourbon, Isle	Africa	Indian Ocean	20	50	54 S	55	30	0	E	3	42	0	E		
Bourdeaux	Europe	France	44	50	14 N	0	34	15	W	0	2	17	W	3	0
Bourgas	Asia	Turkey	40	14	30 N	26	26	52	E	1	45	47	E		
Bourges	Europe	France	47	4	59 N	2	23	45	E	0	9	35	E		
Bow Island	Amer.	Pacific Ocean	18	17	0 S	140	43	0	W	9	22	52	W		
Brandenburg	Europe	Germany	52	27	0 N	12	53	0	E	0	51	32	E		
Brasse, Pulo	Asia	Str. of Malacca	-	-	-	95	11	0	E	6	20	44	E		
Brava, Isle	Africa	Cape Verd	14	50	58 N	24	43	4	W	1	38	52	W		
Breaker's Point	Amer.	Pacific Ocean	49	15	30 N	126	41	30	W	8	26	46	W		
Breda	Europe	Holland	51	35	29 N	4	46	9	E	0	19	5	E		
Bremen	Europe	Germany	53	5	11 N	8	49	34	E	0	35	18	E	6	0
Breslaw	Europe	Silesia	51	6	30 N	17	35	30	E	1	10	22	E		
Brest	Europe	France	48	22	42 N	4	30	0	W	0	18	0	W	3	15
Bridgetown	Amer.	Barbadoes	13	5	0 N	59	41	15	W	3	58	45	W		
St. Brieu	Europe	France	48	31	2 N	2	44	10	W	0	10	57	W		
Brighthelmstone	Europe	England	50	49	32 N	0	11	55	W	0	0	48	W	10	0
Bristol	Europe	England	51	28	0 N	2	34	45	W	0	10	19	W	6	45
Bristol, Cape	Amer.	Sandwich Land	59	2	30 S	26	51	0	W	1	47	24	W		

Digitized by Google

Names of Places.	Continent.	Coast, Sea, or Country.	Latitude.				Longitude In Degrees.				Longitude In Time.				H.W.
			°	′	″		°	′	″		h.	m.	s.		h. m.
Briſtol River	Amer.	Beering's Str.	58	27	0	N	158	7	30	W	10	32	30	W	
Broach Point	Aſia	India	21	38	30	N	72	43	24	E	4	50	54	E	
Brothers, The	Aſia	Sea of Borneo	5	10	20	S	106	14	4	E	7	4	56	E	
Bruges	Europe	Netherlands	51	12	20	N	3	13	13	E	0	12	53	E	
Brunn	Europe	Moravia	49	11	28	N	16	35	6	E	1	6	20	E	
Bruſſels	Europe	Brabant	50	51	0	N	4	21	15	E	0	17	25	E	
Buda	Europe	Hungary	47	29	44	N	19	0	0	E	1	16	0	E	
Buenos Ayres	Amer.	Braſil	34	35	26	S	58	23	38	W	3	53	35	W	
Bukaroſt	Europe	Wallachia	44	26	45	N	26	8	0	E	1	44	32	E	
Buller, Cape	Amer.	S. Georgia Is.	53	58	30	S	37	40	0	W	2	30	40	W	
Burgeo, Iſles	Amer.	Newfoundland	47	36	20	N	57	36	0	W	3	50	24	W	
Burhanpour	Aſia	India	21	19	0	N	76	22	0	E	5	5	28	E	
Byron's Iſle	Aſia	Pacific Ocean	1	13	0	S	177	8	0	E	11	48	32	E	
C.															
Cabello, Port	Amer.	Terra Firma	10	30	50	N	67	32	0	W	4	30	8	W	
Cape Cabron	Amer.	Hiſpaniola	19	21	52	N	69	18	40	W	4	37	15	W	
Cadiz	Europe	Spain	36	31	7	N	6	17	15	W	0	25	9	W	2 30
Caen	Europe	France	49	11	12	N	0	21	53	W	0	1	28	W	9 0
Cahors	Europe	France	44	26	49	N	1	26	22	E	0	5	45	E	
Cairo	Africa	Egypt	30	3	30	N	31	25	30	E	2	5	42	E	
Cajaneburg	Europe	Finland	64	13	30	N	27	45	0	E	1	51	0	E	
Calais	Europe	France	50	57	32	N	1	51	0	E	0	7	24	E	11 30
Calcutta, F. Will.	Aſia	Bengal	22	34	45	N	88	27	56	E	5	53	52	E	3 5
Callao	Amer.	Peru	12	1	53	S	76	58	0	W	5	7	52	W	
Calmar	Europe	Sweden	56	40	30	N	16	25	15	E	1	5	41	E	
Calpy	Aſia	India	26	7	15	N	80	0	0	E	5	20	0	E	
Calymere Point	Aſia	India	10	20	0	N	79	46	0	E	5	19	4	E	
Cambray	Europe	France	50	10	37	N	3	13	32	E	0	12	54	E	
Cambridge	Europe	England	52	12	36	N	0	4	15	E	0	0	17	E	
Cambridge	Amer.	New England	42	25	0	N	71	6	0	W	4	44	24	W	
Camiſchin	Europe	Ruſſia	50	5	6	N	45	24	0	E	3	1	36	E	
Campbell, Cape	Aſia	New Zealand	41	40	48	S	174	33	0	E	11	38	12	E	
Canary, Iſle, N.E. Pt.	Africa	Atlantic Ocean	28	13	0	N	15	38	45	W	1	2	35	W	3 0
Candia, Iſle	Europe	Mediter. Sea	35	18	35	N	25	18	0	E	1	41	12	E	
Candlemas Iſles	Amer.	Sandwich land	57	10	0	S	27	13	0	W	1	48	52	W	
Cananore, Point	Aſia	India	11	51	0	N	75	25	0	E	5	1	40	E	
Canſo, Port	Amer.	Nova Scotia	45	20	7	N	60	55	0	W	4	3	40	W	8 30
Canterbury	Europe	England	51	18	26	N	1	4	53	E	0	4	20	E	
Canton	Aſia	China	23	6	57	N	113	16	7	E	7	33	4	E	
Capricorn, Cape	Aſia	New Holland	23	26	40	S	151	5	40	E	10	4	23	E	8 0
Carcaſſone	Europe	France	43	12	45	N	2	20	49	E	0	9	23	E	
Carleſcroon	Europe	Sweden	56	20	0	N	15	30	0	E	1	2	0	E	
Cariſbrook Caſtle	Europe	Iſle of Wight	50	41	18	N	1	18	26	W	0	5	14	W	
Carpentras	Europe	France	44	3	8	N	5	2	35	E	0	20	10	E	
Carrickfergus	Europe	Ireland	54	43	0	N	5	45	30	W	0	23	2	W	
Carthagena	Europe	Spain	37	36	7	N	1	1	30	W	0	4	6	W	
Carthagena	Amer.	Terra Firma	10	26	19	N	75	20	35	W	5	1	22	W	
Carwar Head	Aſia	India	14	47	0	N	74	12	30	E	4	56	50	E	
Caſan	Aſia	Siberia	55	43	58	N	49	29	30	E	3	17	58	E	
Caſbine	Aſia	Perſia	36	11	0	N	49	33	0	E	3	18	12	E	
Caſſel, Heſs	Europe	Germany	51	19	20	N	9	31	45	E	0	38	7	E	
Caſtres	Europe	France	43	36	11	N	2	14	16	E	0	8	57	E	
St. Catherine's Iſle	Amer.	Braſil	27	32	30	S	49	15	37	W	3	17	2	W	
St. Catherine's Li.	Europe	Iſle of Wight	50	35	33	N	1	17	51	W	0	5	11	W	
Cavan	Europe	Ireland	54	51	41	N	7	25	20	W	0	29	41	W	
Cavaillon	Europe	France	43	50	6	N	5	1	55	E	0	20	8	E	
Cayenne	Amer.	Iſle Cayenne	4	56	15	N	52	15	0	W	3	29	0	W	5 0
Cervia	Europe	Italy	44	15	31	N	12	19	28	E	0	49	18	E	
Cette, Lights	Europe	France	43	23	42	N	3	41	46	E	0	14	47	E	

Digitized by Google

Names of Places.	Continent.	Coast, Sea, or Country	Latitude.				Longitude In Degrees.				Longitude In Time.				H. W.	
			°	′	″		°	′	″		h.	m.	s.		h.	m.
Chain Island	Amer.	Pacific Ocean	17	25	30	S	145	30	0	W	9	42	0	W		
Chalon sur Saone	Europe	France	46	46	54	N	4	51	2	E	0	19	24	E		
Challons sur Marne	Europe	France	48	57	28	N	4	20	15	E	0	17	21	E		
Chandernagor	Asia	Bengal	22	51	26	N	88	29	15	E	5	53	57	E		
Charkow	Europe	Ruſſia	49	59	20	N	36	15	0	E	2	25	0	E		
Charles, Cape	Amer.	Hudſon's Str.	62	46	30	N	74	15	0	W	4	57	0	W	10	0
Q. Charlotte's Cape	Amer.	South Georgia	54	32	0	S	36	11	30	W	2	24	46	W		
Q. Charl. Foreland	Asia	N. Caledonia	22	15	0	S	167	12	45	E	11	8	51	E		
Q. Charlotte's Iſle	Amer.	Pacific Ocean	19	18	0	S	138	20	0	W	9	13	20	W		
Q. Charlotte Sound	Asia	New Zeeland	41	5	57	S	174	20	50	E	11	37	23	E	9	0
Charlotte Town	Amer.	St. John's Iſland	46	14	0	N	62	50	0	W	4	11	20	W		
Charlton Iſland	Amer.	Hudſon's Bay	52	3	0	N	79	5	0	W	5	16	20	W		
Chartres	Europe	France	48	26	54	N	1	29	5	E	0	5	56	E		
Cherbourg	Europe	France	49	38	31	N	1	37	18	W	0	6	29	W	7	30
Cherſon	Europe	Crimea	46	38	29	N	32	56	15	E	2	11	45	E		
Chichester	Europe	England	50	50	11	N	0	46	36	W	0	3	6	W		
Chilbambrum Pagod	Asia	India	11	24	42	N	79	48	6	E	5	19	12	E		
Chiſlehurſt	Europe	England	51	24	33	N	0	4	39	E	0	0	19	E		
Choule, Fort	Asia	India	18	32	0	N	72	59	54	E	4	52	0	E		
Chriſtchurch	Europe	England	50	43	47	N	1	46	3	W	0	7	4	W		
Chriſtiana	Europe	Norway	59	55	20	N	10	48	45	E	0	43	15	E		
Chriſtiansfelt	Europe	Denmark	55	21	27	N	9	29	46	E	0	37	59	E		
Chriſtmas Harbour	Africa	Kergulen's L.	48	41	15	S	69	2	0	E	4	36	8	E	10	0
Chriſtmas Iſle	Amer.	Pacific Ocean	1	57	45	N	157	35	0	W	10	30	20	W		
Chriſtmas Sound	Amer.	Ter. del Fuego	55	21	57	S	70	2	50	W	4	40	11	W	2	30
St. Chriſtopher's Iſla.	Amer.	Carib. Sea	17	15	0	N	62	42	20	W	4	10	49	W		
Churchill River	Amer.	Hudſon's Bay	58	47	32	N	94	13	48	W	6	16	55	W	7	20
Civita Vecchia	Europe	Italy	42	5	24	N	11	46	15	E	0	47	5	E		
Clapham, Obſerv.	Europe	England	51	27	13	N	0	8	39	W	0	0	35	W		
St. Claude	Europe	France	46	23	18	N	5	51	50	E	0	23	27	E		
Clear, Cape	Europe	Ireland	51	19	0	N	9	23	15	W	0	37	33	W	4	30
Clerke's Iſle	Aſia	Beering's Str.	63	15	0	N	169	40	0	W	11	18	40	W		
Clerke's Rocks	Amer.	Atlantic Ocean	55	5	30	S	34	42	0	W	2	18	48	W		
Clermont	Europe	France	45	46	44	N	3	5	2	E	0	12	20	E		
Cochin	Aſia	Malabar	9	58	0	N	76	15	34	E	5	5	2	E		
Cocos Iſles Great	Aſia	Bay of Bengal	14	5	0	N	93	14	0	E	6	12	56	E		
Cocos Iſles Little	Aſia	Bay of Bengal	13	58	0	N	93	7	0	E	6	12	28	E		
Coimbra	Europe	Portugal	40	14	0	N	8	24	0	W	0	33	36	W		
Colenet, Cape	Aſia	N. Caledonia	20	30	0	S	164	56	0	E	10	59	44	E		
Collioure	Europe	France	42	31	31	N	3	5	2	E	0	12	20	E		
Colmar	Europe	France	48	4	44	N	7	22	11	E	0	29	29	E		
Cologne	Europe	Germany	50	55	21	N	6	55	0	E	0	27	40	E		
Colville, Cape	Aſia	New Zeeland	36	24	45	S	175	48	50	E	11	43	15	E		
Comerin, Cape	Aſia	India	8	4	0	N	77	33	50	E	5	10	15	E		
Commachio	Europe	Italy	44	40	27	N	12	9	47	E	0	48	39	E		
Compiegne	Europe	France	49	24	59	N	2	49	41	E	0	11	19	E		
Conception	Amer.	Chili	36	42	54	S	73	6	18	W	4	52	25	W		
Condom	Europe	France	43	57	49	N	0	22	7	E	0	1	28	E		
Condore, Pulo	Aſia	Chineſe Sea	8	40	48	N	106	42	54	E	7	6	52	E	4	16
Conſtantinople	Europe	Turkey	41	1	10	N	28	55	5	E	1	55	40	E		
Cookstown	Europe	Ireland	54	38	20	N	6	40	0	W	0	26	40	W		
Cooper's Iſle	Amer.	Atlantic Ocean	54	57	0	S	36	4	20	W	2	24	17	W		
Copenhagen	Europe	Denmark	55	41	4	N	12	35	10	E	0	50	21	E		
Coquimbo	Amer.	Chili	29	54	33	S	71	15	45	W	4	45	3	W		
Cordouan, Lights	Europe	France	45	35	14	N	1	10	10	W	0	4	41	W		
Cork	Europe	Ireland	51	53	54	N	8	28	15	W	0	33	53	W	6	30
Corneto	Europe	Italy	42	15	23	N	11	43	0	E	0	46	52	E		
Cornwallis, Port	Aſia	Andaman	13	20	30	N	92	51	0	E	6	11	24	E	10	0
Cornwallis, Fort	Aſia	Po. Pinnang	5	27	0	N	100	26	30	E	6	41	46	E		
Coronation, Cape	Aſia	N. Caledonia	22	5	0	S	167	8	0	E	11	8	32	E		
Corvo	Europe	Azores	39	43	38	N	31	4	56	W	2	4	20	W		

Digitized by Google

Names of Places.	Continent.	Coast, Sea, or Country.	Latitude.	Longitude In Degrees.	Longitude In Time	H.W
			° ′ ″	° ′ ″	h. m. s.	h. m.
Coudre Iſle, N.W. ſide	Amer.	Canada - -	47 15 33 N	70 18 57 W	4 41 16 W	
Coullaba Iſland -	Aſia	Indian Ocean	18 37 20 N	72 56 30 E	4 51 46 E	
Coutances - -	Europe	France - -	49 2 54 N	1 26 35 W	0 5 46 W	
Courtray - -	Europe	Netherlands	50 49 43 N	3 15 51 E	0 13 3 E	
Cowes, Weſt -	Europe	Iſle of Wight	50 46 18 N	1 17 17 W	0 5 9 W	10 30
Cracatoa, Iſle -	Aſia	Str. of Sunda	6 6 0 S	105 31 40 E	7 2 7 E	
Cracow - -	Europe	Poland - -	50 10 0 N	19 50 0 E	1 19 20 E	
Cremona - -	Europe	Italy - - -	45 7 49 N	10 6 22 E	0 40 25 E	
Creſmunſter -	Europe	Germany -	48 3 36 N	14 7 21 E	0 56 29 E	
Croiſic - -	Europe	France - -	47 17 40 N	2 31 42 W	0 10 7 W	
Crooked Iſle - -	Amer.	Lucayes -	22 48 50 N	74 26 5 W	4 57 44 W	
Croque Harbour -	Amer.	Newfoundland	51 3 17 N	55 50 0 W	3 43 20 W	
Croſs Cape - -	Amer.	Pacific Ocean	57 58 30 N	136 44 30 W	9 6 58 W	
Cuddalore - -	Aſia	India - -	11 41 0 N	79 37 45 E	5 18 31 E	
Cumberland, Cape	Aſia	N. Hebrides	14 39 30 S	166 47 0 E	11 7 8 E	
Cumberland Ho. -	Amer.	New Wales	53 56 40 N	102 9 0 W	6 48 36 W	
Cumberland Iſle -	Amer.	Pacific Ocean	19 18 0 S	140 52 0 W	9 23 28 W	
Cummin, Iſle -	Aſia	Chineſe Sea	31 40 0 N	121 4 0 E	8 4 16 E	
Curreuſe Iſle -	Aſia	Almirantes -	4 19 0 S	55 47 0 E	3 43 8 E	5 10
D						
Dagger-Ort - -	Europe	Baltic - -	58 56 1 N	22 9 0 E	1 28 36 E	
Damoan Fort -	Aſia	India - -	20 22 0 N	73 2 45 E	4 52 11 E	
Danger, Point -	Aſia	N. Holland	28 8 22 S	153 33 10 E	10 14 13 E	
Danger, Iſles of -	Aſia	Pacific Ocean	10 56 0 S	165 59 0 W	11 3 56 W	
Dantzig - -	Europe	Poland - -	54 22 0 N	18 40 0 E	1 14 40 E	
Darby, Cape - -	Amer.	Beering's Str.	64 21 0 N	163 0 0 W	10 52 0 W	
Daſſen Iſland -	Africa	Caffers - -	33 25 0 S	18 1 52 E	1 12 7 E	
Dax - - -	Europe	France - -	43 42 19 N	1 3 16 W	0 4 13 W	
Deal Caſtle - -	Europe	England -	51 13 5 N	1 23 59 E	0 5 36 E	11 15
Delhi - - -	Aſia	India - -	28 37 0 N	77 40 0 E	5 10 40 E	
Dengeneſs - -	Europe	England -	50 54 52 N	0 57 40 E	0 3 51 E	11 15
Dennis, St. - -	Africa	I. Bourbon -	20 51 43 S	55 30 0 E	3 42 0 E	
Dereham, Eaſt -	Europe	England -	52 40 20 N	0 54 30 E	0 3 38 E	
Devi-cotta - -	Aſia	India - -	11 21 0 N	79 47 0 E	5 19 8 E	
Diamond Iſland -	Aſia	Bay of Bengal	15 50 0 N	94 17 54 E	6 17 12 E	
Diarbekir - -	Aſia	Diarbeck -	37 54 0 N	39 20 0 E	2 37 20 E	
Die - - -	Europe	France -	44 45 31 N	5 22 28 E	0 21 29 E	
Diego, Cape - -	Amer.	Ter.del Fuego	54 33 0 S	65 14 0 W	4 20 56 W	
Diego Garcia -	Aſia	Indian Ocean	7 20 0 S	72 24 52 E	4 49 39 E	
Diego Ramirez -	Amer.	South. Ocean	56 32 30 S	67 55 0 W	4 31 40 W	
Dieppe - - -	Europe	France -	49 55 34 N	1 4 29 E	0 4 18 E	11 15
Digby, Cape - -	Aſia	Kergulen's La.	49 23 30 S	70 32 0 E	4 42 8 E	
Digges, Iſle - -	Amer.	Hudſon's Bay	62 41 0 N	78 50 0 W	5 15 20 W	
Digne - - -	Europe	France -	44 5 18 N	6 14 4 E	0 24 56 E	
Dijon - - -	Europe	France -	47 19 25 N	5 1 48 E	0 20 7 E	
Dilla, Mount -	Aſia	Malabar Coaſt	11 59 40 N	75 14 30 E	5 0 58 E	
Dillengen - -	Europe	Germany -	48 34 10 N	10 29 12 E	0 41 57 E	
Diſappointment, Cape	Amer.	South Georgia	54 58 0 S	36 15 0 W	2 25 0 W	
Diſappointment, Iſle	Amer.	Pacific Ocean	14 7 0 S	141 22 0 W	9 25 28 W	
Diſeada, Cape -	Amer.	Ter. del Fuego	53 4 15 S	74 18 0 W	4 57 12 W	
Diſerada - -	Amer.	Carib. Iſles	16 35 0 N	61 11 15 W	4 4 45 W	
Diu Head - -	Aſia	Guzarat -	20 42 0 N	71 3 30 E	4 44 14 E	
Dix Cove Fort -	Africa	Gold Coaſt -	4 44 0 N	2 37 44 W	0 10 31 W	
Dixmude - -	Europe	Netherlands	51 2 5 N	2 51 39 E	0 11 27 E	
Dol - - -	Europe	France - -	48 33 8 N	1 45 28 W	0 7 2 W	
Domar, Pulo -	Aſia	Chineſe Sea	2 47 0 N	105 21 0 E	7 1 24 E	
Dominique, Iſle -	Amer.	Windward Iſles	15 18 23 N	61 35 30 W	4 6 22 W	
Donna Maria, Cape	Amer.	Hiſpaniola -	18 37 20 N	74 35 52 W	4 58 23 W	
Dorcheſter - -	Europe	England -	50 42 58 N	2 25 40 W	0 9 43 W	

Digitized by Google

Names of Places.	Continent.	Coast, Sea, or Country.	Latitude.	Longitude In Degrees.	Longitude In Time.	H.W.
			° ′ ″	° ′ ″	h. m. s.	h. m.
Douay	Europe	Flanders	50 22 12 N	3 4 47 E	0 12 19 E	
Douglas, Cape	Amer.	Cook's River	58 56 0 N	153 50 0 W	10 15 20 W	
Dover	Europe	England	51 7 48 N	1 19 2 E	0 5 16 E	11 1
Drake's Iſland	Europe	Plymouth Sou.	50 21 30 N	4 13 30 W	0 16 54 W	5 4
Dreſden	Europe	Saxony	51 2 54 N	13 41 15 E	0 54 45 E	
Dreux	Europe	France	48 44 17 N	1 21 24 E	0 5 26 E	
Dronthiem	Europe	Norway	63 26 6 N	10 22 0 E	0 41 28 E	2 1
Druja	Europe	Ruſſia	55 47 29 N	27 13 30 E	1 48 54 E	
Dublin	Europe	Ireland	53 22 0 N	6 17 0 W	0 25 8 W	9 4
Dublin Obſervatory	Europe	Ireland	53 23 7 N	6 20 30 W	0 25 22 W	
Dundee	Europe	Scotland	56 25 0 N	3 2 30 W	0 12 10 W	
Dundra-Head	Aſia	Ceylon	5 51 0 N	80 41 20 E	5 22 45 E	
Dunkirk	Europe	France	51 2 9 N	2 22 4 E	0 9 28 E	11 4
Duſky Bay	Aſia	New Zeeland	45 47 27 S	166 18 9 E	11 5 13 E	10 5
Dun-Noſe	Europe	England	50 37 7 N	1 11 36 W	0 4 46 W	9 4
E						
Eagle Iſland	Aſia	Almirantes	5 10 0 S	55 37 0 E	3 42 28 E	3 3
Eaoowe, Iſle	Aſia	Pacific Ocean	21 24 0 S	174 30 0 W	11 38 0 W	7
Eaſt Cape	Aſia	Beering's Str.	66 5 30 N	169 44 0 W	11 18 56 W	
Eaſt Cape	Aſia	New Zeeland	37 44 25 S	178 58 0 E	11 55 52 E	
Eaſt-Main, Fort	Amer.	Labrador	52 15 0 N	78 57 49 W	5 15 51 W	
Eaſter Iſland	Amer.	Pacific Ocean	27 6 30 S	109 46 45 W	7 19 7 W	2
Ecaterinburg	Aſia	Siberia	56 50 15 N	60 50 0 E	4 3 20 E	
Edam, Iſle	Aſia	Batavia Bay	5 57 30 S	106 51 0 E	7 7 24 E	
Edgecumbe, Cape	America	Pacific Ocean	57 4 30 N	135 55 30 W	9 3 42 W	
Edinburg	Europe	Scotland	55 56 42 N	3 12 15 W	0 12 49 W	4 3
Edward's, Pr. Iſles	Africa	In. Ocean { N.	46 39 30 S	38 2 30 E	2 32 10 E	
		{ S.	46 52 30 S	37 47 0 E	2 31 8 E	
Edyſtone	Europe	Eng. Channel	50 8 0 N	4 24 0 W	0 17 36 W	5 3
Egmont, Cape	Aſia	New Zeeland	39 23 20 S	174 12 30 E	11 36 50 E	
Egmont, Iſle	Amer.	Pacific Ocean	19 20 0 S	138 46 0 W	9 15 4 W	
Eimeo, Iſle	Amer.	Pacific Ocean	17 30 0 S	149 54 0 W	9 59 36 W	
Elias's (St.) Mount	Amer.	Pacific Ocean	60 24 30 N	141 0 0 W	9 24 0 W	
Elephant Point	Aſia	Ceylon	6 20 0 N	81 39 15 E	5 26 37 E	
Elizabeth, Cape	Amer.	Pacific Ocean	59 11 0 N	152 12 0 W	10 8 48 W	
Elmina Caſtle	Africa	Gold Coaſt	5 1 38 N	2 0 12 W	0 8 1 W	
Eltham	Europe	England	51 27 4 N	0 3 10 E	0 0 13 E	
Embrum	Europe	France	44 34 7 N	6 25 54 E	0 25 44 E	
Enatum, Iſle	Aſia	Pacific Ocean	20 10 0 S	170 4 0 E	11 20 16 E	
Enckhuyſen	Europe	Holland	52 42 22 N	5 10 0 E	0 20 40 E	
Engliſh Road	Aſia	Eaoowe	21 20 30 S	174 49 0 W	11 39 16 W	
Endeavour River	Aſia	New Holland	15 27 11 S	145 10 0 E	9 40 40 E	
Enos	Europe	Turkey	40 41 58 N	25 58 30 E	1 43 54 E	
Erramanga, Iſle	Aſia	Pacific Ocean	18 46 30 S	169 18 30 E	11 17 14 E	
Erzerum	Aſia	Turkey	39 56 35 N	48 35 45 E	3 14 23 E	
Eſpiritu Santo	Amer.	Cuba	21 57 41 N	79 49 30 W	5 19 18 W	
Euſtachia, Town	Amer.	Caribb Sea	17 29 0 N	63 2 0 W	4 12 8 W	
Evout's Iſles	Amer.	Ter. del Fuego	55 34 30 S	66 59 0 W	4 27 56 W	
Evreux	Europe	France	49 1 30 N	1 8 54 E	0 4 36 E	
Exeter	Europe	England	50 44 0 N	3 34 30 W	0 14 18 W	10
F						
Fairlight	Europe	England	50 52 39 N	0 38 35 E	0 2 34 E	5
Falmouth	Europe	England	50 8 0 N	5 3 0 W	0 20 12 W	
Falſe, Cape	Africa	Caffres	34 16 0 S	18 44 0 E	1 14 56 E	
Falſe Bay	Africa	Caffres	34 10 0 S	18 33 0 E	1 14 12 E	
Fano	Europe	Italy	43 51 0 N	12 59 38 E	0 51 59 E	
Fareham	Europe	England	50 51 20 N	1 10 11 W	0 4 41 W	
Farewell, Cape	Amer.	Greenland	59 38 0 N	42 42 0 W	2 50 48 W	

Digitized by Google

Names of Places.	Continent.	Coast, Sea, or Country.	Latitude.				Longitude In Degrees				Longitude In Time.				H.W
			°	′	″		°	′	″		h.	m.	s.		h. m.
Farewell, Cape	Asia	New Zeeland	40	37	0	S	172	49	38	E	11	31	19	E	
Farnham	Europe	England	51	13	7	N	0	47	52	W	0	3	11	W	
Fayal, Town	Europe	Azores	38	32	20	N	28	41	5	W	1	54	44	W	2 20
Fecamp	Europe	France	49	45	24	N	0	22	48	E	0	1	31	E	
Felix and Amb. Iſles	Amer.	Pacific Ocean	26	16	0	S	79	16	0	W	5	17	4	W	
Ferdinand Noronha	Amer.	Braſil	3	56	20	S	32	38	0	W	2	10	32	W	
Fermo	Europe	Italy	43	10	18	N	13	41	26	E	0	54	46	E	
Fernando Po	Africa	Atlantic Ocean	3	28	0	N	8	40	0	E	0	34	40	E	
Ferrara	Europe	Italy	44	49	46	N	11	36	15	E	0	46	25	E	
Ferraria, Point	Europe	St. Micheal (Az	37	49	41	N	25	59	49	W	1	43	59	W	
Ferro, Town	Africa	Canaries	27	47	35	N	17	45	8	W	1	11	1	W	3 0
Finiſterre, Cape	Europe	Spain	42	53	30	N	9	18	24	W	0	37	14	W	3 15
Fizeron, Cape	Europe	Portugal	39	19	0	N	11	43	53	W	0	46	56	W	
Fladſtrand	Europe	Denmark	57	27	3	N	10	33	15	E	0	42	13	E	
Flattery, Cape	Amer.	New Albion	48	15	30	N	124	58	30	W	8	19	54	W	
Flenſburg	Europe	Denmark	54	47	8	N	9	27	6	E	0	37	48	E	
Florence	Europe	Italy	43	46	30	N	11	3	30	E	0	44	14	E	
Flores	Europe	Azores	39	26	20	N	31	11	22	W	2	4	45	W	
Flour, Saint	Europe	France	45	1	53	N	3	5	24	E	0	12	22	E	
Flushing	Europe	Holland	51	26	37	N	3	34	9	E	0	14	17	E	0 45
Foggy Iſland	Amer.	Pacific Ocean	56	12	0	N	157	19	30	W	10	29	18	W	
Foktzani	Europe	Turkey	45	38	51	N	27	2	30	E	1	48	10	E	
Folkſtone	Europe	England	51	5	45	N	1	11	29	W	0	4	46	W	
Fontarabia	Europe	Spain	43	21	36	N	1	47	29	W	0	7	10	W	
S. Foreland, Light	Europe	England	51	8	21	N	1	22	6	E	0	5	28	E	
No. Foreland	Europe	England	51	22	49	N	1	26	22	E	0	5	45	E	
Fortaventure, W. P.	Africa	Canaries	28	4	0	N	14	31	30	W	0	58	6	W	
Foul Point	Africa	Madagaſcar	17	40	14	S	49	52	30	E	3	19	30	E	
Foulweather, Cape	Amer.	Pacific Ocean	44	53	0	N	124	10	0	W	8	16	40	W	
Frampton Houſe	Europe	Wales	51	25	1	N	3	29	30	W	0	13	58	W	
France, Iſle of	Africa	Indian Ocean	20	9	43	S	57	31	30	E	3	50	6	E	
Francfort, on the M.	Europe	Germany	50	7	40	N	8	35	45	E	0	34	23	E	
Francfort, on the Od.	Europe	Germany	52	22	8	N	14	45	0	E	0	59	3	E	
Franciſco, St.	Amer.	New Albion	37	48	30	N	122	7	20	W	8	8	30	W	11 25
Francois, Cape	Amer.	Hiſpaniola	19	46	40	N	72	17	45	W	4	49	11	W	
Francois, Old Cape	Amer.	Hiſpaniola	19	40	30	N	70	2	0	W	4	40	8	W	
Frant	Europe	England	51	5	54	N	0	16	13	E	0	1	5	E	
Frawenburg	Europe	Pruſſia	54	22	15	N	20	7	30	E	1	20	30	E	
Free Town	Africa	Sierra Leone	8	29	40	N	13	5	17	W	0	52	21	W	
Frehel, Light	Europe	France	48	41	10	N	2	18	57	W	0	9	15	W	
Frejus	Europe	France	43	25	52	N	6	43	54	E	0	26	56	E	
Frieſland's Peak	Amer.	Sandwich Land	59	2	0	S	26	55	30	W	1	47	42	W	
Frio, Cape	Amer.	Braſil	22	54	0	S	42	8	15	W	2	48	33	W	
Frio, Cape	Africa	Caffraria	18	40	0	S	12	26	0	E	0	49	44	E	
Fronſac, Strait	Amer.	Nova Scotia	45	36	57	N	61	19	30	W	4	5	18	W	
Fuego, Iſle	Africa	Cape Verd	14	57	2	N	24	22	2	W	1	37	32	W	
Fulham	Europe	England	51	28	7	N	0	12	35	W	0	0	50	W	
Funchal	Africa	Medeira	32	37	20	N	16	55	36	W	1	7	42	W	12 4
Furneaux, Iſland	Amer.	Pacific Ocean	17	11	0	S	143	6	40	W	9	32	27	W	
Furneſs	Europe	Netherlands	51	4	23	N	2	39	36	E	0	10	38	E	
G															
Gabey	Aſia	New Guinea	0	6	0	S	126	23	45	E	8	25	35	E	
Galle, Cape de	Aſia	Ceylon	6	1	0	N	80	19	20	E	5	21	17	E	
Gallipoli	Europe	Turkey	40	25	33	N	26	37	15	E	1	46	29	E	
Gand	Europe	Netherlands	51	3	15	N	3	43	20	E	0	14	53	E	
Ganjam	Aſia	India	19	22	30	N	85	18	30	E	5	41	14	E	
Gap	Europe	France	44	33	37	N	6	4	47	E	0	24	19	E	
Gaſpar, Iſland	Aſia	Str. of Gaſper	2	25	0	S	107	7	45	E	7	8	31	E	
Gaſpee	Amer.	G. St. Lawrence	48	47	30	N	64	27	30	W	4	17	50	W	

Digitized by Google

Names of Places.	Continent.	Coast, Sea, or Country.	Latitude.				Longitude In Degrees				Longitude In Time.				H.W.	
			°	′	″		°	′	″		h	m	s.		h.	m.
Gravareea, Cape -	Asia	Kamtſchatſka	51	20	30	N	158	36	0	E	10	34	24	E		
Heinhauſen - -	Europe	Germany -	50	13	25	N	9	13	38	E	0	36	55	E		
Geneva - -	Europe	Savoy -	46	12	17	N	6	8	24	E	0	24	34	E		
Genoa - -	Europe	Italy - -	44	25	0	N	8	51	15	E	0	35	25	E		
St. George, Iſle -	Europe	Azores - -	38	53	30	N	28	10	0	W	1	52	40	W		
St. George, Town -	Amer.	Bermudas -	32	22	20	N	64	14	15	W	4	16	57	W		
St. George, Fort -	Amer.	Hiſpaniola -	18	18	40	N	73	11	49	W	4	52	47	W		
St. George, Fort -	Aſia	India - -	13	4	54	N	80	24	49	E	5	21	39	E		
St. George, Cape -	Amer.	Newfoundland	43	30	5	N	59	20	33	W	3	57	22	W		
St. George, Cape -	Aſia	N. Holland	35	10	30	S	150	29	0	E	10	1	56	E		
St. George, Cape -	Aſia	New Britain	4	53	30	S	153	8	45	E	10	12	35	E		
George, Cape -	Amer.	South Georgia	54	17	0	S	36	32	30	W	2	26	10	W		
George, Cape -	Aſia	Kergulen's La.	49	54	30	S	70	12	0	E	4	40	48	E		
Geriah - -	Aſia	Malabar -	16	37	0	N	73	22	24	E	4	53	30	E		
Ghent - -	Europe	Flanders -	51	3	15	N	3	43	20	E	0	14	53	E		
Gibraltar - -	Europe	Spain -	36	4	44	N	5	4	0	W	0	20	16	W	0	0
Gilbert's Iſle -	Amer.	Ter. del Fuego	55	13	0	S	71	6	45	W	4	44	27	W		
Glandeve - -	Europe	France - -	43	56	43	N	6	48	10	E	0	27	13	E		
Glaſgow - -	Europe	Scotland -	55	51	32	N	4	16	0	W	0	17	4	W		
Gloceſter Houſe -	Amer.	New Wales	51	24	26	N	87	26	2	W	5	49	44	W		
Gloceſter Iſle -	Amer.	Pacific Ocean	19	11	0	S	140	20	0	W	9	21	20	W		
Gluchow - -	Europe	Ruſſia - -	51	40	30	N	34	20	0	E	2	17	20	E		
Gluckſtad - -	Europe	Holſtein -	53	47	44	N	9	27	0	E	0	37	48	E		
Goa - - -	Aſia	India - -	15	28	20	N	73	58	39	E	4	55	55	E		
Goat Iſle - -	Aſia	Chineſe Sea	13	55	0	N	120	2	0	E	8	0	8	E		
Goave, Le Petit -	Amer.	Hiſpaniola -	18	27	0	N	72	45	34	W	4	51	2	W		
Goes - - -	Europe	Zeeland -	51	30	18	N	3	53	5	E	0	15	32	E		
Gogo - - -	Aſia	India - -	21	40	30	N	72	21	15	E	4	49	25	E		
Gomera, Iſle -	Africa	Canaries -	28	5	40	N	17	8	0	W	1	8	32	W		
Gonave, Iſle, N.E. Pt.	Amer.	Hiſpaniola -	18	48	35	N	72	56	27	W	4	51	46	W		
Goodwood - -	Europe	England -	50	52	21	N	0	44	9	W	0	2	57	W		
Good Hope, Cape -	Africa	Caffraria -	34	29	0	S	18	23	15	E	1	13	33	E	3	0
Good Hope, Town	Africa	Caffraria -	33	55	42	S	18	23	7	E	1	13	32	E	2	30
Goree, Iſle - -	Africa	Atlantic Ocean	14	40	5	N	17	24	30	W	1	9	38	W	1	30
Gotha - - -	Europe	Germany -	50	56	17	N	10	41	46	E	0	42	46	E		
Gothaah - -	Amer.	Greenland -	64	9	55	N	51	46	45	W	3	27	7	W		
Gottenburg - -	Europe	Sweden -	57	42	0	N	11	57	30	E	0	47	50	E		
Gottingen, Obſerv.	Europe	Germany -	51	31	54	N	9	54	15	E	0	39	37	E		
Goudhurſt - -	Europe	England -	51	6	50	N	0	27	39	E	0	1	51	E		
Grafton, Iſle -	Aſia	Baſhees -	21	4	0	N	120	55	11	E	8	3	41	E		
Grafton, Cape -	Aſia	N. Holland	16	53	30	S	145	42	45	E	9	42	51	E		
Grenada, Fort Royal	Amer.	Carib. Sea -	12	2	54	N	61	51	15	W	4	7	25	W		
Granville - -	Europe	France - -	48	50	16	N	1	36	15	W	0	6	25	W	6	45
Graſſe - -	Europe	France - -	43	39	19	N	6	55	9	E	0	27	41	E		
Gratioſa - -	Europe	Azores - -	39	11	0	N	27	54	30	W	1	51	38	W		
Gratz - - -	Europe	Germany -	47	4	9	N	15	25	45	E	1	1	43	E		
Gravelines - -	Europe	Flanders -	50	59	10	N	2	7	35	E	0	8	30	E	0	0
Gravois, Point -	Amer.	Hiſpaniola -	18	0	55	N	74	2	15	W	4	56	9	W		
Greenwich, Obſ. -	Europe	England -	51	28	40	N	0	0	0		0	0	0			
Grenaae - -	Europe	Denmark -	58	24	57	N	10	53	21	E	0	43	33	E		
Gregory, Cape -	Amer.	Pacific Ocean	43	29	0	N	124	9	0	W	8	16	36	W		
Grenoble - -	Europe	France - -	45	11	42	N	5	43	34	E	0	22	54	E		
Grenville, Cape -	Amer.	Pacific Ocean	57	31	0	N	152	37	30	W	10	10	30	W		
Grouais, Iſle -	Europe	France - -	47	38	4	N	3	26	23	W	0	13	46	W		
Grinſted, Eaſt -	Europe	England -	51	7	28	N	0	0	16	E	0	0	1	E		
Grinſted, Weſt -	Europe	England -	50	58	24	N	0	19	53	W	0	1	20	W		
Gryphiſwald -	Europe	Germany -	54	5	15	N	13	35	15	E	0	54	5	E		
Guadaloupe - -	Amer.	Carib. Sea -	15	59	30	N	61	48	15	W	4	7	15	W		
Guiaquil - -	Amer.	Peru - -	2	11	18	S	79	20	52	W	5	17	23	W		
Gurief - -	Aſia	Siberia -	47	7	7	N	51	59	15	E	3	27	57	E		

Digitized by Google

Names of Places.	Continent.	Coast, Sea, or Country.	Latitude.	Longitude In Degrees.	Longitude In Time	H.W
			° ′ ″	° ′ ″	h. m. s.	h. m
H						
Haderſleben - -	Europe	Denmark -	55 15 6 N	9 30 15 E	0 38 1 E	
Hague - - -	Europe	Holland - -	52 4 12 N	4 16 2 E	0 17 4 E	8 1
Halifax - -	Amer.	Nova Scotia	44 44 0 N	63 36 0 W	4 14 24 W	7 3
Hamburg - -	Europe	Germany -	53 33 3 N	9 55 15 E	0 39 41 E	6
Hammerfoſt, Iſle -	Europe	North Sea -	70 38 43 N	23 43 35 E	1 34 54 E	
Hampſtead - -	Europe	England -	51 33 19 N	0 10 42 W	0 0 43 W	
Hang lip, Cape -	Africa	Caffraria -	34 16 0 S	18 44 0 E	1 14 56 E	
Hanover - -	Europe	Germany -	52 22 18 N	9 44 15 E	0 38 57 E	
Harbro', Market -	Europe	England -	52 28 30 N	0 57 25 W	0 3 50 W	
Harefield - -	Europe	England -	51 36 10 N	0 29 15 W	0 1 57 W	
Haerlem - -	Europe	Holland -	52 22 14 N	4 37 0 E	0 18 28 E	
Harrow on the Hill	Europe	England -	51 34 27 N	0 20 3 W	0 1 20 W	
Haſtings - -	Europe	England -	50 52 10 N	0 41 10 E	0 2 45 E	11 0
Havannah - -	Amer.	Cuba - -	23 11 52 N	82 8 36 W	5 28 34 W	
Havant - -	Europe	England -	50 51 5 N	0 58 38 W	0 3 55 W	
Haver-de-Grace -	Europe	France - -	49 29 14 N	0 6 23 E	0 0 26 E	9 0
Hawkhill - -	Europe	Scotland -	55 57 37 N	3 10 15 W	0 12 41 W	
Heeſe, La - -	Europe	Netherlands	51 23 2 N	4 44 45 E	0 18 59 E	
St. Helena, Ja-To	Africa	S. Atlan. Ocean	15 55 0 S	5 43 30 W	0 22 54 W	2 15
Hengiſtbury Head -	Europe	England -	50 42 57 N	1 45 11 W	0 7 1 W	
Henley Houſe -	Amer.	New Wales	51 14 28 N	84 46 15 W	5 39 5 W	
Henlopen, Cape -	Amer.	Virginia -	38 47 8 N	75 12 31 W	5 0 50 W	9 0
Henry, Cape -	Amer.	Virgigia -	36 57 0 N	76 31 30 W	5 6 6 W	
Heraclia - -	Europe	Turkey - -	41 1 3 N	27 54 19 E	1 51 37 E	
St. Hermogenes, Iſle	Amer.	Cook's River	58 15 0 N	152 13 0 W	10 8 52 W	
Hernoſand - -	Europe	Sweden -	62 38 0 N	17 50 15 E	1 11 21 E	
Hervey's, Iſle -	Amer.	Pacific Ocean	19 17 0 S	158 56 20 W	10 35 45 W	
Heſſeloe, Iſle -	Europe	Categat - -	56 11 46 N	11 43 45 E	0 46 55 E	
Heve, Cape la -	Europe	France -	49 30 42 N	0 4 0 E	0 0 16 E	
Highbury Houſe -	Europe	England -	51 33 13 N	0 5 51 W	0 0 23 W	
Highclere - -	Europe	England -	51 18 46 N	1 20 16 W	0 5 21 W	
Highgate - -	Europe	England -	51 34 16 N	0 8 50 W	0 0 35 W	
Hinchinbroke, Iſle	Aſia	Pacific Ocean	17 25 0 S	168 38 0 E	11 14 32 E	
Hinchinbroke, Cape	Amer.	Pr. Wm's Sound	60 16 0 N	146 55 0 W	9 47 40 W	
Hioring - -	Europe	Denmark -	57 27 44 N	9 59 58 E	0 40 0 E	
Hoai-Nghan - -	Aſia	China -	33 34 40 N	118 49 30 E	7 55 18 E	
Hogue, Cape la -	Europe	France -	49 44 40 N	1 56 50 W	0 7 47 W	0 0
Hola - - - -	Europe	Iceland -	65 44 0 N	19 44 0 W	1 18 56 W	
Holme Point -	Europe	England -	52 59 40 N	0 30 45 E	0 2 3 E	
Honfleur - -	Europe	France - -	49 25 13 N	0 13 59 E	0 0 56 E	9
Hood's Iſle - -	Amer.	Pacific Ocean	9 26 0 S	138 52 0 W	9 15 28 W	
Hoogſtraeten -	Europe	Netherlands	51 24 44 N	4 46 15 E	0 19 5 E	
Horn, Cape - -	Amer.	Ter. del Fuego	55 58 30 S	67 26 0 W	4 29 44 W	
Horndean - -	Europe	England -	50 55 33 N	1 0 21 W	0 4 1 W	
Horſham - -	Europe	England -	51 3 36 N	0 19 43 W	0 1 19 W	
Hout Bay - -	Africa	Caffraria -	34 3 0 S	18 19 0 E	1 13 16 E	
Howe's Iſle - -	Amer.	Pacific Ocean	16 46 30 S	154 6 40 W	10 16 27 W	
Howe, Cape -	Aſia	New Holland	37 31 15 S	145 31 0 E	9 58 4 E	
Huahine, Iſle -	Amer.	Pacific Ocean	16 44 0 S	151 6 0 W	10 4 24 W	
Hueen, Iſle - -	Europe	Sound - -	55 54 38 N	12 41 30 E	0 50 46 E	
Hudſon's Houſe -	Amer.	New Wales	53 0 32 N	106 27 48 W	7 5 51 W	
Hunaſton Lights -	Europe	England -	52 58 40 N	0 28 0 E	0 1 52 E	
Hurſt Light-houſe	Europe	England -	50 42 23 N	1 32 52 W	0 6 11 W	
Hurſtmonceux -	Europe	England -	50 51 35 N	0 19 42 E	0 1 19 E	
Huſum - -	Europe	Denmark -	54 28 48 N	9 4 7 E	0 36 16 E	
Hydrabad - -	Aſia	Golconda -	17 12 0 N	78 51 0 E	5 15 24 E	

Digitized by Google

Names of Places.	Continent.	Coast, Sea, or Country	Latitude.	Longitude In Degrees	Longitude In Time	H.W
			° ′ ″	° ′ ″	h. m. s.	h. m
I J						
Jackſon, Port	Aſia	New Holland	33 51 7 S	151 13 30 E	10 4 54 E	
Jaffrabad, Fort	Aſia	India	20 52 50 N	71 36 30 E	4 46 26 E	
Jakutſk	Aſia	Siberia	62 1 52 N	129 43 30 E	8 38 55 E	
Jakutſkoi-Noſs	Aſia	Kamtſchatka	66 5 30 N	169 44 0 W	11 18 56 W	
Janeiro, Rio	Amer.	Braſil	22 54 10 S	43 10 45 W	2 52 43 W	2
Jaroſlawl	Europe	Ruſſia	57 37 30 N	40 10 0 E	2 40 40 E	
Jarra, Pulo	Aſia	Str. of Malacca	3 57 0 N	100 17 0 E	6 41 8 E	
Jaſſey	Europe	Moldavia	47 8 32 N	27 29 45 E	1 49 59 E	
Java Head	Aſia	Java	6 48 30 S	105 7 25 E	7 0 30 E	
Icy Cape	Amer.	Beering's Str.	70 29 0 N	161 42 30 W	10 46 50 W	
Idolhos, Iſles	Africa	Atlantic Ocean	9 27 0 N	13 32 30 W	0 54 10 W	
Jenikola	Europe	Crimea	45 21 0 N	36 26 30 E	2 25 46 E	
Jeniſeik	Aſia	Siberia	58 27 17 N	91 58 30 E	6 7 54 E	
Jeremie, Point	Amer.	Hiſpaniola	18 40 20 N	74 13 28 W	4 56 53 W	
Jeruſalem	Aſia	Paleſtine	31 55 0 N	35 20 0 E	2 21 20 E	
St. Ildefonſo iſles	Amer.	Ter. del Fuego	55 51 0 S	69 28 0 W	4 37 52 W	
Ilginſkoi	Aſia	Siberia	- - -	104 59 0 E	6 59 56 E	
Immer, Iſle	Aſia	Pacific Ocean	19 16 0 S	169 46 0 E	11 19 4 E	
Ingolſtadt	Europe	Germany	48 45 50 N	11 25 30 E	0 45 42 E	
Ingornahoix	Amer.	Newfoundland	50 37 17 N	57 15 30 W	3 49 2 W	
Johanna, Peak	Africa	Comora Iſles	12 16 0 S	44 46 18 E	2 59 5 E	
St. John's	Amer.	Antigua	17 4 30 N	62 9 0 W	4 8 30 W	
St. John's	Amer.	Newfoundland	47 32 44 N	52 25 30 W	3 29 42 W	6
St. Joſeph	Amer.	California	23 3 37 N	109 40 45 W	7 18 43 W	
Joy, Port	Amer.	Iſle of St. John's	46 11 0 N	62 57 15 W	4 11 49 W	
Irkutſk	Aſia	Siberia	52 18 8 N	104 33 30 E	6 58 14 E	
Irraname Iſle	Aſia	Pacific Ocean	19 31 0 S	170 21 0 E	11 21 24 E	
Iſlamabad	Aſia	India	22 20 0 N	91 49 43 E	6 7 19 E	
Iſle of Pines	Aſia	Pacific Ocean	22 38 0 S	167 38 0 E	11 10 32 E	
Iſlington	Europe	England	51 32 18 N	0 6 0 W	0 0 24 W	
Iſmael	Europe	Turkey	45 20 58 N	28 50 0 E	1 55 20 E	
Iſpahan	Aſia	Perſia	32 24 34 N	51 50 0 E	3 27 20 E	
St. Juan, Cape	Amer.	Staten Land	54 47 10 S	63 47 0 W	4 15 8 W	
Juan Fernandes, Iſle	Amer.	Pacific Ocean	33 40 0 S	78 33 0 W	5 14 12 W	
Judda	Aſia	Arabia	21 29 0 N	39 22 0 E	2 37 28 E	
Judomſkoi	Aſia	Siberia	- - -	139 52 30 E	9 19 30 E	
St. Julian, Port	Amer.	Patagonia	49 10 0 S	68 44 0 W	4 34 56 W	4 4
Jupiter's Inlet	Amer.	Anticoſta, Iſle	49 26 0 N	63 38 15 W	4 14 33 W	
Juthia	Aſia	India	14 18 0 N	100 50 0 E	6 43 20 E	
K						
Kalouga	Europe	Ruſſia	54 30 0 N	36 5 0 E	2 24 20 E	
Kamenec	Europe	Poland	48 46 53 N	27 1 15 E	1 48 5 E	
Keeling's Iſlands	Aſia	Indian Ocean	12 3 15 S	97 38 30 E	6 30 34 E	
Kamtſchatſkoi-Noſs	Aſia	Kamtſchatka	56 1 0 N	163 22 30 E	10 53 30 E	
Karakakoo Bay	Amer.	Sandwich Iſles	19 28 10 N	155 56 23 W	10 23 46 W	3 4
Kateringburg	Aſia	Siberia	56 50 15 N	60 50 0 E	4 3 20 E	
Kayes Iſland	Amer.	Pacific Ocean	59 52 0 N	145 0 0 W	9 40 0 W	
Kedgeree	Aſia	India	21 48 0 N	88 50 15 E	5 55 21 E	
Keppel's Iſland	Aſia	Pacific Ocean	15 56 30 S	174 10 24 W	9 36 42 W	
Kiam-Cheu	Aſia	China	35 37 0 N	111 29 15 E	7 25 57 E	
Kidnapper's Cape	Aſia	New Zeeland	39 42 45 S	177 16 0 E	11 49 4 E	
Kiel	Europe	Holſtein	54 22 25 N	9 24 45 E	0 37 39 E	
Kinſale	Europe	Ireland	51 41 30 N	8 28 15 W	0 33 53 W	5
Kiow	Europe	Ukraine	50 27 0 N	30 27 30 E	2 1 50 E	
Kiringinſkoi	Aſia	Siberia	57 47 0 N	108 2 0 E	7 12 8 E	

Digitized by Google

Names of Places.	Continent.	Coast, Sea, or Country	Latitude.				Longitude In Degrees.				Longitude In Time.				H.W
			°	′	″		°	′	″		h.	m.	s.		h. m.
Kirk-Newton	Europe	Scotland	55	54	30	N	3	30	33	W	0	14	2	W	
Kittery Point	Amer.	New England	43	4	27	N	70	44	30	W	4	42	58	W	
Koamaroo, Cape	Afia	New Zeeland	41	4	48	S	174	34	30	E	11	38	18	E	
Kola	Europe	Lapland	68	52	26	N	33	1	30	E	2	12	6	E	
Kongfwinger	Europe	Norway	60	12	11	N	11	57	45	E	0	47	51	E	
Kermantini Fort	Africa	Gold Coaft	5	10	58	N	1	34	24	W	0	6	18	W	
Korfar, Lights	Europe	Denmark	55	20	22	N	11	8	30	E	0	44	34	E	
Kofloff	Europe	Crimea	45	14	0	N	33	25	0	E	2	13	40	E	
Kowima, Upper	Afia	Kamtfchatka	65	28	0	N	153	35	0	E	10	14	20	E	
Kowima, Lower	Afia	Kamtfchatka	68	18	0	N	163	18	0	E	10	53	12	E	
Krementzoug	Europe	Ruffia	49	3	28	N	33	28	45	E	2	13	55	E	
Kronotfkoi-Nofs	Afia	Kamtfchatka	54	43	0	N	162	13	30	E	10	48	54	E	
Kullen Lights	Europe	Sweden	56	18	3	N	12	26	14	E	0	49	45	E	
Kurfk	Europe	Ruffia	51	43	30	N	36	27	30	E	2	25	50	E	
L															
La Ciotat	Europe	France	43	10	29	N	5	36	48	E	0	22	27	E	
Ladrone, Grand	Afia	Chinefe Sea	22	2	0	N	113	56	0	E	7	35	44	E	
Lagoon Ifle, Cook's	Amer.	Pacific Ocean	18	46	33	S	138	54	15	W	9	15	37	W	
Lagoon Ifle, Bligh's	Amer.	Pacific Ocean	21	38	0	S	140	37	0	W	9	22	28	W	
Lages	Europe	Turkey	40	58	42	N	25	3	21	E	1	40	13	E	
Laguna	Africa	Teneriffe	28	28	31	N	16	27	13	W	1	5	49	W	
Lambhuus	Europe	Iceland	64	6	17	N	21	54	30	W	1	27	38	W	
Lamplaco	Afia	Turkey	40	20	52	N	26	36	20	E	1	46	25	E	
Lancarota, E. Pt.	Africa	Canaries	29	14	0	N	13	26	0	W	0	53	44	W	
Landau	Europe	France	49	11	38	N	8	7	30	E	0	32	30	E	
Landfcroon	Europe	Sweden	55	52	23	N	12	48	0	E	0	51	12	E	
Langres	Europe	France	47	52	0	N	5	19	50	E	0	21	19	E	
Laon	Europe	France	49	33	54	N	3	37	12	E	0	14	29	E	
St. Lawrence's Ifle	Afia	Beering's Str.	63	47	0	N	171	45	0	E	11	27	0	E	
Laufanne	Europe	Switzerland	46	31	5	N	6	45	15	E	0	27	1	E	
Lavaur	Europe	France	43	40	52	N	1	49	3	E	0	7	16	E	
Le Croific	Europe	France	47	17	43	N	2	30	30	W	0	10	2	W	
Leftoure	Europe	France	43	55	54	N	0	37	11	E	0	2	29	E	
Leeds	Europe	England	53	47	33	N	1	38	30	W	0	6	34	W	
Leghorn	Europe	Italy	43	33	2	N	10	16	30	E	0	41	6	E	
Leicefter	Europe	England	52	38	0	N	1	8	30	W	0	4	34	W	
Leiptic	Europe	Saxony	51	22	22	N	12	20	30	E	0	49	22	E	
Le Mans	Europe	France	48	0	35	N	0	11	49	E	0	0	47	E	
Leopard's Ifle	Africa	Sierra Leone	8	40	10	N	13	8	0	W	0	52	32	W	
Leofloffe	Europe	England	52	29	0	N	1	44	9	E	0	6	57	E	10 30
Leper's Iſland	Afia	Pacific Ocean	15	23	30	S	167	58	15	E	11	11	53	E	
Le Puy	Europe	France	45	2	41	N	3	52	46	E	0	15	31	E	
Lefcar	Europe	France	43	19	52	N	0	26	7	W	0	1	44	W	
Leskeard	Europe	England	50	26	50	N	4	41	45	W	0	18	47	W	
Lefparre	Europe	France	45	18	33	N	0	57	3	W	0	3	48	W	
Liverpool	Europe	England	53	22	0	N	2	56	45	W	0	11	47	W	11 8
Lewis Town	Amer.	Pennſylvania	38	47	27	N	75	15	48	W	5	1	3	W	
Leyden	Europe	Holland	52	8	40	N	4	28	0	E	0	17	52	E	
Liege	Europe	Netherlands	50	39	22	N	5	31	30	E	0	22	6	E	
Lilienthal	Europe	Saxony	53	8	25	N	8	58	0	E	0	35	52	E	
Lima	Amer.	Peru	12	1	56	S	76	54	0	W	5	7	36	W	
Limoges	Europe	France	45	49	44	N	1	15	55	E	0	5	4	E	
Lintz	Europe	Germany	48	16	0	N	13	57	30	E	0	55	50	E	
Lifieux	Europe	France	49	8	50	N	0	13	32	E	0	0	54	E	
Lille	Europe	Flanders	50	37	50	N	3	4	16	E	0	12	17	E	
Lifbon	Europe	Portugal	38	42	20	N	9	9	10	W	0	36	37	W	2 15
Lion's Bank	Europe	Atlantic Ocean	56	40	0	N	17	45	0	W	1	11	0	W	
Liturne, Cape	Afia	N. Hebrides	15	40	45	S	166	57	0	E	11	7	48	E	
Lifburne, Cape	Amer.	Beering's Str.	69	5	0	N	165	22	30	W	11	1	30	W	

Digitized by Google

Names of Places.	Continent.	Coast, Sea, or Country.	Latitude.	Longitude In Degrees.	Longitude In Time	H.W
			° ′ ″	° ′ ″	h. m. s.	h. m.
Lizard - - -	Europe	England -	49 57 30 N	5 13 0 W	0 20 52 W	7 50
Lizier, St. - -	Europe	France - -	43 0 3 N	1 8 5 E	0 4 32 E	
Loam-pit Hill -	Europe	England -	51 28 7 N	0 1 25 W	0 0 6 W	
Lodeve - - -	Europe	France - -	43 43 47 N	3 18 48 E	0 13 15 E	
Loheia - - -	Asia	Arabia -	15 42 8 N	42 8 30 E	2 48 34 E	
Lombez - - -	Europe	France - -	43 28 21 N	0 54 24 E	0 3 38 E	
London, St. Paul's	Europe	England -	51 30 49 N	0 5 47 W	0 0 23 W	2 45
—— Spital Squ.	Europe	England -	51 31 9 N	0 4 20 W	0 0 17 W	
—— Chriſt's Hoſ.	Europe	England -	51 30 52 N	0 5 51 W	0 0 23 W	
—— Mr. Graham's	Europe	England -	51 30 52 N	0 6 10 W	0 0 25 W	
—— Surry-ſtr. Obſ.	Europe	England -	51 30 40 N	0 6 45 W	0 0 27 W	
—— Somerſet Pl.	Europe	England -	51 30 43 N	0 6 54 W	0 0 28 W	
—— Saville Houſe	Europe	England -	51 30 38 N	0 7 42 W	0 0 31 W	
Londonderry -	Europe	Ireland - -	54 59 28 N	7 14 49 W	0 28 59 W	6 0
Lopatka, Cape -	Asia	Kamtſchatka	51 0 15 N	156 42 30 E	10 26 50 E	
Lorenzo, Cape -	Amer.	Peru - -	1 2 0 S	80 59 45 W	5 23 59 W	
Loretto - -	Europe	Italy - -	43 27 0 N	13 34 50 E	0 54 19 E	
Louis, Port -	Amer.	Hiſpaniola -	18 18 40 N	73 16 49 W	4 53 7 W	
Louis, Port -	Africa	Mauritius -	20 9 44 S	57 28 15 E	3 49 53 E	
Louiſburg - -	Amer.	Cape Breton	45 53 50 N	59 59 15 W	3 59 57 W	7 15
Louveau - -	Aſia	India - -	12 42 30 N	101 1 30 E	6 44 6 E	
Louvain - -	Europe	Netherlands	50 53 26 N	4 41 32 E	0 18 46 E	
Lubni - - -	Europe	Ruſſia - -	50 0 37 N	33 3 30 E	2 12 14 E	
St. Lucar, Cape -	Amer.	Mexico -	22 45 0 N	110 0 0 W	7 20 0 W	
St. Lucia, Iſle -	Amer.	Antilles -	13 24 30 N	60 51 30 W	4 3 26 W	
Lucipara - -	Aſia	Str. Banka -	3 11 20 S	106 18 46 E	7 5 15 E	
St. Lunaire Bay -	Amer.	Newfoundland	51 29 0 N	55 30 0 W	3 42 0 W	
Lunden - -	Europe	Sweden -	55 42 13 N	13 11 5 E	0 52 44 E	
Luneville - -	Europe	France - -	48 35 33 N	6 30 6 E	0 26 0 E	
Luſon - - -	Europe	France - -	46 27 15 N	1 10 0 W	0 4 40 W	3 0
Luxembourg - -	Europe	Netherlands	49 37 20 N	6 13 45 E	0 24 55 E	
Lydd - - -	Europe	England -	50 57 7 N	0 54 15 E	0 3 37 E	
Lynn Regis - -	Europe	England -	52 45 34 N	0 24 29 E	0 1 38 E	6 45
Lyons - - -	Europe	France - -	45 45 52 N	4 49 9 E	0 19 17 E	
M.						
Macao, Pia Grand -	Aſia	China - -	22 11 20 N	113 35 15 E	7 34 15 E	5 50
Macaſſar - -	Aſia	Celebes -	5 9 0 S	119 48 45 E	7 59 15 E	
Macclesfield Shoal	Aſia	Chineſe Sea	15 51 18 N	114 18 0 E	7 37 12 E	
Macon - - -	Europe	France -	46 18 27 N	4 49 53 E	0 19 20 E	
Madeira, Funchal -	Africa	Atlantic Ocean	32 37 20 N	16 55 36 W	1 7 42 W	12 4
Madraſs - - -	Aſia	India - -	13 4 54 N	80 24 49 E	5 21 39 E	
Madre de Dios, Port	Amer.	Marqueſas -	9 55 30 S	139 8 40 W	9 16 35 W	2 30
Madrid - -	Europe	Spain -	40 25 18 N	3 38 30 W	0 14 34 W	
Maeſtricht - -	Europe	Netherlands	50 51 7 N	5 40 45 E	0 22 43 E	
Mafamaie - -	Africa	Zanquebar -	16 21 0 S	40 20 30 E	2 41 22 E	
Magdalen, Iſles -	Amer.	G.St.Lawrence	47 17 0 N	61 26 0 W	4 5 44 W	
Magdalena, Iſle -	Amer.	Pacific Ocean	10 25 30 S	138 49 0 W	9 15 16 W	
Mahon, Port -	Europe	Minorca -	39 51 48 N	3 48 30 E	0 15 14 E	
Majorca, Iſle -	Europe	Medit. Sea -	39 35 0 N	2 29 45 E	0 9 59 E	
Maize, Cape -	Amer.	Cuba - -	20 18 0 N	74 23 0 W	4 57 32 W	
Malacca - -	Aſia	India - -	2 12 6 N	102 8 45 E	6 48 35 E	
Malicoy, Iſland -	Aſia	Indian Ocean	8 15 30 N	73 9 30 E	4 52 38 E	
Mallicola, Iſle -	Aſia	Pacific Ocean	16 15 30 S	167 39 15 E	11 10 37 E	
Maloes, St.. - -	Europe	France -	48 39 3 N	2 1 26 W	0 8 6 W	6 0
Malmoe - -	Europe	Sweden -	55 36 37 N	13 1 4 E	0 52 4 E	
Malta, Town -	Africa	Mediter. Sea	35 53 50 N	14 28 30 E	0 57 54 E	
Manchester - -	Europe	England -	53 26 30 N	2 15 0 W	0 9 0 W	
Mangalore - -	Aſia	Malabar -	12 50 0 N	74 57 24 E	4 59 50 E	
Mangeea, Iſle -	Amer.	Pacific Ocean	21 56 45 S	158 3 0 W	10 32 12 W	
Manheim - -	Europe	Germany -	49 28 59 N	8 27 30 E	0 33 49 E	

Digitized by Google

Names of Places.	Continent.	Coast, Sea, or Country.	Latitude.	Longitude In Degrees.	Longitude In Time	H.W
			° ′ ″	° ′ ″	h. m. s.	h. m
Manilla - -	Asia	Philippines	14 36 8 N	120 51 15 E	8 3 25 E	
Mansfelt, Isle -	Amer.	Hudson's Bay	62 38 30 N	80 33 0 W	5 22 12 W	
Maria V. Diem. C.	Asia	New Zeeland	34 29 15 S	172 46 30 E	11 31 16 E	
St. Marcou, Isle -	Europe	France -	49 29 52 N	1 8 56 W	0 4 36 W	
Marigalante, Isle -	Amer.	Atlantic Ocean	15 55 15 N	61 11 0 W	4 4 44 W	
Marmara, Isle -	Asia	Sea of Marmara	40 37 4 N	27 30 35 E	1 50 2 E	
Marpurg - -	Europe	Germany -	46 34 42 N	15 41 20 E	1 2 45 E	
Marseilles - -	Europe	France - -	43 17 43 N	5 22 12 E	0 21 29 E	
St. Martha - -	Amer.	Terra Firma	11 19 2 N	74 4 30 W	4 56 18 W	
St. Martin's Cape -	Africa	St. Helen's Bay	32 41 43 S	17 55 0 E	1 11 40 E	
St. Martin's Isle -	Amer.	Carib. Sea -	18 4 20 N	63 2 0 W	4 12 8 W	
Martinico, Isle -	Amer.	West Indies	14 44 0 N	61 21 16 W	4 5 25 W	
Martin-Vaz - -	Amer.	Atlantic Ocean	20 28 16 S	29 1 0 W	1 56 4 W	
St. Mary's Isle -	Europe	Scilly Isles -	49 55 30 N	6 16 45 W	0 25 7 W	3 45
St. Mary's Town -	Europe	Azores - -	36 56 40 N	25 9 10 W	1 40 37 W	
Mas-a-fuera, Isle -	Amer.	Pacific Ocean	33 45 0 S	80 22 0 W	5 21 28 W	
Maskelyne's Isles -	Asia	N. Hebrides	16 32 0 S	167 59 15 E	11 11 57 E	
Masulipatam -	Asia	India - -	16 8 30 N	81 11 45 E	5 24 47 E	
St. Matthew's Light	Europe	France - -	48 19 34 N	4 45 54 W	0 19 4 W	2 50
Mauritius, Pt. Louis	Africa	Indian Ocean	20 9 45 S	57 29 15 E	3 49 57 E	
Maurua. Isle - -	Amer.	Pacific Ocean	16 25 40 S	152 32 40 W	10 10 11 W	
Mayance - -	Europe	Germany -	49 54 0 N	8 20 0 E	0 33 20 E	
Mayne's Isle, John	Europe	North. Ocean	71 10 0 N	9 49 30 W	0 39 18 W	
Mayo, Isle - -	Africa	Cape Verd -	15 12 40 N	23 14 7 W	1 32 56 W	
Mayotta, Peak -	Africa	Comora Isles	12 59 15 S	45 25 0 E	3 1 40 E	
Meaux - -	Europe	France -	48 57 40 N	2 52 30 E	0 11 30 E	
Mechlin - -	Europe	Netherlands	51 1 50 N	4 28 45 E	0 17 55 E	
Mende - -	Europe	France -	44 31 2 N	3 29 35 E	0 13 58 E	
Mercury Bay -	Asia	New Zeeland	36 48 0 S	176 6 20 E	11 44 25 E	
Mergui - -	Asia	Siam - -	12 10 30 N	98 19 15 E	6 33 17 E	
Mesurado Bay -	Africa	Grain Coast	6 18 20 N	10 49 0 W	0 43 16 W	
Metz - - -	Europe	France - -	49 7 10 N	6 10 13 E	0 24 41 E	
Mew Stone - -	Asia	New Holland	43 47 15 S	146 26 30 E	9 45 46 E	
Mexico - -	Amer.	Mexico -	19 54 0 N	99 41 45 W	6 38 47 W	
Mezieres - -	Europe	France - -	49 45 47 N	4 43 16 E	0 18 53 E	
Miatea, Isle - -	Amer.	Pacific Ocean	17 52 20 S	148 6 0 W	9 52 24 W	
St. Michael's Isle -	Europe	Azores - -	37 47 0 N	25 42 0 W	1 42 48 W	
Middleburg - -	Europe	Zeeland -	51 30 6 N	3 36 35 E	0 14 16 E	
Middleburg Isle -	Asia	Friendly Isles	21 20 30 S	174 34 0 W	11 38 16 W	
Milan - -	Europe	Italy -	45 28 0 N	9 10 52 E	0 36 43 E	
Milo, Isle - -	Europe	Mediter. Sea	36 41 0 N	25 0 0 E	1 40 0 E	
Minster - -	Europe	England -	51 19 50 N	1 18 46 E	0 5 15 E	
Mirepoix - -	Europe	France - -	48 5 7 N	1 52 11 E	0 7 29 E	
Mirroe, Isle - -	Asia	Bay of Bengal	7 29 0 N	93 37 30 E	6 14 30 E	
Mittau - - -	Europe	Courland -	56 39 10 N	23 42 45 E	1 34 51 E	
Mocca - - -	Asia	Arabia - -	13 16 0 N	44 0 0 E	2 56 0 E	
Mocha, Isle - -	Amer.	Pacific Ocean	38 22 30 S	74 37 0 W	4 58 28 W	
Modena - -	Europe	Italy - -	44 34 0 N	11 12 30 E	0 44 50 E	
Mohilew - -	Europe	Russia -	53 54 0 N	30 24 30 E	2 1 38 E	
Monopin Hill -	Asia	Banka -	2 1 20 S	105 21 7 E	7 1 24 E	
Mons - -	Europe	Netherlands	50 27 10 N	3 57 15 E	0 15 49 E	
Monticurs - -	Asia	Borneo -	4 23 40 S	115 34 45 E	7 42 19 E	
Montague, Cape -	Amer.	SandwichLand	58 33 0 S	26 46 0 W	1 47 4 W	
Montagu, Isle -	Asia	New Hebrides	17 26 0 S	168 31 30 E	11 14 6 E	
Montalto - -	Europe	Italy - -	42 59 44 N	13 35 14 E	0 54 21 E	
Montauban - -	Europe	France - -	44 0 55 N	1 20 51 E	0 5 23 E	
Monte-Christi -	Amer.	Peru - -	1 2 0 S	80 49 15 W	5 23 17 W	
Montego Bay -	Amer.	Jamaica -	18 31 0 N	78 20 0 W	5 13 20 W	
Monterrey - -	Amer.	New Albion	36 36 20 N	121 34 15 W	8 6 17 W	7 30
Montlambert -	Europe	France - -	50 43 2 N	1 38 45 E	0 6 35 E	
Montmirail - -	Europe	France - -	48 52 8 N	3 32 16 E	0 14 9 E	

Digitized by Google

Names of Places.	Continent.	Coast, Sea, or Country	Latitude.				Longitude In Degrees.				Longitude In Time.				H.W.
			°	′	″		°	′	″		h.	m.	s.		h. m.
Montpellier	Europe	France	43	36	29	N	3	51	45	E	0	15	27	E	
Montserrat, Isle	Amer.	Carib. Sea	16	49	0	N	62	27	0	W	4	9	48	W	
Monument, Isle	Asia	New Hebridas	17	14	15	S	168	38	15	E	11	14	33	E	
Moose, Fort	Amer.	New Wales	51	15	54	N	80	54	41	W	5	23	39	W	
Morant, Point	Amer.	Jamaica	17	58	0	N	76	15	45	W	5	5	3	W	
Morokinnee	Amer.	Sandwich Isles	20	39	0	N	156	29	30	W	10	25	58	W	
Morotoi	Amer.	Sandwich Isles	21	10	0	N	157	17	0	W	10	29	8	W	
Moscow	Europe	Moscovy	55	45	29	N	37	46	15	E	2	31	5	E	
Mosdok	Europe	Russia	43	43	23	N	43	50	0	E	2	55	20	E	10 15
Mosketto Cove	Amer.	Greenland	64	55	13	N	52	56	45	W	3	31	47	W	10 15
Moulins	Europe	France	46	34	4	N	3	20	0	E	0	13	20	E	
Mount, Cape	Africa	Grain Coast	6	46	0	N	11	48	0	W	0	47	12	W	
Mowee, East Point	Amer.	Sandwich Isles	20	50	30	N	155	55	0	W	10	23	40	W	
Mowee, West Point	Amer.	Sandwich Isles	20	53	30	N	156	38	30	W	10	26	34	W	
Mulgrave, Point	Amer.	Beering's Str.	67	45	30	N	165	12	0	W	11	0	48	W	
Munich	Europe	Bavaria	48	7	37	N	11	32	30	E	0	46	10	E	
Mufwell Hill	Europe	England	51	35	32	N	0	7	20	W	0	0	29	W	
N															
Nagpour	Asia	India	21	8	30	N	79	46	0	E	5	19	4	E	
Namur	Europe	Netherlands	50	28	3	N	4	47	45	E	0	19	11	E	
Nancovery Harbour	Asia	Nicobar Isles	7	58	0	N	93	26	0	E	6	13	44	E	
Nancy	Europe	France	48	41	55	N	6	10	15	E	0	24	41	E	
Nangasacht	Asia	Japan	32	32	0	N	128	46	15	E	8	35	5	E	6 0
Nankin	Asia	China	32	4	40	N	118	47	0	E	7	55	8	E	
Nantes	Europe	France	47	13	7	N	1	43	0	W	0	6	12	W	3 0
Naples	Europe	Italy	40	50	15	N	14	18	0	E	0	57	22	E	9 30
Narbonne	Europe	France	43	10	58	N	3	0	0	E	0	12	0	E	
Narcondam	Asia	Bay of Bengal	13	25	15	N	94	7	0	E	6	16	28	E	
Narva	Europe	Livonia	59	23	27	N	28	21	45	E	1	53	27	E	
Navassa, Isle	Amer.	Atlantic Ocean	18	23	30	N	75	1	18	W	5	0	5	W	
Needles, Light	Europe	Isle of Wight	50	39	53	N	1	33	55	W	0	6	16	W	10 30
Negapatam	Asia	India	10	46	0	N	79	48	26	E	5	19	14	E	
Negrais, Cape	Asia	India	15	56	30	N	94	18	0	E	6	17	12	E	
Nelchin	Europe	Russia	51	2	45	N	31	49	30	E	2	7	18	E	
Neuſtadt	Europe	Auſtria	47	48	27	N	16	13	17	E	1	4	53	E	
Nevers	Europe	France	46	59	17	N	3	9	16	E	0	12	37	E	
Newbury	Amer.	New England	43	2	0	N	70	37	30	W	4	42	30	W	
Newenham, Cape	Amer.	Beering's Str.	58	41	30	N	162	19	30	W	10	49	18	W	0 0
Newington, Stoke	Europe	England	51	33	40	N	0	4	59	W	0	0	20	W	
Newtee, Point	Asia	India	15	56	0	N	73	36	0	E	4	54	24	E	
New-werk, Isle	Europe	Lower Saxony	53	55	19	N	8	31	9	E	0	34	6	E	
New-year's Harbo.	Amer.	Staten Land	54	48	55	S	64	11	0	W	4	16	44	W	
Nice	Europe	Italy	43	41	47	N	7	16	22	E	0	29	5	E	
Nicholas Mole, St.	Amer.	Hiſpaniola	19	49	20	N	73	29	45	W	4	53	59	W	
Nicobar, Great	Asia	Bay of Bengal	7	4	0	N	93	44	0	E	6	14	56	E	
Nicobar, Car.	Asia	Bay of Bengal	9	10	0	N	92	50	0	E	6	11	20	E	
Nieuport	Europe	Flanders	51	7	41	N	2	45	5	E	0	11	0	E	11 45
Ningpo	Asia	China	29	57	45	N	120	18	0	E	8	1	12	E	
Nimes	Europe	France	43	50	12	N	4	18	39	E	0	17	15	E	
Noir, Cape	Amer.	Ter. del Fuego	54	32	30	S	73	3	15	W	4	52	13	W	
Noirmoutier, Isle	Europe	France	47	0	5	N	2	14	22	W	0	8	57	W	
Nootka Sound	Amer.	Pacific Ocean	49	36	7	N	126	42	10	W	8	26	41	W	0 20
Norburg	Europe	Denmark	55	3	43	N	9	45	18	E	0	39	1	E	
Norfolk Iſland	Asia	Pacific Ocean	29	1	45	S	168	10	0	E	11	12	40	E	1 0
Noriton	Amer.	Pennſylvania	40	9	56	N	75	28	30	W	5	1	54	W	
North Cape	Europe	Lapland	71	10	30	N	25	49	0	E	1	43	16	E	3 44
North, Cape	Amer.	South Georgia	54	4	45	S	38	15	0	W	2	33	0	W	
North, Cape	Asia	Beering's Str.	68	56	0	N	179	11	30	W	11	56	46	W	
North Iſland	Asia	Str. of Sunda	5	37	5	S	105	55	0	E	7	3	40	E	

Digitized by Google

Names of Places.	Continent.	Coast, Sea, or Country.	Latitude.			Longitude In Degrees.			Longitude In Time.			H.W
			°	′	″	°	′	″	h.	m	s	h. m
North Island - -	Asia	Chinese Sea	25	14	0 N	141	14	0 E	9	24	56 E	
Norton's Sound -	Amer.	Beering's Str.	64	30	30 N	162	47	30 W	10	51	10 W	
Noyon - -	Europe	France - -	49	34	59 N	2	59	48 E	0	11	59 E	
Nuremberg - -	Europe	Germany -	49	27	3 N	11	0	45 E	0	44	3 E	
O												
Oaitipeha Bay -	Amer.	Otaheite -	17	45	45 S	149	8	57 W	9	56	36 W	
Ochotsk - -	Asia	Tartary -	59	20	10 N	143	12	30 E	9	32	50 E	
Chamaneno Harb.	Amer.	Uliteah -	16	45	30 S	151	37	31 W	10	6	30 W	11 30
Oheteroæ, Isle -	Amer.	Pacific Ocean	22	26	36 S	150	48	45 W	10	3	15 W	
Ohevahoa, Isle -	Amer.	Marquesas -	9	40	40 S	139	1	40 W	9	16	7 W	
Ohitahoo, Isle -	Amer.	Marquesas -	9	55	30 S	139	6	0 W	9	16	24 W	2 30
Oldenburg - -	Europe	Westphalia -	53	8	40 N	8	14	20 E	0	32	57 E	
Oleron - -	Europe	France -	43	11	1 N	0	36	30 W	0	2	26 W	
Oleron, Isle -	Europe	France . -	46	2	51 N	1	24	27 W	0	5	38 W	3 0
Olinde - -	Amer.	Brasil -	8	13	0 S	35	5	30 W	2	20	22 W	
Olonne, Sables d' -	Europe	France - -	46	29	52 N	1	47	5 W	0	7	8 W	3 0
Omergon, Tow. -	Asia	India - -	20	10	30 N	72	56	30 E	4	51	46 E	
Omer's, St. - -	Europe	France - -	50	44	52 N	2	14	57 E	0	9	0 E	
Onateayo, Isle -	America	Marquesas -	9	58	0 N	138	51	0 W	9	15	24 W	
Onecheow, Isle -	Amer.	Sandwich Isles	21	49	30 N	160	13	30 W	10	40	54 W	
Oonalaska - -	Amer.	Beering's Str.	53	54	29 N	166	22	15 W	11	5	29 W	
Oonemak, Cape -	Amer.	Beering's St.	54	30	30 N	165	31	0 W	11	10	4 W	
Opara, Isle - -	Amer.	Pacific Ocean	27	36	0 S	144	8	32 W	9	36	34 W	
Oporto - -	Europe	Portugal -	41	10	0 N	8	22	0 W	0	33	28 W	3 15
Orange - -	Europe	France - -	44	8	10 N	4	48	8 E	0	19	13 E	
Oreehoua - -	Amer.	Sandwich Isles	22	3	0 N	160	6	30 W	10	40	26 W	
Orel - - -	Europe	Russia -	52	56	40 N	35	57	0 E	2	23	48 E	
Orenburg - -	Asia	Tartary -	51	46	3 N	55	7	35 E	3	40	30 E	
Orford, Cape -	Amer.	Pacific Ocean	42	52	0 N	124	25	0 W	8	17	40 W	
Orford-Ness -	Europe	England -	52	4	30 N	1	28	1 E	0	5	52 E	
Orleans - -	Europe	France -	47	54	10 N	1	54	27 E	0	7	38 E	9 45
Orleans, New -	Amer.	Louisiana -	29	57	45 N	89	58	45 W	5	59	55 W	
Oratava - -	Africa	Teneriffe -	28	23	35 N	16	35	35 W	1	6	22 W	3 0
Orfk - - -	Asia	Tartary -	51	12	32 N	58	32	0 E	3	54	8 E	
Ortegal, Cape -	Europe	Spain -	43	46	37 N	7	38	0 W	0	30	32 W	3 0
Osimo - -	Europe	Italy - - -	43	29	36 N	13	27	8 E	0	53	49 E	
Osnaburg - -	Europe	Germany -	52	16	14 N	7	47	30 E	0	31	10 E	
Osnaburg, Isle -	Amer.	Pacific Ocean	17	52	20 S	148	6	0 W	9	52	24 E	
Ostend - -	Europe	Netherlands	51	15	10 N	2	56	30 E	0	11	46 E	11 45
Ostia - - -	Europe	Italy - -	41	45	35 N	12	16	20 E	0	49	5 E	
Otakootaia, Isle -	Amer.	Pacific Ocean	19	51	30 S	158	23	0 W	10	33	32 W	
Overbierg - -	Europe	Norway -	59	6	52 N	11	22	15 E	0	45	29 E	
Ower Rocks -	Europe	England -	50	39	57 N	0	40	0 W	0	2	40 W	
Owharre Bay -	Amer.	Huahine -	16	42	46 S	151	9	6 W	10	4	36 W	11 50
Owhyhee { N. Point	Amer.	Sandwich Isles	20	17	0 N	155	59	0 W	10	23	56 W	
Owhyhee { S. Point	Amer.	Sandwich Isles	18	54	30 N	155	48	0 W	10	23	12 W	
Owhyhee { E. Point	Amer.	Sandwich Isles	19	33	0 N	154	52	0 W	10	19	28 W	
Oxford Observatory	Europe	England -	51	45	38 N	1	15	0 W	0	5	0 W	
P.												
Paddlesworth -	Europe	England -	51	6	50 N	1	8	9 E	0	4	38 E	
Padua - -	Europe	Italy . -	45	23	40 N	11	52	56 E	0	47	32 E	
Paimbeuf - -	Europe	France -	47	17	15 N	2	1	46 W	0	8	7 W	
Paita - -	Amer.	Peru -	5	12	0 S	-	-	-	-	-	-	
Paix, Port - -	Africa	Hispaniola -	19	56	0 N	72	52	15 W	4	51	29 W	
Palermo - -	Europe	Sicily - -	38	6	45 N	13	20	15 E	0	53	21 E	
Pallifer, Cape -	Asia	New Zeeland	41	38	0 S	175	23	12 E	11	41	33 E	
Pallifer's Isles -	Amer.	Pacific Ocean	15	38	15 S	146	30	15 W	9	46	1 W	

Digitized by Google

Names of Places.	Continent	Coast, Sea, or Country.	Latitude.				Longitude In Degrees				Longitude In Time.				H.W
			°	′	″		°	′	″		h.	m.	s.		h. m
Pallifer, Port	Africa	Kergulin's Ia.	49	3	15	S	69	35	0	E	4	38	20	E	
Palma, Isle	Africa	Canaries	28	36	45	N	17	49	6	W	1	11	16	W	
Palmas, Cape	Africa	Grain Coast	4	30	0	N	7	41	0	W	0	30	44	W	
Palmerston's Isle	Amer.	Pacific Ocean	18	0	30	S	163	12	0	*W*	10	52	48	W	
Palmiras, Point	Asia	India	20	44	0	N	87	1	26	E	5	48	6	E	9 30
Palmiers	Europe	France	43	6	44	N	1	36	21	E	0	6	25	E	
Panama	Amer.	Mexico	8	58	12	N	80	15	15	W	5	21	1	W	
Paoom, Isle	Asia	New Hebrides	16	30	0	S	168	28	45	E	11	13	55	E	
Para	Amer.	R. Amazons	1	28	0	S	48	40	0	W	3	14	40	*W*	
Paris, Obſervatory	Europe	France	48	50	14	N	2	20	0	E	0	9	20	E	
Parma	Europe	Italy	44	44	50	N	10	26	30	E	0	41	46	E	
Paſſado	Amer.	Peru	0	10	0	S	82	0	0	W	5	28	0	W	
Patrixfiord	Europe	Iceland	65	35	45	N	24	10	0	W	1	36	40	W	
Pau	Europe	France	43	15	0	N	0	9	0	W	0	0	36	W	
St. Paul's Iſle	Africa	Indian Ocean	38	44	0	S	77	18	0	E	5	9	12	E	
St. Paul de Leon	Europe	France	48	41	24	N	3	58	37	W	0	15	54	W	4 0
Pavia	Europe	Italy	45	10	59	N	9	11	30	E	0	36	46	E	
Pednathias Head	Europe	Scilly Iſles	49	52	2	N	-	-	-		-	-	-		
Pedra Blanca	Asia	Chineſe Sea	22	16	0	N	115	22	57	E	7	41	32	E	
Pedra Branca	Asia	Str. of Malacca	1	18	0	N	104	31	49	E	6	58	7	E	
Pedra, Point	Asia	Ceylon	39	52	0	N	80	27	0	E	5	21	48	E	
Pekin	Asia	China	39	54	47	N	116	24	51	E	7	45	39	E	
Pellew Iſles	Asia	Chineſe Sea	7	19	0	N	134	40	0	E	8	58	40	E	
Pello	Europe	Finland	66	48	16	N	23	58	15	E	1	35	53	E	
Pera, Pulo	Asia	Str. of Malacca		.	.		99	8	30	E	6	36	34	E	
Perigueux	Europe	France	45	11	8	N	0	43	19	E	0	2	53	E	
Perinaldo	Europe	Italy	43	53	20	N	7	42	45	E	0	30	51	E	
Permera, Rocks	Asia	Indian Ocean	13	13	0	N	74	44	0	E	4	58	56	E	
Peros Banhos	Asia	Indian Ocean	5	22	0	N	71	53	0	E	4	47	32	E	
Perpetua, Cape	Amer.	Pacific Ocean	44	4	30	N	124	14	0	W	8	16	56	W	
Perpignan	Europe	France	42	41	53	N	2	53	35	E	0	11	34	E	
Peſaro	Europe	Italy	43	55	1	N	12	53	21	E	0	51	33	E	
St. Peterſburg	Europe	Ruſſia	59	56	23	N	30	19	15	E	2	1	17	E	
St. Peter's Fort	Amer.	Martinico	14	44	0	N	61	21	16	E	4	5	25	W	
St. Peter's Iſle	Amer.	Atlantic Ocean	46	46	30	N	56	17	0	W	3	45	8	W	
St. Peter and Paul	Asia	Kamtſchatſka	53	0	37	N	158	44	30	E	10	34	58	E	4 36
Petit Goave	Amer.	Hiſpaniola	18	27	0	N	72	45	34	W	4	51	2	W	
Petroſawodſk	Europe	Ruſſia	61	47	4	N	34	23	30	E	2	17	34	E	
Pettaw	Europe	Styria	46	26	21	N	15	59	15	E	1	3	57	E	
Petworth	Europe	England	50	59	17	N	0	36	26	W	0	2	26	W	
Pevenſey	Europe	England	50	49	12	N	0	20	14	E	0	1	21	E	
Philadelphia	Amer.	Pennſylvania	39	56	54	N	75	13	45	W	5	0	55	W	3 0
Philip, Str.	Europe	Flanders	51	16	55	N	3	45	12	E	0	15	1	E	
St. Philips Fort	Europe	Minorca	39	50	46	N	3	48	30	E	0	15	14	E	
Philipſburg	Europe	Germany	49	14	1	N	8	26	34	E	0	33	46	E	
Philipville	Europe	Netherlands	50	11	19	N	4	32	19	E	0	18	9	E	
Pickergill's Harb.	Asia	New Zeeland	45	47	27	S	166	18	9	E	11	5	13	E	10 57
Pickergill's Iſle	Amer.	Atlantic Ocean	54	42	30	S	36	58	0	W	2	27	52	W	
Pico	Europe	Azores	38	26	52	N	28	27	40	W	1	53	51	W	
Pines, Iſle of	Asia	N. Caledonia	22	38	0	S	167	38	0	E	11	10	32	E	
Piſa	Europe	Italy	43	43	7	N	10	22	52	E	0	41	31	E	
Piſcadores	Asia	Pacific Ocean	11	15	0	N	167	20	20	E	11	9	21	E	
Plate-Rack, N.E. Pt.	Amer.	Weſt Indies	20	31	0	N	69	33	0	W	4	38	12	W	
Plate-Rack, S. Point.	Amer.	Weſt Indies	20	13	35	N	69	37	45	W	4	38	31	W	
Plate-Rack, N.W.Pt	Amer.	Weſt Indies	20	30	0	N	70	4	30	W	4	40	18	W	
Plymouth	Europe	England	50	22	30	N	4	12	45	W	0	16	51	W	6
Poitiers	Europe	France	46	34	56	N	0	20	48	E	0	1	23	E	
Pollingen	Europe	Germany	47	48	17	N	11	7	30	E	0	44	30	E	
Pondicherry	Asia	India	11	55	41	N	79	51	30	E	5	19	26	E	
Ponoi	Europe	Lapland	67	4	30	N	41	7	45	E	2	44	31	E	

Digitized by Google

Names of Places.	Continent	Coast, Sea, or Country.	Latitude.			Longitude In Degrees.			Longitude In Time.			H.W.
			°	′	″	°	′	″	h.	m.	s.	h. m.
Pontoise - -	Europe	France - -	49	3	2 N	2	5	37 E	0	8	22 E	
Pool - -	Europe	England -	50	42	50 N	1	58	55 W	0	7	56 W	
Poolytopu - -	Asia	India - -	8	8	0 N	77	15	45 E	5	9	3 E	
Popayan - -	Amer.	New Granada	2	27	30 N	76	16	15 W	5	5	5 W	
Port au Prince -	Amer.	Hiſpaniola -	18	33	42 N	72	27	33 W	4	49	50 W	
Portland Point -	Europe	England -	50	31	0 N	2	29	0 W	0	9	56 W	7 30
Portland, Iſle -	Europe	North Sea -	63	22	0 N	18	54	0 W	1	15	36 W	
Portland, Iſle -	Aſia	Pacific Ocean	37	24	40 S	177	51	45 E	11	51	27 E	
Porto - -	Europe	Italy -	41	46	41 N	12	14	10 W	0	48	57 W	
Porto Bello - -	Amer.	Mexico -	9	33	30 N	79	44	15 W	5	18	57 W	
Porto Nova - -	Aſia	India - -	11	30	0 N	79	45	30 E	5	19	2 E	
Porto Praya - -	Africa	St. Jago -	14	53	30 N	23	30	17 W	1	34	1 W	11 0
Porto Rica { N.E. Pt.	Amer.	Weſt Indies	18	29	0 N	65	51	25 W	4	23	26 W	
Porto Rica { N.W. Pt.	Amer.	Weſt Indies	18	31	30 N	67	18	0 W	4	29	12 W	
Porto Santo, Iſle -	Africa	Atlantic Ocean	33	5	35 N	16	14	51 W	1	4	59 W	
Port Paix - -	Amer.	Hiſpaniola -	19	56	30 N	72	58	0 W	4	51	52 W	
Port Parſlin - -	Aſia	New Britain	4	49	27 S	153	6	30 E	10	12	26 E	
Port Royal - -	Amer.	Jamaica -	18	0	0 N	76	44	45 W	5	6	59 W	
Port Royal - -	Amer.	Martinico -	14	35	55 N	61	9	0 W	4	4	36 W	
Portſmouth Town	Europe	England -	50	47	27 N	1	5	57 W	0	4	24 W	11 15
Portſm. Academy	Europe	England -	50	48	2 N	1	6	18 W	0	4	25 W	
Portſmouth -	Amer.	New England	43	4	15 N	70	43	15 W	4	42	53 W	
Poſen - -	Europe	Poland - -	52	26	0 N	15	0	15 E	1	0	1 E	
Prague - -	Europe	Bohemia -	50	53	4 N	14	25	15 E	0	57	41 E	
Praters { N. E. Point	Aſia	Chineſe Sea	20	57	30 N	116	57	30 E	7	47	50 E	
Praters { S. W. Point	Aſia	Chineſe Sea	20	42	0 N	116	40	0 E	7	46	40 E	
Praule - -	Europe	England -	50	14	0 N	3	49	15 W	0	15	17 W	
Preparis, Iſle -	Aſia	Bay of Bengal	14	48	0 N	93	34	0 E	6	14	16 E	
Preſburg - -	Europe	Hungary -	48	8	7 N	17	10	30 E	1	8	42 E	
Prince's Iſland -	Aſia	Str. of Sunda	6	35	10 S	105	14	20 E	7	0	57 E	
Prince's Iſland -	Africa	Atlantic Ocean	1	37	0 N	7	40	0 E	0	30	40 E	
P. of Wales's Fort	Amer.	New Wales	58	47	32 N	94	13	55 W	6	16	56 W	7 20
P. of Wales's, Cape	Amer.	Beering's Str.	65	45	30 N	168	17	30 W	11	13	10 W	
P. W. Henry's Iſle	Amer.	Pacific Ocean	19	0	0 N	141	22	0 W	9	25	28 W	
Providence - -	Amer.	New England	41	50	41 N	71	22	0 W	4	45	28 W	
Pulyona t -	Aſia	N. Caledonia	20	18	0 S	164	41	14 E	10	58	45 E	6 30
Pylſtaart's Iſland	Aſia	Pacific Ocean	22	23	30 N	175	49	30 W	11	43	18 W	
Q												
Quebeck - -	Amer.	Canada - -	46	48	38 N	71	5	29 W	4	44	22 W	7 30
Quibo, Iſle - -	Amer.	Pacific Ocean	7	27	0 N	82	10	0 W	5	28	40 W	3 30
Quilloan - -	Aſia	India - -	8	52	30 N	76	37	30 E	5	6	30 E	
Quimper - -	Europe	France - -	47	58	29 N	4	6	0 W	0	16	24 W	2 30
St. Quinton - -	Europe	France -	49	50	51 N	3	17	23 E	0	13	10 E	
Quiros, Cape -	Aſia	New Hebrides	14	56	8 S	167	20	0 E	11	9	20 E	3 0
Quito - -	Amer.	Peru - -	0	13	27 S	78	10	15 W	5	12	41 W	
R												
Race, Cape - -	Amer.	Newfoundland	46	40	0 N	53	3	30 W	3	32	14 W	
Rakah, Ancient -	Aſia	Meſopotamia	36	1	0 N	38	50	0 E	2	35	20 E	
Ramhead - -	Europe	England -	50	18	24 N	4	17	30 W	0	17	10 E	6 0
Ramſgate - -	Europe	England -	51	19	31 N	1	24	41 E	0	5	39 E	10 30
Ranai, Iſle - -	Amer.	Sandwich Iſles	20	46	30 N	156	55	30 W	10	27	41 W	
Randers - -	Europe	Denmark -	56	27	48 N	10	3	27 E	0	40	14 E	
Ratiſbon - -	Europe	Germany -	49	0	0 N	12	6	25 E	0	48	26 E	
Ravenna - -	Europe	Italy - -	44	25	5 N	12	10	36 E	0	48	42 E	
Recanati - -	Europe	Italy - -	43	25	44 N	13	31	8 E	0	54	5 E	
Recif - -	Amer.	Braſil -	8	10	0 N	35	35	0 W	2	22	20 W	
Reculver - -	Europe	England -	51	22	47 N	1	11	50 E	0	4	47 E	
Red-Buoy - -	Europe	M. of the Elbe	53	39	0 N		-	-		-	-	

Digitized by Google

Names of Places.	Continent.	Coast, Sea, or Country.	Latitude.	Longitude In Degrees.	Longitude In Time.	H.W
			° ′ ″	° ′ ″	h m s.	h. m
Refuge, Port	Asia	Bligh's Islands	18 38 30 S	173 56 0 W	11 31 44 W	
Reikianeſs, Cape	Europe	Iceland	63 55 0 N	22 47 30 W	1 31 10 W	
Rennes	Europe	France	48 6 50 N	1 41 30 W	0 6 46 W	
Reſolution Bay	Amer.	Marqueſas	9 55 30 S	139 8 40 W	9 16 35 W	2 3
Reſolution, Iſle	Amer.	Hudſon's Str.	61 29 0 N	65 16 0 W	4 21 4 W	
Reſolution, Iſle	Amer.	Pacific Ocean	17 23 30 S	141 45 0 W	9 27 0 W	
Reſolution, port	Asia	Tanna	19 32 25 S	169 41 5 E	11 18 44 E	
Revel	Europe	Livonia	59 26 22 N	24 39 15 E	1 38 37 E	
Rhe, Lights	Europe	France	46 14 49 N	1 33 40 W	0 6 15 W	3
Rheims	Europe	France	49 15 16 N	4 1 48 E	0 16 7 E	
Rhodez	Europe	France	44 21 0 N	2 34 17 E	0 10 17 E	
Riche, point	Amer.	Newfoundland	50 40 10 N	57 23 0 W	3 49 32 W	
Richmond, Obſerv.	Europe	England	51 28 8 N	0 18 42 W	0 1 15 W	
Rieux	Europe	France	43 15 23 N	1 12 0 E	0 4 48 E	
Riez	Europe	France	43 48 57 N	6 5 6 E	0 24 20 E	
Riga	Europe	Livonia	56 56 24 N	24 0 15 E	1 36 1 E	
Rimini	Europe	Italy	44 3 43 N	12 32 36 E	0 50 10 E	
Ringſted	Europe	Denmark	55 26 51 N	11 47 55 E	0 47 12 E	
Ringwood	Europe	England	50 50 58 N	1 47 16 W	0 7 9 W	
Rio Janeiro	Amer.	Braſil	22 54 10 N	43 10 45 W	2 52 43 W	2
Ripa-Tranſone	Europe	Italy	43 0 24 N	13 44 30 E	0 54 58 E	
Rochelle	Europe	France	46 9 33 N	1 9 2 W	0 4 36 W	3 4
Rochfort	Europe	France	45 56 10 N	0 57 49 W	0 3 51 W	4 1
Rodoſto	Europe	Turkey	40 58 24 N	27 25 16 E	1 49 41 E	
Rodrigues Iſles	Africa	Indian Ocean	19 40 40 S	63 9 15 E	4 12 37 E	
Roeſkilde	Europe	Denmark	55 38 25 N	12 5 27 E	0 48 22 E	
Romaine Key	America	Bahama Chan.	22 1 30 N	77 39 45 W	5 10 39 W	
Rome, St. Peter's	Europe	Italy	41 53 54 N	12 27 41 E	0 49 51 E	
Romney, New	Europe	England	50 59 7 N	0 56 22 E	0 3 45 E	
Romney, Old	Europe	England	50 59 25 N	0 53 50 E	0 3 35 E	
Ronde, Pulo	Aſia	Str. of Malacca	. . .	95 13 0 E	6 20 52 E	
Rot, Abbey	Europe	Bavaria	47 59 11 N	12 3 30 E	0 48 14 E	
Rotterdam	Europe	Holland	51 56 0 N	4 29 0 E	0 17 56 E	3
Rotterdam, Iſle	Aſia	Friendly Iſles	20 15 22 S	174 44 48 E	11 38 59 E	6
Rouen	Europe	France	49 26 27 N	1 5 30 E	0 4 22 E	1 1
Round Iſland	Amer.	Beering's Str.	58 56 30 N	159 53 30 W	10 39 34 W	
Roxant, Cape	Europe	Portugal	38 45 26 N	9 35 50 W	0 38 23 W	
Royan	Europe	France	45 37 28 N	1 1 32 W	0 4 6 W	
Ruttunpour	Aſia	Berar	22 16 0 N	82 36 0 E	5 30 24 E	
Rypen	Europe	Denmark	55 19 57 N	8 47 5 E	0 35 8 E	
S						
Saba, Iſle	Amer.	Carib. Sea	17 37 30 N	63 17 15 W	4 13 9 W	
Sable, Cape	Amer.	Nova Scotia	43 23 43 N	65 39 15 W	4 22 37 W	8 1
Sacrifice, Rocks	Aſia	Malabar Coaſt	11 28 0 N	75 31 5 E	5 2 4 E	
Saddle-back, Iſles	Amer.	Hudſon's Str.	62 7 0 N	68 13 0 W	4 32 52 W	
Saeby	Europe	Denmark	57 20 2 N	10 32 54 E	0 42 12 E	
Sagan	Europe	Sileſia	51 42 12 N	15 22 15 E	1 1 29 E	
Saintes	Europe	France	45 44 46 N	0 37 45 W	0 2 31 W	
Do. Rocks, W. end	Europe	Bay of Biſcay	48 5 5 N	5 5 0 W	0 20 20 W	
Sainte-Croix	Europe	France	48 0 35 N	7 23 55 E	0 29 36 E	
Salavan, Point	Aſia	Borneo	4 13 45 S	114 29 0 E	7 37 56 E	
Salee, New	Africa	Morocco	34 5 0 N	6 43 30 W	0 26 54 W	
Saliſbury	Europe	England	51 3 49 N	1 47 0 W	0 7 8 W	
Saliſbury, Iſle	Amer.	Hudſon's Bay	63 29 0 N	76 47 0 W	5 7 8 W	11
Sall, Iſle	Africa	Atlantic Ocean	16 38 15 N	22 56 15 W	1 31 45 W	
Salonica	Europe	Turkey	40 41 10 N	23 8 0 E	1 32 32 E	
Salvages, Iſles	Africa	Atlantic Ocean	30 3 27 N	16 6 30 W	1 4 26 W	
Samana, Cape	Amer.	Hiſpaniola	19 15 40 N	69 16 30 W	4 37 6 W	
Samara	Europe	Ruſſia	48 39 35 N	35 20 0 E	2 21 20 E	
Sambelong, Great	Aſia	Bay of Bengal	7 10 0 N	93 40 0 E	6 14 40 E	

Digitized by Google

Names of Places	Continent.	Coast, Sea, or Country.	Latitude.				Longitude In Degrees				Longitude In Time				H.W
			°	′	″		°	′	″		h.	m	s.		h. m
Samgannooda -	Amer.	Oonalaska -	53	54	29	N	166	22	15	W	11	5	29	W	
Sancta Cruz -	Africa	Teneriffe -	28	29	4	N	16	22	30	W	1	5	30	W	
Sancta Cruz -	Africa	Grand Canary	28	10	37	N	15	47	0	W	1	3	8	W	
Sandown Caſtle -	Europe	England -	51	14	18	N	1	23	59	E	0	5	36	E	
Sandoe - -	Europe	Lapland -	68	56	15	N	16	57	0	E	1	7	48	E	
Sandwich - -	Europe	England -	51	16	30	N	1	20	15	E	0	5	21	E	11 30
Sandwich Bay -	Amer.	South Georgia	54	42	0	S	36	12	0	W	2	24	48	W	
Sandwich, Cape -	Aſia	N. Holland	18	17	11	S	146	1	13	E	9	44	5	E	
Sandwich, Cape -	Aſia	Mallicola -	16	28	0	S	167	59	0	E	11	11	56	E	
Sandwich Harbour	Aſia	Mallicola -	16	25	20	S	167	53	0	E	11	11	32	E	
Sandwich, Iſle -	Aſia	New Hebrides	17	41	0	S	168	33	0	E	11	14	12	E	
Sandy Bay - -	Amer.	Nova Scotia	43	31	9	S	65	39	15	W	4	22	37	W	
Sandy Cape - -	Aſia	New Holland	24	45	48	S	153	12	22	E	10	12	49	E	
Sandy-Hook Lights	Amer.	New Jerſey	40	26	30	N	74	6	42	W	4	56	27	W	8 10
Sapata, Pulo -	Aſia	Chineſe Sea	10	2	40	N	109	12	51	E	7	16	51	E	
Saratow - -	Europe	Ruſſia -	51	31	28	N	46	0	0	E	3	4	0	E	
Sarlat - -	Europe	France - -	44	53	20	N	1	12	49	E	0	4	51	E	
Sarum, Old -	Europe	England -	51	5	45	N	1	47	28	W	0	7	10	W	
Saunders's Cape -	Aſia	New Zeeland	45	57	45	S	170	16	0	E	11	21	4	E	
Saunder's Cape -	Amer.	South Georgia	54	6	30	S	36	57	30	W	2	27	50	W	
Saunders's Iſle -	Amer.	Sandwich Land	58	0	0	S	26	58	0	W	1	47	52	W	
Savage Iſle - -	Aſia	Pacific Ocean	19	2	15	S	169	30	30	W	11	18	2	W	
Savannah Lights -	Amer.	Georgia -	32	0	45	N	80	56	0	W	5	23	44	W	
Schwezingen -	Europe	Germany -	49	23	4	N	8	26	15	E	0	33	45	E	
Scilly Lights -	Europe	St. Geo. Chan.	49	53	47	N	6	29	30	W	0	25	58	W	
Scolt Head - -	Europe	England -	52	59	40	N	0	44	11	E	0	2	57	W	6 20
Sebaſtian, Cape St.	Africa	Madagaſcar	12	30	0	S	46	25	0	E	3	5	40	E	
Sedan - -	Europe	France -	49	42	29	N	4	57	36	E	0	19	50	E	
Seez - -	Europe	France - -	48	36	23	N	0	10	44	E	0	0	43	E	
Selingmk - -	Aſia	Siberia - -	51	6	6	N	106	40	45	E	7	6	43	E	
Selſea - -	Europe	England -	50	43	50	N	0	47	54	W	0	3	12	W	
Senegal - -	Africa	Negroland -	15	53	0	N	16	31	30	W	1	6	6	W	10 30
Senez - -	Europe	France - -	43	54	40	N	6	24	5	E	0	25	36	E	
Senlis - -	Europe	France - -	49	12	28	N	2	35	0	E	0	10	20	E	
Senones - -	Europe	France - -	48	23	7	N	6	57	30	E	0	27	50	E	
Sens - - -	Europe	France - -	48	11	56	N	3	17	21	E	0	13	9	E	
Serdze Kamen -	Aſia	Beering's Str.	67	3	0	N	171	54	30	W	11	27	38	W	
Seringapatam -	Aſia	Myſore - -	12	31	45	N	76	46	45	E	5	7	7	E	
Seven Iſlands -	Aſia	Chineſe Sea	1	5	16	S	105	24	4	E	7	1	36	E	
Severndroog -	Aſia	India - -	17	47	30	N	73	9	0	E	4	52	36	E	
Sevaſtopolis -	Europe	Crimea -	44	41	30	N	33	35	0	E	2	14	20	E	
Seychelles, Iſle -	Aſia	Almirantes	4	35	0	S	55	35	0	E	3	42	20	E	5 30
Shepherd's Iſles -	Aſia	New Hebrides	16	58	0	S	168	42	0	E	11	14	48	E	
Sherburn Caſtle -	Europe	England -	51	39	22	N	0	58	15	W	0	3	53	W	
Shipalneſs - -	Amer.	Beering's Str.	59	37	0	N	162	18	30	W	10	49	14	W	
Shoreham - -	Europe	England -	50	50	7	N	0	16	19	W	0	1	5	W	9 30
Siam - - -	Aſia	India - -	14	18	0	N	100	50	0	E	6	43	20	E	
Siao Iſle - -	Aſia	Chineſe Sea	2	49	0	N	125	3	45	E	8	20	15	E	
Sidney Cove -	Aſia	Port Jackſon	33	51	7	S	151	13	30	E	10	4	54	E	
Sienna - -	Europe	Italy - -	43	22	0	N	11	10	0	E	0	44	40	E	
Sierra Leone, Cape	Africa	Sierra Leone	8	29	30	N	13	9	17	W	0	52	37	W	
Siſtran - -	Europe	Ruſſia -	53	9	53	N	48	24	45	E	3	13	39	E	
Singlan-fu - -	Aſia	China -	34	16	30	N	108	43	45	E	7	14	55	E	
Sinigaglia - -	Europe	Italy - -	43	43	16	N	13	11	30	E	0	52	46	E	
Sitteron - -	Europe	France - -	44	11	51	N	5	56	18	E	0	23	45	E	
Skagen Lights -	Amer.	Denmark -	57	43	44	N	10	37	45	E	0	42	31	E	
Skimiſh Bay -	Aſia	Chatham Iſl.	43	49	3	S	176	35	0	E	11	46	20	E	
Sledge Iſland -	Amer.	Beering's Str.	64	30	0	N	166	8	0	E	11	4	32	E	
Slays - - -	Europe	Holland -	51	18	35	N	3	22	54	E	0	13	32	E	
Smeinogorſk -	Aſia	Siberia -	51	9	27	N	82	8	0	E	5	28	32	E	

Digitized by Google

Names of Places.	Continent	Coast, Sea, or Country	Latitude.				Longitude In Degrees				In Time.				(U.W	
			°	′	″		°	′	″		h	m.	s.		h.	m
Smokey Cape	Asia	New Holland	30	54	18	S	153	1	40	E	10	12	7	E		
Smyrna	Asia	Natolia	38	28	7	N	27	6	33	E	1	48	26	E		
Snoefell, Mount	Europe	Iceland	64	52	20	N	23	54	0	W	1	35	36	W		
Socono, Isle	Amer.	Pacific Ocean	18	48	0	N	110	10	0	W	7	20	40	W		
Soiffons	Europe	France	49	22	52	N	3	19	16	E	0	13	17	E		
Sombavera, Isles	Amer.	Carib. Sea	18	38	0	N	63	37	30	W	4	14	30	W		
Sonderburg	Europe	Denmark	54	54	59	N	9	48	10	E	0	39	13	E		
Soolo	Asia	Philippines	5	57	0	N	121	15	30	E	8	5	2	E		
Southampton	Europe	England	50	54	0	N	1	23	56	W	0	5	36	W	0	
South Cape	Asia	New Zeeland	47	16	50	S	167	20	9	E	11	9	21	E		
South Cape	Asia	New Holland	43	42	30	S	146	58	0	E	9	47	52	E		
South Island	Asia	Chinese Sea	24	22	30	N	141	24	0	E	9	25	36	E		
Southern Thule	Amer.	Sandwich Land	59	34	0	S	27	45	0	W	1	51	0	W		
Spartel, Cape	Africa	Morocco	35	46	0	N	5	57	12	W	0	23	49	W		
Speaker Bank	Asia	Indian Ocean	4	45	0	S	72	57	0	E	4	51	48	E	3	
Spichell, Cape	Europe	Portugal	38	22	15	N	9	20	12	W	0	37	21	W		
Spring-Grove	Europe	England	51	28	34	N	10	20	21	W	0	1	21	W		
Sproe, Isle	Europe	Great Belt	55	19	56	N	10	56	45	E	0	43	47	E		
Stade	Europe	Germany	53	36	5	N	9	23	15	E	0	37	33	E		
Stalbridge	Europe	England	50	57	0	N	2	23	30	W	0	9	34	W		
Start Point	Europe	England	50	14	20	N	3	44	30	W	0	14	58	W	6	4
Stephen's Cape	Asia	New Zeeland	40	36	50	S	173	58	30	E	11	35	54	E		
Stephen's Cape	Asia	Beering's Str.	63	33	30	N	162	17	0	W	10	49	8	W		
Stephen's Isle	Asia	Cook's Straits	40	35	26	S	174	0	22	E	11	36	1	E		
Stephen's Port	Asia	New Holland	32	45	0	S	152	12	0	E	10	8	48	E		
Stickhusen	Europe	Germany	53	13	33	N	7	40	6	E	0	30	40	E		
Stockholm	Europe	Sweden	59	20	31	N	18	3	51	E	1	12	15	E		
Strahane	Europe	Ireland	54	49	29	N	7	23	5	W	0	29	32	W		
Straſburg	Europe	France	48	34	56	N	7	44	36	E	0	30	58	E		
Straumneſs	Europe	Iceland	65	39	40	N	24	29	15	W	1	37	57	W		
Streatham	Europe	England	51	25	46	N	0	7	47	W	0	0	31	W		
Stromneſs	Europe	Orkneys	58	56	22	N	3	31	15	W	0	14	5	W	9	
Succeſs Bay	Amer.	Ter. del Fuego	54	49	45	S	65	25	0	W	4	21	40	W	4	3
Succeſs, Cape	Amer.	Ter. del Fuego	55	1	0	S	65	27	0	W	4	21	48	W	4	3
Suez	Africa	Egypt	30	2	0	N	32	28	30	E	2	9	54	E		
Sulpher Island	Asia	Pacific Ocean	24	48	0	N	141	20	0	E	9	25	20	E		
Surat	Asia	India	21	11	0	N	73	2	34	E	4	52	10	E		
Swilly Island	Asia	New Holland	43	55	30	S	147	7	30	E	9	48	30	E		
Swinfield	Europe	England	51	8	48	N	1	11	15	E	0	4	45	E		
T																
Table Cape	Asia	New Zeeland	39	6	40	S	178	2	20	E	11	52	9	E		
Table Island	Asia	New Hebrides	15	38	0	S	167	7	0	E	11	8	28	E		
Tackararee Point	Africa	Gold Coaſt	4	46	53	N	2	27	44	W	0	9	51	W		
Taganrok	Asia	Tartary	47	12	40	N	38	38	45	E	2	34	35	E		
Tahoora	Amer.	Sandwich Iſles	21	42	30	N	160	24	30	W	10	41	38	W		
Tahowrooa	Amer.	Sandwich Iſles	20	38	0	N	156	36	30	W	10	26	26	W		
Tambou	Europe	Ruſſia	52	43	44	N	41	45	0	E	2	47	0	E		
Tanjore	Asia	India	10	46	30	N	79	48	26	E	5	19	14	E		
Tanna	Asia	New Hebrides	19	32	25	S	169	41	5	E	11	18	44	E	3	
Taoukaa Iſle	Amer.	Pacific Ocean	14	30	30	S	145	9	30	W	9	40	38	W		
Tarapia	Europe	Turkey	41	8	24	N	29	0	28	E	1	56	2	E		
Taraſcon	Europe	France	43	48	20	N	4	39	36	E	0	18	38	E		
Tarbes	Europe	France	43	13	52	N	0	3	59	E	0	0	16	E		
Taſman's Head	Asia	New Holland	43	33	30	S	147	30	30	E	9	50	2	E		
Taſſa, Iſle	Europe	Sea of Marmara	40	46	40	N	24	38	54	E	1	38	36	E		
Taſſacorta	Africa	Palma Iſle	28	38	0	N	17	58	0	W	1	11	52	W		
Taya, Pulo	Asia	Chineſe Sea	0	44	30	S	106	3	15	E	7	4	13	E		
Tellicherry	Asia	Malabar Coaſt	11	45	20	N	75	29	3	E	5	1	56	E		
Temontengis	Asia	Soloo	5	57	0	N	120	53	30	E	8	3	54	E		
Teneriffe, Peake	Africa	Canaries	28	15	38	N	16	45	25	W	1	7	2	W	3	

Digitized by Google

Names of Places.	Continent.	Coast, Sea, or Country.	Latitude.				Longitude In Degrees				Longitude In Time			W.H
			°	′	″		°	′	″		h.	m.	s.	h. m.
Tenterden - -	Europe	England -	51	4	8	N	0	41	8	E	0	2	45 E	
Tercera - -	Europe	Azores - -	38	39	7	N	27	12	42	W	1	48	51 W	
Terracina - -	Europe	Italy - -	41	18	14	N	13	13	7	E	0	52	52 E	
St. Thadæus-Nofs	Asia	Kamtſchatka	62	50	0	N	179	5	0	E	11	56	20 E	
Thalpeny Iſle -	Asia	Laccadives N. P.	10	10	30	N	73	49	30	E	4	55	18 E	
		S. P.	10	4	0	N	73	48	0	E	4	55	12 E	
Thionville - -	Europe	France - -	49	21	30	N	6	10	30	E	0	24	42 E	
St. Thomas's Iſle -	Amer.	Virgin Iſles	18	21	55	N	64	51	30	W	4	19	26 W	
St. Thomas's Iſle -	Africa	Atlantic Ocean	0	19	0	N	6	42	30	E	0	26	50 E	
Thorley Hall -	Europe	England -	51	50	45	N	0	9	0	E	0	0	36 E	
Three Hill Iſland -	Aſia	New Hebrides	17	4	0	S	168	35	0	E	11	14	20 E	
Three Kings' Iſle -	Aſia	New Zeeland	34	10	15	S	172	25	8	E	11	29	41 E	
Three Points, Cape	Africa	Gold Coaſt -	4	40	30	N	2	43	32	W	0	10	54 W	
Thrumb Cap -	Amer.	Pacific Ocean	18	36	41	S	139	13	45	W	9	16	55 W	
Thule, Southern -	Amer.	SandwichLand	59	34	0	S	27	45	0	W	1	51	0 W	
Thury - -	Europe	France - -	49	21	28	N	2	18	30	E	0	9	14 E	
Tiburon, Cape -	Amer.	Hiſpaniola -	18	19	25	N	74	34	12	W	4	58	17 W	
Timoan, Pulo -	Aſia	Gulf of Siam	2	53	30	N	104	24	37	E	6	57	38 E	
Timor, S. W. Point	Aſia	India - -	10	6	52	S	124	4	36	E	8	16	18 E	
Timor-band -	Aſia	India - -	8	3	0	S	132	17	0	E	8	49	8 E	
Tinian, Iſle - -	Aſia	Pacific Ocean	15	0	0	N	145	55	30	E	9	43	42 E	
Tobolſki - -	Aſia	Siberia -	58	12	18	N	68	18	30	E	4	33	14 E	
Tolaga Bay - -	Aſia	New Zeeland	38	22	0	S	178	35	54	E	11	54	24 E	6 0
Toledo - -	Europe	Spain -	39	50	0	N	3	20	0	W	0	13	20 W	
Tomſk - -	Aſia	Siberia - -	56	29	58	N	84	58	30	E	5	39	54 E	
Tondern - -	Europe	Denmark -	54	56	19	N	8	53	17	E	0	35	33 E	
Tonga-Tabu, Iſle -	Aſia	Pacific Ocean	21	8	36	S	175	1	50	E	11	40	7 E	6 50
Tongres - -	Europe	Netherlands	50	47	7	N	5	27	23	E	0	21	50 E	
Tonnerre - -	Europe	France -	47	51	8	N	3	58	44	E	0	15	55 E	
Toobouai, Iſle -	Amer.	Pacific Ocean	23	25	0	S	149	20	30	W	9	57	22 W	
Tornea - -	Europe	Sweden -	65	50	50	N	24	14	0	E	1	36	56 E	
Tortadas - -	Amer.	Weſt Indies E. P.	20	0	55	N	72	42	35	W	4	50	50 W	
		W. P.	20	5	20	N	73	1	26	W	4	52	6 W	
Toul - - -	Europe	France - -	48	40	32	N	5	53	18	E	0	23	33 E	
Toulon - -	Europe	France - -	43	7	16	N	5	55	26	E	0	23	42 E	
Toulouſe - -	Europe	France - -	43	35	46	N	1	26	45	E	0	5	47 E	
Tournai - -	Europe	Netherlands	50	36	57	N	3	33	17	E	0	13	33 E	
Tours - - -	Europe	France - -	47	23	46	N	0	41	32	E	0	2	46 E	
Trafalgar - -	Europe	Spain - -	36	7	56	N	6	3	0	W	0	24	45 W	
Traitor's Head -	Aſia	Erramanga	18	43	30	S	169	20	30	E	11	17	22 E	
Tranquebar -	Aſia	India - -	10	56	0	N	79	40	30	E	5	18	42 E	
Treguier - -	Europe	France -	48	46	54	N	3	13	49	W	0	12	55 W	5 30
Treves - -	Europe	Germany -	49	46	37	N	6	38	5	E	0	26	32 E	
Trinidada - -	Amer.	Cuba - -	21	47	45	N	80	19	36	W	5	21	18 W	
Trinidada, Iſle	Amer.	Atlantic Ocean	20	30	30	S	29	33	0	W	1	58	12 W	
Trinity Iſland -	Amer.	Pacific Ocean	56	35	0	N	154	53	0	W	10	19	32 W	
Trinkamaly -	Aſia	Ceylon - -	8	32	0	N	81	12	0	E	5	24	48 E	
Tripoli - -	Africa	Barbary - -	32	53	40	N	13	21	7	E	0	53	24 E	
Tritchinopoly -	Aſia	India - -	10	49	0	N	78	38	26	E	5	14	34 E	
Tropez, St. -	Europe	France -	43	16	8	N	6	38	29	E	0	26	34 E	
Troyes - -	Europe	France - -	48	18	5	N	4	4	34	E	0	16	18 E	
Tſcherkaſki - -	Europe	Ruſſia -	47	13	40	N	39	45	0	E	2	39	0 E	
Tſchukotſkoi -	Aſia	Beering's Str.	64	14	30	N	173	31	0	W	11	34	4 W	
Tubingen - -	Europe	Germany -	48	31	4	N	9	2	29	E	0	36	10 E	
Tulles - -	Europe	France -	45	16	3	N	1	46	2	E	0	7	4 E	
Turin - -	Europe	Italy - -	45	4	14	N	7	40	0	E	0	30	40 E	
Turnagain, Cape -	Aſia	New Zeeland	40	32	30	S	176	49	0	E	11	47	16 E	
Turk's iſles -	Amer.	Windw. Paſſage	21	11	0	N	71	15	22	W	4	45	1 W	
Turtle Iſland -	Aſia	Pacific Ocean	19	48	45	S	177	57	0	W	11	51	48 W	
Two Groups -	Amer.	Pacific Ocean	18	12	36	S	142	11	45	W	9	28	47 W	

Digitized by Google

Names of Places.	Continent.	Coast, Sea, or Country.	Latitude.	Longitude In Degrees.	Longitude In Time.	H.
			° ′ ″	• ′ ″	h. m. s.	h.
Typa	Asia	China	22 9 20 N	113 43 45 E	7 34 55 E	
Tyrnaw	Europe	Hungary	48 23 30 N	17 34 36 E	1 10 18 E	
U						
Ubes, St.	Europe	Portugal	38 22 15 N	8 54 22 W	0 35 37 W	
Ufa	Europe	Ruſſia	54 42 45 N	55 53 30 E	3 43 34 E	
Uliateah	Amer.	Pacific Ocean	16 45 0 S	151 31 0 W	10 6 4 W	
Ulm	Europe	Germany	48 23 45 N	9 58 51 E	0 39 55 E	
Umba	Europe	Lapland	66 39 48 N	34 14 45 E	2 16 59 E	
Unſt	Europe	Shetland	60 44 0 N	0 46 0 W	0 3 4 W	
Upſal	Europe	Sweden	59 51 50 N	17 38 9 E	1 10 33 E	
Uralſk	Aſia	Tartary	51 11 0 N	51 35 15 E	3 36 24 E	
Uraniberg	Europe	Denmark	55 54 17 N	12 53 0 E	0 50 51 E	
Urbine	Europe	Italy	43 43 36 N	12 36 50 E	0 50 27 E	
Uſhant Lights	Europe	France	48 28 8 N	5 3 21 W	0 20 13 W	4
Uſolie, Novo	Europe	Ruſſia	59 23 54 N	56 32 15 E	3 46 9 E	
Uſt-kamenogorſk	Aſia	Siberia	49 56 49 N	82 38 30 E	5 30 34 E	
Utretch	Europe	Netherlands	52 5 0 N	5 9 45 E	0 20 39 E	
Uzes	Europe	France	44 0 45 N	4 25 2 E	0 17 40 E	
V						
Vabres	Europe	France	43 56 27 N	2 50 16 E	0 11 21 E	
Vaiſon	Europe	France	44 14 28 N	5 3 54 E	0 20 16 E	
Valence	Europe	France	44 55 59 N	4 53 10 E	0 19 33 E	
Valenciennes	Europe	France	50 21 27 N	3 31 40 E	0 14 7 E	
Valery (St.) ſur Som	Europe	France	50 11 21 N	1 37 36 E	0 6 30 E	10
Valery (St.) en Caup	Europe	France	49 52 12 N	0 41 10 E	0 2 45 E	9
Valparaiſo	Amer.	Chili	33 1 29 S	72 19 15 W	4 49 17 W	
Van Dieman's Road	Aſia	Tonga-Tabu	21 4 15 S	175 6 0 W	11 40 24 W	7
Vannes	Europe	France	47 39 26 N	2 45 19 W	0 11 1 W	3
Vauxe's Tomb	Aſia	India	21 4 30 N	72 48 44 E	4 51 15 E	
Vence	Europe	France	43 43 13 N	7 6 29 E	0 28 26 E	
Venice	Europe	Italy	45 27 4 N	12 3 15 E	0 48 13 E	9
Venus, Point	Amer.	Otaheite	17 29 15 S	149 30 22 W	9 58 1 W	10
Vera Cruz	Amer.	Mexico	19 9 36 N	95 3 0 W	6 20 12 W	
Verd, Cape	Africa	Negroland	14 47 13 N	17 33 16 W	1 10 13 W	
Verdun	Europe	France	49 9 24 N	5 22 41 E	0 21 31 E	
Verona	Europe	Italy	45 26 26 N	11 1 0 E	0 44 4 E	
Verſailles	Europe	France	48 48 21 N	2 7 7 E	0 8 28 E	
Victoria, Fort	Aſia	Malabar Coaſt	17 56 40 N	73 7 54 E	4 52 32 E	
Vienna, Obſervatory	Europe	Germany	48 12 36 N	16 21 54 E	1 5 28 E	
Vigo	Europe	Spain	42 13 20 N	8 27 45 W	0 33 51 W	3
Villa Franca	Europe	Italy	43 40 20 N	7 19 15 E	0 29 17 E	
St. Vincent's Cape	Europe	Portugal	37 1 0 N	9 2 22 W	0 36 9 W	3
St. Vincent's Iſle	Amer.	Carib. Sea	13 10 15 N	61 30 51 W	4 6 3 W	
Vingorla Rocks	Aſia	Malabar Coaſt	15 55 30 N	73 30 0 E	4 54 0 E	
Vintimiglia	Europe	Italy	43 53 20 N	7 37 30 E	0 30 30 E	
Virgin-Gorda, Fort	Amer.	Weſt Indies	18 18 0 N	64 18 40 W	4 17 15 W	
Virgin, Cape	Amer.	Patagonia	52 23 0 S	67 54 0 W	4 31 36 W	10
Viſagapatam	Aſia	India	17 42 0 N	83 23 52 E	5 33 35 E	
Viviers	Europe	France	44 28 57 N	4 40 45 E	0 18 43 E	
W						
Wakefield	Europe	England	53 41 0 N	1 35 0 W	0 6 20 W	
Wales (P. of) Cape	Amer.	Beering's Str.	65 45 30 N	168 17 30 W	11 13 10 W	
Wales (P. of) Fort	Amer.	New Wales	58 47 32 N	94 13 48 W	6 16 55 W	7
Wales (P. of) Iſles	Amer.	Pacific Ocean	14 58 0 S	147 48 0 W	9 51 12 W	

Digitized by Google

Names of Places.	Continent.	Coast, Sea, or Country	Latitude.				Longitude In Degrees				Longitude In Time.				H.W
			°	′	″		°	′	″		h.	m.	s.		h. m.
Wallis's Isle -	Asia	Pacific Ocean	13	17	0	S	176	45	0	W	11	47	0	W	
Walvisch Bay -	Africa	Caffraria -	22	54	51	S	14	40	0	E	0	58	40	E	
Wanstead - -	Europe	England -	51	34	20	N	0	2	30	E	0	0	10	E	
Waradsden - -	Europe	Hungary -	46	18	18	N	16	25	51	E	1	5	43	E	
Wardhus - -	Europe	Lapland -	70	22	36	N	31	6	0	E	2	4	24	E	
Warsaw - -	Europe	Poland - -	52	14	28	N	21	1	5	E	1	24	4	E	
Warwick, Cape -	Amer.	Hudson's Str.	61	29	0	N	65	16	0	W	4	21	4	W	
Wateeoo - -	Amer.	Pacific Ocean	20	1	30	S	158	14	30	W	10	32	58	W	
Watling's Isle, *W.* P.	Amer.	Bahamas -	23	56	0	N	74	42	32	W	4	58	50	W	
West Cape - -	Asia	New Zeeland	45	56	15	S	166	6	15	E	11	4	25	E	
Westman, Isles -	Europe	North. Ocean	63	20	30	N	20	27	45	E	1	21	51	E	
Whitsunday Cape :	Amer.	Cook's River	58	15	0	N	152	36	0	W	10	10	24	W	
Whitsun Island -	Amer.	Pacific Ocean	19	26	0	S	138	12	0	W	9	12	48	W	
Whitsuntide Isle -	Asia	Pacific Ocean	15	44	20	S	168	20	15	E	11	13	21	E	
Whytootachee -	Amer.	Pacific Ocean	18	51	40	S	159	39	45	W	10	38	39	W	
Wiborg - -	Europe	N. Jutland -	57	27	11	N	9	26	15	E	0	37	45	E	
Wicklow - -	Europe	Ireland -	52	59	0	N	6	1	0	W	0	24	4	W	7 30
Wildeshausen -	Europe	Germany -	52	54	26	N	8	27	39	E	0	33	51	E	
William, Fort -	Asia	Bengal -	22	34	0	N	88	27	56	E	5	53	52	E	
Willis's Isle -	Amer.	South Georgia	54	0	0	S	38	29	40	W	2	33	59	W	
Wilna - -	Europe	Poland - -	54	41	0	N	25	14	51	E	1	40	59	E	
Winchelsea - -	Europe	England -	50	55	28	N	0	42	31	E	0	2	50	E	
Windsor - -	Europe	England -	51	29	0	N	0	35	28	W	0	2	22	W	
Wittemburg -	Europe	Germany -	51	53	0	N	12	42	45	E	0	50	51	E	
Woahoo, Isle -	Amer.	Sandwich Isles	21	40	30	N	158	1	30	W	10	32	6	W	
Wologda - -	Europe	Russia - -	59	13	33	N	40	10	0	E	2	40	40	E	
Wolstenholme Cape	Amer.	Hudson's Str.	62	39	0	N	77	48	0	W	5	11	12	W	
Woody Point -	Amer.	Pacific Ocean	50	0	30	N	127	57	0	W	8	31	44	W	
Worcester - -	Europe	England -	52	9	30	N	2	0	15	W	0	8	1	W	
Woronesch - -	Europe	Russia - -	51	40	30	N	39	20	45	E	2	37	23	E	
Woslak - -	Europe	Russia - -	61	15	0	N									
Wrotham - -	Europe	England -	51	18	54	N	0	19	12	E	0	1	17	E	
Wurtzburg - -	Europe	Germany -	49	46	6	N	9	54	45	E	0	39	39	E	
X															
Xamhay - -	Asia	China - -	31	16	0	N	121	31	45	E	8	6	7	E	
Y															
Yeu, Isle d' -	Europe	France - -	46	42	26	N	2	19	50	W	0	9	19	W	
Ylo - - -	Amer.	Peru - -	17	36	15	S	71	13	0	W	4	44	52	W	
York - - -	Europe	England -	53	57	45	N	1	6	4	W	0	4	24	W	
York Cape - -	Asia	New Holland	10	38	20	S	142	12	20	E	9	28	49	E	
York Fort - -	Amer.	New Wales	57	1	48	N	92	17	11	W	6	9	9	W	9 10
York Isle, Duke of	Asia	Pacific Ocean	8	29	0	S	172	22	0	W	11	29	28	W	
York Minster -	Amer.	Ter. del Fuego	55	26	20	*S*	70	8	0	W	4	40	32	W	
York, New - -	Amer.	New York -	40	43	0	N	74	9	0	W	4	56	36	W	8 54
Young Cape -	Asia	Chatham Island	43	48	0	N	176	58	0	W	11	47	52	W	
Ypres - -	Europe	Netherlands	50	51	10	N	2	52	49	E	0	11	31	E	
Z															
Zachu, Rocks -	Amer.	Porto Rico	18	24	0	N	67	45	30	W	4	31	2	W	
Zaricin - -	Europe	Russia -	48	42	20	N	44	27	30	E	2	57	50	E	
Znaym - -	Europe	Germany -	48	51	15	N	16	1	42	E	1	4	7	E	

Digitized by Google

GENERAL INTRODUCTION

CONCERNING

The Instruments and Observations.

OF THE SEXTANT.

The Sextant, as its name implies, is the sixth part of a circle, and, therefore contains 60°; but, because of the double reflection, it is divided into 120°. It is constructed on the same principles as the quadrant, and may be said to be that instrument extended. As the sextant is particularly intended to measure the distance of the moon from the sun, or a fixed star, in order to find the longitude of a place by lunar observations; and as this distance must be obtained as accurately as possible, it is therefore, constructed with more care, and provided with some appendages, that are wanting in the quadrant.

This instrument is commonly made of metal; the index and limb are of brass, but the frame is of a harder composition; the only wooden part belonging to it is a handle attached to the back, by which, when observing the distance between two objects, it is to be held with one hand, while the other is regulating the motion of the index.

A degree, on the limb of this instrument in commonly divided into three equal parts; each of which therefore contains 20′, and the index scale is divided so as to show half minutes: in some sextants, the degree is divided into six equal parts, hence each contains 10′; and the vernier shows 10″.

That end of the index next the limb is furnished with an *adjusting*, or, as it is sometimes called, a *tangent screw*, by which the index may be moved slowly and regularly, and, therefore, the contact of the limbs of any two objects may be made as perfect as the eye is able to distinguish, when assisted with one of the telescopes, which accompany this instrument.

In some sextants, the lower half of the index glass, or that next the plane of the instrument, is silvered as usual, and the back surface of the other half is ground and painted black. A thin plate of brass, equal in length and breadth to the silvered part of the speculum, and moving on an axis, is to be raised before that part of the index glass, when the sun is very bright; in which case, the reflection is to be taken from the polished surface of the upper half of that glass, so that any error which might probably arise from the want of parallelism in the planes of the glass, is by this means avoided. This plate is also painted black.

A sextant is not fitted up for the back observation; and in some, the horizon glass is so fixed to the instrument, as to be incapable of adjustment. In instruments of this construction, it becomes absolutely necessary to find the index error.

Digitized by Google

The coloured glasses are similar to those applied to a common Had quadrant, and are usually four in number; a sextant is, however, gene provided with three more, to be placed occasionally on the farther sic the horizon glass. These are particularly useful in observing the s altitude by reflection at land; or in finding the index error, by mea the sun.

There are two telescopes belonging to the sextant, one of which sl objects in their natural position; and the other is of the common astr mical construction, and, therefore, showing objects inverted: a tube, v out glasses, also accompanies this instrument.—By means of these, line of sight may be rendered parallel to the plane of the sextant; and contact of the limbs of any two objects more accurately observed. tube, or either telescope, is to be screwed into a brass ring, which is nected with another brass ring, by means of two screws, in such a mar as to raise or lower the telescope, in order that the line of collimation be directed to a proper part of the horizon glass.

A circular head, containing a plate, in which are three coloured gla and an aperture without glass, sometimes accompanies the sextant: head is to be screwed on the eye end of the tube, or on that of either scope; the edge of the plate projects a little beyond the head on one and is moveable by the finger, so as the perforation, or either colo glass, may be brought opposite to the circular aperture in the head.

Adjustments of the Sextant.

The adjustments of a sextant are to set the mirrors pependicul its plane, and parallel to each other, when the index is at zero, and to tify the position of the line of collimation. The deviation of each of t from its true position might indeed be found, and the resulting error o servation, from thence computed: but this by no means ought to be ad ted, unless in cases of absolute necessity.

Adjustment I.

To set the index Glass perpendicular to the Plane of the Sextant.

Put the index to about 60°, and hold the plane of the sextant nearly rallel to the horizon, the limb being from the observer: then direct sight to the speculum, and if the reflected limb of the instrument ap to be exactly in the same plane with that seen directly; the glass is pendicular to the plane of the instrument. But if the limbs are not i same plane, turn the screws in the projecting plate behind the specu till they are apparently so, and the glass will be adjusted. This ad ment might be effected by means of the adjusting tool.

Adjustment II.

To set the Horizon Glass perpendicular to the Plane of the Sextant.

The index glass being previously adjusted, set the beginning of th visions on the index to zero on the limb, and hold the plane of the in ment in a horizontal position; then direct the sight to the horizon and if the reflected horizon is apparently in the same straight line

Digitized by Google

that seen directly, the glass is perpendicular to the plane of the sextant; otherwise, turn the adjusting screw of the horizon glass, at the back of the instrument, till the coincidence of the reflected and direct horizons is perfect.

Adjustment III.

To set the Horizon Glass parallel to the Speculum.

Set the first division on the index to zero on the limb, fasten the index in this position, and make the coincidence of these divisions perfect, by means of the adjusting screw at the end of the index, the eye being assisted with the magnifying lens; screw the telescope in its support, and turn the screw belonging thereto, at the back of the instrument, till the field of the telescope is bisected by the line which separates the silvered and transparent parts of the horizon glass; now hold the sextant vertically, direct the sight to the horizon, and if the reflected and direct horizons do not coincide, release the screw which lies nearly behind the support of the telescope, and turn the nut at the extremity of the lever, till the coincidence of the horizons is perfect; and the horizon glass will be adjusted.

After the screw which retains the lever in its place is fastened, it will be proper to examine this adjustment; if the coincidence of the horizons is not perfect, the adjustment is to be repeated till it is so; but as it is difficult to obtain an exact coincidence by this means, the horizons may be brought to coincide, by turning the adjusting screw of the index, and the difference between the two zeros is the index error.

The index error may also be found, by measuring the diameter of the Sun or Moon twice, with a motion of the index, in contrary directions. If both measures are taken either to the right or left of O on the limb, half their sum will be the index error, and is additive or subtractive accordingly; but if one of the measures is taken to the right, and the other to the left of O, half their difference is the index error, being additive when the diameter measured to the right of O exceeds that measured to the left, otherwise, subtractive. Since in some sextants the horizon glass cannot be adjusted, the index error must, therefore, be found; and in this case it may be considered as a constant quantity, to be applied to all angles measured with the same instrument.

In altitudes observed at land by the method of reflection, the double altitude affected by the index error is given by the instrument; in this case, it will be found convenient to call half the index error, the correction, which being applied to half the angle given by this instrument, will give the apparent altitude of the object,

Adjustment iv.

To make the Line of Collimation parallel to the Plane of the Sextant.*

Turn the eye end of the telescope, containing the two parallel wires, till the wires are parallel to the plane of the instrument, and let two distant objects be selected, as two stars of the first magnitude, or the sun and

* The line of collimation is an imaginary straight line, joining the center of refractions of the object glass of a telescope, and either the intersection of the cross wires, or middle between the parallel wires.

Digitized by Google

moon, whose distance may not be less than 90° or 100°; make the contact of the limbs of these objects as perfect as possible, at the wire nearest the plane of the instrument; fix the index in this position; move the sextant till the objects are at the other wire, and if the same limbs are in contact, the axis is adjusted; but if the limbs are either apparently separated, or partly cover each other, correct half the error by the screws in the circular part of the supporter, one of which is above, and the other between the telescope and sextant; turn the adjusting screw at the end of the index, till the limbs are in contact; then bring the objects to the wire next the instrument, and if the limbs are in contact, the axis of vision of the telescope is parallel to the plane of the instrument, if not, proceed as at the other wire, and continue till no error remains.

If the moon is one of the objects, this adjustment must be performed as quick as possible; otherwise, allowance must be made for the moon's apparent motion in the interval.

This adjustment may also be performed as follows: Lay the sextant on one end of a large table, whose surface is an exact plane; then take the adjusting tool, and raise the circular hole to the height of the middle of the eye end of the telescope, and place it at the other end of the table: direct the telescope to the tool, make the wires parallel to the plane of the instrument, and adjust the telescope to as distinct vision as possible. Now, if the circular hole in the tool is apparently in the middle between the wires, the axis of the telescope is parallel to the plane of the instrument; if not, one half of the error is to be corrected, by raising or lowering the slide containing the circular hole, and the other half by the screws in the socket containing the telescope. For the sake of accuracy, this adjustment is to be repeated, by making the circular part of the tool of the same height as the eye end of the telescope, and proceeding as before, until no error remains.

This adjustment may also be made, by looking directly to the sun through the telescope; then if the shadow of the farther radius exactly covers the hither radius, or middle vertical bar, at the same time that the sun appears in the middle between the wires, the telescope is right; otherwise, it must be adjusted by the wires in the circular part of the supporter.

The error of the line of collimation being given, the resulting error of observation may be found, by entering table xxvi. with the above error at the top, and the observed distance in the side column.

It is sometimes necessary to know the angular distance between the wires of the telescope; to find which, let these wires be placed perpendicular to the instrument, hold the sextant vertical, direct the sight to the horizon, and move the sextant in its own plane, till the horizon and upper wire coincide; keep the sextant in this position, and move the index till the reflected horizon is covered by the lower wire, and the division shown by the index on the limb, corrected by the index error, will be the angular distance between the wires.

Use of the Sextant.

The sextant is particularly adapted to measure the angular distance between the moon and the sun, or a fixed star. When the distance between the moon and either of these objects is to be observed, the sextant

Digitized by Google

must be held so, that its plane produced may pass through the eye of the observer and both objects; and the reflected image of the most luminous of the two, is to be brought in contact with the other seen directly. To effect this, therefore, it is evident, that, when the brightest object is to the right of the other, the face of the sextant must be held upwards; but if to the left, downwards. When the face of the sextant is held upwards, the instrument should be supported with the right hand, and the index moved with the left; but when the face of the sextant is from the observer, it should be held with the left hand, and the motion of the index regulated by the right hand.

Sometimes a sitting posture will be found very convenient for the observer, particularly when the reflected object is to the right of the direct one; in this case, the instrument is to be supported by the right hand, the elbow may rest on the right knee, the right leg at the same time resting on the left knee.

If the sextant is provided with a ball and socket, and a staff, one of whose ends is attached thereto, and the other resting in a belt fastened round the waist of the observer; the greater part of the weight of the instrument may by this means, be supported by his body.

To observe the distance between the Moon and any celestial object.

I. Between the Sun and Moon.

Put the telescope in its place, and the wires parallel to the plane of the instrument; then, if the index glass is half silvered and half blacked, and if the sun is very bright, raise the plate before the silvered part of the speculum; direct the telescope either to the transparent part of the horizon glass, or to the line which separates the silvered and transparent parts of that glass, according to the brightness of the sun, and turn down one of the coloured glasses; then hold the sextant so, that its plane produced may pass through the sun and moon, having its face either upwards or downwards, according as the sun is to the right or left of the moon; direct the sight through the telescope to the moon, and move the index till the limb of the sun is nearly in contact with the enlightened limb of the moon; now fasten the index, and by a gentle motion of the instrument make the image of the sun move alternately past the moon, and, when in that position where the limbs are nearest each other, make the coincidence of the limbs, perfect, by means of the adjusting screw. This being effected, read off the degrees and parts of a degree pointed out on the limb by the index, using the magnifying glass; and thus the angular distance between the limbs of the sun and moon is obtained.

II. Between the Moon and Star.

Direct the middle of the field of the telescope to the line of separation of the silvered and transparent parts of the horizon glass; if the moon is very bright, turn down the lightest coloured glass, and hold the sextant so, that its plane may be parallel to that passing through the eye of the observer and both objects; with its face upwards, if the moon is to the right of the star, but if to the left, the face of the sextant is to be held from the observer. Now direct the sight through, the telescope to the star, and move the index till the moon appears by reflection to be nearly in contact with the star; fasten the index, and turn the adjusting screw, till the coin-

Digitized by Google

cidence of the star and enlightened limb of the moon is perfect, and the degrees and parts of a degree, shown by the index, will be the observed distance between the moon's enlightened limb and the star.

The contact of the limbs must always be observed in the middle between the parallel wires.

It is sometimes difficult, for those not much accustomed to observations of this kind, to find the reflected image in the horizon glass; it will, perhaps, be found more convenient to look directly to the object, and by moving the index, to make its image coincide with that seen directly, or, if the distance between the objects be known nearly, the index may be set to this distance; the sight being directed to one of the objects, and the sextant held as formerly described, the other object will be seen in the field of the telescope.

Besides a good sextant for observing the moon's distance, and two quadrants, Dr. Maskelyne observes, that a watch that can be depended upon within a minute for 6 hours is absolutely necessary; but I would recommend to have at least one pocket chronometer or time piece, for connecting the observation for finding the time, with that for the distance. They are made by Mr. Arnold in London as low as 25 guineas; also by Mr. Earnshaw and Mr. Broeckbank; and would be extremely useful for a variety of purposes both for the longitude and latitude, and in discovering currents.

The circular instrument for observing the moon's distance, which has been very much improved by Joseph de Mendoza Rios, F. R. S. has not yet been brought into such general use as to need a description here.

Of the MANNER *of taking a complete* SET *of* LUNAR OBSERVATIONS.

In order to take a set of lunar observations, in a regular and accurate manner, three assistants will be necessary, whereof two are to observe the altitudes of the moon, and the sun or star, at the same time that the distance is taken by the principal observer; the other assistant, having a watch showing seconds, is to mark the time when these observations are made. If the sun or star is at a proper distance from the meridian, the time may be inferred from the altitude observed at the same time with the distance, and, therefore, the watch is not necessary; but if the objects with which the moon is compared, be too near the meridian, the watch is absolutely necessary, in order to connect the observations for ascertaining the apparent time at the ship, and the longitude, with each other. This last assistant must be provided with a pencil and paper, to write down the observations, as they are taken, which may be as follows:

Digitized by Google

The sextant and quadrants being accurately adjusted, or the error of adjustment found, set their indices to the estimate distance and altitudes respectively. Now, let the principal observer place his assistants in the most convenient situation possible, and desire them to be prepared when he is ready to observe the distance; then all are to begin to observe at the same time, and when the principal observer has obtained a perfect coincidence of the limbs of the objects, he is to make it known to his assistants. The person having the watch is immediately to write down, first the second, and then the minute of observation, the hour being previously marked; the principal observer is to read off the distance, using the magnifying glass, which he is to communicate to the time assistant, that it may be wrote after the time of observation. The other assistants are, in like manner, to report the observed altitudes of the limbs of the objects separately. Hence a complete set of observations is obtained. In this manner let these observations be repeated, till at least four or five different sets are observed, which may be easily accomplished in the space of six or eight minutes; and these sets ought to be taken at nearly equal intervals of time. The mean of each particular observation is to be taken; that is, the sum of each is separately to be divided by the number of sets; and the longitude of the ship is to be inferred from thence, in the same manner as from a single set, but much more to be depended on.

To illustrate the above, the following observations, taken in the manner described are subjoined.

☽ March 2, 1789. Height of the eye 18 feet.

Times per watch.	Dist. ⊙ & ☽'s nearest limbs.	Alt. ☽'s up. limb.	Alt. ⊙'s lower limb.
23h. 8m. 31s.	— 71° 50′ 10″ — — —	19° 5′ — — —	24° 56′
11 18	— — 52 20 — — —	19 26 — — —	25 1
13 15	— — 53 0 — — —	19 45 — — —	25 5
15 1	— — 53 50 — — —	20 2 — — —	25 9
16 36	— — 54 30 — — —	20 15 — — —	25 13
Sum 14 41	14 50	213	24
Mean 23 12 56	71 52 58	19 42.6	25 4.8

The astronomical method of reckoning the time has been followed, in order to make it agree with the Nautical Almanac. The mean of the above times reckoned nautically would be, March 3d, 11h. 12m. 56s. A. M.; and if the above meanhad been March 3d, 1h. 13m.; then, by the nautical account, it would be, March 4th, 1h. 13m. P. M. Hence, in the present case, the astronomical method of reckoning time seems preferable to the nautical method.

An expert observer may, in case of necessity, diminish the number of his assistants, and might even be capable of making all the necessary observations himself, with a tolerable degree of accuracy, as follows:

Let two or three altitudes of the limbs of the sun and moon be taken, and write down the time of each; then observe five or six distances between the limbs of these objects; and lastly, several altitudes of each are to be again observed. Now, find the mean of each particular set of observations, and reduce the altitudes to the time of the mean distance, which may be done by even proportion, the motion in altitude being supposed uniform during the interval between the observations; and hence a complete set will be obtained.

Digitized by Google

The following observations being given, it is required to reduce the altitudes to the time of the mean distance.

Times p. watch.	0h.	24′	31″	Alt. ⊙'s l. limb =	54°	6′	Means, 0h. 25m. 37s. - 54° 5′
	25	41	—	— — —	54	5	
	26	40	—	— — —	54	4	
	27	50	Alt. ☽'s up. limb		20	2	
	28	44	—	— — —	20	3	0h. 28m. 47s. - 20° 3′.3
	29	46	—	— — —	20	5	
	31	10	Dist. nearest limbs		73	13	
	32	50	—	— — —	73	13½	
	33	30	—	— — —	73	14	0h. 33m. 43s. - 73° 13′ 57″
	35	0	—	— — —	73	14½	
	36	40	—	— — —	73	14¾	
	37	15	Alt. ⊙'s lo. limb		53	54	
	38	20	—	— — —	53	53	0h. 38m. 24s. - 53° 52′.7
	39	38	—	— — —	53	51	
	41	12	Alt. ☽'s up. limb		20	57	
	42	4	—	— — —	21	4	0h. 42m. 14s. - 21° 4′.3
	42	36	—	— — —	21	12	

T. ⊙ alt. 0h. 25m. 37s. T. ⊙ alt. 0h. 25m. 37s. ⊙ alt. lo. limb 54° 5′
T. ⊙ alt. 0h. 38m. 24s. M. T. 0h. 33m. 43s. ⊙ alt. lo. limb 53° 52′.7

diff. 12 47 : diff. 8 6 :: diff. 12′.3 : 8″

Sun's altitude at 0h. 25m 37s. — — — — — — — — — 54° 5′

* Reduced altitude of Sun's lower limb — — — 53 57

T. ☽ alt. 0h. 28m. 47s. T. ☽ alt. 0h. 28m. 47s. ☽ alt. up. limb 20° 3′.3
T. ☽ alt. 0h. 42m. 14s. M. T. 0h. 33m. 43s. ☽ alt. up. limb 21° 4′.3

diff. 13 27 : diff. 4 56 :: diff. 1 1 : 22′.3

Moon's Alt. at 0h. 28m. 47s. — — — — — — — — 20° 3′.3

Reduced altitude of the Moon's upper limb — — — — — 20 25.6

We have now obtained the following set of observations:

Times per watch.	Dist. nearest limbs of ⊙ & ☽	Alt. ⊙'s lo. limb.	Alt. ☽'s upper limb.
0h. 33m. 43s.	— 73° 13′ 57″ — — —	53° 57′ — —	20° 25′6

One set of altitudes of the sun and moon would be sufficient, provided the azimuths of the objects be known,† as then the change of altitude, in the interval between the observations of the altitude and distance, may be found by computation as follows:

To the constant logarithm 8.8239, add the log. secant of the latitude, the log. co-secant of the azimuth, and the proportional logarithm of the interval of time between the observations of the altitude and distance; the sum, rejecting radius, will be the proportional logarithm of the corresponding change of altitude.

If the sun is near the meridian, at the time when the distance is observed, the apparent time cannot be deduced from thence with a sufficient

* When the object is near the meridian, as the sun in the present example, the change of altitude is not proportionable to the time. However, as these altitudes are to be used only in clearing the apparent distance, and because no material error can arise in the distance, from an error of a few minutes in the altitude, therefore, the rule of proportion will be still found sufficiently accurate for the above purpose, when the interval of time is short. The change of altitude may be more accurately computed by the rule given in the text.

† Sine of azimuth = secant altitude. Co-sine latitude. Sine dist. object from meridian, to radius 1.

Digitized by Google

degree of accuracy; if, therefore, the error of the watch is not known, altitudes of that object, when at a proper distance from the meridian, should have been taken before the observation of the distance, or must be taken afterwards, for the express purpose of ascertaining its error. The apparent time might, indeed, be inferred from the moon's altitude, but for several reasons, it is not so much to be depended on, as that deduced from the sun's altitude.

If, in places where the sun rises and sets daily, the observations are taken any time between half an hour after sun rise and ten o'clock in the forenoon, or between two in the afternoon and half an hour before sun set, the apparent time may be inferred from the sun's altitude. In this case, a watch is not absolutely necessary.

A set of observations may be taken with accuracy during the time of the evening or morning twilight; and the observer, though not much acquainted with the stars, will not find it difficult to distinguish the star with which the moon is to be compared; for the time of observation, and the ship's longitude by account, being known, the estimate time at Greenwich may be found; and by entering the Nautical Almanac with the reduced time, the distance between the moon and given star will be found nearly. Now, set the index of the sextant to this distance, and hold the plane of the instrument so, as to be nearly at right angles to the line joining the moon's cusps; then, having found the moon in the silvered part of the horizon glass, give the sextant a slow vibratory motion, the axis of which is that of vision; and the star, which is usually one of the brightest in that part of the heavens, will be seen in the transparent part of the horizon glass; the moon, by the above motion, apparently moving alternately up and down with respect to the star. But if the star is known, from which the moon's distance is to be observed, the most convenient, and, at the same time, the most expeditious method will be, to find the moon in the silvered part of the horizon glass, the index being at zero, and then to move the index, until the enlightened limb of the moon is in contact with the star. See page 29.

In taking the means of the several observations, those which are evidently doubtful, or erroneous; ought absolutely to be rejected: A doubtful altitude or distance may be easily discovered, by observing, if the successive differences of altitude or distance be proportional to those of the times of observation, which are supposed to be accurately marked. If, however, the time, and two of the other observations be correct, the error of the third may be inferred.

The above is taken, together with many of the astronomical parts of this work, from Dr. MACKAY'S valuable work on the "Longitude."

Digitized by Google

EXPLANATION OF THE TABLES.

TABLES *A, B, C,*

For the Correction of Altitude.

The Altitude of an object observed at sea requires three separate corrections, independent of those arising from the errors of the instrument; these are the DIP, or DEPRESSION OF THE HORIZON; REFRACTION; and PARALLAX.

THE DIP, or ANGLE OF DEPRESSION OF THE VISIBLE HORIZON BELOW THE TRUE, is given in Table *C*, according to the height of the observer's eye above the sea in feet; and because all altitudes taken at sea are measured from the VISIBLE HORIZON it is evident this correction must be *subtracted* from the *observed altitude* to obtain the *apparent altitude* from the *true horizon*; unless when the back observation by the quadrant is used, when it must be *added*. The horizon of the sea being raised at a mean one fifteenth of the depression, by the effect of terrestrial refraction, this is also allowed for in this table from the rule given in Vince's Astronomy.

RULE

To the constant log. 0.4907, add the propor. log. of the height of the eye in feet, considered as seconds; half the sum will be the propor. log. of the Dip of the Horizon.

EXAMPLE.

Required the Dip of the Horizon for an elevation of 100 *feet above the surface of the sea.*

Constant logarithm - - - - - - - - - -		0.4907
Given height, 100 feet = 1′ 40″ - - -	P. L.	2.0334
Sum		2.5241
Dip of Horizon 9′ 51″ - - - - -	half sum P. L.	1.2620

REFRACTION is caused by the rays of light, from the heavenly bodies, being bent downwards in their passage through the atmosphere, so that all objects appear *higher* than they really are: this effect is greatest at the horizon and gradually decreases till it vanishes at the zenith.

Table *A* contains the correction on this account, according to different apparent altitudes, which must always be *subtracted* from the apparent altitude, or added to the zenith distance.

THE PARALLAX of a celestial object, is the angular distance between its place as seen from the earth's surface, and that in which it would appear if seen from the earth's center; the last is called the *true place*, and is that which is given from astronomical tables. The quantity depends jointly on the distance of the object from the earth's center, and its altitude above the horizon.

Table *B* contains the *Sun's Parallax in Altitude*, to every third degree of his apparant altitude, which must always be *added* to his apparent altitude to obtain the altitude as if seen from the earth's center; or, to include both corrections, the difference between the corrections for the *Sun's* refraction and parallax, contained in the Tables *A* and *B*, must be *subtracted* from the Sun's *apparent altitude* to obtain his *true altitude*.

TABLE *D*.

Augmentation of the Moon's Semidiameter.

All objects appear greater or less as they are at a less or greater distance from the observer; and as the moon in the zenith is nearer to the observer by a semidiameter of the earth than when in the horizon, she must appear greater; and as this augmentation of her diameter, increasing from the horizon to the zenith, is variable, the Nautical Almanac gives the horizontal semidiameter (which is the same as if viewed from the earth's center) for every noon and midnight: and Table *D* contains the augmentation of it according to her

Digitized by Google

apparent altitude; which, if added to her horizontal semidiameter, found for the given time from the Nautical Almanac, the sum will be the *apparent*, or *augmented semidiameter.*

TABLE *E.*

Contraction of the Sun and Moon's Semidiameters.

Since the lower limb of the sun or moon is more affected by refraction than the upper limb, it follows that the vertical diameter will be contracted by refraction, although the diameter measured horizontally remains invariable; therefore it will measure in any other direction than parallel to the horizon less than the true diameter. This *contraction of semidiameter* is found in Table *E*: the arguments of which are—the apparent altitude of the object's center at the top, and in the side column the angle contained between the measured diameter and that parallel to the horizon: the numbers against 90° of inclination being the difference between the refraction of either limb and center.

TABLE *F.*

Reduction of Latitude and Moon's Hor. Parallax for the spheroidal figure of the Earth.

In a *sphere*, all lines perpendicular to its surface, if continued would meet in the center; but in a *spheroid* this can only be the case at the equator and poles; in other latitudes the vertical or plumb line will make an angle with a line drawn to the earth's center. This angle is contained in the second column of Table *F*, for all latitudes to 75°, which must be *subtracted* from the geographical latitude to obtain the spheroidal latitude of the place, supposing the earth's polar and equatorial diameters as 333 to 334; which is adopted in the "Connoissance des Temps," as agreeing best with astronomical observations. This part is never used but where extreme accuracy is thought necessary.

As the moon's horizontal parallax depends on the earth's semidiameter as well as distance, and being given in the Nautical Almanac for the earth's *equatorial semidiamter*, in all other latitudes, the diameter being less, it ought to be *diminished* by the quantities in the 3d, 4th, or 5th column of Table *F*, according to the horizontal parallax given in the Nautical Almanac. The therom from which this table is calculated is taken from "La Lande's Astronomy," 3d edition, pages 30 and 31.

TABLE *G.*

Correction of the mean Refraction.

This Table is intended to correct Table *A*, which is adapted to a mean temperature of the atmosphere. The corrections depend on the heat and weight of the atmosphere, which are pointed out by the thermometer and barometer. Hence the arguments of these corrections, besides the apparent altitude of the object which is expressed in the side column, are the heights of the thermometer and barometer; the first of which is given at the top, and the second at the bottom of the Table, within probable limits. The correction depending on the height of the thermometer is *additive*, while that height is below 50°; and that answering to the barometer is *additive*, when its height is above 29.6 inches; in other cases the corrections are *subtractive*. Propor. parts are to be taken, when the apparent altitude, or the heights of the thermometer and barometer fall between the tabular arguments.

EXAMPLE.

Let the apparent altitude be 7° 0′, *the height of the thermometer* 72°, *and that of the barometer* 29.75; *required the true Refraction.*

Mean refraction Table A - -	7′ 20″
Opposite to 7° and under 72° is	— 23
and above 29.75 is	+ 2
True Refraction - - - - - -	6 59

Digitized by Google

TABLE *H.*

Correction of the Moon's apparent Altitude; to be added in order to obtain the true Altitude.

In this table the correction of the Moon's apparent Altitude is given to every tenth minute of altitude between 4° and 11°, to every degree of the rest of the quadrant, and to every minute of horizontal parallax; with the differences both for altitude and parallax, under the columns marked D. and D. P. by means of which the proportional parts for minutes of apparent altitude, and seconds of horizontal parallax, may be readily found in Table III or VI. by inspection.

EXAMPLE I.

Let the moon's apparent altitude be 32° 52′ *and hor. par.* 56′ 48″; *required the corresponding correction.*

Correction to altitude 32°, and hor. par. 56′ - -	45′ 58″ diff. alt. — 28
	diff. par. + 51
Against 52′ and under — 28′, in Table VI. - -	— 24
Against 48″ and under + 51″- - - - - - - -	+ 41
Correction required - - - - - - - - - - -	46 15

EXAMPLE II.

Let the moon's apparent altitude be 46° 46′, *and hor. par.* 53′ 50″; *required the corresponding correction.*

Correction to altitude 46°, and hor. par. 54′- - -	36′ 36″ diff. alt. —39
	diff. par. +42
Against 46′ and — 39″, Table VI. p. p. - - - - -	— 30
Against — 10 and + 42, - - p. p. - - - - -	— 7
Correction required - - - - - - - - - - -	35 59

This correction can otherwise be easily found by the following RULE.

Subtract the log. cosine of the moon's apparent altitude from the propor. logarithm of the horizontal parallax, the remainder will be the propor. log. of the correction for parallax; from which take the correction for refraction from Table *A*, corresponding to the apparent altitude, and the remainder is the correction required.

Take the last Example.

Hor. par. - 53′ 50″	Prop. log. Tab. V, .52422
App. Alt. 46° 46′	Log. cos. - - 9.83567
Corr. Par. - 36′ 53″	Diff. - Prop. L. .68855
Refract. Tab. *A*. — 54	
Corr. required 35 59 as before	

TABLES *I, K, L.*

Logarithmic Difference.

Table *I* contains certain logarithms which were ingeniously contrived by the late Mr. Dunthorne to shorten the computation of the effects of parallax and refraction on the distance of the moon from the sun or a fixed star. These logarithms are the arithmetical complements of the differences between the logarithmic cosines of the moon's true and apparent altitudes, increased by 0.000120; which number is uniformly the difference between the logarithmic cosines of the true and apparent altitudes of a fixed star, or any object not sensibly affected by parallax when more than 25° degrees in altitude; at less altitudes this uniformity ceases, and the table will require to be corrected by the numbers in Tables *K* and *L*, according as the moon's distance was observed from the sun or a fixed star. The differences of these logarithms being here given both for the moon's altitude and horizontal parallax, the proportional parts for *minutes of altitude*, and *seconds of parallax*, may readily be taken out, by inspection, from Table III or VI, in the same manner, as by the examples to Table *H*.

Digitized by Google

TABLES *M, N, O.*

Reduction of the true to the apparent Altitude.

These tables are intended to facilitate the reduction of the true to the apparent altitude. They are particularly useful in that method of finding the longitude by the moon, where the distance only, or the distance and the altitude of one of the objects, are given. Table *M* contains the reduction of the sun's true altitude. It is *additive*, to obtain the apparent altitude. In table *N* the reduction of the moon's altitude is contained; and in table *O* that of a fixed star. The first of these is *subtractive*, and the other *additive*, to obtain the apparent altitude.

TABLE *P.*

Altitude most favourable for finding the time.

As the change of altitude is quickest when the object is in the prime vertical, the most proper time for observing an altitude, from which the apparent time is to be inferred, is therefore when the object is due east or west; other errors are also in this case avoided, particularly that arising from an error in the latitude by account at the time of observation. This table contains the altitude of an object, when in the above position. The declination is marked at the top, and the latitude of the place of observation in the side column.

Altitudes under 3° should not be used in the computation of the apparent time, upon account of the uncertainty of the refraction. During one half of the year, or while the sun is on the other side of the equator, with respect to the observer, the sun is not due east or west while above the horizon; in that case therefore the observations must be taken while the sun is near the horizon, the altitude, however, not being less than 3°, for the reason assigned above.

TABLE Q.

Reduction of Altitude on account of the spheroidal figure of the Earth.

This Table is useful for finding the latitude by the moon's meridional altitude, and some other problems where accuracy is required. It is constructed by multiplying the cosine of the azimuth by the correction of latitude contained in Table *F.*

TABLE *R.*

Dip of the Sea at different Distances from the Observer.

This Table is to be entered on the top with the height of the eye above the surface of the sea in feet, and on the side with the distance of the ship from the land in sea miles; and directly under the former, and opposite to the latter, stands the dip of that point in minutes of a degree; which is to be *subtracted* from the observed altitude instead of the number in Table *C.* The numbers in the table have been corrected for terrestrial refraction.

Most seamen can estimate, nearly, the distance of any object from the ship, especially when the distance is not greater than five or six miles, which is the greatest distance that the visible horizon can be from an observer on the quarter deck of any ship whatsoever. But if any person wish for a method of determining that distance by actual measurement, the following one, if executed carefully, will give it sufficiently near the truth for the purpose of taking the Dip out of this table.

Let two observers, one placed as high up the main-mast as he can conveniently be, and the other on the deck, directly underneath him, each observe the altitude of the sun, or other object that may be wanted, at the same instant of time; and let the height of each observer's eye, above the surface of the water, be carefully measured. Take the sum and difference of these two heights, in feet, and also the difference of the two altitudes (of which that observed by the upper person will always be the greatest) and say, as the difference of the heights of the two observers is to the sum of them, so is the sine of the difference of the two observed altitudes to the sine of an angle: take half the sum of this angle and the difference of the observed altitudes; add together the constant log. 6.21624, the log. cotan. of the half sum, and the log. of the height in feet of the upper observer above the sea, the sum, subtracting 20, will give the distance in sea miles.

EXAMPLE.

Admit that the height of an observer's eye on the deck of a ship be 22 feet, that of another observer at the main-top-mast-head 90 feet; and that the difference of the altitudes of the sun's

Digitized by Google

limb when brought down to the water's edge, by these two observers, is 12 minutes; how far were they from the land according to this observation?

As Diff. of heights 68	— log. 1.83251	Constant log. - - - - -	6.21624
: Sum of heights 112 -	log. 2.04922	Half sum 0° 15′ 53″ L.cotan.	12.33533
: : Diff. observ. alt. 0° 12′ 0″	L.sine 7.54291	Height of mast head 90 - log.	1.95424
: 0 19 46	L.sine 7.75962	Miles dist. 3,205 - - log.	0.50581
Sum - - - 0 31 46	half su. 15′ 53″	The Dip corresponding to 22 feet, at 3,2 miles is 6′	

TABLE S.

Distances of the visible Horizon from an Observer or Object, according to the Elevation in Feet above the Surface of the Sea.

This table may be useful to find the distance from a ship at sea to any other object when the height depressed under the horizon is known.

EXAMPLE.

Suppose an observer, 20 feet above the sea, is in view of a light-house, and he judges the part hid under the horizon is 50 feet, what is his distance from the light-house?

By the table the distance corresponding to 20 feet height - -	5,136 miles
Distance to 50 feet depressed height - - - - - - - - -	8,121
Distance required - - - - - - - - - - - - - sum	13,257

The Table also shews that the surface viewed is nearly in proportion to the height of the eye; that is, at double the height, can be seen double the surface of the ocean.

TABLE T.

Lengths in Minutes of the Equator, of one Degree of the different Parallels of Latitude, both for the Sphere and Spheroid; and of the different Arcs of the Meridian in the Spheroid from the Equator to the Pole.

This table is useful in some problems of navigation, where the spheroidal figure of the earth is allowed for; also in the construction of maps and charts; but requires here no further explanation.

Logarithmic and Proportional Tables.

TABLE I.

The Logarithms of Numbers and Sexagesimals.

Logarithms are artificial numbers, so adapted to natural numbers that the sums and differences of the former shall be the logarithms that correspond with and shew the products and quotients of the latter.

In common logarithms the numbers in the arithmetical progression 0, 1, 2, 3, 4, 5, &c. are the logarithms of the corresponding terms in the geometrical decuple series 1, 10, 100, 1000, 10000, 100000, &c. thus,

Natural numbers - -	1,	10,	100,	1000,	10000,	100000,	&c.
Corresponding logarithms	0,	1,	2,	3,	4,	5.	&c.

And all the natural numbers between any two adjacent terms of the above series, will have for their corresponding logarithms, the number standing under the first or least term with an additional fraction; thus between 1000 and 10000 all the corresponding logarithms will have 3 and an fractional addition: this number is called the *index*, *characteristic*, or *integral part* of the logarithm; and being always (as is seen above) a unit less than the number of in-

Digitized by Google

teger places in the natural number, is easily supplied by memory, and therefore usually omitted; so that *the tables contain only the fractional part of the logarithm.*

It follows from the above, that the logarithms of numbers less than unit are negative, but for the convenience of having the fractional part of the logarithms of all numbers, that consist of the same figures, to be the same, it is usual to make only the index negative, and in some cases to add 10. to it, as in the common tables of logarithmic sines, tangents, &c. but the whole logarithm of a fraction can also be made negative, which is a third method. The following will illustrate the different scales of logarithms.

Natural Numbers.	First method. Logarithms.	Second method. Logarithms.	Third method. Logarithms.
567,89	2.754264	12.754264	2.754264
56,789	1.754264	11.754264	1.754264
5,6789	0.754264	10.754264	0.754264
,56789	$\bar{1}$.754264	9.754264	—0.245736
,056789	$\bar{2}$.754264	8.754264	—1.245736
,0056789	$\bar{3}$.754264	7.754264	—2.245736

In the *first scale* the index alone varies from positive to negative, and the negative sign is put above it, the fractional part being always positive; thus, the log. of ,056789 is $\bar{2}$.754264; that is —2.+0,754264, which can also be written (being equal) —3+1.754264, or —4+2.754264, &c. for in the extraction of roots, where the logarithm of a fraction is to be divided by the power, the negative index must either be equal to, or a multiple of the divisor, that the negative part of the quotient may be a whole number.

In the *second scale*, (which is that commonly used in the tables of log. sines, log. tangents, &c.) the excess of 10 is always to be understood in the indices; thus if the three last terms were to be added together the sum is 26,362792, which as it contains three times an excess of ten must be supposed — 30 + 26.362792, or — 10 + 6.362792, written 6.362792 when reduced to the same scale, which shews why the multiples of 10 in this scale are commonly omitted; also if the last logarithm 7.754264 were to be divided by 4, the excess should be made 40, thus — 40 + 37.754264, so that the quotient would become —10+9.438566, written simply 9.438566; and in general the power to be extracted —1, will be the multiple of 10 to be added to the index. Thus the fractional part of both these scales is easy to be understood; but if any doubt should arise either can readily be reduced to the *third scale* by taking the fractional part from the negative index, and writing the whole negative, as above.

TABLE I. contains the *fractional part* of the logarithms of all the natural numbers to 10800 extended to six decimal places; also the proportional parts for each tenth of their differences.

The index not being prefixed must be supplied by either of the above methods; which for all numbers exceeding unit is *one less than the number of integer figures in the natural number;* and for numbers less than unit by either of the preceding scales.

To find the log. of any natural number, look for the three first figures under No. in the second column, and for the fourth figure under that figure in the top line; then in the angle of meeting are the *last four* figures of the logarithm, and the *two first* figures of the same at the beginning of the series under Log. 0; which two figures are supposed to be prefixed to every logarithm in that entire series at the beginning of which they are placed. But if there are more than four figures in the Natural Number, the fifth figure must be sought in the small column of the corresponding difference at the right hand; and also the sixth figure in the same small column, taking only one tenth of the number standing against the 6th figure; the numbers against these figures must be added to the logarithm before found, and the index prefixed must be one less than the number of integer figures in the natural number. The Natural Number to any given Logarithm is found by the converse method to the former.

EXAMPLE 1.

To find the logarithm of 324,567.

Index for 3 integer places - -	2.
Opposite No. 324 under 5 - -	511215
Diff. 134 against 6 - - - -	80
One tenth against 7 - - -	9
Logarithm required - - - -	2,511304

EXAMPLE 2.

To find the natural number to log. 2.511304

Nearest No. 3245 - - - - - -	511215
Remains	89
Under diff. 134 against 6 - - -	80
One tenth against - 7 - - -	9

Index 2 shews 324,567 the No. required.

Digitized by Google

This table also contains a column of hours or degrees, minutes, and seconds, being the natural numbers divided sexagesimally, for sexagesimal proportions; to be used where greater exactness is required than can be obtained by Table V of Proportional Logarithms to 5 places of figures.

Although this table is extended only to 3 hours or degrees, yet by taking one tenth, one hundredth, &c. of any higher quantity, and increasing the index by 1, 2, &c. the logarithm can be found for any sexagesimal number whatever to six places of figures, as in the following proportions.

EXAMPLE 1.

As 2h.29m.36s. : 2h.10m.12s :: 1°10′8″ : x
As 2 29 36 - - - - - - —3.953083
: 2 10 12 - - - - - - 3.892762
:: 1 10 8 - - - - - - 3.624076

: 1 1 22=x - - - - - 3.563755

In these logarithmic proportions instead of subtracting the first term, its arithmetic complement can be added to the other two, which can readily be done by memory, without writing the complemental figures, taking the right hand figure from 10, and each of the others from 9; thus the complemental figures of the above are 6.046917 to be added to the other two.

EXAMPLE 2.

As 24h. : 18h. 7m. 0s. :: 4567 : x
one tenth of 24h. is 2h.24m.0s.—L.4.936514
one10th of 18h 7m6s.is1h.48m.42s.4.814381
:: 4567 - - - - - - - L. 3.659631

: x = 3447.46 - - - - 3.537498

Here the index of 2h. 24m. or 8640s. would be 3; but for 10 times that quantity, or 86400s, it is 4 as above, the indices being governed by the No. of seconds, thus,

Nos. 10″ 1′40″ 16′40″ 2° 46′40″ 27° 46′40″
Logs. 1. 2, 3. 4. 5. &c.

When arithmetic complements are used, so many tens must be subtracted from the index of the total sum as there have been arithmetic complements added.

TABLES II. & III.

These two tables are sufficiently explained on their own pages, being designed to work any proportion where 60 is one of the terms. Table II. will also serve as a table of Logistic Logarithms, and shews how both those and Proportional Logarithms may be constructed by a direct instead of the present reverse series.

TABLE IV.

Logarithmic Sines and Tangents and Natural Sines.

As these are somewhat different from the common tables they require a particular explanation.

The natural radius being unit, an excess of 10 is supposed in the index of the log. sines and tangents.

The log. sines and log. tangents of small arcs increase so unequally that the differences for the several seconds do not follow in a simple proportion of the difference for one minute: therefore to obtain them to seconds, in the readiest manner, there is prefixed a column of the number of seconds in every minute, for arcs as far as 9 degrees; also two additional columns marked S.—″ and T.—″ next after log. sines and log. tangents, containing *certain logarithms*, the nearest of which to a given arc, if added to the logarithm of the number of seconds that given arc contains, the sum will be the *log. sine* or *log. tangent* required; or conversely, if subtracted from any given log. sine, or log. tangent, to which it stands nearest, the remainder will be the logarithm of the number of seconds in the required arc.

EXAMPLE 1.

To find the log. sine of 2° 45′ 34″,5
Against 2° 45′ 34″ under S.—″ 4.685407
Table I. log. of 9934,5 is - - 3.997146

Log. sine of 2° 45′ 34″,5 required 8.682553

EXAMPLE 2.

To find the arc to the log. sine - 8.682553
Against the nearest under S.—″ 4.685407

Table I. opposite 2° 45′ 34″,5 is L. 3.997146

The log. sines and log. tangents of arcs, exceeding 9 degrees, are given to every minute, with the differences for 1 minute, and can be found for every second by simple proportion.

Digitized by Google

EXAMPLE 1.

To find the log. sine of 18° 45′ 25″
Against 18° 45′ - - 9.507099 D. 372
372 × 25 ÷ 60 = - 155

Log. sine required - - 9.507254
Or thus, because 372 contains 60 six times and 12 over, 25″ × 6 = - - 150
Table VI. against 12 and 25, p. p. 5

Proportional part as before - 155
See also the examples to Table VI.

EXAMPLE 2.

To find the arc to log. sine - - 9.507254
Preceding arc - 18° 45′ log. sine 9.507099
Diff. for 60″ is 372
155 × 60 ÷ 372 = 25″ - diff. 155

Arc required - 18° 45′ 25″

Or, the proportional part of the difference may be found by Table III. or Table VI.

Or, find the natural number to the log. sine, which will be the nat. sine of the arc.

Or as in example 9 to table VI.

GENERAL RULES NECESSARY TO THIS TABLE.

The *Log. Tangent* of an arc above 81 degrees, is found by first finding the log. cotangent and subtracting it from 20.

The *Log. Co-tangent* of an arc, under 9 degrees, must be found by first finding the log. tangent, and subtractiug it from 20.

The *Log. Secant* of an arc is found by subtracting the log. cosine from 20.

The *Log. Co-secant* of an arc is found by subtracting the log. sine from 20.

The *Log. Versed Sine of an arc* is found by adding twice the log. sine of one half the given arc to the constant log. 0. 301030, and subtracting 10 from the sum.

The *Log. Co-versed Sine* of an arc is found by adding twice the log. cosine of one half the given arc to the constant log. .301030, and subtracting 10 from the sum. Or, by finding the logarithm of the nat. versed or co-versed sine.

The *Natural Sines* in this table are fractions (radius being unit); and are particularly adapted to Dunthorne's and other methods of clearing the moon's distance from the effects of parallax and refraction, where natural sines or versed sines are used; for which purpose, against each *minute* of the *nat. sine* and *cosine* is put the proportional part for the same number of *seconds*, which must be added or subtracted according as it increases or decreases; so that the *nat. sine* or *versed sine* of any arc can be taken to the nearest *second* by inspection.

The *Natural Cosines* of arcs exceeding 90° are *negative*, and equal to the *Nat. Sine* of the excess above 90°, with a *negative* or contrary *sign*.

The *Natural Versed Sine of an arc less than* 90°, is equal to its cosine subtracted from unit.

The *Natural Versed Sine of an arc of more than* 90° is equal to unit, added or prefixed either the nat. sine of its excess above 90°, or to its *nat. cosine* taken positively.

EXAMPLE 1.

To find the natural cosine and versed sine of 70° 19′ 23″.
Against 70° 19′ - - - N. Cos. .336821
Against 23′ for 23″ under *d.*″ - — 105

Natural Cosine required - - - .336716

Or, against 70° 20′ - - N. Cos. .336547
Against 23 on the right hand - - + 169

Natural cosine as before - - - .336716
Taken from unit gives N. V. Sine .663284

EXAMPLE 2.

To find the natural cosine and versed sine of 101° 55′ 21″.
N. Sine of the excess 11°55′. is - .206489
Against 21′ for 21″ is - - - - + 100

Sine of 11°55′21″(excess above 90°).206589

A unit prefixed gives N. V. S. 1.206589

The nat. cos. of 101° 55′ 21″ is — .206589

Or, the N. V. S. might be taken at once by inspection, thus,

1—Nat. Cos. = N. V. S. of 70° 19′ .663179
Against 23′ for 23″ under *d.*″ - - + 105

Natural Versed Sine required - .663284

1 + N. S. 11°55′ = N. V. S. 101°55′ 1.206489
Against 21′ for 21″ under *d*″ - - + 100

Natural Versed Sine required - 1.206589

Digitized by Google

EXAMPLE 3.

To find the arc corresponding to N.V.S. .663284, or to Nat. Cosine .336716
Nearest Nat. Cosine 70° 19′ - .336821

Under *d.″* against 23′ for 23″ is 105

Arc required - - 70 19 23

EXAMPLE 4.

To find the arc to Nat. V. Sine - 1.206589
Nat. Sine of excess of arc above 90° .206589
Nearest Nat. Sine 11° 55′ - - .206489

Under *d.″* against - - 21″ diff. 100
To which add - 90° makes 101° 55′ 21″
arc required.

TABLE V.

Proportional Logarithms to 3 or 12 Degrees or Hours.

This table originally calculated by Dr. Maskelyne to find more readily the apparent time at Greenwich, corresponding to a given distance between the moon and the sun or a fixed star, is here extended to five places of figures; and also adapted to any proportion where either 3 or 12 hours or degrees make one of the terms: the *interior* arguments *within the double rules* serving for the proportional parts of 3 hours, and the *exterior* arguments, *without the double rules*, serving for the proportional parts of 12 hours or degrees: in the latter case as every fourth second only is inserted the proportional parts for one, two, and three seconds are placed at the bottom of the pages.

Proportional Logarithms, as here given, may be considered as common logarithms *with a contrary sign*, of the fractional parts of 3 or 12 hours or degrees; and if compared or combined with common logarithms, must therefore be taken as *negative* or *inversely*; in like manner with them, their use can be extended decimally by the simple alteration of the index; but, from the nature of negative, or inverse quantities, the order is inverted, decreasing as the indices of common logarithms increase, and vice versâ. The following table will shew the index of any proportional logarithm.

	′ ″	h. ′	h.	h.	h. or degrs.
Natural Sexagesimal Nos.	7 12	1 12	12	120	1200 Exterior table.
	1 48	18	3	30	300 Interior table.
Corresponding proper. logs.	2,	1,	0,	—1,	—2, &c.

EXTERIOR TABLE.

So that the index between
- 7m. 12s. and 1h. 12m. is 1
- 1h. 12m. and 12h - - 0
- 12h. and 120h. - - —1
- 120h. and 1200h. - - —2

INTERIOR TABLE.

between
- 1′ 48″ and 18′ is 1
- 18′ and 3h. 0m. - - 0
- 3h. & 30h. 0m - - —1
- 30h. to 300h. - - —2 &c.

Either table will serve for any sexagesimal proportion; but when the three first terms exceed three hours or degrees, it is generally best to use the *exterior* arguments; or if the second or third term is less than three hours, two terms can be sought in the *exterior* and two in the *interior* part, as in the following proportions.

EXAMPLE 1.

12h. : 7h. 15m. 5s. :: 3° 27′ 45″ : *x*

As 12h. 0m. 0s. P. L. 12h. - .00000
: 7h. 15m. 5s. P. L. 12h. - .21876
:: 3° 27′ 45″ - P. L. 12h. - .53979

: 2° 5′ 32″ = *x*, P. L. 12h. - .75855

EXAMPLE 2.

12h. : 7h. 15m. 5s. :: 2h. 10m. 9s. : *x*

As 12h. 0m. 0s. P. L. 12h. - .00000
: 7h. 15m. 5s. P. L. 12h. - .21876
:: 2h. 10m. 9s. P. L. 3h. - .14083

: 1h. 18m. 39s. = *x* P. L. 3h. - .35959

When two terms of a proportion are sexagesimal, and two common decimal numbers, change the signs or invert the terms either of the proportional or common logarithms, in which ever are given two of the terms.

EXAMPLE 3.

As 12h. : 7h. 15m. 5s. :: 678,95 : *x*.

As 12h. 0m. 0s. - - P. L. + .00000
: 7h. 15m. 5s. - - P. L. —.21876
:: 678,95 - - - Com. L. 2.83184

: 419,84 - - - - Com. L. 2.62308

EXAMPLE 4.

As 678,95 : 419,84 :: 12h. : *x*.

As 678.95 - - Com. Log. + 2.83184
: 419,84 - - Com. Log. — 2.62308
:: 12h. 0m. 0s. - - - P. L. 0.00000

: 7h. 15m. 5s. - - - P. L. .21876

Digitized by Google

It may easily be seen that inverting the two first terms will bring the same result as changing their signs. But this attention to changing the signs, or inverting the terms, when combining *Proportional* with *Common Logarithms*, would have been avoided, if the Proportional Logarithms had been made a direct series, like Table II. and not an inverted one as it now stands.

EXAMPLE 5.

To find the Proportional Logarithm of 2″,3 *to* 3 *hours.*

Proportional Log. of 23″ is - 2.67170
Add 1 to the index for one tenth is 3.67170

EXAMPLE 6.

To find the Proportional Log. of 45° 10′ 12″ *to* 12 *hours.*

One tenth is 4° 31′ 1,″2 - P. L. 0.42433
Index — 1 or 9 makes - - - 9.424433

EXAMPLE 7.

What is the sexagesimal number to the Prop. Log. 3.64782 *to* 12 *hours.*

S. N. to P. L. 0.64782 is 2h. 42m.
Divide by 1000 for index 3 is - - 9s.72
The sexagesmal number required.

Note.

The Prop. Logs. of arcs less than 60′ may be used inversely for proportions of Log. Sines and Tangents.

TABLE VI.

To reduce the Latitude, Longitude, Right Ascension, Declination, &c. of a celestial Object to any intermediate time.

The circumstances of the heavenly bodies being given in the Nautical Almanac at certain periods of 24, 12 or 6 hours, this table is intended to reduce them to any intermediate time, supposing their variation in 12 hours to be uniform.

The top argument is the variation for 12 hours, from 1 to 60 *minutes*, which may serve also from 1 to 60 *degrees*, or from 1 to 60 *seconds*, by supposing the sexagesimal numbers in the body of the table to be increased or decreased in the same proportion. And the side argument of *hours* and *minutes*, after noon or midnight, may be accounted as *minutes* and *seconds*, or *seconds* and *thirds*, by supposing the numbers of the table decreased in like proportion.

When the variation is given in the Nautical Almanac for 24 hours, as in the Sun's Declination, Right Ascension, &c. either take half that variation for the top argument, or else half the interval from noon for the side argument, as may be most convenient. Or, if the variation is given for six hours, as in the Moon's North Polar Distance in the Nautical Almanacs for 1807 and the succeeding ones, then double that variation must be taken for the top argument; or else double the interval of time for the side argument, as may be the easiest operation.

EXAMPLE 1.

To find the Moon's Right Ascension the 6th of May 1807, *at* 8*h.* 16*m.* 24*s. Greenwich time.*

☽'s Right Ascension, Nautical Almanac, at noon - - 27° 42′ 0″ Diff. 6° 13′

Under 6° against	8h. 12m. is - -	4° 6′	
	4m. 24s. is -	2 12″,1	- 4 8 12
Under 13′ against	8h. 12m. is - - -	8 53	
	4m. 24s. is - -	4 46‴	[- - 8 57 46‴
☽'s Right Ascension required - - - - - - - - -			31 59 9 46

EXAMPLE 2.

To find the Sun's Right Ascension, 6th May, at 8*h.* 16*m.* 24*s. Greenwich time.*

☉'s Right Ascension at noon, by Nautical Almanac - - - 2h. 50m. 5s. 48‴
Diff. 3m.51s.,6 being for 24h. take half the interval, or 4h.8m.12s.

Under 3m. against	4h. 0m. is - -	1m. 0s.	
	8m. 12s. is -	2 3‴	- - 1 2 3
Under 51s. against	4h. 0m. is - -	17	
	8m. 12s. -	34 41‴	- - 17 34 41‴
Under 48‴ against	4h. 0m. is - - - - -	16	
	8m. 12s. is - - - -	33	- - - 16 33
☉'s Right Ascension required - - - - - - -			2 51 25 42 14

Digitized by Google

EXAMPLE 3.

To find the Sun's Declination the 6th May, 1807, *at* 8*h.* 16*m.* 24*s.*

Sun's declination at noon by Nautical Almanac - - - - N. 16° 20′ 59″
Diff. + 16′ 53″, take half the interval.

Under 16′ against	4h. 0m.	is 5′ 20″		
	8 12″	is 10 56‴	- - -	5 30 56‴
Under 53″ against	4 0	is 17 40		
	8 12	is 36	- - - - - -	18 16
Sun's declination required			- - - - - - - - - - -	N. 16 26 48 12

EXAMPLE 4.

To find the Moon's Hor. Parallax, *6th May*, 1807, *at* 8*h.* 16*m.* 24*s.*

Moon's Horizontal Parallax, at noon, Nautical Almanac - 55′ 20″ diff. + 14″
Under 14″ against 8h. 12m. is - - - - - - + 10

Moon's Horizontal Parallax required - - - - 55 30

This table will serve also for any proportion where 60 is either of the given terms, by means of the right hand column under p. p.

EXAMPLE 5.

As 60′ : 53′ :: 47 : x.

Under 53 at the top, and in the line against 47, under p. p. is $41\frac{31}{60} = x$, or it will be the same if 47 is taken at the top, and 53 under p. p. at the right hand.

EXAMPLE 6.

As 47 : 41 :: 60′ : x.

Under 47	oppos. 52′ - -	is 40 44	
	oppos. 20″	is 15 40‴	
	oppos. 25‴	is 20	
$x =$		52 20 25	41 0 0

Should any of the terms exceed 60, suppose it seconds, divide it sexagesimally and take the parts separately.

EXAMPLE 7.

As 60 : 53 :: 192 : x. 192″ = 3′ 12″

Under 53 against	3′	is 2′ 39″	
	12″	is 10 36‴	
$x = 169\frac{36}{60} =$			2 49 36

Or, multiply by the number of sixties in the third term, and find the remainder in the table, thus,

53 × 3 = - - - - - - 159
Under 53, opposite remainder 12 is 10.36
The same as before - - - - - 169.36

EXAMPLE 8.

As 60″ : 47″ :: 457 : x. 457 ÷ 60 = 7.37

47 × 7 = - - - - - - 329
Under 47 opposite 37 - - - - 28.59
$x =$ - - - - - - - - - 358

EXAMPLE 9.

As 192 : 149 :: 60′ : x.

Or, As 3′ 12″ : 2′ 29″ :: 60′ : x.

Against 3, in the right hand column, taken as minutes, and 12 as seconds, find under what top argument the sum of the two corresponding numbers will be nearest to 2′ 29″; if not exact repeat for the remainder until it is sufficiently exact, and the sum of the top arguments will be the answer, thus,

Under 46′ is 2′ 18″ & 9″ 12‴ = 2′ 27″ 12‴
Under 33″ is 1″ 39‴ & 6‴ 36‴″ = 1″ 46‴″

	46 33	2 28 58
Under	45‴ - - - - -	2
$x =$	46 33 45	2 29 0

TABLES VII. & VIII.

Half elapsed time, Middle time, and Rising.

These tables are used in finding the Latitude, when the *latitude by account*, *two observed altitudes of the Sun*, *the interval of time between*, and *the Sun's declination* are given;

Digitized by Google

they can also be applied in the solution of many other problems, as the computation of *apparent time, the true azimuth* of an object, *the altitude and longitude of the nonagesimal*, &c.

Table VII contains the HALF ELAPSED TIME and MIDDLE TIME; their differences being the same are put in a column between both, marked D. the first is the arithmetic complement of the Log. Sine of the horary angle; the second is the Log. Sine of the horary angle +.301030: they both extend as far as 6 hours, to every tenth second of time.

Table VIII, entitled RISING, contains the Log. Versed Sine of the horary angle corresponding to every tenth second of time as far as 9 hours, with the differences; by which means every second can be taken by inspection.

These tables will be sufficiently explained in the problems for that purpose. They were first invented by Mr. Cornelis Douwes, examiner of the sea officers and pilots by the appointment of the right honourable college of admiralty at Amsterdam, who was rewarded with £50 by the Commissioners of Longitude.

In the Nautical Almanacs for 1797, 1798, 1799, and 1800, three tables were given, with rules adapted to them by the Rev. John Brinkley, Andrew's Professor of Astronomy, near Dublin, to improve this method; which are also added to these tables, being tables XXVII. XXVIII, and XXIX.

TABLES IX. & X.

The Moon's equatorial Semidiameter, in time, and its increase by the Moon's Declination.

These tables serve to find the time of the pas age of the moon's semidiameter over the meridian; which, together with the observed time of the passage of either limb will give the time of the transit of the moon's center. They were first published by Mr. Schulze, in the Berlin Ephemeris for 1779. An Example will easily explain their use.

Suppose the transit of the moon's western limb was observed at Greenwich, March 11, 1805, *at 9h. 5m. 54s. required the time of the passage of the moon's center.*

By the Nautical Almanac the moon's Hor. Par. is 58′ 52″ variation of Right Ascen. 6° 58′
Moon's Declination – N. 17° 41′

Time of moon's western limb on the meridian - - - -	9h.	5m.	54s.
Table IX, opposite 58′ 52″, under 6° 58′ - - - - - +	1		6,8
Table X. opposite 17° 41′ Declin. under 68″,8 - - - +			3,4
Time of the moon's transit required - - - - - - -	9	7	4;2

Table IX. contains also *the Moon's Horizontal Semidiameter* corresponding to her Horizontal Parallax, and either can be taken as the side argument.

TABLE XI.

To *reduce Degrees into time, and conversely.*

This table is very useful for converting degrees and minutes of the equator, or longitude, into time, and the contrary: the method of using it is too obvious to need pointing out. The following rule may also serve independent of the table.

RULE.

Multiply *degrees* and *minutes* by 4, will produce *minutes* and *seconds* of time. And, Conversely,
Divide *minutes* and *seconds* of time by 4, will quote *degrees* and *minutes* of longitude.

TABLES XII & XIII.

These serve to reduce the difference of the mean solar times of the passage of two stars over any meridian or horary circle to degrees of the equator, and conversely; also to convert mean solar time, shown by a clock &c. into parts of the equator.

Digitized by Google

TABLE XIV.

To reduce the time of the Moon's Passage over the Meridian of Greenwich to the time of its Passage over any other Meridian.

As the moon passes the meridian of any place later every day than she did the day before by a number of minutes, which is equal to the difference of the variation of the sun and moon's right ascensions in time, in the interval, it is obvious that the moon must pass the meridians of such places as are to the westward of Greenwich later, and the meridians of such places as are to the eastward of Greenwich sooner, than she passes the meridian of Greenwich, by a number of minutes, which is to the number of minutes in the above-mentioned difference, as the distance of that meridian from the meridian of Greenwich is to 360°.

This table, which is taken from Dr. Maskelyne's "Requisite Tables," and Dr. Mackay's "Longitude Tables," is sufficient for most nautical purposes; but perhaps it would be more exact to make use of table VI, using either half the daily retardation for the top argument, or else half the ship's longitude for the side. A very accurate method of finding the time of the moon's transit at any place may be seen among the problems in the American edition of the Nautical Almanac for the years 1807 and 1808.

Note. The daily variation of the moon's passing the meridian is found by taking the difference between the time of the moon's passage over the meridian of Greenwich on the proposed day, and the day following, if the longitude of the ship or place be west; or between the time of her passage on the proposed day and that preceding it, if the ship or place be in east longitude.

TABLE XV.

Acceleration of the fixed Stars in mean time.

By means of this table, sidereal may be converted into mean time, sufficiently exact for most purposes; and the rate of a *time piece* or chronometer may be ascertained in the simplest manner, by observing the transits of the fixed stars, as they advance each day 3m. 55s. 54‴ on mean solar time; which may be done tolerably exact by observing the instant of disappearance of a star, during several successive nights, behind a fixed object, as a chimney, nearly in the meridian: the place of the eye of the observer being also fixed.

TABLE XVI.

Equation of the time of High Water.

The correction of the time of high water, that depends on the *moon's angular distance from the sun*, and her *greater or less distance from the earth*, is what is given in this table. The time of the moon's passage over the meridian, *above* or *under the Pole*, being corrected by this table, and added to the *port-time* * of any place, or time of high water at full and change, *diminished* by 22 minutes, will give the time of high water following the moon's passage. The moon's angular distance is what is given in the Nautical Almanac in the time of the moon's passage; and her distance from the earth being inversely as the horizontal parallax, they are therefore properly used as the arguments of this table, which is taken and corrected from one printed in Dr. Mackay's valuable collection of Tables, being reduced from a similar table calculated by M. Bernoulli, in the fourth volume of "La Lande's Astronomy." The small differences arising from the declinations of the sun and moon and the sun's distance are neglected, as the winds and other local causes prevent a greater accuracy.

* The time of high water at the full and new moon, as commonly given in tables, should be diminished by 22 minutes, to conform itself to what is called the PORT-TIME in this table: otherwise the time of high water found from this table should be diminished 22 minutes, as in the following example.

Digitized by Google

EXAMPLE.

To find the time of high water at Boston, the 12th day of March 1805.

Longitude of Boston west -	4h. 42m.	Moon's passage at Greenwich -	9h. 58m.
Moon's passage, Naut. Almanac	9h. 58m.	Proportion for W. long. Table VI.	+ 19m.
Daily retardation - -	49m.		
Moon's horizontal parallax, midn.	58′ 28″	Moon's passage at Boston- -	10h. 17m.
		Table XVI. correction for hor. par. 58′ 28″, & ☽'s transit 10h. 17m.	+ 42m.
		High Water at Boston, R. Tables	11h. 30m.
Moon's passage at Boston, added to the diff. of longitude, gives Greenw. time of transit at Boston	14h. 59m.	Deduct constant - -	— 22m.
		Time of high water -	12d. 22h. 7m.

By adding 12 hours, and half the moon's daily retardation 24½′ minutes, to the last found time, the following tide will be found the 13d. 10h. 31½m. sufficiently near.

Also, if the time of high water at Boston had been observed on the 12th to be 22h. 7m. by subtracting the time of the moon's passage corrected by the table, the *port-time* would be found, which should be settled by a mean of several observations.

TABLE XVII.

Height of the Tides.

As it is often useful, and in some cases indispensible, to be able to judge not only the time of high water, but its rise in *feet*: the present table is given as the most correct for that purpose yet published: a small degree of attention will make it intelligible; and, with the last table, it will also serve to instruct any intelligent mariner, how to form a tide table for any foreign port, and assist in advancing this part of navigation from its present uncertain state.

Suppose the height of the tide at any place, when the moon is on the merid. at 1h. 20m. or 13h. 20m. be called A; and the height of the tide at the same place, when the moon is on the meridian at 7h. 20m., or 19h. 20m. to be called B, the moon being supposed at her mean distance, or her horizontal parallax 57′; then, in this table, against any other time of the moon's transit, and according as the moon is in apogeo, mean distance, or in perigeo, at which times the hor. parallaxes are 53′¼, 57′ and 61½′ will be found the numbers to be multiplied by A and B, which added together will give the height in feet of the high tides of that day. The descent of the tides is as the squares of the times from high water, and a tolerably accurate method of finding the time of high water, is by taking equal altitudes of the tides at any interval of time less than 3 hours.

Any one who is but sufficiently acquainted with algebra to solve a simple equation can find the value of A and B for any port, by observing the height at two separate times when the moon is nearly full and at her quarters; for by the Nautical Almanac finding the time of the moon's transit, and horizontal parallax at the time of transit for those days, he will from this table have two equations and two unknown quantics, whereby the values of A and B can readily be found. And if a mean of such corresponding observations be taken to lessen the uncertain effects of winds &c. the value of A & B will be more accurately determined, and a table for different ports may, in time, be obtained, which would be a valuable acquisition.

TABLE XVIII. & XIX.

Difference between the meridian Altitude of an Object, and its Altitude one Minute before, or after the time of transit.

Since the difference between the meridional altitude of an object and its altitude a few minutes before or after is nearly proportional to the square of the time from its transit; the meridan altitude may be found from an observed altitude a few minutes before or after its passage by these two tables. Table XVIII shews the difference in altitude for one minute in time, before or after a transit, according to the latitude and declination, and to their being of the same or contrary names. Table XIX gives the square of the times for every second as far as 11 minutes; so that the number corresponding to the interval from

Digitized by Google

noon, multiplied by the number of seconds of altitude in table XVIII, answering to the declination and latitude, will give the seconds of altitude to be added to the observed altitude to obtain the true.

EXAMPLE.

Let the latitude be 30° north, and declination 15° south, and the altitude observed 5m. 10s. after the sun's passage over the meridian was 25° 14′; required the meridian altitude.

Table XVIII, against 30° N. and 15° S. is -	2″,45	
Table XIX, against 5m. 10s. - - -	26,7	
Product - - - - - -	65″,4 =	1′ 5″
Observed altitude - - - - - -		25° 14 0
Meridian altitude - - - - - -		25 15 5

Remark. When the sun comes near the zenith, as in the places marked *, the difference of altitude is not as the square of the time, and then these tables cannot be used.

The interval between the time of observation and noon can be found by a time-keeper, or good watch; either by equal altitudes, or else regulated by an altitude an hour before or after the observation.

TABLE XX.

Amplitudes.

The Amplitude is from the east if at rising, or from the west if at setting; and to the north or south, according to the name of the declination.

The sun's declination may be found by the Nautical Almanac for the time of its rising and setting at any given place; with which and the latitude, the amplitude can be readily had from the table; but this is the amplitude when the sun is in the true and not in the visible horizon. In order to use it in deducing the variation of the compass, the amplitude must be taken by the compass when the sun's lower limb appears elevated about 15′, added to the dip of the horizon; thus, if an observer be elevated 17 feet, the amplitude should be observed when the altitude of the sun's lower limb is 19′.

In favourable circumstances, when great accuracy is required, the amplitude of the sun's N. and S. limbs may be observed, to which the semidiameter being applied will give the amplitude of the center.

When degrees and minutes are used for the latitude and declination, it will be as expeditious to find the true amplitude by the common rule as by the table: that is, subtracting the log. cosine of the latitude from the log. sine of the declination + radius; the remainder will be the log. sine of the true amplitude.

EXAMPLE.

What is the amplitude of the sun at rising in 21° 43′ N. latitude, when the sun's declination is 6° 47′ north.

BY TABLE XX.		BY CALCULATION.	
Amplitude for 21° 43′ and 6° decl.	6° 27′	⊙'s decl. N. 6°47′ L. Sine + 10 =	19.072306
Diff. 65′ for 60′ makes for 47′ - -	51	Latitude N. 21°43′ L. Cos. —	9.968027
Amplitude required - - -	E. 7 18 N	Amp. req. E.7°18′N. L. Sine -	9.104279

If the true amplitude and observed magnetic amplitude be both N. or both S. their difference is the variation of the compass; but if one be N. and the other S, the sum will be the variation; which will be *east* or *west* according as the true amplitude appears to the *right* or *left* of the magnetic amplitude of the observer.

TABLE XXI.

Variation of Amplitudes, answering to a change of 100′ of Altitude.

This table serves to find the correction which is to be applied to the true amplitude as found by the preceding table, in order to obtain the amplitude which takes place when

Digitized by Google

an object is a few minutes above or below the true horizon; the true altitude having been estimated by the allowance for dip, refraction, parallax, and semidiameter, and if found to be in the true horizon, by having followed the directions for the last table, no correction will be necessary; otherwise the difference in minutes must be multiplied by the numbers in this table, and the product, cutting off the two last figures, will be the correction of amplitude; which, if the center is below the true horizon, must be *added* to the true amplitude when the latitude and declination are of the same name, but *subtracted* when of different names; the contrary will be the case if the object is found to be above the true horizon.

EXAMPLE.

What is the sun's apparent amplitude at the setting of the lower limb in 46° 38′ *north latitude the sun's declination being S.* 21° 27′ 4″, *semidiameter* 16′ 15″, *and height of the observer's eye* 21 *feet?*

Table XX. lat. 46° decl. 21°	amp. 31° 3′		Dip - - - - - - - - - - -		4′ 31″
(Diff. for 60′ lat. 39 & 60′ decli. 95.)			Refraction and parallax - - -		32 51
Table VI. to 38 and 39 - - -	+25		Semidiameter - - - - - - —		16 15
to 27 and 95 - - -	+43				
			Sum gives depression - - -		21 7
True amplitude of ⊙'s center	W. 32 11 S		T. XXI. lat. 46° 38′ am. 32°11′ is		126
Correction for depression - - -	—27				
			Product ÷100 gives correction	—	26 36
Apparent ampl. ⊙'s lower limb	W. 31 44 S				

TABLE XXII.

Time in Seconds, answering to a change of 100′ *of altitude near the horizon.*

This table is to be used with the following table XXIII, and is reduced to seconds of time for the greater ease of multiplication.

The first part extends to 38° of latitude, and is general in all cases; but the second, or middle part must be used when the latitude and declination are both N. or both S; and the third part if one be N. and the other S. The last example to table XXIII will shew the use.

Note. One third of the number of seconds in the table will give the effect of horizontal refraction, making the object rise so much sooner, or set so much later.

If the two last figures are cut off it will give the time in minutes for a change of 60′ of altitude.

TABLE XXIII.

To find the Rising and Setting of a celestial Object.

This table shews half the time of continuance of an object above the horizon when the latitude and declination are of the same name; or the time of half its continuance under the horizon when they are of different names; hence the table gives the time after *midnight* of rising when they are of different names, and the time after *noon* of setting when of the same.

The declination must be reduced to the time sought for rising or setting; and the correction for dip, refraction, semidiameter, and parallax, can be found by table XXII.

EXAMPLE 1.

Required the time of the sun rising and setting in lat. 20° *N. decl.* 16° *N.*

	h. m.
Tab. XXIII, lat. 20° N. dec. 16° N. setting	6 24
Subtract from 24h. gives time of rising	17 36

EXAMPLE 2.

Required the time of sun rising and setting lat. 20° *N. decl.* 16° *S.*

	h. m.
Tab. XXIII. lat. 20° N. 16° S. rising	18 24
Subtract from 24h. gives setting -	5 36

But it can be found more accurately by either of the following rules; First, reducing the declination to the approximate time found by this table.

RULE 1.

Add the log. tangent of the latitude to the log. tangent of the declination, the sum will be the log. cosine of an arc, which, reduced to time, by table XL or its rule, gives the time of rising after midnight, or setting after noon, according as the latitude and declination are of the same or contrary names.

Digitized by Google

RULE 2.

To the cotangent of the latitude add the cotangent of the declination; the time answering to this sum, found in Table VII, under half elapsed time, added to 6 hours, when the latitude and declination are of the same name, but subtracted from 6 hours when of different names will give the time of the half continuance above the horizon.

EXAMPLE.

What time will the sun's lower limb be in the visible horizon at setting, in latitude 20° 16′ *N. and sun's declination* 16° 9′ *N.*

BY RULE 1.		BY RULE 2.	
L. Tang. 20° 16′ - - - -	9.567320	L. Co-tang. 20° 16′ - - -	10.432680
L. Tang. 16° 9′ - - - -	9.461770	L. Co-tang. 16° 9 - - -	10.538230
L. Cosine 83° 52′ - - - -	9.029090	Tab. vii. H.E.T. 0h. 24m. 31s. -	0.970910
Multiply by 4 (Rule to Table XI.)		which added to 6 -	being both N.
5h. 35m. 28s. Time of rising af. midn.		Gives 6 24 33 Semi diur. arc.	
Tab. XXII, to lat. N. 20° & dec. 16°	445s.	Dip - - - - - - - - - -	4′ 11″
Prop. of diff. to 16′ lat. - - - -	1	Refraction and parallax - - -	32 51
Prop. of diff. 9′ declin. - - - -	0	Semidiameter - - - - - -	—15 53
Correction for 100′ altitude - - -	446s	Sum - - - - - Depression	21 9
m.		Prop. to 446s. for 100′ = -	0h. 1m. 34s.
Or, 4,46 for 60′ altitude.		Semidiurnal arc as above -	6 24 33
		App. time setting of lo. limb	6 26 7

TABLE XXIV & PART II.

For computing the Equation of equal Altitudes.

These are calculated from the theorem in La Lande's Astronomy, vol. I, p. 109; the first is the horary angle divided by 360; multiplied by the tangent of the latitude, divided by 15 times the sine of the horary angle. The second is the horary angle divided by 360; multiplied by the tangent of the sun's declination, divided by 15 times the tangent of the horary angle; whence the following

RULE.

With the interval of time between the observations at the top, and the latitude of the place in the side column, take from table XXIV the corresponding number; making a proportion for any excess above the tabular arguments; take also from part II. the number answering to the interval of time and the sun's declination; subtract this from the former when the latitude and declination are of the same name, otherwise add them, and find the logarithm of the remainder or sum; which subtracted from the Prop. Log. of the daily variation of the sun's declination, increased by 5, will leave the prop. log. of the equation of equal altitudes; which is subtractive when by the change of declination the sun approaches the observer; and additive when the sun recedes.

EXAMPLE.

Let the latitude be 57° 9′ *N. the interval of time between the observations* 5*h.* 17*m.; sun's declination* 17° 48′ *S. and daily change of declination* 16′ 19″,5 *N. required the equation of equal altitudes.*

Digitized by Google

BY TABLE XXIV & PART II.		BY CALCULATION.	
Tab. xxiv. to int. 5h. 20m. & lat. 57°	1775	L. sine hor. angle 39° 37½ -	— 9.80466
Prop. for — 3m. interval and 9′ lat. -	7		
	1782	Constant logarithm - - - -	2.81032
		P. L. of half interv. 2h. 38½m. -	0.05524
		Log. tang. of lat. 57° 9′ - -	10.18998
Part π. to int. 5h. 20m. & dec. 17° 30′	278		
Prop. for — 3m. inter. and 18′ declin. +	6	N. num. 1st part, as before, 1782	3.25088
	284	L. tang. hor. angle 39° 37½′ -	— 9.91813
Sum, being of different names -	2066	Constant logarithm - - - -	2.81032
Log. of sum - - - - - - -	3.31513	Prop. log. of half interv. 2h. 38½m.	0.05524
D. var. of dec. 16′ 19″,5 P.L. + 5 is	6.04242	L. tang. sum's declin, 17° 48′ S. -	9.50659
Equat. of equal altits. —20″,2 P.L.	2.72729	N. num. 2d part, as before, 284	2.45402

TABLE XXV.

Correction of equal Altitudes, sufficiently accurate for Sea Purposes.

By means of this table, and taking the proportion for any excess above the tabular arguments, the equation of equal altitudes can be generally found to the nearest second; which is subtractive or additive according as the sun is approaching or receding from the observer by his change in declination.

TABLE XXVI.

Error of Observation arising from an Error in the Line of Collimation.

If the line of sight is not parallel to the plane of the instrument the observed angle will exceed the true angle. This table shews the error, which must be *subtracted* from the observed angle to obtain the true one. Thus, for an observed angle of 44° if there be an error in the line of collimation of 1° 30′ the correction is 57″, to be *subtracted*: and since the error of observation is nearly as the square of the error of the line of collimation, if the prop. log. of the error of 3° in the line of collimation in this table be added to twice the prop. log. of error of the line of collimation in the instrument, the sum will be the prop. log. of the error of observation to be *subtracted*.

EXAMPLE.

Suppose the error of collimation 1° 20′ 30″, *angle observed* 113°.

Against 113°, under 3° is	4′ 14″	Prop. log. 1.10197
Error of collimation - - -	1 20 30″	Prop. log. .34948
Repeated - - - - - - - - - - - - - -		.34948
Error of observed angle	2′ 51″ *subtractive.*	P. L. 1.80093

TABLES XXVII & XXVIII.

For correcting the Latitude computed from the Latitude by Account, two observed Altitudes of the sun, and the Interval of Time between them.

The use of these tables will be sufficiently explained in the problems to exemplify tables VII and VIII, for finding the latitude by two altitudes, to which they are an appendix.

TABLE XXIX.

For computing the final effect of Parallax on the distance between the Moon and the Sun, or a fixed Star.

This table was first given by Mr. Israel Lyons, in his method of reducing the apparent distance of celestial objects to the true: it expresses the difference between the base and

Digitized by Google

hypotheneuse of a right angled spherical triangle, whose third side does not exceed 6°. Those also who use Mr. Witchell's method of reducing the distance may take the third correction from this table.

TABLES

XXX, XXXI, XXXII, XXXIII, XXXIV. XXXV, XXXVI, *XXXVII, XXXVIII, XXXIX.*

In the first of these tables are contained the Right Ascensions and Declinations of sixty-one principal fixed stars, adapted to the beginning of the year 1805. The 4th and 6th columns contain the annual Variation in right ascension and declination, arising from the precession of the equinoxes and combined with the *proper motion* † of a few of the stars: these serve to reduce the place of a star, a few years before and after the epoch of the table with tolerable accuracy. The variation in right ascension of a star is *additive* after the beginning of the year 1805, and *subtractive* before.

The stars marked with an * are those used in the Nautical Almanac.

The mean place of a star may be accurately ascertained for a future period, by applying its proper motion, and the equations from tables XXXI and XXXII, answering to the given interval. Table XXXI contains part first of the precession in right ascension, for complete years, common to all the stars. Part second of the precession in right ascension is found by multiplying the equation from table XXXII, answering to the given interval, and the right ascension of the star at the *mean interval*, by the natural tangent of its declination, and changing the sign, if the star is south of the equator. The precession in declination is found, by entering the same table with the right ascension of the star increased by 90°, and changing the sign, if the star is south. If the given interval is not found in the table, the sum of the equations answering to the years that make up the interval is to be taken. The precession in declination, answering to months and days, is found by multiplying the annual precession by the decimal from table XXXIII, answering to the given time; wherein the effect of the semi-annual equation of precession is allowed. The precession in declination, answering to months and days, is found, by taking a part of the annual precession proportional to the time. The semi-annual solar equation of northern stars in declination, is contained in the *small table* XXXIV, and the sign is to be changed, if the declination of the star is south. These two are taken from Dr Maskelyne's tables.

The Nutation of a star in right ascension and declination is found, by means of tables 34, 35, and 36, as follows:

From the right ascension of the star subtract the longitude of the moon's node; the remainder will be the argument of table xxxiv, and their *sum* ‡ will be the argument of table xxxv, Multiply the sum or difference of the corresponding equations, according as they have the same or contrary signs, by the natural tangent of the star's declination, and change the sign of the product, if the declination is south; to which apply the equation from table xxxvi, answering to the longitude of the moon's node; and the sum or difference will be the nutation in right ascension.

To each of the two first arguments, add three signs, and the sum or difference of the resulting equations, from tables 34, and 35, will be the nutation in declination.

† *Many of the fixed stars are observed to change their position with repect to the adjacent stars, and this change of place is called the* proper motion *of the stars. The* proper motion *in* 100 *years, according to Dr. Maskelyne, is of* Sirius, —1′ 3″; Castor,—28″; Procyon, —1′ 28″; Pollux,—1′ 33″; Regulus, —41″; Arcturus, —2′ 20″ *and* Attair,+57″, *in right ascension: the* proper motion *of* Sirius *in declination, in a century, is* 2′, *and that of* Arcturus 3′ 21″, *both tending to the south. All the stars, except one, in his* Catalogue of the mean right ascensions of 36 principal fixed Stars, January 1, 1790, *appear to have a proper motion in right ascension.* See La Lande's Astronomy, vol. 3, page 73 and 74.

As a necessary result of the proper motions of the stars, Dr. Herschel infers the motion of the whole solar system in absolute space: which in a great measure seems to be confirmed from his comparison of the apparent relative motions of many of the stars.

‡ *The argument both at the top of table* 35, *and the same in* Mackay's Longitude, *is by mistake printed* R. A. Star — Lon. Moon's Node, *instead of* R. A. Star + Long. Moon's node.

Digitized by Google

EXAMPLE 1.

Required the nutation of a Aquilæ in right ascension and declination, January 1, 1815.

R. A. *a* Aquilæ - 9s 25°26′ mean R. A. with 10 years variation in signs and degrees.
Long. ☽'s node 3 13 7

Remainder -	6 12 19	tab. xxxiv.	+ 8″.14	9s 12° 19′	tab. xxxiv.	— 1″.77
Sum - -	1 8 33	tab. xxxv.	— 0 .95	4 8 33	tab. xxxv	+ 0 .76
			+ 7 .19	log. 0.8567	Nut in decl.	1 .01
Declin. of *a* Aquilæ 8 23 - -		tangent - - -		9.1684		
Part first - - - - - - - - - - -			+ 1″.1	0.0251		
Part second, tab. xxxvi. to long. ☽'s node			— 16 .0			
Nutation in right ascension - - -			— 14 .9			

Tables xxxvii, xxxviii, and xxxix, for computing the aberration of a fixed star in right ascension and declination, were constructed by M. de Lambre. The aberration may be found as follows:

Subtract the sun's longitude from the right ascension of the star; the remainder will be argument of table xxxvii, and their sum will be that of table xxxviii. Now the sum or difference of the equations answering thereto, according as they have the same or contrary signs, being multiplied by the natural secant of the star's declination, will be its aberration in right ascension.

Increase the arguments of tables *xxxvii* and *xxxviii*, each by three signs; take out the corresponding equations, and the product of their sum or difference by the natural sine of the star's declination, will be part first of the aberration in declination. The equation from table *xxxix*, answering to the sum of the sun's longitude, and the declination of the star, is part second; and that from the same table, answering to the sun's longitude, diminished by the star's declination, is part third of the aberration in declination; which parts being connected according to their signs, will give the absolute aberration in declination. If the declination of the star is south, the sign of the final result is to be changed.

EXAMPLE.

Required the aberration of a Aquilæ in right ascension and declination, January 1, 1815.

R. A. of *a* Aquilæ = 9s 25° 26′, mean R. A. with 10 years variation in signs and degrees.
Sun's longitude = 9 19 36

Remainder - -	0 5 50	tab. *xxxvii.* =	— 19″.08			
Sum - - - - -	7 15 2	tab. *xxxviii.* =	— 0 .58			
			— 19 .66	- - log. - - -		1.2936
Declination of *a* Aquilæ = 8° 23′ N. - - - - - - -				log. secant - - -		0.0047
Aberration in right ascension - - - - - -			— 19 .87	- - log. - - -		1.2983
Rem. + 3 signs = 3s 5° 50′	tab. *xxxvii.* =		+ 1″.94			
Sum + 3 signs = 10 15 2	tab. *xxxviii.* =		+ 0 .58			
			+ 2 .52	- log. -		0.4014
Declin. of *a* Aquilæ = 8 23 N.		- - - -		log. sine - -		9.1637
Sun's longitude = 9s 19 36		Part 1 - -	+ 0″.37	- log. -		9.5651
Sum - -	9 27 59	tab. *xxxix.* -	— 1 .87			
Remainder -	9 11 13	tab. *xxxix.* -	— 0 .77			
Aberration in declination - - -			— 2 .27			

Digitized by Google

In computing the place of a star, its right ascension and declination at the *mean interval* is to be used. These are found by applying to the tabular place, the multiples of the annual variations answering to half the interval.

Application of the preceding rules to the computation of the apparent right ascension and declination of a fixed star.

EXAMPLE.

Required the apparent right ascension and declination of Arcturus, 12th March, 1865.

Mean R. A. Arcturus, 1805, - -	= 211° 41′ 30″	mean declination.	20° 12′ 10″ N.
Variation in 30 years, *half interval* -	+ 20 24	variation, *half interv.*	— 9 33
R. A. at mean interval - - -	212 1 54	decl. at mean inter.	20 2 37 N.

R. A. of Arcturus at beginning of 1805 - - - - -		211° 41′ 30″
Part first of precession, tab. *xxxi.* for 60 years - - - -		46 2.9
Part second of precess. tab. *xxxii.* to 212° and 60 is 635″,6 × tan. 20° 2′ is		— 3 51
† Precession for days, including the semi-annual equation - -		+ 8 .4
Proper motion of Arcturus in R. A. for 60$\frac{1}{5}$ years - - - -		— 1 24 .5
Mean R. A. 12th March 1865 - - - - -		212 22 26
Nutation per tables 34, 35, and 36 - - - -		+ 10 .6
Aberration per tables 37, 38, and 39 - - - -		+ 14 .8
Apparent R. A. of Arcturus, 12th March 1865 - - -		212 22 51 .4

Mean declination of Arcturus at the beginning of 1805, - -		20° 12′ 10″ N.
Precession in declination for 60 years, table 32 - -		— 16 57
Precession in declination for days - - - -		— 3 .3
Proper motion of Arcturus in declination for 60$\frac{1}{5}$ years - -		— 2 1
Semi-annual equation - - - - -		— 0 .4
Mean declination, 12th March, 1865 - - - -		19 53 8 .3
Nutation - - - - - - - - -		— 7 .3
Aberration - - - - - - - - -		— 11 .5
Apparent declination 12th March, 1865, - - -		19 52 49 .5

TABLES *XL, XLI, XLII, XLIII, XLIV, XLV.*

Of the Longitude and Latitude of the fixed Stars.

The first of these tables contains the mean longitude and latitude of 120 fixed stars, adapted to the beginning of the year 1800. The longitude and latitude of 34 of these stars were computed from a table containing their right ascensions, communicated by Dr. Maskelyne; and the places of the other stars were inferred from the catalogues of Messrs. Bradley and Mayer. The stars in this table are mostly zodiacal, being intended principally for ascertaining the longitude, from occultations of fixed stars by the moon.

The apparent longitude and latitude of a star may be found at any given time from its mean place, by means of the five following tables. The first of them, or table 41, contains the precession in longitude for complete years, and table 42 contains the precession for months and days. The secular equation in longitude is found, by multiplying the equation from table 43, answering to the longitude of the star, by the natural tangent of the star's latitude, and to the product, applying the constant quantity —15″.4. The equation from the same table, answering to the longitude of the star, increased by 3 signs, will be the secular equation in latitude. The equation answering to any number of years is

† *Precession for* 60 *years, tables* 31 *and* 32 - -	42′ 11″.9	
Proportion for 1 *year* - - - -	42 .2	
Table 33, *March* 12*th is* .20, *which* × 42″ *is*	8 .4	*as above.*

Digitized by Google

found by taking the proportional part of the secular equation. Table 44 contains the equation of the equinoxes in longitude, common to fixed stars and planets; and in table 45 is the aberration of points of the ecliptic in longitude: from which the aberration of a star in longitude and latitude may be found thus:

From the sun's longitude subtract that of the star; find the corresponding equation, which multiplied by the natural secant of the star's latitude, will be the aberration in longitude. Increase the former argument by 3 signs, and the equation answering thereto, being multiplied by the natural sine of the star's latitude, will be the aberration of the star in latitude.

In computing the apparent place of a star, for a proposed time, its mean longitude, as settled at some certain epoch, must be corrected by the precession of the equinoxes in longitude, answering to the interval, from tables 41 and 42; the proportional part of the secular variation, table 43; the equation of the equinoxes in longitude, table 44; and the aberration table 45. The apparent latitude is found by applying the proportional part of the secular equation, and the aberration. The proper motion of the star in longitude and latitude should also be applied.

EXAMPLE.

What is the apparent longitude and latitude of a Andromedæ, 1st June 1814?

Mean longitude of *a* Andromedæ, beginning of 1800	=	0s 11°31′26″	
Precession in longitude for 14 years, table 41	=	+ 11 42.8	
For 1st June, table 42	=	+ 20.2	
Proportional part of the secular equation, table 43	=	— 5.2	
Equation of the equinoxes in longitude, table 44	=	— 16.3	
Mean longitude, 1st June 1814		0 11 43 7.5	
Aberration, table 45		— 11.5	
Apparent longitude of *a* Andromedæ, 1st June 1814	=	0 11 42 56.0	
Mean latitude of *a* Andromedæ, beginning of 1800,	=	25 41 4.0	N
Proportional part of secular equation, table 43	=	+ 2.2	
Aberration, table 45	=	+ 7.4	
Apparent latitude of *a* Andromedæ, 1st June 1814		25 41 13.6	N

The maxima of the equations of the above tables for correcting the mean place of a star, are agreeable to the determinations of Drs. Bradley and Maskelyne. The results, as given by the French astronomers differ a little therefrom; for, according to M. de la Lande, the mean annual precession of the equinoxes in longitude is 50″.25 in the present century; and by the late calculations of M. de la Place, the combined action of the planets makes the annual advance of the equinoctial points to be 0″.2016 along the equator, and 0″.1849 along the ecliptic. Agreeable to these elements, M. de Lambre has given very full tables of the precession in right ascension and declination, in the Connoissance des Temps, for 1792.

TABLE *XLVI.*

Aberration of the Planets in Longitude.

Since the aberration of a planet or comet, is equal to its geocentric motion during the interval of time employed by light to move from the planet to the earth; if therefore, the distance of the planet from the earth, and its geocentric motion in any given time, as a day, be given, the aberration may be found. For let d denote the above distance, m the diurnal geocentric motion of the planet; then, the mean distance of the sun from the earth being assumed equal to 1, and the time employed by light to come that distance 8m. 7s.5, we shall have $1 : d ::$ 8m.7s.5 : 487s.5 $\times d$, the time employed by light to come from the planet to the earth.

Again 24h. : 487″.5 $\times d :: m : \frac{487''.5 \times dm}{24h.}$, the aberration: which when m is expressed in minutes, becomes $\frac{487''.5 \times dm}{1440.}$. Hence, the log. of the aberration in secouds, =

Digitized by Google

EXAMPLE 3.

To find the Sun's Declination the 6th May, 1807, *at* 8*h.* 16*m.* 24*s.*

Sun's declination at noon by Nautical Almanac - - - N. 16° 20′ 59″
Diff. + 16′ 53″, take half the interval.

Under 16′ against	4h. 0m.	is	5′ 20″	- - -	5 30 56‴
	8 12″	is	10 56‴		
Under 53″ against	4 0	is	17 40	- - - - -	18 16
	8 12	is	36		

Sun's declination required - - - - - - - - - - N. 16 26 48 12

EXAMPLE 4.

To find the Moon's Hor. Parallax, 6th May, 1807, *at* 8*h.* 16*m.* 24*s.*

Moon's Horizontal Parallax, at noon, Nautical Almanac - 55′ 20″ diff. + 14″
Under 14″ against 8h. 12m. is - - - - - + 10

Moon's Horizontal Parallax required - - - - 55 30

This table will serve also for any proportion where 60 is either of the given terms, by means of the right hand column under p. p.

EXAMPLE 5.

As 60′ : 53′ :: 47 : *x*.

Under 53 at the top, and in the line against 47, under p. p. is $41\frac{1}{60} = x$, or it will be the same if 47 is taken at the top, and 53 under p. p. at the right hand.

EXAMPLE 6.

As 47 : 41 :: 60′ : *x*.

Under 47	oppos. 52′ - -	is	40 44	
	oppos. 20″	is	15 40‴	
	oppos. 25‴	is	20	
x =	52 20 25		41 0 0	

Should any of the terms exceed 60, suppose it seconds, divide it sexagesimally and take the parts separately.

EXAMPLE 7.

As 60 : 53 :: 192 : *x*. 192″ = 3′ 12″

Under 53 against	3′	is	2′ 39″
	12″	is	10 36‴
x = 169 $\frac{36}{60}$ =			2 49 36

Or, multiply by the number of sixties in the third term, and find the remainder in the table, thus,

53 × 3 = - - - - - - 159
Under 53, opposite remainder 12 is 10.36

The same as before - - - - - 169.36

EXAMPLE 8.

As 60″ : 47″ :: 457 : *x*. 457 ÷ 60 = 7.37

47 × 7 = - - - - - - 329
Under 47 opposite 37 - - - - 28.59

x = - - - - - - - - - - 358

EXAMPLE 9.

As 192 : 149 :: 60′ : *x*.

Or, As 3′ 12″ : 2′ 29″ :: 60′ : *x*.

Against 3, in the right hand column, taken as minutes, and 12 as seconds, find under what top argument the sum of the two corresponding numbers will be nearest to 2′ 29″; if not exact repeat for the remainder until it is sufficiently exact, and the sum of the top arguments will be the answer, thus,

Under 46′ is	2′ 18″ & 9″ 12‴ =		2′ 27″ 12‴
Under	33″ is 1″ 39‴ & 6‴ 36⁗ =		1″ 46‴
	46 33		2 28 58
Under	45‴ - - - - -		2
x =	46 33 45		2 29 0

TABLES VII. & VIII.

Half elapsed time, Middle time, and Rising.

These tables are used in finding the Latitude, when the *latitude by account, two observed altitudes of the Sun, the interval of time between*, and *the Sun's declination* are given;

Digitized by Google

they can also be applied in the solution of many other problems, as the computation of *apparent time, the true azimuth* of an object, *the altitude and longitude of the nonagesimal*, &c.

Table VII contains the HALF ELAPSED TIME and MIDDLE TIME; their differences being the same are put in a column between both, marked D. the first is the arithmetic complement of the Log. Sine of the horary angle; the second is the Log. Sine of the horary angle +.301030: they both extend as far as 6 hours, to every tenth second of time.

Table VIII, entitled RISING, contains the Log. Versed Sine of the horary angle corresponding to every tenth second of time as far as 9 hours, with the differences; by which means every second can be taken by inspection.

These tables will be sufficiently explained in the problems for that purpose. They were first invented by Mr. Cornelis Douwes, examiner of the sea officers and pilots by the appointment of the right honourable college of admiralty at Amsterdam, who was rewarded with £50 by the Commissioners of Longitude.

In the Nautical Almanacs for 1797, 1798, 1799, and 1800, three tables were given, with rules adapted to them by the Rev. John Brinkley, Andrew's Professor of Astronomy, near Dublin, to improve this method; which are also added to these tables, being tables XXVII. XXVIII, and XXIX.

TABLES IX. & X.

The Moon's equatorial Semidiameter, in time, and its increase by the Moon's Declination.

These tables serve to find the time of the pas age of the moon's semidiameter over the meridian; which, together with the observed time of the passage of either limb will give the time of the transit of the moon's center. They were first published by Mr. Schulze, in the Berlin Ephemeris for 1779. An Example will easily explain their use.

Suppose the transit of the moon's western limb was observed at Greenwich, March 11, 1805, *at 9h. 5m. 54s. required the time of the passage of the moon's center.*

By the Nautical Almanac the moon's Hor. Par. is 58′ 52″ variation of Right Ascen. 6° 58′

Moon's Declination - N. 17° 41′			
Time of moon's western limb on the meridian - - - -	9h.	5m.	54s.
Table IX, opposite 58′ 52″, under 6° 58′ - - - - - -	+	1	6,8
Table X. opposite 17° 41′ Declin. under 68″,8 - - - -	+		3,4
Time of the moon's transit required - - - - - - -	9	7	4;2

Table IX. contains also *the Moon's Horizontal Semidiameter* corresponding to her Horizontal Parallax, and either can be taken as the side argument.

TABLE XI.

To *reduce Degrees into time, and conversely.*

This table is very useful for converting degrees and minutes of the equator, or longitude, into time, and the contrary: the method of using it is too obvious to need pointing out. The following rule may also serve independent of the table.

RULE.

Multiply *degrees* and *minutes* by 4, will produce *minutes* and *seconds* of time. And, Conversely,

Divide *minutes* and *seconds* of time by 4, will quote *degrees* and *minutes* of longitude.

TABLES XII & XIII.

These serve to reduce the difference of the mean solar times of the passage of two stars over any meridian or horary circle to degrees of the equator, and conversely; also to convert mean solar time, shown by a clock &c. into parts of the equator.

Digitized by Google

constant log. 9.5296, + the log. of the distance of the planet from the earth, + the log. c the diurnal motion of the planet in minutes, thus:

EXAMPLE.

Let the diurnal geocentric motion of an object in right ascension be 2° 36′, *the motion bein direct, and its distance from the earth* .825′, *the mean distance of the sun being* 1. *Re quired the aberration in right ascension?*

Constant logarithm - - - - - - - - -	9.5296
Distance of the object . . .825 . . .	9.9164
Geocentric diurnal motion in right ascension 2° 36′ = 156′	2.1931
Aberration in right ascension — 43″.56	1.6391

In like manner, the aberration in longitude, latitude, or declination, may be found. Th aberration of the moon in longitude does not amount to half a second.

Table 46 contains the aberration of the planets in longitude, in which all the orbits, ex cept that of Mercury, are supposed to be circular. It is given by M. de la Lande in th third volume of the third edition of his Astronomy, page 119.

When the longitude or latitude, the right ascension, or declination of a planet is in creasing, the aberration is subtractive from the mean place, to obtain the apparent; bu when the planet is moving in antecedentia, or contrary to the order of the signs; and whe it is approaching the ecliptic or equator, the aberration is additive: hence, when the pla net's motion is direct, the aberration is negative; and when retrograde, the aberration positive; and when the planet is stationary the aberration is 0.

TABLE *XLVII.*

For computing the Right Ascension of a Planet in Time.

The right ascensions of the planets may be computed from the given geocentric long tude and latitude and the obliquity of the ecliptic; or if the declination be give cos. decl. : cos. latit. :: cos. long. : cos. R. A. or else by this table computed by M. d Lambre, thus,

Reduce the geocentric longitude of the planet to time; to which apply the equation fro part 1, answering to the given longitude, expressed in signs and degrees, and the aggrega will be the longitude in time corrected.

Now multiply the equation from part II answering to the longitude in time corrected, b the latitude of the star, the sign of the latitude being + when N, and — if S; and the pr duct when the signs of the factors are like, is to be *added* to the longitude in time correcte but *subtracted* therefrom when the signs are unlike. Again, multiply the product by th equation from part III, corresponding to the declination of the object, and the last produ being added to the former quantity will be the right ascension of the object in time.

EXAMPLE.

Required the right ascension of Mercury in time, 22d December, 1804, *longit.* 9*s.* 14° 36′ *latit,* 2° 12′, S. *decl.* 24° 51′, S. (Nautical Almanac.)

	h.	m.
Geocentric longitude 9s. 14° 36′, in time	18	58.
Equation to geocentric longitude, table 47, part I . . . . . +	5.	
Geocentric longitude in time corrected	19	3.4
To which, from part II the equation is —0.44, × by lat. 2° 12′ S. = —2° .2 the product is .968 = 1.0 nearly . . . . . +	1.(	
And .968 multiplied by 0.10, the number from part III is . . +	.1	
Right ascension of Mercury in time	19	4.

Or, cos. 24° 51′ : cos. 2° 12″ :: cos. 284° 36′ (=75° 24′) : cos. 73° 53′ 2″ (=286° 6′ 58 which reduced to time is 19h. 4m. 27s.9

Digitized by Google

APPENDIX.

THE

USE AND EXEMPLIFICATION OF THE TABLES.

PROBLEM I.

To find the Time at Greenwich corresponding to a given Time under any other known Meridian.

RULE.

Turn the longitude into time, either by table XI or its rule; and if it be West add it to, or if it be East subtract it from, the estimated time at the ship, reckoned from the preceding noon, and it will give the corresponding time from noon at Greenwich.

EXAMPLE 1.

What is the time at Greenwich, when it is 6h. 15m. at the ship, 30th April, in longitude 76° 45′ West.

	h.	m.
Time at the ship, April 1, -	6	15
Longitude in time West -	+ 5	7
Add for West long. gives time from noon at Greenwich - -	11	22

EXAMPLE 2.

What is the time at Greenwich corresponding to May 1st. 5h. 46m. 39s. at Canton, whose longitude is 113° 2′ 15s. East?

	h.	m.	s.
Time at Canton, May 1, -	5	46	39
Longitude in time East	— 7	32	9
Subtract for E. long. gives time from noon at Greenw. Apr. 30	22	14	30

PROBLEM II.

The Longitude of the Ship being given, to find the R. Ascension, Declination, Longitude, Latitude, Hor. Parallax, Semidiameter, &c. of the Sun or Moon for any Time under that Meridian, by means of the Nautical Almanac.

RULE 1.

1. Find the corresponding *time from noon at Greenwich* by problem I.

2. Take from the Nautical Almanac the right ascension, declination, &c. for the preceding noon or midnight, and also the *difference* for the 24 or 12 hours following, which mark with + or — according as the right ascensions, declinations, &c. *increase* or *decrease*.

3. If the difference is for 12 hours, as in the moon's right ascensions, longitudes, &c. against the *Greenwich time from noon or midnight*, write down its *prop. log. to 12 hours* from table V, and under it the *prop. log.* of the *difference (taking hours and minutes for minutes and seconds, when judged more convenient)* the sum of these will be the prop. log. of the *increase* or *decrease*, of the right ascension, declination, &c. from the preceding noon or midnight.

4. If the difference is for 24 hours, as in the sun's declination, right ascension, &c. take the prop. log. to 12 hours of *half the Greenwich time from noon*; or, if the difference is for 6 hours (as in the moon's declinations in the American Nautical Almanacs after the year 1806) take the *prop. log. to 12 hours of double the time from the nearest given declination*; or, if the difference is for 3 hours, as in the moon's distances from the sun, &c. take

Digitized by Google

the *prop. log. to* 3 *hours* of the time from the preceding given distance; which added, as before to the prop. log. of the *difference* will give the prop. log. of the required *increase* or *decrease* from the preceding given term.

5. The same can also be done by means of table VI, taking the *difference in right ascension, declination, &c.* - - for the *top argument*, and

If the differences are for 12 hours	*the time from noon or midnight*	as the side argument.
If the differences are for 24 hours	*half the time from noon*	
If the differences are for 6 hours	*double the time from nearest term*	
If the differences are for 3 hours	*4 times the time fr. nearest term*	

EXAMPLE 1.

What is the sun's declin. May 25, 1803, *at* 10*h.* 48*m. Greenw. time.*

Sun's declination noon - N. 20° 49′ 58″
(daily diff. +10′ 51″)

h.	m.		
Half time	5	24	P. L. .34679 Tab. V.
Da. diff. 10′51″			P. L. 1.21984
Increase of decl.			P. L. 1.5663 + 4 53
Sun's declination required			N. 20 54 51

THE SAME BY TABLE VI.

Against 5h. 24m. { under +10′ is +4′ 30″ / under +51″ is + 23 }

Increase of declination - - 4 53

EXAMPLE 2.

What is the sun's decl. January 17, 1808, *at* 19*h.* 10*m.* 30*s. Greenwich time?*

Sun's declin. noon - S. 20° 54′ 47″
(daily diff. — 11′ 44″)

h.	m.	s.	
Half time	9	35	15 P. L. .09747 Tab. V.
Da. diff. —11′ 44″			P. L. 1.18585
Decrease of declin.			P. L. 1.28332 — 9 22
Sun's declination required			S. 20 45 25

THE SAME BY TABLE VI.

Agsinst 9h. 36m. { under — 11′ is — 8′ 48″ / under — 44″ is — 35 }

Decrease of declination - — 9 23

EXAMPLE 3.

What is the sun's right ascension, June 6*th,* 1804, *at* 13*h.* 48*m. in long.* 63° 10′ *E.?*

	h.	m.	s.
Time at the ship - -	13	48	
Long. 63° 10′ E. in time -	— 4	12	40
Time at Greenwich - -	9	35	20

	°	′	″
⊙'s R. A. noon - -	4	56	57
(daily diff. + 4m. 7s.)			

h.	m.	s.	
Half time	4	47	40 P. L. .39844 tab. V.
Daily diff. 4m. 7s.			P. L. 1.64073
Increase of R. A.			2.03917 - 1 39
Reduced right ascension - -			4 58 36

EXAMPLE 4.

What is the moon's hor. par. Jan. 1, 1792, *at* 11*h.* 35*m.* 41*s. in long.* 71° 23′ *west?*

	h.	m.	s.
Time at the ship - -	11	35	41
Long. 71° 23′ W. in time -	+ 4	45	32
Corresponding time at Greenw.	16	21	13

	′	″
☽'s Hor. Par. at Midn. (diff.—18″)	55	32

h.	m.		
Table VI, against 4	21	under — 18″ is	—7
Hor. Par. required - -			55 25

REMARK.

The above reductions are sufficiently accurate for most nautical purposes, but when the differences are variable, as in the moon's longitude, latitude, right ascension, &c. or to find the sun's declination to the nearest second, we may substitute the following.

Digitized by Google

RULE 2.

1. Take from the Nautical Almanac, the moon's right ascensions, longitudes, &c. with the *difference preceding* and the *difference following* the term *nearest* the required time, and mark with + or — according as the latitudes, longitudes, &c. *increase* or *decrease*; then add to the *preceding difference, half the variation of the two differences* (usually called the *second difference*) also the *half second difference*, multiplied by the ratio of the *time* to 12 hours, (which can readily be done by the pen or table VI, without referring to the table of prop. logs.) and the sum will be the * CORRECTED DIFFERENCE. (From which may also be subtracted, if judged necessary, one sixth of the mean *third difference*; but this is seldom of any value.)

2. The Prop. log. of the CORRECTED DIFFERENCE added, as in the first rule, to the prop. log. to 12 hours of the time from *noon* or *midnight*, will give the prop. log. of the increase or decrease of the moon's longitude, latitude, &c. for the required time from noon or midnight.

EXAMPLE 1.

What will be the sun's declination January 17, 1808, at 19h. 10m. 30s. Greenwich time?

By Nautical Almanac sun's decl. at noon, is S. 20° 54′ 47″ diff. c' — 11′ 20″ c'' — 24″ d' — 11′ 44″

Preceding difference	c'	— 11′ 20″
Half the *second difference*	$\frac{c''}{2}$	— 12
Table VI, against half the time 9h. 36m. and under $\frac{1}{2}c'' = -12''$, is		— 9.6
CORRECTED DIFFERENCE † (h. m.)	Sum	— 11′ 41″.6
Half the Time from noon		h. m. s. 9 55 15
$a + b$ Decrease of Sun's declination † (h. m)		— 9′ 20″
Sun's declination at noon		S. 20° 54 47
Sun's declination at 19h. 10m. 30s.		S. 20 45 27

P. L. a .01124 — P. L. b .09747 — P. L. .10871 — Q. E. I.

* *The above is the corrected* first difference, *and if very great accuracy be required the* half second difference *can also be* corrected *by adding to it, one sixth of the* mean third difference *multiplied by the proportional part of the time to the interval, which can readily be taken from table VI. and the sum substituted for the half second difference above.*

† *The prop. log. for* 11′ 41″.6 *is here taken as if it were* 11h. 41m. 36s. *in which case the result would be* 9h. 20m. *but reduced in the same proportion becomes* 9′ 20″ *corresponding to* 11′ 41″,6; *the reason of taking it as hours and minutes is to bring the computation near to the end of the table, which is always more convenient.*

EXAMPLE 2.

What is the moon's longitude, July 16, 1767, at 16h. 22m. 16s?

		s.	°	′	″		°	′	″		
July 6, 1767,	N.	11	29	29	34	c'	7	10	51	c''	— 3′ 28″
	M.	0	6	40	25	d'	7	7	23		
	N.	0	13	47	48						

Digitized by Google

		° ′ ″
Preceding difference	c'	7 10 51
Half the *second difference*	$\frac{c''}{2}$	— 1 44
Table VI, against the time 4h. 24m. and under $\frac{1}{2}c'' = -104''$ (or $52'' \times 2$) is		— 38
CORRECTED DIFFERENCE		7 8 30
Time from midnight		h. m. s. 4 22 16
$a + b$ Increase of moon's longitude in 4h. 22m. 16s.		° ′ ″ 2 36 5
Longitude by N. Almanac at	12	6 40 25
Moon's longitude at	16 22 16	9 16 30 Q. E. I.

P.L.	a	.22538
P.L.	b	.43859
P.L.		.66397

PROBLEM III.

To find the Time at Greenwich corresponding to any given Latitude, Longitude, Declination, &c. of the Moon, by means of the Nautical Almanac.

As various rules and tables have been given in most astronomical works for the solution of this problem, which is the converse to problem II; and being a necessary part in the different methods of finding the longitude, we have given the two following practical solutions; the one finding the correction of an *approximate time*; the other finding a CORRECTED DIFFERENCE, as in problem II; the prop. log. of which being subtracted from the prop. log. of the increase or decrease of longitude, &c. from the nearest given term, at noon or midnight, will give the prop. log. of the time corresponding to that increase or decrease: the RULE will be best understood by the formulæ, with an example of each method.

OPERATION.

Write down from the Nautical Almanac the *nearest* given place, and also the two preceding and two following places. Subtract each place from the following for the *first difference*, and prefix the sign — if the numbers decrease. Subtract each *first difference*, thus found, from the following one, of the same order, for the *second difference*. In like manner subtract each first *second difference* from the following one, of the same order, for the *third difference*; applying the signs as in algebraic subtraction. Also set down the difference between the *nearest term* in the Nautical Almanac and the given term, which call + or — S, as it increases or decreases.

EXAMPLE.

Suppose the *moon's longitude* was observed the 16th July, 1767, to be 0s 9° 16′ 31″, to find the time at Greenwich corresponding.

Here the *nearest term* in the Nautical Almanac is 0s. 6° 40′ 25″ at midnight, and the preceding and following terms, with the several orders of differences, are,

1767,		s.	°	′	″		°	′	″		′	″		″
July 15,	Midnight	11	22	15	35	b'	7	13	59	b''	— 3	8	b'''	— 20
16,	Noon,	11	29	29	34	c'	7	10	51	c''	— 3	28	c'''	— 16
	Midnight	0	6	40	25	d'	7	7	23	d''	— 3	44		
17,	Noon	0	13	47	48	e'	7	3	39					
	Midnight	0	20	51	27									

Let S = observed longit. — the *nearest term* = 0s. 2° 36′ 6″

M, = RATIONAL DIFF. $c' + \frac{1}{2}c'' - \frac{b''' + c'''}{12}$ = 7 9 10

N, = half the second diff. = $\frac{1}{2}c''$ = — 1 44

P, = $\frac{1}{6}$ of mean third diff. = $\frac{b''' + c'''}{12}$ = — 3

	° ′ ″
c' =	7 10 51
$\frac{1}{2}c''$ =	— 1 44
$-\frac{b''' + c'''}{12}$ =	+3
M =	7 9 10

Digitized by Google

FIRST METHOD.

	° ′ ″					
S	2 36 6	P. L. 12h	s	.66392		Table V.
M	7 9 10	P. L. 12h	m	.22470		h. m. s.
$s - m$	appro. ti.	P. L. 12h	a	.43922	A	4 21 53,1
$a - m$			b	.21452		
$-$N (h. m.)	+ 1 44	P. L. 3h	n	.23824		
$a + b + n$	1st COR.	P. L. 3h	o	.89198	O	+ 23,1

If a *second correction* should be judged necessary, then,

$b + 2a$	-	-	q	1.09296		
$* - P$ (h.)	+ 3″	P. L. 3h	p	.00000		
$q + p =$	2d COR.	P. L. 3h	r	1.09296	R	0 0 0,2
A + O + R	Time required after midnight.					4 22 16,4

$* - P = 3''$ *is here taken as* 3 *hours, in which case the result* R *would have been* $14' 32''$, *but reduced two steps becomes* $14''' 32'''' = 0',2$.

A third correction would be $q - m + 2n + 9.69897$ *; this can seldom be of any value ; but when taken* n *must be in the same table of prop. logs. as* s *and* m.

SECOND METHOD.

	° ′ ″					
S	2 36 6	P. L. 12h	s	.66392		Table V.
M	7 9 10	P. L. 12h	m	.22470	M	7° 9′ 10″
$s - m$	appro. ti.		t	.43922		
N, (h. m.)	— 1′ 44″	P. L. 3h	n	.23824		
$n + t$	1st COR.	P. L. 3h	o	.67746	O	— 37.8

If a *second correction* should be judged necessary, then,

P, (h.)	— 3″		p	.00000		
$P + 2t$	2d COR.	P. L. 3h	r	.87844	R	— 0,4
†M + O + R	COR. DIF	P. L. 12h	d	.22535	D	7 8 31,8
$s - d$ Time req. aft. midn.		P. L. 12h	t	.43857		4h. 22m. 16,6s.

† M+O+R *is* = D *the* CORRECTED DIFFERENCE, *but if the second correction be omitted it would be* M+O.

PROBLEM IV.

To find the Latitude of a Ship at Sea, from the observed meridional Altitude of the Sun's Limb.

RULE.

Take the sun's declination from page II of the Nautical Almanac, and reduce it to the time at the ship, as in problem II, from the daily difference.

Correct the observed altitude of the sun's limb, by subtracting the dip of the horizon (table C) and refraction (table A) from it, and by adding the parallax of altitude (table B) to it, also by adding to it or subtracting from it the semidiameter (p. III, Naut. Almanac) according as the lower or upper limb was observed, and you will have the true altitude of the sun's center.

Take the true altit. from 90°, and it will leave the true distance from the zenith; which is north if the zenith was north of the sun at the time of observation, but south if it was south of it.

Digitized by Google

If the sun's zenith distance and its declination be both north, or both south, add them together; but if one be north and the other south, subtract the less from the greater; and the sum or difference will be the latitude, of the same name with the greater.

N. B. The sun's meridional altitude subtracted from its distance from the pole towards which the observer's eye was directed will also give the latitude. Which is *Borda's* method.

EXAMPLE.

July 24th, 1799, longitude 54° W. the merid. alt. of the sun's lower limb was observed to be 79° 44′¼, the zenith being north of the sun, and the observer's eye 24 feet above the surface of the sea; what was the latitude?

	°	′	″
Sun's declination, N. A. -	N. 19	51	12
Da. diff.—12′51″; in 12h.—6′26″			
Tab. VI, prop. for 3h.36m. W. long.	— 1	56	
Sun's decl. in long. W. 3h.36m.	N. 19	49	16

	°	′	″
Merid. alt. of lower limb -	S. 79	44	15
Dip of horizon, table C -	— 4	49	
App. alt. of lower limb - -	79	39	26
Refraction, table A - -	—		10
Parallax, table B - -	+		2
Sun's semid. N. A. III - -	+ 15	48	
True altitude of sun's center	S. 79	55	6
True zenith distance -	N. 10	4	54
Sun's declination - -	N. 19	49	16
LATITUDE - - -	N. 29	54	10

Or, by *Borda's* method.

	°	′	″
⊙'s *South polar distance* - -	109	49	16
Merid. alt. of ⊙*'s center* -	S. 79	55	6
LATITUDE - - - -	*N.* 29	54	10

SCHOLIUM.

It has been usual to divide the rule for this problem into different cases; but the necessity for such division arose wholly from considering, improperly, the zenith of the place as a fixed point instead of the sun.

PROBLEM V.

To find the Latitude of a Ship at Sea, from the observed meridional Altitude of a fixed Star.

RULE.

Take the star's declination out of table XXX, and reduce it to the time of observation.

Correct the observed altitude of the star by subtracting the dip of the horizon (table C) and refraction (table A) from it, which will leave the true altitude. Take the true altitude from 90°, and it will leave the true distance from the zenith, which is north or south, according as the zenith was north or south of the star at the time of observation.

Then, if the zenith distance and declination be both north or both south, add them together; but if one be north and the other south, subtract the less from the greater, and the sum or difference will be the latitude, of the same name with the greater.

EXAMPLE.

September 26th, 1807, the meridional altitude of Sirius was observed to be 17° 14¼′, the zenith being north of the star, and the height of the observer's eye 21 feet: what was the latitude?

	°	′	″
Years since 1805 - -	2,75		
Yearly var. in decl. tab. XXX	+4,5″		
Product is - - -	+ 11″,825=12″		
Star's declin. table XXX	S. 16°	27′	26″
Star's declin. Sep. 26, 1807	S. 16	27	38

	°	′	″
Star's merid. alt. - -	17	14	45
Dip of horizon, table C -	— 4	43	
Refraction, table A - -	— 5	2	
Star's true altitude - -	17	7	0
Star's zenith distance -	N. 72	53	0
Star's declination - -	S. 16	27	38
LATITUDE - - -	N. 56	25	22

Digitized by Google

PROBLEM VI.

To find the Latitude of a Ship at Sea, from the observed meridional Altitude of the Moon's Limb.

RULE.

Take from the Nautical Almanac, page VII, the time of the moon's passage at Greenwich on the given day; and also the variation for the succeeding day, if the ship's longitude be west, but for the preceding day if it be east.

To the time of the moon's passage at Greenwich add the proportional part of the daily variation (by table VI or XIV) if the ship's longitude be west, or subtract if east; the sum or difference will be the time of the passage at the ship; and if the longitude in time be added to or subtracted from this time it will give the corresponding time at Greenwich; to which the moon's declination, horizontal parallax, &c. must be reduced as by problem II.

Correct the *observed* altitude of the moon's limb by subtracting the dip of the horizon (table C) from it; the remainder is the *apparent altitude* of the limb; with which and the reduced horizontal parallax, find the correction from table H, or its rule. The *apparent altitude* added to this correction; and also her semidiameter, added if the lower limb was observed, or subtracted if it was the upper limb, will give the *true altitude* of the center. Take the true altitude from 90°, and it will leave her distance from the zenith, which will be north or south, according as the zenith was north or south of the moon at the time of observation.

Then, if the zenith distance and declination be both north or both south, add them together; but if one be north and the other south, subtract the less from the greater, and the sum or difference will be the latitude, of the same name with the greater.

EXAMPLE.

April 5, 1808, longitude 174° W. the merid. alt. of the moon's lower limb was observed to be 67° 42′½, the zenith being north of the moon, and the height of the observer's eye 20½ feet; what was the latitude?

	h. m.		° ′ ″	
Moon's passage, Naut. Almanac	7 27	☽'s Hor. Par.	58 37	P. L. 0.4872.*a*
Daily variation - -	+ 52m.	Merid. alt. lo. l.	67 42 30	
Reduc. T. XIV to 174° W. long.	+ 24	Dip of horizon	— 4 28	
Time of ☽'s passage at ship	7 51	App. altitude	67 38 2	L.Cos.9.5304.*b*
Longitude in time - W.	+ 11 36			
Greenwich time -	19 27	*a—b=cor. par.	22 18	P.L. 0.9068
		☽'s semid. N. A.	+15 58	
		Refrac. tab. A.	— 25	
☽'s N. polar dist. at 18h. N.A.	77 30 0	Alt. ☽'s center	68 15 55	
- Variation in 6 h.	+ 60′			
Propor. for 1 h. 27 m. tab. VI.	+ 14 30	Zenith dist.	N. 21 44 5	
		☽'s decl.	N. 12 15 30	
☽'s N. polar dist. at 19h. 27m.	77 44 30			
☽'s declination do. -	N. 12 15 30	LATITUDE	N.33 59 35	

SCHOLIUM.

If the meridional altitude of a circumpolar star be observed when it is below the pole, or the meridional altitude of the sun or moon at midnight, in any place where it does not set; then, if to such altitude, properly corrected, there be added the polar distance of the sun, moon, or star, that is the complement of its declination, the sum will be the latitude of the place; of the same name with the declination.

* *If more accuracy be required, the horizontal parallax should be diminished, and the altitude increased, according to the supposed latitude, by table F, for the spheroidal figure of the earth, and these arguments substituted for* a *and* b, *to correct the moon's apparent altitude for parallax: this would increase the above latitude* 11″. *The moon's declination might also be calculated to seconds, from the moon's longitude, latitude, and obliquity of the ecliptic.*

Digitized by Google

PROBLEM VII.

To find the Latitude of a Ship at Sea, having the Latitude by Account, two observed Altitudes of the Sun, the Time elapsed between the Observations, measured by a common Watch, and the Sun's Declination.

RULE.

To the arith. comp. of the log. cosine of the latitude by account, add the arith. comp. of the log. cosine of the sun's declination: their sum is the *Log-ratio.*

From the natural sine of the greater altitude, taken out of table IV, subtract the natural sine of the least altitude; find the logarithm of the remainder, and write it under the log-ratio.

With half the elapsed time, enter table VII; and, from the column of half-elapsed time, take out the logarithm answering to it, which must also be put under the log-ratio.

Add these three logarithms together, and look for their sum in table VII, in the column of middle time; and, having found the logarithm nearest to it, take out the time corresponding, put it under half the elapsed time, and subtract the less from the greater: their difference will be the time from noon when the greater altitude was taken.

With this time enter table VIII, and from the column of log-rising, take out the logarithm corresponding to it: from this logarithm subtract the log-ratio, and the remainder will be the logarithm of a natural number, which being found in table I, and added to the natural sine of the greater altitude, will give the natural sine of the meridional altitude of the sun.

From the meridional altitude of the sun the latitude of the ship is to be found in the usual manner.

SCHOLIUM I.

If the latitude found by the preceding rule differ considerably from the latitude by account, the operation must be repeated, using the latitude last found instead of the latitude by account, until the result give a latitude which agrees nearly with the latitude used in the computation.

EXAMPLE 1.

July 19, 1797, latit. by account 38° 3′ N. longit. 111° W. at 0h. 30m. 15s. by my watch, the altitude of the sun's lower limb was observed to be 70° 58′; and at 1h. 26m. 28s. it was 63° 47¼′, what was the latitude? the height of the observer's eye being 20½ feet.

Altitude sun's lower limb,			First observ.		70°	58′	00″	Second		63°	47′	15″
Dip of the horizon	-	-	-		—	4	28			—	4	28
Refraction	-	-	-	-	—		19			—		28
Semidiameter	-	-	-		+	15	48			+	15	48
Sun's parallax	-	-	-		+		3			+		4
True altitude	-	-	-		71	9	4			63	58	11

Sun's declin. for noon at Greenwich (daily diff. — 11′ 40″)			N. 20° 45′ 1″
Longitude by estim. W. 111° -	in time	7h. 24m.	
mean time of observation after noon -		1 0	
Estimate time at Greenwich - -		8 24	
Correction from table VI to 4h. 12m. and — 11′ -		- -	— 3 51
to 4h. 12m. and — 40″ -		- -	— 14
Sun's declination for the given place and time -			N. 20 40 56

Digitized by Google

Registered Form for Double Altitudes.

		° ′ ″				h. m. s.		
Latitude by account	A	38 3 0 N	Ar.C. L.Cos.	a	0. 10376	Times 1 -	0 30 15	
Sun's declination -	B	20 40 56 N	Ar.C. L.Cos.	b	0. 02893	2 -	1 26 28	
$a + b$ - -		- -	Log. ratio	c	0. 13269	lap. time	0 56 13	
Greater altitude -	D	71 0 9	- -			N.Sine d'	.94637	
Lesser altitude -	E	63 58 0	- -			N. Sine e'	.89854	
$d' - e'$ and its logarithm		- -	Logarithm	f	8. 67970	f'	.04783	
		h. m. s.						
Half elapsed time -	G	0 28 6½	H. E. T.	g	0. 91244	T. VII		
$c + f + g$ mid. time	H	1 1 33	Middle time	h	9. 72483	T. VII		
H ~ G time fr. noon	I	0 33 26½	Log. Rising	i	8. 02619	T. VIII		
i — c and Nat. Num.		- -	- -	k	7. 89350	N. No. k'	.00783	
		° ′ ″						
$k' + d'$ mer. zen. dist.	L	17 24 27 N	- -		-	N. Cos. l'	.95420	
L ± B LATITUDE	M	38 5 23 N						

EXAMPLE 2.

November 20, 1796, latitude by account 50° 40′ N. longitude 87° 30′ W. at 10h. 17m. 30s. by my watch, the altitude of the sun's lower limb was observed to be 17° 4′¼, and at 11h. 17m. 30s. the altitude of the same limb was 19° 31′¾; what was the latitude? the height of the observer's eye being 19¾ feet.

		° ′ ″			° ′ ″
Alt. of sun's lower limb,	First observ.	17 4 15	Second	19 31 45
Dip of the horizon -	-	— 4 22		— 4 22
Refraction -	-	— 3 4		— 2 39
Semidiameter -	-	+ 16 15		+ 16 15
Sun's parallax -	-	+ 8		+ 8
True altitude -	-	17 13 12		19 41 7
				° ′ ″
Sun's declin. for noon at Greenwich (daily diff. + 13′ 6″)				S 19 56 52
		h. m.		
Longitude by estim. W. 87° 30′ -		in time + 5 50		
Mean time of observation before noon	-	— 1 30		
Estimate time at Greenwich -	-	4 20		
Prop. from table VI to 2h. 10m. and + 13′ 6″		-		+ 2 23
Sun's declination for the given time and place				S 19 59 15

Digitized by Google

		° ′ ″						h. m. s.	
Latitude by account	A	50 40 0 N	Ar.C. L.Cos.	a	0. 19803	Times 1	-	10 17 30	
Sun's declination -	B	19 59 15 S	Ar.C. L.Cos.	b	0. 02698	2	-	11 17 30	
$a + b$ - - -		- -	Log. ratio	c	0. 22501	Elap. time		1 0 0	
Greater altitude -	D	19 41 0	- -			N.Sine	d'	.33682	
Lesser altitude -	E	17 13 0	- -			N.Sine	e'	.29599	
$d' - e'$ and its logar.		- -	Logarithm	f	8. 61098	-	f'	.04083	
		h. m. s.							
Half elapsed time -	G	0 30 0	H. E. T.	g	0. 88430	T. VII			
$c + f + g$ Mid. time	H	1 0 54	Mid. time	h	9. 72029	T. VII			
H ~ G time fr. noon	I	0 30 54	Log. Rising	i	7. 95786	T. VIII			
$i - c$ and Nat. Num.		- - - -		k	7. 73285	N. num.	k'	.00541	
		° ′ ″							
$k' + d'$ mer. zen. dis.	L	69 59 14 N	- -			N. Cos.	l'	.34223	
L ± B LATITUDE	M	49 59 59 N	- -						

As the latitude resulting from this computation differs 40 miles from the latitude by account, the operation must be repeated, using the last found latitude instead of that by account.

		° ′ ″						
Latitude last found	M	49 59 59 N	Ar.C. L.Cos	m	0. 19193			
Sun's declination -	B	19 59 15 S	Ar.C. L.Cos.	b	0. 02698			
$m + b$ and d' -		- -	Log. ratio	c	0. 21891	-	d^0	.33682
f - -		- -	Logarithm	f	8. 61098			
		h. m. s.						
Half elapsed time -	G	0 30 0	H. E. T.	g	0. 88430	T. VII		
$c + f + g$ Mid. time	H	1 0 1	Mid. time	h	9. 71419	T. VII		
H ~ G time fr. noon	1	0 30 1	Log. Rising	i	7. 93271	T. VIII		
$i - c$ and Nat. Num.		- -		k	7. 71380	N. num.	k'	.00517
		° ′ ″						
$d' + k'$ cos. mer. Z. dist.	L	70 0 0 N	- - -			N. Cos.	l'	.34199
L ± B LATITUDE	M	50 0 45 N						

SCHOLIUM 2.

In the preceding examples it has been supposed that both altitudes were taken at the same place; but as this can seldom happen at sea, it is necessary to shew how to correct one of the altitudes so as to make it what it would have been if observed at the same place where the other was, which may be done as follows:

Digitized by Google

Let the bearing of the sun be observed by the compass, at the instant of the first observation; take the number of points between it and the ship's course, corrected for lee-way, if she makes any; with which, if less than 8 points, or with what it wants of 16 points, if more than 8, and the distance run between the observations, enter the Traverse Table, and take out the difference of latitude corresponding to them. Add this difference of latitude to the first altitude, if the number of points between the sun's bearing and the ship's course were less than 8; but subtract it from the first altitude if the number of points were more than 8, and it will be reduced to what it would have been if observed at the same place where the second was.

Note. The result of the operation will be the latitude of the ship at the time when the second altitude was taken, and must be reduced to noon by means of the log.

EXAMPLE 3.

Novem. 19, 1795, being at sea in long. $8\frac{1}{4}°$ W. and lat. 47° 34′ N. by account, at 9h. 55m, 30s. by my watch, the altitude of the sun's lower limb was observed to be 17° 24m.; and the bearing of its center by compass S. by E. $\frac{1}{4}$ E.; and at 12h. 54m. 10s. the altitude of the same limb was 21° 45′$\frac{1}{2}$; the height of the observer's eye being 19 feet. The ship's course between the observations was E. $\frac{1}{2}$ S. by the compass, at the rate of 7 knots, and she made no lee-way; what was the latitude when the latter observation was taken?

Ship's course	S. 7½ E	Sun's declination for noon at Greenwich	19° 33′ 1″ S
Sun's bearing	S. 1¼ E	(daily diff. declin. + 13′ 32″)	
		33m. W. and 35m. before noon	— 2m.
Angle between them	6¼ points	Tab. VI, prop. for + 13′ 32″ and — 1m.	— 1
And distance run	21 miles,		
Give diff. of lat.	- 7′,07	Sun's true declination - - -	19 33 0 S

		o ′ ″		o ′ ″
Alt. of sun's lower limb,	First observ.	17 24 0	Second	21 45 30
Correction for alteration of station 7,07		+ 7 4		
		17 31 4		
Dip of the horizon - -		— 4 16		— 4 16
		17 26 48		21 41 14
Refraction - - -		— 3 0		— 2 23
		17 23 48		21 38 51
Semidiameter - -		+ 16 15		+ 16 15
		17 40 3		21 55 6
Parallax - - -		+ 8		+ 8
True altitude - -		17 40 11		21 55 14

Digitized by Google

		° ′ ″						h. m. s.	
Latitude by account,	A	47 34 0	N	Ar.C. L.Cos.	a	0.17087	Times 1 -	9 55 30	
Sun's declination -	B	19 33 0	S	Ar.C. L.Cos.	b	0.02579	2 -	12 54 10	
$a + b$ - - -		- -		Log. Ratio	c	0.19666	Elap. time	2 58 40	
Greater altitude -	D	21 55 0		- -		-	N.Sine d'		.37326
Lesser altitude -	E	17 40 0		- -		-	N.Sine e'		.30348
$d' - e'$ and its logar. -		- -		Logarithm	f	8.84373	- f'		.06978
		h. m. s.							
Half elapsed time -	G	1 29 20		H. E. T.	g	0.42022	T. VII		
$c + f + g$ mid. time	H	0 33 13		Mid. time	h	9.46061	T. VII		
H ~ G time fr. noon	I	0 56 7		Log. Rising	i	8.47462	T. VIII		
$i - c$ and Nat. Num.		-		- -	k	8.27796	N. No. k'		.01897
		° ′ ″							
$k' + d'$ mer. zen. dist.	L	66 54 24	N	- -		-	N. Cos. l'		.39223
L ± B LATITUDE	M	47 21 24	N						

As the latitude resulting from this computation differs 13 miles from that by account, the operation must be repeated, using the last found latitude instead of that by account.

		° ′ ″						
Latitude last found	M	47 21 24	N	Ar.C. L.Cos.	m	0.16914		
Sun's declination -	B	19 33 0	S	Ar.C. L.Cos.	b	0.02579		
$m + b$ and d' -		- -		Log. ratio -	c	0.19493	- d'	.37326
f - - -		- -		Logarithm -	f	8.84373		
		h. m. s.						
Half elapsed time	G	1 29 20		H, E. T. -	g	0.42022	T. VII	
$e + f + g$ Mid. time	H	0 33 5		Mid. time	h	9.45888	T. VII	
H ~ G time fr. noon	I	0 56 15		Log. rising	i	8.47667	T. VIII	
$i - c$ and Nat. Num		-		- -	k	8.28174	N. No. k'	.01913
		° ′ ″						
$d' + k'$ mer. zen. dist.	L	66 53 48	N	-			N. Cos. l'	.39239
L ± B LATITUDE	M	47 20 48	N					

EXAMPLE 4.

May 3, 1795, being at sea, in longitude $6\frac{1}{4}°$ W. and latitude 27° 20′ S. by account, at 0h. 19m. 14s. by my watch, the observed altitude of the sun's lower limb was 47° 1′, and the azimuth of its center by compass, N. N. E. $\frac{1}{4}$E.; and at 1h. 14m. 39s. the observed altitude of the same limb was 44° $6'\frac{1}{2}$. The ship's course between the observations was N. by W. $\frac{3}{4}$ W. on the starboard tack, at the rate of 6 knots, and she made $\frac{3}{4}$ of a point lee-way; what was the true latitude, the height of the observer's eye being $19\frac{3}{4}$ feet?

Digitized by Google

Ship's course - N 1¾ W
Lee-way - ¾
Ship's course corr. N 2½ W
Sun's bearing - N 2¼ E
Angle between them 4¼ points
Distance run - 5,5 miles
Give diff. of lat. 3,28 = 3′17″

Sun's declin. for noon at Greenwich - 15 44 46 N
(daily diff. declin. + 16′ 0″)
47m. after noon, & 25m. W. long. is + 72m.
Tab. VI, prop. for 36m. and + 16′ - + 48
Sun's true declination - - 15 45 34 N

Altitude of sun's lower limb, First observ. 47° 1′ 0″ Second 44° 6′ 30″
Correction for difference of ship's station - + 3 17

	First	Second
	47 4 17	
Dip of the horizon - - -	— 4 22	— 4 22
	46 59 55	44 2 8
Refraction — Parallax - -	— 47	— 52
	45 59 8	44 1 16
Semidiameter - - -	+ 15 54	+ 15 54
True altitude - - -	47 15 2	44 17 10

		° ′ ″				h. m. s.	
Latitude by account	A	27 20 0 S	Ar.C. L.Cos.	a	0.05142	Times 1 -	0 19 14
Sun's declination -	B	15 45 34 N	Ar.C. L.Cos.	b	0.01664	2 -	1 14 39
a + b - -		- -	Log. Ratio	c	0.06806	Elap. time	0 55 25
Greater altitude -	D	47 15 0	- -			N. Sine d′	.73432
Lesser altitude -	E	44 17 0	- -			N. Sine e′	.69821
d′ — e′ and its logar.		- -	Logarithm -	f	8. 55763	- f′	.03611
		h. m. s.					
Half elapsed time	G	0 27 42½	H. E. T. -	g	0. 91863	T. VII	
c + f + g Mid. time	H	0 40 20½	Mid. time	h	9. 54432	T. VII	
H ~ G time fr. noon	I	0 12 38	Log. rising	i	7. 18150	T. VIII	
i — c and Nat. Num.		-	- -	k	7. 11344	N.No. k′	.00130
		° ′ ″					
k′ + d′ mer. zen. dist.	L	42 38 25 S	- -			N. Cos. l′	.73562
L ± B LATITUDE	M	26 52 51 S					

As the latitude resulting from this computation differs 27′ from the latitude by account, the operation must be repeated, using the last found lat. instead of the lat. by account.

		° ′ ″					
Latitude last found	M	26 52 51 S	Ar.C. L.Cos.	m	0. 04966		
Sun's declination -	B	15 45 34 N	Ar.C. L.Cos.	b	0. 01664		
m + b and d′ -		- -	Log. ratio	c	0. 06630	N.Sine d′	.73432
f - - -		- -	Logarithm	f	8. 55763		
		h. m. s.					
Half elapsed time	G	0 27 42½	H. E. T.	g	0. 91863	T. VII	
e + f + g Mid. time	H	0 40 10½	Mid. time	h	9. 54256	T. VII	
H ~ H time fr. noon	I	0 12 28	Log. Rising	i	7. 16992	T. VIII	
i — c and Nat. Num.		-	- -	k	7. 10362	N. No. k′	.00127
		° ′ ″					
d′ + k′ mer. zen. dist	L	42 38 35 S	- -			N. Cos. l′	.73559
L ± B LATITUDE	M	26 53 1 S					

Digitized by Google

SCHOLIUM 3.

When the latitude and declination are of the same name, and the latitude greater than the complement of the declination, the sun's altitude may be observed on the meridian, below the pole at midnight: or the latitude may be found by two altitudes of the sun, taken either before or after midnight, its declination, the latitude by account, and the time which elapses between the observations, in a manner scarcely different from that which has been already given for finding it when the altitudes are taken before, or after noon; for the three first articles of the rule are exactly the same. And having added the three logarithms together, found the middle time corresponding to the sum, and taken the difference between it and the half-elapsed time, that difference will be the time from midnight when the less altitude was observed.

With this time enter table VIII, and from the column of Log. Rising, take the logarithm corresponding to it: from this logarithm subtract the log-ratio, and the remainder will be the logarithm of a natural number, which being found in table I, and subtracted from the natural sine of the *least* altitude, will give the natural sine of the meridional altitude of the sun below the pole.

To the meridional altitude of the sun add the complement of its declination, and the sum will be the latitude; subject, however, to the caution given in Scholium I.

EXAMPLE 5.

June 10th, 1795, latitude by account 81° 30′ N. longitude 36¼° E. at 9h. 33m. 8s. by my watch, the altitude of the sun's lower limb was observed to be 16° 3′¼; and at 11h. 16m. 48s. the altitude of the same limb was 14° 36′¼, the height of the observer's eye being 17 feet above the surface of the sea: what was the true latitude of the ship?

		° ′ ″
Sun's declin. at Greenwich	N	23 2 45
(daily var. + 4′ 24″		
Longit. E. 36¼° is —	2h. 25m.	
Time of obs. af. N. +	10 25	
Time at Greenwich +	8 0	
T. VI. prop. for 4h. 0m. & 4′24″		1 28
Sun's true declination	-	23 4 13

	° ′ ″		° ′ ″
First alt. -	16 3 15	2d alt.	14 36 15
Dip -	— 4 3		— 4 3
⊙'s app. alt.	15 59 12		14 32 12
Refrac.— Par.	— 3 9		— 3 28
	15 56 3		14 28 44
⊙'s semid.	+ 15 48		+ 15 48
⊙'s true alt.	16 11 51		14 44 52

Form for Double Altitudes below *the Pole.*

		° ′ ″			h. m. s.
Latitude by account	A	81 30 0 N	Ar.C. L,Cos.	*a* 0.83030	Times 1 - 9 33 8
Sun's declination -	B	23 4 0 N	Ar.C. L.Cos.	*b* 0.03619	2 - 11 16 48
a + *b* - -		- -	Log. Ratio	*c* 0.86649	Elap. time 1 43 40
Greater altitude -	D	16 12 0	- -		N.Sine *d′* .27899
Lesser altitude -	E	14 44 30	- -		N.Sine *e′* .25446
d′ — *e′* and its logar.		- -	Logarithm	*f* 8.38970	- *f′* .02453
		h. m. s.			
Half elapsed time	G	0 51 50	H. E. T.	*g* 0.64928	T. VII
c + *f* + *g* Mid. time	H	1 34 52	Mid. time	*h* 9.90547	T. VII
H ~ G time fr. midn.	I	0 43 2	Log. Rising	*i* 8.24494	T. VIII
i — *c* and Nat. Num.		- -	- - -	*k* 7.37845	N. No. *k′* .00239
		° ′ ″			
e′ — *k′* mer. alt. -	L	14 36 0			- N. Sine *l′* .25207
Comp. declin. -	M	66 56 0			
L + M LATITUDE	N	81 32 0 N			

Digitized by Google

Remark 1. The operation is the same whether the sun hath north or south declination: and also whether the ship be in north or south latitude.

Remark 2. When the sun hath no declination, the arith. comp. of log. cosine of the latitude will be the *log-ratio.*

Remark 3. The observations must always be taken between nine o'clock in the morning and three in the afternoon; and the nearer the greater altitude is to noon the better.

Remark 4. If both observations are in the forenoon, the interval must not be much less than half the distance of the first observation from noon.

Remark 5. If both observations are in the afternoon, the interval between them must not be much less than the distance of the first observation from noon.

Remark 6. If one observation be in the forenoon, and the other in the afternoon, the interval must not exceed four hours and a half.

Remark 7. The above limitations are founded on a supposition that the sun's meridional zenith distance is not less than the latitude of the place; but if the latitude of the place should be double the sun's meridional zenith distance, the first of two altitudes taken in the forenoon must not be before half past nine, nor the second before three quarters past ten. The first of two taken in the afternoon must not be later than a quarter past one, nor the second after half past two. If one be taken in the morning and the other in the afternoon; that in the morning must not be taken before half past nine o'clock, and the interval between them must not exceed three hours and a half.

Remark 8. If the latitude of the place be three times the sun's meridional zenith distance, the first of two observations taken in the forenoon must not be before ten o'clock, nor the second before eleven. The first of two observations taken in the afternoon must not be later than one o'clock, nor the second after two. If one observation be taken in the forenoon, and the other in the afternoon; that in the morning must not be before ten, and the interval between them must not exceed three hours.

Remark 9. If the latit. be five times the sun's merid. zenith distance, the first of two observations taken in the forenoon must not be before half past ten o'clock, nor the second before a quarter after eleven. The first of two taken in the afternoon must not be later than three quarters past twelve, nor the second later than half past one o'clock. If one be taken in the forenoon, and the other in the afternoon, the morning one must not be before half past ten, and the interval between them must not exceed two hours and a quarter.

Remark 10. This method should never be used when the sun passes the meridian within two degrees of the zenith.

If the preceding remarks be attended to, the latitude found by the calculation will be, at least, five times nearer the truth than the latitude by account; that is, the error in the computed latitude will not be above a fourth part of the difference between them: and hence a judgment may be formed whether it will be necessary to repeat the computation with the latitude last found, or not.

PROBLEM VIII.

To correct the Latitude found by the last Problem, after one Computation.

INTRODUCTION.

The latitude may generally be found from two observed altitudes of the sun and the interval of time between them by one operation, as directed in the foregoing problem; but when the computed latitude differs five minutes, or more, from the latitude by account; instead of repeating the operation, as is directed to be done there, it is here proposed to correct it by tables XXVII and XXVIII; as the operation will not only be more concise, but will produce a true result in cases where the other fails, on account of the computed latitudes not approaching nearer and nearer to the true latitude, or not approximating toward it sufficiently fast.

Digitized by Google

RULE.

From the two observed altitudes of the sun, its declination, the elapsed time, and the latitude by account; compute the latitude by problem VII.

With the sun's declination and the computed latitude take the number from table XXVII; and take the sum of this number and unit when the latitude and declination are of different names: but take the difference between this number and unit when the latitude and declination are of the same name, and call the sum or difference A.

With the time from noon when the greater altitude was taken at the top, and the middle time in the side column, take the number from T. XXVIII, according as the observations are on the same or different sides of noon; divide A by this number, and call the quotient B.

When the observations are on the same side of noon, and the declination of a different name from the latitude, or being of the same name, is less than the latitude:—also when the observations are on different sides of noon, and the declination of the same name with the latitude, but greater than it, add unit to B, and divide the difference between the computed latitude and latitude by account by the sum; the quotient will be the correction of the computed latitude: to be added to it when the computed latitude is less than the latitude by account; but subtracted from it when it is greater.

When the observations are on the same side of noon, and the declination is of the same name with the latitude, but greater than it:—or, when the observations are on different sides of noon and the declination is either of a contrary name to the latitude, or of the same name, and less than it, take the difference between B and unit, and divide the difference between the computed latitude and latitude by account by it: the quotient will be the correction of the computed latitude; to be applied to it according to the following rules.

B { greater / less } than 1, and computed latit. { greater / less } than the latit. by acc. *add.*

B { greater / less } than 1, and computed latit. { less / greater } than the latit. by acc. *subtract.*

Note. The observations are on the same, or different sides of noon or midnight, according as the middle time is greater or less than half the elapsed time.

EXAMPLE 1.

Let the first altitude be 41° 33′ 12″, the second 50° 1′ 12″ (both in the morning); the interval between them 1h. 30m. the latitude by account 52° 50′ N, and the sun's declination 14° 0′ N.

By problem VII the computed latitude will be 52° 2′ 17″ N. the middle time 1h. 47m, and the time nearest noon 1h. 2m.

	°	′	″			
Sun's declination	14	0	0	N	in table XXVII, give - -	0,19
Computed latitude	52	2	17	N		1,00
Latitude by acc.	52	50	0	N	- - - Difference	0,81 = A

Difference - 47 43 = 47′,7

Time nearest noon 1h. 2m.
Middle time - 1 47 } in table XXVIII give ,098. And ,81 ÷ .098 = 8,27 = B

Add 1

Divisor 9,27

Then 47′,7 ÷ 9,27 = 5′,15 = + 5′ 9″ the correction of the computed latitude.

Computed latitude -	52°	2	17	N
True latitude -	52	7	26	N

Digitized by Google

EXAMPLE 2.

Let the first altitude be 50° 1′ 12″, before noon; the second 41° 33′ 12″, afternoon; the interval between them 3h. 30m. the latitude by account 51° 30′ N. and the sun's declination 14° 0′ N.

By problem VII the computed latitude will be 52° 4′ 24″ N. the middle time 44′ 28″, and the time nearest noon 1h. 0m. 32″.

Sun's declination	14	0	0 N	in table XXVII give - -	0,19
Computed latitude	52	4	24 N		1,00
Latit. by account	51	30	0 N	- - - - Difference	,81 —A

Difference - 34 24 = 34′,4
Time nearest noon 1h. 0′32″ } in tab. XXVIII give 0,086. And, 81÷.086 = 9,42 = B
Middle time - 0 44 28 }
Subtract 1
Divisor 8,42

Then 34,4 ÷ 8,42 = 4′,09 = + 4′ 5″ the correction of the computed latitude.
Computed latitude - 52 4 24 N

True latitude - 52 8 29 N

EXAMPLE 3.

Let the first altitude be 70° 2′, the second 35° 21′, both in the morning, the interval between them 2h. 20m. the latitude by account 6° 30′ N. and the sun's declination 5° 30′ N.

By problem VII the computed latitude will be 8° 5′ N. the middle time 2h. 29m. 37s., and the time nearest noon 1h. 19m. 37s.

Sun's declination	5	30		in table XXVII give - - - -	0,68
Computed latit.	8	5			1,00
Difference -	1	35	= 95′	- - - - Difference	0,32 = A
Ti. near. noon 1h. 19m. 37s.				in table XXVIII give ,2. And ,32÷,2 = -	1,6 = B
Middle time	2	29	37	Add -	1,
				Divisor	2,6

Then 95′ ÷ 2,6 = 36′,54 = —36′ 32″ the correction of the computed latitude.
Computed latitude - 8° 5 0 N.

Corrected latitude - 7 28 28 N. which if repeated, as in problem VII, would be 7° 29′ 0″, differing only ½ minute.

SCHOLIUM.

When the latitude has been computed from two altitudes of the sun, taken either on the same, or on different sides of midnight, as in the third scholium to problem VII: take the sum of unit and the number from table XXVII for the number A.

With the time from midnight when the less altitude was taken at the top, and the middle time in the side column, take the number from table XXVIII, according as the observations are on the same or different sides of midnight, divide A by this number, and call the quotient B.

When the observations are on the same side of midnight add unit to B, and divide the difference between the computed latitude and the latitude by account by the sum; the quotient will be the correction of the computed latitude: to be added to it when the com-

Digitized by Google

puted latitude is less than the latitude by account, but subtracted from it when it is greater.

When the observations are on different sides of midnight, take the difference between B and unit, divide the difference between the computed latitude and the latitude by account by it, and the quotient will be the correction of the computed latitude: to be applied to it according to the following rules:

B { greater / less } than 1, and computed latit. { greater / less } than the latit. by acc. *add.*

B { greater / less } than 1, and computed latit. { less / greater } than the latit. by acc. *subtract.*

EXAMPLE 4.

Let the first altitude be 16° 12′, the second 14° 44′ 30″, both before midnight, the interval between them 1h. 43m. 40s, the latitude by account 80° 41′ N. and the sun's declination 23° 4′ N.

By problem VII the computed latitude will be 81° 34′ 34″ N. the middle time 1h. 26m. 11s. and the time nearest midnight 0h. 34m. 21s.

	°	′	″			
Sun's declination	23	4	0 N	} in table XXVII, give	-	0,07
Computed latit.	81	34	34 N		Add -	1,00
Latitude by acc.	80	41	0 N	- - -	Sum -	1,07 = A
Difference -		53	34 = 53′,57			

Ti. near. noon 0h. 34m. 21s. } in table XXVIII give ,047. And 1,07 ÷ ,047 = 22,8 = B
Middle time 1 26 11 }

Add 1,0

Divisor 23,8

Then 53′,57 ÷ 23,8 = 2′,25 = — 2′ 15″ the correction of the computed latitude.
Computed latitude - - 81° 34′ 34″ N.

True latitude - - 81 32 19 N.

CAUTIONS.

1. When the latitude by account and that computed differ more than two degrees, or when the declination and latitude are nearly equal, and of the same name; after the computed latitude has been corrected by this method, it may be proper for the sake of safety, to repeat the operation directed by problem VII, using the latitude, once corrected, by this method, as the latitude by account, and then correcting the latitude, re-computed, by these tables, if it be necessary.

2. In high latitudes, when the middle time is more than three hours, and the latitude by account very erroneous, it will also be prudent to repeat the operation directed by problem VII, using the latitude once corrected by this method as the latitude by account, and then correcting the last-found latitude by these tables, if it be necessary.

3. When B happens to be nearly equal to unit, and their difference is to be taken for a divisor of the difference between the computed latitude and the latitude by account; or when the latitude and declination (of the same name) are so nearly equal that it is uncertain whether the true latitude be greater or less than the declination, this method cannot be depended on.

GENERAL OBSERVATION.

Except in the particular cases above mentioned, it is unnecessary to use a second operation: however, as a second operation, using the latitude corrected for the latitude by account, will always be a check upon the first, it is recommended, in general, to use a second operation, as a satisfactory proof that no mistake has been made in the first.

Digitized by Google

PROBLEM IX.

To find the Latitude by two observed Altitudes of the Sun, the Time elapsed between the Observations, measured by a common Watch, and the Sun's Declination, without a supposed Latitude.

EXAMPLE.

Given two observed altitudes of the sun 17° 15′, and 19° 41′; the elapsed time 1 hour, and the sun's declination S. 20°; to find the latitude.

	Sun's polar dist.	A	110	0	0	L. Cos.	a	9.534052	L.Sine a'	9.972986
	angle of ½ elap. time	B	7	30	0	L. tang.	b	9.119429	L.Sine b'	9.115698
*1	$a+b-10$	C	92	34	42	Co-tang	c	8.653481		
	$a'+b'-10$	D	7	2	43	- -		-	L.Sine d'	9.088684
	2 D	E	14	5	26	Ar.C. L.Sine	e	0.613581		
	Greater altitude	F	19	41	0	Ar.C. L.Cos.	f	0.026148		
	Less altitude	G	17	13	0					
	E + F + G	H	50	59	26					
	½ H	I	25	29	43	L. Cos.	i	9.955505		
	I ~ G	K	8	16	43	L. Sine	k	9.158322		
	$e+f+i+k$			-		- -	l	19.753556		
	½ l	M	48	51	0	L. Sine	m	9.876778		
	2 M	N	97	42	0					
*2	N ~ C	O	5	7	18	L. Cos.	o	9.998263		
	Greater altitude	P	19	41	0	L. Co-tang.	p	10.446452	L.Sine p'	9.527400
	$o+p-10$	Q	70	14	38	L. tang.	q	10.444715	A.C.Cos. q'	0.471062
*3	A ~ Q	R	39	45	22	log. tang.	r	9.920056	L. Cos. r'	9.885805
	LATIT. $p'+q'+r'-10$	S	50	0	9	log. tang.	s	10.076224	L.Sine s'	9.884267
	Angle of F fr. noon	$s+r$	7	30	0	L. Cos.		9.996280	= 30m.	from noon.

*1 *Set down the supplement when* A *exceeds* 90°.

*2 *Subtract unless when the latitude exceeds* A.

*3 *Subtract unless when* O *exceeds* 90°.

PROBLEM X.

Given equal Altitudes of the Sun or a Star observed the same Day, the Interval of Time between the Observations, and the Sun or Star's Declination to find the Latitude.

EXAMPLE.

In north latitude at 11h. 10m. and at 12h. 40m. per watch, (*interval* 1h 30m.) the altitude of the sun's limb, corrected, was 26° 55′, and the sun's declination was 5° 17′ S. at noon; required the latitude.

	Sun's declin.	A	5°	17′	0″	L. Tang.	a	8.96602	L. Sine a'	8.96417
	½ interv. 45m. =	B	11	15	0	L. Cos.	b	9.99157		
	Altitude observed	C	26	55	0	- -			L. Sine c'	9.65580
	$a-b$	D	5	23	0	L. Tang.	d	8.97445	L. Sine d'	8.97229
	$c'+d'-a'$	E	62	32	0	- -			L. Cos. -	9.66392
*	LAT. E ± D	F	57	9	0					

* *If the latitude and declination are of the same name, take the* sum, *but if of contrary names the* difference. *(For the correction of equal altitudes near noon, see under problem* XVI.*)*

Digitized by Google

PROBLEM XI.

Given three Altitudes of the Sun's Limb, taken near Noon, *at* equal *Intervals of Time, to find the* MERIDIAN ALTITUDE.

EXAMPLE 1. *Interval* 15 *minutes.*

Suppose that three altitudes of the sun's lower limb were taken at 15 minutes interval *near noon*:—as follows.

Time by watch. h. m.		Altitudes. ° ′ ″		Differences. ′ ″		Sum or differ. ′ ″	
11 56	A	59 55 0	B ~ A	*a*	3 40	*b* ± *a* = E	22 20
12 11	B	59 58 40	C ~ B	*b*	18 40	(*When* B *is the greatest altit.*	+,
12 26	C	59 40 0	C ~ A	*D*	15 0	*otherwise*	-, ~)

Then 2E : ½D :: ½D : correction of altitude B for meridian altitude.
and 2E : ½D :: double interval : time from noon of alt. B (*before* noon when A is *less* than C) which may be worked by the pen, Gunter's scale, or thus, by *prop. logarithms.*

2 E	44 40	P. L.	*e*	.6053	(*When* A *is less than* C, B *is* before *noon.*)
½ D	7′ 30″	P. L.	*d*	1.3802	
d — *e*	-	-	*f*	.7749	
f + *d* = G	1 16	P. L.		2.1551	B + G = MERID. ALT. 59° 59′ 56″
double int.	30m.	P. L.	*h*	.7781	(*of sun's lower limb.*)
f + *h* = I	5m. 2s.	*P. L.*		1.5530	I = Time *after* noon of alt. B, 5m. 2s.

EXAMPLE 2. *Interval* 25 *minutes.*

Time by watch. ° ′		Altitudes. ° ′ ″		Differences. ′ ″		Sum or Diff. ′ ″	
12 0	A	60 0 0	B ~ A	*a*	11 15	*b* ± *a* = E	21 45
12 25	B	59 48 45	C ~ B	*b*	33 0	(*when* B *is the greatest alt.*	+,
12 50	C	59 15 45	C ~ A	D	44 15	*otherwise*	- ~)

2 E	43 30	*P. L.*	*e*	.6168	
½ D	22′ 7″½	*P. L.*	*d*	.9107	
d — *e*	-	-	*f*	.2939	
f + *d* = G	11 14	*P. L.*		1.2046	B + G = MERID. ALT. 59° 59′ 59″.
double int.	50m.	*P. L.*	*h*	.5563	
f + *h* = I	25m. 24s.	*P. L.*		.8502	I = time *after* noon of altit. B 25m. 24s

EXAMPLE 3. *Interval* 30 *minutes.*

Time by watch. h. m.		Altitudes. ° ′ ″		Differences. ° ′		Sum or Diff. ° ′	
11 0	A	66 20 0	B ~ A	*a*	2 47	*b* ± *a* = E	1 46
11 30	B	69 7 0	C ~ B	*b*	1 1	(*where* B *is not greatest* ~)	
12 0	C	70 8 0	C ~ A	D	3 48		

2 E	3 32	*P. L.*	*e*	.5310	
½ D	1° 54′	*P. L.*	*d*	.8004	
d — *e*	-	-	*f*	.2694	
f + *d* = G	1 1 20″	*P. L.*		1.0698	B + G = MERID. ALT. 70° 8′ 20″
double int.	60m.	*P. L.*	*h*	1.0792	
f + *h* = I	32m. 12s.	*P. L.*		1.3486	I = time *before* noon of alt. B. 32m. 12s.

Digitized by Google

PROBLEM XII.

Given three *Altitudes of the Sun's Limb, taken* near Noon, *at* unequal *intervals of Time; to find the MERIDIAN ALTITUDE.*

EXAM. 1. Suppose the following alts. and the *intervals* 29m. & 42m.

Interv.		Altitudes.	Diff.	Int.								
m.												
p 29	A	54° 7	128′½ ÷ 29	a	4′.451	$\frac{c}{p+q}$	D	0′.032	log.	d	8.5060
q 42	B	56 15½	90′½ ÷ 42	b	2.155						
	C	57 46	1§ $b \pm a$	c	2.276	D × p	E	0.928			
1§ *If* B *is greatest* +, *otherwise* ∼.						2§ $a \pm$ E	F	5.359			
2§ *When* B *or* C *is greatest* +, *otherwise* ∼.						½F	G	2.680	log.	g	0.4281
H = minutes *bef.* noon of alt. A = 1h. 23,6m.						$g - d$	H	83,6m.	log.	h	1.9221
A + I = MERID. ALT. 57° 51′						$h + g$	I	224′	log.	i	2.3502

EXAMPLE 2. *Intervals* 44m. *and* 32m.

Interv.		Altitudes.	Diff.	Int.							
m.											
p 44	A	46° 41′	14′ ÷ 44	a	0′.3182	$\frac{c}{p+q}$	D	0′.0394	log.	d	8.5955
q 32	B	46 27	106 ÷ 32	b	3′.3125						
	C	44 41	1§ $b \pm a$	c	2.9943	D × p	E	1.7336 ‡			
1§ *When* B *is greatest* +, *otherwise* ∼.						2§ $a \pm$ E	F	1.4154			
2§ *When* B *or* C *is greatest* + *otherwise* ∼						½F	G	0.7077	log.	g	9.8498
H = 18min. altitude A *before noon*						$g - d$	H	18m.	log.	h	1.2543
A + I = MERID. ALT. 46° 53′,6.						$h + g$	I	12,6	log.	i	1.1041

These methods, may be frequently useful at sea when the time at noon has been cloudy or been neglected, as it depends but little on the goodness of the watch, and nothing on its rate of going; and if more altitudes are taken, the result may be compared, and a mean taken: this method being shorter than double altitudes is frequently preferable.

REMARKS.

‡1. When E exceeds a; A and B are on *different* sides of noon, and it is always to be preferred to have an altitude on each side of noon.

2. The nearer the sun passes the zenith, the nearer should the observations be taken to noon: generally the greatest horary angle should not exceed half the meridional zenith distance; but the differences between the observed altitudes should be sensibly greater than the errors which may be committed in the observations, and the intervals of time may be from 10 to 30 minutes.

3. Without logars. G ÷ D = H; and H × G = I. If the altitudes are taken to exact minutes of time, as in all these examples, it will make the operation more easy.

4. To prove the operation, if D × q be put for E, and $b \pm$ E for F (which is the same as making C the first term) the merid. alt. will be C + I, the same as before, if rightly done; in the second example I would be found 132′,6, or 2° 12′,6, the correction of altitude C.

PROBLEM XIII.

To find the LATITUDE and DECLINATION from three *observed Altitudes at* equal *given Intervals of Time, at any Distance from Noon.*

EXAMPLE 1.

Suppose the following altitudes were observed, and the *interval* of time was 26 minutes between each, = 6° 30′, *horary angle.*

Digitized by Google

		° ′ ″					
First altitude A	73 22 0	N. Sine	a	.95816	$c \sim a$	D	.03421
Second altitude A′	78 50 0	N. Sine	b	.98107	$c \sim b$	e	.01130
Third altitude A″	82 55 0	N. Sine	c	.99237	D ± 2 e	G	.01161 *1
G H	.01161	Log.	h	8.06483			
D I	.03421	Log.	i	8.53415			
	° ′ ″						
½ *horary ang.* K	3 15 0	L. Tang.	k	8.75423			
$k + i - h$ L	9 30 0	L. Tang.	l	9.22355	Mid. hor. angle *bef. noon.* *2		
	h. m. s.				h. m.		
Time of L M	0 38 0	½ el. time	m	0.78239	0 38 Ti. *bef. noon* midd. Alt.		
Interval N	0 26 0	½ el. time	n	0.94614	26 interval + and —		
$n + m + i$ O	1.83100	Log.	o	0.26268	1 4 time *bef. noon* 1st Altit.		
	° ′ ″				0 12 time *bef. noon* 3d Altit.		
§. ½ L P	4 45 0	L. Sine	p	8.91807			
$2p + o$ Q	.01255	Log.	q	8.09882			
				° ′ ″			
Q + b R	.99362	N. Sine	r	83 32 0	MERIDIAN ALTITUDE.		
O — R S	.83738	N. Sine	s	56 52 0	MIDN. DEPRESSION.		
½ $r + s$ T	COMPL. DECLIN.			70 12 0			
*3 ½ $r - s$ U	LATITUDE - -			13 20 0			

EXAMPLE 2.

The following altitudes were observed, with an interval of 2h. 16m. between each, or 34° 0′, horary angle; required the Latitude and the Declination.

		° ′ ″					
First altitude A	41 53 0	Nat. Sine	a	.66762	$c \sim a$	D	.03825
Second altitude A′	50 23 30	Nat. Sine	b	.77042	$c \sim b$	e	.06455
Third altitude A″	44 54 0	Nat. Sine	c	.70587	D ± 2 e	G	.16735 *1
G H	.16735	Log. -	h	9.22363			
D I	.03825	Log. -	i	8.58263			
	° ′ ″						
½ *horary ang.* K	17 0 0	Log. Tang.	k	9.48534			
$k + i - h$ L	4 0 0	Log. Tang.	l	8.84434	Mid. hor. ang. *bef.* noon *2		
	h. m. s.				h. m.		
Time of L M	0 16 0	½ el. time	m	1.15642	0 16 Ti. *before* noon mid. alt.		
Interval N	2 16 0	½ el. time	n	0.25244	2 16 interval + and —		
$n + m + i$ O	.98060	log. -	o	9.99149	2h. 32m. *before* noon 1st alt.		
	° ′ ″				2h. 0 *after* noon 3d altit.		
§ ½ L P	2 0 0	log. Sine	p	8.54282			
$2p + o$ Q	.00119	log. -	q	7.07713			
				° ′ ″			
Q + b R	.77161	Nat. Sine	r	50 30 0	MERIDIAN ALTITUDE		
O — R S	.20899	Nat. Sine	s	12 4 0	MIDN. DEPRESSION.		
½ $r + s$ T	COMPL. LATITUDE			31 17 0			
*3 ½ $r - s$ U	DECLINATION			19 13 0			

REMARK.

§ Instead of P, (2° 0′,) or half the middle horary angle, half of either of the extreme horary angles (as 38° or 30°,) may be used; and then Q + a, or Q + c will give the same meridional altitude.

*1 *When the third altitude is the greatest or least, take the difference, otherwise the sum.*

*2 *When the first altitude exceeds the third, the middle altitude is* after *noon.*

*3 *When the zenith is between the sun and equator, the* half sum *is the complement of the* declination, *and the* half difference *the* latitude; *otherwise the* half sum *is the* co-latitude, *and the* half difference *the* declination.

Digitized by Google

PROBLEM XIV.

To find the LATITUDE and DECLINATION from three *observed Altitudes, at* unequal *Intervals of Time, and any distance from noon.*

EXAMPLE 1.

Let the intervals of time be 40m. and 50m. = 10° and 12° 30′ horary angle, and the altitudes 57° 23′, 55° 0′, and 49° 55′; required the *Latitude* and *Declination*.

		° ′		° ′								
1st inter.	a	10 0	A	57 23	N. S.	*A*	.84230	*C* ~ *A*	.07719	Log.	*b*	8.88756
2d inter.	b	12 30	B	55 0	N. S.	*B*	.81915	*C* ~ *B*	.05404	Log.	*c*	8.73271
a + b	c	22 30	C	49 55	N. S.	*C*	.76511	*D*	11° 15′	L. S.	*d*	9.29024
½ c	*D*	11 15						*d* + *c* − *b* *E*	.13658	Log.	*e*	9.13539

½ a	F	5° 0′	*L.* Sine	*f*	8.94030		N = Q	18° 38′	L. Sine	*q*	9.50448
½ a	G	5 0	*L.* Cos.	*g*	9.99834	*q* + *d*		-	-	*r*	8.79472
½ b	H	6 15	*L.* Sine	*h*	9.03690	*b* − *r*	S	1.23335	Log.	*s*	0.09284
h + *g*	I	.10845	Log.	*i*	9.03524	* ½ P	T	14° 56′½	L. Sine	*t*	9.41134
h + *f*		-	-	*k*	7.97720	2*t* + *s*	U	.08232	Log.		8.91552
E	L	.13658	-			* U + *C*	W	.84743	N. S.	*w*	57° 56′†
§ I ± L	M	.02813	Log.	*m*	8.44917	S − W	X	.39092	N. S.	*x*	23 1
k − *m*	N	18° 38′	L. Tang.		9.52803	½ *w* + *x* = 40° 28′½ CO-LATITUDE.						
						½ *w* ~ *x* = 17 27′½ DECLINATION.						

N ~ D O 7 23 = 0h. 29m. 32s. time from noon of altitude A or C (the *greatest.*)

N + D P 29 53 = 1 59 32 time from noon of altitude A or C (the *least.*)

EXAMPLE 2.

Let the intervals be 1h. 20m. and 1h. 48m. = 20° and 27° horary angles, and the altitudes 30° 31′½, 45° 27′½, and 56° 44′; to find the latitude and declination.

1st interv.	a	20° 0′	A	30° 41′½	N. S.	*A*	.51037	*C* ~ *A*	.32578	Log.	*b*	9.51293
2d interv.	b	27 0	B	45 37½	N. S.	*B*	.71474	*C* ~ *B*	.12141	Log.	*c*	9.08425
a + b	c	47 0	C	56 44	N. S.	*C*	.83615	*D*	23° 30′	L. S.	*d*	9.60070
½ c	*D*	23 30						*d* + *c* − *b* *E*	.14860	log.		9.17202
½ a	F	10° 0′	L. Sine	*f*	9.23667		N Q	26° 30′	L. S.	*q*	9.64953
½ a	G	10 0	L. Cos.	*g*	9.99335	*q* + *d*		-	-	*r*	9.25023
½ b	H	13 30	L. Sine	*h*	9.36818	*b* − *r*	S	1.83110	log.	*s*	0.26270
h + *g*	I	.22990	-		9.36153	* ½ O	T	1° 30′	L. S.	*t*	8.41792
h + *f*		-	-	*k*	8.60785	2*t* + *s*	U	.00125	Log.	*u*	7.09854
E	L	.14860	-			U + *C*	W	.83740	N. S.	*w*	56° 52′ †
§ I ± L	M	.08130	Log.	*m*	8.91009	S − W	X	.99370	N. S.	*x*	83 34 †
k − *m*	N	26° 30′	L. Tan.		9.69776	½ *w* + *x* = 70° 13′ CO. DECLINATION						
						½ *w* + *x* = 13 21 LATITUDE.						

N ~ D O 3 0 = 0h. 12m. time from noon, of altitude A or C (the *greatest*)

N + D P 50 0 = 3 20 time from noon, of altitude A or C (the *least*)

§ *When the third altitude is the greatest or least, take the* difference; *otherwise, the* sum.

* *If instead of* ½ O *for* T, ½ P *had been taken, as above, then* U + *A would give the meridional altitude* W, *instead of* U + *C.*

† *w* = *merid. alt.* *x* = *midn. depression.*

Digitized by Google

PROBLEM XV.

Given two Altitudes of the Sun, within half an hour of Noon, and the Interval of time between; (the Latitude by account and Declination also given) to find the TIME *and* MERID. ALTITUDE, by the help of table XVIII.

EXAMPLE.

In latitude 50° 30′ N. by account, and sun's declination 3° 30′ S. the sun's altitude was observed 35° 8′ 40″; and 17m. minutes after the altitude was 35° 7′ 20; required the time from noon and meridian altitude.

		° ′ ″				
Greater altitude	A	35 8 40	Tab. XVIII lat. 51° 30′ N. dec. 3 30 S.	N	″	1,5
Less altitude	B	35 7 20	Double interval of time	O		34m.
A — B	C	0 1 20 = 80″	N × O	P		51″
		m. s.				
80 ÷ 51. or C ÷ P	D	1 34 quotient in minutes.				
½ interval	E	8 30				
1‡ E ~ D	F	6 56 time (1‡) *before* noon, altitude A.				
E + D	G	10 4 time (1‡) *after* noon, altitude B.				
(tab. XIX) 2‡ F²×N	H	1′ 12″ the correction of A.				
H + A	I	35 9 52 MERIDIAN ALTITUDE.				

1‡ *When* E *is greater than* D, *the altitudes are on different sides of noon.*

2‡ GG × N *would also give the correction which added to* B *gives the* MERID. ALT. *and when* F *or* G *is less than* 11 *minutes, table XIX gives* FF *or* GG.

This method is earnestly recommended to seamen, when the noon has been clouded. When the sun passes near the zenith the time should be more limited; but an interval of five to ten minutes would be sufficient, and a mean result may be taken from several observations.

N. B. The number of seconds in table XVIII may be found independent of the table, thus; add the constant log. 0.29302, the log. cosine of latitude by account, and log. cosine of declination together; and subtract the log. sine of the *difference* or *sum* of the latit. and declin. according as they are of the *same* or *different* names; the remainder will be the logarithm of the number of seconds in table *XVIII.*

If to this log. be added twice the log. of any number of minutes less than 30 minutes, the sum will be the logarithm of a number of seconds; which added to the altitude, taken at that number of minutes from noon, will give the *Meridian Altitude*, the same as above.

PROBLEM XVI.

*Given one Altitude near Noon, and the time from Noon by (equal *Altitudes, or any other Observation) with the Latitude by account and Declination; to find the* MERIDIAN ALTITUDE.

EXAMPLE.

Latitude -	51° 30′ 0	log. Cos.	*a*	9.79415	*a* + *b* + *c*	6.45374	Num. *d*	.00028
Declination	3 30 0	log. Cos.	*b*	9.99919	Obs. alt.	35° 8′ 40″	N. S. *e*	.57564
Horary ang.	0 6 56	log. rising	*c*	6.66040				
					d + *e*	35 9 51	N. S.	.57592
a + *b* + *c* -		logar.	*d*	6.45374	= MERID. ALT. the same as last prob.			

The error of a degree in the assumed latitude would be here almost insensible.

* *The correction of noon from equal altitudes, within* 15 *minutes of noon, is in minutes equal to the change in seconds of sun's declination for one minute; divided by twice the number in tab. XVIII; to be applied* + *or* —, *as the* ⊙*'s dec.* recedes, *or* approaches *the zenith.*

Digitized by Google

EXAMPLE 2, *By another Method.*

Co. Lat.	A	38° 30′ N.	l. sine	a	9.79415	d		h. m. s.	d	9 37998
Declin.	B	3 30 S.	l. cos.	b	9.99919	L. ris.	E	0 6 51	e	6 66040
* A ± B	C	35 0	l. cos.	c	−9.91336	$d+e$	F	° ′ ″ .0 1 11	L.S.	f 6.54038
$a+b-c$		-	-	d	9.37998	Ob. alt.	G	35 8 40		
						Merid. Alt.		35 9 51		

* *If* A *and* B *be both north or both south* +
if one be north and one south -

This is a very near approximation for altitudes taken within 20 minutes of noon, *the nearer the more accurate*, and a mean of the meridian altitudes, resulting from any number of observations, can readily be taken, *as* d *is common*. But if an altitude be taken at a greater distance from noon, any degree of accuracy may also be obtained, by substituting the log. cos. of $C - \frac{1}{2}F +$ log. of 2, for c, (F *having been first found as above*) or, what is the same, let the difference between c and log. cos. of $C - \frac{1}{2}F$, be added to 0.30103 and the sum subtracted from f, will give the log. sine of an arc, the double of which added to the observed altitude, will give the MERIDIAN ALTITUDE.

N. B. *The logarithm* d *added to* 0.29303 *gives the number in table* XVIII.
The log. sine of a small arc subtracted from 8.71900 *gives the prop. log. of the arc.*

PROBLEM XVII.

Given the Sun's or Moon's Declination and Semidiameter, with the Interval of Time between the Instants when the upper and lower Limbs were in the Horizon; to find the LATITUDE.

RULE.

Find by proportion what number of seconds the sun or moon would take to rise 100′; and in table XXII, under the given declination, *according as it is of the same or a different name to the latitude*, and against that number of seconds, the LATITUDE REQUIRED will be found; making a proportion for any excess above the tabular number.

EXAMPLE.

Let the sun's declination, of the same name with the latitude, be 18° 24′, the time of rising his whole diameter 4m. 48s. and his diameter by Nautical Almanac 31′ 44″; required the latitude.

As 31′ 44″ : 100′ (=1° 40′) :: 4m. 48s. : 15m. 8s. = 908s. time of rising 100′.

Table XXII, under 18° decl. (same name) lat. 57°	is	882	diff.	1° *dec.* is	25s.
Table VI, against p. p. 24′ decl. and under 25 -	is	+10s.		1° *lat.* is	35s.
Table VI, against p. p. 35s, the diff. 16 is under		27′½	892	diff. 16.	
LATITUDE required - - -		57° 27′½.			

Continuation of the note, (marked *) on the opposite page, under problem XVI.

THIS CORRECTION *is also the time, in minutes, between the sun and moon's* greatest altitude *and* meridian altitude.

And if THIS CORRECTION *be multiplied into half the number of seconds that the declination varies in one minute,* THE PRODUCT *will be the* difference, *in* seconds, *between the sun and moon's* greatest *and* meridian altitude, *which, respecting the moon, is sometimes considerable; therefore as the altitude* H + A, *found by problem XV. is strictly the* greatest, *not the* meridian altitude, *and the time* F and G *the time before and after the* greatest altitude, THIS PRODUCT *should be applied as a correction to reduce the moon's altitude when thus found, to her meridian altitude, when that is required. The same remark will also apply to problems X, XI, and XII.*

Digitized by Google

REMARK to Problem XVII.

If the declination was of a *contrary* name to the latitude, it will be found in the same manner from table XXII that the latitude would be 56° 53′.

This method cannot be depended upon within 10′ for latitudes between 20 and 30 degrees, nor within 30′ for latitudes under 10 degrees; for higher latitudes it may generally be within 5′ or 6′. But any method, not distinguishing whether the latitude and declination are of the *same* or *contrary* names, must be still wider from the truth.

PROBLEM XVIII.

The Latitude and Longitude of a Place, and the observed Altitude of the Sun's Limb being given, together with the time of Observation nearly, to find the APPARENT TIME *when the Observation was made.*

RULE.

From the observed altitude of the sun's limb, subtract the dip of the horizon, and correct the remainder for semidiameter, refraction, and parallax, to obtain the true altitude.

Take the sun's declination from page II of the Nautical Almanac, reduce it to the estimate time at Greenwich, and note whether it be north or south.

If the sun's declination and the co-latitude of the ship be one north and the other south, take their difference; but if they be both north, or both south, take their sum for the sun's meridian altitude;—if the sum be greater than 90°, take it from 180°.

From the natural sine of the sun's meridian altitude (tab. IV) take the natural sine of the sun's true altitude at the time of observation, find the logarithm of the remainder; to which add the log. secant of the ship's latitude, and the log. secant of the sun's declination: their sum, rejecting 20 from the index, must be sought for in table VIII, under log-rising; and the time corresponding to it will be the apparent time from the nearest noon: consequently, if the observation be made in the morning, the time thus found must be taken from 24 hours, and the remainder will be the apparent time from the noon of the preceding day.

EXAMPLE.

July 8, 1808, at about 20h. in latitude 34° 55′ 43″ N. longitude, 12°½ E. the observed altitude of the sun's lower limb was 36° 49′½; the observer's eye being 20 feet above the surface of the sea; what was the apparent time when the observation was made.

		d.	h.	m.	s.
Estimate time		8	20	0	0
Longitude in time east		—		50	0
Estimate time at Greenwich			19	10	0
Or time *before* noon of the 9th			4	50	0
			°	′	″
⊙'s dec. 9th N.A. (diff.—7′23″)		N.	22	22	45
T. VI. *half time* 2h. 25m. & 7′23″		+		1	29
Sun's reduced declin.	A	N.	22	24	14
Co-latitude	B	N.	55	4	17
* B ± A = Merid. alt			77	28	31
True alt. of sun's center			36	59	44
			h.	m.	s.
Meridian distance east			3	58	23
APPARENT TIME		8d.	20	1	37

		°	′	″
Altit. of sun's lower limb		36	49	30
Dip of horizon		—	4	24
Sun's *apparent* altitude		36	45	6
Semidiam. N. A.	+	15′	47″	
Refrac. — parall.	—	1	9	
	+	14	38	
True altit. of ⊙'s center		36	59	44

L. sec. or Ar. Co. of log. cos.	a	0.03408	
L. cosec. or Ar. Co. of log. sine	b	0.08626	
Nat. sine	c	.97620	
Nat. sine	d	.60175	
c — d and log.		.37445	e 9.57339

e + b + a tab. VIII, log. rising. 9.69373

(* *if both* N. *or both* S. +, *otherwise* −.)

Digitized by Google

PROBLEM XIX.

The Latitude and Longitude of a Place, and the observed Altitude of a known fixed Star being given, together with the Time of Observation nearly, to find the APPARENT TIME *at that Place.*

RULE.

If the time at Greenwich be not given, turn the longitude into time, and if it be west, add it to, but if it be east, subtract it from the estimated time at the ship when the star's altitude was observed, and it will give the time at Greenwich.

To this time take the sun's right ascension, found in page II of the Nautical Almanac, and with the daily variation reduce it to the estimate time at Greenwich by table VI, taking half the daily variation for the variation in 12 hours; or what comes to the same, taking half the time from noon.

Take the star's right ascension and declination from table XXX, and by means of their annual variation, reduce them to the given time.

Subtract the *sun's* reduced right ascen. from the star's reduced right ascen. adding 24 hours if necessary, which will give their difference in right ascension, or * R. A.—⊙ R. A.

Subtract the dip of the horizon and the refraction from the observed altitude of the star, and the remainder will be its true altitude.

From the natural sine of the star's meridian altitude take the natural sine of its true observed altitude, and find the logarithm of the remainder. To this logarithm add the log. secant of the ship's latitude, and the log. secant of the star's declination; their sum, rejecting 20 from the index, must be sought for in table VIII, *Log-rising*, and the time corresponding will be the star's MERIDIAN DISTANCE; which being *subtracted* from the difference of the sun and star's right ascensions, found above, if east, or *added* to it, if west, will give the apparent time when the observation was made.

EXAMPLE.

December 13th, 1804, at about 16½h. in latitude 37° 46′ N. longitude 21° 15′ east, the altitude of Arcturus, east of the meridian, was observed to be 34° 6′ 20″; the height of the observer's eye 10 feet; required the APPARENT TIME of observation.

	h.	m.	s.
Estimate time 13th	16	30	0
Longitude in time east	1	25	0
Estimate time at Greenwich	15	5	0

	h.	m.	s.
⊙'s R. A. at noon, N. Almanac	17	20	15
(daily variation 4m. 25s.)			
Tab. VI. half t. 7h. 32½m. & 4m. 25s.	+	2	31
	+		16
⊙'s reduced right ascension	17	23	2

	°	′	″
Star's declin. 1805, var. —19″	N. 20	12	10
Prop. of variation for 2 years		—	38
Star's reduced declination	20	11	32

	h.	m.	s.
Star's R. A. 1805, tab. XXX	14	6	46
Variation for 2 years, a 2″,75		+	5
Star's reduced right ascension	14	6	51
Sun's reduced right ascension	17	23	2
Star's R. A. +24h. —Sun's R. A.	20	43	49

	°	′	″
Star's observed altitude	34	6	20
Dip of horizon	—	2	57
Refraction	—	1	24
Star's true altitude	34	1	59

		°	′	″
Co-latitude	A	N. 52	14	0
Star's declination	B	N. 20	11	32
A ± B Merid. altitude		72	25	32
Star's true altitude		34	1	59

		h.	m.	s.
Star's R.A.—⊙'s R.A.	F	20	43	49
Star's merid. dist. east	G	4	8	1
F ± G APPARENT TIME		16	35	48

Log. cosec. or ar. co. log. sine	*a*	0.10209
Log. sec. or ar. co. log. cos.	*b*	0.02755
Nat. sine	*c*	.95332
Nat. sine	*d*	.55967
c — *d* and log. .39365 log.	*e*	9.59511
a + *b* + *e* tab. VIII, log-rising		9.72475

Digitized by Google

PROBLEM XX.

The Latitude and Longitude of a Place, and the observed Altitude of the MOON being given, with the Time of the Observation nearly, to find the MOONS'S MERIDIAN DISTANCE and APPARENT TIME.

RULE.

Turn the longitude of the ship into time, and if it be *west*, *add it to*, but if it be *east*, *subtract it from* the estimate time at the ship, and it will give the estimate time at Greenwich.

To which time reduce the moon's declination, as in the explanations, page 43, and horizontal parallax, by table H, or its rule page 36; and find the corrections of the observed altitude, for dip, parallax, and refraction, as before shewn, to obtain the true altitude of the moon's center and her true declination.

If the declination and co-latitude are both north or both south, take their sum; but if one be north and the other south, take their difference, for the moon's meridian altitude; with which, and the moon's true altitude, find the Moon's Meridian Distance, as by the last problem for a Star. Then to find the APPARENT TIME,

Reduce the sun and moon's right ascensions, from the Nautical Almanac, to the estimate time, by the rule page 3, or any other method.

Subtract the reduced sun's right ascension from the moon's, and *add* the moon's merid. distance if *west*, or *subtract* it *east*, from the remainder; and the sum or difference will give the APPARENT TIME of observation, which should be nearly the estimated time. But if this should not agree, the operation must be repeated; or else the estimated time must be corrected by the change in the sun and moon's right ascension for the difference of the times, which will then give the TRUE APPARENT TIME of the observation.

EXAMPLE.

Let the observed altitude of the MOON's upper limb, on the 14th Feb. 1807, at 7h. 58m. 19s. estimated time, be 44° 45′ 20″, west of the merid. in latitude N. 40° 30′, longt. 2h. 18m. 19s. east of Greenwich; required the MOON'S MERID. DISTANCE, and also the APP. TIME of observation.

	h. m. s.
Estimate time	7 58 19
Longitude in time *East*	2 18 19
Estimate time at Greenwich	5 40 0

	° ′ ″
Observed alt. ☽'s upper limb	44 45 20
Dip of horizon (12 feet)	— 3 25
App. alt. moon's upper limb	44 41 55
Correction for parallax	+ 39 35
Refraction in table A	— 57
Semidiameter N. A.	— 15 10
TRUE ALTITUDE of ☽'s center	45 5 23

☽'s hor. par. noon	55′ 40″ N. Almanac.
(diff. +21″ for 5h.40m +	5 table VI.
Reduction for lat.	— 4 table F.
☽'s red. hor. par.	55 41 P. L. | a | 0.5095
App. alt. ☽'s up. l. 44° 41 55 l. cos.	b | 9.8517
a + 10 — b COR. PAR. 39 35 P. L.	0.6578
☽'s N. POLAR DIST. at 6h. N. A.	71° 25′ 0″
(diff. — 44′)	
Tab. VI, prop. for —40m. (doub. t.)	+ 2 27
☽'s reduced N. polar distance	71 27 27
☽'s REDUCED DECLINATION	N. 18 32 33

			° ′ ″			
CO-LATITUDE	A	N.	49 30 0	Log. cosec. or ar. com. log. sine	a	0.11895
MOON'S DECLINATION	B	N.	18° 32′ 33″	Log. sec. or ar. com. log. cosine	b	0.02316
A ± B MERIDIAN ALTIT.			68 2 33	Nat. sine	c	.92746
TRUE ALTIT. ☽'s center			45 5 23	Nat. sine	d	.70821
			h. m. s.	c — d and log.		.21925 | e | 9.34094
MOON'S MERIDIAN DISTANCE		W.	3 3 37	e + b + a log-rising, tab. VIII		9.48305

Digitized by Google

		°	′	″
☽'s R. A. next, N. Alm.	B	37	17	0
* Preced. diff. -	c	+ 6	13	0
Following difference -	d	+ 6	25	0
$d - c$ *second difference*	e	+ 0	12	0
$c + \frac{1}{2}e$ mean diff. -	f	+ 6	19	0
Prop. to 5h. 40 m. & 6′ ($\frac{1}{2}e$)	g	+	2	50
$f + g$ CORRECT. DIFF.	h	+ 6	21	50
Prop. for 5h. 40m. T. VI.	I	+ 3	0	19
B + I ☽'s reduced R. A. -		40	17	19
		h.	m.	s.
Moon's reduced R. A. in time		2	41	9

	h.	m.	s.
☉'s R. A. at noon. N. Almanac	21	48	47
(*daily diff.* + 3m. 54s.)			
Table VI. prop. to 2° 50′ and 3m.	+		42½
to 2° 50 and 54s.	+		12½
SUN'S REDUCED R. A. -	21	49	42
MOON'S REDUCED R. A. -	2	41	9
☽'s R. A. + 24h. — ☉'s R. A.	4	51	27
MOON'S MERID. DIST. W.	3	3	37
APPARENT TIME - -	7	55	4

This as it differs but 3m. 15s. from the estimated time, is sufficiently near for the parallax and declination, or it must be again computed. The correction of apparent time for the change in right ascension may be thus made,—

Moon's motion in R. A. for 12 hours is $h + g$ = 6° 24′ 40″, in time 25m. 39s.
Sun's motion in R. A. for 12 hours - - - 1 57

Difference is the moon's motion from the sun in 12 hours - 23 42

Then as 12h. — 23m. 42s. = 11h. 36m. 18s. : 23m. 42s. :: 3m. 15s. : 6,7s.
Which subtracted from 7h. 55m. 4s. makes 7h. 54m. 57,3s. APPARENT TIME.

Or, 12h.— 23m. 42s. : 12h. :: 3m. 15s. : 3m. 21,6s. which subtracted from 7h. 58m. 19s. leaves 7h. 54m. 57,4s. APPARENT TIME.

* *See page 3 of the Appendix.*

PROBLEM XXI.

The apparent Time and the Ship's Latitude and Longitude being given, to find the Sun's APPARENT ALTITUDE.

RULE.

Take the sun's declination from page II of the Nautical Almanac.

If the sun's declination and the co-latitude of the ship be one north and the other south, take their difference; but if they be both north or both south, take their sum for the sun's meridian altitude. If that sum be greater than 90°, take it from 180°.

With the apparent time from noon enter table VIII, and take the logarithm corresponding to it out of the column of log-rising, to which add the log. cosine of the latitude, and the log. cosine of the sun's declination: their sum, rejecting 20 from the index, will be the logarithm of a natural number, which being subtracted from the natural sine of the meridian altitude, will give the natural sine of the sun's true altitude, at the given time. Add the difference between the sun's refraction and its parallax in altitude to the true altitude and it will give the sun's APPARENT ALTITUDE.

EXAMPLE.

Required the SUN'S APPARENT ALTITUDE on the 24th November 1807, at 3h. 21m. 30s. apparent time, latitude 51° 32′ N. long. 38° E.

	h.	m.	s.		°	′	″
APPARENT TIME -	3	21	30	Sun's declination at noon -	S. 20	38	53
Longitude in time *East* -	— 2	32	0	(daily diff. + 11′ 49″)			
				Table VI, prop. for 24m. 45s.		+ 25	
Time at Greenwich -	0	49	30	Sun's reduced declination	S. 20	39	18

Digitized by Google

Apparent time		h. m. s. 3 21 30	Table VIII			log-rising	9.55900
		° ′ ″					
Sun's reduced declination	S.	20 39 18				log. cos.	9.97115
Co-latitude	N.	38 28 0				log. sine	9.79383
Sun's merid. altitude		17 48 42	Nat. sine	A	.30589		
			Number	B	.21086	log.	9.32398
Sun's true altitude		5 27 12	Nat. sine		.09503	A — B	
Correction table M		+ 8 50					
SUN'S APPARENT ALTIT.		5 36 2					

PROBLEM XXII.

The apparent Time, and the Latitude and Longitude of the Ship being given, to find the APPARENT ALTITUDE *of any known fixed* STAR.

RULE.

Turn the longitude of the ship into time, and if it be west add it to, but if it be east subtract it from the apparent time at the ship, and it will give the time at Greenwich.

Take the sun's right ascension for that time out of the Nautical Almanac, by the help of table VI, and add it to the apparent time at the ship, counted as usual from the preceding noon; the sum will be the right ascension of the mid-heaven. Take the star's declination and right ascension out of table XXX, and take the difference between its right ascen. and right ascension of the mid-heaven, which will be the distance of the star from the meridian.

If the star's declination and the co-latitude of the ship be one north, and the other south, take their difference; but if they be both north or both south, take their sum for the star's meridian altitude. If the sum exceed 90°, subtract it from 180°.

With the distance of the star from the meridian take the log-rising out of table VIII, to which add the log. co-sine of the ship's latitude, and the log. co-sine of the star's declination; their sum, rejecting 20 from the index, will be the logarithm of a natural number, which being subtracted from the natural sine of the meridian altitude of the star, will give the natural sine of the star's true altitude. Add the refraction to the true altitude, and the sum will be the apparent altitude of the star at the given time.

EXAMPLE.

What was the APPARENT ALTITUDE of Aldebaran on the 12th of April, 1806, at 5h. 56m. 20s. app. time, in lat. 51° 32′ N. longit. 54° 55m. E?

		h. m. s.					h. m. s.
Apparent time		5 56 20	☉'s R. A. at noon (diff. 3′ 41″)				1 20 54
Longitude in time *East*		3 39 40	Tab. VI, prop. 1h. 8m. & 3′ 41″				+ 21
Time at Greenwich		2 16 40	Sun's true right ascension				1 21 15
			Apparent time				+ 5 56 20
		h. m. s.	R. A. mid-heaven				7 17 35
Star's R. A. for 1805, tab. XXX (yearly diff. 3″,42)		4 24 44					° ′ ″
Prop. for 1,3 year		+ 4	Star's declin. 1805, tab. XXX (yearly diff. + 8″,1)			N.	16 6 24
Star's reduced R. A.	A	4 24 48	Prop. for 1,3 year				+ 11
R. A. mid-heaven	B	7 17 35	Star's reduced declination				16 6 25
R. A. STAR'S MERID. DISTANCE		2 52 47	Table VIII			log-rising	9.43294
		° ′ ″					
Star's reduced declination	N.	16 6 25				log. cos.	9.98261
Co-latitude	N.	38 28 0				log. sine	9.79383
Meridian altitude		54 34 25	Nat. sine	C	·81303		
		° ′ ″	Number	D	.16195	log.	9.20938
True altitude		40 37 24	Nat. sine C — D		.65108		
Correction, table O		+ 1 6					
APPARENT ALTITUDE		40 38 30					

Digitized by Google

PROBLEM XXIII.

The apparent Time and the Latitude and Longitude of the Ship being given, to find the APPARENT ALTITUDE *of the* MOON'S *Center.*

RULE.

Turn the longitude of the ship into time, and it be west add it to, but if it be east, subtract it from the apparent time at the ship, and it will give the time at Greenwich.

To this time reduce the sun's right ascension from page II of the Nautical Almanac, by the help of table VI, and add it to the apparent time at the ship, counted from the preceding noon, which will give the right ascension of the mid-heaven. Take also the moon's horizontal parallax from page VII of the Nautical Almanac, and reduce it to the time at Greenwich, and the latitude from table F.

Reduce the moon's right ascension and declination also to the time at Greenwich; and take the difference between the moon's right ascension, reduced to time, and the right ascension of the mid-heaven, which will be the MOON'S MERIDIAN DISTANCE.

If the moon's declination and co-latitude of the ship be one north and the other south, take their difference; but if they are both north or both south, take their sum for the moon's meridian altitude. If the sum exceed 90° take it from 180°.

With the distance of the moon from the meridian take the log-rising out of table VIII, to which add the log. co-sine of the ship's latit. and the log. co-sine of the moon's declination; their sum, rejecting 20 from the index, will be the logarithm of a natural number, which being subtracted from the natural sine of the moon's meridian altitude, will give the natural sine of the moon's true altitude at the given time.

With the moon's reduced horizontal parallax, and her true altitude, take the correction from table N, and subtract it from her true altitude, which will give the APPARENT ALTITUDE of the MOON'S center.

EXAMPLE.

What will be the APPARENT ALTITUDE of the moon's center on the 20th of February, 1807, at 12h. 49m. 58s. apparent time, in latitude 39° 54′½ north, and longitude 116° 24′¼ east.

	D.	h.	m.	s.
APPARENT TIME - -	20	12	49	58
Longitude in time *East* -	—	7	45	37
Time at Greenwich -		5	4	21

☽'s hor. par. at noon (diff. +19″)		60′	52″
Table VI, prop. for 5h. 4m. -		+	8
Reduction for lat. table F -		—	4
Moon's reduced hor. par. - -		60	56

		°	′	″
☽'s R. A. at noon (diff. 7 26)		125	32	0
Table VI, prop. for 5h. 4m.		+	3	8 19
Moon's reduced R. A. -		126	40	19

		h.	m.	s.
☽'s reduced R. A. in time	C	8	26	41
R. A. of mid-heaven	D	11	3	7
C ~ D ☽'s merid. dist. *West*		2	36	26

		°	′	″
Moon's declination -	N.	15	16	0
Co-latitude - -	N.	50	5	30
Moon's merid. altitude -		65	21	30

		°	′	″
TRUE ALTITUDE -		47	59	57
Correction, table N -		—	[illegible]	25
APPARENT ALTITUDE -		47	19	32

	h.	m.	s.
⊙'s R. A. at noon (diff. 3m. 50s.)	22	12	20
Tab. VI, prop. for 2h. 32m. & 3m. 50s.			38 11
⊙'s reduced R. A. - A	22	13	9
Apparent time at ship B	12	49	58
A + B — 24h. R.A. of mid-heaven	11	3	7

		°	′	″
☽'s N. pol. dist. noon, N. Alm.		73	50	0
(diff. for 6h. + 64′)				
Table VI, prop. for 10h. 9m.	+		54	0
☽'s reduced N. polar distance		74	44	0
☽'s reduced declination - -		15	16	0

Table VIII -	log-rising	9.35033	
- - -	log. cosine	9.98440	
- - -	log. sine	9.88484	
Nat. sine E	.90893		
Number F	.16580	log.	9.21957
Nat. sine	.74313	E — F	

Digitized by Google

PROBLEM XXIV.

Having the apparent or observed Distance of the MOON *from the* SUN *or fixed* STAR, *together with the observed Altitude of each, and the Moon's Horizontal Parallax, to find their* TRUE DISTANCE.

METHOD I.

Of reducing the APPARENT to the TRUE distance, by a very near approximation, will be easily understood by the form being registered.

EXAMPLE 1.

Given the apparent distance of the moon from a star, and the following apparent altitudes;—to find their TRUE DISTANCE.

		° ′ ″					° ′ ″		
App. dist.	A	43 35 42	tab. H,		☽'s app. alt.	L	9 38 0	l. sine	l 9.2236
☽'s app. alt.	B	9 38 0	cor. 52′ 6″			K	M 57 10 0	l.tan.	m 10.1903
✱'s app. alt.	C	11 17 0			☽'s hor. par.	N	54 42	P. L.	n 0.5173
B + C	D	20 55 0		logar's.					
½ D	E	10 27 30	tan	e 9.2662	$m+n-l$	O	5 54	P. L.	1.4840
E ~ C	F	0 49 30	cot	f 11.8417	Refrac. of K	P	37		
½ A	G	21 48 0	tan	g 9.6020					
$e+f+g-20$	H	78 58 0	tan	10.7099	3 ✱ ± O — P	Q	1st *correction*	—	0° 5′ 17″
					4 ✱ ± *refr.* of I,		2d *correction*	-	+ 11
1 ✱ G + H	I	100 46 0	(79° 14′ 0″)		5 ✱ ± table XXIX,		3d *corr.*	-	+ 26
2 ✱ G + H	K	57 10 0			Apparent distance			-	43 35 42
					TRUE DISTANCE				43 31 2

EXAMPLE 2.

		° ′ ″					° ′ ″		
App. dist.	A	90 21 13	Table H,		☽'s app. alt.	L	5 17 0	l.sin.	l 8.9642
☽'s app. alt.	B	5 17 0	cor. 52′ 9″			K	M 5 17 14	l.tan.	m 8.9662
⊙'s ap. alt.	C	84 7 0			☽'s hor. par.	N	61 48	P. L.	n 0.4643
B + C	D	89 24 0		logar's					
½ D	E	44 42 0	tan	e 9.9954	$n+m-l$	O	1 1 30	P. L.	o 0.4663
E ~ C	F	39 25 0	cot	f 10.0852	Refr. of K	P	9 27		
½ A	G	45 10 36	tan	g 10.0027					
$e+f+g-20$	H	50 27 50	tan	10.0833	3 ✱ ± O — P	Q	1st *correction*	—	52′ 3″
					4 ✱ ± *ref.* of I		(— ⊙ *par.*) 2d *cor.*		+ 5
1 ✱ G + H	I	95 38 26	(84° 21′ 34″)		5 ✱ ± table XXIX,		3d *corr.*	-	0
2 ✱ G + H	K	5 17 14			Apparent distance			-	90 21 13
					TRUE DISTANCE				89 29 15

1 ✱ Add *when* C *is greater than* B, *otherwise subtract.*

2 ✱ Subtract *when* C *is greater than* B, *otherwise* add.

3 ✱ Subtract *when either* I *or* K *exceeds* 90°, *or when* I *is greater than* K, *otherwise add.*

4 ✱ Add *when either* I *or* K *exceeds* 90°, *or when* I *is less than* K, *otherwise* subtract.

5 ✱ *The top argument to table* XXIX, *is the apparent distance corrected by* Q, *and the two side arguments are* Q *and the correction of the moon's altitude, by means of table H, as seen at* B; *the difference of the corresponding numbers found in the table, are to be applied* — *or* +, *according as* A *is more or less than* 90°.

Digitized by Google

METHOD 2, *by the Editor.*

Of reducing the APPARENT to the TRUE DISTANCE, with a *proof.*

In this method it is necessary to remember the following rules:—

1. *That the Natural co-sines of arcs above* 90°, *are equal to the Natural sines of their excess above* 90° *with a negative or contrary sign.*

2. *The sum of an affirmative and a negative number, is the difference of the numbers with the sign of the greater number.*

3. To *subtract* any *number from another*, first change its sign and then *add, by the second rule.*

4. To *add* or *subtract Logarithms*, reject the multiples of 10 in the *index*, or borrow 10 when necessary. (See explanation of Table 1. *second scale* of *Logarithms*).

EXAMPLE 1.

	°	′	″		′	″			′	″		°	′	″
☽'s appar. altit.	12	30	0	H. par.	56	15,	*Cor.* Table H,	+	50	42	True altit.	13	20	42
☀'s appar. altit.	24	48	0	*Refraction*, Table A			- -	—	2	3	True altit.	24	45	57

			Nat. Cosines.			Numbers.			Logarithms.
Sum appar. altit's	37	18	0	A	.795473	A — B	+ .008655	F	
Sum true altit's	38	6	39	B	.786818	C — D	— .003153	G	
Diff. appar. altit's	12	18	0	C	.977046	F + G	.005502		*h* 7. 7405
Diff. true altit's	11	25	15	D	.980199	A + C	1.772519	I	*i* 0. 2486
APPAR. DIST.	51	28	35	E	.622837	*h* — *i*			*k* 7. 4919
Correct. F — M, or O — G					+ 4252	A + E	1.418310	L	*l* 0. 1518
TRUE DIST.	51	9	51		.627089	*l* + *k*	.004403	M	7. 6437

PROOF. { C — E = I — L ‖ I — L | .354209 | O | *n* | 9. 5493
{ O + M = F + G ‖ *n* + *k* | .001099 | | | 7. 0412

EXAMPLE 2.

	°	′	″		′	″			′	″		°	′	″
☽'s appar. altit.	41	6	2	Hor. par.	58	35	*Corr. Tab.* H,	+	43	4	True altit.	41	49	6
☉'s appar. altit.	19	3	36	*Refr.* — *Par.*	Tab. A and B			—	2	36	True altit.	19	1	0

				Nat. Cosines.			Numbers.			Logarithms
Sum appar. altit's.	60	9	38	A	.497572	A — B	.010245	F		
Sum true altit's.	60	50	6	B	.487327	C — D	.005065	G		
Diff. appar. altit's.	22	2	26	C	.926917	F + G	.015310		*h*	8.1850
Diff. true altit's	22	48	6	D	.921852	A + C	1.424489	I -	*i*	0.1537
APP. DIST. -	103	29	27	E	—.233289	*h* — *i*			*k*	8.0313
Correction F — M, or O — G					+ 7405	A + E	.264283	L -	*l*	9.4221
TRUE DIST.	103	3	18		—.225894	*l* + *k*	.002840	M		7.4534

PROOF. { C — E = I — L ‖ I — L | 1.160206 | *n* | 0.0645
{ O + M = F + G ‖ *n* + *k* | .012470 | O | 8.0958

If O + M = F + G, *and* I — L = C — E, *there can be no probable error in adding and subtracting, or taking out the logarithms.*

Digitized by Google

EXAMPLE 3.

☽'s app. alt.	66 33 40	Hor. par.	61 13½	*Corr.* tab. H.	+ 23 56	True alt.	66 57 36
*'s app. alt.	43 13 18	*Refraction*, table A	- -	— 1 1		True alt.	43 12 17

		Nat. Cos.		Numbers.		Logar'ms.
Sum app. altit's	109 46 58	A	— .338455	A — B	.006265 F	
Sum true altit's	110 9 53	B	— .344720	C — D	.002899 G	
Diff. app. altit's	23 20 22	C	.918173	F + G	.009164 - *k*	7.9621
Diff. true altit's	23 45 19	D	.915274	A + C	.579718 I - *i*	9.7632
APP. DISTANCE	45 3 58	E	.706290	*h* — *i*	- *k*	8.1989
Correction F — M = O — G			+ .000450	A + E	.367835 L - *l*	9.5656
TRUE DISTANCE	45 1 47		.706740	*l* + *k*	.005813 M	7.7645

PROOF. { C — E = I — L | I — L .211883 - - *n* | 9.3261
{ O + M = F + G | *n* + *k* .003350 O - | 7.5250

METHODS 3 & 4, *by means of Table I (Logarithmic Difference.)*
The Altitudes and Distance as in the last Example.

METHOD 3.

S. app. alts.	109 46 58 N.cos.	A	—.338455	Diff. app. alt.	23 20 22 N. cos.
App. dist.	45 3 58 N.cos.	B	+.706290	App. dist.	45 3 58 N. cos.
A+B & log.	9.565653	C	Nat. N. .367835	*a* — *b* log.	9.326096
Log. differ.	9.993078	D	Table *I*	Log. diff. -	9.993078
C + D -	9.558731	Nat. N.	E .362019	*c* + *d* -	9.319174 Nat. N.
S. true alt.	110 9 53 N.cos.		F —.344720	Diff. true alt.	23 45 19 N.cos.
T. DIST.	45 1 47 N.cos.		E — F .706739	T. DIST.	45 1 47 N. cos.

METHOD 4.

Diff. app. alt.	23 20 22 N. cos.	*a*	+ .918173
App. dist.	45 3 58 N. cos.	*b*	+ .706290
a — *b* log.	9.326096	*c*	Nat. N. .211883
Log. diff. -	9.993078	*d*	Table *I*
c + *d* -	9.319174 Nat. N.	*e*	.208533
Diff. true alt.	23 45 19 N.cos.	*f*	.915274
T. DIST.	45 1 47 N. cos.	*f* — *e*	.706741

REMARK.

Instead of *Natural Cosines* NATURAL VERSED SINES may be substituted in both these methods; in which case, the supplement of the sum of the apparent and true altitudes should be taken; or, what is the same, the sum of the apparent and true zenith distances, instead of the altitudes: and by this means *negative* signs would be avoided. Thus,

S. app. alt.	109 46 58 Vers. sup.	A	.661545	App. dist.	45 3 58 N. V. S.
App. dist.	45 3 58 N. V. sine	B	.293710	Diff. ap. A.	23 20 22 N. V. S.
A—B & log.	9.565653	C	Nat. N. .367835	*a* — *b* & log.	9.326096
Log. diff. -	9.993078			Log. diff.	9.993078
C + D	9.558731	Nat. N.	E .362019	*c* + *d*	9.319174 Nat. N.
S. true alt.	110 9 53 Vers. sup.		F .655280	Diff. Tr. alt.	23 45 19 N. V. S.
T. DIST.	45 1 47 N. V. S.		F — E .293261	T. DIST.	45 1 47 N. V. S.

a	.293710	*c*	.211883
b	.081827	*d*	
e	.208533	*f*	.084726
f + *e*	.293259		

This is Dr. MACKAY'S *method. Vide his Treatise on the Longitude.*

Digitized by Google

The difference of the cosines of two arcs being equal to twice the sine of half their sum multiplied by the sine of half their difference. Also, The sum of the cosines of two arcs equal to twice the cosine of half their sum multiplied by the cosine of half their difference, the above two methods can be thus varied.

1st VARIETY.

Sum app. alt.	109	46	58	half is	A	54	53	29
App. dist.	45	3	58	half is	B	22	31	59

A + B	77 25 28	Log. cos.	9.337912	
A ~ B	32 21 30	Log. cos.	9.926711	
Log. difference, table *I.*			9.993078	
Logarithm of 2			0.301030	
Sum of the four logarithms — 20			9.558731	
Number corresponding		C	.362019	
Sum tr. alts. 116° 9′ 53″ N. cos.		D	—.344720	
T. DIST.	45 1 47 N. cos.	C—D	.706739	

2d VARIETY.

Diff. app. alt.	23	20	22	half is	*a*	11	40	11
App. dist.	45	3	58	half is	*b*	22	31	59

a + *b*	34 12 10	log. sine	9.749832
a ~ *b*	10 51 48	log. sine	9.275235
Log. diff. table *I*			9.993078
Logarithm of 2			0.301030
Sum of the four logarithms — 20			9.319175
Number corresponding		*c*	.208533
Diff. true alt.	23° 45′ 19″ N. cos.		.915274
T. DIST.	45 1 47 N. cos.	*d*—*c*	.706741

From these are easily derived the following with logarithmic sines only.

3d VARIETY.

A + B	77 25 28	log. cos.	*a*	9.337912	
A ~ B	32 21 30	log. cos.	*b*	9.926711	
Log. difference, table *I*			*c*	9.993078	
a + *b* + *c* — 10			*d*	19.257701	
½ *d*	64 49 15		*e*	l. cos.	9.628850
½ sum, tr. alt.	55 4 56		*f*		
e + *f*	119 54 11	log. sine	*g*	9.937954	
e ~ *f*	9 44 19	log. sine	*h*	9.228281	
g + *h*			*i*	19.166235	
½ *i* | *k* |	22 30 54	log. sine		9.583118	
2 *k* =	45 1 48	TRUE DISTANCE.			

4th VARIETY.

a + b	34 12 10	log. sine	a	9.749832	
a ~ b	10 51 48	log. sine	b	9.275235	
Log. difference, table *I*			c	9.993078	
a + b + c — 10			d	19.018145	
½ d	18 50 19		e	log. sine	9.509072
½ diff. tr. A.	11 52 40		f		
e + f	30 42 59	log. cos.	g	9.934350	
e ~ f	6 57 39	log. cos.	h	9.996787	
g + h			i	19.931137	
½ i | k |	22 30 54	log. cos.		9.965568	
2 k	45 1 48	TRUE DISTANCE.			

As these are the varieties of this problem that have been most approved of by different writers, they are here applied to the same example to shew their affinity to each other, and to exercise the reader. The two first are perhaps preferable from not requiring any but the common tables. The third and fourth, with natural cosines or versed sines, and table *I*, of logarithmic difference, seem the shortest. Two graphical solutions are also given in *Clarke's Seaman's Desiderata.*

PROBLEM XXV.

To find the LONGITUDE of a Ship at Sea by Observations of the Moon's Distance from the Sun, and their Altitudes, taken at the same time: the Latitude of the Ship, and its Longitude by Account, being also known.

RULE.

Turn the longitude of the ship, by account, into time, and if it be west, add it to, but if it be east, subtract it from the estimated time at the ship, when the observation was made, and it will give the time at Greenwich nearly.

To this time take the moon's semidiameter and her horizontal parallax from page VII of the Nautical Almanac; also the sun's semidiameter for the day from page III, and augment the moon's semidiameter by adding to it the number of seconds found in table D with her observed altitude.

Digitized by Google

Correct the observed distance by adding to it the semidiameter of the sun, and the augmented semidiameter of the moon: correct also the observed altitudes, by subtracting the dip of the horizon, taken out of table C, with the height of the observer's eye above the surface of the sea, and adding, or subtracting the semidiameter of the object, according as the altitude of the lower or upper limb was observed; and the apparent distance and altitudes of the centers of the sun and moon will be obtained.

With the apparent distance, and the two apparent altitudes, find the true distance by any of the methods before given in problem XXIV.

Among the distances of the moon's center from the sun and fixed stars, put down on pages VIII, IX, X, and XI. of the Nautical Almanac, find those two distances of the sun and moon which are next less and next greater than the true distance, found from the observation: take the difference between them; also between that which stands first in the Ephemeris, and the true observed distance, and subtract the proportional logarithm of the former difference from the proportional logarithm of the latter; the remainder will be the proportional logarithm of a portion of time, to be added to the time which the distance, standing first in the Ephemeris, was computed for, and the sum will be the apparent time at Greenwich.

To this time take the sun's declination out of page II of the Nautical Almanac; and correct the apparent altitude of the sun's center by subtracting from it the difference between the refraction of the sun and its parallax in altitude, taken out of tables A and B: with these, and the ship's latitude, find the apparent time at the ship by problem XVIII.

Take the difference between the apparent time at Greenwich and the apparent time at the ship, convert it into degrees and minutes by the help of table XI, and it will be the true longitude of the ship at the time of observation: east, if the time at the ship be greater than the time at Greenwich, but west, if the time at the ship be less than the time at Greenwich.

EXAMPLE.

April 18th, 1793, about a quarter past 3 o'clock, latitude 0° 31′ S. longitude by account 95° W. the following observations were made for finding the true longitude of the ship, the height of the observer's eye being 19¾ feet above the surface of the sea. *Note*, 14″ must be subtracted from the distance, and 1′ 9″ added to the sun's altitude for the errors of the quadrants.

Dist. of ☽ and ☉'s nea. limbs.	Altitudes of ☽'s upper L.	Altitude of ☉'s lower L.	
° ′ ″	° ′ ″	° ′ ″	
96 58 15	27 0 0	41 52 30	
58 30	8 0	43 0	
59 0	15 15	33 45	
59 15	31 0	21 30	
59 45	44 0	10 0	
5) 44 45	5) 98 15	5) 160 45	Sums.
96 58 57	27 19 39	41 32 9	Mean distance and altitudes.
Sub. - 14	- - -	Add 1 9	Errors of the quadrants.
- - -	Sub. 4 22	Sub. 4 22	Dip of the horizon.
Add 30 54	Sub. 14 56	Add 15 58	☽'s augmented semid. and ☉'s semidiameter.
97 29 37	27 0 21	41 44 54	Apparent Distance and Altitudes.
	+ 46 37	— 57	Correction for refraction and parallax, tab. A & H
	27 46 58	41 43 57	True Altitudes of Moon and Sun.

	h. m.
Estimate time at ship - -	3 15
Longitude in time - -	W. 6 20
Estimate time at Greenwich, 18th D. -	9 35
	′ ″
☽'s hor. par. N. A. (diff. 5″) -	54 20
Table VI, prop. for 9h. 35m. -	+ 4
Table F, reduction for latitude -	— 0
☽'s reduced horizontal parallax -	56 24

Digitized by Google

Reduction of Distance by the second Method.

		° ′ ″		Nat. Cosines.		Numbers.			Logarithms.
Sum app. alts.		68 45 15	A	.362370	A — B	.012412	F		
Sum true alts.		69 30 55	B	.349958	C — D	—.003428	G		
Diff. app. alts.		14 44 33	C	.967079	F + G	.008984	-	h	7.9535
Diff. true alts.		13 56 59	D	.970507	A + C	1.329449	I	- i	0.1237
APP. DIST.		97 29 37	E	—.130416	h — i		-	- k	7.8298
Correction F — M = O — G				+ .010845	A + E	.231954	L	- l	9.3654
TR. DIS.	P	96 52 2½		—.119571	l + k	.001567	M		7.1952
At 9 h.	Q	96 38 0		*Proof.*	I — L	1.097495	-	n	0.0404
At 12	R	97 59 18	C — E = I — L O + M = F + G		n + k	.007417	O		7.8702

P ~ Q	-	0 14 3	P. L. 1.1076	s	⊙'s Decl. N. A. (diff. + 21′ 10″)	N.	° ′ ″ 11 4 59
R ~ Q	-	1 21 18	P. L. 0.3452	t	Table VI, prop. for 9h. 31m. (*half*)	- +	8 26
		h. m. s.					
s — t	-	0 31 6½	P. L. 0.7624		⊙'s reduced declination	- N.	11 13 25

Preceding time	-	9 0 0	⊙'s declin.	N. 11 13 25	-	Ar. comp. cos.	0.00839
			Co-latitude	S. 89 29 0	-	Ar. comp. sine	0.00002
Time at Greenw.		9 31 6½					
			Merid. altit.	78 15 35	Nat. sine .97908		
App. time	-	3 8 29	⊙'s true alt.	41 43 67	Nat. sine .66565		
					.31343	- log.	9.49614
LONG. in ti. W.		6 22 37½					

Apparent time, 3h. 8m. 29s. Table VIII. log. rising 9.50455

PROBLEM XXVI.

To find the LONGITUDE of a Ship at Sea by Observations of the Moon's Distance from a known fixed Star, and their Altitudes, taken at the same Time; the Latitude of the Ship and its Longitude by Account being also known.

RULE.

Turn the longitude of the ship by account into time, and, if it be west, add it to; but if it be east, subtract it from the estimated time at the ship when the observation was made, and it will give the time at Greenwich nearly.

To this time take the moon's semidiameter and her horizontal parallax from page VII of the Nautical Almanac; and augment the moon's semidiameter by adding to it the number of seconds which stand against her altitude in table D.

Correct the observed distance by adding the augmented semidiameter of the moon to it, if the enlightened limb of the moon be that which is nearest to the star, or by subtracting the augmented semidiameter of the moon from it, if the enlightened limb of the moon be that which is farthest from the star; and the result will be the apparent distance of the star from the moon's center: correct also the two altitudes, by subtracting the dip of the horizon from each, and by adding the

Digitized by Google

augmented semidiameter of the moon to, or subtracting it from, the moon's observed altitude, according as the lower or upper limb was observed, and the apparent distance of each will be obtained.

With the apparent distance and the two apparent altitudes, find the true distance by any of the methods in problem XXIV.

Among the distances of the ☽ 's center from the sun and fixed stars, put down on p. VIII, IX, X, and XI, of the N. Almanac, find those two distances of the moon and star which are next less and next greater than the true distance, found from the observation; take the difference between them; also between that which stands first in the Ephemeris and the true observed distance, and subtract the proportional logarithm of the former difference from the proportional logarithm of the latter: the remainder will be the proportional logarithm of a portion of time, to be added to the time which the distance standing first in the Ephemeris was computed for, and the sum will be the apparent time at Greenwich.

Take the star's right ascension and declination for the date of the observation from table XXX, and correct its apparent altitude by subtracting the refraction from table A from it. With these and the latitude of the ship find the apparent time at the ship by problem XIX.

Take the difference between the apparent time at Greenwich and the apparent time at the ship, convert it into degrees and minutes, and it will be the true longitude of the ship at the time of observation: east, if the time at the ship be greater than the time at Greenwich; but west, if the time at the ship be less than the time at Greenwich.

EXAMPLE.

May 6th, 1794, about 6h. 25m., latitude 23° 11′⅔ S. longitude by account 66° W. the following distances of the moon's remote limb from the Virgin's Spike were observed to determine the true longitude of the ship; the height of the observer's eye above the surface of the sea being 19¾ feet. *Note*, 43″ must be subtracted from the distance, 21′ 30″ from the star's altitude, and 5′ 0″ added to the moon's altitude for the errors of the quadrants.

Dist. ☽ 's rem. L. from star.	Alt. Moon's lower l mb.	Star's Altitude.	
° ′ ″	° ′ ″	° ′ ″	
64 22 45	50 51 30	32 25 0	
21 45	46 0	33 22 30	
20 0	42 0	34 19 30	
18 15	34 30	35 13 15	
4) 82 45	4) 174 0	4) 15 20 15	Sums.
64 20 41	50 43 30	33 50 4	Mean distance and altitudes.
— 43	+ 5 0	— 21 30	Errors of the quadrants.
- -	— 4 22	— 4 22	Dip of the horizon.
— 15 11	+ 15 11		Moon's augmented semidiam. N. A. and tab. D.
64 4 47	B 50 59 19	C 33 24 12	Apparent Distance and Altitudes.
	A + 33 51	— 1 26	Correction, tables H & A.
	51 34 10	33 22 46	True Altitudes of Moon and Star.

	h. m.
Estimate time at ship - -	6 25
Longitude in time - -	W. 4 24
Estimate time at Greenwich -	10 49
Moon's hor. par. (diff. + 7″) -	54′ 55″
Prop. for 10h. 19m. table VI -	+ 6
Reduction for latitude, table F -	— 1½
Moon's reduced horizontal parallax -	54 59½

Digitized by Google

Reduction of the Distance by the first Method.

		° ′ ″		
B + C	D	84 23 31		
½ D	E	42 11 46	l. tan. e	9.9574
E ~ C	F	8 47 34	l. cot. f	10.3106
½ A	G	32 2 23	l. tan. g	9.7965
$e+f+g$ — 20	H	74 45 10	l. tan.	10.5645
G + H	I	42 42 47	(C ◁ B *is* —)	
G ~ H	K	106 47 33	(73° 12′ 27″)	

☽'s app. alt.	50 59 19	l. sine. f	9.8904
K	73 12 27	l. tan. m	10.5203
☽'s hor. par.	54 59½	P. L. n	0.5150
$n+m-l$	O | 12 53	P. L.	1.1449
Refrac. of K	P | 17		

		° ′ ″
1st *Corr.* ± O — P (K ▷ 90°)	Q	— 12 36
2d *Correction*, refraction of I	-	+ 1 1
3d *Corr.* table XXIX, Q & A 5″ — 1″	=	+ 0 4
Apparent distance	-	64 4 47
TRUE DISTANCE	R	63 53 16

		h. m. s.
Star's R. A. table XXX, 1805 (*diff.* +3″,14)	-	13 14 56
Prop. for 10,6 years (*before*)	-	— 33
Star's reduced R. A.	-	13 14 23

		° ′ ″
Star's decl. 1805 (*diff.* + 19″)	S.	10 8 15
Prop. for 10,6 years (*before*)		— 3 20
Star's reduced declination	S.	10 4 55

		h. m. s.
Sun's R. A. at noon (*diff.* 3m. 50s.)		2 54 30,8
Prop. for 10h. 49m.	-	+ 1 44
Sun's reduced R. A.	-	2 56 15
*'s R. A — ⊙'s R. A.	-	10 18 8

Distance at 9h.	-	S	64 47 53
at 12h.	-	T	63 17 47
S ~ R | u	.5179	P. L.	0 54 37
S ~ T | w	.3005	P. L.	1 30 6
$u - w$ prop. p.	.2174	P. L.	h. m. s. 1 49 6
Preceding time	-		9 0 0
TIME at GREENWICH, May 6	-		10 49 6

		° ′ ″
Co-latitude - -	S.	66 48 20
Star's declination -	S.	10 4 55
Meridian altitude -		76 53 15
True altitude - -		33 22 46

		h. m. s.
Meridian distance east - -		3 51 30
*'s R. A. — ⊙'s R. A.	-	10 18 8
Apparent time at ship	-	6. 26 38
Time at Greenwich, May 6		10 49 6

Co-secant or arith. comp. sine	-	0.03660
Secant or arith. comp. cosine	-	0.00676
Nat. sine .97393 diff. .42575	log.	9.62711
Nat. sine .55018		
Log-rising, Table VIII	-	9.67047

4h. 22m. 28s. LONGITUDE in TIME, West.

SCHOLIUM.

In the two preceding problems the apparent time at the ship has been found from the altitude of the sun or star which was taken at the same time with the distances: but if the sun, or star, from which the moon's distance is observed, be near the meridian; or if, from the badness of the horizon, there be reason to suspect that such altitude is not exact enough for that purpose, which may sometimes be the case, and yet the altitude be sufficiently accurate for the purpose of clearing the observed distance from the effects of parallax and refraction; or if, from some local impediment, one, or both the altitudes, cannot be observed: then the times when those distances, or distances and altitudes were taken must be noted by a watch; and other altitudes, either of the sun or a bright star must be taken at a greater distance from the meridian, or when the horizon is more

Digitized by Google

distinct, and the times noted by the same watch, also the interval between the mean times of both observations (corrected for the rate of the watch, if known to lose or gain upon mean solar time; and to be strictly accurate, the difference in the equation of time, during the interval, must be allowed for); which interval if added or subtracted from the time at Greenwich, computed from the observed distance will give the time at Greenwich when the last-mentioned altitudes were taken for finding the time at the ship, from which the longitude may be found as before; and, if either of the altitudes could not be observed, it may be computed by problems XXI and XXII.

EXAMPLE 1.

July 12th, 1804, latitude 71° 10′ N. longitude 44° E. by account, the following observations were made in order to determine the ship's true Longitude, the height of the observer's eye being 27¼ feet.

Times by the watch.	Dist. limbs ☽ and ☉.	Alt. of the ☽'s lo. limb.	Alt. of the ☉'s lo. limb.	
h. m. s.	° ′ ″	° ′ ″	° ′ ″	
0 24 10	64 8 30	8 9 0	41 58 0	
26 46	9 40	18 0	56 0	
29 4	10 35	25 0	54 0	
31 33	11 40	34 0	51 0	
34 7	12 45	44 0	48 0	
5) 45 40	5). 190	5) .130	5)17.	
0 29 8	64 10 38	8 26 0	41 53 24	Means.
		0 0		Errors.
		— 5 12	— 5 12	Dip of horizon.
	31 5	+15 16	+ 15 47	☉'s semid. & ☽'s aug. semid.
	64 41 41	8 36 0	42 4 0	App. Distance & Altitudes.
		+ 49 5	— 57	Corr. refr. & par. tab. A, B & H.
		9 25 5	42 3 3	True Altitudes of ☽ & ☉.

	h. m. s.
Time at ship, 12th	0 30 0
Longit. in time, east	2 56 0
Ti. at Greenw. 11th	21 34 0
	′ ″
☽'s hor. par. N. 12th	55 51
(*diff.* —20″)	
Prop. for —2h. 26m. T.VI +	4
Correct. for latit. tab. F.	— 9
☽'s reduced hor. par.	55 46

Reduction of the Distance by Methods 3d and 4th, to prove each other.

	° ′ ″				° ′ ″		
☽ app. alts.	50 40 0 N. cos.	A	.633831	Diff. app. alt.	33 28 0 N. cos.	*a*	.834207
App. dist.	64 41 41 N. cos.	B	.427441	App. dist.	64 41 41 N. cos.	*b*	.427441
A + B & log.	0.025827	C	Nat. N. 1.061272	*a* — *b* log.	9.609344	*c*	Nat. N. .406766
Log. differ.	9.999125	D	Table *I.*	Log. diff.	- 9.999125	*d*	Table *I.*
C + D -	0.024952	Nat. N.	E 1.059138	*c* + *d* -	9.608469	Nat. N.	*e* .405947
	° ′ ″				° ′ ″		
☽ true alts.	51 28 8 N. cos.	F	.622940	Diff. true alt.	32 37 58 N. cos.	*f*	.842144
T. DIST.	64 8 18 N. cos.	E—F	.436198	T. DIST.	64 8 18 N. cos	*f* — *e*	.436197

The sun being too near the meridian for finding the time with sufficient accuracy by his altitude, the following altitudes were therefore taken in the afternoon; the ship's latitude at the same time being estimated N. 70° 57′, and the interval between the mean times of the two observations corrected for the rate of the watch, &c, was 2h. 29m. 49s.

Digitized by Google

Times by Watch.	*Altitude b* ⊙'s lower li.
h, m. s.	° ′ ″
2 55 37	35 1 0
2 57 11	34 55 0
2 58 49	34 48 0
3 0 29	34 41 0
3 2 14	34 33 0
5) 294 20	5) 238 0
Mean time by wa. 2 58 52	34 47 36
Ti. of obs. dist. 0 29 8	— 5 12 Dip.
Interv. by watch 2 29 44	— 1 12 Ref. — par.
Watch loses - - 5	+ 15 48 Semidiam.
True Interval 2 29 49	34 57 0 *Tr. Altit. b*

	° ′ ″	° ′ ″	
True dist.	64 8 18	⊙ 11 58	P.L. 1.1773
11th at 21h.	63 56 20	☽ 26 49	P.L. .3167
12th at N.	65 23 9		

	h. m. s.	
Proportional part -	0 24 49	diff. .8606
Preceding time, 11th	21 0 0	
Time at Greenw. of observed dist.		21 24 49
Interval of time to *altitude b* -		+ 2 29 49
TIME at GREENWICH of *Alt. b*, 11th		23 54 38

	° ′ ″
⊙'s DECL. 12th at noon N.	21 59 53
daily diff. — 8′ 9″	
Prop. part for — 5m. 22s. -	+ 2
Sun's reduced declin. N.	21 59 55

⊙'s decl. N. 21 59 55 ar. co. l. cos. 0.03283

Co-latit. N. 19 3 0 ar. co. l. sine 0.48626

Merid. alt. 41 2 55 N. S. .65670

⊙'s tr. alt. *b* 34 57 0 N. S. .57286

Difference of nat. sines - .08384 log. 8.92345

	h. m. s.	
App. ti. *alt. b* 12th	2 54 48	log-rising 9.44254
Greenw. time 11th	23 54 38	

LONGITUDE, East 3 0 10 = 45° 2′½.

The mean of the times when the *altit. b* was taken.

REMARK.

If the watch is known to gain or lose upon mean solar time, the proportional part must be allowed for the *interval*; and to be strictly accurate, the difference also in the equation of time; but if the watch cannot be depended upon, the time must be inferred from the moon's altitude at the time of the distance by problem XX. *Quere*, Might not an instrument be contrived with an allowance for temperature, as an hour-glass with quicksilver, to measure an interval of two or three hours mean solar time?

EXAMPLE 2.

September 14th, 1804, in latitude 17° 40′ S. and longitude 85° east, by estimation, several altitudes of the sun's lower limb were taken, with the times corresponding, preparatory to finding the longitude by the moon's distance from a fixed star; the mean of the times was 4h. 2m. 15s. and the mean altit. 26° 13′ 0″.—After sunset several distances were observed, between the ☽'s enlightened limb and Antares, with the corresponding alts. of each and times, the mean of the times was 10h. 1m. 24s. (making an interval of time from the first altitude of 5h. 59m. 9s. allowing for the rate of the watch) and the mean distance and altitudes as under. Required the *ship's Longitude*.

Time by the Watch.	Alt. *b* of ⊙'s lower limb.
h. m. s.	° ′ ″
4 2 15	26 13 0
Dip -	— 4 12
Refr. — par.	— 1 48
Semidiam.	+ 16 0
TRUE ALTITUDE	26 23 0

Time by the Watch.	Mean dist. of ☽ & Antares.	Altit. of ☽'s lower limb.	Altitude of Star.
h. m. s.	° ′ ″	° ′ ″	° ′ ″
10 1 24	42 5 50	61 40 46	19 54 12
Dip - -		— 4 12	— 4 12
Semidiam.	+ 15 26	+ 15 26	
App. dist. & alt.	42 21 16	61 52 0	19 50 0
(☽'s H. P. 55′ 52) refr. & par.		+ 25 51	— 2 37
TRUE ALTITUDES		62 17 51	19 47 23

f

Digitized by Google

	h.	m.	s.
Time by watch of observed dist.	10	1	24
Estimated longitude, east - -	5	40	0
Estimated time at Greenwich -	4	21	24

Reduction of Dist. by 4th Method.

		°	′	″			
Diff. app. alt.	42	2	0	N. cos.	A		.742755
App. dist.	42	21	16	N. cos.	B		.738991
A — B & log.	7.575650				C		.003764
Log. diff.	9.993957				D	Tables *I* & *L*.	
C + D -	7.569607			Nat. N.	E		.003712
Diff. true alt.	42	30	28	N. cos.	F		.737185
TR. DIST.	42	49	18		G	F — E	.733473
Dist. at 3h.	42	4	37		H		(N. cos.)
Dist. at 6h.	43	38	34		I		

G ~ H -	0	44	41	P. L.	.6051
I ~ H -	1	33	57	P. L.	.2824
	h.	m.	s.		
Prop. part	1	25	37	diff. P. L.	.3227
Preceding time	3	0	0		

		h.	m.	s.
Time at Greenw. of obs. dist.	14th	4	25	37
Interval to observed *altitude b*		—5	59	9
Time at Greenw. of obs. *alt. b*	13th	22	26	28

	°	′	″	
⊙'s decl. 13th N. (diff. —23′ 3″) N.	3	47	30	
Tab. VI (half time 11h. 13m.) prop.	—21	30		
⊙'s red. decl. N.	3	26	0	ar.co. cos. 0.00078
Co-latit. S.	72	20	0	ar.co. sine 0.02098
Merid. altit.	68	54	0	N. S. .93295
⊙'s true altit.	26	23	0	N. S. .44437
Diff. of Nat. sines and log. -				.48858 9.68894

	h.	m.	s.	
App. time -	4	3	36	log-rising 9.71076
Ap. ti. Greenw.	22	26	28	

LONGITUDE 5 37 8 = 84° 17′ EAST
(which is the ship's longitude at the time when the *altitude b* was taken.)

Or thus by the error of the watch.—

	h.	m.	s.
Apparent time of *altitude b* -	4	3	36
Time by watch - -	4	2	15
Watch too slow - -	0	1	21
Time by watch of observed distance	10	1	24
Apparent time of ditto	10	2	45
Time at Greenwich of ditto	4	25	37
LONGITUDE as before	East 5	37	8

(at the time when *altitude* was taken.)

PROBLEM XXVII.

Given the apparent Time at the Ship, and the Moon's Distance from the Meridian; to find the LONGITUDE from Greenwich.

RULE.

1. Set down from the Nautical Almanac the moon's and sun's right ascensions in degrees and minutes at the nearest time to the estimated time at Greenwich, and the noon and midnight preceding and following. Subtract the sun's right ascensions from the moon's, and set down the differences, with the first, second, and third differences, of their differences, as in problem XX.

2. *Add* the meridian distance if *East*, or *subtract* it if *West* from the apparent time at the ship; the sum or difference will be the difference of the moon's and sun's right ascensions at the time of observation. To which by problem III find the corresponding time at Greenwich from which the ship's longitude is known.

EXAMPLE.

On the 3d June, 1805, the moon's distance from the meridian was determined from her observed altitude (see problem XX) to be 3h. 14m. 25s. west, at 8h. 45m. 35s. apparent time; required the ship's Longitude?

N. B. *The time may be either found from the sun or star's altitudes, or the same observed altitude of the moon, by problem XX.*

Digitized by Google

1803, June	☽'s R. A.	⊙'s R.A. in c		☽'s R.A.—⊙'s		1st Diff.		2nd Diff.		3d Diff.
	° ′	° ′ ″		° ′ ″		° ′ ″		′ ″		′ ″
2nd, noon.	139 39	69 52 42	B	69 46 18	b'	6 3 24	b''	— 13 18	b'''	+ 2 24
midn.	146 13	70 23 18	C	75 49 42	c'	5 50 6	c''	— 10 54	c'''	+ 2 54
3d noon.	152 34	70 54 12	D	81 39 48	d'	5 39 12	d''	— 8 0		
midn.	158 44	71 25 0	E	87 19 0	e'	5 31 12				
4th noon.	164 46	71 55 48	F	92 50 12						

		h. m. s.	
Apparent time -	G	8 45 35	
Meridian distance, West	H	3 14 25	
☽'s R.A.— ⊙'s R.A. = G ± H		5 31 10	(+ *if E*, — *if W.*)
		° ′ ″	
G — H in degrees	I	82 47 30	
D Nearest diff. June 3d	K	81 39 48	
I — K	S	1 7 42	P. L. 12h.
$a' + \frac{1}{2}c'' - \frac{1}{12}(b''' + c''')$	M	5 44 12½	P. L. 12h.
		$s - m$	P. L. 12h.
		$a - m$	
$-\frac{1}{2}c'' = -N =$		+ 5′ 27″	P. L. 3h.
$a + b + n =$ *Correction*			P. L. 3h.

Then by Problem III.

$c' =$ - - 5° 50′ 6″

$N = \frac{1}{2}c'' =$ — 5 27

$-P = -\frac{b''' + c'''}{12} =$ — 26½

$M =$ Sum 5 44 12½

s	1.02674	
m	.32051	h. m. s.
a	.70623	2 21 35
b	.38572	
n	1.51388	
	2.61083	+ 26,5

Time at Greenwhich from noon, June 3d - - - 2 22 1,5

Apparent time at the ship - - - - 8 45 35

LONGITUDE in TIME, East - - - - 6 23 33,5

REMARK.

Should the observed difference of the sun and moon's right ascensions fall much nearer the 6th or 18th hour than noon or midnight, it would be somewhat more accurate first to calculate by Dr. Maskelyne's rule the difference of right ascensions at the near 6th or 18th hour, and put $M = d' - \frac{c'''}{24}$ and $N = \frac{c'' + d''}{4}$ (supposing the time to fall between D and E) and then proceed as above;—thus taking the same Example.

The diff. of R. A. at the 6th hour between D and E by Dr. Maskelyne's rule is $D + \frac{1}{2}d' - \frac{1}{16}\overline{c'' + d''} = 84° 30′ 35″$, which subtracted from (I) 82° 47′ 30″ = — 1° 43′ 5″ = S.

Then as above $S = -$ 1° 43′ 5″ P. L. 12h.

s	.84414		
m	.32703		
			h. m. s.
$s - m$ *(is —)*	a	.51711	P. L. 12h. — 3 38 53
$a - m$ *(is —)*	b	.19008	
n		1.58100	
$a + b + n$ *(is +)* *Correction*		2.28819	+ 0 56

$M = d' - \frac{1}{24}c''' =$ 5 39 4¾ P. L. 12h.

$-N = -\frac{1}{4}\overline{c'' + d''} =$ + 4′ 43″½ P. L. 3h.

Time at Greenwich *from the 6th hour* - - — 3 37 57

Or time from *noon* at Greenwich - - - - 2 22 3

Apparent time at the ship - - - - 8 45 35

LONGITUDE - - - - - - East 6 23 32

But this result is not so near the truth as that by the first operation, because the time happens to fall nearer noon than the 6th hour, otherwise this would have been the most accurate.

In this problem it is necessary to be acquainted with algebraic multiplication and division, as that two like signs make + and two unlike signs —, thus in the last method of operation, a and b having both negative numbers, & that of n being *positive*, their product, or the sum of their logs. is +, making the correction + 56s. which added to — 3h. 38m. 53s. is = — 3h. 37m. 57s.

Digitized by Google

The time most favourable for this problem is when the moon has little or no change in declination, as an approximate time is necessary in problem XX for finding both the moon's declination and horizontal parallax, and if not known sufficiently near, the operation must be repeated. To find the Longitude by the time of the moon's transit is included in this problem, the meridian distance in that case being 0.

PROBLEM XXVIII.

The Moon's true Distance from the Sun or fixed Star, or Planet, and the Latitude of each being given, to find the MOON's true LONGITUDE; (from which if the Apparent Time at the ship be also known, the Longitude of the Place may be easily found by problem III.)

EXAMPLE 1.

Suppose the moon's true distance from the sun on July 22, 1806, was 88° 37′ 35″ sun being West, and the moon's latitude 4° 32′ 45; required the moon's true Longitude.

	°	′	″			
Given distance	88	37	35	l. cos.	a	8,379700
Moon's latit.	4	32	45	l. cos.	b	9.998633
a—b diff. lon.	88	37	19	l. cos.		8,381067
Sun's long.	118	54	49	W. of ☽.		
					s ° ′ ″	
☽'s LONG.	207	32	8		= 6 27 32 8	

The reverse of this problem will serve to correct the ☽'s true distance from the ☉ or star as given in the N. A. for any known error in the tables of the ☽'s or ☉'s longitude.

By this problem the longitude may be found by the moon's distance from the sun, a star, or planet, whose distance is not given in the Nautical Almanac, provided the difference of latitude is not too great for the difference in longitude;—the following table is a proper limit.

D.Lat.	D. Lon.	D.Lat.	D. Lon.	D.Lat.	D. Lon.
°	° ′	°	° ′	°	° ′
5	10 0	14	26 46	22	46 52
7	12 49	16	31 12	24	53 52
10	18 34	18	35 56	26	61 46
12	22 35	20	41 6	28	73 48

EXAMPLE 2.

Suppose the moon's true distance from Antares on May 7, 1808, was 52° 32′ 28″, the star being *East*, and the moon's latitude 3° 11′ 10″ S. required the moon's true longitude.

	°	′	″		
Given dist.	52	32	28	a	*(star East)*
Moon's lat.	3	11	10	S. ar. co. l.cos.	0.000672
Star's latit.	4	32	22	S. ar. co. l.cos.	0.001364
Diff. *lat.*	1	21	12	b	
$\frac{1}{2}\overline{a+b}$	26	56	50	- log. sine	9.656261
$\frac{1}{2}\overline{a\sim b}$	25	35	38	- log. sine	9.635473
Sum of the four logarithms				c	19.295770
$\frac{1}{2}c$				D	0s. 26° 19′ 36″ log. sine 9.646885
2 D				E	1 22 39 12 Diff. of longit.

		S.	°	′	″
Star's mean lon. May 7, 1806		8	7	5	10,3
Equation of Equinoxes, table xliv				+	14,1
Aberration - table xlv				+	19
Star's true longitude *East*	F	8	7	5	43,4
Difference of longitude *E.*	G	1	22	39	12
☽'s TRUE LONGIT. F ± G		6	14	26	31

PROBLEM XXIX.

Given the meridian Altitude of either Limb of the Moon, when the Change in Declination is about the greatest, also the Latitude and Longitude by Account of the Place of Observation, to find the LONGITUDE of the Place.

EXAMPLE.

November 13th, 1804, in latitude 48° 35′ 25″ N. and long. by account 1h. 20m. West, the greatest altitude of the moon's lower limb was 48° 35′ 39″, the height of the observer's eye 14 feet; required the Longitude of the place.

Digitized by Google

	h.	m.	s.
☽ 's transit at Greenwich, N. Alm.	8	42	0
(da. var. + 51m.) p. p. lon. 1h. 20m.		2	50
Time of moon's transit at ship -	8	44	50
Longitude by account, in time	W. 1	20	0
TIME at GREENWICH -	10	4	50

	′	″
Moon's hor. par. at noon, N. Almanac	59	3
Var. + 29″ prop. part for 10h. 5m.	+	24
Reduc. for latit. 45° 35′, table F -	—	5
Moon's reduced hor. par. -	59	22

	°	′	″
Apparent altitude	48	29	30
*Correction, tab. F	+ 10	18	
☽ 's spheroidal alt.	48	39	48
Correc. of ☽ 's spheroid. altit. tab. H	+	39	21

* *If the* ☽ *'s transit is on side of elevat. pole* —

		°	′	″
☽ 's ch. of decl. in 12h. at midn.	A	3	4	30
Change in one minute -	a		0	15,4
Table XVIII, lat. 45° 55′, declin. 5°	b		0	2,1
$aa \div 4\,b$ = difference between the greatest and meridian altitude	c		0	28

* *See note at the bottom of pages* 24 *and* 25.

	°	′	″
Observed altit. of moon's lower limb	48	33	39
Dip of the horizon - -	—	3	41
App. altit. of moon's lower limb	48	29	58
Spheroidal correction, table H	+	39	21
True altitude of moon's lower limb	49	9	19
Correction | *c* | of greatest altitude	*	—	28
Merid. altit. of ☽ 's lower limb -	49	8	51
Moon's semidiameter - -	+	16	12
True meridian alt. of moon's center	49	25	3
Co-latitude - -	44	24	35
Moon's declination -	N. 5	0	28
Declin. at midn. N. Alman. (*incr.*)	N. 5	30	0
Difference - - -	0	29	32

Diff. - 0° 29′ 32″ P. L. 3h. .78496
☽ 's var. A 3 4 30 P. L. 12h. .59128

	h.	m.	s.		
Ti. *bef.* midn.	1	55	14	P. L. 12h. diff.	.19368

	h.	m.	s.
Apparent time, 12h.—1h.55m.14s. =	10	4	46
Time at ship - -	8	44	50
LONGITUDE in TIME -	1	19	56

= 19° 59′ West.

REMARK.

Here the *time* of the moon's greatest altitude was 3m. 40s. after the moon's center had passed the meridian.

PROBLEM XXX.

To find the DIFFERENCE *in* LONGITUDE *of two Places by the observed Intervals of time between the* TRANSITS *of the Moon and a fixed Star over the Meridian of each Place.*

RULE.

1. Set down the moon's right ascensions from the Nautical Almanac for the nearest noon or midnight to the *middle time* at Greenwich by estimation between the two transits of the moon over the two meridians, also the moon's right ascensions for the noon or midnight preceding and following, with their two first differences and second difference.

Then the *first* first difference will be the *rate of the moon's increase* in R. ascen. *in* 12 *hours* at the VIth or XVIIIth hour between the noon and midnight where it stands; to which add for the rate of increase at any succeeding time *(as the middle time between the moon's two transits)* the additional *time in hours* multiplied by the second difference and divided by 12; which is also readily done by table VI;—let the rate of increase so found be called A.

Call B the increase of the moon's right ascension between the times of its transits at both places (which is equal to the *difference* or *sum* in sidereal time of the intervals between the moon and star's transit at each place, according as the moon happens to be on the *same* or on a *different* side of the star at the times of her transit.)

Call C the variation of the equation of time *for* 12 *hours* from the Nautical Almanac page II.

Then as A : B :: (D =) 12h. 1m. 58s. — A ± C : the DIFFERENCE of LONGITUDE; where

Digitized by Google

PROBLEM XXIV.

Having the apparent or observed Distance of the MOON *from the* SUN *or fixed* STAR, *together with the observed Altitude of each, and the Moon's Horizontal Parallax, to find their* TRUE DISTANCE.

METHOD 1.

Of reducing the APPARENT to the TRUE distance, by a very near approximation, will be easily understood by the form being registered.

EXAMPLE 1.

Given the apparent distance of the moon from a star, and the following apparent altitudes;—to find their TRUE DISTANCE.

		° ′ ″					° ′ ″		
App. dist.	A	43 35 42	tab. H, cor. 52′ 6″		☽'s app. alt.	L	9 38 0	l. sine	9.2236
☽'s app. alt.	B	9 38 0							
*'s app. alt.	C	11 17 0			K	M	57 10 0	l.tan.	10.1905
					☽'s hor. par.	N	54 42	P. L.	0.5173
B + C	D	20 55 0		logar's.					
½ D	E	10 27 30	tan	9.2662					
E ~ C	F	0 49 30	cot	11.8417	m + n − l	O	5 54	P. L.	1.4840
½ A	G	21 48 0	tan	9.6020	Refrac. of K	P	37		
e + f + g − 20	H	78 58 0	tan	10.7099	3 * ± O − P	Q	1st *correction*	—	0° 5′ 17″
					4 * ± *refr.* of I, 2d *correction*			-	+ 11
1 * G + ~ H	I	100 46 0	(79° 14′ 0″)		5 * ± table XXIX, 3d *corr.*			-	+ 26
					Apparent distance			- -	43 35 42
2 * G ~ + H	K	57 10 0			TRUE DISTANCE				43 31 2

EXAMPLE 2.

		° ′ ″					° ′ ″		
App. dist.	A	90 21 13	Table H, cor. 52′ 9″		☽'s app. alt.	L	5 17 0	l.sin.	8.9642
☽'s app. alt.	B	5 17 0							
⊙'s ap. alt.	C	84 7 0			K	M	5 17 14	l.tan.	8.9662
					☽'s hor. par.	N	61 48	P. L.	0.4643
B + C	D	89 24 0		logar's					
½ D	E	44 42 0	tan	9.9954					
E ~ C	F	39 25 0	cot	10.0852	n + m − l	O	1 1 30	P. L.	0.4663
½ A	G	45 10 36	tan	10.0027	Refr. of K	P	9 27		
e + f + g − 20	H	50 27 50	tan	10.0833	3 * ± O − P	Q	1st *correction*	—	52′ 3″
					4 * ± *ref.* of I (− ⊙ *par.*) 2d *cor.*				+ 5
1 * G + ~ H	I	95 38 26	(84° 21′ 34″)		5 * ± table XXIX, 3d *corr.*			-	0
					Apparent distance			- -	90 21 13
2 * G ~ + H	K	5 17 14			TRUE DISTANCE				89 29 15

1 * Add *when* C *is greater than* B, *otherwise subtract.*

2 * Subtract *when* C *is greater than* B, *otherwise* add.

3 * Subtract *when either* I or K *exceeds* 90°, *or when* I *is greater than* K, *otherwise* add.

4 * Add *when either* I *or* K *exceeds* 90°, *or when* I *is* less *than* K, *otherwise* subtract.

5 * *The top argument to table* XXIX, *is the apparent distance corrected by* Q, *and the two side arguments are* Q *and the correction of the moon's altitude, by means of table H, as seen at* B; *the difference of the corresponding numbers found in the table, are to be applied* — *or* +, *according as* A *is more or less than* 90°.

Digitized by Google

METHOD 2, *by the Editor.*

Of reducing the APPARENT to the TRUE DISTANCE, with a *proof.*

In this method it is necessary to remember the following rules:—

1. *That the Natural co-sines of arcs above* 90°, *are equal to the Natural sines of their excess above* 90° *with a negative or contrary sign.*

2. *The sum of an affirmative and a negative number, is the difference of the numbers with the sign of the greater number.*

3. To *subtract* any *number from another*, first change its sign and then *add, by the second rule.*

4. To *add* or *subtract Logarithms*, reject the multiples of 10 in the *index*, or borrow 10 when necessary. (See explanation of Table 1. *second scale* of *Logarithms*).

EXAMPLE 1.

	° ′ ″		′ ″		° ′ ″
☽'s appar. altit.	12 30 0	H. par. 56 15, *Cor.* Table H,	+ 50 42	True altit.	13 20 42
☀'s appar. altit.	24 48 0	*Refraction*, Table A - -	— 2 3	True altit.	24 45 57

	° ′ ″		Nat. Cosines.		Numbers.			Logarithms.
Sum appar. altit's	37 18 0	A	.795473	A — B	+ .008655	F		
Sum true altit's	38 6 39	B	.786818	C — D	— .003153	G		
Diff. appar. altit's	12 18 0	C	.977046	F + G	.005502		*h*	7. 7405
Diff. true altit's	11 25 15	D	.980199	A + C	1.772519	I	*i*	0. 2486
APPAR. DIST.	51 28 35	E	.622837	*h* — *i*			*k*	7. 4919
Correct. F — M, or O — G			+ 4252	A + E	1.418310	L	*l*	0. 1518
TRUE DIST.	51 9 51		.627089	*l* + *k*	.004403	M		7. 6437

PROOF. { C — E = I — L ‖ I — L | .354209 | | *n* | 9. 5493
O + M = F + G ‖ *n* + *k* | .001099 | O | | 7. 0412

EXAMPLE 2.

	° ′ ″		′ ″		′ ″		° ′ ″
☽'s appar. altit.	41 6 2	Hor. par. 58 35	*Corr. Tab.* H,	+ 43 4	True altit.	41 49 6	
☉'s appar. altit.	19 3 36	*Refr.* — *Par.*	Tab. A and B	— 2 36	True altit.	19 1 0	

	° ′ ″		Nat. Cosines.		Numbers.			Logarithms
Sum appar. altit's.	60 9 38	A	.497572	A — B	.010245	F		
Sum true altit's.	60 50 6	B	.487327	C — D	.005065	G		
Diff. appar. altit's.	22 2 26	C	.926917	F + G	.015310		*h*	8.1850
Diff. true altit's	22 48 6	D	.921852	A + C	1.424489	I -	*i*	0.1537
APP. DIST. -	103 29 27	E	—.233289	*h* — *i*			*k*	8.0313
Correction F — M, or O — G			+ 7405	A + E	.264283	L -	*l*	9.4221
TRUE DIST.	103 3 18		—.225894	*l* + *k*	.002840	M		7.4534

PROOF. { C — E = I — L ‖ I — L | 1.160206 | | *n* | 0.0645
O + M = F + G ‖ *n* + *k* | .012470 | O | | 8.0958

If O + M = F + G, *and* I — L = C — E, *there can be no probable error in adding and subtracting, or taking out the logarithms.*

Digitized by Google

EXAMPLE 3.

☽'s app. alt.	66 33 40	Hor. par.	61 13½	*Corr.* tab. H.	+ 23 56	True alt.	66 57 36
☀'s app. alt.	43 13 18	*Refraction*, table A	- -		— 1 1	True alt.	43 12 17

			Nat. Cos.		Numbers.			Logar'ms.
Sum app. altit's	109 46 58	A	— .338455	A — B	.006265	F		
Sum true altit's	110 9 53	B	— .344720	C — D	.002899	G		
Diff. app. altit's	23 20 22	C	.918173	F + G	.009164	-	*k*	7.9621
Diff. true altit's	23 45 19	D	.915274	A + C	.579718	I	- *i*	9.7632
APP. DISTANCE	45 3 58	E	.706290	*k* — *i*		-	*k*	8.1989
Correction F — M = O — G			+ .000450	A + E	.367335	L	- *l*	9.5656
TRUE DISTANCE	45 1 47		.706740	*l* + *k*	.005813	M		7.7645

PROOF. { C — E = I — L | O + M = F + G } | I — L .211883 - - *n* 9.3261 | *n* + *k* .003350 O - 7.5250

METHODS 3 & 4, *by means of Table I (Logarithmic Difference.)*
The Altitudes and Distance as in the last Example.

METHOD 3.

S. app. alts.	109 46 58 N.cos.	A	—.338455	Diff. app. alt.	23 20 22 N. cos.
App. dist.	45 3 58 N.cos.	B	+.706290	App. dist.	45 3 58 N. cos.
A+B & log.	9.565653	C	Nat. N. .367835	*a* — *b* log.	9.326096
Log. differ.	9.993078	D	Table *I*	Log. diff. -	9.993078
C + D -	9.558731	Nat. N.	E	.362019	*c* + *d* - 9.319174 Nat. N.
S. true alt.	110 9 53 N.cos.		F	—.344720	Diff. true alt. 23 45 19 N.cos.
T. DIST.	45 1 47 N.cos.		E — F	.706739	T. DIST. 45 1 47 N. cos.

METHOD 4.

Diff. app. alt.	23 20 22 N. cos.	*a*	+.918173
App. dist.	45 3 58 N. cos.	*b*	+.706290
a — *b* log.	9.326096	*c*	Nat. N. .211883
Log. diff. -	9.993078	*d*	Table *I*
c + *d* -	9.319174 Nat. N.	*e*	.208533
Diff. true alt.	23 45 19 N.cos.	*f*	.915274
T. DIST.	45 1 47 N. cos.	*f* — *e*	.706741

REMARK.

Instead of *Natural Cosines* NATURAL VERSED SINES may be substituted in both these methods; in which case, the supplement of the sum of the apparent and true altitudes should be taken; or, what is the same, the sum of the apparent and true zenith distances, instead of the altitudes: and by this means *negative* signs would be avoided. Thus,

S. app. alt.	109 46 58 Vers. sup.	A	.661545	App. dist.	45 3 58 N. V. S.
App. dist.	45 3 58 N. V. sine	B	.293710	Diff. ap. A.	23 20 22 N. V. S.
A—B & log.	9.565653	C	Nat. N. .367835	*a* — *b* & log.	9.326096
Log. diff. -	9.993078			Log. diff.	9.993078
C + D	9.558731	Nat. N.	E	.362019	*c* + *d*
S. true alt.	110 9 53 Vers. sup.		F	.655280	Diff. Tr. alt. 23 45 19 N. V. S.
T. DIST.	45 1 47 N. V. S.		F — E	.293261	T. DIST. 45 1 47 N. V. S.

App. dist.	45 3 58	N. V. S.	*a* .293710
Diff. ap. A.	23 20 22	N. V. S.	*b* .081827
a — *b* & log.	9.326096	*c* Nat. N.	.211883
Log. diff.	9.993078	*d*	
c + *d*	9.319174	Nat. N.	*e* .208533
Diff. Tr. alt.	23 45 19	N. V. S.	*f* .084726
T. DIST.	45 1 47	N. V. S.	*f* + *e* .293259

This is Dr. MACKAY'S *method. Vide his Treatise on the Longitude.*

Digitized by Google

The difference of the cosines of two arcs being equal to twice the sine of half their sum multiplied by the sine of half their difference. Also, The sum of the cosines of two arcs equal to twice the cosine of half their sum multiplied by the cosine of half their difference, the above two methods can be thus varied.

1st VARIETY.

Sum app. alt.	109	46	58	half is	A	54	53	29
App. dist.	45	3	58	half is	B	22	31	59

A + B	77 25 28	Log. cos.	9.337912		
A ~ B	32 21 30	Log. cos.	9.926711		
Log. difference, table *I.*			9.993078		
Logarithm of 2			0.301030		
Sum of the four logarithms		—20	9.558731		
Number corresponding				C	.362019
Sum tr. alts. 110° 9′ 53″ N. cos.				D	—.344720
T. DIST.	45 1 47 N. cos.			C—D	.706739

2d VARIETY.

Diff. app. alt.	23	20	22	half is	*a*	11	40	11
App. dist.	45	3	58	half is	*b*	22	31	59

a + *b*	34 12 10	log. sine	9.749832		
a ~ *b*	10 51 48	log. sine	9.275235		
Log. diff. table *I*			9.993078		
Logarithm of 2			0.301030		
Sum of the four logarithms		—20	9.319175		
Number corresponding				*c*	.208533
Diff. true alt. 23° 45′ 19″ N. cos.					.915274
T. DIST.	45 1 47 N. cos.			*d*—*c*	.706741

From these are easily derived the following with logarithmic sines only.

3d VARIETY.

A + B	77 25 28	log. cos.	*a*	9.337912	
A ~ B	32 21 30	log. cos.	*b*	9.926711	
Log. difference, table *I*			*c*	9.993078	
a + *b* + *c* — 10			*d*	19.257701	
½ *d*	64 49 15		*e*	l. cos.	9.628850
½ sum, tr. alt.	55 4 56		*f*		
e + *f*	119 54 11	log. sine	*g*	9.937954	
e ~ *f*	9 44 19	log. sine	*h*	9.228281	
g + *h*			*i*	19.166235	
½ *i* | *k* |	22 30 54	log. sine		9.583118	
2 *k* =	45 1 48	TRUE DISTANCE.			

4th VARIETY.

a + b	34 12 10	log. sine	a	9.749832	
a ~ b	10 51 48	log. sine	b	9.275235	
Log. difference, table *I*			c	9.993078	
a + b + c — 10			d	19.018145	
½ d	18 50 19		e	log. sine	9.509072
½ diff. tr. A.	11 52 40		f		
e + f	30 42 59	log. cos.	g	9.934350	
e ~ f	6 57 39	log. cos.	h	9.996787	
g + h			i	19.931137	
½ i | k |	22 30 54	log. cos.		9.965568	
2 k	45 1 48	TRUE DISTANCE.			

As these are the varieties of this problem that have been most approved of by different writers, they are here applied to the same example to shew their affinity to each other, and to exercise the reader. The two first are perhaps preferable from not requiring any but the common tables. The third and fourth, with natural cosines or versed sines, and table *I*, of logarithmic difference, seem the shortest. Two graphical solutions are also given in *Clarke's Seaman's Desiderata.*

PROBLEM XXV.

To find the LONGITUDE of a Ship at Sea by Observations of the Moon's Distance from the Sun, and their Altitudes, taken at the same time: the Latitude of the Ship, and its Longitude by Account, being also known.

RULE.

Turn the longitude of the ship, by account, into time, and if it be west, add it to, but if it be east, subtract it from the estimated time at the ship, when the observation was made, and it will give the time at Greenwich nearly.

To this time take the moon's semidiameter and her horizontal parallax from page VII of the Nautical Almanac; also the sun's semidiameter for the day from page III, and augment the moon's semidiameter by adding to it the number of seconds found in table D with her observed altitude.

Digitized by Google

Correct the observed distance by adding to it the semidiameter of the sun, and the augmented semidiameter of the moon: correct also the observed altitudes, by subtracting the dip of the horizon, taken out of table C, with the height of the observer's eye above the surface of the sea, and adding, or subtracting the semidiameter of the object, according as the altitude of the lower or upper limb was observed; and the apparent distance and altitudes of the centers of the sun and moon will be obtained.

With the apparent distance, and the two apparent altitudes, find the true distance by any of the methods before given in problem XXIV.

Among the distances of the moon's center from the sun and fixed stars, put down on pages VIII, IX, X, and XI. of the Nautical Almanac, find those two distances of the sun and moon which are next less and next greater than the true distance, found from the observation: take the difference between them; also between that which stands first in the Ephemeris, and the true observed distance, and subtract the proportional logarithm of the former difference from the proportional logarithm of the latter; the remainder will be the proportional logarithm of a portion of time, to be added to the time which the distance, standing first in the Ephemeris, was computed for, and the sum will be the apparent time at Greenwich.

To this time take the sun's declination out of page II of the Nautical Almanac; and correct the apparent altitude of the sun's center by subtracting from it the difference between the refraction of the sun and its parallax in altitude, taken out of tables A and B: with these, and the ship's latitude, find the apparent time at the ship by problem XVIII.

Take the difference between the apparent time at Greenwich and the apparent time at the ship, convert it into degrees and minutes by the help of table XI, and it will be the true longitude of the ship at the time of observation: east, if the time at the ship be greater than the time at Greenwich, but west, if the time at the ship be less than the time at Greenwich.

EXAMPLE.

April 18th, 1793, about a quarter past 3 o'clock, latitude 0° 31′ S. longitude by account 95° W. the following observations were made for finding the true longitude of the ship, the height of the observer's eye being 19¾ feet above the surface of the sea. *Note*, 14″ must be subtracted from the distance, and 1′ 9″ added to the sun's altitude for the errors of the quadrants.

Dist. of ☽ and ☉'s nea. limbs.	Altitudes of ☽'s upper L.	Altitude of ☉'s lower L.	
° ′ ″	° ′ ″	° ′ ″	
96 58 15	27 0 0	41 52 30	
58 30	8 0	43 0	
59 0	15 15	33 45	
59 15	31 0	21 30	
59 45	44 0	10 0	
5) 44 45	5) 98 15	5) 160 45	Sums.
96 58 57	27 19 39	41 32 9	Mean distance and altitudes.
Sub. - 14	- - -	Add 1 9	Errors of the quadrants.
- - -	Sub. 4 22	Sub. 4 22	Dip of the horizon.
Add 30 54	Sub. 14 56	Add 15 58	☽'s augmented semid. and ☉'s semidiameter.
97 29 37	27 0 21	41 44 54	Apparent Distance and Altitudes.
	+ 46 37	— 57	Correction for refraction and parallax, tab. A & H
	27 46 58	41 43 57	True Altitudes of Moon and Sun.

	h. m.
Estimate time at ship - -	3 15
Longitude in time - -	W. 6 20
Estimate time at Greenwich, 18th D. -	9 35
	′ ″
☽'s hor. par. N. A. (diff. 5″) -	54 20
Table VI, prop. for 9h. 35m. -	+ 4
Table F, reduction for latitude -	— 0
☽'s reduced horizontal parallax -	56 24

Digitized by Google

Reduction of Distance by the second Method.

	° ′ ″		Nat. Cosines.		Numbers.			Logarithms.
Sum app. alts.	68 45 15	A	.362370	A — B	.012412	F		
Sum true alts.	69 30 55	B	.349958	C — D	—.003428	G		
Diff. app. alts.	14 44 33	C	.967079	F + G	.008984	-	h	7.9535
Diff. true alts.	13 56 59	D	.970507	A + C	1.329449	I	- i	0.1237
APP. DIST.	97 29 37	E	—.130416	$h - i$		-	- k	7.8298
Correction F — M = O — G			+ .010845	A + E	.231954	L	- l	9.3654
TR. DIS. P	96 52 2½		—.119571	$l + k$	.001567	M		7.1952
At 9 h. Q	96 38 0		*Proof.*	I — L	1.097495	-	n	0.0404
At 12 R	97 59 18		C — E = I — L O + M = F + G	$n + k$	.007417	O		7.8702

					° ′ ″
P ~ Q	-	0 14 3	P. L. 1.1076 s	⊙'s Decl. N. A. (diff. + 21′ 10″)	N. 11 4 59
R ~ Q	-	1 21 18	P. L. 0.3452 t	Table VI, prop. for 9h. 31m. (*half*)	- + 8 26
		h. m. s.			
s — t	-	0 31 6½	P. L. 0.7624	⊙'s reduced declination	- N. 11 13 25

Preceding time	- 9 0 0	⊙'s declin.	N. 11 13 25	-	Ar. comp. cos.	0.00839
		Co-latitude	S. 89 29 0	-	Ar. comp. sine	0.00002
Time at Greenw.	9 31 6½					
		Merid. altit.	78 15 35	Nat. sine .97908		
App. time	- 3 8 29	⊙'s true alt.	41 43 67	Nat. sine .66565		
LONG. in ti. W.	6 22 37½			.31343	- log.	9.49614

Apparent time, 3h. 8m. 29s. Table VIII. log. rising 9.50455

PROBLEM XXVI.

To find the LONGITUDE of a Ship at Sea by Observations of the Moon's Distance from a known fixed Star, and their Altitudes, taken at the same Time; the Latitude of the Ship and its Longitude by Account being also known.

RULE.

Turn the longitude of the ship by account into time, and, if it be west, add it to; but if it be east, subtract it from the estimated time at the ship when the observation was made, and it will give the time at Greenwich nearly.

To this time take the moon's semidiameter and her horizontal parallax from page VII of the Nautical Almanac; and augment the moon's semidiameter by adding to it the number of seconds which stand against her altitude in table D.

Correct the observed distance by adding the augmented semidiameter of the moon to it, if the enlightened limb of the moon be that which is nearest to the star, or by subtracting the augmented semidiameter of the moon from it, if the enlightened limb of the moon be that which is farthest from the star; and the result will be the apparent distance of the star from the moon's center: correct also the two altitudes, by subtracting the dip of the horizon from each, and by adding the

Digitized by Google

augmented semidiameter of the moon to, or subtracting it from, the moon's observed altitude, according as the lower or upper limb was observed, and the apparent distance of each will be obtained.

With the apparent distance and the two apparent altitudes, find the true distance by any of the methods in problem XXIV.

Among the distances of the ☽ 's center from the sun and fixed stars, put down on p. VIII, IX, X, and XI, of the N. Almanac, find those two distances of the moon and star which are next less and next greater than the true distance, found from the observation; take the difference between them; also between that which stands first in the Ephemeris and the true observed distance, and subtract the proportional logarithm of the former difference from the proportional logarithm of the latter: the remainder will be the proportional logarithm of a portion of time, to be added to the time which the distance standing first in the Ephemeris was computed for, and the sum will be the apparent time at Greenwich.

Take the star's right ascension and declination for the date of the observation from table XXX, and correct its apparent altitude by subtracting the refraction from table A from it. With these and the latitude of the ship find the apparent time at the ship by problem XIX.

Take the difference between the apparent time at Greenwich and the apparent time at the ship, convert it into degrees and minutes, and it will be the true longitude of the ship at the time of observation: east, if the time at the ship be greater than the time at Greenwich; but west, if the time at the ship be less than the time at Greenwich.

EXAMPLE.

May 6th, 1794, about 6h. 25m., latitude 23° 11′⅔ S. longitude by account 66° W. the following distances of the moon's remote limb from the Virgin's Spike were observed to determine the true longitude of the ship; the height of the observer's eye above the surface of the sea being 19¾ feet. *Note*, 43″ must be subtracted from the distance, 21′ 30″ from the star's altitude, and 5′ 0″ added to the moon's altitude for the errors of the quadrants.

Dist. ☽ 's rem. L. from star.	Alt. Moon's lower l mb.	Star's Altitude.	
° ′ ″	° ′ ″	° ′ ″	
64 22 45	50 51 30	32 25 0	
21 45	46 0	33 22 30	
20 0	42 0	34 19 30	
18 15	34 30	35 13 15	
4) 82 45	4)174 0	4) 15 20 15	Sums.
64 20 41	50 43 30	33 50 4	Mean distance and altitudes.
— 43	+ 5 0	— 21 30	Errors of the quadrants.
- -	— 4 22	— 4 22	Dip of the horizon.
— 15 11	+ 15 11		Moon's augmented semidiam. N. A. and tab. D.
64 4 47	B 50 59 19	C 33 24 12	APPARENT DISTANCE and ALTITUDES.
	A + 33 51	— 1 26	Correction, tables H & A.
	51 34 10	33 22 46	TRUE ALTITUDES of MOON and STAR.

	h.	m.
Estimate time at ship - -	6	25
Longitude in time - -	W. 4	24
Estimate time at Greenwich -	10	49
Moon's hor. par. (diff. + 7″) -	54′	55″
Prop. for 10h. 19m. table VI -	+	6
Reduction for latitude, table F -	—	1½
Moon's reduced horizontal parallax -	54	59½

Digitized by Google

Reduction of the Distance by the first Method.

B + C	D	84 23 31	
½ D	E	42 11 46	l. tan. e 9.9574
E ~ C	F	8 47 34	l. cot. f 10.3106
½ A	G	32 2 23	l. tan. g 9.7965
$e+f+g$ − 20	H	74 45 10	l. tan. 10.5645
G + H	I	42 42 47	(C < B *is* −)
G ~ H	K	106 47 33	(73° 12′ 27″)

☽'s app. alt.	50 59 19	l. sine. t	9.8904
K	73 12 27	l. tan. m	10.5203
☽'s hor. par.	54 59½	P. L. n	0.5150
$n+m-l$	⊙ 12 53	P. L.	1.1449
Refrac. of K	P 17		

1st Corr. ± ⊙ − P (K > 90°) Q	− 12 36
2d Correction, refraction of I -	+ 1 1
3d Corr. table XXIX, Q & A 5″ − 1″ =	+ 0 4
Apparent distance - -	64 4 47
TRUE DISTANCE - R	63 53 16

Star's R. A. table XXX, 1805 (*diff.* +3″,14) -	13 14 56	
Prop. for 10,6 years (*before*) -	− 33	
Star's reduced R. A. -	13 14 23	
Star's decl. 1805 (*diff.* + 19″)	S. 10 8 15	
Prop. for 10,6 years (*before*)	− 3 20	
Star's reduced declination	S. 10 4 55	
Sun's R. A. at noon (*diff.* 3m. 50s.)	2 54 30,8	
Prop. for 10h. 49m. -	+ 1 44	
Sun's reduced R. A. -	2 56 15	
☽'s R.A — ⊙'s R.A. -	10 18 8	

Distance at 9h. -	S	64 47 53	
at 12h. -	T	63 17 47	
S ~ R	u	.5179 P. L.	0 54 37
S ~ T	w	.3005 P. L.	1 30 6
$u-w$ prop. p. .2174 P. L.			1 49 6
Preceding time -			9 0 0
TIME at GREENWICH, May 6 -			10 49 6

Co-latitude - -	S. 66 48 20	Co-secant or arith. comp. sine -	0.03660
Star's declination -	S. 10 4 55	Secant or arith. comp. cosine -	0.00676
Meridian altitude -	76 53 15	Nat. sine .97393	
		diff. .42375	log. 9.62711
True altitude - -	33 22 46	Nat. sine .54018	
	h. m. s.		
Meridian distance east - -	3 51 30	Log-rising, Table VIII -	9.67047
☽'s R. A. — ⊙'s R. A. -	10 18 8		
Apparent time at ship -	6. 26 38	4h. 22m. 28s. LONGITUDE in TIME, West.	
Time at Greenwich, May 6	10 49 6		

SCHOLIUM.

In the two preceding problems the apparent time at the ship has been found from the altitude of the sun or star which was taken at the same time with the distances: but if the sun, or star, from which the moon's distance is observed, be near the meridian; or if, from the badness of the horizon, there be reason to suspect that such altitude is not exact enough for that purpose, which may sometimes be the case, and yet the altitude be sufficiently accurate for the purpose of clearing the observed distance from the effects of parallax and refraction; or if, from some local impediment, one, or both the altitudes, cannot be observed: then the times when those distances, or distances and altitudes were taken must be noted by a watch; and other altitudes, either of the sun or a bright star must be taken at a greater distance from the meridian, or when the horizon is more

Digitized by Google

distinct, and the times noted by the same watch, also the interval between the mean times of both observations (corrected for the rate of the watch, if known to lose or gain upon mean solar time; and to be strictly accurate, the difference in the equation of time, during the interval, must be allowed for); which interval if added or subtracted from the time at Greenwich, computed from the observed distance will give the time at Greenwich when the last-mentioned altitudes were taken for finding the time at the ship, from which the longitude may be found as before; and, if either of the altitudes could not be observed, it may be computed by problems XXI and XXII.

EXAMPLE 1.

July 12th, 1804, latitude 71° 10′ N. longitude 44° E. by account, the following observations were made in order to determine the ship's true Longitude, the height of the observer's eye being 27¾ feet.

Times by the watch.	Dist. limbs ☽ and ☉.	Alt. of the ☽'s lo. limb.	Alt. of the ☉'s lo. limb.
h. m. s.	° ′ ″	° ′ ″	° ′ ″
0 24 10	64 8 30	8 9 0	41 58 0
26 46	9 40	18 0	56 0
29 4	10 35	25 0	54 0
31 33	11 40	34 0	51 0
34 7	12 45	44 0	48 0
5) 45 40	5). 190	5) .130	5)17.
0 29 8	64 10 38	8 26 0	41 53 24
		0 0	
		— 5 12	— 5 12
	31 5	+15 16	+ 15 47
	64 41 41	8 36 0	42 4 0
		+ 49 5	— 57
		9 25 5	42 3 3

	h.	m.	s.
Time at ship, 12th	0	30	0
Longit. in time, east	2	56	0
Ti. at Greenw. 11th	21	34	0
	′	″	
☽'s hor. par. N. 12th (*diff.* —20″)	55	51	
Prop. for —2h. 26m. T.VI +	4		
Correct. for latit. tab. F. —	9		
☽'s reduced hor. par.	55	46	

Sums.

Means.
Errors.
Dip of horizon.
☉'s semid. & ☽'s aug. semid.

App. Distance & Altitudes.
Corr. refr. & par. tab. A, B & H.

True Altitudes of ☽ & ☉.

Reduction of the Distance by Methods 3d and 4th, to prove each other.

S. app. alts.	50 40 0	N. cos.	A	.633831	Diff. app. alt.	33 28 0	N. cos.	a	.834207
App. dist.	64 41 41	N. cos.	B	.427441	App. dist.	64 41 41	N. cos.	b	.427441
A + B & log.	0.025827		C	Nat. N. 1.061272	a — b log.	9.609344		c	Nat. N. .406766
Log. differ.	9.999125		D	Table I.	Log. diff. -	9.999125		d	Table I.
C + D -	0.024952	Nat. N.	E	1.059138	c + d -	9.608469	Nat. N.	e	.405947
	° ′ ″					° ′ ″			
S. true alts.	51 28 8	N. cos.	F	.622940	Diff. true alt.	32 37 58	N. cos.	f	.842144
T. DIST.	64 8 18	N. cos.	E—F	.436198	T. DIST.	64 8 18	N. cos	f — e	.436197

The sun being too near the meridian for finding the time with sufficient accuracy by his altitude, the following altitudes were therefore taken in the afternoon; the ship's latitude at the same time being estimated N. 70° 57′, and the interval between the mean times of the two observations corrected for the rate of the watch, &c, was 2h. 29m. 49s.

Digitized by Google

Times by Watch.	*Altitude b* ⊙'s lower li.
h. m. s.	° ′ ″
2 55 37	35 1 0
2 57 11	34 55 0
2 58 49	34 48 0
3 0 29	34 41 0
3 2 14	34 33 0
5) 294 20	5) 238 0
Mean time by wa. 2 58 52	34 47 36
Ti. of obs. dist. 0 29 8	— 5 12 Dip.
Interv. by watch 2 29 44	— 1 12 Ref. — par.
Watch loses - - 5	+ 15 48 Semidiam.
True Interval 2 29 49	34 57 0 *Tr. Altit. b*

	° ′ ″	° ′ ″	
True dist.	64 8 18	) 11 58	P.L. 1.1773
11th at 21h.	63 56 20	) 26 49	P.L. .3167
12th at N.	65 23 9		
		h. m. s.	
Proportional part -		0 24 49	diff. .8606
Preceding time, 11th		21 0 0	
			h. m. s.
Time at Greenw. of observed dist.			21 24 49
Interval of time to *altitude b* -			+ 2 29 49
TIME at GREENWICH of *Alt. b*, 11th			23 54 38

	° ′ ″
⊙'s DECL. 12th at noon	N. 21 59 53
daily diff. — 8′ 9″	
Prop. part for — 5m. 22s.	- + 2
Sun's reduced declin.	N. 21 59 55

⊙'s decl. N. 21 59 55 ar. co. l. cos. 0.03283

Co-latit. N. 19 3 0 ar. co. l. sine 0.48626

Merid. alt. 41 2 55 N. S. .65670

⊙'s tr. alt. *b* 34 57 0 N. S. .57286

Difference of nat. sines - .08384 log. 8.92345

	h. m. s.	
App. ti. *alt. b* 12th	2 54 48	log-rising 9.44254
Greenw. time 11th	23 54 38	

LONGITUDE, East 3 0 10 = 45° 2′½.

The mean of the times when the *altit. b* was taken.

REMARK.

If the watch is known to gain or lose upon mean solar time, the proportional part must be allowed for the *interval*; and to be strictly accurate, the difference also in the equation of time; but if the watch cannot be depended upon, the time must be inferred from the moon's altitude at the time of the distance by problem XX. *Quere*, Might not an instrument be contrived with an allowance for temperature, as an hour-glass with quicksilver, to measure an interval of two or three hours mean solar time?

EXAMPLE 2.

September 14th, 1804, in latitude 17° 40′ S. and longitude 85° east, by estimation, several altitudes of the sun's lower limb were taken, with the times corresponding, preparatory to finding the longitude by the moon's distance from a fixed star; the mean of the times was 4h. 2m. 15s. and the mean altit. 26° 13′ 0″.—After sunset several distances were observed, between the ☽'s enlightened limb and Antares, with the corresponding alts. of each and times, the mean of the times was 10h. 1m. 24s. (making an interval of time from the first altitude of 5h. 59m. 9s. allowing for the rate of the watch) and the mean distance and altitudes as under. Required the *ship's Longitude*.

Time by the Watch.	Alt. *b* of ⊙'s lower limb.
h. m. s.	° ′ ″
4 2 15	26 13 0
Dip -	— 4 12
Refr. — par.	— 1 48
Semidiam.	+ 16 0
TRUE ALTITUDE	26 23 0

Time by the Watch.	Mean dist. of ☽ & Antares.	Altit. of ☽'s lower limb.	Altitude of Star.
h. m. s.	° ′ ″	° ′ ″	° ′ ″
10 1 24	42 5 50	61 40 46	19 54 12
Dip - -		— 4 12	— 4 12
Semidiam.	+ 15 26	+ 15 26	
App. dist. & alt.	42 21 16	61 52 0	19 50 0
(☽'s H. P. 55′ 52) refr. & par.		+ 25 51	— 2 37
TRUE ALTITUDES		62 17 51	19 47 23

f

Digitized by Google

	h.	m.	s.
Time by watch of observed dist.	10	1	24
Estimated longitude, east - -	5	40	0
Estimated time at Greenwich -	4	21	24

Reduction of Dist. by 4th Method.

	°	′	″			
Diff. app. alt.	42	2	0	N. cos.	A	.742755
App. dist.	42	21	16	N. cos.	B	.738991
A — B & log.	7.575650				C	.003764
Log. diff.	9.993957				D	Tables *I* & *L*.
C + D -	7.569607			Nat. N.	E	.003712
	°	′	″			
Diff. true alt.	42	30	28	N. cos.	F	.737185
TR. DIST.	42	49	18		G	F — E .733473
Dist. at 3h.	42	4	37		H	(N. cos.)
Dist. at 6h.	43	38	34		I	

G ~ H -	0	44	41	-	P. L. .6051
I ~ H -	1	33	57	-	P. L. .2824
	h.	m.	s.		
Prop. part	1	25	37	diff.	P. L. .3227
Preceding time	3	0	0		

		h.	m.	s.
Time at Greenw. of obs. dist.	14th	4	25	37
Interval to observed *altitude b*		—5	59	9
Time at Greenw. of obs. *alt. b*	13th	22	26	28

	°	′	″	
⊙'s decl. 13th N. (diff. —23′ 3″) N.	3	47	39	
Tab. VI (half time 11h. 13m.) prop.	—21	30		
⊙'s red. decl. N.	3	26	0	ar.co. cos. 0.00078
Co-latit. S.	72	20	0	ar.co. sine 0.02098
Merid. altit.	68	54	0	N. S. .93295
⊙'s true altit.	26	23	0	N. S. .44437

Diff. of Nat. sines and log. -				.48858	9.68894
	h.	m.	s.		
App. time -	4	3	36	log-rising	9.71076
Ap. ti. Greenw.	22	26	28		

LONGITUDE 5 37 8 = 84° 17′ EAST
(which is the ship's longitude at the time when the *altitude b* was taken.)

Or thus by the error of the watch.—

	h.	m.	s.
Apparent time of *altitude b* -	4	3	36
Time by watch - -	4	2	15
Watch too slow - -	0	1	21
Time by watch of observed distance	10	1	24
Apparent time of ditto	10	2	45
Time at Greenwich of ditto	4	25	37
LONGITUDE as before	East 5	37	8

(at the time when *altitude* was taken.)

PROBLEM XXVII.

Given the apparent Time at the Ship, and the Moon's Distance from the Meridian; to find the LONGITUDE *from Greenwich.*

RULE.

1. Set down from the Nautical Almanac the moon's and sun's right ascensions in degrees and minutes at the nearest time to the estimated time at Greenwich, and the noon and midnight preceding and following. Subtract the sun's right ascensions from the moon's, and set down the differences, with the first, second, and third differences, of their differences, as in problem XX.

2. *Add* the meridian distance if *East*, or *subtract* it if *West* from the apparent time at the ship; the sum or difference will be the difference of the moon's and sun's right ascensions at the time of observation. To which by problem III find the corresponding time at Greenwich from which the ship's longitude is known.

EXAMPLE.

On the 3d June, 1805, the moon's distance from the meridian was determined from her observed altitude (see problem XX) to be 3h. 14m. 25s. west, at 8h. 45m. 35s. apparent time; required the ship's Longitude?

N. B. *The time may be either found from the sun or star's altitude, or the same observed altitude of the moon, by problem XX.*

Digitized by Google

1805, June	☽'s R. A.	⊙'s R.A. in c		☽'s R.A.—⊙'s		1st Diff.		2nd Diff.		3d Diff.
	° ′	° ′ ″		° ′ ″		° ′ ″		′ ″		′ ″
2nd, noon.	139 39	69 52 42	B	69 46 18	b'	6 3 24	b''	— 13 18	b'''	+ 2 24
midn.	146 13	70 23 18	C	75 49 42	c'	5 50 6	c''	— 10 54	c'''	+ 2 34
3d noon.	152 34	70 54 12	D	81 39 48	d'	5 39 12	d''	— 8 0		
midn.	158 44	71 25 0	E	87 19 0	e'	5 31 12				
4th noon.	164 46	71 55 48	F	92 50 12						

		h. m. s.
Apparent time -	G	8 45 35
Meridian distance, West	H	3 14 25
☽'s R.A.— ⊙'s R.A. = G ± H		5 31 10 (+ if E, — if W.)
		° ′ ″
G — H in degrees	I	82 47 30
D Nearest diff. June 3d	K	81 39 48
I — K	S	1 7 42 P. L. 12h.
$s' + \frac{1}{2}c'' - \frac{1}{12}(b''' + c''')$	M	5 44 12½ P. L. 12h.
		$s - m$ P. L. 12h.
		$a - m$
$-\frac{1}{2}c'' = -N =$		+ 5′ 27″ P. L. 3h.
$a + b + n =$		Correction P. L. 3h.

Then by Problem III.

c' = -	-	5° 50′ 6″	
$N = \frac{1}{2}c'' =$		— 5 27	
$-P = -\frac{b''' + c'''}{12} =$		— 26½	
M =	Sum	5 44 12½	

s	1.02674	
m	.32051	h. m. s.
a	.70623	2 21 35
b	.38572	
n	1.51888	
	2.61083	+ 26,5

Time at Greenwhich from noon, June 3d - - -	2 22 1,5
Apparent time at the ship - - - -	8 45 35
LONGITUDE in TIME, East - - - -	6 23 33,5

REMARK.

Should the observed difference of the sun and moon's right ascensions fall much nearer the 6th or 18th hour than noon or midnight, it would be somewhat more accurate first to calculate by Dr. Maskelyne's rule the difference of right ascensions at the near 6th or 18th hour, and put $M = d' - \frac{c'''}{24}$ and $N = \frac{c'' + d''}{4}$ (supposing the time to fall between D and E) and then proceed as above;—thus taking the same Example.

The diff. of R. A. at the 6th hour between D and E by Dr. Maskelyne's rule is $D + \frac{1}{2}d' - \frac{1}{8}\frac{1}{6}\overline{c'' + d''} = 84° 30′ 35″$, which subtracted from (I) 82° 47′ 30″ = — 1° 43′ 5″ = S.

Then as above $S = -$	1° 43′ 5″	P. L. 12h.	s .84414
$M = d' - \frac{1}{24}c''' =$	5 39 4½	P. L. 12h.	m .32703
			h. m. s.
		$s - m$ (is —)	a .51711 P. L. 12h. — 3 38 53
		$a - m$ (is —)	b .19008
$-N = -\frac{1}{4}\overline{c'' + d''} =$	+ 4′ 43″½	P. L. 3h.	n 1.58100
$a + b + n$ (is +)	Correction	P. L. 3h.	2.28819 + 0 56

Time at Greenwich *from the 6th hour* - -	— 3 37 57
Or time from *noon* at Greenwich - - - -	2 22 3
Apparent time at the ship - - - -	9 45 35
LONGITUDE - - - - - - East	6 23 32

But this result is not so near the truth as that by the first operation, because the time happens to fall nearer noon than the 6th hour, otherwise this would have been the most accurate.

In this problem it is necessary to be acquainted with algebraic multiplication and division, as that two like signs make + and two unlike signs —, thus in the last method of operation, a and b having both negative numbers, & that of n being *positive*, their product, or the sum of their logs. is +, making the correction + 56s. which added to — 3h. 38m. 53s. is = —3h. 37m. 57s.

Digitized by Google

The time most favourable for this problem is when the moon has little or no change in declination, as an approximate time is necessary in problem XX for finding both the moon's declination and horizontal parallax, and if not known sufficiently near, the operation must be repeated. To find the Longitude by the time of the moon's transit is included in this problem, the meridian distance in that case being 0.

PROBLEM XXVIII.

The Moon's true Distance from the Sun or fixed Star, or Planet, and the Latitude of each being given, to find the MOON's true LONGITUDE; (from which if the Apparent Time at the ship be also known, the Longitude of the Place may be easily found by problem III.)

EXAMPLE 1.

Suppose the moon's true distance from the sun on July 22, 1806, was 88° 37′ 35″ sun being West, and the moon's latitude 4° 32′ 45; required the moon's true Longitude.

	°	′	″			
Given distance	88	37	35	l. cos.	a	8.379700
Moon's latit.	4	32	45	l. cos.	b	9.998633
a—b diff. lon.	88	37	19	l. cos.		8.381067
Sun's long.	118	54	49	W. of ☽.		

	s	°	′	″
☽'s LONG. 207 32 8	= 6	27	32	8

The reverse of this problem will serve to correct the ☽'s true distance from the ☉ or star as given in the N. A. for any known error in the tables of the ☽'s or ☉'s longitude.

By this problem the longitude may be found by the moon's distance from the sun, a star, or planet, whose distance is not given in the Nautical Almanac, provided the difference of latitude is not too great for the difference in longitude;—the following table is a proper limit.

D. Lat.	D. Lon.	D. Lat.	D. Lon.	D. Lat.	D. Lon.
°	° ′	°	° ′	°	° ′
5	10 0	14	26 46	22	46 52
7	12 49	16	31 12	24	53 52
10	18 34	18	35 56	26	61 46
12	22 35	20	41 6	28	73 48

EXAMPLE 2.

Suppose the moon's true distance from Antares on May 7, 1808, was 52° 32′ 28″, the star being *East*, and the moon's latitude 3° 11′ 10″ S. required the moon's true longitude.

	°	′	″		
Given dist.	52	32	28	a	*(star East)*
Moon's lat.	3	11	10	S. ar. co. l. cos.	0.000672
Star's latit.	4	32	22	S. ar. co. l. cos.	0.001364
Diff. *lat.*	1	21	12	b	
$\frac{1}{2}\ a + b$	26	56	50	- log. sine	9.656261
$\frac{1}{2}\ a \sim b$	25	35	38	- log. sine	9.635473
Sum of the four logarithms				c	19.295770
$\frac{1}{2}\ c$				D	0s. 26° 19′ 36″ log. sine 9.646885
2 D				E	1 22 39 12 Diff. of longit.

	S.	°	′	″
Star's mean lon. May 7, 1806	8	7	5	10,3
Equation of Equinoxes, table xliv			+	14,1
Aberration - table xlv			+	19
Star's true longitude *East*	F	8	7	5 43,4
Difference of longitude *E.*	G	1	22	39 12
☽'s TRUE LONGIT. F ± G		6	14	26 31

PROBLEM XXIX.

Given the meridian Altitude of either Limb of the Moon, when the Change in Declination is about the greatest, also the Latitude and Longitude by Account of the Place of Observation, to find the LONGITUDE of the Place.

EXAMPLE.

November 13th, 1804, in latitude 48° 35′ 25″ N. and long. by account 1h. 20m. West, the greatest altitude of the moon's lower limb was 48° 35′ 39″, the height of the observer's eye 14 feet; required the Longitude of the place.

Digitized by Google

	h.	m.	s.
☽ 's transit at Greenwich, N. Alm.	8	42	0
(da. var. + 51m.) p. p. lon. 1h. 20m.		2	50
Time of moon's transit at ship -	8	44	50
Longitude by account, in time	W. 1	20	0
TIME at GREENWICH -	10	4	50

	°	′	″
Moon's hor. par. at noon, N. Almanac		59	3
Var. + 29″ prop. part for 10h. 5m.		+ 24	
Reduc. for latit. 45° 35′, table F -		— 5	
Moon's reduced hor. par. -		59	22

Apparent altitude	48	29	30
*Correction, tab. F	+ 10	18	
☽ 's spheroidal alt.	48	39	48
Correc. of ☽ 's spheroid. altit. tab. H		+ 39	21

* *If the* ☽ *'s transit is on side of elevat. pole* —

		°	′	″
☽ 's ch. of decl. in 12h. at midn.	A	3	4	30
Change in one minute -	a		0	15,4
Table XVIII, lat. 45° 35′, declin. 5°	b		0	2,1
$a \div 4\,b$ = difference between the greatest and meridian altitude	c		0	28

* *See note at the bottom of pages* 24 *and* 25.

	°	′	″
Observed altit. of moon's lower limb	48	33	39
Dip of the horizon - -		— 3	41
App. altit. of moon's lower limb	48	29	58
Spheroidal correction, table H		+ 39	21
True altitude of moon's lower limb	49	9	19
Correction | *c* | of greatest altitude	*	—	28
Merid. altit. of ☽ 's lower limb -	49	8	51
Moon's semidiameter - -		+ 16	12
True meridian alt. of moon's center	49	25	3
Co-latitude - -	44	24	35
Moon's declination -	N. 5	0	28
Declin. at midn. N. Alman. (*incr.*)	N. 5	30	0
Difference - - -	0	29	32

Diff. - 0° 29′ 32″ P. L. 3h. .78496
☽ 's var. [A] 3 4 30 P. L. 12h. .59128
h. m. s.
Ti. *bef.* midn. 1 55 14 P. L. 12h. diff. .19368

	h.	m.	s.
Apparent time, 12h.—1h.55m.14s. =	10	4	46
Time at ship - -	8	44	50
LONGITUDE in TIME -	1	19	56

= 19° 59′ West.

REMARK.

Here the *time* of the moon's greatest altitude was 3m. 40s. after the moon's center had passed the meridian.

PROBLEM XXX.

To find the DIFFERENCE *in* LONGITUDE *of two Places by the observed Intervals of time between the* TRANSITS *of the Moon and a fixed Star over the Meridian of each Place.*

RULE.

1. Set down the moon's right ascensions from the Nautical Almanac for the nearest noon or midnight to the *middle time* at Greenwich by estimation between the two transits of the moon over the two meridians, also the moon's right ascensions for the noon or midnight preceding and following, with their two first differences and second difference.

Then the *first* first difference will be the *rate of the moon's increase* in R. ascen. *in* 12 *hours* at the VIth or XVIIIth hour between the noon and midnight where it stands; to which add for the rate of increase at any succeeding time *(as the middle time between the moon's two transits)* the additional *time in hours* multiplied by the second difference and divided by 12; which is also readily done by table VI;—let the rate of increase so found be called A.

Call B the increase of the moon's right ascension between the times of its transits at both places (which is equal to the *difference* or *sum* in sidereal time of the intervals between the moon and star's transit at each place, according as the moon happens to be on the *same* or on a *different* side of the star at the times of her transit.)

Call C the variation of the equation of time *for* 12 *hours* from the Nautical Almanac page II.

Then as A : B :: (D=) 12h. 1m. 58s. — A ± C : the DIFFERENCE of LONGITUDE; where

Digitized by Google

+ C must be used if the equation of time is *additive* and *increasing*, or *subtractive* and *decreasing*, and — C if the equation is *additive* and *decreasing*, or *subtractive* and *increasing*.

EXAMPLE.

On June 13, 1791, the following observations of the passage of the moon and *a Serpentis* were made at the Greenwich and Dublin observatories.

AT DUBLIN.	h.	m.	s.	GREENWICH, at 9h. 36m. *app. time.*	h.	m.	s.
R. A. of moon's first limb -	15	6	12,49	R. A. of moon's first limb -	15	5	3,52
R. A. of *a Serpentis* -	15	33	36,91	R. A. of *a Serpentis* -	15	33	34,70
Interval by clock, in sidereal time	0	27	24,42	Interval at Greenw. in sider. time	0	28	31,18
Clock *loses* in 24h. 16″,88, prop. - +	0		0,32	Interval at Dublin -	0	27	24,74
True interval at Dublin, sider. time	0	27	24,74	Diff. of observed intervals | B |	0	1	6,44

Middle time by estimation 9h. 37m. apparent time.

☽'s R. A.	°	′	1st Diff.	°	′	2d Diff.
13th Noon	220	38	c′	+ 7	33	c″ + 9′
Midn.	228	11	d′	+ 7	42	
14th Noon	235	53				

	h.	m.				
Rate of increase at	6	0	= c′ =	7	33	0
Prop. part for	3	37	and 9′ (c″)	2	43	
Rate of increase at	9	37	-	7	35	43

	m.	s.
Reduced to time is - | A |	30	22,87

	h.	m.	s.
12h. in sidereal time - - -	12	1	58
Subtract rate of incr. in 12h. | A |	— 30	22	87
Var. of equat. time *sub.* & *decr.* | C |		+ 6	
h. m. s.			
12 1 58 — A ± C = | D |	11	31	41,13

As A 30 22,87 = 1822,87s.	log.	3.26076
: B * 1 6,44 = 66,44s. —	log.	1.82243
:: D - 11h. 31m. 41,13s. P. L.		.01743
: DIFF. LONGIT. 25m. 13s. P. L.		1.45576

* *See Explanation of Prop. Logs.* Ex. 4. *p.* 42.

REMARKS.

When the two places differ much in longitude an allowance ought to be made for the change of the moon's semidiameter in the interval of the passages, and also for the change of semidiameter in right ascension if there be any considerable change in declination.

Mr. *Brinkley* very strongly recommends this method as being extremely easy in practice, and capable of much greater accuracy than the eclipses of Jupiter's satellites.

2. When a corresponding observation cannot be obtained, if the time be known, the moon's right ascension may be inferred from the interval between the moon and star's transit, using tables IX and X for the moon's semidiameter, and the time at Greenwich corresponding, can be found by problem III, whence the longitude is known.

PROBLEM *XXXI.*

To find the Augmentation of the Moon's Semidiameter, by means of table XLVIII.

To avoid the trouble of computing the moon's altitude, in solar eclipses and occultations, table XLVIII has been calculated. *See the construction in La Lande's Astron. 3d edit. vol. II. page* 389.

Digitized by Google

EXAMPLE 1.

Let the altitude of the nonagesimal be 67° 20′, the moon's apparent distance 23° 41, and horizontal semidiameter 16′ 26″; required the augmentation.

	s	°	′			
Alt. of nonages.	2	7	20	a		
☽'s app. dist.	0	23	41	b	Tab. XLVIII.	
						″
$a+b$ -	3	1	1	Part 1st	+	8,19
$a\sim b$ -	1	13	39	1st		5,66
				Sum	+	13,85
Equation to 13,58				Part 2d	+	,19
				Sum		14,04
Equat. to 14,04 Part IV. is 1″,75						
Prop. part for +26″ moon's semidiam.						+,78
AUGMENTATION required -						14,82

EXAMPLE 2.

Let the altitude of the nonagesimal be 55° 17′, the apparent distance of the moon 14° 43′, the moon's true latitude *S.* 24′ 2″, parallax in latitude 35′ 40″, and horizontal semidiameter 15′ 30″; required the augmentation.

	s	°	′			
Alt. of nonagesimal	1	25	17	a		
☽'s app. distance	0	14	43	b	Tab. XLVIII.	
						″
$a+b$ -	2	10	0	Part 1st	+	7,70
$a\sim b$ -	1	10	34	1st	+	5,33
				Sum		13,03
Equation to 15″,03 -				Part II.		0,17
Equation to moon's lat. and par. in lat.	24′	2″	S. 35 40	Part III		—,02
(*equation part* IV. 1″,64) -				Sum		13,18
Prop. part for —3″ moon's semidiam.						—0,82
AUGMENTATION required -						12,36

PROBLEM *XXXII.*

To find the Longitude of a Place by an ECLIPSE of the SUN.

INTRODUTION.

The most exact method of determining the difference in longitude of two distant places is that by solar eclipses or occultations of stars by the moon: (unless a correct time-keeper could be obtained) the chief impediment seems to be the length of the necessary calculations; notwithstanding which it is so frequently employed that every means should be tried to make the operation as simple as possible.

When the beginning or end of a solar eclipse or occultation of a star by the moon has been observed, the true time of the ecliptic conjuntion must be found, as seen from the earth's center, and if the same be done at any other place, the difference of the times will be the difference of the meridians; but for want of the latter, the time of the conjunction at Greenwich, must be found from the Nautical Almanac, or from the best astronomical Tables; but then the result will be affected by the error of the tables, which is avoided when correspondent observations are made.

The greatest part of the calculation consists in finding the effect of parallax, or difference between the apparent place of the sun and moon and that as seen from the earth's center, which is usually done by means of the *nonagesimal.*

As the *ecliptic* is a great circle, one half of it is always above the *horizon*, and the middle of this part, being 90° distant from their intersection, it is thence called the NONAGESIMAL; on the altitude of which, and the longitude from the equinoctial point Aries, the effects of parallax depend; for when the object is in the *nonagesimal*, it has no parallax in longitude, and the parallax in latitude is then equal to the parallax in altitude;— because as a great circle passing through the pole of the ecliptic and nonagesimal passes also through the zenith.

The longitude of the place from Greenwich must be estimated as nearly as possible in order to take out from the Nautical Almanac, or other tables, the moon's longitude, latitude, sun's right ascension, &c. for the required time, and if not assumed at first sufficiently near, the whole operation must be repeated with the longitude corrected by the first calculation; but in order to avoid an unnecessary repetition in the following example the longitude is supposed to have been found nearly from a previous similar calculation, and the error of the tables assumed as known.

Digitized by Google

To find the Moon's Parallax in Longitude and Latitude by means of the Nonagesimal, take the following Formulæ. Let

A = ⊙'s R.A. + apparent time in degrees.
If A exceeds 360°, take A—360° for A.

B = A ~ 270° in N. lat. or A ~ 90° in S. lat.
If B is greater than 180° subt. from 360°.

C = Latitude of place corrected by table F.

O = Apparent obliquity of the ecliptic.

D = 90° — C — O.

E = 90° — C + O.

K = Longitude of the Nonagesimal.

L, & l = ☽'s true, and apparent latitude.

M, & m = ☽'s true, and apparent longitude.

N = M ~ K = ☽'s dist. from the nonages.
If N exceeds 180° subtract it from 360°.

P = ☽'s hor. par. corrected by table F.
(in solar eclipses — ⊙'s hor. par.)

p = moon's parallax in longitude.

q = ☽'s parallax in latitude.

To find the Altitude and Longitude of the Nonagesimal.

Sine ½ E : sine ½ D :: cotan. ½ B : tang. F
Cos. ½ E : cos. ½ D :: cotan. ½ B : tang. G
Sine F : sine G :: tang. ½ D : tan. ½ H

H = the ALTITUDE of NONAGESIMAL.

In North Latitudes,

$K = 90° \pm \overline{F + G}$ = LONG. of NONAGES.
Sign + when A is between 90° and 270°, otherwise —; in which case if F + G is greater than 90°, K = 450° — F + G.

In South Latitudes,

$K = 270° \mp \overline{F + G}$. *The sign — when A is between 90° and 270°, otherwise +; and if it exceeds 360° take its excess.*

To find the Moon's Parallax in Longitude and Latitude.

$$\text{Sine } p = \frac{\text{Sine P . Sine H . Sine (N} + p)}{\text{Cosine L}}$$

$$\text{Sine } q = \frac{\text{si. P . cos. H . si. N} + p - \text{si. } p \text{ . si. L . cos. N} + p}{\text{Sine N.}} \times \text{ cosine } l.$$

(*The second term of the equation becomes positive when the moon has south latitude; the sign of south latitude being negative.*)

$m = M \pm p$. *The sign + if* M *is east of* K, *— if west.*

$l = L \pm q$ *Sign + if the ☽'s true lat. is South, — if North.*
The contrary in South latitudes; (changing the signs when q is negative.)

EXAMPLE.

At the solar Eclipse on the 16th June 1806, the following observations were taken at *Kinderhook south-landing*, on the Hudson river, in latitude north 42° 23′ 3″, and the assumed west longitude from Greenwich 4h. 55m. 20s. required the true LONGITUDE of the place.

The latitude of the place having been determined from the sun's meridian altitude by a mean of three preceding days, and the time-keeper, which was a very correct one of *Arnold's*, adjusted by a great number of altitudes preceding and following the eclipse, the times of the different contacts were observed with two of *Dolland's* best four feet achromatic telescopes;—the sky during the whole time was perfectly clear; and the eye being fixed on the point of contact which was before calculated, the times are supposed to be extremely accurate.

	Mean time. h. m. s.	Apparent time. h. m. s.
Beginning of the eclipse June 15th	21 49 37	21 49 31,1
Beginning of total obscuration	23 8 2	23 7 55,4
End of total obscuration	23 12 39	23 12 32,4
End of the eclipse, June 16th	0 33 45	0 35 37,7

Digitized by Google

To find the *Altitude* and *Longitude* of the *Nonagesimal*, and the Moon's *Apparent Longitude* and *Latitude* at the time of the FIRST CONTACT.

		h.	m.	s.
⊙'s R. Ascen. N. Almanac	-	5	36	48,6
⊙'s R. Ascen. + app. time	—24h.	3	26	19,7
		°	′	″
The same in degrees	A	51	34	55
A ~ 270°	b	218	25	5
(b > 180°) 360° — b	B	141	34	55
Latitude of Kinderhook	c	42	23	3
Latitude — 10′ 16″ (table F)	C	42	12	47
90° — C		47	47	13
* App. Obliquity of Ecliptic	O	23	27	54
90° — C — O	D	24	19	19
90° — C + O	E	71	15	7

		h.	m.	s.
Apparent time of beginning	-	21	49	31,1
Estimate longitude *West*	-	4	55	15
(*Corrected from* 4° 55′ 20″)				
Estimate time at Greenwich	-	2	44	46,1

		′	″
☽'s hor. par. 16th noon, N. A. (—10″)		60	11
Prop. for 14″ and 2h. 45m.	-	+	3,2
Reduction from table F	-	—	4,9
☽'s reduced horizontal parallax		60	9,3
Sun's horizontal parallax	-		8,5
☽'s hor. par. — ⊙'s hor par.	P	60	0,8

½ E		35	37	33,5	Ar.co. l.sin.	e	0.234711	Ar.co. L.cos.	e′ 0.089997
½ D		12	9	39,5	L. sine	d	9.323580	Log. cosine	d′ 9.990143
½ B		70	47	28	L. cotang.	b	9.542092	Log. cotang.	b′ 9.542092
e + d + b	F	7	10	54	L. tangent		9.100383	Log. tang.	g 9.622232
	F	7	10	54	Ar.co. l.sin.	f	0.903035	arc cor.	G 22°44′4″½
e′ + d′ + b′	G	22	44	4,5	L. sine	g	9.587108		
½ D		12	9	39,5	L. tangent	d	9.333437		
f + g + d	h	33	40	12	L. tangent		9.823580		
2 h	H	67	20	24	ALTITUDE of the NONAGESIMAL.				
90° ± (F + G)	K	60	5	1,5	LONGITUDE of the NONAGESIMAL. (*See page* 48.)				
☽'s long. N. A. —1′ 5″,3	M	83	45	50,2	MOON's TRUE LONGITUDE. (*allowing for error of the tables* 1′ 5″,3.)				
M ~ K	N	23	40	48,7	MOON's DISTANCE from the NONAGES.				
☽' true latitude, N. A.	L	0	24	56,27	MOON's TRUE LATITUDE North.				

To find the ☽'s Parallax in Long. and Latitude at the time of the FIRST CONTACT.

		°	′	″								
☽'s lat.	L	0	24	56,35	ar.co. l.cos.	l	0.000011	☽'s dist.	N	23	40	48,7	ar.co. l.sin.	0.396172
	H	67	20	24	log. sine	h	9.965111		P		60	0,8	log.	3.556399
	P		60	0,8	log.		3.556399		H	67	20	24	log. cos.	9.585756
								N + p		24	3	23,2	log. sine	9.610273
Sum			*Constant logarithm*			r	3.521521							
	N	23	40	48,7	log. sine	n	9.603828	Sum4log. [— 20	T	0	25	27,9	log.	3.148609
n + r	p″		22	14	1st appr.		3.125349		N	23	40	48,7	ar.co. l.sin.	0.396172
									p		22	34,5	log.	3.131802
N + p″		24	3	2,7	log. sine	s	9.610176		L		24	56,35	log. sine	7.860590
s + r	p′		22	34,1	2d appr.		3.131697	N + ½p		23	52	6	log. cos.	9.961173
N + p′		24	3	22,8	log. sine	t	9.610271	Sum4log. [— 20	ω	0	0	22,41	log.	1.349747
t + r	p		22	34,5	PAR. in [LONG.		3.131792	† T ± U ± q	η	0	23	5,49	☽'s PAR. in LAT.	
									l	0	1	50,86	☽'s APP. LAT. N. (cosine being = 1)	

See p. 48.

In the same manner the elements for the times of the other contacts were found to be as in the followiog table.

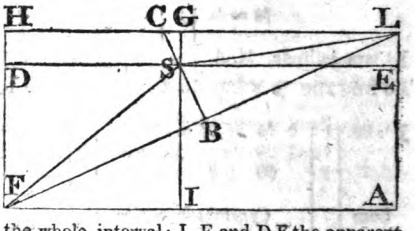
* *The obliquity of the ecliptic, and* ☽*'s horizontal parallax are corrected from the new tables of* Mr. Burg *of Vienna.* † *The sign* — *when the* ☽*'s true latitude is North.*

Digitized by Google

ELEMENTS of the TOTAL SOLAR ECLIPSE, of June 16, 1806.

At the several contacts.		First.	Second.	Third.	Fourth.
		h. m. s.	h. m. s.	h. m. s.	h. m. s.
Mean times of observations		21 49 37	23 8 2	23 12 39	0 33 45
Apparent times	a	21 49 31,1	23 7 55,4	23 12 32,4	0 33 37,7
Longitude by estim. *West*		4 55 15			
Time at Greenwich		2 44 46,1	4 3 10,4	4 7 47,4	5 28 52,7
⊙'s R. Ascen. N. Alman.	b	5 36 48,6	5 37 2,1	5 37 3,1	5 37 17,1
R. Ascen. Med. Cœl. $a + b$ (— 24 h.)		3 26 19,7	4 44 57,5	4 49 35,5	6 10 54,8
		° ′ ″	° ′ ″	° ′ ″	° ′ ″
The same in degrees	A	51 34 55	71 14 22	72 23 52	92 43 42
Altitude of Nonagesimal	H	67 20 24	70 18 4	70 24 51	71 15 55
Longitude of Nonagesimal	K	60 5 1,5	75 20 39	76 14 50	92 8 2
☽'s tr. long. *N. Al. —1′5″,3	M	83 45 50,2	84 33 46,5	84 36 36	85 26 13,1
⊙'s tr. long. * N. Al. —5″,3	S	84 40 46,0	84 43 53,1	84 44 4,1	84 47 17,7
☽'s tr. long. — ⊙ true long.	D	— 54 55,3	— 10 6,6	— 7 28,1	+ 38 55,4
☽'s tr. dist. from Nonages.	N	23 40 48,7	9 13 7,5	8 21 46	−6 41 48,9
☽'s Hor. Par. — ⊙'s Hor. P.	P	0 60 0,8	0 60 2,3	0 60 2,4	0 60 3,9
☽'s Parallax in Longitude	p	+ 22 34,5	+ 9 12,29	+ 8 21,79	— 6 44,59
☽'s app. dist. from Nonages.	n	24 3 23,2	9 22 13,79	8 30 7,79	6 35 4,31
☽'s ap. long. — ⊙'s ap. long.	d	— 32 21,3	— 0 54,31	+ 0 53,69	+ 32 10,81
☽'s tr. lat. N. Alm. North	L	0 24 56,35	0 20 30,66	0 20 14,98	0 15 59,67
☽'s Parallax in Latitude	q	— 23 5,49	— 20 13,99	— 20 7,44	— 19 23,17
☽'s Appar. diff. Latit. N. A.	l	Nor 1 50,86	N. 0 16,67	N. 0 7,54	Sou. 3 43,5
☽'s aug. sem. —2″,977 infl.		0 16 38,373	0 16 40,253	0 16 40,283	0 16 40,803
⊙'s sem. N.A. —1,623 irrad		0 15 44,457			
☽'s relat. vel. in 12h. from ⊙		6 51 23,8	6 51 45,3	6 51 46,7	6 52 8,4
☽'s do. between obs. & conj.	R	6 51 37	6 51 47,8	6 51 48,4	6 51 59,3

* *These are the supposed errors in the tables of the sun and moon's longitude, deduced from the observations with the estimate longitude of Kinderhook; but a corresponding observation at Greenwich will be more accurate; allowing for these, the time of the true conjunction at Greenwich by the Nautical Almanac will be* 4h. 20m. 50,5s. *when the relative velocity in* 12 *hours was* 6°. 51′ 50″,14.



This table contains all that is necessary for finding the time of the *true conjunction*; the annexed figure will explain the operation; where DSE represent a portion of the ecliptic, and S the Sun; (or if an occultation D S E a parallel to the ecliptic through S the star); L and F the *apparent* places of the ☽'s center at the beginning and at the end of the eclipse; S L and S F the sums of ⊙ and ☽'s semidiameters (or the ☽'s if an occultation); A F the ☽'s *apparent* relative motion in Longitude and L A in Latitude during the whole interval; L E and D F the apparent differences of Latitude at each contact; S B the nearest distance of the centers. A F L the *angle of inclination* of the ☽'s apparent orbit, S L E and S F D the *angles of conjunction* at the beginning and end. Whence, E S and S D the apparent differences of Longitude are to be found, and the true differences of longitude and latitude both at the beginning and end by applying the parallaxes with a contrary sign, from which with the velocity or horary motion found by the tables, the time of the true conjunct. is found.—As in the following example for the 1st and 4th contact.

		° ′ ″					
☽'s relat. motion in app. latit.	L A	0 5 34,36	log.	a	2.524214		
☽'s relat. motion in app. long.	A F	0 64 32,11	log.	b	3.587948 log.	b'	3.587948
(betw. first and last contact.)							
$a - b$ ANGLE OF INCLINATION.	L F A	4 56 7	tan.		8.936266 cos.	c'	9.998387
$b' - c' =$ ☽'s relative motion in apparent orbit or cord of transit L F, 3886″,52						log.	3.589561

Note, S B *will not be correctly the nearest distance, for on account of the curvature of the apparent orbit,* L F *is not a right line.*

Digitized by Google

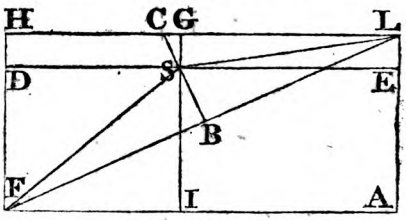
☽'s semidiam. — 2″,977 inflexion *at immersion*																			
⊙'s semidiam. — 1″,623, irradiation																			
Sum of the two semidiameters																			

ELEMENTS of the TOTAL SOLAR ECLIPSE, of June 16, 1806.

At the several contacts.		*First.*	*Second.*	*Third.*	*Fourth.*
		h. m. s.	h. m. s.	h. m. s.	h. m. s.
Mean times of observations		21 49 37	23 8 2	23 12 39	0 33 45
Apparent times -	a	21 49 31,1	23 7 55,4	23 12 32,4	0 33 37,7
Longitude by estim. *West*		4 55 15			
Time at Greenwich		2 44 46,1	4 3 10,4	4 7 47,4	5 28 52,7
☉'s R. Ascen. N. Alman.	b	5 36 48,6	5 37 2,1	5 37 3,1	5 37 17,1
R. Ascen. Med. Cœl. $a + b$ (— 24 h.)		3 26 19,7	4 44 57,5	4 49 35,5	6 10 54,8
		° ′ ″	° ′ ″	° ′ ″	° ′ ″
The same in degrees -	A	51 34 55	71 14 22	72 23 52	92 43 42
Altitude of Nonagesimal	H	67 20 24	70 18 4	70 24 51	71 15 55
Longitude of Nonagesimal	K	60 5 1,5	75 20 39	76 14 50	92 8 2
☽'s tr. long. * N. Al. — 1′5″,3	M	83 45 50,2	84 33 46,5	84 36 36	85 26 13,1
☉'s tr. long. * N. Al. — 5″,3	S	84 40 46,0	84 43 53,1	84 44 4,1	84 47 17,7
☽'s tr. long. — ☉ true long.	D	— 54 55,3	— 10 6,6	— 7 28,1	+ 38 55,4
☽'s tr. dist. from Nonages.	N	23 40 48,7	9 13 7,5	8 21 46	−6 41 48,9
☽'s Hor. Par. — ☉'s Hor. P.	P	0 60 0,8	0 60 2,3	0 60 2,4	0 60 3,9
☽'s Parallax in Longitude	p	+ 22 34,5	+ 9 12,29	+ 8 21,79	— 6 44,59
☽'s app. dist. from Nonages.	n	24 3 23,2	9 22 13,79	8 30 7,79	6 35 4,31
☽'s ap. long. — ☉'s ap. long.	d	— 32 21,3	— 0 54,31	+ 0 53,69	+ 32 10,81
☽'s tr. lat. N. Alm. North	L	0 24 56,35	0 20 30,66	0 20 14,98	0 15 59,67
☽'s Parallax in Latitude	q	— 23 5,49	— 20 13,99	— 20 7,44	— 19 23,17
☽'s Appar. diff. Latit. N. A.	l	Nor 1 50,86	N. 0 16,67	N. 0 7,54	Sou. 3 43,5
☽'s aug. sem. — 2″,977 infl.		0 16 38,373	0 16 40,253	0 16 40,283	0 16 40,803
☉'s sem. N.A. — 1,623 irrad		0 15 44,457			
☽'s relat. vel. in 12h. from ☉		6 51 23,8	6 51 45,3	6 51 46,7	6 52 8,4
☽'s do. between obs. & conj.	R	6 51 37	6 51 47,8	6 51 48,4	6 51 59,3

* *These are the supposed errors in the tables of the sun and moon's longitude, deduced from the observations with the estimate longitude of Kinderhook; but a corresponding observation at Greenwich will be more accurate; allowing for these, the time of the true conjunction at Greenwich by the Nautical Almanac will be* 4h. 20m. 50,5s. *when the relative velocity in* 12 *hours was* 6°. 51′ 50″,14.

This table contains all that is necessary for finding the time of the *true conjunction*; the annexed figure will explain the operation; where DSE represent a portion of the ecliptic, and S the Sun; (or if an occultation D S E a parallel to the ecliptic through S the star); L and F the *apparent* places of the ☽'s center at the beginning and at the end of the eclipse; S L and S F the sums of ☉ and ☽'s semidiameters (or the ☽'s if an occultation); A F the ☽'s *apparent* relative



motion in Longitude and L A in Latitude during the whole interval; L E and D F the apparent differences of Latitude at each contact; S B the nearest distance of the centers. A F L the *angle of inclination* of the ☽'s apparent orbit, S L E and S F D the *angles of conjunction* at the beginning and end. Whence, E S and S D the apparent differences of Longitude are to be found, and the true differences of longitude and latitude both at the beginning and end by applying the parallaxes with a contrary sign, from which with the velocity or horary motion found by the tables, the time of the true conjunct. is found.—As in the following example for the 1st and 4th contact.

		° ′ ″					
☽'s relat. motion in app. latit.	L A	0 5 34,36	log.	*a*	2.524214		
☽'s relat. motion in app. long. *(betw. first and last contact.)*	A F	0 64 32,11	log.	*b*	3.587948	log.	b′ 3.587948
$a - b$ ANGLE OF INCLINATION.	L F A	4 56 7	tan.		8.936266	cos.	c′ 9.998387

b′ — c′ = ☽'s relative motion in apparent orbit or cord of transit L F, 3886″,52 log. 3.589561

Note, S B *will not be correctly the nearest distance, for on account of the curvature of the apparent orbit,* L F *is not a right line.*

Digitized by Google

☽'s semidiam. — 2″,977 inflexion *at immersion*	16 38,373	*at emersion*	16 40,803
☉'s semidiam. — 1″,623, irradiation	15 44,457		15 44,457
Sum of the two semidiameters	SL 32 22,83		SF 32 25,26

			Logr's.				Logr's.
L F	3886,52	*a*	3.589561	L F − *x* = 2LB	3884,089	*d*	3.589289
S L + S F	3888,09	*b*	3.589736	2 S L	3885,66	*e*	3.589465
S L ~ S F	2,43	*c*	0.385606	*d* − *e* F	1 37 45	cos.	9.999824 = ang. S L B
e + *b* − *a* [= *x*	2″,431		0.385781	L F A G	4 56 7 = angle of inclination.		

1* F ~ G central angle	L SE	3° 18′ 22″	l. cos.	*h*	9.999277	l.sin.	*h′*	8.760954
Sum of Semidiameters	S L	1942″,83	log.	*i*	3.288435	log.	*i′*	3.288435
2* *h* + *i*, = ☽'s App. Long.—☉'s	S E	−32 19,60	log.		3.287712		*h′* + *i′*	2.049389
☽'s Parallax in Longitude	*p*	+22 34,50						

S E − *p* = ☽'s Tr. Long. —☉'s by obs.	− 54 54,1	P. L. .51568	*Number corresponding* = L E
☽'s relative motion in 12 hours	6 51 37	P. L. .24284	= ☽'s *app. lat.* 1′ 52,05
	h. m. s.		*Ditto by tables* 1 50,86
Interv. of time betw. *immersion* & *conjunction*	1 36 2,15	P. L. .27284	*Corr. in Lat.* + 0 1,19
App. time of *immersion* at Kinderhook	21 49 31,1		☽B. DIFF. LON.—54 54,1
APP. TIME of CONJUNC. at Kinderhook	23 25 33,25	by immers.	*Do. by tables* — 53 55,8
			Correction — 0 58,3

To be satisfied there is no error in the calculation, it may be useful to calculate the true time of conjunction also, from the triangle D S F at the Emersion—thus.

L F + *x* = 2 B F	3888″,951	log.	*d*	3.589833				
2 S F	3890,52	log.	*e*	3.590008				
d − *e* = angle B F S	F 1 37 37	cos.		9.999825				
Angle of inclin. L F A	G 4 56 7							
1* F ~ G, Central angle	FSD 6 33 34	cos.	*h*	9.997145	sine	*h′*	9.057978	
Sum of semidiameters	S F 32 25,26	log.	*i*	3.288978	log.	*i′*	3.288978	
h + *i*, ☽'s app. long.—☉'s	D S 32 12,51	log.		3.286123	log.		2.346956	
☽'s parallax in longitude	*p* − 6 44,59							

D S—*p*, ☽'s true long.—☉'s by obs.	0 38 57,1	P. L .66475	*h′* + *i′* *app. lat.* DF 3 42,31
☽'s relative motion in 12 hours	6 51 59,3	P. L. .24245	*Ditto by N. A.* 3 43,50
	h. m. s.		*Corr. in latit. N.* 0 1,19
Interval from conjunction to emersion	1 8 4,45	P.L .42250	
Apparent time of emersion	0 33 37,7		☽ *s lon.*—☉*s by ob.* 38′ 57″,1
APP. TIME of TRUE CONJUNCT.	23 25 33,25	by emersion.	*Ditto by tables* 39 55,4
			Correction as bef. —0 58,3

1* *When the apparent difference of latitude* L E *at the immersion is greater, than* D F *at the emersion; the sign is* +, *otherwise* ~. *The contrary at the emersion.*

2* *In occultations this is to be multiplied by the cosine of the* ☽*'s apparent latitude, at the middle latitude between* L *and* F. *(Or else the star's latitude. See the next Problem.)*

Digitized by Google

	h.	m.	s.
Time by watch of observed dist.	10	1	24
Estimated longitude, east - -	5	40	0
Estimated time at Greenwich -	4	21	24

Reduction of Dist. by 4th Method.

	°	′	″			
Diff. app. alt.	42	2	0	N. cos.	A	.742755
App. dist.	42	21	16	N. cos.	B	.738991
A — B & log.	7.575650				C	.003764
Log. diff.	9.993957				D	Tables *I* & *L*.
C + D -	7.569607			Nat. N.	E	.003712
Diff. true alt.	42	30	28	N. cos.	F	.737185
TR. DIST.	42	49	18		G	F — E .733473
Dist. at 3h.	42	4	37		H	(N. cos.)
Dist. at 6h.	43	38	34		I	

	h.	m.	s.			
G ~ H -	0	44	41	-	P. L.	.6051
I ~ H -	1	33	57	-	P. L.	.2824
Prop. part	1	25	37	diff.	P. L.	.3227
Preceding time	3	0	0			

	h.	m.	s.
Time at Greenw. of obs. dist. 14th	4	25	37
Interval to observed *altitude b*	−5	59	9
Time at Greenw. of obs. *alt. b* 13th	22	26	28

	°	′	″		
⊙'s decl. 13th N. (diff. −23′ 3″) N.	3	47	38		
Tab. VI (half time 11h. 13m.) prop.	−21	30			
⊙'s red. decl. N.	3	26	0	ar.co. cos.	0.00078
Co-latit.	S. 72	20	0	ar.co. sine	0.02098
Merid. altit.	68	54	0	N. S.	.93295
⊙'s true altit.	26	23	0	N. S.	.44437
Diff. of Nat. sines and log. -					.48858 9.6°894

	h.	m.	s.	
App. time -	4	3	36	log-rising 9.71076
Ap. ti. Greenw.	22	26	28	

LONGITUDE 5 37 8 = 84° 17′ EAST
(which is the ship's longitude at the time when the *altitude b* was taken.)

Or thus by the error of the watch.—

	h.	m.	s.
Apparent time of *altitude b* -	4	3	36
Time by watch - -	4	2	15
Watch too slow - -	0	1	21
Time by watch of observed distance	10	1	24
Apparent time of ditto	10	2	45
Time at Greenwich of ditto	4	25	37
LONGITUDE as before	East 5	37	8

(at the time when *altitude* was taken.)

PROBLEM XXVII.

Given the apparent Time at the Ship, and the Moon's Distance from the Meridian; to find the LONGITUDE from Greenwich.

RULE.

1. Set down from the Nautical Almanac the moon's and sun's right ascensions in degrees and minutes at the nearest time to the estimated time at Greenwich, and the noon and midnight preceding and following. Subtract the sun's right ascensions from the moon's, and set down the differences, with the first, second, and third differences, of their differences, as in problem XX.

2. *Add* the meridian distance if *East*, or *subtract* it if *West* from the apparent time at the ship; the sum or difference will be the difference of the moon's and sun's right ascensions at the time of observation. To which by problem III find the corresponding time at Greenwich from which the ship's longitude is known.

EXAMPLE.

On the 3d June, 1805, the moon's distance from the meridian was determined from her observed altitude (see problem XX) to be 3h. 14m. 25s. west, at 8h. 45m. 35s. apparent time; required the ship's Longitude?

N. B. *The time may be either found from the sun or star's altitudes or the same observed altitude of the moon, by problem XX.*

Digitized by Google

1805, June	☽'s R. A. ° ′	☉'s R.A. in ° ′ ″		☽'s R.A.—☉'s ° ′ ″		1st Diff. ° ′ ″		2nd Diff. ′ ″		3d Diff. ′ ″
2nd, noon.	139 39	69 52 42	B	69 46 18	b′	6 3 24	b″	— 13 18	b‴	+ 2 24
midn.	146 13	70 23 18	C	75 49 42	c′	5 50 6	c″	— 10 54	c‴	+ 2 54
3d noon.	152 34	70 54 12	D	81 39 48	d′	5 39 12	d″	— 8 0		
midn.	158 44	71 25 0	E	87 19 0	e′	5 31 12				
4th noon.	164 46	71 55 48	F	92 50 12						

		h. m. s.
Apparent time -	G	8 45 35
Meridian distance, West	H	3 14 25
☽'s R.A.— ☉'s R.A. = G ± H		5 31 10 (+ *if E*, — *if W.*)
		° ′ ″
G — H in degrees	I	82 47 30
D Nearest diff. June 3d	K	81 39 48
I — K	S	1 7 42 P. L. 12h.
$a' + \frac{1}{2}c'' - \frac{1}{12}(b''' + c''')$	M	5 44 12½ P. L. 12h.
$s - m$		P. L. 12h.
$a - m$		
$-\frac{1}{2}c'' = -N =$		+ 5′ 27″ P. L. 3h.
$a + b + n =$ *Correction*		P. L. 3h.

Then by Problem III.

$c' =$	-		5° 50′ 6″
$N = \frac{1}{2}c'' =$			— 5 27
$-P = -\frac{b''' + c'''}{12} =$			— 26½
$M =$	Sum		5 44 12½

			h. m. s.
s	1.02674		
m	.32051		
a	.70623		2 21 35
b	.38572		
n	1.51888		
	2.61083		+ 26,5

Time at Greenwich from noon, June 3d - - -	2 22 1,5
Apparent time at the ship - - - -	8 45 35
LONGITUDE in TIME, East - - - -	6 23 33,5

REMARK.

Should the observed difference of the sun and moon's right ascensions fall much nearer the 6th or 18th hour than noon or midnight, it would be somewhat more accurate first to calculate by Dr. Maskelyne's rule the difference of right ascensions at the near 6th or 18th hour, and put $M = d' - \frac{c'''}{24}$ and $N = \frac{c'' + d''}{4}$ (supposing the time to fall between D and E) and then proceed as above;—thus taking the same Example.

The diff. of R. A. at the 6th hour between D and E by Dr. Maskelyne's rule is $D + \frac{1}{2}d' - \frac{1}{8}\overline{c'' + d''} = 84° 30′ 35″$, which subtracted from (I) 82° 47′ 30″ = — 1° 43′ 5″ = S.

Then as above S =	— 1° 43′ 5″	P. L. 12h.	*s* .84414
$M = d' - s\frac{1}{24}c'''$ =	5 39 4½	P. L. 12h.	*m* .32703
			h. m. s.
$s - m$ *(is —)*			*a* .51711 P. L. 12h. — 3 38 53
$a - m$ *(is —)*			*b* .19008
$-N = -\frac{1}{4}\overline{c'' + d''} =$	+ 4′ 43″½	P. L. 3h.	*n* 1.58100
$a + b + n$ *(is +)* *Correction*		P. L. 3h.	2.28819 + 0 56

Time at Greenwich *from the 6th hour* - - -	— 3 37 57
Or time from *noon* at Greenwich - - -	2 22 3
Apparent time at the ship - - - -	8 45 35
LONGITUDE - - - - - - East	6 23 32

But this result is not so near the truth as that by the first operation, because the time happens to fall nearer noon than the 6th hour, otherwise this would have been the most accurate.

In this problem it is necessary to be acquainted with algebraic multiplication and division, as that two like signs make + and two unlike signs —, thus in the last method of operation, *a* and *b* having both negative numbers, & that of *n* being *positive*, their product, or the sum of their logs. is +, making the correction + 56*s*. which added to — 3h. 38m. 53s. is = — 3h. 37m. 57*s*.

Digitized by Google

The time most favourable for this problem is when the moon has little or no change in declination, as an approximate time is necessary in problem XX for finding both the moon's declination and horizontal parallax, and if not known sufficiently near, the operation must be repeated. To find the Longitude by the time of the moon's transit is included in this problem, the meridian distance in that case being 0.

PROBLEM XXVIII.

The Moon's true Distance from the Sun or fixed Star, or Planet, and the Latitude of each being given, to find the MOON's true LONGITUDE; (from which if the Apparent Time at the ship be also known, the Longitude of the Place may be easily found by problem III.)

EXAMPLE 1.

Suppose the moon's true distance from the sun on July 22, 1806, was 88° 37′ 35″ sun being West, and the moon's latitude 4° 32′ 45; required the moon's true Longitude.

	°	′	″			
Given distance	88	37	35	l. cos.	a	8.379700
Moon's latit.	4	32	45	l. cos.	b	9.998633
a—b diff. lon.	88	37	19	l. cos.		8.381067
Sun's long.	118	54	49	W. of ☽.		

	s	°	′	″
☽'s LONG.	207	32	8	= 6 27 32 8

The reverse of this problem will serve to correct the ☽'s true distance from the ☉ or star as given in the N. A. for any known error in the tables of the ☽'s or ☉'s longitude.

By this problem the longitude may be found by the moon's distance from the sun, a star, or planet, whose distance is not given in the Nautical Almanac, provided the difference of latitude is not too great for the difference in longitude;—the following table is a proper limit.

D. Lat.	D. Lon.	D. Lat.	D. Lon.	D. Lat.	D. Lon.
°	° ′	°	° ′	°	° ′
5	10 0	14	26 46	22	46 52
7	12 49	16	31 12	24	53 52
10	18 34	18	35 56	26	61 46
12	22 35	20	41 6	28	73 48

EXAMPLE 2.

Suppose the moon's true distance from Antares on May 7, 1808, was 52° 32′ 28″, the star being *East*, and the moon's latitude 3° 11′ 10″ S. required the moon's true longitude.

	°	′	″		
Given dist.	52	32	28	a	*(star East)*
Moon's lat.	3	11	10	S.	ar. co. l. cos. 0.000672
Star's latit.	4	32	22	S.	ar. co. l. cos. 0.001364
Diff. *lat.*	1	21	12	b	
$\frac{1}{2}\ a + b$	26	56	50	-	log. sine 9.656261
$\frac{1}{2}\ a \sim b$	25	35	38	-	log. sine 9.635473
Sum of the four logarithms				c	19.295770
$\frac{1}{2}\ c$	D	0s. 26° 19′ 36″			log. sine 9.646885
2 D	E	1 22 39 12			Diff. of longit.

		S.	°	′	″
Star's mean lon. May 7, 1806		8	7	5	10,3
Equation of Equinoxes, table xliv				+	14,1
Aberration - table xlv				+	19
Star's true longitude *East*	F	S	7	5	43,4
Difference of longitude *E.*	G	1	22	39	12
☽'s TRUE LONGIT. F ± G		6	14	26	31

PROBLEM XXIX.

Given the meridian Altitude of either Limb of the Moon, when the Change in Declination is about the greatest, also the Latitude and Longitude by Account of the Place of Observation, to find the LONGITUDE of the Place.

EXAMPLE.

November 13th, 1804, in latitude 48° 35′ 25″ N. and long. by account 1h. 20m. West, the greatest altitude of the moon's lower limb was 48° 35′ 39″, the height of the observer's eye 14 feet; required the Longitude of the place.

Digitized by Google

	h.	m.	s.
☽ 's transit at Greenwich, N. Alm.	8	42	0
(da. var. + 51m.) p. p. lon. 1h. 20m.		2	50
Time of moon's transit at ship -	8	44	50
Longitude by account, in time	W. 1	20	0
TIME at GREENWICH -	10	4	50

	°	′	″
Moon's hor. par. at noon, N. Almanac		59	3
Var. + 29″ prop. part for 10h. 5m.		+ 24	
Reduc. for latit. 45° 35′, table F -		— 5	
Moon's reduced hor. par. -		59	22

	°	′	″
Apparent altitude	48	29	30
*Correction, tab. F	+ 10	18	
☽ 's spheroidal alt.	48	39	48
Correc. of ☽ 's spheroid. altit. tab. H		+ 39	21

* *If the* ☽ *'s transit is on side of elevat. pole* —

		°	′	″
☽ 's ch. of decl. in 12h. at midn.	A	3	4	30
Change in one minute -	*a*		0	15,4
Table XVIII, lat. 45° 55′, declin. 5°	*b*		0	2,1
aa ÷ 4 *b* = difference between the greatest and meridian altitude	*c*		0	28

* *See note at the bottom of pages* 24 *and* 25.

	°	′	″
Observed altit. of moon's lower limb	48	33	39
Dip of the horizon - -		— 3	41
App. altit. of moon's lower limb	48	29	58
Spheroidal correction, table H		+ 39	21
True altitude of moon's lower limb	49	9	19
Correction | *c* | of greatest altitude		* —	28
Merid. altit. of ☽ 's lower limb -	49	8	51
Moon's semidiameter - -		+ 16	12
True meridian alt. of moon's center	49	25	3
Co-latitude - -	44	24	35
Moon's declination -	N. 5	0	28
Declin. at midn. N. Alman. (*incr.*)	N. 5	30	0
Difference - - -	0	29	32

Diff. - 0° 29′ 32″ P. L. 3h. .78496
☽ 's var. A 3 4 30 P. L. 12h. .59128
h. m. s.
Ti. *bef.* midn. 1 55 14 P. L. 12h. diff. .19368

	h.	m.	s.
Apparent time, 12h.—1h.55m.14s. =	10	4	46
Time at ship - -	8	44	50
LONGITUDE in TIME -	1	19	56

= 19° 59′ West.

REMARK.

Here the *time* of the moon's greatest altitude was 3m. 40s. after the moon's center had passed the meridian.

PROBLEM XXX.

To find the DIFFERENCE *in* LONGITUDE *of two Places by the observed Intervals of time between the* TRANSITS *of the Moon and a fixed Star over the Meridian of each Place.*

RULE.

1. Set down the moon's right ascensions from the Nautical Almanac for the nearest noon or midnight to the *middle time* at Greenwich by estimation between the two transits of the moon over the two meridians, also the moon's right ascensions for the noon or midnight preceding and following, with their two first differences and second difference.

Then the *first* first difference will be the *rate of the moon's increase* in R. ascen. *in* 12 *hours* at the VIth or XVIIIth hour between the noon and midnight where it stands; to which add for the rate of increase at any succeeding time *(as the middle time between the moon's two transits)* the additional *time in hours* multiplied by the second difference and divided by 12; which is also readily done by table VI;—let the rate of increase so found be called A.

Call B the increase of the moon's right ascension between the times of its transits at both places (which is equal to the *difference* or *sum* in sidereal time of the intervals between the moon and star's transit at each place, according as the moon happens to be on the *same* or on a *different* side of the star at the times of her transit.)

Call C the variation of the equation of time *for* 12 *hours* from the Nautical Almanac page II.

Then as A : B :: (D=) 12h. 1m. 58s. — A ± C : the DIFFERENCE of LONGITUDE; where

Digitized by Google

+ C must be used if the equation of time is *additive* and *increasing*, or *subtractive* and *decreasin* and — C if the equation is *additive* and *decreasing*, or *subtractive* and *increasing*.

EXAMPLE.

On June 13, 1791, the following observations of the passage of the moon a *a Serpentis* were made at the Greenwich and Dublin observatories.

AT DUBLIN.	h. m. s.	GREENWICH, at 9h. 56m. *app. time*	h. m. s.
R. A. of moon's first limb -	15 6 12,49	R. A. of moon's first limb -	15 5 3
R. A. of *a Serpentis* -	15 33 36,91	R. A. of *a Serpentis* -	15 33 34
Interval by clock, in sidereal time	0 27 24,42	Interval at Greenw. in sider. time	0 28 31
Clock *loses* in 24h. 16″,88, prop. -	+ 0,32	Interval at Dublin -	0 27 24
True interval at Dublin, sider. time	0 27 24,74	Diff. of observed intervals | B |	0 1 6

Middle time by estimation 9h. 37m. apparent time.

☽'s R. A.		1st Diff.		2d Diff.
	° ′		° ′	
13th Noon	220 38	c′	+ 7 33	c″ | + 9′
Midn.	228 11	d′	+ 7 42	
14th Noon	235 53			

	h.	m.			
Rate of increase at	6	0	= c′ =	7 33	0
Prop. part for	3	37	and 9′ (c″)	2	43
Rate of increase at	9	37	-	7 35	43

	m. s.
Reduced to time is - | A |	30 22,87

		h. m. s.
12h. in sidereal time - - -		12 1 58
Subtract rate of incr. in 12h.	A	— 30 2
Var. of equat. time *sub. & decr.*	C	+
h. m. s.		
12 1 58 — A ± C =	D	11 31 4

As A 30 22,87 = 1822,87s. log. 3.26
: B * 1 6,44 = 66,44s. — log. 1.8
:: D - 11h. 31m. 41,13s. P. L. .0

: DIFF. LONGIT. 25m. 13s. P. L. 1.4

* *See Explanation of Prop. Logs. Ex. 4. p.*

REMARKS.

When the two places differ much in longitude an allowance ought to be made for the ch of the moon's semidiameter in the interval of the passages, and also for the change of se ameter in right ascension if there be any considerable change in declination.

Mr. *Brinkley* very strongly recommends this method as being extremely easy in practice, capable of much greater accuracy than the eclipses of Jupiter's satellites.

2. When a corresponding observation cannot be obtained, if the time be known, the r right ascension may be inferred from the interval between the moon and star's transit, using IX and X for the moon's semidiameter, and the time at Greenwich corresponding, can be fou problem III, whence the longitude is known.

PROBLEM *XXXI.*

To find the Augmentation of the Moon's Semidiameter, by means of table XL

To avoid the trouble of computing the moon's altitude, in solar eclipses occultations, table XLVIII has been calculated. *See the construction in La L Astron. 3d edit. vol. II. page* 389.

Digitized by Google

EXAMPLE 1.

Let the altitude of the nonagesimal be 67° 20′, the moon's apparent distance 23° 41, and horizontal semidiameter 16′ 26″; required the augmentation.

	s	°	′		
Alt. of nonages.	2	7	20	a	
☽'s app. dist.	0	23	41	b	Tab. XLVIII.

						″
$a+b$	-	3	1	1	Part 1st +	8,19
$a\sim b$	-	1	13	39	1st	5,66
					Sum +	13,85
Equation to		13,58			Part 2d +	,19
					Sum	14,04

Equat. to 14,04 Part IV. is 1″,75
Prop. part for +26″ moon's semidiam. +,78

AUGMENTATION required - 14,82

EXAMPLE 2.

Let the altitude of the nonagesimal be 55° 17′, the apparent distance of the moon 14° 43′, the moon's true latitude *S.* 24′ 2″, parallax in latitude 35′ 40″, and horizontal semidiameter 15′ 30″; required the augmentation.

	s	°	′		
Alt. of nonagesimal	1	25	17	a	
☽'s app. distance	0	14	43	b	Tab. XLVIII.

						″
$a+b$	-	2	10	0	Part 1st +	7,70
$a\sim b$	-	1	10	34	1st +	5,33
					Sum	13,03
Equation to		13″,03			Part II.	0,17
Equation to moon's lat. and par. in lat.		24′ 2″ S. 35 40			Part III	—,02
(*equation part* IV. 1″,64)					Sum	13,18
Prop. part for —3″ moon's semidiam.						—0,82

AUGMENTATION required - 12,36

PROBLEM *XXXII.*

To find the Longitude of a Place by an ECLIPSE of the SUN.

INTRODUTION.

The most exact method of determining the difference in longitude of two distant places is that by solar eclipses or occultations of stars by the moon: (unless a correct time-keeper could be obtained) the chief impediment seems to be the length of the necessary calculations; notwithstanding which it is so frequently employed that every means should be tried to make the operation as simple as possible.

When the beginning or end of a solar eclipse or occultation of a star by the moon has been observed, the true time of the ecliptic conjuntion must be found, as seen from the earth's center, and if the same be done at any other place, the difference of the times will be the difference of the meridians; but for want of the latter, the time of the conjunction at Greenwich, must be found from the Nautical Almanac, or from the best astronomical Tables; but then the result will be affected by the error of the tables, which is avoided when correspondent observations are made.

The greatest part of the calculation consists in finding the effect of parallax, or difference between the apparent place of the sun and moon and that as seen from the earth's center, which is usually done by means of the *nonagesimal.*

As the *ecliptic* is a great circle, one half of it is always above the *horizon*, and the middle of this part, being 90° distant from their intersection, it is thence called the NONAGESIMAL; on the altitude of which, and the longitude from the equinoctial point Aries, the effects of parallax depend; for when the object is in the *nonagesimal*, it has no parallax in longitude, and the parallax in latitude is then equal to the parallax in altitude;— because as a great circle passing through the pole of the ecliptic and nonagesimal passes also through the zenith.

The longitude of the place from Greenwich must be estimated as nearly as possible in order to take out from the Nautical Almanac, or other tables, the moon's longitude, latitude, sun's right ascension, &c. for the required time, and if not assumed at first sufficiently near, the whole operation must be repeated with the longitude corrected by the first calculation; but in order to avoid an unnecessary repetition in the following example the longitude is supposed to have been found nearly from a previous similar calculation, and the error of the tables assumed as known.

Digitized by Google

To find the Moon's Parallax in Longitude and Latitude by means of the Nonagesimal, take the following Formulæ. Let

A = ⊙'s R.A. + apparent time in degrees.
If A *exceeds* 360°, *take* A—360° *for* A.

B = A ~ 270° in N. lat. or A ~ 90° in S. lat.
If B *is greater than* 180° *subt. from* 360°.

C = Latitude of place corrected by table F.

O = Apparent obliquity of the ecliptic.

D = 90° — C — O.

E = 90° — C + O.

K = Longitude of the Nonagesimal.

L, & l = ☽'s true, and apparent latitude.

M, & m = ☽'s true, and apparent longitude.

N = M ~ K = ☽'s dist. from the nonages.
If N *exceeds* 180° *subtract it from* 360°.

P = ☽'s hor. par. corrected by table F.
(in solar eclipses — ⊙'s hor. par.)

p = moon's parallax in longitude.

q = ☽'s parallax in latitude.

To find the Altitude and Longitude of the Nonagesimal.

Sine ½ E : sine ½ D :: cotan. ½ B : tang. F
Cos. ½ E : cos. ½ D :: cotan. ½ B : tang. G
Sine F : sine G :: tang. ½ D : tan. ½ H

H = the ALTITUDE of NONAGESIMAL.

In North Latitudes,

K = 90° ± F + G = LONG. of NONAGES.
Sign + *when* A *is between* 90° *and* 270°, *otherwise* —; *in which case if* F + G *is greater than* 90°, K = 450° — F + G.

In South Latitudes,

K = 270° ∓ F + G. *The sign* — *when* A *is between* 90° *and* 270°, *otherwise* +; *and if it exceeds* 360° *take its excess.*

To find the Moon's Parallax in Longitude and Latitude.

$$\text{Sine } p = \frac{\text{Sine P} \cdot \text{Sine H} \cdot \text{Sine (N} + p\text{)}}{\text{Cosine L.}}$$

$$\text{Sine } q = \frac{\text{si. P} \cdot \text{cos. H} \cdot \text{si. N} + p - \text{si.} p \cdot \text{si. L} \cdot \text{cos. N} + p}{\text{Sine N.}} \times \text{cosine } l.$$

(*The second term of the equation becomes positive when the moon has south latitude; the sign of south latitude being negative.*)

m = M ± p. *The sign* + *if* M *is east of* K, — *if west.*

l = L ± q *Sign* + *if the* ☽*'s true lat. is South.* — *if North.*
The contrary in South latitudes; (changing the signs when q *is negative.)*

EXAMPLE.

At the solar Eclipse on the 16th June 1806, the following observations were taken at *Kinderhook south-landing*, on the Hudson river, in latitude north 42° 23′ 3″, and the assumed west longitude from Greenwich 4h. 55m. 20s. required the true LONGITUDE of the place.

The latitude of the place having been determined from the sun's meridian altitude by a mean of three preceding days, and the time-keeper, which was a very correct one of *Arnold's*, adjusted by a great number of altitudes preceding and following the eclipse, the times of the different contacts were observed with two of *Dolland's* best four feet achromatic telescopes;—the sky during the whole time was perfectly clear; and the eye being fixed on the point of contact which was before calculated, the times are supposed to be extremely accurate.

	Mean time. h. m. s.	Apparent time. h. m. s.
Beginning of the eclipse June 15th	21 49 37	21 49 31,1
Beginning of total obscuration	23 8 2	23 7 55,4
End of total obscuration	23 12 39	23 12 32,4
End of the eclipse, June 16th	0 33 45	0 33 37,7

Digitized by Google

To find the *Altitude* and *Longitude* of the *Nonagesimal*, and the Moon's *Apparent Longitude* and *Latitude* at the time of the FIRST CONTACT.

		h. m. s.
☉'s R. Ascen. N. Almanac -		5 36 48,6
☉'s R. Ascen. + app. time —24h.		3 26 19,7
The same in degrees -	A	51 34 55
A ~ 270°	*b*	218 25 5
(*b* > 180°) 360° — *b*	B	141 34 55
Latitude of Kinderhook	*c*	42 23 3
Latitude — 10′ 16″ (table F)	C	42 12 47
90° — C		47 47 13
* App. Obliquity of Ecliptic	O	23 27 54
90° — C — O	D	24 19 19
90° — C + O	E	71 15 7

	h. m. s.
Apparent time of beginning -	21 49 31,1
Estimate longitude *West* -	4 55 15
(*Corrected from* 4° 55′ 20″)	
Estimate time at Greenwich -	2 44 46,1

	′	″
☽'s hor. par. 16th noon, N. A. (—10″)	60	11
Prop. for 14″ and 2h. 45m. -	+	3,2
Reduction from table F -	—	4,9
☽'s reduced horizontal parallax	60	9,3
Sun's horizontal parallax -		8,5
☽'s hor. par. — ☉'s hor par. | P |	60	0,8

		°	′	″						
½ E		35	37	33,5	Ar.co. l.sin.	*e*	0.234711	Ar.co. L.cos.	e′	0.089997
½ D		12	9	39,5	L. sine	*d*	9.323580	Log. cosine	d′	9.990143
½ B		70	47	28	L. cotang.	*b*	9.542092	Log. cotang.	b′	9.542092
e + *d* + *b*	F	7	10	54	L. tangent		9.100383	Log. tang.	g	9.622232
	F	7	10	54	Ar.co. l.sin.	*f*	0.903035	arc cor.	G	22°44′4″½
e′ + d′ + b′ ½ D	G	22	44	4,5	L. sine	*g*	9.587108			
		12	9	39,5	L. tangent	d	9.333437			
f + *g* + d	*h*	33	40	12	L. tangent		9.823580			
2 *h*	H	67	20	24	ALTITUDE of the NONAGESIMAL.					
90° ± (F + G)	K	60	5	1,5	LONGITUDE of the NONAGESIMAL. (*See page* 48.)					
☽'s long. N. A.—1′ 5″,3	M	83	45	50,2	MOON'S TRUE LONGITUDE. (*allowing for error of the tables* 1′ 5″,3.)					
M ~ K	N	23	40	48,7	MOON'S DISTANCE from the NONAGES.					
☽' true latitude, N. A.	L	0	24	56,27	MOON'S TRUE LATITUDE North.					

To find the ☽'s Parallax in Long. and Latitude at the time of the FIRST CONTACT.

		°	′	″								
☽'s lat.	L	0	24	56,35	ar.co. l.cos.	*l*	0.000011	☽'s dist.	N	23	40	48,7 ar.co. l.sin. 0.396172
	H	67	20	24	log. sine	*h*	9.965111		P		60	0,8 log. 3.556399
	P		60	0,8	log.		3.556399		H	67	20	24 log. cos. 9.585756
								N + *p*		24	3	23,2 log. sine 9.610273
Sum					*Constant logarithm*	*r*	3.521521					
	N	23	40	48,7	log. sine	*n*	9.603828	Sum 4 log. [— 20	T	0	28	27,9 log. 3.148600
n + *r*	p″		22	14	1st appr.		3.125349		N	23	40	48,7 ar.co. l.sin. 0.396172
N + *p*″		24	3	2,7	log. sine	*s*	9.610176		*p*		22	34,5 log. 3.131802
s + *r*	p′		22	34,1	2d appr.		3.131697		L		24	56,35 log. sine 7.860590
N + *p*′		24	3	22,8	log. sine	*t*	9.610271	N + ½*p*		23	52	6 log. cos. 9.961173
								Sum 4 log. [— 20	*v*	0	0	22,41 log. 1.349747
t + *r*	*p*		22	34,5	PAR. in [LONG.		3.131792	† T ± U L ± *q*	*η*	0	23	5,49 ☽'s PAR. in LAT.
									l	0	1	50,86 ☽'s APP. LAT. N. (cosine being = 1) *See p.* 48.

In the same manner the elements for the times of the other contacts were found to be as in the followiog table.

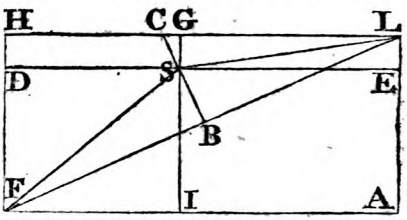
* *The obliquity of the ecliptic, and* ☽*'s horizontal parallax are corrected from the new tables of* Mr. BURG *of Vienna.* † *The sign* — *when the* ☽*'s true latitude is North.*

Digitized by Google

ELEMENTS of the TOTAL SOLAR ECLIPSE, of June 16, 1806.

At the several contacts.		First.	Second.	Third.	Fourth.
		h. m. s.	h. m. s.	h. m. s.	h. m. s.
Mean times of observations		21 49 37	23 8 2	23 12 39	0 33 45
Apparent times -	a	21 49 31,1	23 7 55,4	23 12 32,4	0 33 37,7
Longitude by estim. *West*		4 55 15			
Time at Greenwich		2 44 46,1	4 3 10,4	4 7 47,4	5 28 52,7
☉'s R. Ascen. N. Alman.	b	5 36 48,6	5 37 2,1	5 37 3,1	5 37 17,1
R. Ascen. Med. Cœl. $a + b$ (— 24 h.)		3 26 19,7	4 44 57,5	4 49 35,5	6 10 54,8
		° ′ ″	° ′ ″	° ′ ″	° ′ ″
The same in degrees -	A	51 34 55	71 14 22	72 23 52	92 43 42
Altitude of Nonagesimal	H	67 20 24	70 18 4	70 24 51	71 15 55
Longitude of Nonagesimal	K	60 5 1,5	75 20 39	76 14 50	92 8 2
☽'s tr. long. *N. Al. —1′5″,3	M	83 45 50,2	84 33 46,5	84 36 36	85 26 13,1
☉'s tr. long. *N. Al. —5″,3	S	84 40 46,0	84 43 53,1	84 44 4,1	84 47 17,7
☽'s tr. long. — ☉ true long.	D	— 54 55,3	— 10 6,6	— 7 28,1	+ 38 55,4
☽'s tr. dist. from Nonages.	N	23 40 48,7	9 13 7,5	8 21 46	—6 41 48,9
☽'s Hor. Par. — ☉'s Hor. P.	P	0 60 0,8	0 60 2,3	0 60 2,4	0 60 3,9
☽'s Parallax in Longitude	p	+ 22 34,5	+ 9 12,29	+ 8 21,79	— 6 44,59
☽'s app. dist. from Nonages.	n	24 3 23,2	9 22 13,79	8 30 7,79	6 35 4,31
☽'s ap. long. — ☉'s ap. long.	d	— 32 21,3	— 0 54,31	+ 0 53,69	+ 32 10,81
☽'s tr. lat. N. Alm. North	L	0 24 56,35	0 20 30,66	0 20 14,98	0 15 59,67
☽'s Parallax in Latitude	q	— 23 5,49	— 20 13,99	— 20 7,44	— 19 23,17
☽'s Appar. diff. Latit. N. A.	l	Nor 1 50,86	N. 0 16,67	N. 0 7,54	Sou. 3 43,5
☽'s aug. sem. —2″,977 infl.		0 16 38,373	0 16 40,253	0 16 40,283	0 16 40,803
☉'s sem. N.A. —1,623 irrad		0 15 44,457			
☽'s relat. vel. in 12h. from ☉		6 51 23,8	6 51 45,3	6 51 46,7	6 52 8'4
☽'s do. between obs. & conj.	R	6 51 37	6 51 47,8	6 51 48,4	6 51 59,3

* *These are the supposed errors in the tables of the sun and moon's longitude, deduced from the observations with the estimate longitude of Kinderhook; but a corresponding observation at Greenwich will be more accurate; allowing for these, the time of the true conjunction at Greenwich by the Nautical Almanac will be* 4h. 20m. 50,5s. *when the relative velocity in* 12 *hours was* 6°. 51′ 50″,14.



This table contains all that is necessary for finding the time of the *true conjunction*; the annexed figure will explain the operation; where DSE represent a portion of the ecliptic, and S the Sun; (or if an occultation D S E a parallel to the ecliptic through S the star); L and F the *apparent* places of the ☽'s center at the beginning and at the end of the eclipse; S L and S F the sums of ☉ and ☽'s semidiameters (or the ☽'s if an occultation); A F the ☽'s *apparent* relative motion in Longitude and L A in Latitude during the whole interval; L E and D F the apparent differences of Latitude at each contact; S B the nearest distance of the centers. A F L the *angle of inclination* of the ☽'s apparent orbit, S L E and S F D the *angles of conjunction* at the beginning and end. Whence, E S and S D the apparent differences of Longitude are to be found, and the true differences of longitude and latitude both at the beginning and end by applying the parallaxes with a contrary sign, from which with the velocity or horary motion found by the tables, the time of the true conjunct. is found.—As in the following example for the 1st and 4th contact.

		° ′ ″					
☽'s relat. motion in app. latit.	L A	0 5 34,36	log.	a	2.524214		
☽'s relat. motion in app. long.	A F	0 64 32,11	log.	b	3.587948	log.	b' 3.587948
(betw. first and last contact.)							
$a - b$ ANGLE OF INCLINATION.	L F A	4 56 7	tan.		8.936266	cos.	c' 9.998387

$b' - c' =$ ☽'s relative motion in apparent orbit or cord of transit L F, 3886″,52 log. 3.589561

Note, S B *will not be correctly the nearest distance, for on account of the curvature of the apparent orbit,* L F *is not a right line.*

Digitized by Google

☽'s semidiam. — 2″,977 inflexion *at immersion*							16	38,373	-	*at emersion*			16	40,803	
⊙'s semidiam. — 1″,623, irradiation							15	44,457	-				15	44,457	
Sum of the two semidiameters						SL	32	22,83				SF	32	25,26	
			Logr's.										Log'rs.		
L F	3886,52	*a*	3.589561	L F − *x* = 2LB	3884,089	*d*	3.589289								
S L + S F	3888,09	*b*	3.589736		2 S L	3885,66	*e*	3.589465							
S L ~ S F	2,43	*c*	0.385606	*d* − *e*	F	1 37 45	cos.	9.999824	= ang. S L B						
e + *b* − *a* [= *x*	2″,431		0.385781	L F A	G	4 56 7	= angle of inclination.								

1* F ± G central angle -	L S E	3° 18′ 22″	l. cos.	*h*	9.999277	l.sin.	*h′*	8.760954			
Sum of Semidiameters - -	S L	1942″,83	log.	*i*	3.288435	log.	*i′*	3.288435			
2* *h* + *i*, = ☽'s App. Long.—⊙'s	S E	−32 19,60	log.		3.287712		*h′* + *i′*	2.049389			
☽'s Parallax in Longitude -	*p*	+22 34,50									

S E − *p* = ☽'s Tr. Long. —⊙'s by obs.	− 54	54,1	P. L. .51568
☽'s relative motion in 12 hours -	6	51 37	P. L. .24284
	h.	m. s.	
Interv. of time betw. *immersion* & *conjunction*	1	36 2,15	P. L. 27284
App. time of *immersion* at Kinderhook -	21	49 31,1	
APP. TIME of CONJUNC. at Kinderhook	23	25 33,25	by immers.

Number corresponding = L E

= ☽'s *app. lat.*	1′ 52,05
Ditto by tables	1 50,86
Corr. in Lat. +	0 1,19
☽'s B. diff. Lon.—	54 54,1
Do. by tables —	53 55,8
Correction	— 0 58,3

To be satisfied there is no error in the calculation, it may be useful to calculate the true time of conjunction also, from the triangle D S F at the Emersion—thus.

L F + *x* = 2 B F		3888″,951	log.	*d*	3,589833						
2 S F		3890,52	log.	*e*	3.590008						
d − *e* = angle B F S	F	1 37 37	cos.		9.999825						
Angle of inclin. L F A	G	4 56 7									
1* F ± G, Central angle	F S D	6 33 34	cos.	*h*	9.997145	sine	*h′*	9.057978			
Sum of semidiameters	S F	32 25,26	log.	*i*	3.288978	log.	*i′*	3.288978			
h + *i*, ☽'s app. long.—⊙'s	D S	32 12,51	log.		3.286123	log.		2.346956			
☽'s parallax in longitude	*p*	− 6 44,59									
D S—*p*, ☽'s true long.—⊙'s by obs.		0 38 57,1	P. L. .66475								
☽'s relative motion in 12 hours		6 51 59,3	P. L. .24245								
		h. m. s.									
Interval from conjunction to emersion		1 8 4,45	P. L. .42250								
Apparent time of emersion -		0 33 37,7									
APP. TIME of TRUE CONJUNCT.		23 25 33,25	by emersion.								

h′ + *i′* *app. lat.*	DF	3 42,31	
Ditto by N. A.		3 43,50	
Corr. in latit. N.		0 1,19	
☽ *s lon.*—⊙*s by ob.*		38′ 57″,1	
Ditto by tables -		39 55s4	
Correction as bef.		—0 58,3	

1* *When the apparent difference of latitude* L E *at the immersion is greater, than* D F *at the emersion; the sign is* +, *otherwise* ~. *The contrary at the emersion.*

2* *In occultations this is to be multiplied by the cosine of the* ☽*'s apparent latitude, at the middle latitude between* L *and* F. *(Or else the star's latitude. See the next Problem.)*

Digitized by Google

REMARKS.

As this eclipse was nearly central, it is less proper for determining the error of the tables in latitude, and also a small variation of the diameters will materially affect the deduced latitude, which seem to require the inflexion and irradiation here used.

The time of the true conjunction can also be accurately determined in a similar manner, by the interior contacts (or by one exterior and one interior) if any accident should prevent the others from being observed; but S L and S F will represent the differences of the semidiameters at the interior contacts, instead of the sums—thus

☽'s relative motion in app. lat.	L A	9″,13	log.	a	0.960471					
☽'s relative motion in app. long.	A F	108,00	log.	b	2.033424	log.	b'	2.033424		
(*between the interior contacts.*)										
$a - b$ ANGLE of INCLINATION	L F A	4° 49′ 55″,7	tang.		8.927047	cos.	c'	9.998454		

$b' - c' =$ ☽'s motion in rel. orbit or cord of transit L F — 108″,385 log. 2.034970

☽'s semidiam. — 2,977 (inflexion) 1st inter. cont. 16 40,253 2nd inter. cont. 16 40,283
☉'s semidiam. — 1,623 (irradiation) 15 44,457 15 44,457

Differences of the two semidiameters — S L 55,796 — S F 55,826

L F	108,385	log.	a	2.034969	L F $- x$	108,354	log.	d	2.034845	
					2 S L	111,592	log.	e	2.047633	
S L + S F	111,622	log.	b	2.047750						
S L — S F	0,03	log.	c	8.477121	$d - e$	F	13 50 10	cos.	9.987212	= angle S L B
$c + b - a$					L F A	G	4 49 55,7	= angle of inclination.		
$= x$	,030896	log.		8.489902						

† F ∼ G central angle	L S E	18 40 5,7	cos.	h	9.976528	sine	h'	9.505270		
difference of semidiameters	S L	55″,796	log.	i	1.746603	log.	i'	1.746603		
$h + i$, ☽'s app. long. — ☉'s	S E	—52″,86	log.		1.723131	$h' + i'$		1.251873		
☽'s parallax in longitude	p	0° 9′ 12″,29				No. to $h' + i'$		*app. diff. Lat.*		17″,86
								Diff. by table	-	16 ,67
S E — p, ☽'s true Long. — ☉'s by obs.		— 10′ 5″,15	P. L.	s	1.25166					
☽'s relative motion in 12 hours	-	6° 51′ 38″,4	P. L.	t	.24265	*Corr. in Lat.*		N.		1 ,19
		h. m. s.								
$s - t$, interval of time to the conjunction		0 17 37,8	P. L.		1.00901	*Tr. diff. in lon.*				—10′ 5″,15
Apparent time of first inter. contact		23 7 55,4				*By table*	-	—	9	6 ,6
APP. TIME of TRUE CONJUNCTION		23 25 33,2	as before			*Corr. in long.*				—58 ,55

The time of thetrue Conjunction being found by an observation at any other place, the difference of the times will be the difference of the meridians.

Or if the time of the conjunction be found for Greenwich by the Nautical Almanac, allowing for the errors of the tables, the longitude from Greenwich will be known. The following is an easy method of finding the time of the true conjunction at Greenwich, and the velocity at any time, or rate of motion in 12 hours, by the Nautical Almanac. *(See Problem III.)*

1806 June.	☽'s long.	☉'s long	☽'s long. — ☉'s		1st diff.		2d diff.		3d & 4th diff.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″		′ ″		″
15th N.	67 35 57	83 37 0	—16 1 3	B					
					b′ 6 44 22				
Midn.	74 48 58	84 5 39	— 9 16 41	C		b″	4 20		
					c′ 6 48 42			b‴ —47,5	
16th N.	82 6 19	84 34 18	— 2 27 59	D		c″	3 32,5		—3
					d′ 6 52 14,5			c‴ —50,5	
Midn.	89 27 12	85 2 56¼	+ 4 24 15,5	E		d″	2 42		
					e′ 6 54 56,5				
17th N.	96 50 47	85 31 35	+11 19 12	F					

$b''' = -3''$

† *Sign* +, *when* ☽'s *lat. is greater at the first interior contact than the second.*

Digitized by Google

Form to find the Apparent Time of the true ecliptic Conjunction at Greenwich.

		° ′ ″		pro. logs.
Nearest to conjunction	D	−2 27 59		
*Err. of ☽ 's diff. lon. in tab.		− 58,3		
Corr. diff. of ☉ & ☽ 's long.	S	2 28 57,3		.68428
M	M	6 50 36,4		.24390
$s - m$ approximate time			t	.44038
$N = 1'\ 46''\frac{1}{4}$ (h. and m.)			n	.22894
1st corr. $n + t$	O	38,5		.66932
$P = -8''\ 10'''$ (m. & s.)			p	1.34323
2d corr. $p + 2t$	R	− 1,1		2.22399
M + O + R		6 51 13,8	d	.24325
		h. m. s.		
TR. CONJ. at Greenw. $s - d$		4 20 47,7	z	.44103
TRUE CONJ. at Kinderhook		23 25 33,2		
LONGITUDE of Kinderhook		4 55 14,5 West.		

° ′ ″

$c = 6\ 48\ 42$

$N = \frac{1}{2}c'' = 1\ 46{,}25$

$-P = \frac{1}{12}b''' + c''' = +8{,}17$

$M = \text{sum}\ 6\ 50\ 36{,}42$

M = the relative velocity or motion in 12 hours for the 16th at noon; and the velocity at any other time may be accurately found by the following Theorem. Let x, + or −, = the time from M divided by 12 hours, then the VELOCITY continued for 12h. is,

$$M + x \times c'' - \frac{1}{12}b''' + x^2 \times \frac{b''' + c'''}{4} + x^3 \times \frac{1}{6}b'''$$

N. B. *Twice the prop. log. of* x = *the prop. log. of* x^2, *thrice, of* x^3.

Note. z *may be substituted for* t, *if it be thought necessary to repeat the operation.*

* *This error of the tables in the moon's longitude is supposed to be taken from later observations, which have been adopted by Dr. Maskelyne in the Nautical Almanacs after* 1808. *(See the Preface to the N. Almanac for* 1809.*) Instead of the* hor. motion *the rate is here given for* 12 *hours, being easily deduced from the form, and adapted to the tables of Prop. Logs. for* 12 *hours.*

If the errors of the tables in lat. were accurately known, the quantity of Irradiat. *and* Index *of the sun and moon could also be found by this eclipse, as will easily be understood from the figure—thus,*

To find the sum of semids. by the Immers.

		° ′ ″			Log'rs.
Angle of Inclin.	CLB	4 56 7	tan.	a	8.936265
1* $\frac{1}{2}$ LF − x	BL	1942″,05	log.	b	3.288950
$a + b$	BC	167″,696	log.		2.224595
☽ 's ap. lat. cor.	GS	112″,05	log.	d	2.049413
Angle of Inclin.	CSG	4°56′ 7″	cos.	e	9.998387
$d - e$	SC	112″,461	log.		2.051026
2* BC + SC	BS	55″,235	log.	g	1.742251
$b - g$	LSB	88° 22′ 9″	tan.		1.546045
		88 22 9	sin.		9.999829
$b - i$	SL	1942″,84	log.		3.288436
= sum of semidiam. at the immersion				m	32′ 22″,84
Diffierence of ditto at the immersion				n	53″,916

Diff. by the first Inter. Contact

° ′ ″			Log'rs.
4 49 55,7	tan.	a'	8.927047
54″,177	log.	b'	1.733815
4″,180	log.	c'	0.621362
17″,36	log.	f'	1.251881
4°49′55″,7	cos.	e'	9.998454
17″,924	log.		1.253427
13″,344	log.	g'	1.125286
76° 9′ 48″	tan.		0.608529
76 9 48	sine	i'	9.987211
55,796	log.		1.746604
Diff. at first inter. cont.			55″,796
Var. from the immersion			− 1″,88
Diff. of semid. at immers.			53′,916

$\frac{1}{2}\overline{m + n}$ = ☽ 's app. semid. at immers. 16′ 38″,373 makes INFLEXION 2′,977

$\frac{1}{2}\overline{m - n}$ = ☉ 's app. semid. - 15′ 44″,457 makes IRRADIATION 1,623

1* $\frac{1}{2}\overline{\text{LF} - x}$ = BL *is obtained by an assumed value of the semids. (see page* 51*) which will always be sufficiently near; or* $\frac{1}{2}$L F *would find the semids. at the intermediate time very nearly.*

2* *The sign is* +, *if the lat. (or diff. of lat. if a star) is least at the immer ion, without changing its denomination; in all other cases* −. (B S = 13″,344, *the near. dist. of the* ☽ *'s cen. N. of* ☉ *'s.)*

Digitized by Google

The end of this Eclipse was observed at LANCASTER in Pennsylvania,

June 16th, at 0h. 19m. 2s. mean time. In latitude 40° 2′ 36″ N. and by estimation 5h. 5m. 24s. West of Greenwich; whence the altitude of the Nonagesimal is 73° 40′. Longitude of ditto 89° 14′ 10″. ☽'s distance from ditto 3° 50′ 43″. ☽'s hor. parallax corrected for Lancaster, — ☉'s hor. par. 60′ 3″,9. Par. in longitude —3′ 55″,8. Parallax in latitude —16′ 54″,2. ☽'s apparent semidiameter corrected 16′ 40″,88. ☉'s 15′ 44″,43. From whence the *mean* time of the true Conjunction at Lancaster is - - - - 23h. 15m. 24,2s.
at Kinderhook - - - - 23 25 33,2

Difference of longitude between Kinderhook and Lancaster - West 10 9

PROBLEM XXXIII.

To find the LONGITUDE of a Place by the OCCULTATION of a FIXED STAR by the MOON.

EXAMPLE.

The occultation of Spica ♍ by the moon was observed May 24th, 1801, at the Royal Observatory of the Isle of Leon by Dn. J. O. CANELAS, in Latitude North 36° 27′ 50″ Longit. West from Paris National Observatory 0h. 38m. 8s.

	Immersion. h. m. s.	Emersion. h. m. s.
Mean times of the observation - -	8 49 16,4	9 29 1,8
Longitude West from Paris - -	+ 34 8	+ 34 8
Mean times in Paris - -	9 23 24.4	10 3 9,8
Apparent times of observations -	8 52 49,76	9 32 35,18
Sun's right ascension - -	+4 4 21,34	+4 4 28,3
R. ascen. of med. cœl. (—24h. *if neces.*) | A |	12 57 11,1	13 37 3,48

To find the Altitude and Longitude of the *Nonagesimal* at the IMMERSION, By Mr. *Brinkley's* Method.

		° ′ ″		Loga'rs.		Loga'rs.
Right Ascen. med. cœl. in degrees	B	194 17 51	sine	*b* 9. 392621	cos.	*b′* 9. 986336
Latitude reduced by table F -	C	36 18 0	cot.	*c* 0. 133965	cos.	*c′* 9. 906296
b + *c*	D	71 25 4	cot.	*d* 9. 526586	cos.	*g′* 9. 892632
Apparent obliquity of the ecliptic	E	23 28 5				
1 * D ± E	F	94 53 9	sine	*f* 9. 998419	cos.	*f′* 8. 950290
2 * *b′* + *c′*	G	141 20 57	sine	*g* 9. 795583	tan.	*g″* 9. 902950
ALTIT. of NONAGES. *g* + *f*	H	51 30 56	cos.	*h* 9. 794002	tan.	*k′* 8. 833240
3* LON. of NONAGES. *g″* + *f′*	K	176 6 12	☽'s *Horizontal Parallax at*			
☽'s LONGITUDE *by the tables*	M	200 41 58,6	9*h.* 29*m.* -			58′ 20″,97
☽'s Distance from nonagesimal	N	24 35 46	*Reduction from table F* -			— 3 ,71
☽'s Latitude by the tables South	L	1 · 9 12,2	☽'s *reduced Hor. Par.* | P |			58 17 ,26

1* *The sign* + *when* B *is greater than* 180°, *otherwise* —.

2* *When* B *is between* 90° *and* 270°, *take the supplement of* G.

3* *When* F *is less than* 90°, K *is in the same quadrant as* B; *when greater than* 90°, *in the same quadrant as* G.

Digitized by Google

To find the Moon's Parallax in Longitude and Latit. at the IMMERSION.

		°	′	″						°	′	″		
☽'s lat. S.	L	1	9	12,2	ar.c. l. cos.	0.000088		N	24	35	46	ar.c. l.sin.	0.380678
Alt. Non.	H	51	30	56	log. sine	9.893638		P		58	17,86	log.	3.543729
H.P. red.	P		58	17,26	log.	3.543728	Alt. Non.	H	51	30	56	l. cos.	9.794001
							$N+p$		24	54	59,56	l. sine	9.624591
Sum			*Constant Log.*		r	3.437454							
☽ dis.Non	N	24	35	46	log. sine	n 9.619322	Sum	T		36	42,91	log.	3.342998
$n+r$	p′	0	19	0	1st *approx.*	3.056776		N	24	35	46	ar.co.l.sin.	0.380678
								p		19	13,56	log.	3.062044
$N+p'$		24	54	46	log. sine	s 9.624528	$N+\frac{1}{2}p$		24	45	22,8	l. cos.	9.958132
$s+r$	p″	0	19	13′4	2d *approx.*	3.061982	☽'s latit.	L	1	9	12,2	l. sin.	8.303824
$N+p''$		24	54	59,4	log. sine	t 9.624588							
$t+r$	p	0	19	13,56	PAR. in LONG.	3.062042	Sum	U	0	0	50,66	log.	1.704678
					† Approximate parallax		$T \mp U$	q′	0	37	33,57	log.	3.352871
					☽'s apparent latitude nearly		$L+q =$		1	46	46	l. cos.	9.999791
In the same manner are found these elements (*See page* 48)						PAR. LAT.	q		° 0	′ 37	″ 32,49	Sum	3.352662
☽'s TRUE LONGIT. by Tables at Immersion						M	200	41	58,60	Emer.	M′	201	4 43,30
PARALLAX in LONGITUDE						p	+	19	13,56		p'	+	11 51,05
☽'s APPARENT LONGITUDE						$M+p$	m	201	1	12,16	m'	201	16 34,35
☽'s TRUE LATITUDE by the Tables *South*						L		1	9	12,20	L′	1	11 10,92
PARALLAX in LATITUDE						q	+	37	32,49		q'	+	40 41,05
☽'s APPARENT LATITUDE $L+q$ *South*						l	1	46	44,69		l′	1	51 51,97

To find the time of the true Conjunction.

☽'s motion in app. long. $m'-m$	0° 15′ 22″,19	log.	a	2.964820						
‡ Star's app. latitude South	2 2 13	l. cos.	b	9.999726						
$a+b = AF$	-	log.	c	2.964546	log.	c'	2.964546			
☽'s mo. in app. lat. $l'-l = LA$	0 5 7,28	log.	d	2.487534						
(*See figure, p.* 50.)										
$d-c$, Inclin. of appar. orbit LFA	18 26 21	tan.	e	9.522988	l.cos.	e'	9.977111			

$e'-e'$, ☽'s motion in app. orbit or cord of transit | LF | 971″,483 - log. 2.987435

☽'s semidiam. − 2″ inflex. *Immersion* | SL | 16′ 4″,98 at *Emersion* | SF | 16′ 5″,36

			Log'rs.							
LF	971″,483	a	2.987436	LF − x = 2 BL	970″,728	log.	d	2.987097		
SL + SF	32′10″,54	b	3.285634	2 SL	1929,96	log.	e	3.285548		
SL − SF	0,38	c	9.579784							
$c+b-a$ = x	,755061		9.877982	$d-e$	F	59° 48′ 10″	l. cos.	9.701549		
			Inclin. of app. orbit	LFA	G	18 26 21				
§ F + G Central angle F S D	78°14′31″	l.cos.	h	9.309160	l.sine	h'	9.990790			
☽'s semidiam. S L	964″,98	log.	i	2.984518	log.	i'	2.984518			
Latitude of Spica ♍	2° 2′13″	l.cos.	k	9.999725	$h'+i'$		2.975308	*Num. corres.*		
					= app. diff. Lat.		0° 15′ 44″,73			
$i+h-k$ = SE	−3 16, 77	log.		2.293953						
☽'s par. in long.	p	19′.13″,56			Apparent latitude of Spica ♍		2	2 13″		
Tr.diff. lon. obs. SE − p.	−22 30″,33	P. L.	s	.90298	☽'s apparent latitude		1	46′ 28,27		
☽'s motion in 12 hours	6°51′ 52″,3	P. L.	t	.24257	By tables -		1	46 44,69		
	h. m. s.									
$s-t$ interval to conjunction	0 39 20,6	P. L.		.66041	Correc. of ☽'s latitude			— 16,42		
Mean time of immersion	8 49 16,4	† *The sign* + *when the* ☽*'s true lat. is South.*								
MEAN TIME of CONJ.	9 28 37	§ *Sign* + *when the* ☽*'s diff. of lat. is greatest at immers.*								

‡ *La Lande, vol.* 2, *page* 443, *takes the* ☽*'s apparent latitude between immersion and emersion.*

Digitized by Google

Observations of the same occultation were also made at the following places.

	Lat. N.	Long.	Immersion.	Emersion.	Observers.
	° ′ ″	m. s.	° ′ ″	° ′ ″	
National observatory at Paris	48 50 14	0 0	9 5 42,4	10 16 37,2	Mr. MECHAIN.
Ecole Militaire - Paris	48 51 6	W.0 7,6	9 5 28,9	10 16 24,2	LE FRANCOIS.
			9 5 28,9	10 16 24,2	BURCKHART.
College de France - Paris	48 50 58	E. 0 2,2	9 5 41,5	10 16 39,8	HENRY.

The following elements are deduced, as before shewn.

		National Observatory.		Ecole Militaire.	
		Immersion.	Emersion.	Immersion.	Emersion.
		h. m. s.	h. m. s.	h. m. s.	h. m. s.
Mean times of observations		9 5 42,4	10 16 37,2	9 5 28,9	10 16 24,2
Longit. West from Nat. Observ.		-	-	7,6	7,6
Mean time at National Observ.		-	-	9 5 36,5	10 16 31,8
		° ′ ″	° ′ ″	° ′ ″	° ′ ″
Altitude of Nonagesimal -	H	39 29 16	32 26 12	39 29 54	32 26 50
Longitude of Nonagesimal -	K	170 13 59	186 15 32	170 10 19	186 11 18
☽'s longitude by the tables	M	200 31 51,8	201 12 25	200 31 48,5	201 12 21,8
☽'s distance from Nonagesimal	N	30 17 52	14 56 53	30 21 29	15 1 3
Equat. horizontal parallax -	ı	58 20,28	58 23 3	58 20 28	58 23 3
Correction for latit. (table F)		— 5,95	— 5,95	— 5,95	— 5,95
☽'s parallax in longitude -	p	+ 18 51,8	+ 8 7,85	+ 18 54,1	+ 8 10,2
☽'s parallax in latitude -		+ 45 59,7	+ 50 12,8	+ 45 59,1	+ 50 11,6
☽'s latitude by the tables -	L	1 8 19,2	1 11 50,77	1 8 19,1	1 11 50,48
☽'s apparent latitude -		1 54 18,9	2 2 3,57	1 54 18,2	2 2 2,08
Cor. of ☽'s lat. by obs. at I. of Leon		— 16,4	— 16,4	— 16,4	— 16,4
☽'s corrected app. latit. South	l′	1 54 2,5	2 1 47,17	1 54 1,8	2 1 45,68
Appar. latit. of Spica ♍ South		2 2 13	2 2 13	2 2 13	2 2 13
Apparent difference of latitude		8 10,5	25,43	8 11,2	27,32
☽'s app. semid. —2″ inflexion		16 2,01	— 16 2,18		
					′ ″
☽'s horary motion between the Immersion and Conjunction at Paris -					34 18,8
between the Conjunction and Emersion - - -					34 20,9

From which the time of the true Conjunction at the National Observatory is,

	h. m. s.
By the *observed Immersion* -	10 2 48,9
By the *observed Emersion* -	10 2 48,1
By the *Immersion* at the Ecole Militaire, reduced to the National Observatory	10 2 47
By the *observed Emersion* - -	10 2 46,3
Time of TRUE CONJ. at the National Observ. Paris by the mean of the obs.	10 2 47,5
Time of ditto at the Island of Leon - - -	9 28 37
LONGITUDE of the ISLE of LEON, West from Paris - -	0 34 10,5

Mr. J. J. FERRER (*to whom the Editor is indebted for the examples to the two last problems, but for want of room the calculations are necessarily given in an abridged form*) *observes, that the Longitude of the Isle of Leon, by a mean of* ten *occultations, compared with corresponding observations in Paris, is* 34m. 8s. *West from Paris; and that the Inflexion of the moon's semidiameter, as calculated from this occultation, is* 2″,18.

FINIS.

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google