AUXILIARY TABLES

TO FACILITATE THE CALCULATIONS

OF THE

SURVEY OF INDIA.

FOURTH EDITION.

REVISED AND EXTENDED UNDER THE DIRECTION OF

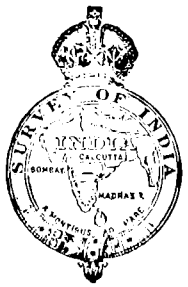
COLONEL F. B. LONGE, R.E.,

SURVEYOR GENERAL OF INDIA

BY

LIEUT.-COLONEL S. G. BURRARD, R.E., F.R.S.,

SUPERINTENDENT TRIGONOMETRICAL SURVEYS.



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PRICE TWO RUPEES.

PREFACE TO THIRD EDITION.

Thirty-six years have elapsed since the publication of the first edition of the Auxiliary Tables of this Department, which was issued in 1851 under the title "Tables to facilitate the "computations of a trigonometrical survey and the projection of maps for India. Computed "and arranged by Babu Radhanath Sikdhar, Chief Computer in the Surveyor General's Office." This edition contained but seventeen tables, two of which consisted of symbols, formulæ and constants. In 1868 this was "revised and extended under the direction of Lieut.-Colonel J. T. "Walker, R.E., F.R.S., &c., Superintendent of the Great Trigonometrical Survey of India, by "J. B. N. Hennessey, Esq., F.R.A.S., Deputy Superintendent 1st Grade, Great Trigonometrical "Survey, in charge Computing Office," and issued as a second edition under the title of "Auxiliary "Tables to facilitate the calculations of the Survey Department of India." This edition contained twenty-six tables which were also, like those of the first edition, confined to the requirements of a trigonometrical survey and the projection of maps. Since 1868, however, ten other tables were from time to time added, which were generally numbered in continuation of the twenty-six as they were brought out, and now that the 1868 edition has been exhausted a new issue is imperatively called for, which of necessity requires a new arrangement of the old tables, grouping those together which relate to the same subjects; so that it has been impossible to retain the old familiar numbering by which many a table was popularly designated in the department. The present issue is moreover somewhat enlarged in scope and includes tables that will be useful to geographical explorers and save them the trouble of carrying other and perhaps cumbersome compilations, while at the same time it includes some new tables within the old scope which will also be found useful. The range of latitude—where it is the argument—has been somewhat enlarged, and now extends in all cases from the equator to 40°, except in tables XXIX, XXX and XXXVI to XLI inclusive in which it extends to 46°.

This edition contains sixty-three tables of which the following numbers were to be found in the previous editions with the less extended range of latitude:—I, II, III, V to XIV, XXIV to XXX, XXXII, XXXIII, XXXV to XL and XLIX to LI. Four concise tables, XLV to XLVIII, occupying but one opening now take the place of the more voluminous table of Mile Equivalents in Feet and Links.

A set of four Star Charts containing all the stars of the first, second and third magnitudes, originally published by General Walker in 1873 for the use of geographical explorers, has been reduced to a suitable scale and inserted in this edition.

For the assistance of the ordinary computer the Tables are preceded by the usual explanations regarding their use, and these are now supplemented by additional explanations in smaller type, shewing how the tables themselves or the formulæ on which they are based have been obtained; with these the ordinary computer need have no concern.

To assist officers employed beyond the Frontier in reducing the astronomical observations that may require to be taken, a few examples of such calculations are added in an Appendix.

The preparation and printing of these Tables have been accomplished under the superintendence of Mr. W. H. Cole, M.A., Deputy Superintendent in charge of the Computing and Printing Offices, but my acknowledgments are also due to Mr. J. Eccles, M.A., Assistant Superintendent, for the preparation of the explanations and appendix and for the trouble he has taken to make them as complete as possible.

July 1887.

C. T. HAIG, COLONEL, R.E.,

Deputy Surveyor General,

In charge of Trigonometrical Surveys.

PREFACE TO FOURTH EDITION.

The first edition of these Tables was issued in 1851, the second in 1868, and the third in 1887. The preface to the third edition, which has been reproduced on page 3, shows how the tables were gradually expanded between 1851 and 1887.

Since 1887 addenda have been printed and circulated at various times, and these have been incorporated in the present edition.

The principal differences between the present and the third editions are due to the changes that have been recently made in the methods of projecting maps. The projections which were formerly used for the atlas sheets and for the general maps of India have been abandoned as unsuited to the wide extent of longitude that has come to be included in Indian mapping.

The modification of the secant conical projection, which was introduced by Colonel Gore in 1900 for the construction of a Map of India and Adjacent Countries on the scale of $\frac{1}{1000,000}$, has been recently adopted by Colonel Longe for all maps on a smaller scale than that of $\frac{1}{1000,000}$.

In accordance with the resolution of the International Geographical Congress that assembled at Berne in 1891, it has been decided to adopt a polyconic projection for maps on the scale of $\frac{1}{1000,000}$.

The polyconic system was first introduced into the Survey of India by Colonel Blacker: under his original design the central meridian of a map was a straight line, and all others were curved and concave to the central meridian: this however was found to be inconvenient, as no two contiguous maps could be placed together so as to form a single map, and eventually General Walker replaced the method by a modified polyconic projection, in which all meridians were straight lines. The latter system has for many years been employed in the Survey of India for topographical maps, and it will be used in future for all maps on the scale of $\frac{1}{1000,000}$ and larger scales.

The several scales, for which tables of "Graticules of Maps" have been constructed in this edition have been determined from the following considerations:—

(1stly). In the Report of the Survey Committee published in 1905 a list of the maps to be undertaken by the Survey of India was proposed.

(2ndly). As it was undesirable to fold the margins of sheets, when two or more were being photographed on one negative, it became necessary, in the case of maps being prepared for reduction, to arrange that every complete map should be drawn on a single sheet of drawing paper.

(3rdly). The maximum size of a sheet of drawing paper, which a draftsman can conveniently handle, had to be estimated.

The preparation and printing of the tables of this edition have been accomplished under the superintendence of Mr. J. Eccles, M.A., Superintendent of the Survey of India. The changes that have been lately made in the projections of Indian maps have necessitated the recalculation of many tables. Mr. Eccles is a recognised authority on the subject of map-projection, and his knowledge has been of great value both in assisting the Surveyor General to decide on the new projections, and in the computation of the data for the new tables. He assisted Colonel Gore in designing the secant-conical projection for India in 1900, and he has prepared the explanations of the projections for this edition.

DEHRA DUN
March 23rd 1906.

S. G. BURRARD, LIEUT.-COLONEL, R.E.,
Superintendent Trigonometrical Surveys.

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TABLES AND THEIR EXPLANATION.

APPENDICES.

SYMBOLS AND FORMULÆ.

a = Equatorial radius of the earth.

b = Polar radius „ „

λ = Geodetic latitude.

c = Compression or ellipticity $= \dfrac{a-b}{a}$.

e = Eccentricity $= \left\{\dfrac{a^2-b^2}{a^2}\right\}^{\frac{1}{2}}$.

ν = Normal to the meridian at λ terminated by the minor axis

$$= \frac{a}{(1-e^2\sin^2\lambda)^{\frac{1}{2}}}.$$

ρ = Radius of Curvature to the meridian at λ

$$= \frac{a(1-e^2)}{(1-e^2\sin^2\lambda)^{\frac{3}{2}}}.$$

ρ_1 = Radius of Curvature of an oblique section at an azimuth of A in latitude λ

$$= \frac{\rho\nu}{\rho\sin^2 A + \nu\cos^2 A}.$$

CONSTANTS EMPLOYED IN THE CALCULATION OF THE TABLES.

EVEREST'S CONSTANTS, 1ST SET.

See *Account of the Measurement of an Arc of the Meridian between the parallels of* 18° 3′ *and* 24° 7′, A.D. 1830, page 115.

a = 20922931·80 feet . . . . . $\log a = 7\cdot320\ 6225\ 395$

b = 20853374·58 „ . . . . . $\log b = 7\cdot319\ 1763\ 443$

$c = 0\cdot003324449014 = \dfrac{1}{300\cdot8}$ . . . . . $\log c = 3\cdot521\ 7196\ 767$

$e^2 = 0\cdot00663784607$ . . . . . $\log e^2 = \bar{3}\cdot822\ 0271\ 770$

$(1-e^2) = 0\cdot99336215393$ . . . . . $\log (1-e^2) = \bar{1}\cdot997\ 1076\ 098$

AUXILIARY TABLES

TO FACILITATE THE CALCULATIONS

OF THE

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EXPLANATION OF THE TABLES.

TABLE I.—*Normals terminated by the Minor Axis, and their Logarithms.*

The Normals are given for every 10′ of latitude between the parallels of 0° and 40° to the nearest tenth of a foot, and their logarithms to nine places of decimals.

The formula by which they have been computed, *viz.*,

$$\nu = \frac{a}{(1 - e^2 \sin^2 \lambda)^{\frac{1}{2}}},$$

follows at once from the simple geometry of the ellipse, a being the semi-axis major of the ellipse, e the eccentricity and ν the normal at a point whose latitude is λ.

The argument with which to enter the table is the given latitude, and the corresponding Normal must be found by interpolation either in the ordinary way or, where extreme accuracy is required, according to the method exhibited in the foot note on the next page.

EXAMPLE.—To find the Normal at a point in latitude 9° 15′ 25″·7.

1°. Approximately

In latitude 9° 10′	Normal =	20924694·4 feet
(Difference = 64·1) × 5′·43	=	+ 34·8 „
Therefore in latitude 9° 15′ 25″·7 ...	Normal =	20924729·2 feet

2°. Rigorously*

If F = the value of the Normal corresponding to 9° 10′ 0″

and $F^{(n)}$ = ,, ,, ,, 9 15 25·7

where n = 5′ 25″·7 reduced to the decimal of 10′

= ·543

the formula in the Note gives

$$F^{(n)} = F + n\,a + \frac{n(n-1)}{1.2}\,b + \frac{n\,(n-1)\,(n-2)}{1.\,2.\,3}\,c + \&c.,$$

---

* NOTE.—*On Interpolation by Differences of any order.*

(See Chauvenet's Astronomy Vol. I.)

Let it be required to determine intermediate values of a function from tabulated values corresponding to equidistant values of the variable on which they depend.

Let T, $T + w$, $T + 2w$, $T + 3w$, &c., express equidistant values of the variable, F, $F^{(1)}$, $F^{(2)}$, $F^{(3)}$, &c., corresponding values of the given function, and let the differences of the first, second and following orders be formed as expressed in the following table:—

Argument	Function	1st Diff.	2nd Diff.	3rd Diff.	4th Diff.	5th Diff.	6th Diff.
T	F						
		a					
$T + w$	$F^{(1)}$		b				
		$a^{(1)}$		c			
$T + 2w$	$F^{(2)}$		$b^{(1)}$		d		
		$a^{(2)}$		$c^{(1)}$		e	
$T + 3w$	$F^{(3)}$		$b^{(2)}$		$d^{(1)}$		f
		$a^{(3)}$		$c^{(2)}$		$e^{(1)}$	
$T + 4w$	$F^{(4)}$		$b^{(3)}$		$d^{(2)}$		
		$a^{(4)}$		$c^{(3)}$			
$T + 5w$	$F^{(5)}$		$b^{(4)}$				
		$a^{(5)}$					
$T + 6w$	$F^{(6)}$						

These differences are found by subtracting each number from the one below it and the proper algebraical signs must be prefixed. The differences of any order are found from those of the preceding order in the same manner as the first differences are found from the given functions.

The even differences (2nd, 4th, &c.,) fall in the same lines as the arguments and functions and the odd differences (1st, 3rd, &c.,) between these lines.

Now, denoting the value of the function corresponding to a value of the argument $T + nw$ by $F(n)$ we have by algebra

$$F(n) = F + n\,a + \frac{n\,(n-1)}{1.\,2}\,b + \frac{n\,(n-1)\,(n-2)}{1.\,2.\,3}\,c + \frac{n\,(n-1)\,(n-2)\,(n-3)}{1.\,2.\,3.\,4}\,d + \&c.,$$

in which the coefficients are those of the nth power of a binomial. If n be taken successively 0, 1, 2, 3, &c., we shall obtain the function F, $F^{(1)}$, $F^{(2)}$, $F^{(3)}$, &c., and intermediate values are found by using fractional values of n.

The formula is usually applied only to interpolating between the function from which we set out and the next following one, in which case n is less than unity.

To find the proper value of n in each case let $T + t$ be the value of the argument for which we wish to interpolate a value of the function: then

$$n\,w = t \quad \text{and} \quad n = \frac{t}{w}$$

that is, n is the value of t reduced to a fraction of the interval w.

EXAMPLE.—Suppose that, instead of being given for every hour as it is, the Moon's Right Ascension had been given in the Nautical Almanac for every twelfth hour as follows:—

where the 1st, 2nd, and 3rd differences, a, b, c, are found from the following data given in the table:

		Differences		
		1st	2nd	3rd
In latitude 9° 10′ . . . Normal =	20924694·4			
		+ 64·1		
„ 9° 20′ . . . „ =	20924758·5		+ 1·1	
		+ 65·2		0·0
„ 9° 30′ . . . „ =	20924823·7		+ 1·1	
		+ 66·3		
„ 9° 40′ . . . „ =	20924890·0			

So that $a = + 64{\cdot}1$, $b = + 1{\cdot}1$, $c = 0{\cdot}0$,

therefore

$$F^{(n)} = 20924694{\cdot}4 + 34{\cdot}81 - 0{\cdot}14$$

$$= 20924729{\cdot}1.$$

Hence the Normal at a point in latitude 9° 15′ 25″·7 is 20924729·1 feet.

		☽'s R. A.			1st Diff.		2nd Diff.	3rd Diff.	4th Diff.	5th Diff.
	h	h	m	s	m	s	s	s	s	s
1905, January 1,	0	15	4	35·61						
					+ 27	34·89				
„ „ 1,	12	15	32	10·50			+ 12·61			
					27	47·50		− 2·10		
„ „ 2,	0	15	59	58·00			10·51		− 1·31	
					27	58·01		3·41		+ 0·14
„ „ 2,	12	16	27	56·01			− 7·10		1·17	
					28	5·11		4·58		
„ „ 3,	0	16	56	1·12			2·52			
					28	7·63				
„ „ 3,	12	17	24	8·75						

Required the Moon's Right Ascension on January 1, at 6^h.

Here T = January 1, 0^h; $t = 6^h$; $w = 12^h$, $\therefore n = \frac{6^h}{12^h} = \frac{1}{2}$; and if we denote the coefficients of a, b, c, d, e by A, B, C, D, E, we have

								F =	15	4	35·61
a =	+ 27	34·89,	$A = n$	$= + \frac{1}{2}$,				Aa =	+ 0	13	47·45
b =	+ 0	12·61,	$B = A\frac{n-1}{2}$	$= -\frac{1}{8}$,				Bb =	− 0	0	1·58
c =	− 0	2·10,	$C = B\frac{n-2}{3}$	$= + \frac{1}{16}$,				Cc =	− 0	0	0·13
d =	− 0	1·31,	$D = C\frac{n-3}{4}$	$= -\frac{5}{128}$,				Dd =	+ 0	0	0·05
e =	+ 0	0·14,	$E = D\frac{n-4}{5}$	$= + \frac{7}{256}$,				Ee =	+ 0	0	0·00

Therefore

☽'s Right Ascension on January 1, 1905, at $6^h = F(\frac{1}{2})$ = 15 18 21·40

which is the value given in the Nautical Almanac for that hour.

TABLE II.—*Radii of Curvature to the Meridian, and their Logarithms.*

The Radii of Curvature are given in feet for every 10′ of latitude between the parallels 0° and 40° to the nearest tenth of a foot, and their logarithms to nine places of decimals.

The formula by which they have been computed, *viz.*,

$$\rho = \frac{a(1-e^2)}{(1-e^2\sin^2\lambda)^{\frac{3}{2}}},$$

follows very simply from that given for ν on page 9, ρ being the Radius of Curvature to the meridian at a point whose latitude is λ.

The argument with which to enter the table is the given latitude, and the corresponding Radius of Curvature must be found by interpolation in exactly the same way that the normal is found from Table I.

TABLE III.—*Logarithms of the Factor* $\frac{(\rho+\nu)^2\ \mathrm{cosec}\ 1''}{8\rho^2\nu^2}$ *for computing the Spherical Excess of a Triangle.*

The Spherical Excess of a triangle ABC may be found with all necessary accuracy from any one of the formulæ

$$e'' = a\,b\sin C \times \frac{\mathrm{cosec}\ 1''}{2\ (\mathrm{radius})^2};$$

$$e'' = \frac{c^2\sin A\sin B}{\sin C} \times \frac{\mathrm{cosec}\ 1''}{2\ (\mathrm{radius})^2};$$

$$e'' = 2 \text{ area of triangle} \times \frac{\mathrm{cosec}\ 1''}{2\ (\mathrm{radius})^2};$$

where e'' is the Spherical Excess in seconds.

The factor $\frac{\mathrm{cosec}\ 1''}{2\ (\mathrm{radius})^2}$ has been computed with a radius $= \frac{\rho\nu}{\rho\cos^2 45 + \nu\sin^2 45} = \frac{2\rho\nu}{\rho+\nu}$, the radius of curvature of an oblique section passing through the centre of the spheroid and having an azimuth of 45°, where ρ is the radius of curvature of the meridian and ν the normal terminated by the minor axis, for the mean latitude of the triangle, ρ and ν being taken in feet. The factor thus becomes $\frac{(\rho+\nu)^2\ \mathrm{cosec}\ 1''}{8\rho^2\nu^2}$, and its logarithm is given in the table to five places of decimals for each degree of latitude from 0° to 40°.

Example.—For a triangle of which the mean latitude is 24°·28 :—

Given	log a in feet	= 4·97554
	log b „	= 4·98531
	log sin C	= $\bar{1}$·97054
Tabular log for lat. 24°·28		= $\bar{1}$0·37407
$e'' = 2''{\cdot}020$	Sum = log e''	= 0·30546

The correction to be applied to each of the observed angles of a triangle on account of the spherical excess of the triangle is $-\frac{e''}{3}$ when the lengths of the sides do not exceed 100 miles.

TABLE IV.—*For determining the Spherical Excess in Secondary Operations.*

This table* is intended to be used only in Secondary Operations where the Spherical Excess is not required with greater accuracy than the nearest tenth of a second, or in observations to distant snow peaks when the nearest second of Spherical Excess is sufficient.

In using the table the area of the triangle will be found with sufficient accuracy by measuring the base and perpendicular with a pair of compasses from a working chart and taking their lengths from a scale.

Having obtained the area, enter the table with it as the argument, and the Spherical Excess will be found in the column corresponding to the mean latitude of the triangle which need not be known with greater accuracy than the nearest 5°.

EXAMPLE.—To find the Spherical Excess of a triangle whose area is 545 square miles in mean latitude of 26°.

For area of	500	square miles ...	Spherical Excess = 6″·60
„	40	„ ...	„ = ·53
„	5	„ ...	„ = ·07
For area of	545	square miles ...	Spherical Excess = 7·20.

Therefore

Spherical Excess of the triangle = 7″·2.

---

* The table is further useful in readily calculating with fair approximation the effect of neglecting spherical excess in a triangulation of some magnitude.

Suppose that a triangulation of an average width of 5 miles proceeds, at any azimuth, for a distance of 200 miles, then the spherical excess applicable is 13″ of which one half or say 7″ may be applied to each flank.

The computations being made with plane angles will give erroneous values of the azimuth of the terminal side, that obtained from the {left / right} flank being too {great / small} by half the spherical excess (=7″), while the difference in latitudes and longitudes will depend on the direction in which the series runs.

1*st*.—For a Meridional Series.

The latitudes of the two extremities of the terminal side will be insensibly affected.

The longitude of the {eastern / western} extremity will be {too small / „ great} by the subtense of $\frac{7''}{2}$ at 200 miles, *i.e.* by 17½ feet or 0″·19.

2*nd*.—For a Longitudinal Series.

The longitudes of the two extremities would be practically unaffected.

The latitude of the {northern / southern} extremity would be {too small / „ great} by the subtense of $\frac{7''}{2}$ at 200 miles, *i.e.* by 17½ feet or 0″·17.

3*rd*.—For a series in a direction whose azimuth is A.

In this case, for each extremity of the terminal side the subtense of 17½ feet will be divided up between the latitude and longitude in the proportion of sin A : cos A.

It must also be noted that if the length of the terminal side were computed from the latitudes and longitudes, it would be 35 feet in defect of that given by the triangular calculations.

TABLE V.—*Reciprocals of Numbers to facilitate the Computation of Weights of Observed Angles.*

This table has been prepared for use in the calculation of 'weights of observed angles' which are employed in the reduction of geodetical figures by the 'method of least squares'.

The table has been so constructed that each number in the second column is the reciprocal, to two places of decimals, of all quantities between the corresponding upper and lower numbers in the first column.

Thus the reciprocal of 8·000 being ·125

" " 7·407 " ·135

" " 6·897 " ·145

any number between 8·000 and 7·407 has a reciprocal between ·125 and ·135, *i.e.* ·13 to two places of decimals; and any number between 7·407 and 6·897 has a reciprocal ·14.

TABLE VI.—*Logarithms for facilitating the Computation of Terrestrial Latitudes, Longitudes and Reverse Azimuths.*

This table gives the logarithms of the quantities P, Q, R, S, T, U, V, W, X, Y, Z used in the forms employed in this Department for the computation of terrestrial Latitudes, Longitudes and Reverse Azimuths.

The formulæ on which the calculations are based are due to Puissant and are demonstrated in the "Measurement of the Meridional Arc of India, 1847" by Colonel Everest and also in Vol. II of the *Account of the Operations of the G.T. Survey of India.*

Suppose that **A** and **B** are two stations and that the latitude and longitude of **A** and the azimuth of **B** from **A** are given, together with the distance at the mean sea level between the two stations, and it is required to compute the latitude and longitude of **B** and the azimuth of **A** from **B**.

We have given:—

λ = latitude of **A**,

L = longitude of **A**,

A = azimuth of **B** from **A** measured from S. by W. round the horizon,

c = distance at mean sea level between **A** and **B**,

and we require:—

λ' = latitude of **B**,

L' = longitude of **B**,

B = azimuth of **A** from **B** measured in the same way,

If we put

$$\lambda' = \lambda + \Delta\lambda; \qquad L' = L + \Delta L; \qquad \text{and } B = \overline{\pi + A} + \Delta A;$$

It will be seen that we require the differences

$$\Delta\lambda, \ \Delta L \text{ and } \Delta A$$

each of which consists of four parts :—

$$\delta_1 \lambda, \quad \delta_2 \lambda, \quad \delta_3 \lambda, \quad \delta_4 \lambda,$$

$$\delta_1 L, \quad \delta_2 L, \quad \delta_3 L, \quad \delta_4 L,$$

$$\delta_1 A, \quad \delta_2 A, \quad \delta_3 A, \quad \delta_4 A.$$

The formulæ for $\Delta\lambda$, ΔL and ΔA as given in Vol. II of the *Account of the Operations &c.*, pages 116 to 118, are as follows :—

$$\Delta\lambda = \text{in seconds of arc} \begin{Bmatrix} -\frac{c}{\rho}\cos A \operatorname{cosec} 1'' \\ -\frac{1}{1.2}\frac{c^2}{\rho.\nu}\sin^2 A \tan\lambda \operatorname{cosec} 1'' \\ -\frac{3}{4}\frac{c^2}{\rho.\nu}\frac{e^2}{1-e^2}\cos^2 A \sin 2\lambda \operatorname{cosec} 1'' \\ +\frac{1}{1.2.3}\frac{c^3}{\rho.\nu^2}\sin^2 A \cos A\,(1+3\tan^2\lambda)\operatorname{cosec} 1'' \end{Bmatrix} = \begin{Bmatrix} +\delta_1\lambda \\ +\delta_2\lambda \\ +\delta_3\lambda \\ +\delta_4\lambda \end{Bmatrix}$$

$$\Delta L = \text{in seconds of arc} \begin{Bmatrix} -\frac{c}{\nu}\frac{\sin A}{\cos\lambda}\operatorname{cosec} 1'' \\ +\frac{1}{1.2}\frac{c^2}{\nu^2}\frac{\sin 2A\tan\lambda}{\cos\lambda}\operatorname{cosec} 1'' \\ -\frac{1}{1.2.3}\frac{c^3}{\nu^3}\frac{(1+3\tan^2\lambda)\sin 2A\cos A}{\cos\lambda}\operatorname{cosec} 1'' \\ +\frac{1}{1.2.3}\frac{c^3}{\nu^3}\frac{2\sin^3 A\tan^2\lambda}{\cos\lambda}\operatorname{cosec} 1'' \end{Bmatrix} = \begin{Bmatrix} +\delta_1 L \\ +\delta_2 L \\ +\delta_3 L \\ +\delta_4 L \end{Bmatrix}$$

$$\Delta A = \text{in seconds of arc} \begin{Bmatrix} -\frac{c}{\nu}\sin A\tan\lambda\operatorname{cosec} 1'' \\ +\frac{1}{4}\frac{c^2}{\nu^2}\left(1+2\tan^2\lambda+\frac{e^2\cos^2\lambda}{1-e^2}\right)\sin 2A\operatorname{cosec} 1'' \\ -\frac{c^3}{\nu^3}\left(\frac{5}{6}+\tan^2\lambda\right)\frac{\tan\lambda}{2}\sin 2A\cos A\operatorname{cosec} 1'' \\ +\frac{1}{2.3}\frac{c^3}{\nu^3}\sin^3 A\tan\lambda\,(1+2\tan^2\lambda)\operatorname{cosec} 1'' \end{Bmatrix} = \begin{Bmatrix} +\delta_1 A \\ +\delta_2 A \\ +\delta_3 A \\ +\delta_4 A \end{Bmatrix}$$

where ρ is the radius of curvature of the meridian and ν the normal terminated by the minor axis, both at A, and e the eccentricity of the ellipse.*

In these formulæ put,

$$P = \frac{\operatorname{cosec} 1''}{\rho}; \quad Q = \frac{\rho}{\nu}; \quad R = \frac{1}{2\rho}; \quad S = 2\sec\lambda\frac{\rho}{\nu}; \quad T = \left(2\tan^2\lambda+\frac{\nu}{\rho}\right)\frac{\cot\lambda\cos\lambda}{2};$$

$$U = \left(\frac{1}{3}+\tan^2\lambda\right)\sec^2\lambda\operatorname{cosec}\lambda\frac{\rho}{\nu^2}\frac{2(1-e^2)}{3e^2}; \quad V = \frac{\sin\lambda\cos\lambda}{\left(2\tan^2\lambda+\frac{\nu}{\rho}\right)}\frac{\nu}{\rho}\frac{3e^2}{1-e^2};$$

$$W = \frac{\frac{5}{6}+\tan^2\lambda}{\frac{1}{3}+\tan^2\lambda}\sin\lambda; \quad X = \frac{\frac{1}{6}+\frac{1}{2}\tan^2\lambda}{\frac{5}{6}+\tan^2\lambda}\cot\lambda\frac{\nu}{\rho}; \quad Y = \frac{2\tan^2\lambda\sec\lambda}{1+3\tan^2\lambda}\frac{\rho}{\nu}; \quad Z = \frac{\frac{1}{2}+\tan^2\lambda}{\tan\lambda\sec\lambda}.$$

* The above values of $\Delta\lambda$, ΔL, and ΔA are only the first three terms of infinite series in which each of them may be expanded. The magnitudes of the neglected terms depend on c and λ. In the operations of this Survey c averages about 30 miles in hilly tracts and 11 miles in the plains: a very few of the sides of principal triangles exceed 60 miles but not one is as great as 70 miles: the latitude λ ranges in the Tables from 0° to 40°. If then we take $c = 70$ miles and $\lambda = 40°$ and compute the maximum values of the terms in $\frac{c^4}{\nu^4}$ (from the formulæ as given in Vol. II, page 119) we find that they and the azimuths on which they occur are as follows:—in $\Delta\lambda$, 0″·0024 on azimuth 40° 25′; in ΔL, 0″·0079 on azimuth 23° 50′; in ΔA, 0″·0087 on azimuth 24° 21′, which are within the limits of instrumental errors.

The terms $\delta_1\lambda$, &c., $\delta_1 L$, &c., $\delta_1 A$, &c., assume the forms :—

$$\delta_1\lambda = \mathrm{P}\,.\cos A\,.\,c; \qquad \delta_1 L = \delta_1\lambda\,.\,\mathrm{Q}\,.\sec\lambda\tan A; \qquad \delta_1 A = \delta_1 L\sin\lambda;$$
$$\delta_2\lambda = \delta_1 A\,.\,\mathrm{R}\,.\sin A\,.\,c; \qquad \delta_2 L = \delta_2\lambda\,.\,\mathrm{S}\,.\cot A; \qquad \delta_2 A = \delta_2 L\,.\,\mathrm{T};$$
$$\delta_3\lambda = \delta_2 A\,.\,\mathrm{V}\,.\cot A; \qquad \delta_3 L = \delta_3\lambda\,.\,\mathrm{U}\,.\sin A\,.\,c; \qquad \delta_3 A = \delta_3 L\,.\,\mathrm{W};$$
$$\delta_4\lambda = \delta_3 A\,.\,\mathrm{X}\,.\tan A; \qquad \delta_4 L = \delta_4\lambda\,.\,\mathrm{Y}\,.\tan A; \qquad \delta_4 A = \delta_4 L\,.\,\mathrm{Z};$$

which are the expressions used in the form for computation. It will be noticed that by this method the terms are found consecutively each from the preceding one. The proper signs to be given to the quantities will be found in Table VII.

Each of the quantities P, Q is given in logarithms to 7 places of decimals
" " R, S, T " 5 " " } for every 10′ of latitude from 0° to 40°.
" " U, V, W, X, Y, Z " 3 " "

For latitudes other than those given in the table the quantities must be found by interpolation.

Example.—To find P for latitude 24° 8′ 3″·723 or 24° 8′·062.

From the table, P for 24° 0′	=	$\bar{3}\cdot9959792$
Tab. difference for 10′ = − 94		
Therefore " 8′·062 = − 8·062 × 9·4 =	−	76
Therefore P for 24° 8′ 3″·723	=	$\bar{3}\cdot9959716$

The other quantities must be treated in a similar way.

To illustrate the use of this table we will now give examples of computations of latitude, longitude and reverse azimuth both of a principal and of a secondary station.

Example 1.—Principal Triangulation. Given

Stations	Spherical Angles	Log Sides opposite Angles
	° ′ ″	*Feet*
Bhaorása H.S.	56 22 7·472	4·9853089
Párdho H.S.	69 8 3·472	5·0354039
Handiapáro H.S.	54 29 51·076	4·9755350

Latitude of Bhaorása = 24 8 3·728, of Párdho = 24 16 17·867
Longitude " = 78 3 7·913, " = 77 48 40·557

Azimuth of Handiapáro at Bhaorása = 178 15 53·888
" " Párdho = 232 39 47·353

In case of adjusted triangulation these azimuths are deduced in one way only on the margin of the form as the values remain the same whichever route is adopted to deduce them. But in case of unadjusted triangulation two values of A are deduced on the margin and their mean used in the computation.

To find the latitude and longitude of Handiapáro and the azimuths of Bhaorása and Párdho at Handiapáro.

Computation of Latitudes, Longitudes and Azimuths of Principal Stations.

Stn. **A**, Bhaorásá H.S.	Stn. **B**, Handiapáro H.S.	Stn. **A**, Párdho H.S.	Stn. **B**, Handiapáro II.S.
λ_A = 24° 8′ 3″·728	A = 178° 15′ 53″·888	λ_A = 24° 16′ 17″·867	A = 232° 39′ 47″·353
L_A = 78 3 7 ·913	Log c = 5·0354039	L_A = 77 48 40 ·557	Log c = 4·9853089

P	3·9959716		P	3·9959639	
cos A	$\bar{1}$·9998009	λ_A = 24 8 3·728	cos A	$\bar{1}$·7828307	λ_A = 24 16 17·867
c	5·0354039	$\Delta\lambda$ = + 17 54·404	c	4·9853089	$\Delta\lambda$ = + 9 40·264
($\delta_1\lambda$)	3·0311764	λ_B = 24 25 58·132	($\delta_1\lambda$)	2·7041035	λ_B = 24 25 58·131
Q	$\bar{1}$·9975898	+ 1074·4257	Q	$\bar{1}$·9975950	+ 580·9028
sec λ_B	0·0397247	L_A = 78 3 7·913	sec λ	0·0401924	L_A = 77 48 40·557
tan A	$\bar{2}$·4813174	ΔL = − 35·549	tan A	0·1175821	ΔL = + 13 51·807
($\delta_1 L$)	1·5498083	L_B = 78 2 32·364	($\delta_1 L$)	2·9194730	L_B = 78 2 32·364
sin λ	$\bar{1}$·6115937	− 35·4657	sin λ	$\bar{1}$·6139084	+ 830·7551
($\delta_1 A$)	1·1614020	− 14·5011	($\delta_1 A$)	2·5333814	+ 341·4927
R	8·38051	180° + A = 358 15 53·888	R	8·38051	180° + A = 52 39 47·353
sin A	$\bar{2}$·48112	ΔA = − 14·619	sin A	$\bar{1}$·90041	ΔA = + 5 42·992
c	5·03540	B = 358 15 39·269	c	4·98531	B = 52 45 30·345
($\delta_2\lambda$)	3·05843	− ·0011	($\delta_2\lambda$)	$\bar{1}$·79961	− ·6304
S	0·33835		S	0·33882	
cot A	1·51868		cot A	$\bar{1}$·88242	
($\delta_2 L$)	2·91546	− ·0823	($\delta_2 L$)	0·02085	+ 1·0492
T	0·15624		T	0·15458	
($\delta_2 A$)	$\bar{1}$·07170	− ·1180	($\delta_2 A$)	0·17543	+ 1·4977
V	3·728		V	3·728	
cot A	1·519		cot A	$\bar{1}$·882	
($\delta_3\lambda$)	2·319	− ·0208	($\delta_3\lambda$)	3·785	− ·0061
U	6·869		U	6·870	
sin A	$\bar{2}$·481		sin A	$\bar{1}$·900	
c	5·035		c	4·985	
($\delta_3 L$)	4·704	− ·0005	($\delta_3 L$)	3·540	+ ·0035
W	$\bar{1}$·899		W	$\bar{1}$·900	
($\delta_3 A$)	4·603	− ·0004	($\delta_3 A$)	3·440	+ ·0028
X	$\bar{1}$·763		X	$\bar{1}$·762	
tan A	$\bar{2}$·481		tan A	0·118	
($\delta_4\lambda$)	6·847	− ·0000	($\delta_4\lambda$)	3·320	− ·0021
Y	$\bar{1}$·436		Y	$\bar{1}$·440	
tan A	$\bar{2}$·481		tan A	0·118	
($\delta_4 L$)	8·764	+ ·0000	($\delta_4 L$)	$\bar{4}$·878	− ·0008
Z	0·154		Z	0·153	
($\delta_4 A$)	8·918	+ ·0000	($\delta_4 A$)	3·031	− ·0011

	Deduced Station **B**, Handiapáro H.S.				Deduced Station **B**, Handiapáro H.S.		
	Latitude	Longitude	Azimuth of Bhaorásá II.S.		Latitude	Longitude	Azimuth of Párdho H.S.
From 1st Dedn.	24 25 58·132	78 2 32·364	358 15 39·269	From 2nd Dedn.	...	...	52 45 30·345
From 2nd Dedn.	·131	·364	·269	From 1st Dedn.	...	...	·345
Mean	24 25 58·132	78 2 32·364	358 15 39·269	Mean	...	...	52 45 30·345

At **A** Azimuth of Párdho H.S. = ° 121 ′ 53 ″ 46·416
" ∠ between ___ do. ___ and **B** = + 56 22 7·472
" Az. of **B** (Handiapáro H.S.) = A = 178 15 53·888

Mean =

At **A** Azimuth of ___ =
" ∠ between ___ do. ___ and **B** = −
" Az. of **B** = A =

At **A** Azimuth of Bhaorásá H.S. = ° 301 ′ 47 ″ 50·825
" ∠ between ___ do. ___ and **B** = − 69 8 3·472
" Az. of **B** (Handiapáro H.S.) = A = 232 39 47·353

Mean =

At **A** Azimuth of ___ =
" ∠ between ___ do. ___ and **B** = −
" Az. of **B** = A =

Computation of Latitudes, Longitudes and Azimuths of Principal Stations.

(When both Stations A and B or one of them are in South Latitude or West Longitude or in both.)

Example I.

λ_A = N 0 10 55·139 L_A = E 77 10 44·460
A = 345 45 10·250 Log c = 5·2804014

P	8·9966949	λ_A = N	0 10 55·139
cos A	1·9864327	$\Delta\lambda$ = −	30 34·548
c	5·2804014	λ_B = S	0 19 39·409
($\delta_1\lambda$)	3·2635290	−	1834·5477
Q	1·9971076	L_A = E	77 10 44·460
sec λ	0·0000022	ΔL = +	7 42·728
tan A	1·4046879	L_B = E	77 18 27·188
($\delta_1 L$)	2·6053267	+	402·7289
(sin λ)	3·5019075		
($\delta_1 A$)	0·1672342	+	1·4697
R	8·38124	180° + A =	165 45 10·250
sin A	1·39112	ΔA = −	0·588
c	5·28040	B =	165 45 9·662
($\delta_2\lambda$)	3·21999	−	·0017
S	0·29814		
cot A	0·59531		
($\delta_2 L$)	2·11344	−	·0130
T	2·19996		
($\delta_2 A$)	0·31340	−	2·0578
V	5·804		
cot A	0·595		
($\delta_3\lambda$)	4·712	−	·0005
U	4·697		
sin A	1·391		
c	5·280		
($\delta_3 L$)	2·080	+	·0120
W	3·900		
($\delta_3 A$)	5·980	+	·0001
X	1·802		
tan A	1·405		
($\delta_4\lambda$)	3·187	+	·0015
Y	5·302		
tan A	1·405		
($\delta_4 L$)	9·894	−	·0000
Z	2·197		
($\delta_4 A$)	6·091	−	·0000

Example III.

λ_A = S 0 19 39·409 L_A = E 77 18 27·188
A = 165 45 9·662 Log c = 5·2804014

P	3·9966948	λ_A = S	0 19 39·409
cos A	1·9864324	$\Delta\lambda$ = −	30 34·548
c	5·2804014	λ_B = N	0 10 55·139
($\delta_1\lambda$)	3·2635286	−	1834·5460
Q	1·9971077	L_A = E	77 18 27·188
sec λ	0·0000071	ΔL = −	7 42·728
tan A	1·4046931	L_B = E	77 10 44·460
($\delta_1 L$)	2·6053365	−	462·7395
sin λ	3·7572369		
($\delta_1 A$)	0·4225734	+	2·6459
R	8·38124	180° + A =	345 45 9·662
sin A	1·39113	ΔA = +	0·588
c	5·28040	B =	345 45 10·250
($\delta_2\lambda$)	3·47534	−	·0030
S	0·29815		
cot A	0·59531		
($\delta_2 L$)	2·30880	+	·0234
T	1·94466		
($\delta_2 A$)	0·31346	−	2·0581
V	4·059		
cot A	0·595		
($\delta_3\lambda$)	4·967	−	·0009
U	4·441		
sin A	1·391		
c	5·280		
($\delta_3 L$)	2·079	−	·0120
W	2·155		
($\delta_3 A$)	4·234	+	·0002
X	1·547		
tan A	1·405		
($\delta_4\lambda$)	3·186	+	·0015
Y	5·813		
tan A	1·405		
($\delta_4 L$)	8·404	+	·0000
Z	1·942		
($\delta_4 A$)	6·346	−	·0000

Example V.

λ_A = S 0 20 33·338 L_A = E 76 53 57·756
A = 267 54 47·906 Log c = 5·1736281

P	3·9966948	λ_A = S	0 20 33·338
cos A	2·5612398	$\Delta\lambda$ = −	53·928
c	5·1736281	λ_B = S	0 19 39·410
($\delta_1\lambda$)	1·7315627	−	53·8968
Q	1·9971077	L_A = E	76 53 57·756
sec λ	0·0000078	ΔL = +	24 29·432
tan A	1·4384721	L_B = E	77 18 27·188
($\delta_1 L$)	3·1671503	+	1469·4338
sin λ	3·7766544		
($\delta_1 A$)	0·9438047	−	8·7863
R	8·38124	180° + A =	87 54 47·906
sin A	1·99971	ΔA = −	8·594
c	5·17363	B =	87 54 39·312
($\delta_2\lambda$)	2·49838	−	·0315
S	0·29815		
cot A	2·56152		
($\delta_2 L$)	3·35805	−	·0023
T	1·92523		
($\delta_2 A$)	1·28328	+	·1920
V	4·079		
cot A	2·562		
($\delta_3\lambda$)	7·924	−	·0000
U	4·422		
sin A	0·000		
c	5·174		
($\delta_3 L$)	5·520	+	·0000
W	2·175		
($\delta_3 A$)	7·695	−	·0000
X	1·527		
tan A	1·438		
($\delta_4\lambda$)	4·660	+	·0005
Y	5·851		
tan A	1·438		
($\delta_4 L$)	7·949	−	·0000
Z	1·922		
($\delta_4 A$)	5·871	+	·0001

Example II.

λ_A = N 0 10 55·139 L_A = W 0 4 3·000
A = 345 45 10·250 Log c = 5·2804014

The computation will remain the same as above except the following:—

L_A = W 0 4 3·000
ΔL = − 0 7 42·728

L_B = E 0 3 39·728

Example IV.

λ_A = S 0 19 39·409 L_A = E 0 3 39·728
A = 165 45 9·662 Log c = 5·2804014

The computation will remain the same as above except the following:—

L_A = E 0 3 39·728
ΔL = − 0 7 42·728

L_B = W 0 4 3·000

Example VI.

λ_A = S 0 20 33·338 L_A = W 0 30 45·200
A = 267 54 47·906 Log c = 5·1736281

The computation will remain the same as above except the following:—

L_A = W 0 30 45·200
ΔL = − 0 24 29·432

L_B = W 0 6 15·768

Notes:— 1. When Station **A** is very close to the Equator, *i.e.*, when λ_A is very small, the quantities T, V, U, W, X, Y and Z are to be computed from the formulæ on p. 15 instead of interpolating.

2. The Latitude North or South and the Longitude East or West should always be considered *positive*.

3. When $\Delta\lambda$ comes out negative and greater than the Latitude of **A**, the difference is the Latitude of the deduced station **B** on the other side of the Equator.

4. When **A** is *west* of Greenwich, the sign of ΔL must be *changed* before applying it to the Longitude of **A**.

5. When ΔL comes out greater than the Longitude of **A**, and negative when **A** is east or negative after changing sign when **A** is west, the difference is the Longitude of **B** on the other side of the Meridian of Greenwich.

EXAMPLE 2.—Secondary Triangulation. Given:—

Stations	Angles	Log Sides opposite Angles
	° ′ ″	*Feet*
Shadau s.	62 53 15	4·8399742
Maláni „	56 52 30	4·8135035
Kingríáli h.s.	60 14 15	4·8290939

Latitude of Shadau s. = 32 3 34·03, Latitude of Maláni s. = 32 7 22·66
Longitude „ „ = 71 3 29·80, Longitude „ „ = 71 15 46·72

Azimuth of Maláni s. at Shadau s. = 249 55 15
„ of Shadau s. at Maláni s. = 70 1 45

To find the latitude and longitude of Kingríáli h.s. and the azimuths of Shadau s. and Maláni s. at Kingríáli h.s.

COMPUTATION OF LATITUDES, LONGITUDES AND AZIMUTHS OF SECONDARY STATIONS.

Stn. A, Shadau s. At A Az. of Maláni s. „ ∠ between do. „ Az. of B, Kingríáli h.s.	Stn. B, Kingríáli h.s. = 249° 55′ 15″ and B = − 62 53 15 = A = 187 2 0
P 3·9954755	λA = 32 3 34·03
cos A Ī·9967196	Δλ = + 10 39·28
c 4·8135035	λB = 32 14 13·31
(δ1 λ) 2·8056986	+ 639·291
Q Ī·9979206	LA = 71 3 29·80
sec λ 0·0718614	ΔL = + 1 32·80
tan A Ī·0912277	LB = 71 5 2·60
(δ1 L) 1·9667083	+ 92·621
sin λ Ī·7249301	
(δ1 A) 1·6916384	+ 49·2
R 8·38002	180° + A = 7 2 0
sin A Ī·08795	ΔA = + 49
c 4·81350	B = 7 2 49
(δ2 λ) 3·97311	− ·009
S 0·37082	
cot A 0·90877	
(δ2 L) Ī·25270	+ ·179
T 0·08301	
(δ2 A) Ī·33571	+ ·2

	Deduced Station B, Kingríáli h.s.		
	Latitude	Longitude	Azimuth of Shadau s.
	° ′ ″	° ′ ″	° ′ ″
From 1st Deduction	32 14 13·31	71 5 2·60	7 2 49
„ 2nd „	13·30	2·60	47
Mean ...	32 14 13·31	71 5 2·60	7 2 48

Stn. A, Maláni s. At A Az. of Shadau s. „ ∠ between do. „ Az. of B, Kingríáli h.s.	Stn. B, Kingríáli h.s. = 70° 1′ 45″ and B = + 56 52 30 = A = 126 54 15
P 3·9954712	λA = 32 7 22·66
cos A Ī·7784974	Δλ = + 6 50·64
c 4·8399742	λB = 32 14 13·30
(δ1 λ) 2·6139428	+ 411·096
Q Ī·9979235	LA = 71 15 46·72
sec λ 0·0721633	ΔL = − 10 44·12
tan A 0·1243977	LB = 71 5 2·60
(δ1 L) 2·8084273	− 643·320
sin λ Ī·7256978	
(δ1 A) 2·5341251	− 342·1
R 8·38001	180° + A = 306 54 15
sin A Ī·90290	ΔA = − 5 43
c 4·83997	B = 306 48 32
(δ2 λ) Ī·65701	− ·454
S 0·37112	
cot A Ī·87560	
(δ2 L) Ī·90373	− ·801
T 0·08258	
(δ2 A) Ī·98631	− 1·0

	Deduced Station B, Kingríáli h.s.		
	Latitude	Longitude	Azimuth of Maláni s.
			° ′ ″
From 2nd Deduction	...	...	306 48 32
„ 1st „	...	...	34
Mean ...	...	...	306 48 33

TABLE VII.—*Directions for applying the Signs to the Terms of the Latitude, Longitude and Azimuth Formulæ.*

This table is to be used in conjunction with the preceding one and gives the proper signs to be applied to the terms $\delta_1\lambda$, &c., $\delta_1 L$, &c., and $\delta_1 A$, &c., in the computations of Latitude, Longitude and Reverse Azimuths.

TABLE VIII.—*For Calculating Azimuths and Distances of Points of which the Latitudes and Longitudes are known.*

When the latitudes and longitudes of two Stations **A** and **B** are known and we require the distance between them and the azimuth of each station at the other, this table is to be used for finding the quantities R′, S′, T′, U′, V′, W′, X′, Y′, Z′ employed in the forms for calculation.

The formulæ on which the calculations are based are those given under Table VI, and the treatment is as follows:—

Taking the formulæ for $\Delta\lambda$, ΔL, and ΔA and remembering that

$$\left.\begin{aligned}\delta_1\lambda &= -\frac{c}{\rho}\cos A \operatorname{cosec} 1''\\ \delta_1 L &= -\frac{c}{\nu}\frac{\sin A}{\cos\lambda}\operatorname{cosec} 1''\end{aligned}\right\}$$

we get by eliminating A from each term in succession

$$\Delta\lambda = \text{in seconds of arc} \left\{\begin{matrix}+\delta_1\lambda\\ -R'\delta_1 L^2\\ -V'\delta_1\lambda^2\\ -X'\delta_1\lambda\delta_1 L^2\end{matrix}\right\} = \left\{\begin{matrix}+\delta_1\lambda\\ +\delta_2\lambda\\ +\delta_3\lambda\\ +\delta_4\lambda\end{matrix}\right\} \text{ of Table VI, page 15.}$$

$$\Delta L = \text{in seconds of arc} \left\{\begin{matrix}+\delta_1 L\\ +S'\delta_1\lambda\delta_1 L\\ +U'\delta_1\lambda^2\delta_1 L\\ -Y'\delta_1 L^3\end{matrix}\right\} = \left\{\begin{matrix}+\delta_1 L\\ +\delta_2 L\\ +\delta_3 L\\ +\delta_4 L\end{matrix}\right\} \quad " \quad "$$

$$\Delta A = \text{in seconds of arc} \left\{\begin{matrix}+\sin\lambda\,\delta_1 L\\ +T'\delta_1\lambda\delta_1 L\\ +W'\delta_1\lambda^2\delta_1 L\\ -Z'\delta_1 L^3\end{matrix}\right\} = \left\{\begin{matrix}+\delta_1 A\\ +\delta_2 A\\ +\delta_3 A\\ +\delta_4 A\end{matrix}\right\} \quad " \quad "$$

where R′, S′, T′, &c., have the following values:—

$$R' = \frac{\nu}{4\rho}\sin 2\lambda \sin 1''; \qquad S' = \frac{\rho}{\nu}\tan\lambda \sin 1''; \qquad T' = \frac{1}{2}\left(1+\frac{2\rho}{\nu}\tan^2\lambda\right)\cos\lambda\sin 1'';$$

$$U' = \frac{1}{3}\frac{\rho^2}{\nu^2}\left(\frac{2-\cos 2\lambda}{\cos^2\lambda}\right)\sin^2 1''; \qquad V' = \frac{3}{4}\frac{\rho}{\nu}\frac{e^2}{1-e^2}\sin 2\lambda\sin 1''; \qquad W' = \frac{1}{12}\frac{\rho^2}{\nu^2}\frac{\sin\lambda}{\cos^2\lambda}(11-\cos 2\lambda)\sin^2 1'';$$

$$X' = \frac{1}{6}(2-\cos 2\lambda)\sin^2 1''; \qquad Y' = \frac{1}{3}\sin^2\lambda\sin^2 1''; \qquad Z' = \frac{1}{12}\sin\lambda(3-\cos 2\lambda)\sin^2 1''.$$

It thus appears that $\delta_1\lambda$ and $\delta_1 L$ are found by the first pair of equations, and then $\Delta\lambda$ and ΔL depend only on these and the quantities given in the table; and ΔA only needs in addition $\sin\lambda$.

Again in the reverse process, if $\Delta\lambda$ and ΔL are given, we have the 3rd and 4th equations for finding $\delta_1\lambda$ and $\delta_1 L$ and then the first pair of equations will give A and c; and ΔA will be found as before.

The differences $\Delta\lambda$, ΔL and ΔA in the explanation to Table VI may be computed as follows:—

Station **A**, Bhaorása H.S.		Station **B**, Handiapáro H.S.
$\lambda = 24^\circ\ 8'\ 3''{\cdot}728$		$A = 178^\circ\ 15'\ 53''{\cdot}888$
$L = 78\ 3\ 7\ {\cdot}913$		$\log c = 5{\cdot}0354039$
$c = 5{\cdot}0354039$	$c = 5{\cdot}0354039$	
$\cos A = \bar{1}{\cdot}9998009$	$\sin A = \bar{2}{\cdot}4811183$	
$\frac{1}{\rho} = \bar{8}{\cdot}6815465$	$\sec\lambda = 0{\cdot}0397247$	
$\operatorname{cosec} 1'' = 5{\cdot}3144251$	$\frac{1}{\nu} = \bar{8}{\cdot}6791363$	$\sin\lambda = \bar{1}{\cdot}6115937$
	$\operatorname{cosec} 1'' = 5{\cdot}3144251$	$\delta_1 L = 1{\cdot}5498083$
$\delta_1\lambda = 3{\cdot}0311764 = +1074{\cdot}4257$	$\delta_1 L = 1{\cdot}5498083 = -35{\cdot}4657$	$\delta_1 A = 1{\cdot}1614020 = -14{\cdot}5011$
$R' = \bar{7}{\cdot}95882$	$S' = \bar{6}{\cdot}33448$	$T' = \bar{6}{\cdot}49072$
$\delta_1 L^2 = 3{\cdot}09962$	$\delta_1\lambda = 3{\cdot}03118$	$\delta_1\lambda = 3{\cdot}03118$
	$\delta_1 L = 1{\cdot}54981$	$\delta_1 L = 1{\cdot}54981$
$\delta_2\lambda = 3{\cdot}05844 = -{\cdot}0011$	$\delta_2 L = \bar{2}{\cdot}91547 = -{\cdot}0823$	$\delta_2 A = \bar{1}{\cdot}07171 = -{\cdot}1180$
$V' = \bar{8}{\cdot}256$	$U' = \bar{1}\bar{1}{\cdot}094$	$W' = \bar{1}\bar{2}{\cdot}992$
$\delta_1\lambda^2 = 6{\cdot}062$	$\delta_1\lambda^2 = 6{\cdot}062$	$\delta_1\lambda^2 = 6{\cdot}062$
	$\delta_1 L = 1{\cdot}550$	$\delta_1 L = 1{\cdot}550$
$\delta_3\lambda = \bar{2}{\cdot}318 = -{\cdot}0208$	$\delta_3 L = \bar{4}{\cdot}706 = -{\cdot}0005$	$\delta_3 A = \bar{4}{\cdot}604 = -{\cdot}0004$
$X' = \bar{1}\bar{2}{\cdot}718$		
$\delta_1\lambda = 3{\cdot}031$	$Y' = \bar{1}\bar{2}{\cdot}117$	$Z' = \bar{1}\bar{2}{\cdot}272$
$\delta_1 L^2 = 3{\cdot}100$	$\delta_1 L^3 = 4{\cdot}649$	$\delta_1 L^3 = 4{\cdot}649$
$\delta_4\lambda = \bar{6}{\cdot}849 = {\cdot}0000$	$\delta_4 L = \bar{8}{\cdot}766 = {\cdot}0000$	$\delta_4 A = \bar{8}{\cdot}921 = {\cdot}0000$
$\Delta\lambda = +1074{\cdot}4038$	$\Delta L = -35{\cdot}5485$	$\Delta A = -14{\cdot}6195$
$= 17'\ 54''{\cdot}4038$		

NOTE.—Some slight abbreviation may be introduced into this calculation by employing P from Table VI for $\frac{1}{\rho}$ cosec 1″ and the co-log from Table XXVII for $\frac{1}{\nu}$ sec λ cosec 1″.

It remains now to explain how, having given $\Delta\lambda$ and ΔL, we can obtain $\delta_1\lambda$ and $\delta_1 L$, the quantities required for finding A, c and ΔA.

We have

$$\Delta\lambda = \delta_1\lambda - R'\,\delta_1 L^2 - V'\,\delta_1\lambda^2 - X'\,\delta_1\lambda\,\delta_1 L^2, \quad \ldots\ldots\ldots\ldots (1)$$

$$\Delta L = \delta_1 L + S'\,\delta_1\lambda\,\delta_1 L + U'\,\delta_1\lambda^2\,\delta_1 L - Y'\,\delta_1 L^3, \quad \ldots\ldots\ldots\ldots (2)$$

and the terms involving U′, V′, X′, Y′ are very small compared with those involving R′, S′; therefore, omitting the last two terms of $\Delta\lambda$ and putting ΔL for $\delta_1 L$, we get as a first approximation

$$\delta_1\lambda_a = \Delta\lambda + R'\,\Delta L^2. \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Substitute this for $\delta_1\lambda$ in (2) and we get

$$\delta_1 L = \Delta L \div \left\{1 + S'\,\delta_1\lambda_a + U'\,\delta_1\lambda_a^2 - Y'\,\Delta L^2\right\} \quad \ldots\ldots\ldots\ldots (4)$$

where we have put ΔL^2 for $\delta_1 L^2$ in the last term, which we may safely do considering the magnitude of Y′.

Returning now to (1) and putting $\delta_1\lambda_a$ for $\delta_1\lambda$ in the third and fourth terms, we get a more accurate value of $\delta_1\lambda$, *viz.*,

$$\delta_1\lambda = \Delta\lambda + R'\,\delta_1 L^2 + V'\,\delta_1\lambda_a^2 + X'\,\delta_1\lambda_a\,\delta_1 L^2 \quad \ldots\ldots\ldots\ldots (5)$$

In the practical application of these formulæ it will be sufficient to use 5 places of decimals of logarithms in the terms involving R′, S′, T′, and 3 places in the terms involving U′, V′, W′, X′, Y′, Z′. Hence in the great majority of cases the values of $\delta_1\lambda$ and $\delta_1 L$, obtained from equations (5) and (4) will be as accurate as can be desired: and this accuracy can be tested by comparing $\delta_1\lambda$ from (5) with $\delta_1\lambda_a$ used in (4), and $\delta_1 L$ from (4) with ΔL employed in (4), and should the differences be sensible another approximation can be made.

The method just described is applicable to principal triangulation where great accuracy is required. In the case of secondary triangulation and for topographical purposes we may neglect the last two terms in each of the equations (1) and (2).

We shall then have

$$\delta_1 \lambda = \Delta\lambda + R' \Delta L^2, \quad \ldots \quad (6)$$

$$\delta_1 L = \Delta L \div \left\{ 1 + S' \delta_1 \lambda \right\} \quad \ldots \quad (7)$$

If necessary we can further approximate by using this value of $\delta_1 L$ for ΔL in (6) and the new value of $\delta_1 \lambda$ in (7), but this will rarely be required.

Having now obtained $\delta_1\lambda$ and $\delta_1 L$ we find A and c from the formulæ :—

$$\left.\begin{aligned} \delta_1\lambda &= -\frac{c}{\rho} \cos A \operatorname{cosec} 1'', \\ \delta_1 L &= -\frac{c}{\nu} \frac{\sin A}{\cos \lambda} \operatorname{cosec} 1''. \end{aligned}\right\}$$

From which

$$\cot A = \frac{\rho}{\nu} \sec \lambda \frac{\delta_1\lambda}{\delta_1 L},$$

$$c = -\delta_1\lambda \sec A \, \rho \sin 1'';$$

and finally ΔA will be found as before.

The signs of $\delta_1\lambda$ and $\delta_1 L$ will define the quadrant in which A lies; see Table VII.

The quantities R′, S′, T′ are given in logs to 5 places and U′, V′, W′, X′, Y′, Z′ to 3 places of decimals, the former for every 10′ and the latter for every 1° of latitude from 0° to 40°.

The method of computing will then be as follows :—

1*st*. Principal Triangulation :—

Subtract the latitude and longitude of **A** from those of **B**, and we get $\Delta\lambda$ and ΔL with their proper signs.

Find $\delta_1\lambda_a$, an approximate value of $\delta_1\lambda$, from the formula

$$\delta_1\lambda_a = \Delta\lambda + R' \Delta L^2,$$

and find the quantity a from the formula

$$a = 1 + S' \delta_1\lambda_a + U' \delta_1\lambda_a{}^2 - Y' \Delta L^2;$$

then

$$\delta_1 L = \Delta L \div a,$$

and

$$\delta_1\lambda = \Delta\lambda + R' \delta_1 L^2 + V' \delta_1\lambda_a{}^2 + X' \delta_1\lambda_a \delta_1 L^2.$$

With these values of $\delta_1\lambda$ and $\delta_1 L$ find A, c and ΔA from the equations :—

$$\cot A = \mathbf{Q} \sec \lambda \frac{\delta_1\lambda}{\delta_1 L},$$

$$c = -\frac{\delta_1\lambda \sec A}{P},$$

and

$$\Delta A = \sin \lambda \, \delta_1 L + T' \delta_1\lambda \, \delta_1 L + W' \delta_1\lambda^2 \, \delta_1 L - Z' \delta_1 L^3,$$

in which P and Q are obtained from Table VI.

The signs of $\delta_1\lambda$ and $\delta_1 L$ will determine in which quadrant A lies according to Table VII.

EXAMPLE.

Station **A**, Párdho. Station **B**, Handiapáro.

$\lambda = 24° \ 16' \ 17''{\cdot}867$ $\lambda = 24° \ 25' \ 58''{\cdot}132$

$L = 77 \ 48 \ 40 \cdot 557$ $L = 78 \ 2 \ 32 \cdot 364$

To find A, c and B.

		°	′	″		°	′	″
Station **A**, Párdho	λ	24	16	17·867	L	77	48	40·557
,, **B**, Handiapáro	λ	24	25	58·132	L	78	2	32·364
B − **A**,	$\Delta\lambda$	+	9	40·265	ΔL	+	13	51·807

	Logarithms.	*Nat. Nos.*
$\Delta\lambda$		*+ 580″·265
R′	$\bar{7}\cdot96066$	
ΔL^2	$5\cdot84005$	
	$\bar{1}\cdot80071$	+ ·632
$\delta_1\lambda_a$		+ 580·897

		1″·000000
S′	$\bar{3}\cdot33727$	
$\delta_1\lambda_a$	$2\cdot76410$	
	$\bar{3}\cdot10137$	*+ ·001263
U′	$\bar{11}\cdot096$	
$\delta_1\lambda_a^2$	$5\cdot528$	
	$\bar{6}\cdot624$	+ ·000004
Y′	$\bar{12}\cdot122$	
ΔL^2	$5\cdot840$	
	$\bar{7}\cdot962$	− ·000001
a	$0\cdot0005494$	+ 1·001266
ΔL	$2\cdot9200225$	
$\delta_1 L = \Delta L - a$	$2\cdot9194731$	

$\Delta\lambda$		*+ 580·265
R′	$\bar{7}\cdot96066$	
$\delta_1 L^2$	$5\cdot83895$	
	$\bar{1}\cdot79961$	+ ·6304
V′	$\bar{8}\cdot258$	
$\delta_1\lambda_a^2$	$5\cdot528$	
	$\bar{3}\cdot786$	+ ·0061
X′	$\bar{12}\cdot719$	
$\delta_1\delta_a$	$2\cdot764$	
$\delta_1 L^2$	$5\cdot839$	
	$\bar{3}\cdot322$	*+ ·0021
$\delta_1\lambda$		+ 580·9036

	Logarithms.
Q	$\bar{1}\cdot9975950$
Sec λ	$0\cdot0401924$
$\delta_1\lambda$	$2\cdot7641041$
Co-log $\delta_1 L$	$\bar{3}\cdot0805269$
Cot A	$\bar{1}\cdot8824184$
†A = 232° 39′ 47″·233	

$\delta_1\lambda$	$2\cdot7641041$	
Co-log P	$2\cdot0040361$	
Sec A	$0\cdot2171690$	
c	$4\cdot9853092$	

		Nat. Nos.
$\delta_1 L$	$2\cdot9194731$	
Sin λ	$\bar{1}\cdot6139084$	″
	$2\cdot5333815$	*+ 341·4928
T′	$\bar{6}\cdot49185$	
$\delta_1\lambda$	$2\cdot76410$	
$\delta_1 L$	$2\cdot91947$	
	$0\cdot17542$	*+ 1·4977
W′	$\bar{12}\cdot996$	
$\delta_1\lambda^2$	$5\cdot528$	
$\delta_1 L$	$2\cdot919$	
	$\bar{3}\cdot443$	*+ ·0028
Z′	$\bar{12}\cdot275$	
$\delta_1 L^3$	$8\cdot758$	
	$\bar{3}\cdot633$	‡− ·0011
ΔA		+ 342·9922

	°	′	″
$\pi + A$ =	52	39	47·233
ΔA =	+ 5	42	992
B =	52	45	30·225

* *Plus* or *minus* as the case may be.

† A is in 1st, 2nd, 3rd, 4th Quadrant, when $\frac{\delta_1\lambda}{\delta_1 L}$ are $\frac{-}{-}$, $\frac{+}{-}$, $\frac{+}{+}$, $\frac{-}{+}$.

‡ This term is + when $\delta_1 L$ is −, and − when $\delta_1 L$ is +.

When both stations **A** and **B**, or one of them, lie in *south* Latitude or *west* Longitude or in both, the following changes are required in the computation :—

If the ray crosses the Equator the *sum* of the Latitudes should be taken for $\Delta\lambda$ and it is always to be taken as *negative*.

When **A** lies to the *south* of the Equator the quadrant in which Azimuth A lies, is to be determined from the following :—

A is in	1st	2nd	3rd	4th Quadrant,
when $\frac{\delta_1\lambda}{\delta_1 L}$ are	$\frac{+}{-}$	$\frac{-}{-}$	$\frac{-}{+}$	$\frac{+}{+}$

When **A** lies to the *south* of the Equator, the *sign* of ΔA is to be changed.

When Longitudes of both the stations are *west* of Greenwich the sign of ΔL will be $\frac{+}{-}$ according as the Longitude of **B** is $\frac{less}{greater}$ than the Longitude of **A**.

When the ray crosses the Meridian of Greenwich the *sum* of the Longitudes should be taken for ΔL and its sign is $\frac{+}{-}$ according as the Longitude of **B** is $\frac{east}{west}$ of Greenwich.

When the Latitude of A is very small, the quantities R′, S′, Y′, V′, W′, and Z′ are to be computed from the formulæ on page 20.

On the following page are given 6 examples showing how computations can be effected in conformity with the above notes.

EXAMPLE I.

Station A	λ	N 0 19 55·139	L	E	77 18 44·460
„ B	λ	S 0 19 39·409	L	E	77 18 27·188
B—A	Δλ	−0 30 34·548	ΔL		+0 7 42·728

Logarithms.		*Nat. Nos.*
Δλ		−1834·548
R′	5·88934	
ΔL^2	5·33065	
	3·21999	+ ·0017
$\delta_1\lambda_a$		−1834·5463
		1·000000
S′	8·18459	
$\delta_1\lambda_a$	3·26353	
	5·44812	− ·000028
U′	$\overline{12}$·888	
$\delta_1\lambda_a^2$	6·527	
	5·415	+ ·000026
Y′	$\overline{17}$·898	
ΔL^2	5·331	
	$\overline{11}$·229	− ·000000
a	$\overline{1}$·9999991	+ 0·999998
ΔL	2·6653258	
$\delta_1 L$	2·6653267	= ΔL − a
Δλ		−1834·548
R′	5·88934	
$\delta_1 L^2$	5·33065	
	3·21999	+ ·0017
V′	$\overline{10}$·186	
$\delta_1\lambda_a^2$	6·527	
	4·713	+ ·0005
X′	$\overline{12}$·593	
$\delta_1\lambda_a$	3·264	
$\delta_1 L^2$	5·331	
	3·188	− ·0015
$\delta_1\lambda$		−1834·5473

Logarithms.		*Nat. Nos.*
Q	$\overline{1}$·9971076	
sec λ	0·0000022	
$\delta_1\lambda$	3·2635289	
Co-log $\delta_1 L$	$\overline{3}$·3346733	
cot A	0·5953120	
	A = 345° 45′ 10″·239	
$\delta_1\lambda$	3·2635289	
Co-log P	2·0033051	
sec A	0·0135673	
c	5·2804013	
		Nat. Nos.
$\delta_1 L$	2·6653267	
sin λ	$\overline{3}$·5019075	″
	0·1672342	+ 1·4697
T′	6·38455	
$\delta_1\lambda$	3·26353	
$\delta_1 L$	2·66533	
	0·31341	− 2·0578
W′	$\overline{14}$·788	
$\delta_1\lambda^2$	6·527	
$\delta_1 L$	2·665	
	5·980	+ ·0001
Z′	$\overline{14}$·095	
$\delta_1 L^3$	7·996	
	6·091	− ·0003
ΔA		− 0·5883
	180 + A = 165 45 10·239	
	ΔA = − 0·588	
	B = 165 45 9·651	

EXAMPLE II.

Station A	λ	N 0 10 55·139	L	W	0 4 3·000
„ B	λ	S 0 19 39·409	L	E	0 3 39·728
B—A	Δλ	−0 30 34·548	ΔL	+	0 7 42·728

The computation will remain the same as above.

EXAMPLE III.

Station A	λ	S 0 19 39·409	L	E	77 18 27·188
„ B	λ	N 0 10 55·139	L	E	77 18 44·460
B—A	Δλ	−0 30 34·548	ΔL		−0 7 42·728

Logarithms.		*Nat. Nos.*
Δλ		− 1834·548
R′	5·14467	
ΔL^2	5·33065	
	3·47532	+ ·0030
$\delta_1\lambda_a$		−1834·5450
		1·000000
S′	8·43993	
$\delta_1\lambda_a$	3·26353	
	5·70346	− ·000051
U′	$\overline{12}$·888	
$\delta_1\lambda_a^2$	6·527	
	5·415	+ ·000026
Y′	$\overline{16}$·409	
ΔL^2	5·331	
	$\overline{11}$·740	− ·000000
a	$\overline{1}$·9999892	+ 0·999975
ΔL	2·6653258	
$\delta_1 L$	2·6653366	= ΔL − a
Δλ		−1834·518
R′	8·14467	
$\delta_1 L^2$	5·33067	
	3·47534	+ ·0030
V′	$\overline{10}$·441	
$\delta_1\lambda_a^2$	6·527	
	4·968	+ ·0009
X′	$\overline{12}$·593	
$\delta_1\lambda_a$	3·264	
$\delta_1 L^2$	5·331	
	3·188	− ·0015
$\delta_1\lambda$		−1834·5456

Logarithms.		*Nat. Nos.*
Q	$\overline{1}$·9971077	
sec λ	0·0000071	
$\delta_1\lambda$	3·2635285	
Co-log $\delta_1 L$	$\overline{3}$·3346634	
cot A	0·5953067	
	A = 165° 45′ 9″·640	
$\delta_1\lambda$	3·2635285	
Co-log P	2·0033052	
sec A	0·0135676	
c	5·2804013	
		Nat Nos.
$\delta_1 L$	2·6653366	
sin λ	$\overline{3}$·7572369	″
	0·4225735	− 2·6458
T′	6·38457	
$\delta_1\lambda$	3·26353	
$\delta_1 L$	2·66534	
	0·31344	+ 2·0580
W′	$\overline{13}$·043	
$\delta_1\lambda^2$	6·527	
$\delta_1 L$	2·665	
	4·235	− ·0002
Z′	$\overline{14}$·350	
$\delta_1 L^3$	7·996	
	6·346	+ ·0000
ΔA		− 0·5881
	180 + A = 345 45 9·640	
	ΔA = + 0·588	
	B = 345 45 10·228	

EXAMPLE IV.

Station A	λ	S 0 19 39·409	L	E	0 3 39·728
„ B	λ	N 0 10 55·139	L	W	0 4 3·000
B—A	Δλ	−0 30 34·548	ΔL	−	0 7 42·728

The computation will remain the same as above.

EXAMPLE V.

Station A	λ	S 0 19 39·409	L	E	77 18 27·188
„ B	λ	S 0 20 33·338	L	E	76 53 57·756
B—A	Δλ	+0 0 53·929	ΔL		− 0 24 29·432

Logarithms.		*Nat. Nos.*
Δλ		+ 53·929
R′	8·14467	
ΔL^2	6·33430	
	2·47897	+ ·0301
$\delta_1\lambda_a$		+ 53·9591
		1·000000
S′	8·43993	
$\delta_1\lambda_a$	1·73206	
	6·17199	+ ·000001
U′	$\overline{12}$·888	
$\delta_1\lambda_a^2$	3·464	
	8·352	+ ·000000
Y′	$\overline{16}$·409	
ΔL^2	6·334	
	$\overline{10}$·743	− ·000000
a	0·0000004	+ 1·000001
ΔL	3·1671495	
$\delta_1 L$	3·1671491	= ΔL − a
Δλ		+ 53·929
R′	8·14467	
$\delta_1 L^2$	6·33429	
	2·47896	+ ·0301
V′	$\overline{10}$·441	
$\delta_1\lambda_a^2$	3·464	
	7·905	+ ·0000
X′	$\overline{12}$·593	
$\delta_1\lambda_a$	1·732	
$\delta_1 L^2$	6·334	
	4·659	+ ·0005
$\delta_1\lambda$		+ 53·9596

Logarithms.		*Nat. Nos.*
Q	$\overline{1}$·9971077	
sec λ	0·0000071	
$\delta_1\lambda$	1·7320687	
Co-log $\delta_1 L$	4·8328509	
cot A	2·5620344	
	A = 87° 54′ 39″·149	
$\delta_1\lambda$	1·7320687	
Co-log P	2·0033052	
sec A	1·4382544	
c	5·1736283	
		Nat. Nos.
$\delta_1 L$	3·1671491	
sin λ	$\overline{3}$·7572369	″
	0·9243860	− 8·4021
T′	6·38457	
$\delta_1\lambda$	1·73207	
$\delta_1 L$	3·16715	
	$\overline{1}$·28379	− ·1922
W′	$\overline{13}$·043	
$\delta_1\lambda^2$	3·464	
$\delta_1 L$	3·167	
	7·674	− ·0000
Z′	$\overline{14}$·350	
$\delta_1 L^3$	9·501	
	5·851	+ ·0001
ΔA		− 8·5942
	180 + A = 267 54 30·140	
	ΔA = + 8·594	
	B = 267 54 47·743	

EXAMPLE VI.

Station A	λ	S 0 19 39·409	L	W	0 6 15·768
„ B	λ	S 0 20 33·338	L	W	0 30 45·200
B—A	Δλ	+0 0 53·929	ΔL	−	0 24 29·432

The computation will remain the same as above.

2nd. Secondary Triangulation :—

The computations are based on the following three formulæ :—

$$\Delta\lambda = -\frac{c}{\rho}\cos\left(A + \frac{\Delta A}{2}\right)\operatorname{cosec} 1'' \quad \ldots \quad \ldots \quad (1)$$

$$\Delta L = -\frac{c}{\nu}\frac{\sin\left(A + \frac{\Delta A}{2}\right)}{\cos\left(\lambda + \frac{\Delta\lambda}{2}\right)}\operatorname{cosec} 1'' \quad \ldots \quad \ldots \quad (2)$$

$$\frac{\Delta A}{2} = \frac{\Delta L}{2}\sin\left(\lambda + \frac{\Delta\lambda}{2}\right) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

These formulæ are deduced as follows :—

Let **A** and **B** be two points on the earth's surface, and let λ, L be the latitude and longitude of **A** and A the azimuth of **B** at **A**, and $\lambda + \Delta\lambda$, $L + \Delta L$ and $\pi + A + \Delta A$ be the corresponding quantities for **B**, and c = the distance **AB**.

Let O be the middle point of **A B**, and let its latitude and longitude be Λ and l respectively, and the azimuth of **A** at O be α and of **B** at O be $\pi + \alpha$, and let $\Delta_B\Lambda$, &c., $\Delta_A\Lambda$, &c., represent the differences of latitude, &c., between O and **B** and **A**.

Then the formulæ on page 15 gives :—

$$\Delta_A\Lambda \sin 1'' = -\frac{c}{2\rho}\cos\alpha - \frac{1}{2}\frac{c^2}{4\rho\nu}\sin^2\alpha\tan\Lambda - \frac{3}{4}\frac{c^2}{4\rho\nu}\frac{e^2}{1-e^2}\cos^2\alpha\sin 2\Lambda$$
$$+ \frac{1}{6}\frac{c^3}{8\rho\nu^2}\sin^2\alpha.\cos\alpha\,(1 + 3\tan^2\Lambda);$$

$$\Delta_B\Lambda \sin 1'' = +\frac{c}{2\rho}\cos\alpha - \frac{1}{2}\frac{c^2}{4\rho\nu}\sin^2\alpha\tan\Lambda - \frac{3}{4}\frac{c^2}{4\rho\nu}\frac{e^2}{1-e^2}\cos^2\alpha\sin 2\Lambda$$
$$- \frac{1}{6}\frac{c^3}{8\rho\nu^2}\sin^2\alpha\cos\alpha\,(1 + 3\tan^2\Lambda);$$

$$\text{therefore } \Delta\lambda \sin 1'' = \frac{c}{\rho}\cos\alpha - \frac{1}{24}\frac{c^3}{\rho\nu^2}\sin^2\alpha\cos\alpha\,(1 + 3\tan^2\Lambda).$$

$$\text{Similarly } \Delta L \sin 1'' = \frac{c}{\nu}\frac{\sin\alpha}{\cos\Lambda} + \frac{1}{24}\frac{c^3}{\nu^3}\left\{\frac{1 + 3\tan^2\Lambda}{\cos\Lambda}.\sin 2\alpha\cos\alpha - 2\sin^3\alpha.\frac{\tan^2\Lambda}{\cos\Lambda}\right\}$$

$$\Delta A \sin 1'' = \frac{c}{\nu}\sin\alpha\tan\Lambda + \frac{1}{4}\frac{c^3}{\nu^3}\left\{\left(\frac{5}{6} + \tan^2\Lambda\right)\frac{\tan\Lambda}{2}\sin 2\alpha\cos\alpha\right.$$
$$\left. - \frac{1}{6}\sin^3\alpha\tan\Lambda\,(1 + 2\tan^2\Lambda)\right\}.$$

Now $\pi + \alpha + \Delta_B\alpha = A + \Delta A$,

therefore $$\pi + \alpha = A + \frac{\Delta A}{2} - \frac{1}{16}\frac{c^2}{\nu^2}\left(1 + 2\tan^2\Lambda + \frac{e^2\cos^2\Lambda}{1-e^2}\right)\sin 2\alpha\operatorname{cosec} 1''.$$

Now the maximum value of the last term for a distance of 60 miles and $\Lambda = 45°$ is between 8″ and 9″;

therefore $$-\cos\alpha = \cos\left(A + \frac{\Delta A}{2}\right) + \sin\left(A + \frac{\Delta A}{2}\right) \times \cdot 00004,$$

$$= \cos\left(A + \frac{\Delta A}{2}\right) \text{ very nearly;}$$

and $$-\sin\alpha = \sin\left(A + \frac{\Delta A}{2}\right) \text{ very nearly.}$$

Also $$\Lambda = \lambda - \Delta_A\Lambda = \left(\lambda + \frac{\Delta\lambda}{2}\right) + \frac{1}{8}\frac{c^2}{\rho\nu}\sin^2\alpha\tan\Lambda\operatorname{cosec} 1'',$$

and the maximum value of the second term is about 6″;

therefore $\sin A = \sin\left(\lambda + \frac{\Delta\lambda}{2}\right)$ and $\cos A = \cos\left(\lambda + \frac{\Delta\lambda}{2}\right)$ nearly.

Consequently leaving out the terms containing third powers of e which are small we get:—

$$\left.\begin{aligned} \Delta\lambda &= -\frac{e}{\rho}\cos\left(A + \frac{\Delta A}{2}\right)\operatorname{cosec} 1'' \\ \Delta L &= -\frac{e}{\nu}\,\frac{\sin\left(A + \frac{\Delta A}{2}\right)}{\cos\left(\lambda + \frac{\Delta\lambda}{2}\right)}\operatorname{cosec} 1'' \\ \Delta A &= \Delta L \sin\left(\lambda + \frac{\Delta\lambda}{2}\right) \end{aligned}\right\}$$

The terms in e^3 are:—

In $\Delta\lambda$ . . . . $-\frac{1}{24}\frac{e^3}{\rho\nu^2}\cdot\sin^2\theta\cos\theta\,(2 + 3\tan^2\phi)\operatorname{cosec} 1''$,

„ ΔL . . . . $-\frac{1}{24}\frac{e^3}{\nu^3}\cdot\sin\theta\sec\phi\left\{\sin^2\theta\sec^2\phi - 1\right\}\operatorname{cosec} 1''$,

„ ΔA . . . . $-\frac{1}{24}\frac{e^3}{\nu^3}\cdot\sin\theta\tan\phi\left\{2 + \tan^2\phi\sin^2\theta\right\}\operatorname{cosec} 1''$;

where $\theta = A + \frac{\Delta A}{2}$ and $\phi = \lambda + \frac{\Delta\lambda}{2}$,

and the greatest values of these for a distance of 60 miles in latitude 40° are:—

In $\Delta\lambda$ . . . 0″·05 on an azimuth 54° 44′.

„ ΔL . . . 0″·03 „ 90°,

„ ΔA . . . 0″·07 „ 90°.

We have therefore the above three formulæ with all requisite amount of accuracy for secondary triangulation and snow peaks.

In the preceding formulæ $\log\frac{\operatorname{cosec} 1''}{\rho}$ = co-log (Table XXVI) and $\log\frac{\operatorname{cosec} 1''}{\nu\cos\left(\lambda + \frac{\Delta\lambda}{2}\right)}$ = co-log (Table XXVII).

From (1) and (2) we get:—

$$\operatorname{Cot}\left(A + \frac{\Delta A}{2}\right) = \frac{\rho}{\nu\cos\left(\lambda + \frac{\Delta\lambda}{2}\right)}\cdot\frac{\Delta\lambda}{\Delta L} \qquad \text{or}$$

$$\operatorname{Log}\cot\left(A + \frac{\Delta A}{2}\right) = \log\text{ (Table XXVI)} + \text{co-log (Table XXVII)} + \log\Delta\lambda + \text{co-log}\,\Delta L.$$

Since λ, $\Delta\lambda$, L, ΔL, ρ and ν are given, this gives $A + \frac{\Delta A}{2}$: c follows from equation (1) and ΔA from equation (3), so that A and c are determined, and $B = 180° + \left(A + \frac{\Delta A}{2}\right) + \frac{1}{2}\Delta A$.

EXAMPLE

Station **A**, Shadau s.	Station **B**, Kingríáli h.s.
$\lambda = 32°\ 3'\ 34''{\cdot}03$	$\lambda = 32°\ 14'\ 13''{\cdot}31$
$L = 71\ 3\ 29{\cdot}80$	$L = 71\ 5\ 2{\cdot}60$

To find A, c and B.

Station **A**	... Shadau		s.
„ **B**	... Kingríáli		h.s.
		° ′	″
λ_A	...	32 3	34·03
λ_B	...	32 14	13·31
$\lambda_B - \lambda_A = \Delta\lambda$	...+	0 10	39·28
$\frac{\lambda_A + \lambda_B}{2} = \lambda_m$	...	32 8	53·67
L_A	...	71 3	29·80
L_B	...	71 5	2·60
$L_B - L_A = \Delta L$	...+	0 1	32·80
Log $\Delta\lambda$	(1)		2·8056911
„ Tab. XXVI for λ_m ...	(2)		2·0045305
Co-log ΔL	...		$\bar{2}$·0324520
„ Tab. XXVII for λ_m ...	...		$\bar{2}$·0656779
Sum = log cot $\left(A + \frac{\Delta A}{2}\right)$ ...	...		0·9083515
		° ′	″
$A + \frac{\Delta A}{2}$* ...	(3)	187 2	24
Log sec $\left(A + \frac{\Delta A}{2}\right)$	...		0·0032866
(1) + (2)	...		4·8102216
Sum = log c	...		4·8135082
Log ΔL	...		1·9675480
„ sin λ_m	...		$\bar{1}$·7260028
Sum = Log ΔA	...		1·6935508
		° ′	″
ΔA†	... +		49
$\frac{1}{2}\Delta A$	(4) +		25
(3) − (4) = A	...	187 1	59
180° + (3) + (4) = B	...	7 2	49

* $A + \frac{\Delta A}{2}$ is in the 1st, 2nd, 3rd, 4th Quadrant when $\frac{\Delta\lambda}{\Delta L}$ are $\frac{-}{-}$, $\frac{+}{-}$, $\frac{+}{+}$, $\frac{-}{+}$ respectively.

† ΔA has the same sign as ΔL.

When both the stations **A** and **B**, or one of them, lie in *south* Latitude or *west* Longitude or in both, the following notes besides those on page 24 will have to be taken into consideration :—

When the stations are on opposite sides of the Equator the middle Latitude is half the difference and ΔA has the $\frac{same}{opposite}$ sign as ΔL according as the Latitude of the north station is $\frac{greater}{less}$ than that of the south station. The quadrant in which $A + \frac{\Delta A}{2}$ lies, will be determined from the following :—

When **A** is *north* of the Equator,

$A + \frac{\Delta A}{2}$ is in	1st	2nd	3rd	4th	Quadrant,
when $\frac{\Delta\lambda}{\Delta L}$ are	$\frac{-}{-}$	$\frac{+}{-}$	$\frac{+}{+}$	$\frac{-}{+}$	;

When **A** is *south* of the Equator,

$A + \frac{\Delta A}{2}$ is in	1st	2nd	3rd	4th	Quadrant,
when $\frac{\Delta\lambda}{\Delta L}$ are	$\frac{+}{-}$	$\frac{-}{-}$	$\frac{-}{+}$	$\frac{+}{+}$	.

TABLE IX.—*Computation of Heights.—Correction to Log. Distance in Feet between two Stations* **A** *and* **B** *to reduce to the Level of Station* **A**.

In the computation of the difference of height of two stations it is necessary to find the distance between them at the level of the station whose height is known.

The sides of the triangles are the distances at the level of the sea, and this table gives the corrections in the 7th place to be added to their logarithms so as to get the values at any required height.

The correction is determined as follows :—

Let c = length of side at the sea level,

c' = " at height of station **A**,

h = height of **A** above sea level,

R = radius of earth,

then $\frac{c'}{c} = \frac{R + h}{R}$.

Therefore

$\log c' = \log c + \log \frac{R + h}{R}$, and R is taken equal to $\frac{2\rho\nu}{\rho + \nu}$, see page 12 of explanation of Table III.

EXAMPLE.—Let h = 1000 feet in latitude 20°.

From Table II	ρ = 20808279·7	$\log \rho$ = 7·318236178
„ I	ν = 20931059·7	$\log \nu$ = 7·320791216
		$\log 2$ = 0·301029996
		$\log 2\rho\nu$ = 14·94005739
	$\rho + \nu$ = 41739339·4	$\log \overline{\rho + \nu}$ = 7·62054557
	R = 20869489·2	$\log R$ = 7·31951182
	$R + h$ = 20870489·2	$\log \overline{R + h}$ = 7·31953263
		$\log \frac{R + h}{R}$ = ·00002081

so that the correction to the 7th place of logs = 208·1 as in the table.

The table gives the correction for every thousand feet from one to ten and for each degree of latitude from 0° to 40°.

For other heights and latitudes the correction must be found by interpolation.

EXAMPLE.—To find the log distance in feet between **A** and **B** in lat. 30° at the level of the station **A** when the height of **A** is 5,679 feet above sea level.

From the table the correction for	5,000 feet is	1039·6
„ „	600 „	124·8
„ „	70 „	14·6
„ „	9 „	1·9
Therefore the correction for	5,679 feet is	1181

Thus if the log distance between **A** and **B** at sea level = 4·9826056

then the log distance between **A** and **B** at level of **A** = 4·9827237

If the difference of height between **A** and **B** is less than 5,000 feet, five-place logarithms are sufficient. In this case the small table at the foot of the page, which is the same for all latitudes, may be employed.

EXAMPLE.—To find the log distance in feet between **A** and **B** at the level of the station **A** when the height of **A** is 4679 feet above sea level.

From the table the correction for	4,000 feet is	8
„ „	600 „	1
„ „	79 „	0
Therefore the correction for	4,679 feet is	9

Thus if the log distance between **A** and **B** at sea level = 4·67015

then the log distance between **A** and **B** at level of **A** = 4·67024

TABLE X.—*Computation of Heights.—For converting Geodetic Distance in Miles into Seconds of Contained Arc.*

In the computation of difference of height it is necessary for the calculation of terrestrial refraction to convert the distance between the two stations into Seconds of Contained Arc, and this table is to be used for the purpose when the distance is given in miles.

Seconds of Contained Arc are determined as follows:—

Let c = the distance in miles,

and c'' = the corresponding contained arc in seconds;

then $c'' = c \times 5280 \times \frac{\text{cosec } 1''}{\text{radius in feet}}$,

and the radius is taken = $\frac{2\rho\nu}{\rho+\nu}$ as in Table III, page 12.

EXAMPLE.—Suppose c = 10 miles in latitude 20°.

log 52800 =	4·7226339
log cosec 1″ =	5·3144251
Sum =	10·0370590
log radius =	7·3195118, *see* page 30.
log c'' =	2·7175472

Therefore the Contained Arc or c'' = 521″·9 as in the table.

The table gives the Contained Arc in seconds for geodetic distances ranging in length from 10 miles to 90 miles, for each degree of latitude from 0° to 40°, and also for two places of decimals of a mile, the latter part of the table being independent of the latitude.

EXAMPLE.—To convert 42·58 miles in latitude 24° into Seconds of Contained Arc.

From the upper table,	40 miles	= 2086″·7
„ „	2 „	= 104·3
„ lower	0·58	= 30·3
Therefore the Contained Arc in Seconds		= 2221·3

TABLE XI.—*Computation of Heights.—For converting Geodetic Distance in Feet into Seconds of Contained Arc.*

This table is to be used instead of Table X, when the distance is given in feet.

It is calculated as follows:—

Let c = distance in feet;

then, from the last table, we have for latitude 20°

$$\log c'' = \log c + 3{\cdot}3940133;$$

therefore

$$c'' = c \times 0{\cdot}000884 = \frac{c}{100}\left\{1 - {\cdot}0116\right\}$$

$$= \frac{c}{100} - \frac{c}{1000} \times 0{\cdot}116$$

The quantity $= \frac{c}{1000} \times 0{\cdot}116$ is tabulated.

The table is constructed for geodetic distances in feet reckoned from 1000 feet to 9000 feet for each degree of latitude from 0° to 40°, but a sufficient number of decimal places is given to admit of its being used for distances up to 500,000 feet.

To find the Contained Arc proceed by the following rule:—

RULE.—Divide the number of feet in the geodetic distance by 100 and diminish the quotient by the quantity in the table corresponding to the number of feet reckoned by thousands and the result gives the number of Seconds of Contained Arc.

EXAMPLE.—To convert 224,822 feet in latitude 24° into Seconds of Contained Arc.

224,822 feet =	225,000 feet approximately.	
For 200,000 feet the table gives		− 23″·9
20,000 ,, ,, ,,		− 2·4
5,000 ,, ,, ,,		− 0·6
Therefore for 225,000 ,, ,, ,,		− 26·9
224,822 divided by 100		= 2248·2
Therefore the Contained Arc in Seconds		= 2221·3

TABLE XII.—*Computation of Heights.—For obtaining the Quantity β'' in the formula for finding the Terrestrial Refraction.*

The formulæ for computation of Difference of Height and of Terrestrial Refraction between two stations are deduced as follows:—(see *Account of the Operations of the Great Trigonometrical Survey of India*, Vol. II).

Let **A** and **B** be two stations at which reciprocal vertical observations have been taken, the height of **A** above sea level being known it is required to find that of **B**.

Let H = the height of **A** in feet,

$H + h$ = ,, **B** ,,

c = the distance between the normals of **A** and **B** at the level of the sea,

c' = ,, ,, ,, ,, ,, of **A**,

obtained with the aid of Table IX.

Also let κ = the chord of the arc c',

R = the mean radius of curvature;

then $\kappa = 2R \sin \frac{c'}{2R} = c' - \frac{c'^3}{24R^2}$.

Now $c' = c\left(1 + \frac{H}{R}\right)$.

Therefore $\kappa = c'\left(1 + \frac{H}{R} - \frac{c'^2}{24R^2}\right)$,

or neglecting the third term which is inappreciable, 1*st*, in principal triangulation on account of the smallness of the side, 2*nd*, in high secondary points or distant snow peaks in comparison with the uncertainty in refraction;—

$$\kappa = c\left(1 + \frac{H}{R}\right) = c'.$$

Let D_1 and D_2 be the vertical angles, both assumed to be depressions, which would be observed at **A** and **B** if there was no refraction and the heights of the signal and instrument were equal;

then
$$h = \kappa \frac{\sin \frac{1}{2}(D_2 - D_1)}{\cos D_2}$$
$$= c' \sin \tfrac{1}{2}(D_2 - D_1) \sec D_2.$$

Let i_a, i_b = the heights in feet of the instruments at **A** and **B** respectively,

g_a, g_b = ,, ,, signals ,, ,,

$\delta = g_a - g_b + i_a - i_b$,

r_a, r_b = the refractions in the vertical angles at **A** and **B** respectively, assumed to be the same and $= r''$

D_a, D_b = the observed vertical angles at **A** and **B** respectively, both assumed to be depressions,

also let S' = the subtended angle, that is the angle at **A** between the line joining **A** and **B** and the chord κ,

then
$$h = c' \sin S' \sec D_2.$$

But
$$D_2 = D_b + r_b + \frac{g_a - i_b}{c' \sin 1''},$$

$$D_1 = D_a + r_a + \frac{g_b - i_a}{c' \sin 1''};$$

therefore if we take $r_a = r_b = r''$, we get

$$S' = \frac{D_2 - D_1}{2} = \tfrac{1}{2}(D_b - D_a) + \frac{\delta}{2c' \sin 1''};$$

or if we neglect insignificant quantities,

then
$$h = c' \sin \tfrac{1}{2}(D_b - D_a) \sec D_b + \frac{\delta}{2};$$

or if S is put for $\frac{1}{2}(D_b - D_a)$

$$h = c' \sin S \sec D_b + \frac{\delta}{2}.$$

To calculate the refraction,

if c'' = the contained arc in seconds,

$$c'' = D_1 + D_2,$$
$$= D_a + D_b + 2r'' - \frac{i_a - g_a + i_b - g_b}{c' \sin 1''}.$$

Put
$$\gamma = i_a - g_a + i_b - g_b$$

and
$$\beta'' = \frac{\gamma \text{ feet}}{2c' \text{ feet} \sin 1''},$$

then
$$r'' = \tfrac{1}{2}\{c'' - (D_a + D_b)\} + \beta''.$$

If either of the observed angles at **A** or **B** is an elevation $-E_a$ or $-E_b$ must be substituted for D_a or D_b.

As the difference of height is only required to the nearest foot, it will be sufficient to take δ to the nearest 0·1 foot, while γ need only be kept to the nearest 0·5 foot.

The coefficient of refraction is usually deduced at the same time as the difference of height, the former being required in the calculation of heights of surrounding points from which reciprocal observations have not been taken.

The table gives β'' where, as above,

$$\beta'' = \frac{\gamma \text{ feet. cosec } 1''}{2\,c' \text{ feet}} = \frac{\gamma \text{ feet. cosec } 1''}{2 \times 5280 \times (\text{distance in miles})} = 19''{\cdot}53\,\frac{\gamma}{\text{distance in miles}}.$$

The table is constructed for values of γ up to 12 feet and for all distances likely to be required; where the limits of the table are exceeded, β'' must be calculated by the above formula.

To obtain β'', enter the table with the value of γ, under which look for the number of miles representing the distance between the stations, and take the corresponding value of β'' given in the margin. β'' has the same sign as γ.

The following form has been adopted for the computation of height and refraction when the angles at **A** and **B** are both observed:—

Computation of Height and Refraction.

No. of Deduction	Astronomical Dates of Observation 1902		Station	No. of Observations	Observed Vertical Angles	$S = \frac{D-D}{2}$, $\frac{D+E}{2}$ or $\frac{E-E^*}{2}$ $R = \frac{D+D}{2}$, $\frac{D-E}{2}$ or $\frac{E+E^*}{2}$	Heights in Feet: Instrument or i	Signal or g	δ ‡ γ	B − A	Heights in Feet: Above Sea Level A	B	Mean	Distance in Miles and Contd. Arc or c″ ‡‡	Terrestrial Refraction r″	$\frac{r''}{c''}$	Height of Tower or Platform in Feet
No. of Column			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
1	Oct. 17	h m 2 21	**A** Banog H.S.	9	° ′ ″ E 0 56 30·6	° ′ ″ S 1 3 10·2	i_a 5·6	g_b 2·3	δ +0·6	+1647·9	7432·8	9080·7	...	16·97	50	·056	...
	„ 12,13	2 39	**B** Sirkanda „	8	D 1 9 49·7	R 0 6 39·6	i_b 5·0	g_a 2·3	γ +6·0					985			

Logarithms

Corrn. for Height of **A**, Table IX	0·00015
Sec ∠ at **B** of col. (3) from Tab. XIII	0·00009
sin S of col. 4	$\bar{2}$·26421
Geodetic Distance **A** to **B** in feet	4·95240
Sum = Log a ...	3·21685
‖a ...	+ 1647·6

Feet

$\frac{\delta}{2}$ from col. (7)	+ 0·3
Sum = Height **B** − **A** for col. (8) ...	+ 1647·9

Seconds

¶ β from Table XII	+ 7
§ R from col. (4)	− 400
$\frac{1}{2}$c from col. (12)	+ 443
Sum = r for col. (13)	50

* These cases are very unusual being due to abnormal conditions; when they occur, they should be very carefully treated as the quantities involved will be small.

‡ $\delta = i_a - i_b + g_a - g_b$ and $\gamma = i_a + i_b - g_a - g_b$, where i_a and i_b are the heights of instruments and g_a and g_b heights of signals, each respectively at **A** and **B**. ‖ When both angles are Depressions a is $\frac{+}{-}$, or when both are Elevations a is $\frac{-}{+}$, according as the angle at **B** is $\frac{greater}{less}$ than the angle at **A**; and when one angle is an Elevation and another a Depression a is $\frac{+}{-}$ according as the $\frac{\text{angle at B}}{\text{angle at A}}$ is a Depression.

‡‡ From Table X or XI. ¶ β has the same sign as γ.

§ R is negative when both angles are Depressions and positive when both are Elevations; and when one angle is an Elevation and another a Depression R is $\frac{-}{+}$ according as the angle of Depression is $\frac{greater}{less}$ than the angle of Elevation.

When only one angle is observed the computation of heights may be effected on the foregoing form as follows :—

Computation of Heights.

No. of Deduction	Astronomical Dates of Observation 1905		Station	No. of Observations	Observed Vertical Angles	$S = \frac{D-D}{2}$, $\frac{D+E}{2}$ or $\frac{E-E'}{2}$ $R = \frac{D+D}{2}$, $\frac{D-E}{2}$ or $\frac{E+E'}{2}$	Heights in Feet: Instrument or i	Heights in Feet: Signal or g	Heights in Feet: δ γ‡	Heights in Feet: B − A	Heights in Feet: Above Sea Level A	Above Sea Level B	Above Sea Level Mean M	Distance in Miles and Contd. Arc or c″ ‡‡	Terrestrial Refraction: r″	Terrestrial Refraction: $\frac{r''}{c''}$	Height of Tower or Platform in Feet
No. of Column			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
1	Nov. 6	h m 2 23	A Mussooree B Jaonli Peak	4	° ′ ″ E 2 37 28 D 3 19 10	° ′ ″ S 2 58 19 R	i_a 5 i_b	g_b 0 g_a	δ +5 γ	+14835	6930	21765	...	54·06 2819	161	·057	...

Logarithms

Corrn. for Height of **A**, Table IX	0·00015
sec ∠ at **B** of col. (3) from Tab. XIII	0·00073
sin S of col. (4)	$\bar{2}$·71472
Geodetic Distance **A** to **B** in feet	5·45553
Sum = Log a	4·17113

Feet

$\|a$	+14830
δ from col. (7)	+ 5
Sum = Height **B** − **A** for col. (8)	+14835

Note.—When one angle is observed the other angle = c + E − 2r + 39·1 $\frac{\gamma}{\text{Distance in miles}}$ or = c − D − 2r + 39·1 $\frac{\gamma}{\text{Distance in miles}}$, where r is equal to the coefficient of refraction in col. (14) multiplied by Contained Arc, the coefficient of refraction being determined from rays at which reciprocal vertical observations are taken : this angle if + is a Depression or D, and if − an Elevation or E; enter it in column (3) and proceed as if both angles at **A** and **B** were observed, except that in finding the height (**B** − **A**) use δ instead of $\frac{\delta}{2}$.

For explanation of * ‡ ‖ ‡‡ ¶ § *see* Footnotes to the form on previous page.

It will be noticed that we add δ to a instead of $\frac{\delta}{2}$. The reason of this is that as we only observe one angle, and that from a height δ above **A**, we get the difference of height between **B** and **A** too small by this quantity and must therefore add it to the result to obtain the true difference of height.

Instead of employing the foregoing method of finding S we may use either Table XIV or Table XV.

TABLE XIII.—*Computation of Heights.—Log. secant of Observed Angle at Station* **B**.

It will be seen from the formula for h on page 33 that sec D_b is required, and it is the logarithm of this which is given in this table. The table is so arranged that the log secants have 5 in their sixth place. The log secant of any angle between two of those given in the table will be represented by the mean in the fifth place.

EXAMPLE.—To find log secant of 1° 41′ 15″

			°	′	″		
From the table log secant of		...	1	40	20	is	0·000185
,,	,,	...	1	43	0	,,	195
Therefore	log secant of	...	1	41	15	is	0·00019

The log secant is rejectaneous if the angle is less than 16′ 25″, while it is seldom greater than 2° 7′: the table has accordingly been given within these limits.

TABLE XIV.—*Computation of Heights.—To facilitate finding the Subtended Angle when only one angle has been observed and the Distance between Stations* **A** *and* **B** *is given in Log. Feet.*

This table is designed to meet both variation of refraction and change of latitude, and at the same time it is only necessary to know the log distance in feet between **A** and **B**. The range for the coefficient of refraction is from ·03 to ·20, while the latitude is given for every 5° from 0° to 40°.

The quantity given in the table is obtained as follows:—

Using the notation in Table XII.—

$$S = \frac{D_b - D_a}{2},$$

$$D_b = c'' - D_a - 2r'';$$

therefore
$$S = \frac{c'' - 2D_a - 2r''}{2}.$$

Now $r'' = k\,c''$, where k is the coefficient of refraction;

therefore
$$S = c''\frac{1 - 2k}{2} - D_a.$$

But
$$c'' = c\,\frac{\rho + \nu}{2\rho\nu}\,\mathrm{cosec}\ 1'';$$

therefore
$$S = \frac{1 - 2k}{2} \cdot \frac{\rho + \nu}{2\rho\nu} \cdot c\ \mathrm{cosec}\ 1'' - D_a$$

$$= K - D$$

where
$$K = \frac{1 - 2k}{2} \cdot \frac{\rho + \nu}{2\rho\nu} \cdot c\ \mathrm{cosec}\ 1''.$$

The co-logarithm of $\left(\frac{1 - 2k}{2} \cdot \frac{\rho + \nu}{2\rho\nu}\ \mathrm{cosec}\ 1''\right)$ is the tabular quantity.

To find K:—

RULE.—Subtract the quantity in the table from the log distance in feet and look out the result in the 4-place logarithms. The natural number corresponding is K in seconds of arc.

The subtended angle S is found by subtracting depressions from or adding elevations to K.

If any refraction between those given in the table is to be used, it will be sufficient to interpolate by simple proportion between the next lower and the next higher.

The following form has been adopted for the computation of heights:—

Fixed Station **A**		Mussoorce
Deduced Station **B**		Jaonli Peak
Log Side in feet	(1)	5·4555
From Table for latitude 30° and refraction ·057	(2)	2·3591
(1) − (2) = log K in seconds of arc		3·0964
		° ′ ″
K		0 20 49
Observed Angle D or E		E 2 37 28
S = K − D or K + E		2 58 17
Log tan S		$\bar{2}$·71523
(1)		5·45553
Sum = log *h*		4·17076
h		14817
± (i − s) *		5
Sum = difference of height in feet		14822
Height of **A** above sea level in feet		6930
„ **B** „ „		21752
Mean „ „ „ „		...

* When the ∠ at **A** is observed *h* has the same sign as S, and (i−s) its proper sign; when the ∠ at **B** is observed *h*, S and (i−s) have opposite signs.

TABLE XV.—*Computation of Heights.—To facilitate finding the Subtended Angle when only one angle has been observed and the Distance between Stations* **A** *and* **B** *is given in Feet.*

The table gives the quantity K of the last table, and from it the subtended angle S is found by subtracting depressions or adding elevations.

The table is constructed for coefficients of refraction ranging from ·00 to ·5, for distances from 100 feet to 400,000 feet, and for latitude 20°, the mean between the limits generally adopted in these tables; by means of it the subtended angle can be found at once when the distance is given in feet and the coefficient of refraction is known.

The construction of the table will be seen from the following Example:—

To find K when c = 10000 feet and k = ·08

$$\log \frac{\rho + \nu}{2\rho\nu} \operatorname{cosec} 1'' = 3{\cdot}9949133 \text{ as on page 31.}$$

$$\frac{1 - 2k}{2} = {\cdot}42 \ldots \quad \log = \bar{1}{\cdot}6232493$$

$$c = 10000 \ldots \quad \log = 4{\cdot}0000000$$

$$\text{Nat. No.} = 41{\cdot}5 \ldots \quad \log = 1{\cdot}6181626$$

Therefore K = 42″·4 as in the table.

EXAMPLE.—To find S when the coefficient of refraction is ·07, the distance is 77,746 feet and the observed depression is 0° 14′ 35″.

It is sufficient to keep the distance to the nearest 100 feet.

		° ′ ″
From the table, for 70,000 feet	K =	0 4 58
„ 7,000 „	„ =	30
„ 700 „	„ =	3
therefore „ 77,700 „	K =	0 5 31
	D =	0 14 35
Therefore S = K − D	=	0 9 4

TABLE XVI.—*Computation of Heights.—Natural Tangents to 5 places of Decimals.*

The table gives the tangents of angles for each minute from 0° to 16°, and is intended to aid in the calculation of heights when a clinometer is not available.

TABLE XVII.—*Computation of Heights.—Correction for Curvature and Refraction in determining Heights with the Clinometer.*

This table gives the correction, for curvature of the earth and for refraction, to the difference of height found by multiplying the distance in feet by the tangent of the angle of depression or elevation obtained from the clinometer. It has been calculated with a radius equal to the radius of curvature to the meridian in latitude 20° and with coefficients of refraction 0·10, 0·07 and 0·05. The correction is only required to the nearest foot, and the table is so arranged as to give this by inspection for any distance up to 48,000 feet.

The correction is found thus:—

Let the tangent at A meet the normal at B in B; then if B' is vertically below B at a height equal to that of A

$$\text{the correction for curvature} = B'B = \frac{(\text{distance})^2}{2 \text{ radius}}.$$

Again, the correction for refraction = distance × k $\frac{\text{distance}}{\text{radius}}$, where k is the coefficient of refraction,

$$= k \frac{(\text{distance})^2}{\text{radius}};$$

therefore the total correction $= \frac{(\text{distance})^2}{\text{radius}} \left\{ \frac{1 - 2k}{2} \right\}$.

The argument with which to enter the table is the distance in feet. Thus suppose the distance was 20,000 feet and the coefficient of refraction 0·10; then as 20,000 lies between 19,752 and 21,028 the correction will lie between 7·5 and 8·5, and will consequently be 8.

The way in which the argument is computed may be seen from the following example:—

Given $k = \cdot10$, find the distance corresponding to a correction $= 0\cdot5$,

$$(\text{distance})^2 = \frac{\text{radius}}{\cdot8}$$

$$\log \text{radius} = 7\cdot3182362$$

$$\log \cdot8 = \bar{1}\cdot9030900$$

$$\log (\text{distance})^2 = 7\cdot4151462$$

$$\log \text{distance} = 3\cdot7075731;$$

therefore distance = 5100 feet.

EXAMPLE.—*Computation of Clinometric Heights.*

Fixed Station A	Deduced Station B	1 Reading at A or B		2 Distance in feet	3 1 × 2	4 Correction*	5 i − s feet	Alg. Sum of 3, 4 and 5	Height of A in feet	Height of B in feet	Mean Height of B in feet
Hill temple	Rampur ⊙	A	−·115	9950	− 1144	+ 2	− 4	− 1146	2181	1035	1036
Pamta Cone Rock	Ditto	A	−·0775	13230	− 1025	+ 3	− 4	− 1026	2063	1037	
Pamta H.S.	Tiri ⊙	B	+·096	10900	− 1046	− 2	+ 4	− 1044	1961	917	918
Pamta N. po. 2	Ditto	B	+·0375	10100	− 370	− 2	+ 4	− 377	1295	918	

NOTE.—The reading in column 1 will be + if an Elevation and − if a Depression. * This correction from Table is always − when the angle observed is at **B** and + when the angle observed is at **A**. When the angle observed is at **A**, 3 and 5 are to be entered with their *proper* signs, and with their signs *changed* when the angle observed is at **B**.

TABLE XVIII.—*Computation of Heights.—For determining Differences of Height with the Barometer.*—BAILY.

The formula on which this table depends as investigated in works on Hydrostatics (*see* Besant's Hydro-Mechanics), is as follows:—

Let H = height of barometer in inches at lower station,

H' = ,, ,, ,, upper ,,

T = temperature of barometer in degrees Fah. at lower station,

T' = ,, ,, ,, upper ,,

t = ,, air ,, lower ,,

t' = ,, ,, ,, upper ,,

λ = mean latitude.

s = height in feet of lower station above sea level,

x = difference between the heights of the two stations,

μ = the modulus of the common system of logarithms,

θ = the difference of expansion between mercury and brass for 1° Fah.,

r = mean radius of the earth,

then
$$x = 60158{\cdot}6 \text{ feet } \left\{ \log \frac{H}{H'} - \mu\theta\,(T - T') \right\}$$
$$\times \left\{ 1 + \frac{t + t' - 64^\circ}{900} \right\} \times (1 + 0{\cdot}002695 \cos 2\lambda)$$
$$\times \left\{ 1 + \frac{x + 2\mu x}{r} + \frac{2s}{r} \right\}.$$

Assuming s to be 4000 feet, the mean radius of the earth as 20898240 feet, and taking an approximate value of. x, the expression $60158{\cdot}6 \left\{ 1 + \frac{x + 2\mu x}{r} + \frac{2s}{r} \right\}$ becomes equal to 60345·51. If we leave out the expansion of the thermometer scale and take the value of θ to be ·0001 the formula then becomes as given by Baily,

$$x = 60345{\cdot}51 \left\{ 1 + \frac{t + t' - 64^\circ}{900} \right\} \times (1 + 0{\cdot}002695 \cos 2\lambda)$$
$$\times \log \left\{ \frac{H}{H'} \frac{1}{\{1 + {\cdot}0001\,(T - T')\}} \right\}.$$

The quantity A in Part I is the logarithm of $60345{\cdot}51 \left\{ 1 + \frac{t + t' - 64^\circ}{900} \right\}$,

„ B „ II „ of $\{1 + {\cdot}0001\,(T - T')\}$,

„ C „ III „ of $(1 + {\cdot}002695 \cos 2\lambda)$.

The method of using the table is as follows:—

From Part II take out the quantity B corresponding to the difference T — T′ of the attached thermometers (if aneroid barometers are employed B is zero), add it to log H′, and subtract the sum from log H. This gives a quantity D.

To the logarithm of D add the quantity A from Part I corresponding to the sum t + t′ of the detached thermometers, and the quantity C from Part III corresponding to the mean latitude. The natural number of the resulting logarithm will be the required difference of height in feet.

EXAMPLE :—

Computation of Heights from Barometrical Observations.

Lower Station (L)	Dehra
Upper „ (U)	Mussooree
Date and Time of Observation	
	in.
Barometer at (L) = H	27·563
„ (U) = H′	23·408
Attached Thermometer at (L) = T	79°·0
„ „ (U) = T′	70 ·1
T − T′	8·9
Detached Thermometer at (L) = t	79·6
„ „ (U) = t′	65·1
t + t′	144·7
B for T − T′ from Part II	0·00039
Log H′	1·36936
Sum (1)	1·36975
Log H (2)	1·44033
(2) − (1) = D	0·07058
Log „	2·84868
A for t + t′ from Part I	4·81794
C for mean latitude 30° from Part III	0·00058
Sum = difference of height in log feet	3·66720
„ „ in feet	4647·3
Height of given station above sea level in feet	2233·1
„ deduced „ „	6880·4

NOTE.—If Aneroid Barometers are employed, B = 0.

TABLE XIX.—*Computation of Heights.—For determining Differences of Height with the Barometer.*—LOOMIS.

The formula on which this table depends is the same as that given in the last table; but the constants employed by Baily are in some cases different from those of Loomis: the latter takes the mean radius of the earth as 20888629 feet, and the coefficient of cos 2λ as 0·00265 instead of 0·002695.

If we take the coefficient of expansion of mercury for 1° Fah. = ·0001;

„ „ „ brass scale „ = ·0000104;

and their difference, *viz.*, ·0000896 for θ, the first line of the formula on previous page becomes

$$60158 \cdot 6 \log \frac{H}{H'} - 2 \cdot 3409 \, (T - T').$$

The formula then stands as given by Loomis, *viz* :—

$$x = 60158{\cdot}6 \log \frac{H}{H'} - 2{\cdot}3409\ (T - T')$$

$$\times \left\{1 + \frac{t + t' - 64^\circ}{900}\right\} \times (1 + 0{\cdot}00265 \cos 2\lambda)$$

$$\times \left\{1 + \frac{x + 52251}{20888629} + \frac{s}{10444315}\right\}.$$

Part I of the table gives the value in feet of the expression $60158{\cdot}6 \log H$ for heights of the barometer from 11 to 31 inches, only that each value has been decreased by a certain constant which does not change the difference

$$60158{\cdot}6 \log H - 60158{\cdot}6 \log H'.$$

Part II gives the correction $-2{\cdot}3409\,(T - T')$ depending on the difference of temperatures of the barometers at the two stations. This correction is to be omitted if aneroid barometers are employed.

Part III gives the correction due to the term $0{\cdot}00265 \cos 2\lambda$.

Part IV „ „ „ $\frac{x + 52251}{20888629}$.

Part V „ „ „ $\frac{s}{10444315}$.

The method of using the table is as follows :—

From Part I take out the two numbers corresponding to the heights of the barometers at the upper and lower stations.

To their difference apply the correction in Part II corresponding to the value of $T - T'$, the difference of reading of the two attached thermometers, unless the barometers are aneroids, when this correction is not required. This gives a first approximate difference of height; denote this by a and apply the correction $\frac{a}{900} \times (t + t' - 64^\circ)$ for the temperature of the air: this gives a second approximation b.

Enter Part III with the two arguments, b and the mean latitude;

„ IV „ argument b;

„ V „ two arguments, b and the height of the barometer at the lower station.

The sum of the three corrections thus obtained when applied to b gives the required difference of height.

EXAMPLE :—

Computation of Heights from Barometrical Observations.

	Dehra Mussooree
Lower Station (L)	
Upper „ (U)	
Date and Time of Observation	
	in.
Barometer at (L) = H	27 ·563
„ (U) = H′	23 ·408
Attached Thermometer at (L) = T	79°·0
„ „ (U) = T′	70 ·1
T − T′	8 ·9
Detached Thermometer at (L) = t	79 ·6
„ „ (U) = t′	65 ·1
$\frac{t + t' - 64°}{900} = f$	0 ·08967
Part I for H	25396·1
„ „ H′	21127·2
Difference = D	4268·9
Part II for T − T′ = C†	− 20·9
D + C = a	4248·0
$a \times f$	+ 380·9
Sum = $a + (a \times f) = b$	4628·9
Part III for b and mean latitude 30°	+ 6·1
„ IV „ b	+ 12·6
„ V „ b and H	+ 1·0
Sum = Difference of height in feet	4648·6
Height of given station above sea level in feet	2233·1
„ deduced „ „ „	6881·7

† Negative when the temperature at (U) is the lower and *vice versâ*; but if Aneroid Barometers are employed, C = 0.

TABLE XX.—*Computation of Heights.—For determining Heights with the Boiling Point Thermometer.*

The heights of the barometer corresponding to different boiling points are derived from the results of Regnault's Experiments, revised by A. Moritz, by conversion from French into English units.

The approximate heights in the third column of Part I may be obtained by subtracting the feet of Table XIX from 27541·5 feet, which is the value in that table corresponding to the reading of the barometer at the sea level, *viz.*, 29·9218 inches.

The multipliers in Part II are found, on the supposition that dry air expands 0·00208333 of its volume for 1° Fah., from the formula—multiplier = 1 + (t° − 32°) × 0·00208333, where t° is the mean temperature of the stratum of air passed through. Now the temperature of the air decreases 1° Fah. for every 331 feet ascended; so that if T is the temperature at a height h, the temperature at the sea level is $T + \frac{h}{331}$, and the mean temperature $= T + \frac{h}{660}$ nearly.

The method of using the table is as follows:—

Enter Part I with the given boiling point as argument and take out the approximate height.

Divide it by 660 and add the result to the air temperature. This gives the mean temperature of the stratum of air passed through.

Enter Part II with the mean temperature as argument, and the corresponding quantity when multiplied by the approximate height will give the required height above the sea level.

EXAMPLE.—The boiling point of water at Dehra is 208°·14 Fah. when the temperature of the air is 78°·5 Fah. To find the height of Dehra above the sea level.

Part I gives for 208°·14 approximate height = 2020 feet;

therefore mean temperature $= 78°{\cdot}5 + \left[\frac{2020}{660}\right]° = 81°{\cdot}6.$

Part II gives for 81°·6 multiplier = 1·103;

therefore height of Dehra above sea level = 1·103 × 2020 feet = 2228 feet.

TABLE XXI.—*Parallax of the Sun.*

This table gives the parallax of the sun for different months of the year at altitudes increasing by 5° from 0° to 90°. The values of the parallax for altitudes other than those given in the table may be found from inspection by simple interpolation.

The quantities given in the first line of the table are the angles subtended by the equatorial radius of the earth at the sun; and as the sun's distance is constantly changing, this quantity is greatest when the sun is nearest, that is in January, and least when the sun is furthest away, that is in July. The ratio of these two quantities is $1 + \frac{1}{60} : 1 - \frac{1}{60}$, since the eccentricity of the earth's orbit $= \frac{1}{60}$ nearly.

The values given in the first line are the "horizontal parallaxes" for the particular months, and for other altitudes the parallaxes have been found by multiplying the quantities in the first line by the cosines of the corresponding altitudes.

TABLE XXII.—*Astronomical Refractions.*

This table gives the mean refractions of celestial objects for zenith distances ranging from 0° to 88° 40′ (a limit which is never exceeded), when the height of the barometer is 30 inches and the air temperature 50° Fah.

The table, as stated in Appendix I to Greenwich Observations, 1893, is based on Bessel's Tabulæ Regiomontanæ down to Z. D. 85° and for all other Z. D.'s on Bessel's Fundamenta modified.

In addition to this, the third, fourth and fifth columns of the table supply the requisite data for computing the refraction for any zenith distance and for other readings of the barometer and thermometer. The refraction and differences which correspond most nearly to the apparent zenith distance are to be employed.

EXAMPLE.—To find the refraction for a zenith distance 76° 17′ with the barometer at 29·85 inches and the temperature of the air 45° Fah.

			′	″
The table gives for zenith distance 76° 20′	refraction	=	3	55·2
„ correction for 3′ of zenith distance	= − 0″·29 × 3	=	−	0·87
„ correction for − ·15 in. of barometer	= − 7 ·97 × 0·15	=	−	1·20
„ correction for − 5° of temperature	= + 0 ·470 × 5	=	+	2·35
	Total correction	=	+	0·28
	Therefore the required refraction	=	3	55·48

TABLE XXIII.—*Values of* $\frac{2\ Sin^2 \frac{1}{2} t}{Sin\ 1''}$ *for Computation of Circumpolar Azimuths.*

The values in this table are computed to two places of decimals required for the computation of azimuth according to the new formula which, as well as the method of taking observations, will be found fully explained in the Trigonometrical Hand-Book, subject "Azimuths". In this table, t is the same as Δp of the Hand-Book.

TABLE XXIV.—*Computation of Circumpolar Azimuths.—To Facilitate the Calculation of the Corrections—for Instrumental Errors of Collimation, Inclination and Deviation—to the Observed Times of Transit.*

The use of the table will be seen at once from the formulæ for the corrections.

Let a, b, c be the corrections in seconds of arc for *deviation, inclination,* and *collimation* respectively.

Then the correction to the observed time of transit in seconds of time

$$= \frac{a \sin \text{Z.D.} + b \cos \text{Z.D.} + c}{15 \sin \text{N.P.D.}}.$$

The table gives the values of the sine and cosine of the star's zenith distance for each degree from 0° to 90°, and the value of the factor $\frac{1}{15 \sin \text{N.P.D.}}$ for N. or S. declinations of stars for each degree from 0° to 45°.

The three quantities in the numerator of the above expression ought to be kept to the first place of decimals, while the resulting correction must be obtained to two places of decimals.

The rules for the signs of the corresponding corrections are as follows:—
with the star above the pole,

Collimation. If as the azimuth increases the circle reading also increases, then the collimation correction is + if F. L. reads highest and the star is observed with the Face to the east.

Inclination. The correction is + when west pivot of telescope axis is highest.

Deviation. When the azimuth of R. M. from south by west deduced from the angle between the R. M. and the Transit Star is less than its geodetic azimuth, the deviation correction is $\frac{+}{-}$ for stars $\frac{\text{N}}{\text{S}}$ of the zenith, and *vice versâ.*

TABLE XXV.—*Computation of Circumpolar Azimuths.—To Facilitate the Computation of* δA *or the Reduction to Elongation* (*old formula*).

Let A = the azimuth of the star at maximum elongation,

P = the corresponding hour angle in arc,

δP = the interval in time from maximum elongation at a given moment,

δA = the corresponding change in azimuth;

then δA is found in seconds of arc (see *Account of the Operations of the Great Trigonometrical Survey of India*, Vol. II, pages 145—7) from the formula:—

$$\delta A = \frac{2 \sin^2 \tfrac{1}{2} \delta P \operatorname{cosec} 1'' \tan A \cos^2 \text{N.P.D.}}{1 - 2 \sin^2 \text{N.P.D.} \sin^2 \tfrac{1}{2} \delta P \pm \cot P \sin \delta P}.$$

The sign of the last term of the denominator is $\pm$ according as the position of the star is $\frac{\textit{before}\ \text{E. or}\ \textit{after}\ \text{W. Elongation}}{\textit{after}\ \text{E. or}\ \textit{before}\ \text{W. Elongation}}$.

Part I of the table gives the values in natural numbers of $2 \sin^2 \text{N.P.D.} \sin^2 \tfrac{1}{2} \delta P$ for every minute of time of δP from 0^m to 30^m and for every degree of the star's N.P.D. from 0° to 10°. Enter the table with δP in minutes of time and carry the eye along the line until the quantity corresponding to the N.P.D. of the star is reached. The variation either for N.P.D. or for δP is so slow that the quantity can readily be taken out by inspection. Subtract it from unity and enter the result in the form for computation.

Part II contains values of the term cotP sinδP in natural numbers between the limits P = 82° and P = 90° and for values of δP from 0^m to 30^m. The differences for each minute of time and for each 10 minutes of arc are so nearly constant that the column for 1^m may be taken as giving the former, and the horizontal line corresponding to P = 89° 50′ as giving the latter.

To use Part II of the table, enter with P to the nearest 10′ and carry the eye along the corresponding horizontal line until the column headed with the integral part of δP in minutes of time is reached. Interpolate for minutes and decimals of a minute of P in arc, using the quantity in the last line but one as the common difference. Next add the product between the decimals of δP in minutes and the quantity in the column for 1^m corresponding to the value of P.

EXAMPLE.—To find the value of cot P sin δP, when P = 87° 42′ 16″ or 87° 42′·3 and $\delta P = 15^m \cdot 72$.

For	P = 87° 40′, the column for 15^m gives	·00266
	Common difference for 10′ = − ·00019	
therefore	difference for 2′·3 . . . = − ·00019 × ·23 =	− 4
,,	P = 87° 42′·3 gives	·00262
	Common difference for 1^m = + ·00018	
,,	difference for $0^m \cdot 72$ . . . = + ·00018 × ·72 =	+ 13
	Therefore the required result =	·00275

Part III contains the logarithmic values of $2 \sin^2 \frac{1}{2}\delta P \operatorname{cosec} 1''$ for every second of time of δP from 0^m to 30^m, and is to be used in computing the numerator of the expression for δA, δP for the purpose being kept to two places of decimals of seconds.

Tables XXIV and XXV have been constructed to facilitate the calculation involved in determining the meridian from circumpolar star observations. The method, which is described below, is a rigorous one and is only to be employed in the principal operations of the Survey of India. It is not to be adopted except where great accuracy is required.

Observations are made between some fixed mark or station, which is called the referring mark, and a circumpolar star near its elongation. As the position of the star at each observation has to be referred to its position at elongation the time must be carefully noted, and it is necessary therefore to employ a chronometer of which the error and rate are known. These may be determined in several ways, but the usual method, when the station at which the observations are made appertains to triangulation, is to place the telescope of the theodolite in the plane of the meridian as given by the triangulation, and to observe the transits of suitable stars every night throughout the time occupied by the observations for azimuth.

When commencing work the first thing to be done is to level the instrument with extreme care. As the transit axis level does not show errors of level in the body of the instrument, the readings of a level fixed near the base of the pillars of the instrument parallel to the transit axis are necessary. With this level any residual errors which may exist prior to and at the conclusion of the observations, are to be carefully noted in the four positions of the vertical circle facing N., S., E. and W., both ends of the level being read and entered in the field book.

The instrument should now be set to the adopted meridian and the transit axis tested for inclination with the transit axis level, the two ends of the level being read with its cross-level both east and west, the position of the face of the instrument, E. or W., being also noted, as this position must be maintained when observing the time star. These readings are required for finding the corrections to the times of transit of the time stars due to the dislevelment of the transit axis, but the operation should be repeated at the end of the observations as a test of the stability of the instrument. Level readings on one face are not to be combined with those on the opposite face for the determination of the correction to the time star. The time stars should for convenience be taken from the Nautical Almanac and ought to be near the equator. One time star each night is all that is absolutely necessary, as the rate of the chronometer for 24 hours is what is wanted, but it is preferable to have two in case of accidents. It is not material whether they are observed before or after the azimuth observations, but it is safer to commence with the time star lest clouds interfere with its observation afterwards. In setting for a star on (or very near) the meridian, it should be remembered that in north latitudes

zenith distance = co-latitude − N.P.D. for stars at upper culmination,

„ = co-latitude + N.P.D. „ lower „

a negative result signifies that the star is south of the zenith.

The time stars being chosen, let us suppose, to precede the azimuth observations, the telescope should be brought round, say, from left to right to intersect the referring mark and the readings of all the microscopes taken and recorded in the field book. It should then be moved on in the same direction till placed in the adopted meridian, when the first time star should be transited and the readings of the microscopes again taken and entered. The method of reducing these observations will be explained hereafter.

To enable the observer to find the circumpolar star to which observations are to be taken it is necessary to compute its horary angle P, its altitude, and its azimuth A, all at elongation, by the formulæ:—

1. $\log \cos P = \log \tan \text{N.P.D.} + \log \tan \lambda$,
2. $\log \sin A = \log \sin \text{N.P.D.} + \log \sec \lambda$,
3. $\log \sin \text{Alt.} = \log \sec \text{N.P.D.} + \log \sin \lambda$,

where λ is the latitude of the place. The true altitude thus found must be corrected for refraction by adding the proper quantity given in Table XXII.

The horary angle reduced to time will, when added to the star's right ascension, give the sidereal time of western elongation and when subtracted it will give the time of eastern elongation; from these the chronometer times of elongation may be found. It is convenient to know the different apparent altitudes of the star during the observations, and for this purpose the change in altitude from elongation may be found with sufficient approximation by the formula:—

Increment in altitude for 1 minute of time for $n°$ of polar distance

$$= \frac{2\pi\, n°}{60 \times 24} = 5'' \times 3{\cdot}14159\, n° = 15''{\cdot}71 \times n°.$$

A small table showing the apparent altitude and zenith distance at intervals of say 5 minutes before and after elongation may with advantage be constructed and placed conveniently for reference, as follows:—

Polaris—for 30th January 1903, Latitude 23° 14′ N., Longitude 98° E. of Greenwich.

N.P.D. = 1° 12′ 17″; $n°$ = 1°·205.

	Chronometer Time	Apparent Altitude	Apparent Zenith Distance
	h *m* *s*	° ′ ″	° ′ ″
At W. Elongation	6 52 0	23 26 5	66 33 55
	57 0	24 30	35 30
	7 2 0	22 55	37 5
	7 0	21 20	38 40
	12 0	19 45	40 15
	17 0	18 10	41 50
	22 0	16 35	43 25
	27 0	15 0	45 0
	32 0	13 25	46 35
	37 0	11 50	48 10
	42 0	10 15	49 45
	47 0	8 40	51 20
	52 0	7 5	52 55

About 20 or 30 minutes before elongation the observer intersects the referring mark, moving the telescope from the side opposite the star, and registers the reading. He then raises the telescope to the required altitude and moves the instrument to within half a minute of the star's azimuthal reading, when he clamps the instrument and employs the tangent screw to bring it into such a position that the star, after the lapse of a few seconds, may transit the wire, and directs the assistant to count the beats of the chronometer aloud, so that when the star appears bisected on the wire the observer may be able to call out the exact second, which is recorded with the hour and minute. The level on the body of the instrument is then read and recorded and also the microscope readings of the horizontal limb. The observer next unclamps and overshoots the star and then with a reverse motion he again observes first the star and then the mark: this gives a pair of observations on one face. A similar pair is then taken on the other face beginning with the referring mark. Four pairs of observations are generally taken, and they should be so timed that two are before and two after elongation.

In circumpolar star observations two different systems may be adopted. First, one star may be observed at both elongations, or secondly, two stars may be selected, of approximately equal polar distance, but differing by about 12 hours in right ascension, and the one observed at its eastern and the other at its western elongation. The advantage of the first method is that any errors which may exist in the tabulated place of the star do not affect the result; but on the other hand the observations must be conducted near sun-rise and sun-set, when both star and referring mark may be difficult to see. The second method has the advantage that the stars can be chosen so as to be observed at night when small stars are easily visible, but the results of the observations are burdened by the errors in the stars' places, so that the first method is the preferable of the two.

When the second method is adopted, care should be taken to select stars of which the north polar distances are nearly equal, and it is advisable that their times of elongation should differ by about 45 minutes so as to allow of the observations to one star being completed before those to the other are begun. When they are simultaneously at elongation both may be observed in the same round of angles with the referring mark, but this should not be attempted by any but a rapid and experienced observer.

If the selected stars are not in the Nautical Almanac, their mean places must be computed for the first day of the year either from a catalogue or from Table LIV, by the formula:—

Mean Right Ascension on 1st January $(1910 + y)$ = Mean Right Ascension on 1st January 1910 + $\left(p + \mu + \frac{s\,y}{200}\right) y$,

where p = annual precession in Right Ascension,

μ = annual proper motion ,,

s = secular variation ,,

y = number of years,

with a similar formula for North Polar Distance.

The following is a specimen of the observations as entered in the field book :—

Azimuth observed at Loi Hpa-Lang Hill Station with Troughton and Simms' 12-Inch Theodolite No. II., Chronometer No. 4345 by A. J. Johansson & Co.

Observations taken to Polaris at Western Elongation.

Date 30th January, 1903.

Readings of Levels on body of Instrument at commencement.

Face of Vertical Circle	Readings of Levels				Remarks	
	Level M, $1^d = 2''{\cdot}28$		Level N, $1^d = 1''{\cdot}80$			
East ...	E. end 35·1	W. end 32·7	E. end 38·1	W. end 31·2	Barometer	26in·19
South ...	S. end 35·0	N. end 32·9	S. end 38·0	N. end 35·0	Thermometer	61°·0
West ...	W. end 34·8	E. end 33·2	W. end 38·0	E. end 34·8		
North ...	N. end 35·8	S. end 32·1	N. end 38·3	S. end 34·5		

Readings of Transit Axis Level ($1^d = 1''{\cdot}70$) at commencement.

Face of Vertical Circle	Cross Level	Readings		Remarks
		West end	East end	
W	East	18·0	34·5	
	West	29·0	23·5	

Object	Face and Zero	Microscope Readings B	Microscope Readings A	Mean of B & A = c	Micrometer $1^d = 1''{\cdot}059675$. $1^d \times$ (Corrn. Z. D.) $= 1''{\cdot}15354^*$ Mean of readings = e	Micrometer $1^d = 1''{\cdot}059675$. $1^d \times$ (Corrn. Z. D.) $= 1''{\cdot}15354^*$ Value in arc = D	Corrected Mean = C + D	Angles	Chronometer Times of Transit of Star A	B	C	D	E	Micrometer Readings		
		° ′ ″	″	″	d	″	° ′ ″	° ′ ″	h m s	s	s	s	s	d	d	d
Loi Song H.S. R.M.	W	75 6 27·9	54·9	41·40	55·9	59·23	75 5 42·17							55·9	55·9	55·8
θ Canis Majoris		66 29 47·5	76·1	61·80			66 29 61·80	8 35 40·37	6 45 108·5	94 0	79·6	65·0	50·7			
ε Canis Majoris		66 29 47·7	74·9	61·30			66 29 61·30	8 35 40·87	6 50 119·5	103 8	87·8	71·1	55·0			
									Chronometer Times	Levels on body of Instrument No. M $1^d = 2''{\cdot}28$ E	W	No. N $1^d = 1''{\cdot}80$ E	W			
									h m s							
Loi Song H.S. R.M.	F.L.	75 6 26·1	51·3	38·70	54·1	57·64	75 5 41·06	9 54 9·16						54·8	54·1	54·3
Polaris		65 12 19·9	49·4	34·65	54·4	62·75	65 11 31·90		7 2 41·0	33·1	34·9	35·0	37·9	54·4		
Polaris	75° 6′	65 12 39·8	69·1	54·8*	74·1	85·48	65 11 29·32		7 5 20·0	33·3	34·7	35·0	38·0	74·1		
Loi Song H.S. R.M.		75 6 47·8	74·0	60·90	74·9	79·37	75 5 41·53	9 54 12·21						75 2	74·4	75·1
Loi Song H.S. R.M.	F.R.	255 4 44·3	56·0	50·15	55·8	59·13	255 5 40·28	9 54 19·97						56·1	55·7	55·6
Polaris		245 10 27·1	36·4	31·75	19·9	57·56	245 11 29·31		7 13 34·0	35·2	32·5	38·9	34·6	49·9		
Polaris	255° 5′	245 9 57·1	67·9	62·50	75·1	86·63	245 11 29·13		7 15 52·0	35·2	32·7	38·6	34·0	75·1		
Loi Song H.S. R.M.		255 4 25·1	36·2	30·65	74·3	78·74	255 5 49·39	9 54 20·26						73·8	74·2	75·0
Loi Song H.S. R.M.	F.L.	105 8 6·1	29·4	17·75	55·6	58·92	105 7 18·83	9 54 22·96						55·4	55·8	55·6
Polaris		95 13 48·3	72·4	60·35	55·9	64·48	95 12 55·87		7 25 21·0	33·1	34·9	34·9	38·0	65·9		
Polaris	105° 7′	95 14 14·8	39·0	26·90	75·5	87·09	95 12 59·81		7 27 55·0	33·1	34·9	35·0	38·0	76·6		
Loi Song H.S. R.M.		105 8 28·5	51·6	40·05	76·7	81·28	105 7 18·77	9 54 18·96						77·9	76·8	75·8,76·1
Loi Song H.S. R.M.	F.R.	285 6 18·1	33·0	25·55	55·3	59·60	285 7 24·15	9 54 5·24						55·1	55·0	55·7
Polaris		275 12 6·4	21·3	13·85	56·4	65·06	275 13 18·91		7 37 15·0	35·1	32·9	38·0	34·9	56·4		
Polaris	285° 7′	275 11 44·6	59·2	51·90	76·1	87·78	275 13 19·68		7 39 22·0	35·1	33·0	39·0	34·0	76·1		
Loi Song H.S. R.M.		285 5 57·4	73·3	65·35	77·0	81·59	285 7 26·94	9 54 7·26						76·8	77·8	76·5

* Multiplier for e in case of star.

Here follow level readings similar to those at the commencement but in the reverse order.

In these observations FL denotes that the face of the instrument is to the left and FR that it is to the right of the observer, while 75° 5′, 255° 5′, 105° 7′ and 285° 7′ are the zero-settings of the instrument which remain the same for one night but are changed on successive nights in accordance with the system of zero-settings adopted in observing horizontal angles.

The reduction of the observations now remains. The corrections to the times of transit of the time-stars for collimation, inclination and deviation must first be obtained.

The collimation correction is found from the observations of the referring mark, taken during the azimuth observations, by comparing the readings on faces right and left in which the instrument has been moved in the same direction; thus a reading of referring mark, before intersection of the circumpolar star, on face left will be compared with a similar reading on face right. Following this method in the example given, we get the numbers 8″·22, 7″·86, 5″·32 and 8″·17. Half the mean of these is 3″·7, so that the correction for collimation in seconds of time is $+ 3{\cdot}7 \times \frac{1}{15 \sin \text{N.P.D.}}$, the sign being determined by the rule given in Table XXIV.

The readings of the transit axis level are W. 47·0, E. 58·0, and the difference divided by the number of readings, or 2·75 divisions, multiplied by the value of one division of the scale, *viz.*, 1″·70, gives 4″·7. The correction for inclination is therefore $- 4{\cdot}7 \cos \text{Z.D.} \times \frac{1}{15 \sin \text{N.P.D.}}$ seconds of time, the sign being determined by the rule in Table XXIV.

To obtain the deviation correction apply the angle between the referring mark and the transit star to the azimuth of the referring mark, to deduce the azimuth at which the star was transited. The difference between this and 180° gives the horizontal deviation of the instrument in arc E. or W. of the meridian, and when multiplied by $\frac{\sin \text{Z.D.}}{15 \sin \text{N.P.D.}}$ we have the correction to the transit in seconds of time. The sign of the correction is determined by the rule in Table XXIV. For the example given, the azimuth of the referring mark is 188° 35′ 49″·74; hence the horizontal deviation for θ Can. Maj. is 9″·37 E. and for ϵ Can. Maj. 8″·87 E.

The sum of the three corrections gives the total correction to be applied to the star's transit and for θ Can. Maj. it is $- 0^{s}{\cdot}4$ and for ϵ Can. Maj. $- 0^{s}{\cdot}5$.

The readings of the chronometer times as noted on 5 wires A, B, C, D and E, when reduced to centre wire C and their mean taken, give the chronometer time of transit of θ Canis Majoris as $6^{h}\ 46^{m}\ 19^{s}{\cdot}5$ and that of ϵ Can. Maj $6^{h}\ 51^{m}\ 27^{s}{\cdot}3$, so that the corrected times become $6^{h}\ 46^{m}\ 19^{s}{\cdot}1$ and $6^{h}\ 51^{m}\ 26^{s}{\cdot}8$. The right ascensions of the stars being $6^{h}\ 49^{m}\ 42^{s}{\cdot}9$ and $6^{h}\ 54^{m}\ 50^{s}{\cdot}8$, the error of the chronometer as deduced from the two time stars is $3^{m}\ 23^{s}{\cdot}9$ slow. The observations of the next night furnish the rate of the chronometer.

Now proceeding to the calculation of the azimuth: the right ascension and north polar distance of the circumpolar star or stars have to be deduced rigorously for the times of elongation on the first and last nights of observation, and those for intermediate nights by interpolation. A list of circumpolar stars for the epoch 1st January 1910 is given in Table LIV. The corrections for apparent places are to be computed either by the formulæ given in Nautical Almanac or by using Turner's Tables.

The horary angle P and azimuth at elongation A of the circumpolar star, are found for the first day from the formulæ previously given. Instead of computing these for each day their changes are found corresponding to the daily change in N.P.D. from the formulæ:—

If tabular difference in log tan N.P.D. for variation of $1''$ $= a$
" " " cos P " $= b$
" " " sin N.P.D. " $= c$
" " " sin A " $= d$

then the change in hour angle $= -\frac{a}{b} \times$ change in N.P.D.,

" " azimuth $= +\frac{c}{d} \times$ change in N.P.D.,

whence follow the N.P.D., azimuth and sidereal time at elongation on the dates of observation.

The recorded times of observing the star are now corrected for the error of the chronometer and for the rate of the chronometer for the interval elapsed from the time star's transit. The corrected times being subtracted from the sidereal time of elongation give the interval in time between each observation and elongation, and the differences between the azimuth of the star at these times and at elongation are found by the formula on p. 46, the several terms being found by the three Parts of this table. The observed angle between the referring mark and the star is corrected up by this quantity and the mean of the corrected angles applied to the azimuth of the star at elongation from south by west, the result being the azimuth of the referring mark from south by west. The mean of these results is taken for each zero on each face.

There is still one further correction to be applied due to the dislevelment of the body of the instrument. To obtain this, take the level readings for each star and add the mean of all the east readings on face left to the mean of all the east readings on face right, doing the same for the west readings. A quarter of the difference reduced to seconds of arc and multiplied by the tangent of the star's apparent altitude at the time of elongation will give the correction to the angle between the referring mark and the star at elongation. The sign of this correction is found by the following rule:—

When the sum of the E. end readings is *greater* than that of the W. end, the correction is $\frac{\textit{additive to}}{\textit{subtractive from}}$ the angle between referring mark and star according as the azimuth (from south by west) of the star at elongation is $\frac{\textit{less}}{\textit{greater}}$ than the azimuth of referring mark by triangulation and *vice versâ* when the sum of the W. end readings is *greater*.

The correction will have the same sign for all observations of the same group whether on face right or face left and whether the instrument reads from left to right or from right to left. It must be determined separately for each star and should be applied to the zero means of face left and face right. If the referring mark is not in the horizon a further correction to the angle, which is generally insignificant, is necessary, *viz.*, a quarter of the difference of the level readings multiplied by the tangent of the altitude of the mark. The sign of this correction is always opposite to that of the former one.

The dislevelment in divisions of the level scale obtained as above is 0·17 and this multiplied by $2''\cdot28 \times$ tan Alt. gives $0''\cdot17$: the sign is + because the east end readings are greater and the azimuth (south by west) of star at elongation less.

Applying the corrections the angle between the referring mark and the star at elongation is obtained for the different zeros; the means are then taken out by eastern and western elongation, and finally the azimuth of the referring mark from south by west deduced.

TABLE XXVI.—*Linear Value in Feet of one Second of Arc and its Logarithm, measured along the Meridian.*

The formula on which this table is based is

$$sm = \rho\, l \sin 1''.$$

It is deduced as follows:—

Let s_1 = the length in feet of the arc between lats λ and $\lambda + \frac{l}{2}$,

s_2 = " " " λ and $\lambda - \frac{l}{2}$;

then
$$s_1 = \frac{l}{2} \sin 1'' \frac{ds}{d\lambda} + \frac{1}{1.2}\left(\frac{l}{2}\right)^2 \sin^2 1'' \frac{d^2s}{d\lambda^2} + \frac{1}{1.2.3}\left(\frac{l}{2}\right)^3 \sin^3 1'' \frac{d^3s}{d\lambda^3} + \&c.,$$

$$-s_2 = -\frac{l}{2} \sin 1'' \frac{ds}{d\lambda} + \frac{1}{1.2}\left(\frac{l}{2}\right)^2 \sin^2 1'' \frac{d^2s}{d\lambda^2} - \frac{1}{1.2.3}\left(\frac{l}{2}\right)^3 \sin^3 1'' \frac{d^3s}{d\lambda^3} + \&c.;$$

therefore if sm = the length in feet of an arc of l'',

$$sm = s_1 + s_2$$

$$= l \sin 1'' \frac{ds}{d\lambda} + \frac{1}{24} l^3 \sin^3 1'' \frac{d^3s}{d\lambda^3} + \&c.$$

Now $\frac{ds}{d\lambda} = \rho = \frac{a(1-e^2)}{(1-e^2\sin^2\lambda)^{\frac{3}{2}}}$ where ρ is the radius of curvature to the meridian in lat. λ;

therefore $\frac{d^3s}{d\lambda^3} = 3\, e^2 \rho \cos 2\lambda$, neglecting terms in e^4;

" $sm = \rho\, l \sin 1'' + \frac{1}{8} \rho\, l^3 \sin^3 1''\, e^2 \cos 2\lambda + \&c.$

The value of this second term when $\lambda = 0°$ is ·000 000 000 002 l^3 feet; or ·09 feet for an arc of 1°.

So that for calculating the length of an arc of 1″ we need the above formula.

The table is computed for every 5′ of latitude from 0° to 40°, and is to be used in conjunction with the two succeeding tables in computing rectangular co-ordinates, as is explained on pages 54 and 55.

TABLE XXVII.—*Linear Value in Feet of one Second of Arc and its Logarithm, measured along Parallels of Latitude.*

The formula on which the table is based is

$$sp = \cdot 00000\ 48481\ 36811\ \nu \cos \lambda\, p''.$$

It is deduced as follows:—

Let sp = the length in feet of arc of p'' in a parallel of latitude where radius is r.

then $sp = \frac{\pi}{180 \times 3600} \cdot rp''$.

and $r = \nu \cos \lambda$;

whence the above value.

The table is computed for parallels of latitude 5′ apart between the latitudes 0° and 40°, and is to be used in conjunction with the preceding and succeeding tables in computing rectangular co-ordinates, as is explained on pages 54 and 55.

TABLE XXVIII.—*Arc-versines of Spheroidal Arcs of Parallel* 1° *in length.*

If O and P are two points on the surface of the earth, and if the parallel through P cuts the meridian through O in p: and if a great circle through P be drawn perpendicular to this meridian cutting it in N, then p N is called the Arc-versine of the arc P p and is given by:—

$$\text{Arc-versine of } P\,p = R'\,\Delta\,L^2$$

where R′ is that for the latitude of P.

We can find this quantity as follows:—Equations (1) and (2) on page 21 give the expressions for the differences of latitude and longitude of two points. If we employ them for finding the position of P referred to N we shall have, see page 20, since the azimuth of P at N is 270°,

$$\delta_1 \lambda = -\frac{e}{\rho}\cos A \operatorname{cosec} 1'' = 0,$$

so that $$\Delta\lambda = -R'\,\delta_1 L^2,$$

and $$\Delta L = \delta_1 L - Y'\,\delta_1 L^3.$$

Now if $\delta_1 L$ is taken as 1°, we have

$$Y'\,\delta_1 L^3 = 0''{\cdot}04 \text{ in latitude } 20°.$$

So that if we take $\Delta L = \delta_1 L$ we commit an error of 0″·04 or 4 feet in 1°.

Now $P\,p' = \Delta L$ and $P\,N = \delta_1 L$,

therefore P p may be employed in place of P N;

and $\Delta\lambda = p\,N =$ arc-versine of P p.

therefore we have Arc-versine of $P\,p = -R'\,\Delta L^2$,

or arc-versine of $P\,p = +R'\,\Delta\,L^2$ when N is referred to P.

where R′ is that for the latitude of N which is practically the same as for P.

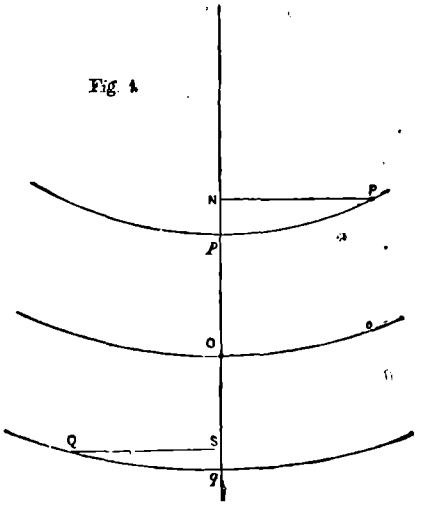
The table gives the arc-versine in seconds and in feet for an arc of 1° at every 5′ of latitude from 0° to 40°. It also gives for the same latitudes the logarithm of the number of seconds in the arc-versine of an arc of 1″, and it is this last logarithm which is to be used in conjunction with the two preceding tables in computing rectangular co-ordinates, as is explained below.

Tables XXVI, XXVII and XXVIII have been prepared to enable surveyors whose operations are based on rectangular co-ordinates to convert the latitudes and longitudes of the Trigonometrical Survey Stations, which fall within range of their operations, into rectangular co-ordinates, and thus obtain data for correcting the errors of their operations by simple proportion.

The operations of the Revenue Survey are based on rectangular co-ordinates computed on the supposition that the earth is a plane, and this assumption introduces errors which are insensible in small areas, and insignificant when compared with the ordinary errors of measurement.

Suppose O, P, Q are three stations of the Trigonometrical Survey whose latitudes and longitudes are known, and we want the co-ordinates of P and Q with respect to O which are respectively perpendicular and parallel to the meridian at O.

Fig. 4.



Draw the parallels O o, P p, Q q, cutting the meridian through O in O, p, q, and draw P N and Q S perpendicular to the meridian through O.

Then the co-ordinates of P and Q are:—

$$X = PN, \qquad X = QS,$$

and

$$Y = ON, \qquad Y = OS.$$

As explained above the X co-ordinates P N and Q S may be considered equal to the arcs P p and Q q.

Also $$O N = p N + O p,$$

and $$O S = S q - O q,$$

O S being negative because S falls south of O.

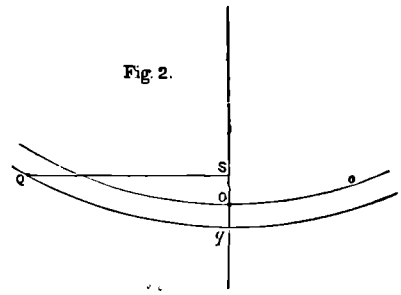


Fig. 2.

Therefore X in feet = the difference of longitude converted into feet by Table XXVII, and

$$\text{Y in feet} = \left\{\begin{array}{c}\text{the arc-versine}\\ \text{in feet from}\\ \text{Table XXVIII}\end{array}\right\} \pm \left\{\begin{array}{c}\text{the difference of}\\ \text{latitude converted}\\ \text{into feet by Table}\\ \text{XXVI.}\end{array}\right\}$$

The + sign being used when the point is north of O,

and the − „ „ „ south of O;

in the latter case Y will be + or − according as the arc-versine is greater or less than the difference of latitude.

We have thus the following rules:—

Rule I.—To find the perpendicular co-ordinate X in chains.

Find the difference of longitude between the point and the origin in seconds; take its logarithm and add the logarithm from Table XXVII corresponding to the latitude of the point and the arithmetical complement of log 66. This will give the logarithm of X in chains.

X will be + or − according as the longitude of the point is greater or less than that of the origin.

Rule II.—To find the arc-versine in seconds.

To twice the logarithm of the difference of longitude in seconds add the logarithm from Table XXVIII corresponding to the latitude of the point. This will give the logarithm of the arc-versine in seconds.

Rule III.—To find the meridional co-ordinate Y in chains.

Find Y in seconds from the equation,

$$\text{Y seconds} = \text{arc-versine} + \text{latitude of point} - \text{latitude of origin},$$

and note its sign. To the logarithm of Y in seconds add the logarithm in Table XXVI (corresponding to a latitude = latitude of origin $\pm \frac{1}{2}$ Y) and the arithmetical complement of log 66. This will give the logarithm of Y in chains.

The sign of Y in chains will be the same as that of Y in seconds.

Computation of Rectangular Co-ordinates of Trigonometrical and other Stations of which the Latitude and Longitude are known.

*From origin*_____

Number of Sheet	...
Name of Station (S)	...
	° ′ ″
Long. of Origin (O)	72 10 13·73
„ (S)	71 20 10·25
Difference	0 50 3·48
„ in seconds	3003·48
Log „ „	3·4776247
Log from Tab. XXVII for Lat. of (S)	1·9786411
A. C. of log 66	$\bar{2}$·1804561
Sum = log X	3·6367219
*X (Easting or Westing) in chains	− 4332·63W.
Twice log diff. of Long. (4 places)	6·9552
Log from Tab. XXVIII for Lat. of (S)	$\bar{7}$·8987
Sum = log Arc-versine	0·8539
Arc-versine in seconds	7·14
	° ′ ″
Lat. of (O)	20 15 30·62
Lat. of (S)	20 15 26·50
Difference (d) †	−0 0 4·12
Arc-versine in seconds	+ 7·14
Algebraical sum = Y in arc	+0 0 3·02
Y in seconds	+ 3·02
	° ′ ″
½ Y in arc	+0 0 1·51
Lat. of (O)	20 15 30·62
Algebraical sum	20 15 32·13
Log from Tab. XXVI for Alg. sum	2·0038236
Log of Y in seconds	0·4800069
A. C. of log 66	$\bar{2}$·1804561
Sum = log Y	0·6642866
‡ Y (Northing or Southing) in chains	+ 4·62 N.

* X is $\frac{east}{west}$ of Origin according as the Longitude of the Station is $\frac{greater}{less}$ than that of the Origin. † (d) is $\frac{+}{-}$ according as the Latitude of the Station is $\frac{greater}{less}$ than that of the Origin. ‡ Y is $\frac{north}{south}$ of the Origin according as Y in arc is $\frac{+}{-}$.

Tables XXVI, XXVII and XXVIII may also be employed, with all the accuracy desirable for most practical purposes, for determining the latitude and longitude of a Revenue Survey Station whose rectangular co-ordinates have been corrected for errors of measurement and made consistent with the corresponding co-ordinates of the Trigonometrical Survey Stations in the districts under survey. The latitude and longitude of the origin must of course be known, and the given rectangular co-ordinates must be perpendicular and parallel to the meridian of the origin.

The method of proceeding will be as follows:—

RULE I.—To log Y in chains add the log of 66, the sum is log Y in feet, and Y in feet divided by 100 will give an approximate value of Y in seconds (*see* Table XXVI): find the approximate middle latitude = latitude of origin $\pm \frac{1}{2}$ Y and with it enter Table XXVI and take out the corresponding logarithm: add its Arithmetical complement to the logarithm of Y in feet, and the result will be the logarithm of Y in seconds of arc.

RULE II.—To log X in chains add the log of 66 and the Arithmetical complement of the logarithm in Table XXVII corresponding to a latitude = latitude of the origin $\pm$ Y in arc, and keep the sum to 4 places of decimals; multiply this by 2 and add the logarithm in Table XXVIII corresponding to the same latitude: the result will be the logarithm of the arc-versine in seconds.

RULE III.—To find the latitude of the point.

The required latitude = latitude of origin $\pm$ Y in arc $-$ arc-versine, where Y has the same sign in arc as it has in chains.

RULE IV.—To find the longitude of the point.

To log X in chains add the log of 66 and the arithmetical complement of the logarithm in Table XXVII corresponding to the latitude just found. This will give the logarithm of the difference of longitude in seconds. This difference must be added to the longitude of the origin if X is *plus* and subtracted when X is *minus*.

Reduction of the Co-ordinates of Stations from Rectangular to Spherical.

Latitude of origin (λ_o) = 20° 15′ 30″·62; Longitude of origin (L_o) = 72° 10′ 13″·73

Name of Station (S)	...
Y in chains	+ 2877·56
Log ,, ...	3·4590244
,, 66	1·8195439
Sum = log Y in feet	5·2785683
	° ′ ″
$\frac{\text{Y in feet}}{100}$ = Y in arc approximately = Y_a*	0 31 39
$\pm \frac{1}{2} Y_a$	0 15 49·5
λ_o	20 15 30·62
Algebraical sum	20 31 20
A. C. of log from Table XXVI for Alg. Sum	3·2961633
Log Y in feet	5·2785683
Sum = log Y in seconds	3·2747316
	° ′ ″
Y in arc †	0 31 22·49
$\lambda_o \pm$ Y in arc = λ'_a	20 46 53·11
X in chains	+ 3295·18
Log ,, ...	3·5179
,, 66	1·8195
A. C. of log from Table XXVII for λ'_a	$\bar{2}$·0228
Sum	3·3602
Twice Sum	6·7204
Log from Table XXVIII for λ'_a	$\bar{7}$·9079
Sum = log Arc-versine	0·6283
	° ′ ″
Arc-versine	0 0 4·25
λ'_a − Arc-versine = Lat. of (S)	20 46 48·86
Log X in chains	3·5178792
,, 66	1·8195439
A. C. of log from Table XXVII for Lat. of (S)	$\bar{2}$·0228337
Sum = log X in seconds	3·3602568
	° ′ ″
X in arc †	+ 0 38 12·22
L_o	72 10 13·73
Algebraical sum = Long. of (S)	72 48 25·95

* Y_a has the same sign as Y in chains. † X in arc and Y in arc have the same signs as they have in chains.

TABLE XXIX—*Linear Value in Miles of a Degree of Arc measured along the Meridian.*

This table is computed from the same formula as Table XXVI, the unit being changed from feet to miles. The term $\rho l \sin 1''$ gives the result correct to 4 places of decimals of a mile.

The argument in this table is the mean latitude of the extremities of the given arc. Thus the meridional distance between the parallels of $7\frac{1}{2}°$ and $8\frac{1}{2}°$ is 68·7159 miles and may be reckoned as the length of a degree at the latitude of 8°. The table is constructed for mean latitudes ranging from 0° to 46°.

EXAMPLE.—Required the meridional distance between the parallels of 8° 5′ and 8° 38′.

The mean latitude . . . . . $= \frac{8°\ 5' + 8°\ 38'}{2} = 8°{\cdot}358.$

The table gives the length of a degree at 8° . . . . . $=$ Miles $68{\cdot}7159$

Difference for 1° . . . . . $= + {\cdot}0035$

Therefore difference for 0°·358 . . . $= + {\cdot}0035 \times {\cdot}358 = + {\cdot}0013$

Length of a degree at 8°·358 . . . . . $= 68{\cdot}7172$

Therefore distance between the parallels of 8° 5′ and 8° 38′

$$= \frac{33}{60} \times 68{\cdot}7172 \text{ miles} = 37{\cdot}7945 \text{ miles.}$$

TABLE XXX.—*Linear Value in Miles of a Degree of Arc measured along Parallels of Latitude.*

This table is computed by the same formula as Table XXVII, the unit being changed from feet to miles.

The argument in this table is the latitude of the parallel on which the length is required. Thus the distance on the parallel of 28° between two meridians 1° apart is 61·1109 miles. The table is constructed for parallels of latitude 1° apart from latitude 0° to latitude 46°.

EXAMPLE.—Required the distance between the meridians 78° 24′ and 78° 53′ on the parallel of 28° 41′ = 28°·683.

If $F^{(n)}$ = value in miles of 1° on the parallel of 28°·683

F = „ „ „ 28°

then $F^{(n)} = F + n\,a + \frac{n\,(n-1)\,b}{1.2} +$ &c. (see note to Table I)

where $n = {\cdot}683$, and a and b are the 1st and 2nd differences given by the table.

The table gives . . . . . $F =$ Miles $61{\cdot}1109$

„ $a = -{\cdot}5734$; therefore $n\,a = -{\cdot}3916$

„ $b = -{\cdot}0185$ „ $\frac{n\,(n-1)\,b}{1.2} = +{\cdot}0020$

therefore $F^{(n)} = 60{\cdot}7213$

Therefore the distance between meridians 78° 24′ and 78° 53′ on the parallel of 28°·683

$$= \frac{29}{60} \times 60{\cdot}7213 \text{ miles} = 29{\cdot}3486 \text{ miles.}$$

TABLE XXXI.—*Graticules of maps.—Sides and Diagonals of Squares of* $\frac{1}{16}$*th of a Degree of Latitude and Longitude, on the Scale of* 4 *Inches* = 1 *Mile, or* 1 *inch to* $\frac{1}{4}$ *of a Mile.*

TABLE XXXII.—*Graticules of maps.—Sides and Diagonals of Squares of* $\frac{1}{8}$*th of a Degree of Latitude and Longitude, on the Scale of* 1 *Inch to* $\frac{1}{2}$ *a Mile.*

TABLE XXXIII A.—*Graticules of maps.—Sides and Diagonals of Squares of* $\frac{1}{8}$*th of a Degree of Latitude and Longitude, on the Scale of* 1 *Inch to* $\frac{3}{4}$ *of a Mile.*

TABLE XXXIII B.—*Graticules of maps.—Sides and Diagonals of Squares of* $\frac{1}{8}$ *of a Degree of Latitude and Longitude, on the Scale of* 1 *Inch to* 1 *Mile.*

TABLE XXXIV.—*Graticules of maps.—Sides and Diagonals of Squares of* $\frac{1}{2}$ *of a Degree of Latitude and Longitude, on the Scale of* 1 *Inch to* 2 *Miles.*

TABLE XXXV A.—*Graticules of maps.—Sides and Diagonals of Squares of* $\frac{1}{2}$ *of a Degree of Latitude and Longitude, on the Scale of* 1 *Inch to* 3 *Miles.*

TABLE XXXV B.—*Graticules of maps.—Sides and Diagonals of Squares of* $\frac{1}{2}$ *of a Degree of Latitude and Longitude, on the Scale of* 1 *Inch to* 4 *Miles.*

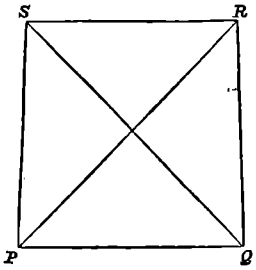
TABLE XXXVI.—*Graticules of maps.—Sides and Diagonals of Squares of* 1 *Degree of Latitude and Longitude, on the Scale of* 1 *Inch to* 8 *Miles.*

TABLE XXXVII.—*Graticules of maps.—Sides and Diagonals of Squares of* 2 *Degrees of Latitude and Longitude, on the Scale of* 1 *Inch to* 12 *Miles.*

TABLE XXXVIII.—*Graticules of maps.—Sides and Diagonals of Squares of* 2 *Degrees of Latitude and Longitude, on the Scale of* 1 : 1000,000.

These tables are for use in constructing the graticules of maps, on the different scales mentioned, when the projection used is the modified form of polyconic which has been employed by the department for many years.

The quantities m, n, p and q in the tables are the respective lengths of the sides PS or RQ, PQ, SR and of the diagonal PR or SQ, of each so called little square SPQR whose size is indicated in the table.



As the lengths PQ and SR are the correct lengths of a particular angular amount of the corresponding parallels of latitude and SP or RQ is the correct length of the meridian between these parallels, the projection of each small square may be considered a modified secant conical one and the projection as a whole may with sufficient accuracy be denominated polyconic.

On the scales employed in Tables XXXI and XXXII the area comprised in each little square is that of a standard sheet, or of a plane-table section, and therefore it will be sufficient in plotting such sheets or sections on these scales to draw a line parallel to the top edge of the paper and lay off SR, the corresponding p, on it.

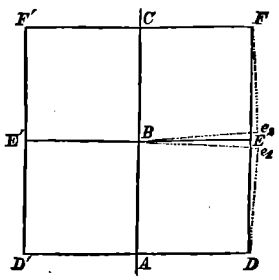
Then with S and R as centres and SP = m and RP = q as radii, two circles must be described cutting each other in P and two others with the same centres but with radii SQ = q and RQ = m cutting in Q and the lines SP, PQ, and RQ joined to form the graticule, the practical test being that PQ shall equal n.

If however the sheet to be projected is of the old form *viz* twice the angular distance in longitude that it is in latitude then a line should be drawn down the middle of the paper and PS = m laid off on it: the point R and a corresponding point R′ on the left of PS should then be determined from centres P and S and similarly the points Q and Q′. The graticule is then completed by joining PQ, PQ′, SR, SR′, RQ and R′Q′, the practical test being that each of the two latter shall be equal to m.

In the remainder of the tables the angular size of the squares is such that four of them are required to make up a sheet of standard size.

Such sheets should be plotted in the following manner :—

A line is drawn down the centre of the paper and on it AB and BC are laid off equal respectively to each of two successive m's on the particular scale. With A and B as centres and the corresponding n and q as radii circles are described cutting in D and D′ and with C and B as centres and the corresponding p and q as radii circles are described cutting in F and F′: DF and D′F′ are joined, DE and D′E′ are each made equal to AB and the graticule completed by joining the various points.



It will be noticed that there is here a departure from the polyconic projection described above since the point E belonging to each little square is not plotted but obtained after joining up the line DF. This is done to make the meridians straight lines and does not affect the accuracy of the projection, for if e_1 and e_2 are the corners of the respective little squares then

we have, if θ_1 and θ_2 are the angles which AD and Be_2 make with AC

on the scale of 1 inch = 1 mile between the parallels of 39° 45′ and 40°

$$\cos\theta_1 = \frac{6\cdot656 - 6\cdot644}{2 \times 8\cdot623} = \frac{\cdot012}{17\cdot246}, \quad \cos\theta_2 = \frac{6\cdot644 - 6\cdot632}{2 \times 8\cdot623} = \frac{\cdot012}{17\cdot246}$$

$$\theta_1 = \theta_2 \quad \text{and}$$

D e_1 e_2 F is a straight line and e_1 and e_2 coincide with E.

On the scale of 1 inch = 4 miles between the parallels of 39° and 40°

$$\cos\theta_1 = \frac{\cdot047}{17\cdot244} \quad \cos\theta_2 = \frac{\cdot048}{17\cdot246} \quad \text{whence}$$

the co-ordinates of D, e_1, e_2, F are found to be

$$\left.\begin{matrix}6\cdot727\\ \cdot018\end{matrix}\right\} \qquad \left.\begin{matrix}6\cdot680\\ 8\cdot640\end{matrix}\right\} \qquad \left.\begin{matrix}6\cdot680\\ 8\cdot641\end{matrix}\right\} \qquad \left.\begin{matrix}6\cdot632\\ 17\cdot263\end{matrix}\right\}$$

from which it follows that

DF = 17·245 and that the co-ordinates of E are $\left.\begin{matrix}6\cdot680\\ 8\cdot640\end{matrix}\right\}$

so that e_1, e_2 and E coincide to the one-thousandth part of an inch and DF is equal to AC.

On the scale of 1 to 1000,000 between the parallels of 36° and 40°,

$$\cos\theta_1 = \frac{\cdot 183}{17\cdot 476} \qquad \cos\theta_2 = \frac{\cdot 192}{17\cdot 482} \quad \text{whence}$$

the co-ordinates of D, e_1, e_2, F are found to be

$$\left.\begin{matrix}7\cdot 098\\ \cdot 074\end{matrix}\right\} \quad \left.\begin{matrix}6\cdot 915\\ 8\cdot 810\end{matrix}\right\} \quad \left.\begin{matrix}6\cdot 915\\ 8\cdot 814\end{matrix}\right\} \quad \left.\begin{matrix}6\cdot 723\\ 17\cdot 553\end{matrix}\right\}$$

From which it follows that

$$\mathrm{DF} = 17\cdot 483 \text{ and that the co-ordinates of E are } \left.\begin{matrix}6\cdot 911\\ 8\cdot 811\end{matrix}\right\}$$

so that e_1, e_2 and E differ from each other by about the four one-thousandth parts of an inch and DF and AC differ by the same amount. This for all practical purposes is coincidence.

The detail on the sheets on the scale of 1 inch = 4 miles is obtained directly from that on the scale of 1 inch = 1 mile by reduction. No appreciable error in detail is introduced by this, for if two sheets (the equivalent of four half sheets) in each of which the lower parallel is 39° are placed together, two in each of which the lower parallel is 39° 30′ and two in each of which the upper parallel is 40°, the extreme points of these parallels correspond to the points D,E,F, and

if θ is the angle which the n of the first half sheet makes with AC, the n of the second half sheet will make an angle $3\theta - 180$, that of the third half sheet an angle of $5\theta - 360$ and that of the fourth half sheet an angle of $7\theta - 540$ each with the same line so that the co-ordinates of the extreme point are

$$n\left\{\sin\theta + \sin(3\theta - 180) + \sin(5\theta - 360) + \sin(7\theta - 540)\right\} = n \cdot \frac{\sin(4\theta - 270)\sin(4\theta - 360)}{\sin(\theta - 90)}$$

and

$$n\left\{\cos\theta + \cos(3\theta - 180) + \cos(5\theta - 360) + \cos(7\theta - 540)\right\} = n \cdot \frac{\cos(4\theta - 270)\sin(4\theta - 360)}{\sin(\theta - 90)}$$

and for the three parallels under discussion θ is given by

$$\cos\theta = \frac{\cdot 012}{17\cdot 244} \qquad \cos\theta = \frac{\cdot 012}{17\cdot 246} \qquad \cos\theta = \frac{\cdot 012}{17\cdot 246}$$

while the values of n are respectively 6·728, 6·680 and 6·632
whence it easily follows that:—

the co-ordinates of the three points under consideration when reduced to scale of 1 inch = 4 miles are respectively

$$\left.\begin{matrix}6\cdot 728\\ \cdot 019\end{matrix}\right\} \quad \left.\begin{matrix}6\cdot 680\\ 8\cdot 641\end{matrix}\right\} \quad \left.\begin{matrix}6\cdot 632\\ 17\cdot 264\end{matrix}\right\}$$

while the co-ordinates of D, E, F are respectively

$$\left.\begin{matrix}6\cdot 727\\ \cdot 018\end{matrix}\right\} \quad \left.\begin{matrix}6\cdot 680\\ 8\cdot 640\end{matrix}\right\} \quad \left.\begin{matrix}6\cdot 632\\ 17\cdot 263\end{matrix}\right\}$$

so that the points are practically identical.

Similarly if two sheets on the scale of 1 inch = 4 miles in each of which the lower parallel is 36° be placed together, two in each of which the lower parallel is 38° and two in each of which the

upper parallel is 40°, the co-ordinates of the three extreme points one on each parallel when reduced to the scale of 1 to 1000,000 are found to be

7·098	6·914	6·723
·074	8·813	17·554

while the co-ordinates of D, E, F on the scale of 1 to 1000,000 are

7·098	6·911	6·723
·074	8·811	17·553

so that the points are identical for all purposes of plotting.

TABLE XXXIX.—*Graticules of maps.—Sides and Diagonals of Squares of 2 Degrees of Latitude and Longitude, on the Scale of 1 Inch to 28 Miles.*

TABLE XL.—*Graticules of maps.—Sides and Diagonals of Squares of 2 Degrees of Latitude and Longitude, on the Scale of 1 Inch to 32 Miles.*

TABLE XLI.—*Graticules of maps.—Sides and Diagonals of Squares of 4 Degrees of Latitude and Longitude, on the Scale of 1 Inch to 64 Miles.*

TABLE XLII.—*Graticules of maps.—Sides and Diagonals of Squares of 4 Degrees of Latitude and Longitude, on the Scale of 1 Inch to 80 Miles.*

TABLE XLIII.—*Graticules of maps.—Sides and Diagonals of Squares of 4 Degrees of Latitude and Longitude, on the Scale of 1 Inch to 96 Miles.*

TABLE XLIV.—*Graticules of maps.—Sides and Diagonals of Squares of 4 Degrees of Latitude and Longitude, on the Scale of 1 Inch to 192 Miles.*

TABLE XLV.—*Graticules of maps.—Sides and Diagonals of Squares of 4 Degrees of Latitude and Longitude, on the Scale of 1 Inch to 256 Miles.*

These tables are for use in constructing the graticules of maps on the various scales indicated, when the projection used is a modified secant conical one having for its limits the parallels of 8° and 40°. The tables are carried down to 0° and in some cases up to 44°, but the projection is really constructed with the above limits.

The meridians are represented by straight lines and the parallels by arcs of circles described round a common centre. The position of this centre and the angle of projection (that is the angle subtended at the centre by an arc of parallel of 1°) are determined by the following considerations:—

1°. The lengths on the meridians shall be the same as the corresponding lengths on the earth's surface.

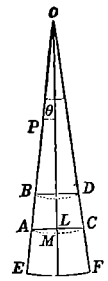
2°. The errors of lengths of the parallels of 8° and 40° shall be equal and each shall be equal to the error of length of the parallel at a certain latitude between these parallels where it is maximum. The sign of the latter will differ from those of the two former and there will be two parallels on which the errors will be zero. The projection is thus a *quasi* secant conical one though it cannot be illustrated geometrically.

From these considerations it follows that if O is the centre and θ the angle of projection, P and E the positions on the projection of the north pole and of a point on the equator respectively,

$$\theta = 0^\circ\ 24'\ 5''{\cdot}9$$

$$O\,P = 4280{\cdot}11 \text{ miles}$$

$$O\,E = 10494{\cdot}33 \text{ ,,}$$



The error is zero on the parallels of 12° 30′ and 35° 8′ and on the parallels of 8°, 23° 40′ 51″ and 40° the percentages of error are respectively 1·8, 1·9 and 2·3.

The parallels should be arcs of circles but the chords are plotted instead.

If ABCD is a small square of, say, 2° and if OA is, say, 10,000 miles then

$$OL = OA \cos\theta = 9999{\cdot}75 \text{ miles,}$$

so that LM is $\frac{1}{4}$ of a mile or on the scale of 1 inch = 32 miles less than the one-hundredth part of an inch.

As each of the squares forms part of one projection in which the meridians are straight lines it is immaterial from what line the projection is started and convenience of handling must be the guide. For example the Map of India on the scale of 1 inch = 32 miles extending in longitude from about 60° to about 104° east longitude and from about 4° to about 40° north latitude is in twelve sheets. Each sheet is a rectangle 20·5 inches in longitude and 24·511 inches in latitude, and the sheets are arranged by fours in longitude. The central meridian, *viz.*, that of 82° east longitude is drawn down through the three western central sheets parallel to the eastern edges of the rectangles and a little way to the west of them. Another line to represent the same meridian is drawn parallel to the western edges of the eastern sheets at the same distance outside the edges. Along these two lines the lengths of each two degrees of latitude are laid off starting from a point representing 6° a little north of the lowest edge, care being taken that at the junctions of the various sheets the sum of the two parts shall be the correct value.

The right hand bottom corner of the bottom square and the right hand top corner of the top square in the eastern central sheets are plotted, and the corresponding left hand corners in the western central sheets. The points are joined forming two new meridians which are divided up as before and the parallels formed by joining the corresponding points of section: the process is continued on these two new meridians until the edges of the sheets are reached.

The practical test is that the lengths of all the meridians shall be the same and also that the n's shall be those given in the table but there is a further test in the check diagonal of which one is given for each sheet. Thus in the bottom sheets the diagonal of the square eight degrees in latitude between 8° and 16° and eight degrees in longitude is 24·127 inches.

The only difficulty now is to get the next meridians drawn in their proper place on the adjoining sheets. This is easily effected by projecting corners of the last squares of the central sheets on the margins outside the eastern or western edges as the case may be and then carefully transferring these last squares to their proper positions on the contiguous sheets.

It is hardly necessary to describe the projection of the other scales in detail: the general principle to be observed is that the top corner of the top square and the bottom corner of the bottom square of each sheet should be first plotted and then joined to form the new meridian.

TABLE XLVI.—*Rectangular Co-ordinates in Chains of the Corners of $\frac{1}{8}$th Degree Squares, referred to the centre of the Degree as Origin.*

This table gives the rectangular co-ordinates in chains of the corners of $\frac{1}{8}$th degree squares referred to the centre of the degree as origin for latitudes ranging from 0° to 40°.

It is computed according to the principles laid down in Tables XXVI, XXVII, and XXVIII, and is for the use of Revenue Surveyors and others whose operations are based on rectangular co-ordinates referred to the centre of a square degree as origin, but which are intended for publication in maps based on spherical co-ordinates. The points of which the rectangular co-ordinates are given in the table are the corners of 7′ 30″ squares.

TABLE XLVII.—*Convergency between Meridians* 1 *Mile apart measured on Parallels of Latitude.*

The formula from which this table has been constructed, is

$$\text{Convergency} = 5280 \operatorname{cosec} 1'' \frac{\tan \lambda}{\nu}$$

where ν is the normal to the meridian in latitude λ.

It may be deduced as follows:—

Let P and Q be two points 1 mile apart on the parallel of latitude $\lambda°$ whose difference of longitude is ΔL; draw tangents at the points P and Q to the meridians through P and Q; these tangents will meet at a point T on the polar axis of the earth.

Then the convergency = the angle P T Q = $\Delta L \sin \lambda$

$$\text{or} \quad = P\,Q \operatorname{cosec} 1'' \frac{\tan \lambda}{\nu} = 5280 \operatorname{cosec} 1'' \frac{\tan \lambda}{\nu}$$

Example.—To find the convergency of two points 1 mile apart in latitude 17° 40′.

$$\log 5280 = 3{\cdot}72263$$
$$\log \operatorname{cosec} 1'' = 5{\cdot}31443$$
$$\log \tan \lambda = \bar{1}{\cdot}50311$$
$$\log \frac{1}{\nu} = \bar{8}{\cdot}67924 \text{ from Table I}$$

Nat. No. = 16·57 . . . . log = 1·21941

therefore the convergency = 16″·6 as given in the table.

The table is constructed for every 5′ of latitude from 0° to 40°, and enables Revenue Surveyors and others who employ rectangular co-ordinates, to refer observed azimuths or azimuths obtained through triangulation to their meridian of origin.

Rule.—Enter the table with the latitude of the point at which the convergency is wanted, and multiply the quantity so obtained by the number of miles in the perpendicular co-ordinate of the point: the result will be the convergency required, and will be additive to the observed azimuth if *west* of the origin, subtractive if *east*.

Example.—In latitude 30° 25′ let the length of the co-ordinate perpendicular to the meridian of origin be 15·67 miles,

then the convergency = 15·67 × 30″·5 = 477″·9 = 7′ 57″·9.

TABLE XLVIII.—*Lengths of Circular Arcs.*

This table gives, to 7 places of decimals in terms of radius unity, the lengths of arcs of a circle subtending angles at the centre ranging from 0″·01 to 180°. The tabular numbers are also of course the circular measures of the corresponding angles.

RULE I.—To find the length of the arc which subtends a given angle at the centre of a circle of given radius. Find the tabular number corresponding to the given angle and multiply it by the radius.

EXAMPLE.—

To find the length of an arc of 57° 17′ 44″·8 with a radius of 100 feet.

Tabular No. for	57°		is	0·9948377
,, ,,	17′		,,	49451
,, ,,	44″		,,	2135
,, ,,	″·8		,,	39
				1·0000000

therefore the length of the arc = 100 feet.

RULE II.—To find the degrees, &c., subtended by a given arc at the centre of a circle of given radius. Divide the arc by the radius; from the result subtract the next lower tabular number; from the difference the next lower and so on, till no subtrahend remains; and opposite the several numbers subtracted will be the degrees, minutes, &c.

EXAMPLE.—To find the angle subtended by an arc of 13·6578 feet in a circle whose radius is 100 feet.

			Arc ÷ radius =	·1365780
The table gives for	. . .		7°	·1221730
	Difference .	.	.	·0144050
,, ,,	,,		49′	·0142535
	,,			·0001515
,, ,,	,,		31″	1503
	,,			·0000012
,, ,,	,,		″·25	12
therefore	the required angle = 7° 49′ 31″·25.			0

TABLE XLIX.—*Gauss's Sum and Difference Logarithms.*

This table contains Gauss's Logarithms *adapted from Shortrede's Logarithmic Tables, and Galbraith and Haughton's Manual of Mathematical Tables*, and by means of it the logarithms of the sum and difference of two numbers may be immediately derived from the logarithms of the numbers themselves. The table consists of three parts headed respectively A, B and C, the construction of which is as follows:—

$$A = \log m$$

$$B = \log \left(1 + \frac{1}{m}\right)$$

$$C = \log (1 + m)$$

hence it follows that $C = A + B$.

First, let it be required to find the logarithm of $(a + b)$ when $\log a$ and $\log b$ are given, a being $> b$. Put $m = \frac{a}{b}$; then

$$\log m = \log a - \log b = \text{A in table},$$

$$\log (a + b) = \log a \left(1 + \frac{b}{a}\right) = \log a + \log \left(1 + \frac{1}{m}\right) = \log a + \text{B in table},$$

or $$\log (a + b) = \log b \left(1 + \frac{a}{b}\right) = \log b + \log (1 + m) = \log b + \text{C in table}.$$

RULE.—Subtract the lesser logarithm from the greater; with the difference enter part A, find the corresponding number in part B, and add it to the greater logarithm; or enter part A, find the corresponding number in part C, and add it to the lesser logarithm. Either process will give the logarithm of $(a + b)$.

EXAMPLE.—Find the logarithm of the sum of the numbers whose logarithms are 0·36173 and 0·23045.

$$\log a = 0\cdot36173$$
$$\log b = 0\cdot23045$$
$$\log a - \log b = 0\cdot13128 = \text{A},$$
$$\text{corresponding value in B} = 0\cdot24033$$
$$\log a = 0\cdot36173$$
$$\log (a + b) = 9\cdot60206$$

or

$$\text{corresponding value in C} = 0\cdot37161$$
$$\log b = 0\cdot23045$$
$$\log (a + b) = 0\cdot60206$$

Next, let it be required to find $\log (a - b)$ with the same data. There will be two cases, one in which $\frac{a}{b}$ will be > 2 or $(\log a - \log b) > 0\cdot30103$, the other in which $\frac{a}{b}$ will be < 2 or $(\log a - \log b) < 0\cdot30103$, a being $> b$ in both cases.

In the first case let $\frac{a}{b} = 1 + m$, then $a - b = \frac{a}{1 + \frac{1}{m}}$

$$\log a - \log b = \log (1 + m) = \text{C in table},$$

$$\log (a - b) = \log a - \log \left(1 + \frac{1}{m}\right) = \log a - \text{B in table}.$$

RULE.—When $(\log a - \log b)$ is $> 0\cdot30103$, with the difference enter part C, find the corresponding number in part B, and subtract it from the greater logarithm.

In the second case let $\frac{a}{b} = 1 + \frac{1}{m}$, then $a - b = \frac{a}{1 + m}$

$$\log a - \log b = \log \left(1 + \frac{1}{m} \right) = \text{B in table}$$

$$\log (a - b) = \log a - \log (1 + m) = \log a - \text{C in table.}$$

RULE.—When $(\log a - \log b)$ is $< 0{\cdot}30103$, with the difference enter part B, find the corresponding number in part C, and subtract it from the greater logarithm.

EXAMPLE 1.—Find the logarithm of the difference of the numbers whose logarithms are $3{\cdot}44134$ and $1{\cdot}21352$.

$\log a = 3{\cdot}44134$

$\log b = 1{\cdot}21352$

$\log a - \log b = 2{\cdot}22782$

Next lower number in C $= 2{\cdot}22261$ . . . . . corresponding value in B $= 0{\cdot}00261$

Remainder $= 521$

Tabular difference in C $= 994$ . . . . . subtract $\frac{521 \times 6}{994} = 3$

" " in B $= 6$

$B = 0{\cdot}00258$

$\log a = 3{\cdot}44134$

$\log (a - b) = \log a - B = 3{\cdot}43876$

EXAMPLE 2.—Find the logarithm of the difference of the numbers whose logarithms are $0{\cdot}25042$ and $0{\cdot}08395$.

$\log a = 0{\cdot}25042$

$\log b = 0{\cdot}08395$

$\log a - \log b = 0{\cdot}16647$

Next lower number in B $= 0{\cdot}16633$ . . . . . corresponding value in C $= 0{\cdot}49733$

Remainder $= 14$

Tabular difference in B $= 32$ . . . . . subtract $\frac{14 \times 68}{32} = 30$

" " in C $= 68$

$C = 0{\cdot}49703$

$\log a = 0{\cdot}25042$

$\log (a - b) = \log a - C = 1{\cdot}75339$

Gauss's Tables give logarithmically the correlations of the following functions:—

A	B	C
x	$1 + \frac{1}{x}$	$1 + x$
$y - 1$	$\frac{y}{y-1}$	y
$\frac{z}{1-z}$	$\frac{1}{z}$	$\frac{1}{1-z}$
$\tan^2\theta$	$\operatorname{cosec}^2\theta$	$\sec^2\theta$
$\frac{1}{A}$	C	B

Thus if the logarithm of $\tan^2\theta$ is given, and part A of the table is entered with it as an argument, the corresponding number in part B will be the logarithm of $\operatorname{cosec}^2\theta$, and in part C the logarithm of $\sec^2\theta$.

Example.—Given $\log \tan^2\theta = 0{\cdot}47712$, part A; then from part B $\log \operatorname{cosec}^2\theta = 0{\cdot}12494$, and from part C $\log \sec^2\theta = 0{\cdot}60206$.

When the index of the given logarithm is negative enter part A with the corresponding negative logarithm, then the logarithm of the function B will be found in part C, and the logarithm of the function C will be found in part B. Conversely when the logarithm of B or C is only to be found in part C or B the corresponding logarithm of the function A will be negative.

Example.—Given $\log \tan^2\theta = \bar{2}{\cdot}04324 = -1{\cdot}95676$, part A; then from part C $\log \operatorname{cosec}^2\theta = 1{\cdot}96153$, and from part B, $\log \sec^2\theta = 0{\cdot}00477$.

Again $\log a$ being given let it be required to find $\log(1 + a)$.

Rule 1.—When a is greater than 1, *i.e.*, when $\log a$ positive, enter part A with the given logarithm, and the corresponding number in C will be $\log(1 + a)$.

Rule 2.—When a is less than 1, *i.e.*, when $\log a$ negative, enter part A with the negative logarithm, and the corresponding number in B will be $\log(1 + a)$.

Examples.

1. Given $\log a = 2{\cdot}62562$

Next lower number in A $= 2{\cdot}62000$ . . . . . corresponding value in C $= 2{\cdot}62104$

Difference $= 562$

Tabular difference in C $= 998$ . . . . . add $\frac{562 \times 998}{1000} = 561$

$\log(1 + a) = C = 2{\cdot}62665$

2. Given $\log a = \bar{2}\cdot62562$

Then the negative log of $a = 1\cdot37438$

Next lower number in A $= 1\cdot37400$ . . . . . corresponding value in B $= 0\cdot01798$

Difference $= 38$

Tabular difference in B $= 4$ . . . . . subtract $\frac{38 \times 4}{100} = 2$

$\log (1 + a) = B = 0\cdot01796$

Lastly, $\log a$ being given let it be required to find $\log (a - 1)$ or $\log (1 - a)$.

RULE 1.—If $\log a$ is $> 0\cdot30103$, *i.e.*, $a > 2$, enter part C with it, the corresponding number in A will be $\log (a - 1)$.

RULE 2.—If $\log a$ is $< 0\cdot30103$ but > 0, *i.e.*, $a < 2$ but > 1, enter part B with it, the corresponding number in A will be the negative log of $(a - 1)$.

RULE 3.—If $\log a$ be negative, *i.e.*, $a < 1$. with the negative log of a enter part B or C and take the corresponding number in C or B; this will be the negative log of $(1 - a)$.

EXAMPLES.

1. Given $\log a = 2\cdot62562$

Next lower number in C $= 2\cdot62101$ . . . . . corresponding value in A $= 2\cdot62000$

Difference $= 458$

Tabular difference in C $= 998$ . . . . . add $\frac{458 \times 1000}{998} = 459$

$\log (a - 1) = A = 2\cdot62459$

2. Given $\log a = 0\cdot03981$

Next higher number in B $= 0\cdot03987$. . . . . corresponding value in A $= 1\cdot01700$

Difference $= 6$

Tabular difference in B $= 8$ . . . . . add $\frac{6 \times 100}{8} = 75$

therefore negative log of $(a - 1) = \bar{1}\cdot01775$

therefore $\log (a - 1) = A = \bar{2}\cdot98225$

3. Given $\log a = \bar{1}\cdot62562$

Then the negative log of $a = 0\cdot37438$

Next lower number in C $= 0\cdot37433$ . . . . . corresponding value in B $= 0\cdot23833$

Difference $= 5$

Tabular difference in B $= 42$

" " in C $= 58$ . . . . . subtract $\frac{5 \times 42}{58} = 4$

therefore negative log of $(1 - a) = B = 0\cdot23829$

therefore $\log (1 - a) = \bar{1}\cdot76171$

TABLE L.—*Common Logarithms to 4 places of Decimals.*

This table gives the logarithms to 4 places of decimals of all numbers from 100 to 999.

TABLE LI.—*Common Logarithms to 5 places of Decimals.*

This table gives the logarithms to 5 places of decimals of all numbers from 1000 to 9999, and is intended especially to aid the calculations of the Revenue Branch of this Survey.

TABLE LII.—*Logarithmic Sines and Cosines to 5 places of Decimals.*

This table gives the logarithmic sines and cosines of angles differing by 1′ between 0° and 90°, and is intended especially to aid in the traverse calculations of the Revenue Branch of this Survey.

TABLE LIII.—*Azimuth and Apparent Altitude of Polaris computed with North Polar Distance* 1° 10′, *and Mean Refraction.*

The table is constructed for a North Polar Distance of Polaris 1° 10′, but as corrections for every 10″ of N. P. D. are given, it can be used for the correct North Polar Distance as given by the Nautical Almanac. The time being known, all that is necessary is to intersect the star and read the horizontal circle, then the azimuth can be obtained by inspection from the table. The table is constructed to suit latitudes differing by 2° between 0° and 40° and for hour angles from 0^h to 12^h. The table further gives the hour angle at elongation with its correction for an increment of 10″ in N. P. D.

The formulæ by which the altitude and azimuth and the changes in them due to change in N.P.D. (Δ) have been computed are as follows:—

Let t = hour angle at any time except elongation,

λ = latitude,

δ = the declination,

ζ = the zenith distance,

q = the paraliactic angle,

A = the azimuth,

then $$\sin \tfrac{1}{2}\zeta = n \sec N \quad \text{and} \quad \sin A = \operatorname{cosec} \zeta \sin \Delta \sin t;$$

where $$\tan N = \frac{m}{n} \sin \tfrac{1}{2} t; \quad m = \sqrt{\cos \lambda \cos \delta}; \quad \text{and } n = \sin \tfrac{1}{2}(\delta - \lambda).$$

$$d\,(\text{alt.}) = -\cos q \, d\Delta \quad \text{and} \quad d A = \frac{\sin q}{\sin \zeta} d\Delta;$$

where $$\sin q = \frac{\cos \lambda \sin A}{\sin \Delta}.$$

From the above the true zenith distance ζ has been computed and the mean refraction, from Table I of Chauvenet's Astronomy, Vol. II, has been applied to obtain the apparent altitude.

The formulæ *at* elongation, P being the hour angle, are:—

$$\sin (\text{alt.}) = \sin \lambda \sec \Delta; \qquad \sin A = \sin \Delta \sec \lambda; \qquad \text{and } \cos P = \tan \lambda \tan \Delta;$$

the apparent altitude being found as before.

The changes in the preceding elements for a change in Δ are:—

$$d\,P = -\tan\lambda \operatorname{cosec} P \sec^2\Delta\, d\Delta;$$

$$d\,(\text{alt.}) = -d\,P \sin\Delta;$$

$$d\,A = d\,\Delta \sec(\text{alt.}).$$

The table may be used for two purposes. *First,* Given the altitude and hour angle, the latitude may be obtained by a series of interpolations. The results differ only by a few seconds from those arrived at by the method given in the Nautical Almanac, but the computation is rather laborious and cannot be recommended. *Second,* Given the latitude and hour angle, to find the azimuth.

EXAMPLE:—

On Nov. 9th 1905, in latitude 27° 47′ 26″ an observation was taken to Polaris at $21^h\ 4^m\ 54^s$; determine the azimuth.

						h	*m*	*s*				
On Nov. 9th 1905, the Right Ascension of Polaris					=	25	26	17				
Sidereal time of observation					=	21	4	54				
Hour angle					=	4	21	23				

The North Polar Distance of Polaris = 1° 11′ 41″: correcting the tabular quantities for 1′ 41″ of N. P. D., we get:—

		°	′	″		*h*	*m*	*s*			°	′	″	
	In latitude	26	0	0	at	4	20	0	Azimuth	=	1	12	36	}
	,,		,,		,,	4	40	0	,,	=	1	15	12	}
	,,	28	0	0	,,	4	20	0	,,	=	1	13	56	}
	,,		,,		,,	4	40	0	,,	=	1	16	34	}
therefore	,,	26	0	0	,,	4	21	23	,,	=	1	12	47	}
and	,,	28	0	0			,,		,,	=	1	14	7	}
whence	,,	27	47	26			,,		,,	=	1	13	59	

so that the required azimuth of Polaris = 1 13 59.

This is the azimuth of Polaris measured from north either to the east or to the west. If the sidereal time of observation be between the R.A. and 12^h + R.A. then Polaris is west of the meridian, otherwise it is east. The azimuth from south round by west will therefore be 180° minus the azimuth found from the table in the 1st case and 180° plus the azimuth found from the table in the 2nd case. In the case given above the sidereal time of observation is *not* between R.A. and 12^h + R.A.; therefore the azimuth is east of the meridian and the azimuth from south by west is 181° 13′ 59″.

It is evident that the arithmetic in this computation would have been much simplified if Polaris had been observed at one of the hour angles mentioned in the table; but as this may not be convenient at all times, an example of the most general type has been chosen.

TABLE LIV.—*Elements of Circumpolar Stars for 1st January* 1910.

The table contains a list of 80 circumpolar stars down to the 8th magnitude situated within 9° of the pole and arranged in order of their right ascensions. The mean right ascensions and declinations are given to 2 places of decimals of a second, except those of the Nautical Almanac stars: the apparent places of the latter can be taken out at once from the almanac. The mean right ascensions and declinations, the annual precessions in right ascension and declination, the secular variations of precession and the third differences, have been computed by the rigorous formulæ given in the *Catalogue of Fundamental Stars* by Newcomb. In most cases Newcomb's *Catalogue of Fundamental Stars* and the *Greenwich Second Ten-Year Catalogue 1890* were used, but a few stars which are not given there were obtained from the *Greenwich Ten-Year Catalogue 1880* or *Greenwich Nine-Year Catalogue 1872*. The proper motion was taken from the corresponding catalogue when given there, and when not, it is left blank. The unit in the columns headed $\frac{d^3a}{dt^3}$ and $\frac{d^3\delta}{dt^3}$ is the sixth place of decimals or the quantities are in millionths of a second.

The formulæ for finding the mean place of a star on the 1st January of the year $(1910 + y)$ are:—

$$a' = a + \frac{da}{dt} \cdot y + \frac{d^2a}{dt^2} \cdot \frac{y^2}{200} + \frac{d^3a}{dt^3} \cdot \frac{y^3}{6} + \mu y$$

$$\delta' = \delta + \frac{d\delta}{dt} \cdot y + \frac{d^2\delta}{dt^2} \cdot \frac{y^2}{200} + \frac{d^3\delta}{dt^3} \cdot \frac{y^3}{6} + \mu' y$$

where a and δ are the mean right ascension and declination on 1st January 1910,

and $\frac{da}{dt}$ and $\frac{d\delta}{dt}$ are the annual precessions in right ascension and declination,

,, $\frac{d^2a}{dt^2}$ and $\frac{d^2\delta}{dt^2}$,, secular variations ,, ,, ,,

,, μ and μ' ,, proper motions ,, ,, ,,

The formulæ for computing the apparent places and the values of constants therein will be found in the Nautical Almanac, but the computations are much facilitated by using Turner's *Tables for facilitating the computation of Star Constants*.

TABLE LV.—*Values of* $\frac{2\ Sin^2\ \frac{1}{2}\ t}{Sin\ 1''}$ *for the Reduction of Circum-meridian Observations for Latitude.*

This table is intended to be employed in the computation of latitude from circum-meridian observations of the sun or a star. The formula for finding the latitude is as follows:—

If ζ = true meridian zenith distance,

ζ_0 = an observed ex-meridian zenith distance, corrected for refraction, and in the case of the sun or a planet also for semi-diameter and parallax,

Δ = north polar distance of sun or star,

γ_0 = an approximate value of co-latitude,

$= \Delta \pm \zeta_0$ when the object is above the pole,

or $= \zeta_0 - \Delta$ „ „ „ below „

the positive sign being used when the star is north of the zenith and the negative one when the star is south of the zenith.

t = the difference between the chronometer time of transit and that of observation,

then $\zeta = \zeta_0 - Am$ when the object is above the pole

or $= \zeta_0 + Am$ „ „ „ below „

where $A = \text{cosec}\ \zeta_0 \sin \Delta \sin \gamma_0$ and $m = 2\ \frac{\sin^2 \frac{1}{2}\ t}{\sin 1''}$,

and the co-latitude $= \Delta \pm \zeta$ when the object is above the pole,

or $= \zeta - \Delta$ „ „ „ below „

the positive sign being used when the star is north of the zenith and the negative one when the star is south of the zenith.

In the above formula *t should be less than 20 minutes and* ζ *greater than 10°*, and consequently the table is only constructed to give m for all values of t from 0^s to 20^m. The logarithms of the several quantities m, should they be required, will be found in Part III of Table XXV.

In practice a number of observations (say ten) should be taken, and it is better that some should be on one side and some on the other side of the meridian, but it is not necessary to reduce each of these separately: the above formula is sufficiently accurate if ζ_0 be taken to represent the mean of the zenith distances corrected as above described and m the mean of the quantities $\frac{2\ \sin^2 \frac{1}{2}\ t}{\sin 1''}$ corresponding to the respective hour angles of observation. In case of the sun Δ is the north polar distance corresponding to the mean of the times of observation.

EXAMPLE.—Circum-meridian Observations for Latitude to *a* Gruis (South) at Mahadeo Pokra h.s., November 8, 1903.

Angles observed with 6-inch Theodolite No. 1100 by Troughton & Simms ; Vertical Circle { *F. L. reads Altitude* / *F. R. ,, Zenith distance*

Object N. or S. β Barometer τ Thermometer	Face	Circle Readings A	Circle Readings B	Circle Readings Mean	Mean Zenith Distance	Level Readings (1 Division = 6″·0) Object End −	Level Readings (1 Division = 6″·0) Eye End +	Chronometer Times of Observation 1st Wire	2nd	3rd	Mean	t	m	Remarks
		° ′ ″	′ ″	° ′ ″	° ′ ″	*d*	*d*	*h m s*	*m s*	*m s*	*h m s*	*m s*		
a Gruis S.	L	194 53 59	55 31	194 54 45		25·0	21·0	21 55 12				6 15	77	
in.	R	345 3 2	4 20	345 3 41	75 4 28	23·0	23·0	56 32				4 55	47	
$\beta = 22\cdot9$	R	345 2 58	4 24	345 3 41	75 4 4	25·0	21·0	57 58				3 29	24	
$\tau = 44°\cdot0$	L	194 54 32	56 34	194 55 33		25·0	21·0	59 26				2 1	8	
	L	194 54 44	56 40	194 55 42		22·0	24·0	22 0 48				0 39	1	
	R	345 2 29	4 1	345 3 15	75 3 46·5	22·0	24·0	2 20				0 53	2	
	R	345 2 31	4 13	345 3 22	75 3 57	22·0	24·0	3 28				2 1	8	
	L	194 54 35	56 21	194 55 28		22·0	24·0	4 56				3 29	24	
	L	194 54 13	56 1	194 55 7		23·0	23·0	6 44				5 17	55	
	R	345 3 9	4 43	345 3 56	75 4 24·5	20·0	26·0	8 16				6 49	91	
				Mean	75 4 8·0							Sum	337	
				Level corrn.	+ 0·6							Mean	33·7	
Mean obsd. Z.D. (corrected for level)					75 4 8·6									

Computation of Latitude by Circum-meridional Zenith Distances.

Station ...	Mahadeo Pokra
Date (Astronomical)	Nov. 8, 1903
Longitude	85 ° 31 ′ 20 ″
Object, N. or S.	*a* Gruis (South)
R. A. of object	22 h 2 m 10 s
Chr. error	− 43
Chr. time of transit	22 1 27
Mean obsd. Z. D.	75 ° 4 ′ 9 ″
Refn.—parallax	+ 0 2 47
Approx. Z. D. = ζ_0	75 6 56
N.P.D. = Δ	137 25 42
Δ * $\pm$† ζ_0 = γ_0	62 18 46
Log cosec ζ_0	0·0148225
,, sin Δ	$\bar{1}$·8302754
,, sin γ_0	$\bar{1}$·9471872
,, *m*	1·5276299
Sum = log *A.m*	1·3199150
A.m	0 ° 0 ′ 21 ″
ζ_0	75 6 56
$\zeta_0 \mp$¶ *A.m* = ζ	75 6 35
Δ	137 25 42
Co-lat. = Δ * $\pm$† ζ	62 19 7
Latitude	27 40 53

* Δ is − if the object is below the Pole. † $\frac{+}{-}$ according as the object is $\frac{N}{S}$ of the Zenith. ¶ $\frac{-}{+}$ according as the object is $\frac{\text{above}}{\text{below}}$ the Pole. In the upper table t is the difference between the chronometer time of transit and that of observation and in the lower m is the mean of the quantities m of the upper table corresponding to the quantities t, taken from Table LV.

TABLE LVI.—*Factors for Bessel's Probable Error Formulæ.*

The formulæ for finding the probable error of a single observation of a group, or of the mean of the group, are given in "Airy's *Theory of Errors of Observations*, 1875" article 60, as follows:—

$$p.e. \text{ of a single observation} = \mp \frac{0{\cdot}6745}{\sqrt{n-1}} \cdot \sqrt{\text{sum of squares of apparent errors.}}$$

$$p.e. \text{ of the mean} = \frac{0{\cdot}6745}{\sqrt{n\,(n-1)}} \cdot \sqrt{\text{sum of squares of apparent errors.}}$$

The table gives the values of the two factors $\frac{0{\cdot}6745}{\sqrt{n-1}}$ and $\frac{0{\cdot}6745}{\sqrt{n\,(n-1)}}$ for values of n from 2 to 100 inclusive.

TABLE LVII.—*Quadrilateral Surfaces of 15′ in Latitude and in Longitude on the Terrestrial Ellipsoid.*

This table gives the areas in square miles, to 3 places of decimals, of squares of 15′ side between the latitudes 0° and 40°.

The table is computed from the formula:—

$$\text{Area} = \frac{\rho\nu \cos\lambda}{(5280)^2} \times (\text{circular measure of } 15')^2 = \left(\frac{15}{88}\right)^2 \rho\nu \cos\lambda \sin^2 1''.$$

For purposes of interpolation each area given in the table must be considered as corresponding to its middle latitude and the interpolation carried on, as in the foot-note to Table I, for the middle latitude of the space required.

If the area of a 5′ space is required, the areas in the table must first be divided by 9 and then considered as the 5′ spaces corresponding to the middle latitudes, and the interpolation carried on as before.

More generally, if the area of an n' space is required, multiply the 15′ areas by $\frac{n^2}{225}$ and interpolate as before.

TABLE LVIII.—*Semi-diurnal and Semi-nocturnal Arcs, showing the time of the rising and setting of the Sun, Moon, or Equatorial Stars.*

The table, abridged from that in "*Hints to Travellers*," gives half the time that a celestial body continues above or below the horizon when the latitude and declination are of the same or of contrary names: it affords the means of computing the rising and setting of the sun, moon and equatorial stars, and the length of the day and night. No allowance is made for refraction which in extreme cases will cause an error of 3^m. For convenience a table of the dates corresponding to sun's declination is added.

To find the time of the sun's rising or setting. Enter the table with arguments latitude and declination. Then the tabular number is the apparent time of the sun's setting or rising according as the arguments are of the same or contrary names, and this subtracted from 12 hours will be the apparent time of rising in the former case or setting in the latter. Twice the time of rising or setting will give the length of the night or day.

EXAMPLE.—To find the apparent time of sunrise and sunset and the length of the day and night in lat. 32° N., declination 18° N.

For arguments, lat. 32° N., declination 18° N. . . . . tabular number = h 6 m 47

Therefore the time of sunset = h 6 m 47 . . . . . Length of the day = 13 34

And „ „ sunrise = 5 13 . . . . . „ „ night = 10 26

To find the time of a star's rising and setting. Find the right ascensions of the sun and star from the Nautical Almanac and subtract the former from the latter increased by 24 hours if necessary. The difference is the approximate time of the star's passing the meridian. Enter the table with arguments latitude and declination, the tabular number is half the time the star is above or below the horizon according as the latitude and declination are of the same or different names, and in the latter case it must be subtracted from 12 hours to get half the time of continuance above the horizon; subtract or add half the time above the horizon from star's meridian passage and the result will be the time of the star's rising or setting.

EXAMPLE.—At what apparent time does δ Ophiuchi rise and set on May 1st 1905 in lat. 30° N.?

	h	m
Star's Right Ascension on 1st May 1905 . . . =	16	9
Sun's „ „ „ . . . =	2	32
Approximate time of star's meridian passage . . =	13	37

Arguments, lat. 30° N., declination 3° 27′ S.

	h	m	
Tabular number = 6^h 8^m, subtract from 12 hours . =	5	52	
Time of star's rising . . . . . =	7	45	P.M.
„ „ setting . . . . . =	19	29	„ or = 7 29 A.M.

TABLE LIX.—*Corrections for reducing Apparent to Mean Solar Time.*

These corrections must be applied to the apparent time with the signs given in the table to reduce to mean time. If greater accuracy is required the Nautical Almanac must be used where the quantities will be found under the heading "Equation of Time," on page I of each month.

TABLE LX.—*Showing Links to be subtracted from each Chain, in an ascending or descending line, in order to reduce it to the Horizontal Measure.*

This table gives the number of links to be subtracted from each chain on different ascents or descents from 1° to 30° so as to reduce it to the horizontal.

The horizontal space passed over in ascending 1 chain on a slope of θ degrees is 100 cos θ links, so that the numbers given in the tables are the values corresponding to 100 versin θ for different values of θ from 1° to 30°.

Thus if the slope be 12°,

Tabular expression = 100 versin 12° = 100 × ·021852 = 2·19.

EXAMPLE.—To find the horizontal measure corresponding to a distance of 2 chains 56 links on an incline of 3° 20′.

Tabular number corresponding to 3° 20′ $= 0{\cdot}14 + \frac{20}{60} \times {\cdot}10 = 0{\cdot}173$;

therefore the number of links to be subtracted $= 2{\cdot}56 \times {\cdot}173 = {\cdot}44$,

and the horizontal distance = 2 chains 55·56 links.

TABLE LXI.—*For the conversion of Feet into Miles.*

The table gives the equivalent in miles of any number of feet from 1 to 99,999, and by simply altering the decimal points it can be used for any larger number.

EXAMPLE.—To find the number of miles in 35,798 feet.

The table gives	35,000	feet	= 6·6288	miles
,, ,,	790	,,	= 0·1496	,,
,, ,,	8	,,	= 0·0015	,,
Therefore	35,798	,,	= 6·7799	,,

TABLE LXII.—*For the conversion of Miles into Feet.*

The table gives the equivalent in feet of any number of miles from 0·01 to 99·99, and by altering the decimal places it can be used for any number of miles.

EXAMPLE.—To convert 6·7799 miles into feet.

The table gives	6	miles	=	31680	feet,
,, ,,	·7700	,,	=	4065·6	,,
,, ,,	·0099	,,	=	52·3	,,
Therefore	6·7799	,,	=	35798	,,

TABLE LXIII.—*For the conversion of Links into Feet.*

The table gives the value in feet of any number of links from 1 to 99,999 and may be used for any other number by altering the decimal places.

EXAMPLE.—To find the number of feet in 77210·52 links.

The table gives	77000	links	=	50820	feet,
,, ,,	210	,,	=	138·6	,,
,, ,,	·52	,,	=	·34	,,
Therefore	77210·52	,,	=	50958·94	,,

TABLE LXIV.—*For the conversion of Feet into Links.*

The table gives the value in links of any number of feet from 1 to 99,999 and may be used for any other number by altering the decimal places.

EXAMPLE.—To find the number of links in 50958·94 feet.

The table gives	50,000	feet	=	75757·6	links,
„	„	950	„	=	1439·4	„
„	„	8	„	=	12·1	„
„	„	·94	„	=	1·42	„
Therefore		50958·94	„	=	77210·52	„

TABLE LXV.—*For the conversion of Versts and Kilometres into Miles and vice versâ.*

This table gives the values, to 4 places of decimals of miles, of distances from 1 to 10 versts and from 1 to 10 kilometres: and it gives values of distances from 1 to 10 miles in versts and kilometres: it also gives the accurate value in kilometres of 1 mile and the value in feet of 1 verst.

TABLE LXVI.—*For the conversion of French into English Measures.*

TABLE LXVII.—*For the conversion of English into French Measures.*

APPENDICES.

APPENDIX.

No. 1.

Problems relating to Trigonometrical Interpolations.

1.—*To find the positions of two points by observations from them to two known points.*

1st Solution.

The following solution of the problem is due to Major R. A. Wahab, R.E., and will be found of especial use in trans-frontier reconnaissance where a Surveyor is working in a valley with fixed but inaccessible points on either flank.

Let A and B be the two known points and X and Y the points whose positions are to be determined.

Fig. 1.

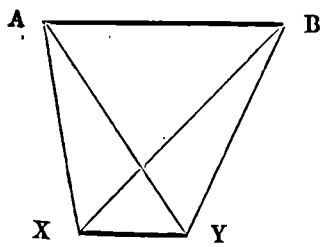
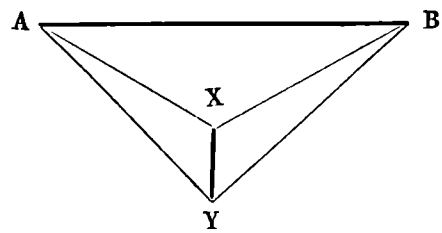


Fig. 2.



From the triangles B X Y and A X Y,

$$B X = XY \sin B Y X \operatorname{cosec} XBY;$$

$$A X = XY \sin A Y X \operatorname{cosec} XAY;$$

therefore

$$\frac{B X}{A X} = \sin B Y X \sin X A Y \operatorname{cosec} X B Y \operatorname{cosec} A Y X.$$

Thus in the triangle A B X the ratio $\frac{B X}{A X}$ is determined, and the included angle A X B is given by observation and the side A B is known, so that the sides A X and B X may be determined as follows:—

Let $$\tan x = \frac{B X}{A X} \sin A X B;$$

then if B N is drawn perpendicular to A X,

A M parallel to B N, and B M parallel to A X,

then $$\frac{B X}{A X} \sin A X B = \frac{B N}{A X} = \frac{A M}{A X} = \tan A X M;$$

therefore the angle A X M = x.

Now $$\sin A X B \sin x \operatorname{cosec} (A X B - x) = \frac{B X}{B M} \sin A X B$$

$$= \frac{B X \sin A X B}{A B \cos B A X};$$

but $$\frac{B X}{A B} \sin A X B = \sin B A X;$$

therefore $$\tan B A X = \sin A X B \sin x \operatorname{cosec} (A X B - x),$$

and $$A X = A B \sin A B X \operatorname{cosec} A X B,$$

$$B X = A B \sin B A X \operatorname{cosec} A X B,$$

and X Y is determined by the solution of the triangle A X Y.

The following is a specimen of the form in which the computation may be carried out:—

	°	′	″			
B Y X . .	114	30	25	. . .	log sin	Ī·9589989
X A Y . .	24	2	25	. . .	,, sin	Ī·6099984
X B Y . .	19	20	17	. . .	,, cosec	0·4799868
A Y X . .	55	24	43	. . .	,, cosec	0·0844658
A X B . .	54	23	34	. . .	,, sin	Ī·9101052
x . .	47	52	6	Sum =	,, tan x	0·0435551
A X B					,, sin	Ī·9101052
x					,, sin	Ī·8701728
(x − A X B)* or (A X B − x) . .	6	31	28	. . .	,, cosec	0·9445181
(180° − B A X)* or B A X . .	79	19	39	Sum =	,, tan B A X	0·7247961
Sum of B A X and A X B .	133	43	13			
1. 180° − Sum = A B X . .	46	16	47	. .	,, sin	Ī·8589716
2. . . . . B A X					,, sin	Ī·9924218
3. . . . . A X B					,, cosec	0·0898948
4. . . . . A B					,,	4·9061884
Sum of 1, 3 and 4					,, A X	4·8550548
,, 2, 3 and 4					,, B X	4·9885050

* This should be used when x is greater than A X B.

2nd Solution.

This is due to Colonel T. F. B. Renny-Tailyour, R.E.

Assuming 1 foot as the value of XY, the values of log B X and log A X are found in terms of it from the triangles X B Y and X A Y.

With these two values and the included angle A X B the value of log A B is computed on Form P. 25. The difference between this and the true value of log A B is then added to the above values of log B X, log A X and log X Y to get their true values.

Thus

Log X Y	= 0·0000000	Log X Y	= 0·0000000
Log sin B Y X	= $\bar{1}$·9589989	Log sin A Y X	= $\bar{1}$·9155342
Log cosec X B Y . . .	= 0·4799868	Log cosec X A Y . . .	= 0·3900016
Log B X	= 0·4389857	Log A X	= 0·3055358

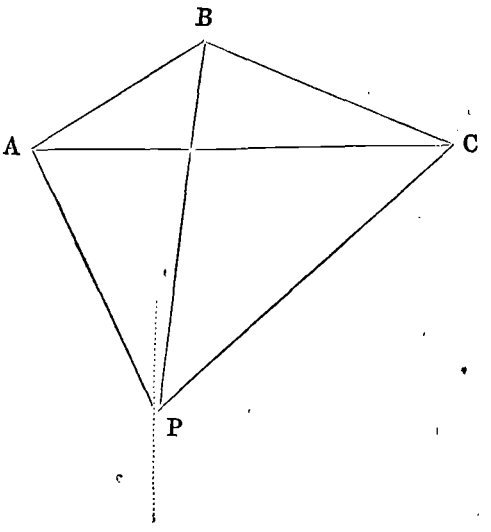
Included Angle C	54° 23′ 34″
Log sin C	$\bar{1}$·9101052
„ (B C = a)	0·4389857
Co-log (A C = b)	$\bar{1}$·6944642
Sum = log tan x	0·0435551
x	47° 52′ 6″
($C - x$) or ($x - C$)* = D	6 31 28
Log sin C	$\bar{1}$·9101052
„ sin x	$\bar{1}$·8701728
„ cosec D	0·9445181
Sum = log tan y	0·7247961
y or ($180° - y$)* = A	79° 19′ 39″
$180° - (A + C)$ = B	46° 16′ 47″
Log cosec A	0·0075782
„ sin C	$\bar{1}$·9101052
„ a	0·4389857
Sum = log (AB = c)	0·3566691
Known value (see Major Wahab's example) . . .	4·9061884
Difference	4·5495193

log B X = 4·9885050 . . . . log A X = 4·8550551 . . log X Y = 4·5495193

* This should be used when x is greater than C.

2.—*To find the position of a point by observations from it to three known points.*

Let A B C be three known points, snow peaks for instance, and let P be the point whose position is required.



The azimuth of A at P and the angles A P B and B P C are observed, and the approximate lengths P A and P C taken off by a pair of compasses or otherwise.

With the azimuth of A and the length P A the back azimuth of P at A is computed. This applied to the known azimuth of B at A will give an approximate value for the angle B A P and similarly an approximate value of the angle B C P is obtained.

The triangles B A P and B C P are computed and two values of the log side B P obtained.

Also $$\frac{B\,P}{A\,B} = \frac{\sin B\,A\,P}{\sin A\,P\,B}$$

so that $\log B\,P = \log \sin B\,A\,P +$ a constant

therefore the change in log B P due to an error in B A P is equal to the change in log sin B A P.

Similarly the change in log B P due to an error in B C P is equal to the change in log sin B C P.

So that the total difference of the two values must be divided up in the ratio of change in log sin B A P : change in log sin B C P.

Now $$\frac{P\,A}{P\,B} = \frac{\sin A\,B\,P}{\sin P\,A\,B} =$$ a constant practically since the small change in P A B

will not much affect the sines of these angles. So that

$$\text{Log } P\,A = \log P\,B +$$ a constant nearly

and the change in log P A = change in log P B very approximately.

Therefore when the total difference of the two values of log P B has been divided up in the above ratio the part belonging to triangle B A P must be applied to log P A to get a new value and that belonging to triangle B C P must be applied to log P C to get its new value.

With these new values and the original azimuth at P the values of P B are computed and these should now agree. If they do not, the process must be continued till they do.

The differences of latitude and longitude can then be computed as usual.

EXAMPLE.

Taken from Captain Wood's *Report on the Identification and Nomenclature of the Himalayan Peaks as seen from Katmandu, Nepal, 1904.*

From the known triangle Peak XXVIII(A)-Peak XXV (B)-Peak XXII (C) :—

Log side A B in feet = 5·4612370

„ B C „ = 5·0882648

At A azimuth of B = 282° 44′ 7″

„ C „ „ = 112 23 23

And from observations :—

At Kaulia h.s. (P) azimuth of A = 139° 35′ 38″

„ „ angle between B and A = 69 47 54

„ „ „ B and C = 31 24 4

The approximate length of P A = 54·72 miles = 5·4607800 Log feet

„ „ P C = 45·28 „ = 5·3785403 „

and the approximate latitude of P = 27° 49′ 9″.

With these approximate lengths and latitude and the observed azimuth, back azimuths were computed on Form P. 17, the values deduced being :—

At A azimuth of P = 319° 19′ 9″

„ C „ „ = 61 5 50

The differences between these and the azimuths at A of B and at C of B are the angles at A between B and P and at C between B and P, namely, 36° 35′ 2″ and 51° 17′ 33″ respectively.

The three angles of each of the triangles B A P and B C P being thus known, by solving the triangles, two values of the log side B P are obtained, *viz* :—

5·2640562 from triangle B A P

and 5·2636939 „ „ B C P

The difference 3623 must be divided up in the ratio of the change in log sin B A P : the change in log sin B C P, *i.e.*, in the ratio of + 28 : + 17

so that Log P A = 5·4708110 − 2254 = 5·4705856

and Log P C = 5·3678646 + 1369 = 5·3680015

With these values of the sides and the observed azimuth the process was repeated and the two values of the common side now became

5·2639938 from triangle B A P

5·2637378 „ „ B C P

After dividing up the difference 2560 as before it was found that

Log P A = 5·4706653

and Log P C = 5·3679683.

The process was again repeated with the above values, and as both the triangles gave the same value of the common side, *i.e.*, 5·2638345 no further approximation was necessary.

The co-ordinates of Kaulia h.s. were now computed from Peak XXV with this value of the common side, the results being :—

Latitude 27° 48′ 58″·7, Longitude 85° 16′ 48″·3.

The values given in Captain Wood's revised computation are :—

Latitude 27° 48′ 58″·9, Longitude 85° 16′ 47″·9.

A sufficiently close agreement for the purpose.

3.—*Computation of the Azimuth of* B *from* A *and their Distance apart when the Latitudes of* A *and* B *and the Azimuth of* A *from* B *are known.*

The solution of the problem is obtained from pages 26 and 27 as follows:—

$$\text{If} \quad \log \frac{\rho}{\nu} . \Delta\lambda . \tan\left(\lambda + \frac{\Delta\lambda}{2}\right) = \log n.$$

1st Approximation, $\log \Delta A = \log n + \log \tan (A + \Delta A)$.

$$\Delta A = x_1 \qquad A + \frac{\Delta A}{2} = A + \Delta A - \frac{x_1}{2} = y_1.$$

2nd Approximation, $\log \Delta A = \log n + \log \tan y_1$

$$\Delta A = x_2 \qquad A + \frac{\Delta A}{2} = A + \Delta A - \frac{x_2}{2} = y_2.$$

3rd Approximation, $\log \Delta A = \log n + \log \tan y_2$

$$\Delta A = x_3 \qquad A + \frac{\Delta A}{2} = A + \Delta A - \frac{x_3}{2} = y_3.$$

$$A = A + \Delta A - x_3$$

$$c = -\rho\ \Delta\lambda \sin 1'' \sec y_3.$$

In Secondary Triangulation where great accuracy is not required, the 3rd approximation is superfluous.

The following is a specimen of the form in which the computation may be carried out:—

	° ′ ″	° ′ ″	° ′ ″
λ_A	32 3 34·03	24 8 3·728	26 49 50·81
λ_B	32 14 13·31	24 25 58·132	27 45 15·52
$\lambda_B - \lambda_A = \Delta\lambda$	+ 0 10 39·28	+ 0 17 54·404	+ 0 55 24·71
$\frac{\lambda_A + \lambda_B}{2} = \lambda_m$	32 8 53·67	24 17 0·93	27 17 33·17
Azimuth of A from B = B ...	7 2 49	358 15 39	58 1 51
Log Q	$\bar{1}$·9979206	$\bar{1}$·9975898	$\bar{1}$·9976953
,, $\Delta\lambda$	2·8056911	3·0311676	3·5217538
,, $\tan \lambda_m$	$\bar{1}$·7982864	$\bar{1}$·6543427	$\bar{1}$·7126276
Sum = log n	2·6018981	2·6831001	3·2320767
Log tan B	$\bar{1}$·0920759	$\bar{2}$·4823520	0·2047310
Sum = log x_1	1·6939740	1·1654521	3·4368077
	° ′ ″	° ′ ″	° ′ ″
x_1*	+ 0 0 49·4	− 0 0 14·6	+ 0 45 34
$\frac{1}{2}x_1$	+ 24·7	− 7·3	+ 22 47
$B - \frac{1}{2}x_1 = y_1$	7 2 24·3	358 15 46·3	57 39 4
Log tan ,, ...	$\bar{1}$·0916485	$\bar{2}$·4818450	0·1983434
,, n	2·6018981	2·6831001	3·2320767
Sum = log x_2	1·6935466	1·1649451	3·4304201
	° ′ ″	° ′ ″	° ′ ″
x_2†	+ 0 0 49·4	− 0 0 14·6	+ 0 44 54
$\frac{1}{2}x_2$	+ 24·7	− 7·3	+ 22 27
$B - \frac{1}{2}x_2 = y_2$	7 2 24·3	358 15 46·3	57 39 24
$A = 180° + (B - x_2)$	187 2 0	178 15 54	237 16 57
Co-log P	2·0045245	2·0040284	2·0041865
Log $\Delta\lambda$	2·8056911	3·0311676	3·5217538
,, sec y_2	0·0032867	0·0001997	0·2716531
Sum = log c	4·8135023	5·0353957	5·7975934

* x_1 is $\frac{+}{-}$ according as B is in $\frac{\text{1st or 3rd}}{\text{2nd or 4th}}$ quadrant when $\Delta\lambda$ is positive but the signs will be reversed when $\Delta\lambda$ is negative.

† x_2 is $\frac{+}{-}$,, ,, y_1 is in $\frac{\text{1st or 3rd}}{\text{2nd or 4th}}$,, ,, ,, ,, ,, ,, ,,

APPENDIX.

No. 2.

Methods of determining Time, Latitude and Azimuth from Astronomical Observations.

The following methods for determining *Time*, *Latitude* and *Azimuth* by astronomical observations are those in most general use among explorers and surveyors engaged in trans-frontier work, and are here given to obviate the necessity of consulting larger works. The methods for determining *Longitude* are purposely omitted, as the results will in general not be found more accurate than those derived from dead reckoning.

I.—To find the Time.

1st Method. ***By a single altitude of a star or of the sun when the latitude is known.***

The altitude should be observed with a sextant, or with a theodolite on both faces, and the time noted by a clock or watch. For greater precision observe several altitudes in quick succession, noting the time of each, and take the mean of the altitudes as corresponding to the mean of the times. Correct the observed altitude for instrumental errors, refraction and also, in case of the sun or a planet, for semi-diameter and parallax.

Then if ζ = the corrected zenith distance,

γ = the co-latitude,

Δ = the north polar distance,

t = the hour angle,

T = clock time corresponding to ζ;

$$\sin \tfrac{1}{2} t = \sqrt{\frac{\sin \tfrac{1}{2}(\zeta + \Delta - \gamma) \sin \tfrac{1}{2}(\zeta + \gamma - \Delta)}{\sin \gamma \sin \Delta}},$$

$$= \sqrt{\frac{\sin (s - \gamma) \sin (s - \Delta)}{\sin \gamma \sin \Delta}},$$

or

$$\tan \tfrac{1}{2} t = \sqrt{\frac{\sin \tfrac{1}{2}(\zeta + \Delta - \gamma) \sin \tfrac{1}{2}(\zeta + \gamma - \Delta)}{\sin \tfrac{1}{2}(\Delta + \gamma - \zeta) \sin \tfrac{1}{2}(\zeta + \Delta + \gamma)}},$$

$$= \sqrt{\sin (s - \gamma) \sin (s - \Delta) \operatorname{cosec} (s - \zeta) \operatorname{cosec} s}$$

where $\dfrac{\zeta + \Delta + \gamma}{2} = s.$

If α = the right ascension of the star or planet for the approximate time of observation, then the sidereal time of observation $= \alpha \pm \dfrac{t}{15}$, the upper or lower sign being used according as the star is west or east of the meridian; and the error of the clock on sidereal time is $T - \left(\alpha \pm \dfrac{t}{15}\right)$. If the clock employed gives mean time, the sidereal time at mean noon must be subtracted from the sidereal time of observation and the result converted to mean time; the difference from the clock time is the clock error.

If the sun be observed, then the *apparent time* $= \frac{t}{15}$ if on the west side, or $\left(12 \text{ hrs.} - \frac{t}{15}\right)$ if on the east side of the meridian. To this must be applied the equation of time to obtain the true mean time of observation. The difference from the clock time is now the clock error.

The body observed should not have less than 10° of altitude and should be as near the prime vertical as possible.

EXAMPLE.—*Computation of Time.*

Station ...	... ...	Dehra Dún
Date (Astronomical)	... ...	12th Oct., 05
		° ′ ″
Longitude ...	... ...	78 3 15
Object, E. or W.	... ...	*a* Coronæ W.
		° ′ ″
Mean Obsd. Z.D.	... ...	58 45 45
Refraction — Parallax	... ...	+ 1 24
Corrected Z.D. $= \zeta$	... ...	58 47 9
N.P.D. $= \Delta$	... ...	62 57 47
Co-latitude $= \gamma$	... ...	59 40 31
Sum $= 2s$	... ...	181 25 27
s	... ...	90 42 44
$s - \zeta$	... ...	31 55 35
$s - \Delta$	... ...	27 44 57
$s - \gamma$	... ...	31 2 13
Log cosec s	... ...	0·0000336
,, ,, $(s - \zeta)$	... ...	0·2766845
,, sin $(s - \Delta)$	... ...	$\bar{1}$·6680145
,, ,, $(s - \gamma)$	... ...	$\bar{1}$·7123051
Sum = Log $\tan^2 \frac{1}{2} t$	... ...	$\bar{1}$·6570377
,, $\tan \frac{1}{2} t$	... ...	$\bar{1}$·8285189
		° ′ ″
$\frac{1}{2} t$	... ...	33 58 16·9
t	... ...	67 56 33·8
		h *m* *s*
t in time †	... ...	4 31 46·2
*'s R.A. or ⊙'s Eq. of T.	... ...	15 30 40·0
For Stars only: Local S.T. of Obsn.	... ...	20 2 26·2
For Stars only: S.T. at Local M.N.	... ...	−13 20 42·3
For Stars only: S. Interval from ,,	... ...	6 41 43·9
For Stars only: Retardation ...	... ...	− 1 5·8
True M.T. of Obsn.	... ...	6 40 38·1
Chr. Time ,,	... ...	6 40 28
Chr. Error ...	... ...	− 10·1

† In case of Sun when observed *east* of meridian $12^h - t$ should be entered: and in case of Star when observed $\frac{east}{west}$ of meridian, t is to be $\frac{subtracted\ from}{added\ to}$ its R.A.

2nd Method. *By equal altitudes of a star or the sun.*

If T_1, T_2 be the times marked by a clock when a star has the same altitude before and after crossing the meridian, then $T = \frac{1}{2}(T_1 + T_2)$ will be the clock time of its meridian transit, and the error of the clock can at once be found.

If instead of a star the sun be employed, the clock time of *apparent noon* will be equal to

$$T - \left(\frac{\tan \lambda}{\sin t} - \frac{\cot \Delta}{\tan t}\right)\frac{t\,\theta}{15},$$

where $2t$ = the elapsed time between the observations, θ = the small horary *decrease* of polar distance: if the polar distance is increasing θ will be negative. The equation of time having been applied, the clock error on mean noon is known.

For equal altitudes of the sun before and after midnight, *i.e.*, on the afternoon of one day and the morning of the next, tan λ changes sign and the clock time of *apparent midnight* is

$$T + \left(\frac{\tan \lambda}{\sin t} + \frac{\cot \Delta}{\tan t}\right)\frac{t\,\theta}{15}.$$

The most favourable condition of observation will be when the object is observed nearly *east* or *west* of the meridian, but the altitude should not be less than 10°.

The advantage of this method is that any error of graduation of the sextant or theodolite will have no effect; and the disadvantage is that some hours must elapse between the two observations, as the star should not be near the meridian.

II.—To find the Latitude by Observation.

1st Method. *By circum-meridian altitudes of a star or the sun.*

For an explanation and example see Explanation of Table LV pages 74 and 75.

2nd Method. *By altitude of the pole star out of the meridian.*

Adopting the notation employed in the Preface to the Nautical Almanac,

if l = the latitude,

a = the true altitude of the star,

p = the apparent polar distance,

h the hour angle of the star = S − a; S being the local sideral time of observation and a the apparent right ascension of the star;

then $l = a - p \cos h + \frac{1}{2} \sin 1'' \,(p \sin h)^2 \tan a$.

The Nautical Almanac gives tables to facilitate the computation as follows:—

Table I gives $-p \cos h$, or the *first correction.*

„ II „ $\frac{1}{2} \sin 1'' \,(p \sin h)^2 \tan a$, or the *second correction.*

Table III, which depends on the difference between the true and assumed values of p and a, contains the *third correction* increased by 1′ to render the quantities additive, and this accounts for the 1′ which is subtracted from the "Corrected Altitude".

For an example *see* the Nautical Almanac.

III.—To find the Azimuth by Observation.

1st Method. *Given the time and the latitude.*

The azimuth can be obtained from *Polaris* at once by means of Table LIII; the method of proceeding will be found in the explanation of that table.

2nd Method. *Given the latitude and also the time approximately.*

Observe the angle between the referring mark and a circumpolar star *at elongation.*

The time of elongation of the star, its azimuth and the altitude for setting the telescope may all be found from formulæ 1, 2 and 3 on page 48. The azimuth of the mark from north will be the angle between star and mark $\pm$ the azimuth of the star at elongation according as the star is between the mark and the pole or otherwise.

3rd Method. *Given the latitude and time.*

Observe the angle between the referring mark and a circumpolar star *near elongation.*

If P be the hour angle at elongation, and δP the interval before or after elongation, and δA the corresponding difference in azimuth,

$$\text{then } \tan \delta A = -2 \sin^2 \frac{\delta P}{2} \sec \lambda \cot \delta \operatorname{cosec} P \text{ approximately;}$$

$$\text{or } \delta A'' = -2 \frac{\sin^2 \frac{\delta P}{2}}{\sin 1''} \sec \lambda \cot \delta \operatorname{cosec} P.$$

The log. of the first part is given in Table XXV, Part III.

Example.—Observations were taken at Jalpaiguri s., latitude 26° 31′ 15″, longitude 88° 45′, on 7th January 1904, to λ Ursæ Minoris *near* Western Elongation, the angle between the referring mark and star was 1° 8′ 36″·5, the sidereal time of observation 1^h 1^m 48^s·5 and the Azimuth of R.M. by triangulation 180° 1′ 40″.

The declination δ = 88° 59′ 54″

and R. A. = 19^h 16^m 48^s·3 } at elongation.

To obtain δP the time from elongation, employ formula 1, and also to get A, the azimuth of the star at elongation, employ formula 2 on page 48.

Log cos P = log tan λ + log cot δ		Log sin A = log cos δ + log sec λ	
log tan λ	= $\bar{1}\cdot6981316$	log cos δ	= $\bar{2}\cdot2425785$
„ cot δ	= $\bar{2}\cdot2426448$	„ sec λ	= $0\cdot0482876$
Sum = „ cos P	= $\bar{3}\cdot9407764$	Sum = log sin A	= $\bar{2}\cdot2908661$
P in arc	= 89° 30′ 0″		A = 1° 7′ 10″
P in time	= 5 58 0·0		
Star's Right Ascension at elongation			19 16 48·3
Sidereal time „			1 14 48·3
„ of observation			1 1 48·5
δP			0 12 59·8
Log $2\sin^2\frac{\delta P}{2}$ cosec 1″			= 2·52058
„ sec λ			0·04829
„ cot δ			$\bar{2}\cdot24264$
„ cosec P			0·00002
Sum = Log δA			0·81153
δA*			+ 6″·5
Angle between R. M. and star			= 1° 8′ 36″·5
Corrected angle „			= 1 8 43
Azimuth of star at elongn. = A			= 1 7 10
„ Mark from north			= 0 1 33

4th Method. *Given the time and the latitude.*

Observe the angle between referring mark and any star of *North Aspect, i.e.,* whose declination is greater than the latitude of the place.

If z is the azimuth of a star, then $\cot z = \frac{\cos\lambda\tan\delta - \sin\lambda\cos t}{\sin t}$ where λ is the latitude, δ the declination and t the hour angle of the star.

The formula is taken from Doolittle's Practical Astronomy, p. 535.

---

* δA is $\frac{-}{+}$ for eastern and $\frac{+}{-}$ for western elongation according as the azimuth (from S. by W.) of the star at elongation is $\frac{less}{greater}$ than the azimuth of R.M. by triangulation. In cases where R. M. falls beween the star at elongation and its observed position, the observed angle is to be subtracted from δA to get the angle between R.M. and star at elongation.

Computation of Azimuth from Star Observations when the Latitude and Time are known.

Applicable to Stars of North Aspect only.

Station		Toungoo
Object observed		δ Ursæ Minoris
Date (Astronomical)		14th Dec., 1904
		° ′ ″
Longitude in Arc		96 27 3
		h m s
Mean of Chr. Times		11 21 59
Chronometer Correction		− 5
Local Mean Time		11 21 54
Longitude in Time		− 6 25 48
Greenwich Mean Time (*a*)		4 56 6
S. T. at Gr. Mean Noon		17 30 54
Local Mean Time		11 21 54
Acceleration for (*a*)		+ 49
Sum = Local S. T. of Obsn. = θ		4 53 37
R. A. of Star = a		18 2 36
$\theta - a$ = Hour Angle = t		10 51 1
		° ′ ″
t in Arc		162 45 15
Latitude ... = λ		18 55 45
Declination ... = δ		86 37 2
Log cos λ		$\bar{1}$·9758546
,, tan δ		1·2283441
Sum = Log (*b*)		1·2041987
(*b*) *		16·003
Log sin λ		$\bar{1}$·5110795
,, cos t		$\bar{1}$·9800222
Sum = Log (*c*)		$\bar{1}$·4911017
(*c*) *		0·310
(*b*) − (*c*) †		16·313
Log ,, = (*d*)		1·2125338
,, sin t = (*e*)		$\bar{1}$·4719839
(*d*) − (*e*) = Log cot z		1·7405499
		° ′ ″
z = Azimuth of Star		1 2 28
Angle R. M. and Star ‡		2 10 23
Azimuth of R.M. from N. = A		1 7 55

* To 3 places of decimals. † Sum is to be taken when t lies between 90° and 270°. ‡ In deducing this angle always subtract the reading of Star from that of R. M. To obtain A, the *Azimuth of Star* is to be $\frac{\textit{added to}}{\textit{subtracted from}}$ this angle according as it is $\frac{\textit{east}}{\textit{west}}$ of the Meridian, i.e., according as t is $\frac{\textit{greater}}{\textit{less}}$ than 180°.

5th Method. *Given the latitude.*

Observe the angle between the referring mark and the star and the star's altitude simultaneously, which is done by getting the star on the intersection of the cross wires of the theodolite. The star should not be at a high altitude: it should be near the prime vertical and rather on the side towards the apparent pole than on the other side.

Then if ζ = corrected zenith distance,
Δ = north polar distance,
A = the azimuth of the star from north,
γ = co-latitude,

then
$$\tan\frac{A}{2} = \sqrt{\frac{\sin\frac{1}{2}(\Delta+\gamma-\zeta)\sin\frac{1}{2}(\Delta+\zeta-\gamma)}{\sin\frac{1}{2}(\gamma+\zeta-\Delta)\sin\frac{1}{2}(\Delta+\gamma+\zeta)}},$$
$$= \sqrt{\sin(s-\zeta)\sin(s-\gamma)\operatorname{cosec}(s-\Delta)\operatorname{cosec} s}$$

where $\frac{\zeta+\Delta+\gamma}{2} = s$

Computation of Azimuth (Horizontal and Vertical Angles observed simultaneously).

Station ...	...	...	Yengweytaung h.s.
Star, E. or W.	...	...	*a* Andromedæ W.
Date (Astronomical)	...	...	19th Jan., 1902
		° ′	″
Mean Zenith Distance	...	43 17	0
Refraction ...	...	+	45
Corrected Z.D. $= \zeta$	...	43 17	45
Co-latitude $= \gamma$	...	69 17	30
N.P. Distance $= \Delta$	...	61 26	51
Sum $= 2s$	...	174 2	6
s	...	87 1	3
$s - \Delta$	...	25 34	12
$s - \gamma$	...	17 43	33
$s - \zeta$	...	43 43	18
Log cosec s	...		0·0005887
,, ,, $(s - \Delta)$	...		0·3649050
,, sin $(s - \gamma)$	...		$\bar{1}$·4835339
,, ,, $(s - \zeta)$	...		$\bar{1}$·8395759
Sum = log $\tan^2\frac{1}{2}A$	...		$\bar{1}$·6886035
,, $\tan\frac{1}{2}A$	...		$\bar{1}$·8443018
		° ′	″
$\frac{1}{2}A$	...	34 56	34
A	...	69 53	8
Angle R.M. and Star*	...	163 18	1
Azimuth of R.M. from N.*	...	93 24	51

* For deduction of the angle between R.M. and Star and the Azimuth of R.M. from north *see* footnotes to the last page.

6th Method. *Given the time and latitude.*

Observe the angle between the referring mark and *any* star. The best result will be got when the star is near the pole.

If t = the hour angle of the star,
δ = declination ,,
A = azimuth ,, from north,
γ = the co-latitude;
and if $\tan y = \cot \delta \cos t$,
then $\cot A = \sin (\gamma - y) \cot t \times \operatorname{cosec} y$.

Computation of Azimuth from Star Observations when the Time is known.

Station	Kaulia h.s.
Star E. or W.	ζ Ursæ Minoris
Date (Astronomical)	Oct. 25, 1903
	h m s
Local sidereal time of observation	21 43 33·6
R.A. of star	15 47 21·6
Difference = x	5 56 12·0
	° ′ ″
x in arc	89 3 0
x or $(360°-x)$* = p	89 3 0
p or $(180°-p)$† = t	89 3 0
Declination of star = δ‡	78 5 43
Log cot δ	$\bar{1}\cdot3239100$
,, cos t	$\bar{2}\cdot2195811$
Sum = log tan y	$\bar{3}\cdot5434911$
	° ′ ″
y	0 12 1
Co-latitude = γ	62 11 34
Difference or sum§ = β	61 59 33
β or $(180°-\beta)$‖ = θ	61 59 33
Log sin θ	$\bar{1}\cdot9459047$
,, cot t	$\bar{2}\cdot2196408$
,, cosec y	2·4564908
Sum = log cot z	0·6220363
	° ′ ″
z or $(180°-z)$¶ = A	13 25 43
Angle R.M. and star	106 52 16
Az. of R.M. from N.	93 26 33

* $360°-x$ is to be used when x is greater than 180°. † $180°-p$ is to be used when p is greater than 90°. ‡ To be used without regard to signs. § Sum is to be used 1st with stars of south declination and 2ndly when p is greater than 90°. ‖ $180°-\beta$ is to be used when θ is greater than 90° ¶ $180°-z$ is to be used 1st with stars of south declination and 2ndly with stars of north declination when y is greater than γ.

As the zenith distances must be corrected for refraction barometric and thermometric readings should be taken wherever they are observed.

APPENDIX.

No. 3.

Formulæ frequently employed in Calculations.

Solution of Oblique-Angled Spherical Triangles.

Given the three sides, a, b, c.

$$\cos A = \frac{\cos (a + \theta)}{\sin b \sin c \cos \theta'}, \text{ where } \tan \theta = \frac{\cos b \cos c}{\sin a};$$

$$\text{or } \sin \tfrac{1}{2} A = \sqrt{\frac{\sin (s-b) \sin (s-c)}{\sin b \sin c}}; \ \cos \tfrac{1}{2} A = \sqrt{\frac{\sin s \sin (s-a)}{\sin b \sin c}};$$

$$\text{or } \tan \tfrac{1}{2} A = \sqrt{\frac{\sin (s-b) \sin (s-c)}{\sin s \sin (s-a)}}, \text{ where } s = \tfrac{1}{2}(a + b + c).$$

Given two sides and the contained angle, a, b, C.

$$\cos c = \cos a \cos b + \sin a \sin b \cos C$$

$$= \frac{\cos a \cos (b - \theta)}{\cos \theta}, \text{ where } \tan \theta = \tan a \cos C;$$

$$\text{or } \tan \frac{A + B}{2} = \frac{\cos \tfrac{1}{2}(a - b)}{\cos \tfrac{1}{2}(a + b)} \cot \tfrac{1}{2} C \text{ and } \tan \frac{A - B}{2} = \frac{\sin \tfrac{1}{2}(a - b)}{\sin \tfrac{1}{2}(a + b)} \cot \tfrac{1}{2} C.$$

Given two sides and an angle opposite one of them, a, b, A.

$$c = \theta \pm \theta',$$

where $\tan \theta = \tan b \cos A,$

and $\cos \theta' = \frac{\cos \theta \cos a}{\cos b}.$

There are two triangles fulfilling the given conditions; if however c is either greater than 180° or negative, the corresponding triangle must be rejected.

The other parts can be found by one of the formulæ of the first group.

Given the three angles, A, B, C.

$$\cos a = \frac{\sin (A + \theta)}{\sin B \sin C \sin \theta'}, \text{ where } \cot \theta = \frac{\cos B \cos C}{\sin A};$$

$$\text{or } \sin \tfrac{1}{2} a = \sqrt{\frac{-\cos S \cos (S-A)}{\sin B \sin C}}; \ \cos \tfrac{1}{2} a = \sqrt{\frac{\cos (S - B) \cos (S - C)}{\sin B \sin C}};$$

$$\text{or } \tan \tfrac{1}{2} a = \sqrt{\frac{-\cos S \cos (S - A)}{\cos (S - B) \cos (S - C)}}, \text{ where } S = \tfrac{1}{2}(A + B + C).$$

Given two angles and the side adjacent, A, B, *c.*

$$\cos C = -\cos A \cos B + \sin A \sin B \cos c$$

$$= \frac{\cos A \sin (B - \theta)}{\sin \theta}, \text{ where } \cot \theta = \cos c \tan A;$$

$$\text{or } \tan \frac{a + b}{2} = \frac{\cos \frac{1}{2}(A - B)}{\cos \frac{1}{2}(A + B)} \tan \tfrac{1}{2} c \text{ and } \tan \frac{a - b}{2} = \frac{\sin \frac{1}{2}(A - B)}{\sin \frac{1}{2}(A + B)} \tan \tfrac{1}{2} c.$$

Given two angles and a side opposite one of them, A, B, *a.*

$$C = \theta + \theta',$$

where $\cot \theta = \tan B \cos a$,

and $\sin \theta' = \frac{\sin \theta \cos A}{\cos B}$.

There will be two triangles fulfilling the required conditions; if however C is either greater than 180° or negative, the corresponding triangle must be rejected.

The three angles being known, the other parts can be found by one of the formulæ of the fourth group.

Solution of Right-Angled Spherical Triangles.

Arrange the five parts a, $90° - B$, $90° - c$, $90° - A$ and b in a circle leaving out the right angle C; consider any one of them as a middle part, then all the formulæ follow from Napier's two rules:—

1st The sine of the middle part = The product of the tangents of the adjacent parts

2nd ,, ,, = ,, cosines ,, opposite ,,

Solution of Oblique-Angled Plane Triangles.

Given the three sides, a, b, c.

$$\sin \frac{A}{2} = \sqrt{\frac{(s - b)(s - c)}{b c}}; \quad \cos \frac{A}{2} = \sqrt{\frac{s (s - a)}{b c}};$$

$$\text{or } \tan \frac{A}{2} = \sqrt{\frac{(s - b)(s - c)}{s (s - a)}}, \text{ where } s = \tfrac{1}{2}(a + b + c).$$

Given two sides and the angle contained, a, b, C.

$$c = b \sec^2 \phi \cos \theta,$$

where $\tan^2 \phi = \frac{a}{b}$

and $\sin \theta = \sin 2\phi \cos \frac{1}{2} C.$

Or $\tan A = \frac{\sin C \sin x}{\sin (C - x)},$

where $\tan x = \frac{a}{b} \sin C$

and c can be found from the formula, $c = \frac{a \sin C}{\sin A}$.

Given the angles and a side, A, B, C, *a.*

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}.$$

Given two sides and an angle opposite one of them, a, b, A.

$$\sin B = \frac{b}{a} \sin A \text{ ; and } c = \frac{a \sin C}{\sin A}.$$

If $b > a$ there are two triangles fulfilling the required conditions.

Reduction of the reading of a Mercurial Barometer to any temperature.

Let h = observed height of the Barometer,
t = temperature of the Attached Thermometer,
T = temperature to which the observed height is to be reduced,
m = expansion, in volume, of mercury,
l = linear expansion of scale,
θ = normal temperature of standard scale (generally = 62° Fah.),

then the reduction to the required temperature will be

$$- h. \frac{m (t - T) - l (t - \theta)}{1 + m (t - T)}.$$

Comparison of the Thermometrical Scales.

$x°$ Fahrenheit $= \left(x° - 32°\right) \frac{5}{9}$ Centigrade $= \left(x° - 32°\right) \frac{4}{9}$ Reaumur

$x°$ Centigrade* $= \left(32° + \frac{9}{5} x°\right)$ Fahrenheit $= \frac{4}{5} x°$ Reaumur

$x°$ Reaumur $= \left(32° + \frac{9}{4} x°\right)$ Fahrenheit $= \frac{5}{4} x°$ Centigrade.

* This graduation was used by Celsius and is sometimes called after him.

APPENDIX.

No. 4.

Certain Numerical Quantities frequently required.

Base of Napierian Logarithms	=	ϵ = 2·718 2818 285
Modulus of the common Logarithms	= log	ϵ = 0·434 2944 819
Ratio of the circumference of a circle to its diameter	=	π = 3·141 5926 536
		log π = 0·497 1498 727
Arc of a circle equal in length to the radius	=	57° 17′ 44″·8
Sin 1″ = 0·0000048481	log sin 1″	= $\bar{6}$·685 5748 668
	log cosec 1″	= 5·314 4251 332
Weight of a litre of dry air (bar. = 760 millimetres, ther. = 0°C)	=	1·293 grammes
,, cubic foot of water = 436247·424 grains . . .	=	62·32 lbs. avoir.
Length of the seconds pendulum in latitude of Greenwich . .	=	39·1400 inches
Acceleration produced by gravity ,, ,,	=	32·191374 ft. per sec.
Co-efficient of expansion of air in volume per 1° Fahrenheit	=	0·0020361
,, ,, mercury in volume ,,	=	0·0001001
,, of linear expansion of brass ,,	=	0·0000104
,, ,, ,, iron ,,	=	0·0000065
,, ,, ,, glass ,,	=	0·0000050

Velocity of light = 186300 miles per second

,, sound in air at 32° Fahrenheit = 1091 feet per second.

APPENDIX.

No. 5.

The Morse Alphabet.

The system adopted in the army and navy is called the *flashing system*, and has for its elements a long and a short flash, representing a dash (——) and a dot (-). Every requisite signal is formed of a combination of these symbols with pauses of proper duration. A dash occupies the space of three dots. The pause between the symbols composing a letter or other sign equals a dot; that between the letters of a word a dash.

All messages are spelt out by means of the Morse Alphabet. No abbreviations are used, except such as are common in ordinary writing, or may be specially authorised.

A - ——	B —— - - -
C —— - —— -	D —— - -
E -	F - - —— -
G —— —— -	H - - - -
I - -	J - —— —— ——
K —— - ——	L - —— - -
M —— ——	N —— -
O —— —— ——	P - —— —— -
Q —— —— - ——	R - —— -
S - - -	T ——
U - - ——	V - - - ——
W - —— ——	X —— - - ——
Y —— - —— ——	Z —— —— - -

Miscellaneous Signs.

Station sign - —— —— -	Repeat - - —— —— - -
Right - —— - ——	Cipher —— - —— - —— - —— -
Comma - —— - —— - ——	Full stop - - - - - -

Preparative or Erasure - - - - - - - - - etc.

Stop —— —— —— —— —— —— —— etc.

General answer —— - —— - —— - etc.

The *station sign* followed by a letter is the distinguishing signal of the station to which that letter has been assigned. This is used at the beginning of every message as a call signal, and at the end to show that the message is finished.

The *repeat sign* is used after receiving a message to show what words require repetition. The numerical order of such words is indicated by the letters a. b. c. . . . . k instead of the figures 1. 2. 3. . . . . 0. Thus "repeat" bk means repeat the 20th word of the message.

The *cipher sign* is used when the whole or part of a message is to be transmitted in cipher. It should precede and follow the portion in cipher.

The *preparative* is used when communicating with two or more stations in sight to call their attention. It is also used to call the attention of an unknown station. To acknowledge this sign, the receiving station should give, instead of the "general answer", its own distinguishing letter (without the prefix P.), and repeat this till the next signal is begun.

This sign is also the *erasure*, and is used to erase a word that has been wrongly sent. It should in this case be acknowledged by the erasure.

The *stop* denotes the end of a message that has been preceded by no distinguishing signal.

The *general answer* is the acknowledgment of a signal received.

Every word must be repeated till answered before the next word is sent.

APPENDIX.

No. 6.

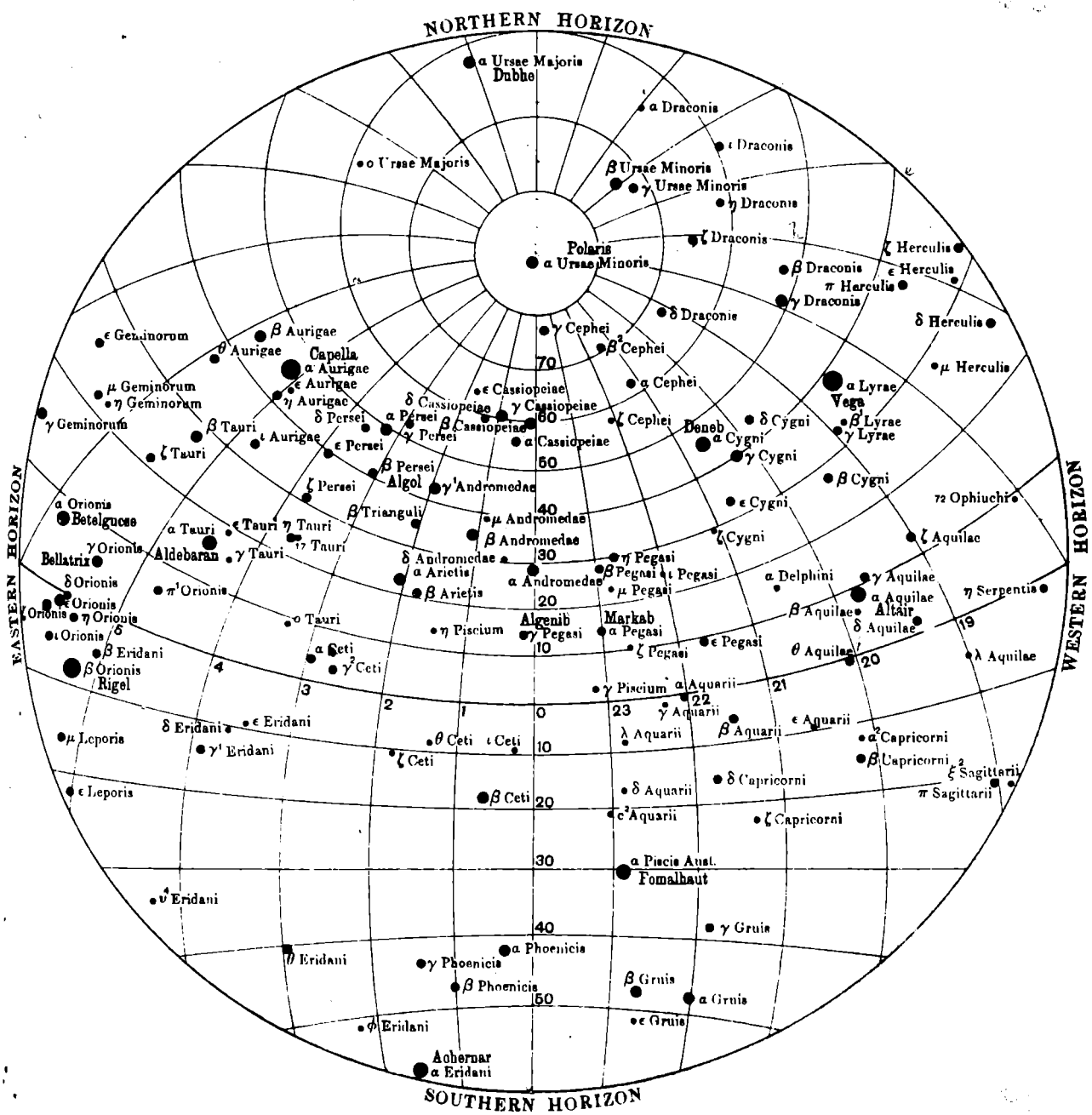
Star Charts.

These Charts represent the aspect of the heavens as seen from a place in latitude 30° N.

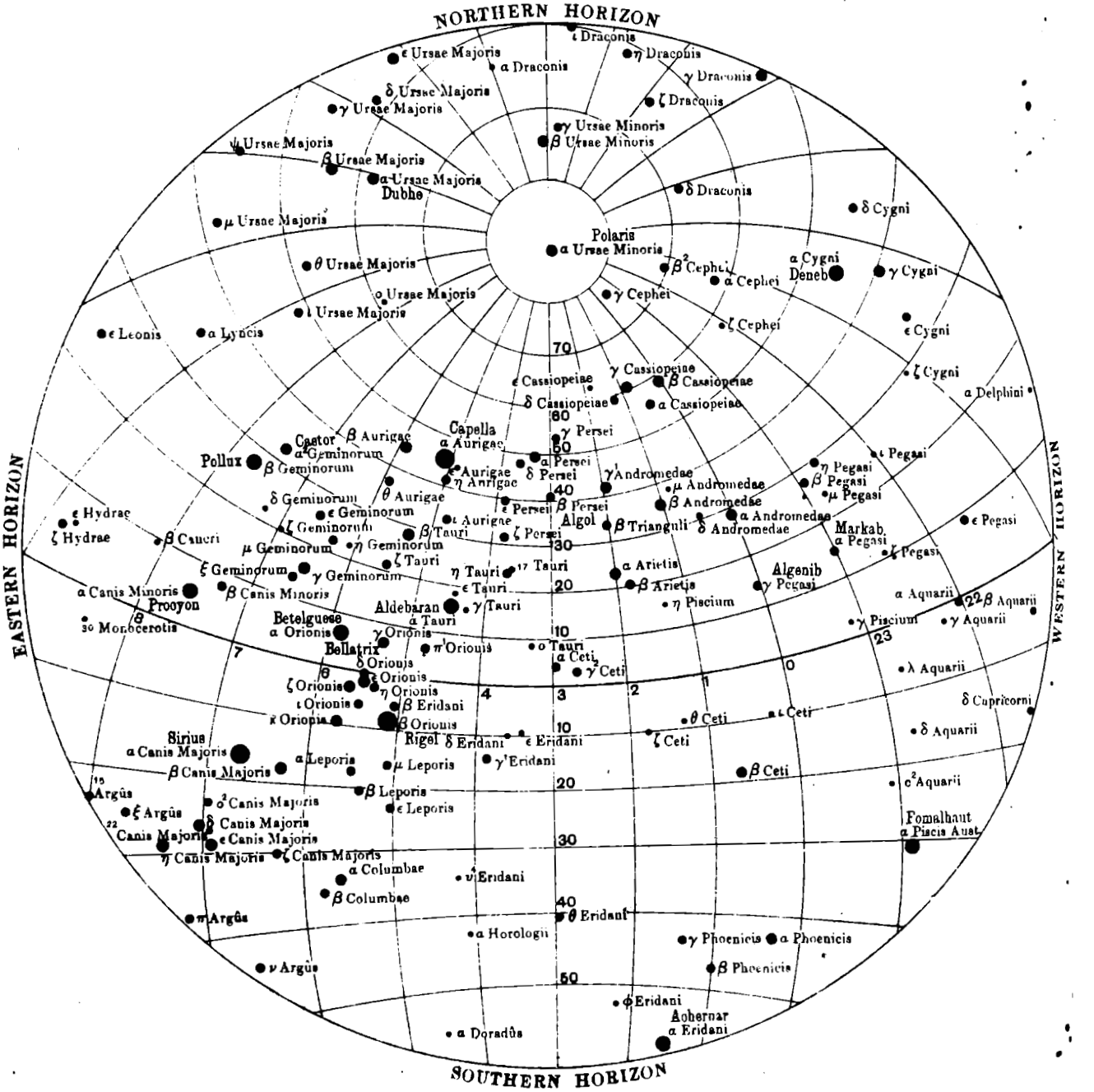
The projection used is the ordinary stereographical one, the eye being supposed at the nadir and the plane of projection that passing through the centre and perpendicular to the line joining the zenith and nadir. In this projection every circle on the sphere is represented by a circle on the plane and it is a very simple matter to determine the positions of the centres and the radii of the various circles representing the graticule of right ascension and declination. The stars are taken from the Nautical Almanac of 1909 and go down to the 4th Magnitude.

STAR CHART FOR LATITUDE 30° N.

0 HOURS

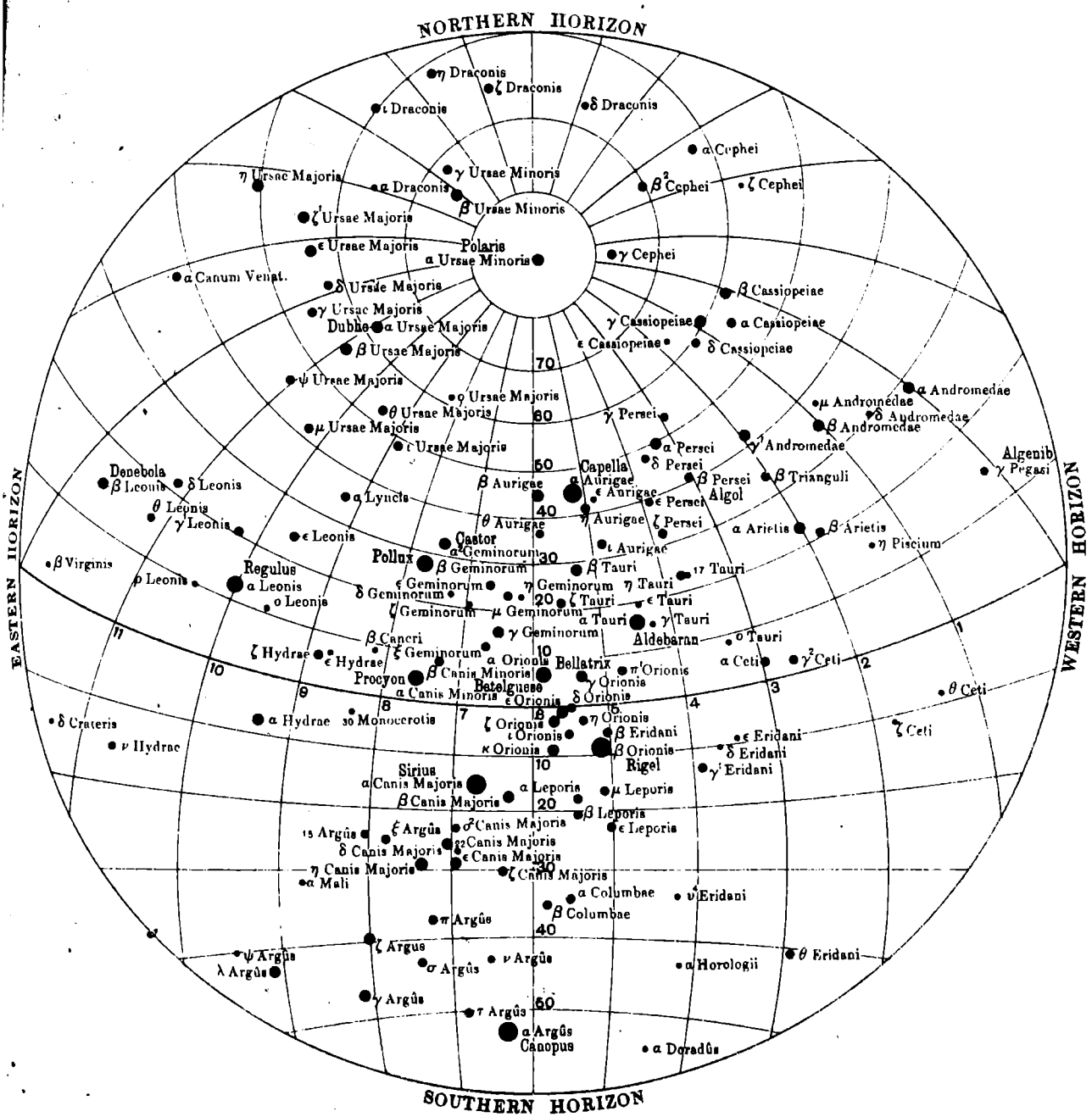


STAR CHART FOR LATITUDE 30° N.
3 HOURS

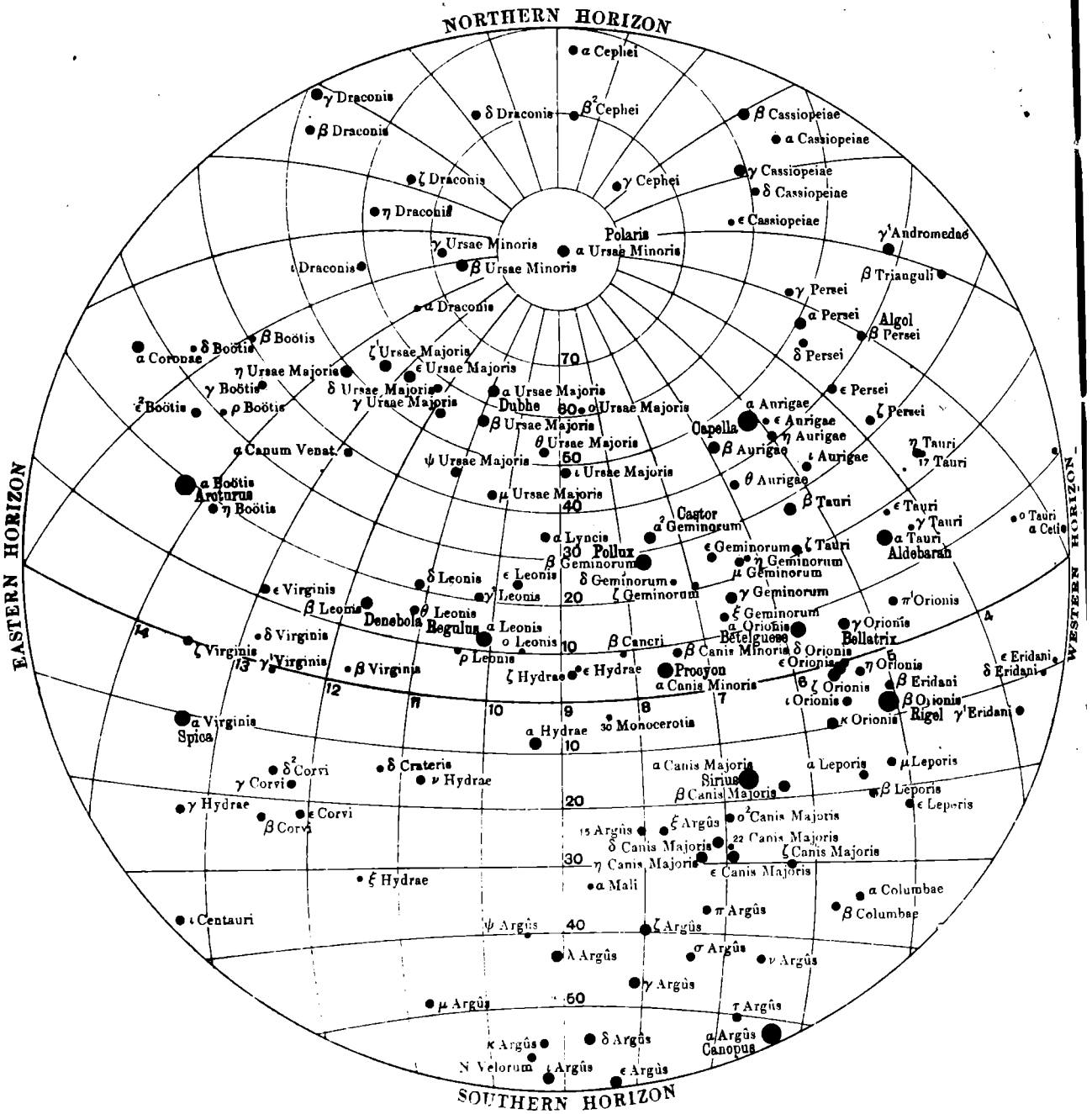


STAR CHART FOR LATITUDE 30° N.

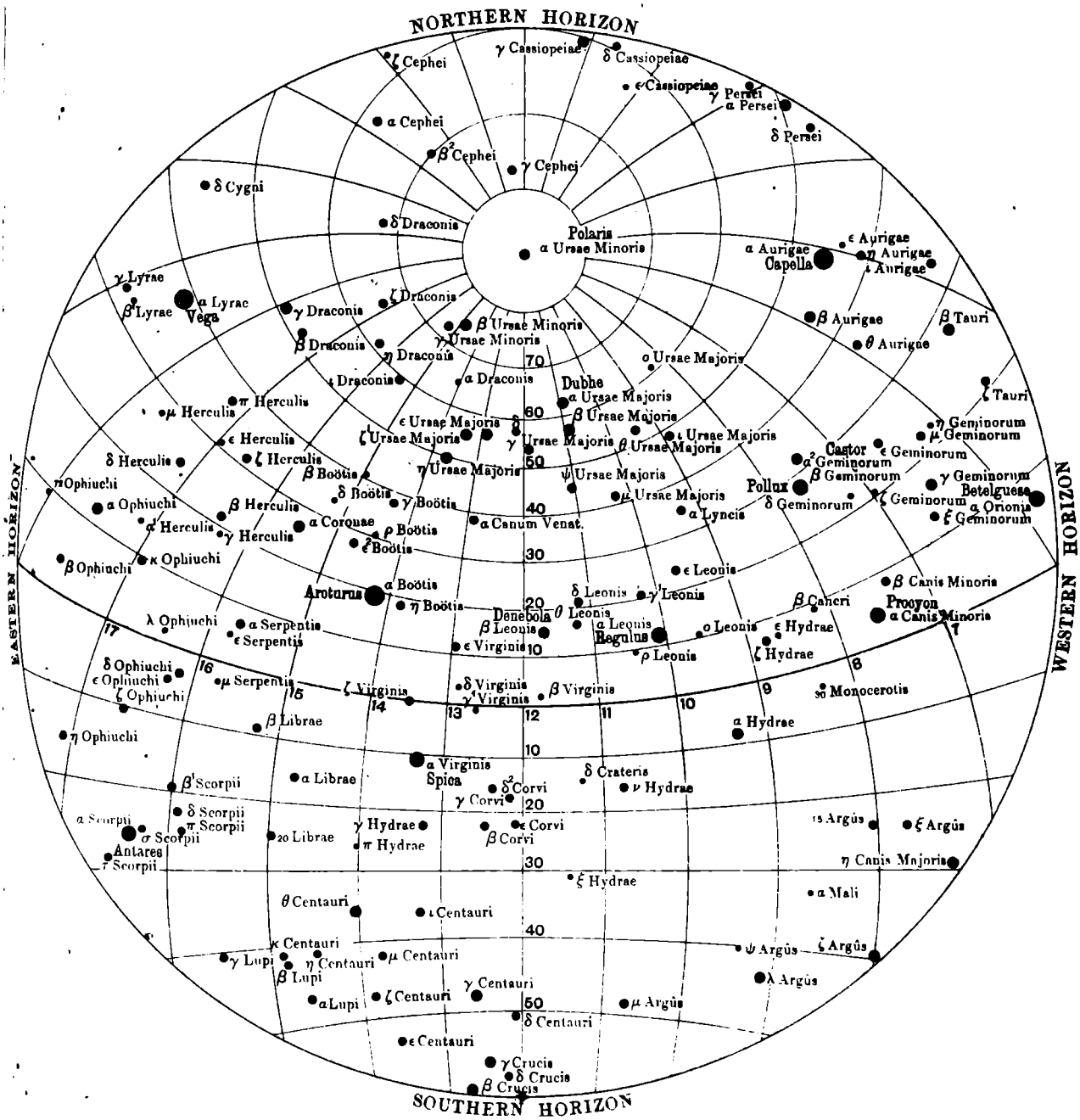
6 HOURS



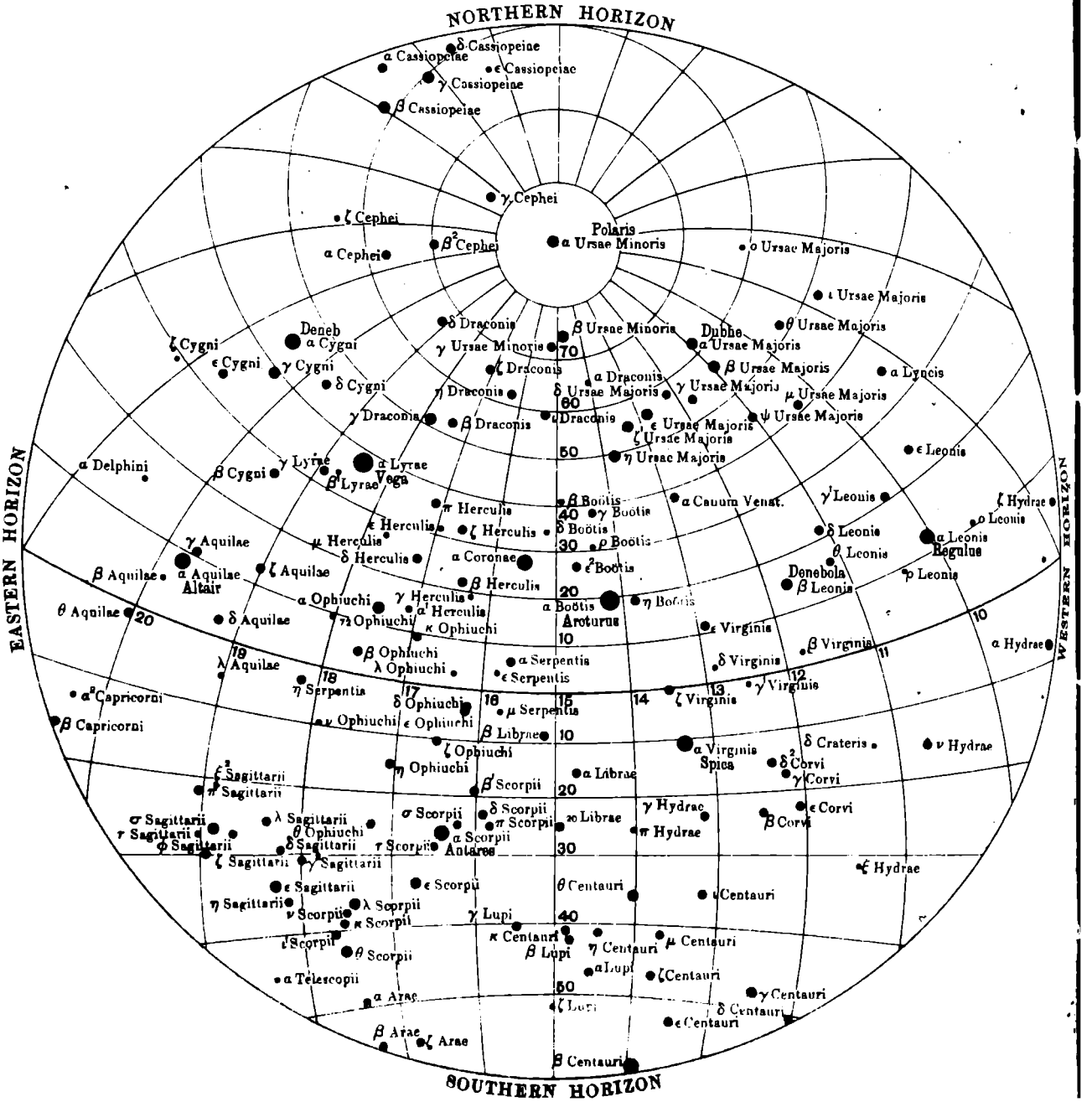
STAR CHART FOR LATITUDE 30° N.
9 HOURS



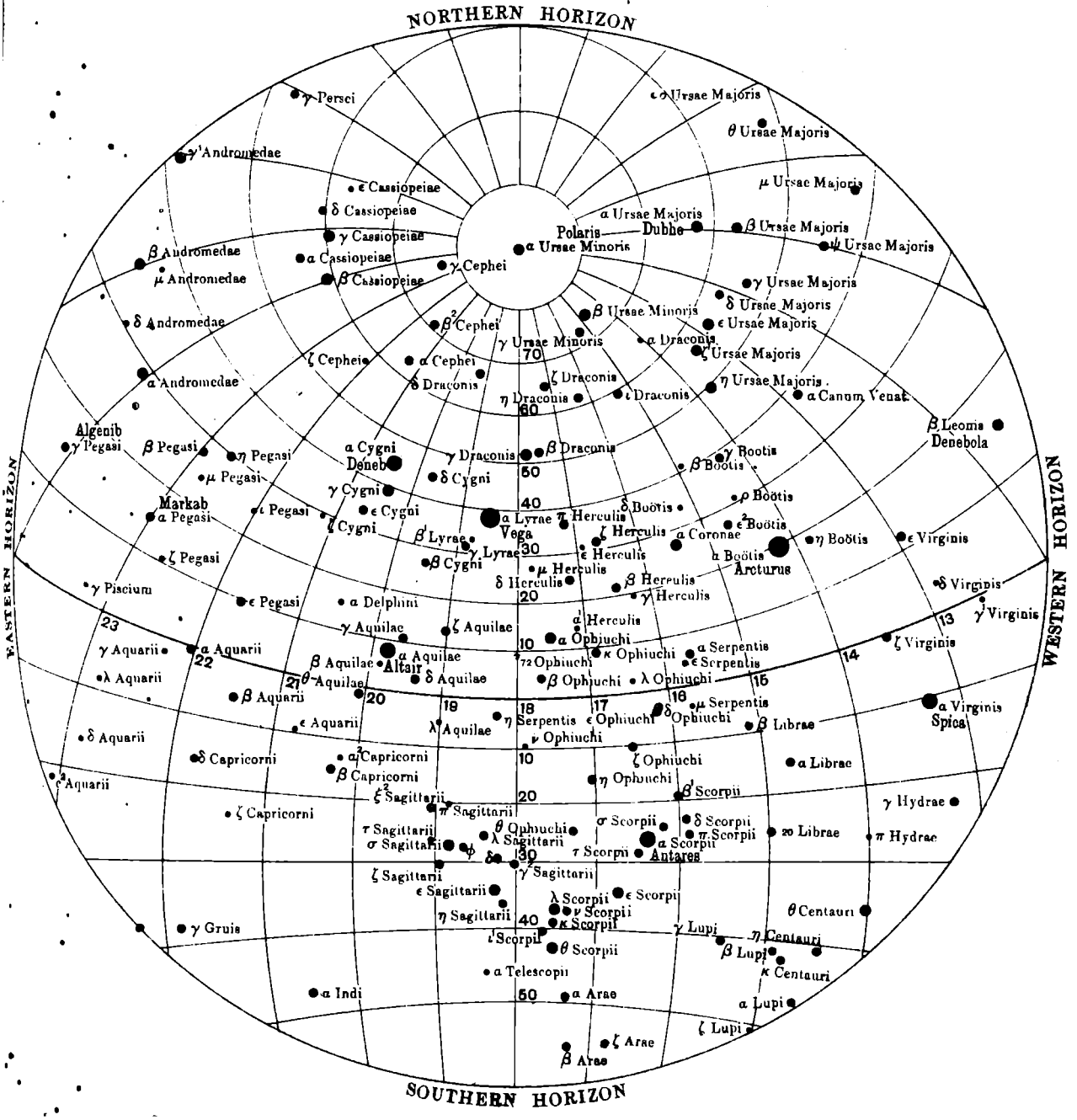
STAR CHART FOR LATITUDE 30° N.
12 HOURS



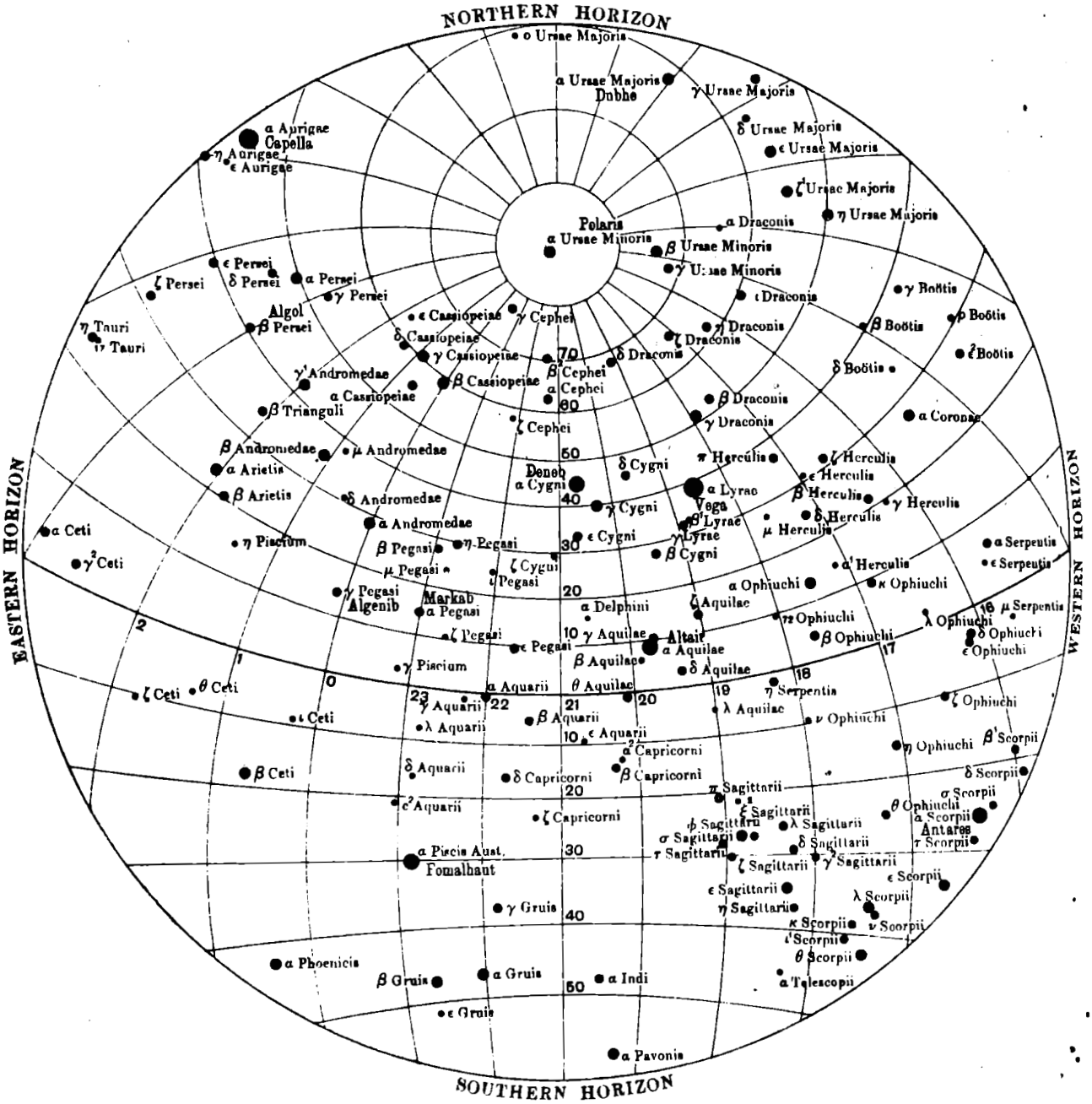
STAR CHART FOR LATITUDE 30° N.
15 HOURS



STAR CHART FOR LATITUDE 30° N.
18 HOURS



STAR CHART FOR LATITUDE 30° N.
21 HOURS



TABLES.

TABLE I.—Normals terminated by the Minor Axis, and their Logarithms.

Latitude		Normals in feet	Diff.	Logarithms of the Normals	Diff.	Latitude		Normals in feet	Diff.	Logarithms of the Normals	Diff.
°	′	209		7·320		°	′	209		7·320	
0	0	22931·8	+	6225,40	+	7	0	23963·2	+	6439,48	+
	10	22932·4	0·6	6225,52	,12		10	24012·7	49·5	6449,75	10,27
	20	22934·2	1·8	6225,88	,36		20	24063·3	50·6	6460,24	10,49
	30	22937·1	2·9	6226,49	,61		30	24115·0	51·7	6470,98	10,74
	40	22941·2	4·1	6227,35	,86		40	24167·8	52·8	6481,95	10,97
	50	22946·5	5·3	6228,44	1,09		50	24221·8	54·0	6493,16	11,21
1	0	22953·0	6·5	6229,79	1,35	8	0	24277·0	55·2	6504,60	11,44
	10	22960·6	7·6	6231,37	1,58		10	24333·2	56·2	6516,27	11,67
	20	22969·4	8·8	6233,20	1,83		20	24390·6	57·4	6528,18	11,91
	30	22979·4	10·0	6235,27	2,07		30	24449·1	58·5	6540,33	12,15
	40	22990·5	11·1	6237,59	2,32		40	24508·7	59·6	6552,70	12,37
	50	23002·9	12·4	6240,15	2,56		50	24569·5	60·8	6565,31	12,61
2	0	23016·4	13·5	6242,95	2,80	9	0	24631·4	61·9	6578,16	12,85
	10	23031·1	14·7	6246,00	3,05		10	24694·4	63·0	6591,23	13,07
	20	23046·9	15·8	6249,29	3,29		20	24758·5	64·1	6604,54	13,31
	30	23063·9	17·0	6252,82	3,53		30	24823·7	65·2	6618,08	13,54
	40	23082·1	18·2	6256,60	3,78		40	24890·0	66·3	6631,84	13,76
	50	23101·5	19·4	6260,61	4,01		50	24957·5	67·5	6645,84	14,00
3	0	23122·0	20·5	6264,88	4,27	10	0	25026·0	68·5	6660,07	14,23
	10	23143·7	21·7	6269,38	4,50		10	25095·7	69·7	6674,53	14,46
	20	23166·6	22·9	6274,13	4,75		20	25166·5	70·8	6689,22	14,69
	30	23190·6	24·0	6279,12	4,99		30	25238·3	71·8	6704,13	14,91
	40	23215·8	25·2	6284,35	5,23		40	25311·3	73·0	6719,27	15,14
	50	23242·2	26·4	6289,82	5,47		50	25385·3	74·0	6734,64	15,37
4	0	23269·7	27·5	6295,53	5,71	11	0	25460·5	75·2	6750,24	15,60
	10	23298·4	28·7	6301,49	5,96		10	25536·7	76·2	6766,06	15,82
	20	23328·3	29·9	6307,69	6,20		20	25614·1	77·4	6782,11	16,05
	30	23359·3	31·0	6314,13	6,44		30	25692·5	78·4	6798,39	16,28
	40	23391·5	32·2	6320,81	6,68		40	25772·0	79·5	6814,89	16,50
	50	23424·8	33·3	6327,73	6,92		50	25852·6	80·6	6831,61	16,72
5	0	23459·3	34·5	6334,89	7,16	12	0	25934·2	81·6	6848,56	16,95
	10	23495·0	35·7	6342,29	7,40		10	26017·0	82·8	6865,73	17,17
	20	23531·8	36·8	6349,93	7,64		20	26100·8	83·8	6883,12	17,39
	30	23569·8	38·0	6357,81	7,88		30	26185·6	84·8	6900,74	17,62
	40	23608·9	39·1	6365,93	8,12		40	26271·6	86·0	6918,57	17,83
	50	23649·2	40·3	6374,29	8,36		50	26358·6	87·0	6936,63	18,06
6	0	23690·6	41·4	6382,89	8,60	13	0	26446·6	88·0	6954,90	18,27
	10	23733·2	42·6	6391,73	8,84		10	26535·8	89·2	6973,40	18,50
	20	23776·9	43·7	6400,80	9,07		20	26625·9	90·1	6992,11	18,71
	30	23821·8	44·9	6410,12	9,32		30	26717·2	91·3	7011,05	18,94
	40	23867·8	46·0	6419,67	9,55		40	26809·5	92·3	7030,20	19,15
	50	23914·9	47·1	6429,46	9,79		50	26902·8	93·3	7049,57	19,37
	60	23963·2	48·3	6439,48	10,02		60	26997·1	94·3	7069,15	19,58
		209		7·320				209		7·320	

TABLE I.—Normals terminated by the Minor Axis, and their Logarithms.

Latitude	Normals in feet	Diff.	Logarithms of the Normals	Diff.	Latitude	Normals in feet	Diff.	Logarithms of the Normals	Diff.
° ′	209		7·320		° ′	209		7·320	
14 0	26997·1	+	7069,15	+	21 0	31855·7	+	8077,33	+
10	27092·6	95·5	7088,95	19,80	10	31991·5	135·8	8105,50	28,17
20	27189·0	96·4	7108,96	20,01	20	32128·1	136·6	8133,85	28,35
30	27286·5	97·5	7129,19	20,23	30	32265·7	137·6	8162,38	28,53
40	27385·0	98·5	7149,64	20,45	40	32404·0	138·3	8191,09	28,71
50	27484·5	99·5	7170,29	20,65	50	32543·3	139·3	8219,98	28,89
15 0	27585·1	100·6	7191,16	20,87	22 0	32683·4	140·1	8249,04	29,06
10	27686·6	101·5	7212,24	21,08	10	32824·3	140·9	8278,28	29,24
20	27789·2	102·6	7233,53	21,29	20	32966·1	141·8	8307,70	29,42
30	27892·8	103·6	7255,03	21,50	30	33108·7	142·6	8337,29	29,59
40	27997·5	104·7	7276,74	21,71	40	33252·2	143·5	8367,05	29,76
50	28103·1	105·6	7298,65	21,91	50	33396·5	144·3	8396,99	29,94
16 0	28209·7	106·6	7320,78	22,13	23 0	33541·6	145·1	8427,09	30,10
10	28317·3	107·6	7343,11	22,33	10	33687·5	145·9	8457,37	30,28
20	28425·9	108·6	7365,65	22,54	20	33834·3	146·8	8487,81	30,44
30	28535·5	109·6	7388,40	22,75	30	33981·8	147·5	8518,43	30,62
40	28646·1	110·6	7411,35	22,95	40	34130·2	148·4	8549,21	30,78
50	28757·7	111·6	7434,50	23,15	50	34279·4	149·2	8580,15	30,94
17 0	28870·3	112·6	7457,86	23,36	24 0	34429·3	149·9	8611,26	31,11
10	28983·8	113·5	7481,42	23,56	10	34580·1	150·8	8642,54	31,28
20	29098·3	114·5	7505,19	23,77	20	34731·6	151·5	8673,98	31,44
30	29213·8	115·5	7529,15	23,96	30	34883·9	152·3	8705,58	31,60
40	29330·3	116·5	7553,31	24,16	40	35037·0	153·1	8737,34	31,76
50	29447·7	117·4	7577,67	24,36	50	35190·9	153·9	8769,26	31,92
18 0	29566·0	118·3	7602,24	24,57	25 0	35345·5	154·6	8801,33	32,07
10	29685·4	119·4	7627,00	24,76	10	35500·9	155·4	8833,57	32,24
20	29805·6	120·2	7651,95	24,95	20	35657·1	156·2	8865,96	32,39
30	29926·9	121·3	7677,10	25,15	30	35814·0	156·9	8898,51	32,55
40	30049·0	122·1	7702,45	25,35	40	35971·6	157·6	8931,21	32,70
50	30172·1	123·1	7727,99	25,54	50	36130·0	158·4	8964,07	32,86
19 0	30296·1	124·0	7753,73	25,74	26 0	36289·1	159·1	8997,07	33,00
10	30421·1	125·0	7779,66	25,93	10	36449·0	159·9	9030,23	33,16
20	30547·0	125·9	7805,78	26,12	20	36609·5	160·5	9063,54	33,31
30	30673·8	126·8	7832,09	26,31	30	36770·8	161·3	9096,99	33,45
40	30801·5	127·7	7858,59	26,50	40	36932·8	162·0	9130,60	33,61
50	30930·1	128·6	7885,28	26,69	50	37095·5	162·7	9164,35	33,75
20 0	31059·7	129·6	7912,16	26,88	27 0	37258·9	163·4	9198,24	33,89
10	31190·1	130·4	7939,22	27,06	10	37423·0	164·1	9232,28	34,04
20	31321·5	131·4	7966,47	27,25	20	37587·8	164·8	9266,46	34,18
30	31453·7	132·2	7993,91	27,44	30	37753·3	165·5	9300,79	34,33
40	31586·8	133·1	8021,53	27,62	40	37919·5	166·2	9335,25	34,46
50	31720·8	134·0	8049,34	27,81	50	38086·3	166·8	9369,85	34,60
60	31855·7	134·9	8077,33	27,99	60	38253·8	167·5	9404,60	34,75
	209		7·320			209		7·320	

TABLE I.—Normals terminated by the Minor Axis, and their Logarithms.

Latitude	Normals in feet	Diff.	Logarithms of the Normals	Diff.	Latitude	Normals in feet	Diff.	Logarithms of the Normals	Diff.
° ′	209		7·320		° ′	209		7·321	
28 0	38253·8	+	9404,60	+	34 0	44679·8	+	0737,26	+
10	38422·0	168·2	9439,48	34,88	10	44867·9	188·1	0776,26	39,00
20	38590·8	168·8	9474,49	35,01	20	45056·5	188·6	0815,35	39,09
30	38760·2	169·4	9509,64	35,15	30	45245·4	188·9	0854,54	39,19
40	38930·4	170·2	9544,93	35,29	40	45434·8	189·4	0893,81	39,27
50	39101·1	170·7	9580,34	35,41	50	45624·6	189·8	0933,16	39,35
29 0	39272·5	171·4	9615,89	35,55	35 0	45814·9	190·3	0972,61	39,45
10	39444·5	172·0	9651,57	35,68	10	46005·5	190·6	1012,14	39,53
20	39617·2	172·7	9687,37	35,80	20	46196·6	191·1	1051,75	39,61
30	39790·4	173·2	9723,31	35,94	30	46388·0	191·4	1091,44	39,69
40	39964·3	173·9	9759,37	36,06	40	46579·8	191·8	1131,21	39,77
50	40138·8	174·5	9795,55	36,18	50	46772·0	192·2	1171,06	39,85
30 0	40313·8	175·0	9831,86	36,31	36 0	46964·6	192·6	1210,99	39,93
10	40489·5	175·7	9868,30	36,44	10	47157·6	193·0	1251,00	40,01
20	40665·8	176·3	9904,85	36,55	20	47350·9	193·3	1291,08	40,08
30	40842·6	176·8	9941,52	36,67	30	47544·6	193·7	1331,23	40,15
40	41020·0	177·4	9978,32	36,80	40	47738·6	194·0	1371,46	40,23
50	41198·0	178·0	0015,23	36,91	50	47933·0	194·4	1411,76	40,30
31 0	41376·5	178·5	0052,26	37,03	37 0	48127·7	194·7	1452,13	40,37
10	41555·6	179·1	0089,40	37,14	10	48322·7	195·0	1492,56	40,43
20	41735·3	179·7	0126,66	37,26	20	48518·1	195·4	1533,06	40,50
30	41915·5	180·2	0164,03	37,37	30	48713·8	195·7	1573,63	40,57
40	42096·2	180·7	0201,51	37,48	40	48909·8	196·0	1614,26	40,63
50	42277·5	181·3	0239,10	37,59	50	49106·1	196·3	1654,96	40,70
32 0	42459·3	181·8	0276,80	37,70	38 0	49302·7	196·6	1695,71	40,75
10	42641·6	182·3	0314,61	37,81	10	49499·5	196·8	1736,53	40,82
20	42824·5	182·9	0352,53	37,92	20	49696·7	197·2	1777,40	40,87
30	43007·8	183·3	0390,55	38,02	30	49894·2	197·5	1818,33	40,93
40	43191·7	183·9	0428,67	38,12	40	50091·9	197·7	1859,32	40,99
50	43376·0	184·3	0466,90	38,23	50	50289·9	198·0	1900,36	41,04
33 0	43560·9	184·9	0505,23	38,33	39 0	50488·1	198·2	1941,45	41,09
10	43746·2	185·3	0543,66	38,43	10	50686·6	198·5	1982,60	41,15
20	43932·0	185·8	0582,19	38,53	20	50885·3	198·7	2023,79	41,19
30	44118·2	186·2	0620,81	38,62	30	51084·3	199·0	2065,04	41,25
40	44305·0	186·8	0659,53	38,72	40	51283·5	199·2	2106,33	41,29
50	44492·2	187·2	0698,35	38,82	50	51482·9	199·4	2147,67	41,34
60	44679·8	187·6	0737,26	38,91	60	51682·6	199·7	2189,05	41,38
	209		7·321			209		7·321	

TABLE II.—Radii of Curvature to the Meridian, and their Logarithms.

Latitude	Radii of Curvature in feet	Diff.	Logthms. of the Radii of Curvature	Diff.	Latitude	Radii of Curvature in feet	Diff.	Logthms. of the Radii of Curvature	Diff.
° ′	207		7·317		° ′	207		7·317	
0 0	84048·6	+	7301,49	+	7 0	87122·5	+	7943,76	+
10	84050·4	1·8	7301,86	,37	10	87269·9	147·4	7974,54	30,78
20	84055·6	5·2	7302,96	1,10	20	87420·6	150·7	8006,04	31,50
30	84064·4	8·8	7304,78	1,82	30	87574·8	154·2	8038,25	32,21
40	84076·6	12·2	7307,35	2,57	40	87732·3	157·5	8071,16	32,91
50	84092·4	15·8	7310,64	3,29	50	87893·2	160·9	8104,78	33,62
1 0	84111·6	19·2	7314,66	4,02	8 0	88057·5	164·3	8139,10	34,32
10	84134·4	22·8	7319,42	4,76	10	88225·2	167·7	8174,13	35,03
20	84160·7	26·3	7324,91	5,49	20	88396·2	171·0	8209,86	35,73
30	84190·4	29·7	7331,12	6,21	30	88570·6	174·4	8246,29	36,43
40	84223·7	33·3	7338,07	6,95	40	88748·4	177·8	8283,42	37,13
50	84260·4	36·7	7345,75	7,68	50	88929·4	181·0	8321,25	37,83
2 0	84300·7	40·3	7354,16	8,41	9 0	89113·9	184·5	8359,78	38,53
10	84344·4	43·7	7363,30	9,14	10	89301·6	187·7	8399,00	39,22
20	84391·6	47·2	7373,17	9,87	20	89492·7	191·1	8438,92	39,92
30	84442·4	50·8	7383,77	10,60	30	89687·1	194·4	8479,53	40,61
40	84496·6	54·2	7395,10	11,33	40	89884·9	197·8	8520,84	41,31
50	84554·3	57·7	7407,15	12,05	50	90085·9	201·0	8562,84	42,00
3 0	84615·5	61·2	7419,94	12,79	10 0	90290·2	204·3	8605,52	42,68
10	84680·1	64·6	7433,45	13,51	10	90497·9	207·7	8648,89	43,37
20	84748·3	68·2	7447,69	14,24	20	90708·8	210·9	8692,95	44,06
30	84819·9	71·6	7462,65	14,96	30	90923·0	214·2	8737,70	44,75
40	84895·0	75·1	7478,35	15,70	40	91140·5	217·5	8783,13	45,43
50	84973·6	78·6	7494,77	16,42	50	91361·2	220·7	8829,24	46,11
4 0	85055·6	82·0	7511,91	17,14	11 0	91585·2	224·0	8876,03	46,79
10	85141·1	85·5	7529,78	17,87	10	91812·5	227·3	8923,50	47,47
20	85230·1	89·0	7548,37	18,59	20	92043·0	230·5	8971,65	48,15
30	85322·6	92·5	7567,69	19,32	30	92276·8	233·8	9020,47	48,82
40	85418·5	95·9	7587,73	20,04	40	92513·7	236·9	9069,97	49,50
50	85517·8	99·3	7608,49	20,76	50	92753·9	240·2	9120,14	50,17
5 0	85620·7	102·9	7629,97	21,48	12 0	92997·4	243·5	9170,98	50,84
10	85726·9	106·2	7652,18	22,21	10	93244·0	246·6	9222,49	51,51
20	85836·6	109·7	7675,10	22,92	20	93493·8	249·8	9274,67	52,18
30	85949·8	113·2	7698,74	23,64	30	93746·8	253·0	9327,51	52,84
40	86066·4	116·6	7723,10	24,36	40	94003·0	256·2	9381,02	53,51
50	86186·4	120·0	7748,18	25,08	50	94262·4	259·4	9435,19	54,17
6 0	86309·9	123·5	7773,98	25,80	13 0	94524·9	262·5	9490,02	54,83
10	86436·8	126·9	7800,49	26,51	10	94790·6	265·7	9545,51	55,49
20	86567·1	130·3	7827,72	27,23	20	95059·4	268·8	9601,65	56,14
30	86700·8	133·7	7855,66	27,94	30	95331·4	272·0	9658,45	56,80
40	86838·0	137·2	7884,31	28,65	40	95606·5	275·1	9715,90	57,45
50	86978·5	140·5	7913,68	29,37	50	95884·7	278·2	9774,01	58,11
60	87122·5	144·0	7943,76	30,08	60	96166·0	281·3	9832,76	58,75
	207		7·317			207		7·317	

TABLE II.—Radii of Curvature to the Meridian, and their Logarithms.

Latitude		Radii of Curvature in feet	Diff.	Logthms. of the Radii of Curvature	Diff.	Latitude		Radii of Curvature in feet	Diff.	Logthms. of the Radii of Curvature	Diff.
°	′	207		7·317		°	′	208		7·318	
14	0	96166·0	+	9832,76	+	21	0	10654·0	+	2857,29	+
	10	96450·4	284·4	9892,16	59,40		10	11059·0	405·0	2941,80	84,51
	20	96738·0	287·6	9952,20	60,04		20	11466·6	407·6	3026,85	85,05
	30	97028·6	290·6	0012,89	60,69		30	11876·7	410·1	3112,45	85,60
	40	97322·3	293·7	0074,21	61,32		40	12289·5	412·8	3198,58	86,13
	50	97619·0	296·7	0136,18	61,97		50	12704·8	415·3	3285,24	86,66
15	0	97918·8	299·8	0198,78	62,60	22	0	13122·6	417·8	3372,43	87,19
	10	98221·6	302·8	0262,02	63,24		10	13543·1	420·5	3460,16	87,73
	20	98527·5	305·9	0325,89	63,87		20	13966·0	422·9	3548,40	88,24
	30	98836·4	308·9	0390.39	64,50		30	14391·4	425·4	3637,17	88,77
	40	99148·3	311·9	0455,52	65,13		40	14819·4	428·0	3726,46	89.29
	50	99463·2	314·9	0521,27	65,75		50	15249·8	430·4	3816,27	89,81
16	0	99781·1	317·9	0587,65	66,38	23	0	15682·7	432·9	3906,59	90,32
	10	00102·0	320·9	0654,65	67,00		10	16118·0	435·3	3997,41	90,82
	20	00425·9	323·9	0722,27	67,62		20	16555·8	437·8	4088,75	91,34
	30	00752·7	326·8	0790,51	68,24		30	16996·0	440·2	4180,59	91,84
	40	01082·5	329·8	0859,36	68,85		40	17438·6	442·6	4272,93	92,34
	50	01415·2	332·7	0928,82	69,46		50	17883·6	445·0	4365,77	92,84
17	0	01750·8	335·6	0998,89	70,07	24	0	18331·0	447·4	4459,10	93,33
	10	02089·4	338·6	1069,58	70,69		10	18780·8	449·8	4552,93	93,83
	20	02430·8	341·4	1140,86	71,28		20	19232·9	452·1	4647,24	94,31
	30	02775·2	344·4	1212,75	71,89		30	19687·4	454·5	4742,04	94,80
	40	03122·4	347·2	1285,24	72,49		40	20144·1	456·7	4837,32	95,28
	50	03472·5	350·1	1358,33	73,09		50	20603·2	459·1	4933,08	95,76
18	0	03825·5	353·0	1432,02	73,69	25	0	21064·6	461·4	5029,31	96,23
	10	04181·3	355·8	1506,29	74,27		10	21528·2	463·6	5126,02	96,71
	20	04539·9	358·6	1581,16	74,87		20	21994·1	465·9	5223,19	97,17
	30	04901·4	361·5	1656,62	75,46		30	22462·3	468·2	5320,84	97,65
	40	05265·7	364·3	1732,66	76,04		40	22932·6	470·3	5418,94	98,10
	50	05632·8	367·1	1809,29	76,63		50	23405·2	472·6	5517,50	98,56
19	0	06002·6	369·8	1886,49	77,20	26	0	23880·0	474·8	5616,52	99,02
	10	06375·3	372·7	1964.28	77,79		10	24357·0	477·0	5716,00	99,48
	20	06750·7	375·4	2042,64	78,36		20	24836·1	479·1	5815,92	99,92
	30	07128·9	378·2	2121,57	78,93		30	25317·4	481·3	5916,28	100,36
	40	07509·8	380·9	2201,07	79,50		40	25800·8	483·4	6017,09	100,81
	50	07893·4	383·6	2281,14	80,07		50	26286·3	485·5	6118,34	101,25
20	0	08279·7	386·3	2361,78	80,64	27	0	26773·9	487·6	6220,03	101,69
	10	08668·8	389·1	2442.97	81,19		10	27263·7	489·8	6322,15	102,12
	20	09060·5	391·7	2524,73	81,76		20	27755·4	491·7	6424,69	102,54
	30	09454·9	394·4	2607,04	82,31		30	28249·3	493·9	6527,66	102,97
	40	09852·0	397·1	2689,91	82,87		40	28745·1	495·8	6631,06	103,40
	50	10251·7	399·7	2773,32	83,41		50	29243·0	497·9	6734,87	103,81
	60	10654·0	402·3	2857,29	83,97		60	29742·9	499·9	6839,10	104,23
		208		7·318				208		7·318	

TABLE II.—Radii of Curvature to the Meridian, and their Logarithms.

Latitude	Radii of Curvature in feet	Diff.	Logthms. of the Radii of Curvature	Diff.	Latitude	Radii of Curvature in feet	Diff.	Logthms. of the Radii of Curvature	Diff.
° ′	208		7·318		° ′	208		7·319	
		+		+			+		+
28 0	29742·9	501·9	6839,10	104,63	34 0	48927·0	561·7	0837,08	117,01
10	30244·8	503·8	6943,73	105,05	10	49488·7	563·0	0954,09	117,28
20	30748·6	505·8	7048,78	105,45	20	50051·7	564·4	1071,37	117,54
30	31254·4	507·8	7154,23	105,85	30	50616·1	565·6	1188,91	117,82
40	31762·2	509·6	7260,08	106,25	40	51181·7	566·9	1306,73	118,07
50	32271·8		7366,33		50	51748·6		1424,80	
29 0	32783·3	511·5	7472,97	106,64	35 0	52316·7	568·1	1543,13	118,33
10	33296·8	513·5	7580,01	107,04	10	52886·1	569·4	1661,72	118,59
20	33812·1	515·3	7687,43	107,42	20	53456·7	570·6	1780,55	118,83
30	34329·2	517·1	7795,23	107,80	30	54028·5	571·8	1899,63	119,08
40	34848·2	519·0	7903,41	108,18	40	54601·5	573·0	2018,95	119,32
50	35369·0	520·8	8011,97	108,56	50	55175·6	574·1	2138,50	119,55
30 0	35891·6	522·6	8120,90	108,93	36 0	55750·8	575·2	2258,29	119,79
10	36416·0	524·4	8230,19	109,29	10	56327·2	576·4	2378,31	120,02
20	36942·1	526·1	8339,86	109,67	20	56904·6	577·4	2498,55	120,24
30	37470·0	527·9	8449,88	110,02	30	57483·1	578·5	2619,01	120,46
40	37999·6	529·6	8560,26	110,38	40	58062·7	579·6	2739,69	120,68
50	38531·0	531·4	8671,00	110,74	50	58643·3	580·6	2860,58	120,89
31 0	39064·0	533·0	8782,08	111,08	37 0	59225·0	581·7	2981,68	121,10
10	39598·7	534·7	8893,51	111,43	10	59807·6	582·6	3102,99	121,31
20	40135·0	536·3	9005,28	111,77	20	60391·2	583·6	3224,49	121,50
30	40673·0	538·0	9117,39	112,11	30	60975·8	584·6	3346,20	121,71
40	41212·6	539·6	9229,84	112,45	40	61561·3	585·5	3468,09	121,89
50	41753·8	541·2	9342,61	112,77	50	62147·8	586·5	3590,17	122,08
32 0	42296·6	542·8	9455,72	113,11	38 0	62735·1	587·3	3712,44	122,27
10	42841·0	544·4	9569,14	113,42	10	63323·3	588·2	3834,88	122,44
20	43386·9	545·9	9682,89	113,75	20	63912·4	589·1	3957,51	122,63
30	43934·3	547·4	9796,95	114,06	30	64502·3	589·9	4080,30	122,79
40	44483·2	548·9	9911.33	114,38	40	65093·1	590·8	4203,26	122,96
50	45033·7	550·5	0026,01	114,68	50	65684·6	591·5	4326,38	123,12
33 0	45585·6	551·9	0141,00	114,99	39 0	66276·9	592·3	4449,66	123,28
10	46139·0	553·4	0256,28	115,28	10	66870·0	593·1	4573,10	123,44
20	46693·8	554·8	0371,86	115,58	20	67463·8	593·8	4696,69	123,59
30	47250·0	556·2	0487,74	115,88	30	68058·4	594·6	4820,43	123,74
40	47807·6	557·6	0603,90	116,16	40	68653·6	595·2	4944,30	123,87
50	48366·6	559·0	0720,35	116,45	50	69249·5	595·9	5068,32	124,02
60	48927·0	560·4	0837,08	116,73	60	69846·1	596·6	5192,47	124,15
	208		7·319			208		7·319	

TABLE III.—Logarithms of the Factor $\frac{(\rho + \nu)^2 \operatorname{cosec} 1''}{8 \rho^2 \nu^2}$ for computing the Spherical Excess of a Triangle.

Latitude	Logarithms	Latitude	Logarithms	Latitude	Logarithms	Latitude	Logarithms
°		°		°		°	
0	$\overline{10}\cdot37505$	11	$\overline{10}\cdot37484$	22	$\overline{10}\cdot37424$	33	$\overline{10}\cdot37333$
1	505	12	480	23	417	34	324
2	504	13	476	24	409	35	315
3	503	14	471	25	402	36	305
4	502	15	466	26	394	37	295
5	500	16	461	27	386	38	286
6	498	17	455	28	377	39	276
7	496	18	450	29	369	40	266
8	494	19	444	30	360		
9	491	20	437	31	351		
10	487	21	431	32	342		

TABLE IV.—For determining the Spherical Excess in Secondary Operations.

Area of Triangle in Square Miles	Mean Latitude of Triangle								
	0°	5°	10°	15°	20°	25°	30°	35°	40°
	"	"	"	"	"	"	"	"	"
5	0·07	0·07	0·07	0·07	0·07	0·07	0·07	0·07	0·07
10	·13	·13	·13	·13	·13	·13	·13	·13	·13
15	·20	·20	·20	·20	·20	·20	·20	·20	·20
20	·26	·26	·26	·26	·26	·26	·26	·26	·26
30	·40	·40	·40	·40	·40	·40	·40	·39	·39
40	·53	·53	·53	·53	·53	·53	·53	·53	·53
50	·66	·66	·66	·66	·66	·66	·66	·66	·66
60	·79	·79	·79	·79	·79	·79	·79	·79	·79
70	·93	·93	·93	·93	·92	·92	·92	·92	·92
80	1·06	1·06	1·06	1·06	1·06	1·06	1·05	1·05	1·05
90	1·19	1·19	1·19	1·19	1·19	1·19	1·19	1·18	1·18
100	1·32	1·32	1·32	1·32	1·32	1·32	1·32	1·32	1·32
200	2·64	2·64	2·64	2·64	2·64	2·64	2·64	2·63	2·63
300	3·97	3·97	3·97	3·96	3·96	3·96	3·95	3·95	3·95
400	5·29	5·29	5·29	5·28	5·28	5·28	5·27	5·27	5·26
500	6·61	6·61	6·61	6·61	6·60	6·60	6·59	6·58	6·58
600	7·93	7·93	7·93	7·93	7·92	7·92	7·91	7·90	7·89
700	9·26	9·26	9·25	9·25	9·24	9·23	9·23	9·22	9·21
800	10·58	10·58	10·57	10·57	10·56	10·55	10·54	10·53	10·52
900	11·90	11·90	11·90	11·89	11·88	11·87	11·86	11·85	11·84
1000	13·22	13·22	13·22	13·21	13·20	13·19	13·18	13·17	13·15

TABLE V.—Reciprocals of Numbers to facilitate the Computation of Weights of Observed Angles.

Numbers	Reciprocals	Numbers	Reciprocals	Numbers	Reciprocals	Numbers	Reciprocals	Numbers	Reciprocals
200·000	0·01	4·878	0·21	2·469	0·41	1·653	0·61	1·242	0·81
66·667	·02	4·651	·22	2·410	·42	1·626	·62	1·227	·82
40·000	·03	4·444	·23	2·353	·43	1·600	·63	1·212	·83
28·571	·04	4·255	·24	2·299	·44	1·575	·64	1·198	·84
22·222	·05	4·082	·25	2·247	·45	1·550	·65	1·183	·85
18·182	·06	3·922	·26	2·198	·46	1·527	·66	1·170	·86
15·385	·07	3·774	·27	2·151	·47	1·504	·67	1·156	·87
13·333	·08	3·636	·28	2·105	·48	1·481	·68	1·143	·88
11·765	·09	3·509	·29	2·062	·49	1·460	·69	1·130	·89
10·526	·10	3·390	·30	2·020	·50	1·439	·70	1·117	·90
9·524	·11	3·279	·31	1·980	·51	1·418	·71	1·105	·91
8·696	·12	3·175	·32	1·942	·52	1·399	·72	1·093	·92
8·000	·13	3·077	·33	1·905	·53	1·379	·73	1·081	·93
7·407	·14	2·985	·34	1·869	·54	1·361	·74	1·070	·94
6·897	·15	2·899	·35	1·835	·55	1·342	·75	1·058	·95
6·452	·16	2·817	·36	1·802	·56	1·325	·76	1·047	·96
6·061	·17	2·740	·37	1·770	·57	1·307	·77	1·036	·97
5·714	·18	2·667	·38	1·739	·58	1·290	·78	1·026	·98
5·405	·19	2·597	·39	1·709	·59	1·274	·79	1·015	·99
5·128	·20	2·532	·40	1·681	·60	1·258	·80	1·005	1·00
4·878		2·469		1·653		1·242		0·995	

TABLE VI.—Logarithms for facilitating the Computation of

Latitude		P	Diff.	Q	Diff.	R	Diff.	S	Diff.	T	Diff.
°	′										
0	0	$\bar{3}\cdot9966950$	—	$\bar{1}\cdot9971076$	+	$\bar{8}\cdot38124$	—	0·29814	+	Infinite	—
	10	6949	1	1076	0	24	0	814	0	2·23814	Infinite
	20	6948	1	1077	1	24	0	815	1	1·93712	30102
	30	6947	1	1078	1	24	0	816	1	76105	17607
	40	6944	3	1080	2	24	0	817	1	63614	12491
	50	6941	3	1082	2	24	0	818	1	53927	9687
1	0	$\bar{3}\cdot9966937$	4	$\bar{1}\cdot9971085$	3	$\bar{8}\cdot38124$	0	0·29820	2	1·46014	7913
	10	6932	5	1088	3	24	0	823	3	39325	6689
	20	6926	6	1092	4	24	0	826	3	33532	5793
	30	6920	6	1096	4	24	0	829	3	28423	5109
	40	6913	7	1101	5	24	0	832	3	23856	4567
	50	6905	8	1106	5	24	0	836	4	19725	4131
2	0	$\bar{3}\cdot9966897$	8	$\bar{1}\cdot9971111$	5	$\bar{8}\cdot38124$	0	0·29841	5	1·15956	3769
	10	6888	9	1117	6	23	1	845	4	12490	3466
	20	6878	10	1124	7	23	0	850	5	09283	3207
	30	6868	10	1131	7	23	0	856	6	06299	2984
	40	6856	12	1139	8	23	0	862	6	03509	2790
	50	6844	12	1147	8	23	0	868	6	00890	2619
3	0	$\bar{3}\cdot9966831$	13	$\bar{1}\cdot9971155$	8	$\bar{8}\cdot38123$	0	0·29874	6	0·98423	2467
	10	6818	13	1164	9	23	0	881	7	96090	2333
	20	6804	14	1174	10	23	0	888	7	93879	2211
	30	6789	15	1184	10	22	1	896	8	91777	2102
	40	6773	16	1194	10	22	0	904	8	89775	2002
	50	6757	16	1205	11	22	0	912	8	87863	1912
4	0	$\bar{3}\cdot9966739$	18	$\bar{1}\cdot9971216$	11	$\bar{8}\cdot38122$	0	0·29921	9	0·86034	1829
	10	6722	17	1228	12	22	0	930	9	84282	1752
	20	6703	19	1241	13	22	0	940	10	82600	1682
	30	6684	19	1254	13	21	1	950	10	80983	1617
	40	6664	20	1267	13	21	0	960	10	79427	1556
	50	6643	21	1281	14	21	0	971	11	77927	1500
5	0	$\bar{3}\cdot9966621$	22	$\bar{1}\cdot9971295$	14	$\bar{8}\cdot38121$	0	0·29982	11	0·76479	1448
	10	6599	22	1310	15	20	1	993	11	75080	1399
	20	6576	23	1325	15	20	0	0·30005	12	73728	1352
	30	6553	23	1341	16	20	0	017	12	72418	1310
	40	6528	25	1357	16	20	0	029	12	71150	1268
	50	6503	25	1374	17	20	0	042	13	69919	1231
6	0	$\bar{3}\cdot9966477$	26	$\bar{1}\cdot9971391$	17	$\bar{8}\cdot38119$	1	0·30055	13	0·68725	1194
	10	6451	26	1409	18	19	0	069	14	67566	1159
	20	6424	27	1427	18	19	0	083	14	66439	1127
	30	6396	28	1446	19	18	1	098	15	65342	1097
	40	6367	29	1465	19	18	0	112	14	64276	1066
	50	6338	29	1484	19	18	0	127	15	63237	1039
	60	6308	30	1504	20	18	0	143	16	62224	1013

Terrestrial Latitudes, Longitudes, and Reverse Azimuths.

Latitude		V	Diff.	U	Diff.	W	Diff.	X	Diff.	Y	Diff.	Z	Diff.
°	′		+		−		+		−		+		−
0	0	Inf. neg.	Infinite	Infinite	Infinite	Inf. neg.	Infinite	Infinite	Infinite	Inf. neg.	Infinite	Infinite	Infinite
	10	5·766	301	4·735	301	3·862	301	1·840	301	5·226	602	2·235	301
	20	4·067	176	434	176	2·163	176	539	176	— 828	352	1·934	176
	30	243	125	258	125	339	125	363	125	4·180	250	758	125
	40	368	97	133	97	464	97	238	97	430	193	633	97
	50	465		036		561		141		623		536	
1	0	4·544	79	5·957	79	2·640	79	1·062	79	4·782	159	1·457	79
	10	610	66	890	67	706	66	0·995	67	— 916	134	390	67
	20	668	58	833	57	764	58	937	58	3·031	115	332	58
	30	719	51	782	51	815	51	886	51	134	103	281	51
	40	765	46	736	46	861	46	841	45	225	91	236	45
	50	806	41	695	41	902	41	800	41	308	83	194	42
2	0	4·844	38	5·658	37	2·940	38	0·762	38	3·383	75	1·157	37
	10	878	34	623	35	— 974	34	727	35	452	69	122	35
	20	910	32	592	31	1·006	32	695	32	517	65	090	32
	30	940	30	562	30	036	30	665	30	576	59	060	30
	40	967	27	535	27	064	28	638	27	632	56	032	28
	50	993	26	509	26	090	26	611	27	685	53	006	26
3	0	3·018	25	5·484	25	1·115	25	0·587	24	3·734	49	0·981	25
	10	041	23	462	22	138	23	563	24	781	47	958	23
	20	063	22	440	22	160	22	541	22	825	44	936	22
	30	084	21	419	21	181	21	520	21	867	42	915	21
	40	104	20	400	19	201	20	500	20	907	40	895	20
	50	122	18	381	19	220	19	481	19	946	39	876	19
4	0	3·140	18	5·363	18	1·238	18	0·463	18	3·982	36	0·858	18
	10	158	18	346	17	255	17	446	17	2·017	35	840	18
	20	174	16	330	16	272	17	429	17	051	34	823	17
	30	190	16	314	16	288	16	413	16	084	33	807	16
	40	205	15	300	14	303	15	397	16	115	31	792	15
	50	220	15	285	15	318	15	382	15	145	30	777	15
5	0	3·234	14	5·271	14	1·332	14	0·368	14	2·174	29	0·762	15
	10	248	14	258	13	346	14	354	14	202	28	748	14
	20	261	13	245	13	360	14	340	13	229	27	734	14
	30	274	13	233	12	372	12	327	12	255	26	721	13
	40	286	12	221	12	385	13	315	12	281	26	709	12
	50	298	12	209	12	397	12	303	12	306	25	696	13
6	0	3·309	11	5·198	11	1·409	12	0·291	12	2·330	24	0·684	12
	10	321	12	187	11	420	11	279	12	353	23	673	11
	20	332	11	177	10	431	11	268	11	376	23	662	11
	30	342	10	167	10	442	11	257	11	398	22	651	11
	40	352	10	157	10	452	10	247	10	419	21	640	11
	50	362	10	147	10	463	11	236	11	440	21	630	10
	60	372	10	138	9	472	9	226	10	461	21	619	11

TABLE VI.—Logarithms for facilitating the Computation of

Latitude		P	Diff.	Q	Diff.	R	Diff.	S	Diff.	T	Diff.
°	′		−		+		−		+		−
7	0	$\bar{3}\cdot$9966308	31	$\bar{1}\cdot$9971504	21	$\bar{8}\cdot$38118	1	0·30143	16	0·62224	986
	10	6277	32	1525	21	17	0	159	16	61238	963
	20	6245	32	1546	21	17	0	175	17	60275	939
	30	6213	33	1567	22	17	1	192	17	59336	917
	40	6180	33	1589	23	16	0	209	17	58419	896
	50	6147		1612		16		226		57523	
			35		23		0		18		875
8	0	$\bar{3}\cdot$9966112	35	$\bar{1}\cdot$9971635	23	$\bar{8}\cdot$38116	1	0·30244	18	0·56648	856
	10	6077	36	1658	24	15	0	262	19	55792	837
	20	6041	36	1682	24	15	0	281	19	54955	819
	30	6005	37	1706	25	15	1	300	19	54136	801
	40	5968	38	1731	25	14	0	319	20	53335	784
	50	5930		1756		14		339		52551	
			38		26		1		20		768
9	0	$\bar{3}\cdot$9965892	40	$\bar{1}\cdot$9971782	26	$\bar{8}\cdot$38113	0	0·30359	20	0·51783	753
	10	5852	40	1808	26	13	0	379	21	51030	737
	20	5812	40	1834	27	13	1	400	21	50293	723
	30	5772	42	1861	28	12	0	421	22	49570	709
	40	5730	42	1889	28	12	1	443	22	48861	695
	50	5688		1917		11		465		48166	
			42		28		0		22		682
10	0	$\bar{3}\cdot$9965646	44	$\bar{1}\cdot$9971945	29	$\bar{8}\cdot$38111	0	0·30487	23	0·47484	669
	10	5602	44	1974	30	11	1	510	23	46815	656
	20	5558	44	2004	30	10	0	533	24	46159	645
	30	5514	46	2034	30	10	1	557	24	45514	633
	40	5468	46	2064	31	09	0	581	24	44881	621
	50	5422		2095		09		605		44260	
			47		31		1		25		611
11	0	$\bar{3}\cdot$9965375	47	$\bar{1}\cdot$9972126	31	$\bar{8}\cdot$38108	0	0·30630	25	0·43649	599
	10	5328	48	2157	33	08	1	655	25	43050	590
	20	5280	49	2190	32	07	0	680	26	42460	579
	30	5231	50	2222	33	07	1	706	26	41881	570
	40	5181	50	2255	34	06	0	732	27	41311	560
	50	5131		2289		06		759		40751	
			51		33		1		27		550
12	0	$\bar{3}\cdot$9965080	51	$\bar{1}\cdot$9972322	35	$\bar{8}\cdot$38105	0	0·30786	27	0·40201	542
	10	5029	52	2357	35	05	1	813	28	39659	532
	20	4977	53	2392	35	04	0	841	28	39127	524
	30	4924	54	2427	35	04	1	869	29	38603	516
	40	4870	54	2462	37	03	0	898	29	38087	507
	50	4816		2499		03		927		37580	
			55		36		1		29		500
13	0	$\bar{3}\cdot$9964761	55	$\bar{1}\cdot$9972535	37	$\bar{8}\cdot$38102	0	0·30956	30	0·37080	491
	10	4706	56	2572	38	02	1	986	30	36589	484
	20	4650	57	2610	37	01	1	0·31016	30	36105	477
	30	4593	58	2647	39	00	0	046	31	35628	469
	40	4535	58	2686	38	00	1	077	32	35159	462
	50	4477	58	2724	40	$\bar{8}\cdot$38099	0	109	31	34697	455
	60	4419		2764		99		140		34242	

Terrestrial Latitudes, Longitudes, and Reverse Azimuths.

Latitude		V	Diff.	U	Diff.	W	Diff.	X	Diff.	Y	Diff.	Z	Diff.
°	′		+		−		+		−		+		−
7	0	$\bar{3}\cdot372$	9	$\bar{5}\cdot138$	9	$\bar{1}\cdot472$	10	0·226	10	$\bar{2}\cdot461$	19	0·619	9
	10	381	9	129	8	482	9	216	9	480	20	610	10
	20	390	9	121	9	491	10	207	9	500	19	600	9
	30	399	9	112	8	501	8	198	10	519	18	591	10
	40	408	8	104	8	509	9	188	8	537	18	581	8
	50	416		096		518		180		555		573	
8	0	$\bar{3}\cdot425$	9	$\bar{5}\cdot088$	8	$\bar{1}\cdot527$	9	0·171	9	$\bar{2}\cdot573$	18	0·564	9
	10	433	8	081	7	535	8	162	9	590	17	555	9
	20	440	7	074	7	543	8	154	8	607	17	547	8
	30	448	8	066	8	551	8	146	8	624	17	539	8
	40	456	8	060	6	559	8	138	8	640	16	531	8
	50	463	7	053	7	566	7	130	8	656	16	523	8
9	0	$\bar{3}\cdot470$	7	$\bar{5}\cdot046$	7	$\bar{1}\cdot574$	8	0·123	7	$\bar{2}\cdot672$	16	0·515	7
	10	477	7	040	6	581	7	115	8	687	15	508	8
	20	484	7	034	6	588	7	108	7	702	15	500	7
	30	490	6	028	6	595	7	101	7	716	14	493	7
	40	497	7	022	6	602	7	094	7	731	15	486	7
	50	503	6	016	6	608	6	087	7	745	14	479	7
10	0	$\bar{3}\cdot509$	6	$\bar{5}\cdot011$	5	$\bar{1}\cdot615$	7	0·080	7	$\bar{2}\cdot759$	14	0·472	7
	10	515	6	005	6	621	6	074	6	772	13	466	6
	20	521	6	000	5	627	6	067	7	786	14	459	7
	30	527	6	$\bar{6}\cdot995$	5	634	7	061	6	799	13	453	6
	40	532	5	990	5	640	6	055	6	812	13	446	7
	50	538	6	985	5	645	5	049	6	824	12	440	6
11	0	$\bar{3}\cdot543$	5	$\bar{6}\cdot981$	4	$\bar{1}\cdot651$	6	0·043	6	$\bar{2}\cdot837$	13	0·434	6
	10	548	5	976	5	657	6	037	6	849	12	428	6
	20	554	6	972	4	662	5	031	6	861	12	422	6
	30	559	5	967	5	668	6	025	6	873	12	416	6
	40	563	4	963	4	673	5	020	5	885	12	411	5
	50	568	5	959	4	678	5	014	6	896	11	405	6
12	0	$\bar{3}\cdot573$	5	$\bar{6}\cdot955$	4	$\bar{1}\cdot684$	6	0·009	5	$\bar{2}\cdot908$	12	0·399	6
	10	578	5	951	4	689	5	$\bar{1}\cdot003$	6	919	11	394	5
	20	582	4	947	4	694	5	$\bar{1}\cdot998$	5	930	11	389	5
	30	586	4	944	3	698	4	993	5	940	10	384	5
	40	591	5	940	4	703	5	988	5	951	11	378	6
	50	595	4	937	3	708	5	983	5	962	11	373	5
13	0	$\bar{3}\cdot599$	4	$\bar{6}\cdot933$	4	$\bar{1}\cdot713$	5	$\bar{1}\cdot978$	5	$\bar{2}\cdot972$	10	0·368	5
	10	603	4	930	3	717	4	973	5	982	10	363	5
	20	607	4	927	3	722	5	968	5	$\bar{1}\cdot992$	10	359	4
	30	611	4	924	3	726	4	964	4	$\bar{1}\cdot002$	10	354	5
	40	615	4	921	3	730	4	959	5	012	9	349	5
	50	618	3	918	3	734	4	954	5	021	10	345	4
	60	622	4	915	3	739	5	950	4	031		340	5

TABLE VI.—Logarithms for facilitating the Computation of

Latitude		P	Diff.	Q	Diff.	R	Diff.	S	Diff.	T	Diff.
°	′		−		+		−		+		−
14	0	$\bar{3}$·9964419	60	$\bar{1}$·9972764	39	$\bar{8}$·38099	1	0·31140	32	0·34242	448
	10	4359	60	2803	40	98	1	172	33	33794	442
	20	4299	61	2843	41	97	0	205	33	33352	435
	30	4238	61	2884	41	97	1	238	33	32917	429
	40	4177	62	2925	41	96	0	271	34	32488	422
	50	4115	62	2966	42	96	1	305	34	32066	417
15	0	$\bar{3}$·9964053	64	$\bar{1}$·9973008	42	$\bar{8}$·38095	1	0·31339	34	0·31649	410
	10	3989	64	3050	42	94	0	373	35	31239	404
	20	3925	64	3092	43	94	1	408	35	30835	399
	30	3861	65	3135	44	93	1	443	36	30436	393
	40	3796	66	3179	44	92	0	479	36	30043	388
	50	3730	66	3223	44	92	1	515	37	29655	382
16	0	$\bar{3}$·9963664	67	$\bar{1}$·9973267	45	$\bar{8}$·38091	1	0·31552	36	0·29273	377
	10	3597	68	3312	45	90	0	588	38	28896	371
	20	3529	68	3357	45	90	1	626	37	28525	367
	30	3461	69	3402	46	89	1	663	38	28158	361
	40	3392	69	3448	46	88	0	701	39	27797	357
	50	3323	71	3494	47	88	1	740	39	27440	351
17	0	$\bar{3}$·9963252	70	$\bar{1}$·9973541	47	$\bar{8}$·38087	1	0·31779	39	0·27089	347
	10	3182	72	3588	48	86	0	818	40	26742	342
	20	3110	71	3636	48	86	1	858	40	26400	338
	30	3039	73	3684	48	85	1	898	40	26062	333
	40	2966	73	3732	49	84	1	938	41	25729	329
	50	2893	74	3781	49	83	0	979	42	25400	324
18	0	$\bar{3}$·9962819	74	$\bar{1}$·9973830	49	$\bar{8}$·38083	1	0·32021	41	0·25076	320
	10	2745	75	3879	50	82	1	062	43	24756	316
	20	2670	75	3929	51	81	1	105	42	24440	312
	30	2595	76	3980	50	80	0	147	43	24128	307
	40	2519	77	4030	51	80	1	190	44	23821	304
	50	2442	77	4081	52	79	1	234	43	23517	300
19	0	$\bar{3}$·9962365	78	$\bar{1}$·9974133	52	$\bar{8}$·38078	1	0·32277	45	0·23217	295
	10	2287	78	4185	52	77	0	322	44	22922	292
	20	2209	79	4237	52	77	1	366	45	22630	289
	30	2130	80	4289	53	76	1	411	46	22341	284
	40	2050	80	4342	54	75	1	457	46	22057	281
	50	1970	80	4396	54	74	1	503	46	21776	278
20	0	$\bar{3}$·9961890	82	$\bar{1}$·9974450	54	$\bar{8}$·38073	0	0·32549	47	0·21498	273
	10	1808	81	4504	54	73	1	596	47	21225	271
	20	1727	83	4558	55	72	1	643	47	20954	267
	30	1644	83	4613	55	71	1	690	48	20687	263
	40	1561	83	4668	56	70	1	738	49	20424	261
	50	1478	84	4724	56	69	1	787	49	20163	257
	60	1394		4780		68		836		19906	

Terrestrial Latitudes, Longitudes, and Reverse Azimuths.

Latitude		V	Diff.	U	Diff.	W	Diff.	X	Diff.	Y	Diff.	Z	Diff.
°	′		+		−		+		−		+		−
14	9	$\bar{3}\cdot622$	4	$\bar{6}\cdot915$	2	$\bar{1}\cdot739$	4	$\bar{1}\cdot950$	4	$\bar{1}\cdot031$	9	0·340	4
	10	626	3	913	3	743	4	946	5	040	9	336	5
	20	629	3	910	3	747	4	941	4	049	9	331	4
	30	632	4	907	2	751	4	937	4	058	9	327	4
	40	636	3	905	2	755	3	933	4	067	9	323	5
	50	639		903		758		929		076		318	
15	0	$\bar{3}\cdot642$	3	$\bar{6}\cdot900$	3	$\bar{1}\cdot762$	4	$\bar{1}\cdot925$	4	$\bar{1}\cdot085$	9	0·314	4
	10	645	3	898	2	766	4	920	5	093	8	310	4
	20	648	3	896	2	769	3	916	4	102	9	306	4
	30	651	3	894	2	773	4	913	3	110	8	302	4
	40	654	3	892	2	777	4	909	4	119	9	298	4
	50	657	3	890	2	780	3	905	4	127	8	294	4
16	0	$\bar{3}\cdot659$	2	$\bar{6}\cdot888$	2	$\bar{1}\cdot783$	3	$\bar{1}\cdot901$	4	$\bar{1}\cdot135$	8	0·290	4
	10	662	3	886	2	787	4	897	4	143	8	287	3
	20	665	3	885	1	790	3	894	3	151	8	283	4
	30	667	2	883	2	793	3	890	4	158	7	279	4
	40	670	3	882	1	796	3	887	3	166	8	276	3
	50	672	2	880	2	800	4	883	4	174	8	272	4
17	0	$\bar{3}\cdot675$	3	$\bar{6}\cdot879$	1	$\bar{1}\cdot803$	3	$\bar{1}\cdot880$	3	$\bar{1}\cdot181$	7	0·269	3
	10	677	2	877	2	806	3	876	4	189	8	265	4
	20	679	2	876	1	809	3	873	3	196	7	262	3
	30	681	2	875	1	812	3	869	4	203	7	258	4
	40	683	2	874	1	815	3	866	3	210	7	255	3
	50	685	2	873	1	817	2	863	3	217	7	252	3
18	0	$\bar{3}\cdot687$	2	$\bar{6}\cdot872$	1	$\bar{1}\cdot820$	3	$\bar{1}\cdot860$	3	$\bar{1}\cdot224$	7	0·249	3
	10	689	2	871	1	823	3	856	4	231	7	245	4
	20	691	2	870	1	826	3	853	3	238	7	242	3
	30	693	2	869	1	828	2	850	3	245	7	239	3
	40	695	2	868	1	831	3	847	3	251	6	236	3
	50	697	2	867	1	834	3	844	3	258	7	233	3
19	0	$\bar{3}\cdot698$	1	$\bar{6}\cdot867$	0	$\bar{1}\cdot836$	2	$\bar{1}\cdot841$	3	$\bar{1}\cdot265$	7	0·230	3
	10	700	2	866	1	839	3	838	3	271	6	227	3
	20	702	2	866	0	841	2	835	3	277	6	224	3
	30	703	1	865	1	844	3	832	3	284	7	221	3
	40	705	2	865	0	846	2	829	3	290	6	219	2
	50	706	1	864	1	848	2	827	2	296	6	216	3
20	0	$\bar{3}\cdot708$	2	$\bar{6}\cdot864$	0	$\bar{1}\cdot851$	3	$\bar{1}\cdot824$	3	$\bar{1}\cdot302$	6	0·213	3
	10	709	1	864	0	853	2	821	3	308	6	210	3
	20	710	1	863	1	855	2	818	3	314	6	208	2
	30	711	1	863	0	858	3	816	2	320	6	205	3
	40	713	2	863	0	860	2	813	3	326	6	202	3
	50	714	1	863	0	862	2	810	3	332	6	200	2
	60	715	1	863	0	864	2	808	2	338	6	197	3

TABLE VI.—Logarithms for facilitating the Computation of

Latitude		P	Diff.	Q	Diff.	R	Diff.	S	Diff.	T	Diff.
°	′		−		+		−		+		−
21	0	$\bar{3}$·9961394	84	$\bar{1}$·9974780	56	$\bar{8}$·38068	0	0·32836	49	0·19906	253
	10	1310	86	4836	57	68	1	885	50	19653	251
	20	1224	85	4893	57	67	1	935	50	19402	248
	30	1139	86	4950	57	66	1	985	50	19154	244
	40	1053	87	5007	58	65	1	0·33035	51	18910	241
	50	0966		5065		64		086		18669	
22	0	$\bar{3}$·9960879	87	$\bar{1}$·9975123	58	$\bar{8}$·38063	1	0·33138	52	0·18430	239
	10	0791	88	5182	59	62	1	189	51	18195	235
	20	0703	88	5241	59	62	0	242	53	17962	233
	30	0614	89	5300	59	61	1	294	52	17732	230
	40	0525	89	5359	59	60	1	348	54	17506	226
	50	0435	90	5419	60	59	1	401	53	17281	225
23	0	$\bar{3}$·9960345	90	$\bar{1}$·9975479	60	$\bar{8}$·38058	1	0·33455	54	0·17060	221
	10	0254	91	5540	61	57	1	510	55	16841	219
	20	0163	91	5601	61	56	1	565	55	16625	216
	30	0071	92	5662	61	55	1	620	55	16412	213
	40	$\bar{3}$·9959978	93	5724	62	54	1	676	56	16201	211
	50	9886	92	5786	62	53	1	732	56	15993	208
24	0	$\bar{3}$·9959792	94	$\bar{1}$·9975848	62	$\bar{8}$·38052	1	0·33788	56	0·15788	205
	10	9698	94	5910	62	51	1	846	58	15584	204
	20	9604	94	5973	63	51	0	903	57	15384	200
	30	9509	95	6036	63	50	1	961	58	15185	199
	40	9414	95	6100	64	49	1	0·34020	59	14990	195
	50	9318	96	6164	64	48	1	078	58	14796	194
25	0	$\bar{3}$·9959222	96	$\bar{1}$·9976228	64	$\bar{8}$·38047	1	0·34138	60	0·14605	191
	10	9125	97	6292	64	46	1	197	59	14416	189
	20	9028	97	6357	65	45	1	258	61	14229	187
	30	8930	98	6422	65	44	1	318	60	14045	184
	40	8832	98	6488	66	43	1	380	62	13863	182
	50	8734	98	6553	65	42	1	441	61	13683	180
26	0	$\bar{3}$·9958635	99	$\bar{1}$·9976619	66	$\bar{8}$·38041	1	0·34503	62	0·13505	178
	10	8535	100	6686	67	40	1	566	63	13330	175
	20	8435	100	6752	66	39	1	629	63	13156	174
	30	8335	100	6819	67	38	1	692	63	12984	172
	40	8234	101	6886	67	37	1	756	64	12815	169
	50	8133	101	6954	68	36	1	820	64	12648	167
27	0	$\bar{3}$·9958031	102	$\bar{1}$·9977022	68	$\bar{8}$·38035	1	0·34885	65	0·12482	166
	10	7929	102	7090	68	34	1	950	65	12319	163
	20	7827	102	7158	68	33	1	0·35016	66	12157	162
	30	7724	103	7227	69	32	1	082	66	11998	159
	40	7620	104	7296	69	31	1	149	67	11840	158
	50	7516	104	7365	69	30	1	216	67	11685	155
	60	7412	104	7435	70	29	1	284	68	11531	154

Terrestrial Latitudes, Longitudes, and Reverse Azimuths.

Latitude		V	Diff.	U	Diff.	W	Diff.	X	Diff.	Y	Diff.	Z	Diff.
°	′				+		+		−		+		−
21	0	$\bar{3}\cdot715$	+1	$\bar{6}\cdot863$	0	$\bar{1}\cdot864$	2	$\bar{1}\cdot808$	3	$\bar{1}\cdot338$	5	0·197	2
	10	716	1	863	0	866	2	805	3	343	6	195	3
	20	717	1	863	0	868	2	802	2	349	6	192	2
	30	718	1	863	0	870	2	800	3	355	5	190	3
	40	719	1	863	0	872	2	797	2	360	6	187	2
	50	720		863		874		795		366		185	
22	0	$\bar{3}\cdot721$	1	$\bar{6}\cdot864$	1	$\bar{1}\cdot876$	2	$\bar{1}\cdot793$	2	$\bar{1}\cdot371$	5	0·182	3
	10	722	1	.864	0	878	2	790	3	376	5	180	2
	20	722	0	864	0	880	2	788	2	382	6	178	2
	30	723	1	865	1	882	2	785	3	387	5	175	3
	40	724	1	865	0	884	2	783	2	392	5	173	2
	50	724	0	866	1	885	1	781	2	397	5	171	2
23	0	$\bar{3}\cdot725$	1	$\bar{6}\cdot866$	0	$\bar{1}\cdot887$	2	$\bar{1}\cdot778$	3	$\bar{1}\cdot403$	6	0·169	2
	10	726	1	867	1	889	2	776	2	408	5	167	2
	20	726	0	868	1	891	2	774	2	413	5	164	3
	30	727	1	868	0	892	1	771	3	418	5	162	2
	40	727	0	869	1	894	2	769	2	423	5	160	2
	50	727	0	870	1	896	2	767	2	428	5	158	2
24	0	$\bar{3}\cdot728$	1	$\bar{6}\cdot870$	0	$\bar{1}\cdot897$	1	$\bar{1}\cdot765$	2	$\bar{1}\cdot432$	4	0·156	2
	10	728	0	871	1	899	2	763	2	437	5	154	2
	20	728	0	872	1	900	1	761	2	442	5	152	2
	30	729	1	873	1	902	2	758	3	447	5	150	2
	40	729	0	874	1	903	1	756	2	451	4	148	2
	50	729	0	875	1	905	2	754	2	456	5	146	2
25	0	$\bar{3}\cdot729$	0	$\bar{6}\cdot876$	1	$\bar{1}\cdot906$	1	$\bar{1}\cdot752$	2	$\bar{1}\cdot461$	5	0·144	2
	10	729	0	877	1	908	2	750	2	465	4	143	1
	20	729	0	878	1	909	1	748	2	470	5	141	2
	30	729	0	880	2	911	2	746	2	474	4	139	2
	40	729	0	881	1	912	1	744	2	479	5	137	2
	50	729	0	882	1	914	2	742	2	483	4	135	2
26	0	$\bar{3}\cdot729$	0	$\bar{6}\cdot883$	1	$\bar{1}\cdot915$	1	$\bar{1}\cdot740$	2	$\bar{1}\cdot487$	4	0·133	2
	10	729	0	885	2	916	1	738	2	492	5	132	1
	20	729	0	886	1	918	2	736	2	496	4	130	2
	30	729	0	888	2	919	1	734	2	500	4	128	2
	40	729	0	889	1	920	1	732	2	505	5	127	1
	50	728	−1	890	1	921	1	730	2	509	4	125	2
27	0	$\bar{3}\cdot728$	0	$\bar{6}\cdot892$	2	$\bar{1}\cdot923$	2	$\bar{1}\cdot729$	1	$\bar{1}\cdot513$	4	0·123	2
	10	728	0	894	2	924	1	727	2	517	4	122	1
	20	727	1	895	1	925	1	725	2	521	4	120	2
	30	727	0	897	2	926	1	723	2	525	4	119	1
	40	727	0	898	1	927	1	721	2	529	4	117	2
	50	726	1	900	2	929	2	719	2	533	4	115	2
	60	726	0	902	2	930	1	717	2	537	4	114	1

TABLE VI.—Logarithms for facilitating the Computation of

Latitude		P	Diff.	Q	Diff.	R	Diff.	S	Diff.	T	Diff.
°	′		−		+		−		+		−
28	0	$\bar{3}$·9957412	104	$\bar{1}$·9977435	69	$\bar{8}$·38029	1	0·35284	68	0·11531	152
	10	7308	105	7504	70	28	1	352	69	11379	151
	20	7203	106	7574	71	27	2	421	69	11228	148
	30	7097	106	7645	70	25	1	490	69	11080	147
	40	6991	106	7715	71	24	1	559	70	10933	145
	50	6885		7786		23		629		10788	
29	0	$\bar{3}$·9956778	107	$\bar{1}$·9977857	71	$\bar{8}$·38022	1	0·35700	71	0·10645	143
	10	6671	107	7928	71	21	1	771	71	10504	141
	20	6564	107	8000	72	20	1	842	71	10364	140
	30	6456	108	8072	72	19	1	914	72	10226	138
	40	6348	108	8144	72	18	1	986	72	10089	137
	50	6239	109	8216	72	17	1	0·36059	73	09955	134
30	0	$\bar{3}$·9956130	109	$\bar{1}$·9978289	73	$\bar{8}$·38016	1	0·36133	74	0·09821	134
	10	6021	109	8362	73	15	1	207	74	09690	131
	20	5911	110	8435	73	14	1	281	74	09560	130
	30	5801	110	8508	73	13	1	356	75	09431	129
	40	5691	110	8582	74	11	2	431	75	09304	127
	50	5580	111	8656	74	10	1	507	76	09179	125
31	0	$\bar{3}$·9955469	111	$\bar{1}$·9978730	74	$\bar{8}$·38009	1	0·36584	77	0·09055	124
	10	5358	111	8804	74	08	1	661	77	08932	123
	20	5246	112	8879	75	07	1	738	77	08811	121
	30	5134	112	8953	74	06	1	816	78	08692	119
	40	5021	113	9028	75	05	1	894	78	08574	118
	50	4909	112	9104	76	04	1	973	79	08457	117
32	0	$\bar{3}$·9954796	113	$\bar{1}$·9979179	75	$\bar{8}$·38002	2	0·37053	80	0·08342	115
	10	4682	114	9255	76	01	1	133	80	08228	114
	20	4568	114	9330	75	00	1	213	80	08115	113
	30	4454	114	9406	76	$\bar{8}$·37999	1	294	81	08004	111
	40	4340	114	9483	77	98	1	376	82	07894	110
	50	4225	115	9559	76	97	1	458	82	07786	108
33	0	$\bar{3}$·9954110	115	$\bar{1}$·9979636	77	$\bar{8}$·37996	1	0·37540	82	0·07678	108
	10	3995	115	9713	77	94	2	623	83	07572	106
	20	3879	116	9790	77	93	1	707	84	07468	104
	30	3764	115	9867	77	92	1	791	84	07364	104
	40	3647	117	9944	77	91	1	876	85	07262	102
	50	3531	116	$\bar{1}$·9980022	78	90	1	961	85	07161	101
34	0	$\bar{3}$·9953414	117	$\bar{1}$·9980100	78	$\bar{8}$·37989	1	0·38047	86	0·07062	99
	10	3297	117	0178	78	87	2	133	86	06963	99
	20	3180	117	0256	78	86	1	220	87	06866	97
	30	3062	118	0334	78	85	1	307	87	06770	96
	40	2945	117	0413	79	84	1	395	88	06675	95
	50	2827	118	0492	79	83	1	483	88	06581	94
	60	2708	119	0571	79	82	1	572	89	06488	93

Terrestrial Latitudes, Longitudes, and Reverse Azimuths.

Latitude	V	Diff.	U	Diff.	W	Diff.	X	Diff.	Y	Diff.	Z	Diff.
° ′		−		+		+		−		+		−
28 0	$\bar{3}\cdot726$	1	$\bar{6}\cdot902$	2	$\bar{1}\cdot930$	1	$\bar{1}\cdot717$	1	$\bar{1}\cdot537$	4	0·114	2
10	725	0	904	2	931	1	716	2	541	4	112	1
20	725	1	906	1	932	1	714	2	545	4	111	2
30	724	0	907	2	933	1	712	2	549	4	109	1
40	724	1	909	2	934	1	710	1	553	4	108	1
50	723		911		935		709		557		107	
29 0	$\bar{3}\cdot722$	1	$\bar{6}\cdot913$	2	$\bar{1}\cdot936$	1	$\bar{1}\cdot707$	2	$\bar{1}\cdot561$	4	0·105	2
10	722	0	915	2	937	1	705	2	565	4	104	1
20	721	1	917	2	938	1	703	2	568	3	102	2
30	720	1	919	2	939	1	702	1	572	4	101	1
40	719	1	921	3	940	1	700	2	576	4	100	1
50	718		924		941		698	2	580		098	2
30 0	$\bar{3}\cdot718$	0	$\bar{6}\cdot926$	2	$\bar{1}\cdot942$	1	$\bar{1}\cdot697$	1	$\bar{1}\cdot583$	3	0·097	1
10	717	1	928	2	943	1	695	2	587	4	096	1
20	716	1	930	2	944	1	693	2	590	3	094	2
30	715	1	932	2	945	1	692	1	594	4	093	1
40	714	1	935	3	946	1	690	2	598	4	092	1
50	713		937	2	947		688	2	601	3	091	
31 0	$\bar{3}\cdot712$	1	$\bar{6}\cdot939$	2	$\bar{1}\cdot947$	0	$\bar{1}\cdot687$	1	$\bar{1}\cdot605$	4	0·089	2
10	711	1	942	3	948	1	685	2	608	3	088	1
20	710	1	944	2	949	1	684	1	612	4	087	1
30	708	2	947	3	950	1	682	2	615	3	086	1
40	707	1	949	2	951	1	680	2	619	4	085	1
50	706	1	952	3	952	1	679	1	622	3	083	2
32 0	$\bar{3}\cdot705$	1	$\bar{6}\cdot954$	2	$\bar{1}\cdot952$	0	$\bar{1}\cdot677$	2	$\bar{1}\cdot625$	3	0·082	1
10	704	1	957	3	953	1	676	1	629	4	081	1
20	702	2	960	3	954	1	674	2	632	3	080	1
30	701	1	962	2	955	1	672	2	635	3	079	1
40	700	1	965	3	955	0	671	1	639	4	078	1
50	698	2	968	3	956	1	669	2	642	3	077	1
33 0	$\bar{3}\cdot697$	1	$\bar{6}\cdot971$	3	$\bar{1}\cdot957$	1	$\bar{1}\cdot668$	1	$\bar{1}\cdot645$	3	0·076	1
10	696	1	973	2	958	1	666	2	649	4	075	1
20	694	2	976	3	958	0	665	1	652	3	074	1
30	693	1	979	3	959	1	663	2	655	3	073	1
40	691	2	982	3	960	1	662	1	658	3	072	1
50	690	1	985	3	960	0	660	2	661	3	071	1
34 0	$\bar{3}\cdot688$	2	$\bar{6}\cdot988$	3	$\bar{1}\cdot961$	1	$\bar{1}\cdot659$	1	$\bar{1}\cdot665$	4	0·070	1
10	687	1	991	3	962	1	657	2	668	3	069	1
20	685	2	994	3	962	0	656	1	671	3	068	1
30	683	2	997	3	963	1	654	2	674	3	067	1
40	682	1	$\bar{5}\cdot000$	3	963	0	653	1	677	3	066	1
50	680	2	003	3	964	1	651	2	680	3	065	1
60	678	2	006	3	965	1	650	1	683	3	064	1

TABLE VI.—Logarithms for facilitating the Computation of

Latitude		P	Diff.	Q	Diff.	R	Diff.	S	Diff.	T	Diff.
°	′		−		+		−		+		−
35	0	$\bar{3}\cdot$9952708	118	$\bar{1}\cdot$9980571	79	$\bar{8}\cdot$37982	2	0·38572	90	0·06488	91
	10	2590	119	0650	79	80	1	662	90	06397	91
	20	2471	119	0729	79	79	1	752	90	06306	89
	30	2352	120	0808	80	78	1	842	92	06217	88
	40	2232	119	0888	79	77	1	934	91	06129	87
	50	2113		0967		76		0·39025		06042	
36	0	$\bar{3}\cdot$9951993	120	$\bar{1}\cdot$9981047	80	$\bar{8}\cdot$37974	2	0·39118	93	0·05956	86
	10	1873	120	1127	80	73	1	211	93	05871	85
	20	1753	120	1207	80	72	1	304	93	05787	84
	30	1632	121	1288	81	71	1	398	94	05704	83
	40	1512	120	1368	80	70	1	493	95	05622	82
	50	1391	121	1449	81	68	2	588	95	05541	81
37	0	$\bar{3}\cdot$9951270	121	$\bar{1}\cdot$9981530	81	$\bar{8}\cdot$37967	1	0·39683	95	0·05461	80
	10	1148	122	1610	80	66	1	780	97	05382	79
	20	1027	121	1691	81	65	1	877	97	05304	78
	30	0905	122	1773	82	64	1	974	97	05227	77
	40	0783	122	1854	81	62	2	0·40072	98	05151	76
	50	0661	122	1935	81	61	1	171	99	05076	75
38	0	$\bar{3}\cdot$9950539	123	$\bar{1}\cdot$9982017	82	$\bar{8}\cdot$37960	1	0·40270	99	0·05002	74
	10	0416	122	2098	81	59	1	370	100	04928	74
	20	0294	123	2180	82	57	2	470	100	04856	72
	30	0171	123	2262	82	56	1	571	101	04785	71
	40	0048	123	2344	82	55	1	673	102	04714	71
	50	$\bar{3}\cdot$9949925	123	2426	82	54	1	775	102	04644	70
39	0	$\bar{3}\cdot$9949802	124	$\bar{1}\cdot$9982508	83	$\bar{8}\cdot$37953	2	0·40878	103	0·04576	68
	10	9678	123	2591	82	51	1	981	103	04508	68
	20	9555	124	2673	82	50	1	0·41085	104	04441	67
	30	9431	124	2755	83	49	1	190	105	04374	67
	40	9307	124	2838	83	48	2	295	105	04309	65
	50	9183	124	2921	82	46	1	401	106	04244	65
	60	9059		3003		45		508	107	04181	63

Terrestrial Latitudes, Longitudes, and Reverse Azimuths.

Latitude		V	Diff.	U	Diff.	W	Diff.	X	Diff.	Y	Diff.	Z	Diff.
°	′		−		+		+		−		+		−
35	0	$\bar{3}\cdot678$	2	$\bar{5}\cdot006$	4	$\bar{1}\cdot965$	0	$\bar{1}\cdot650$	2	$\bar{1}\cdot683$	3	0·064	1
	10	676	1	010	3	965	1	648	1	686	3	063	1
	20	675	2	013	3	966	0	647	2	689	3	062	1
	30	673	2	016	3	966	1	645	1	692	3	061	1
	40	671	2	019	4	967	0	644	2	695	3	060	1
	50	669		023		967		642		698		059	
36	0	$\bar{3}\cdot667$	2	$\bar{5}\cdot026$	3	$\bar{1}\cdot968$	1	$\bar{1}\cdot641$	1	$\bar{1}\cdot701$	3	0·059	0
	10	665	2	029	3	969	1	639	2	704	3	058	1
	20	663	2	033	4	969	0	638	1	707	3	057	1
	30	661	2	036	3	970	1	636	2	710	3	056	1
	40	659	2	040	4	970	0	635	1	713	3	055	1
	50	657		043	3	971	1	633	2	716	3	055	0
37	0	$\bar{3}\cdot655$	2	$\bar{5}\cdot047$	4	$\bar{1}\cdot971$	0	$\bar{1}\cdot632$	1	$\bar{1}\cdot719$	3	0·054	1
	10	653	2	050	3	972	1	631	1	722	3	053	1
	20	651	2	054	4	972	0	629	2	725	3	052	1
	30	649	2	057	3	973	1	628	1	728	3	051	1
	40	647	2	061	4	973	0	626	2	731	3	051	0
	50	645		065	4	974	1	625	1	734	3	050	1
38	0	$\bar{3}\cdot642$	3	$\bar{5}\cdot068$	3	$\bar{1}\cdot974$	0	$\bar{1}\cdot623$	2	$\bar{1}\cdot736$	2	0·049	1
	10	640	2	072	4	975	1	622	1	739	3	049	0
	20	638	2	076	4	975	0	620	2	742	3	048	1
	30	636	2	080	4	975	0	619	1	745	3	047	1
	40	633	3	084	4	976	1	618	1	748	3	046	1
	50	631	2	088	4	976	0	616	2	751	3	046	0
39	0	$\bar{3}\cdot628$	3	$\bar{5}\cdot091$	3	$\bar{1}\cdot977$	1	$\bar{1}\cdot615$	1	$\bar{1}\cdot753$	2	0·045	1
	10	626	2	095	4	977	0	613	2	756	3	044	1
	20	624	2	099	4	977	0	612	1	759	3	044	0
	30	621	3	103	4	978	1	610	2	761	2	043	1
	40	619	2	107	4	978	0	609	1	764	3	042	1
	50	616	3	111	4	979	1	608	1	767	3	042	0
	60	614	2	115	4	979	0	606	2	770	3	041	1

TABLE VII.—Directions for applying the Signs to the

When station **A** lies to the *north* of the Equator.

Terms of the Formulæ	Magnitude of the given Azimuth *A*			
	0° to 90°	90° to 180°	180° to 270°	270° to 360°
$\delta_1 \lambda$	−	+	+	−
$\delta_1 L$	−	−	+	+
$\delta_1 A$	−	−	+	+
$\delta_2 \lambda$	−	−	−	−
$\delta_2 L$	+	−	+	−
$\delta_2 A$	+	−	+	−
$\delta_3 \lambda$	−	−	−	−
$\delta_3 L$	−	−	+	+
$\delta_3 A$	−	−	+	+
$\delta_4 \lambda$	+	−	−	+
$\delta_4 L$	+	+	−	−
$\delta_4 A$	+	+	−	−

NOTE.—The Azimuth is to be reckoned from South by West.

Terms of the Latitude, Longitude and Azimuth Formulæ.

When station **A** lies to the *south* of the Equator.

Terms of the Formulæ	Magnitude of the given Azimuth A			
	0° to 90°	90° to 180°	180° to 270°	270° to 360°
$\delta_1 \lambda$	+	−	−	+
$\delta_1 L$	−	−	+	+
$\delta_1 A$	+	+	−	−
$\delta_2 \lambda$	−	−	−	−
$\delta_2 L$	−	+	−	+
$\delta_2 A$	+	−	+	−
$\delta_3 \lambda$	−	−	−	−
$\delta_3 L$	−	−	+	+
$\delta_3 A$	+	+	−	−
$\delta_4 \lambda$	−	+	+	−
$\delta_4 L$	+	+	−	−
$\delta_4 A$	−	−	+	+

NOTE.—The Azimuth is to be reckoned from South by West.

TABLE VIII.—For calculating Azimuths and Distances of Points of which the Latitudes and Longitudes are known.

Lat.	R′	Diff.	S′	Diff.	T′	Diff.	Lat.	R′	Diff.	S′	Diff.	T′	Diff.
° ′		+		+		+	° ′		+		+		+
0 0	Inf. neg.	Inf.	Inf. neg.	Inf.	$\overline{6}\cdot38454$	1	5 0	$\overline{7}\cdot32606$	1408	$\overline{7}\cdot62466$	1431	$\overline{6}\cdot38944$	
10	$\overline{9}\cdot85116$	30102	$\overline{8}\cdot14641$	30103	38455	2	10	34014	1364	63897	1387	38977	33
20	$\overline{8}\cdot15218$	17608	44744	17610	38457	3	20	35378	1320	65284	1345	39012	35
30	32826	12492	62354	12495	38460	3	30	36698	1280	66629	1304	39047	35
40	45318	9689	74849	9692	38463	5	40	37978	1242	67933	1268	39083	36
50	55007		84541		38468		50	39220		69201		39120	37
1 0	$\overline{8}\cdot62923$	7916	$\overline{8}\cdot92460$	7919	$\overline{6}\cdot38474$	6	6 0	$\overline{7}\cdot40425$	1205	$\overline{7}\cdot70433$	1232	$\overline{6}\cdot39159$	39
10	69614	6691	99157	6697	38481	7	10	41597	1172	71633	1200	39198	39
20	75410	5796	$7\cdot04958$	5801	38490	9	20	42737	1140	72800	1167	39239	41
30	80521	5111	10075	5117	38499	9	30	43846	1109	73938	1138	39280	41
40	85092	4571	14653	4578	38509	10	40	44926	1080	75047	1109	39323	43
50	89226	4134	18795	4142	38521	12	50	45978	1052	76130	1083	39367	44
2 0	$\overline{8}\cdot92999$	3773	$\overline{7}\cdot22577$	3782	$\overline{6}\cdot38533$	12	7 0	$\overline{7}\cdot47004$	1026	$\overline{7}\cdot77187$	1057	$\overline{6}\cdot39411$	44
10	96469	3470	26056	3479	38547	14	10	48005	1001	78220	1033	39457	46
20	99681	3212	29278	3222	38561	14	20	48982	977	79229	1009	39504	47
30	$\overline{7}\cdot02670$	2989	32278	3000	38578	17	30	49935	953	80216	987	39552	48
40	05465	2795	35085	2807	38594	16	40	50867	932	81182	966	39601	49
50	08090	2625	37722	2637	38612	18	50	51778	911	82128	946	39651	50
3 0	$\overline{7}\cdot10563$	2473	$\overline{7}\cdot40209$	2487	$\overline{6}\cdot38631$	19	8 0	$\overline{7}\cdot52669$	891	$\overline{7}\cdot83054$	926	$\overline{6}\cdot39702$	51
10	12902	2339	42561	2352	38652	21	10	53540	871	83962	908	39754	52
20	15120	2218	44794	2233	38673	21	20	54393	853	84852	890	39807	53
30	17229	2109	46918	2124	38695	22	30	55228	835	85724	872	39861	54
40	19239	2010	48944	2026	38718	23	40	56046	818	86581	857	39916	55
50	21158	1919	50880	1936	38743	25	50	56847	801	87421	840	39972	56
4 0	$\overline{7}\cdot22995$	1837	$\overline{7}\cdot52734$	1854	$\overline{6}\cdot38769$	26	9 0	$\overline{7}\cdot57632$	785	$\overline{7}\cdot88247$	826	$\overline{6}\cdot40029$	57
10	24756	1761	54513	1779	38795	26	10	58402	770	89057	810	40087	58
20	26446	1690	56223	1710	38823	28	20	59157	755	89854	797	40146	59
30	28072	1626	57868	1645	38852	29	30	59897	740	90637	783	40207	61
40	29638	1566	59455	1587	38882	30	40	60624	727	91407	770	40268	61
50	31148	1510	60986	1531	38912	30	50	61337	713	92164	757	40330	62
5 0	32606	1458	62466	1480	38944	32	10 0	62037	700	92909	745	40393	63

Lat.	U′	Diff.	Y′	Diff.	V′	Diff.	X′	Diff.	W′	Diff.	Z′	Diff.
°		+		+		+		+		+		+
0	$\overline{12}\cdot888$		Inf. neg.	Infinite	Inf. neg.	Infinite	$\overline{12}\cdot593$	0	Inf. neg.	Infinite	Inf. neg.	Infinite
1	889	1	$\overline{15}\cdot378$	602	$\overline{10}\cdot926$	300	593	1	$13\cdot528$	302	$14\cdot835$	301
2	890	1	980	352	$9\cdot226$	176	594	2	830	177	$13\cdot136$	177
3	892	2	$14\cdot332$	249	402	124	596	1	$\overline{12}\cdot007$	125	313	126
4	895	3	581		526		597		132		439	
5	$\overline{12}\cdot898$	3	$\overline{14}\cdot775$	194	$\overline{9}\cdot622$	96	$\overline{12}\cdot600$	3	$\overline{12}\cdot230$	98	$\overline{13}\cdot537$	98
6	902	4	932	157	701	79	602	2	311	81	617	80
7	908	6	$13\cdot066$	134	766	65	606	4	380	69	685	68
8	913	5	181	115	823	57	610	4	440	60	745	60
9	920	7	283	102	873	50	614	4	494	54	798	53
10	927	7	373	90	917	44	618	4	542	48	846	48

TABLE VIII.—For calculating Azimuths and Distances of Points of which the Latitudes and Longitudes are known.

Lat.	R′	Diff.	S′	Diff.	T′	Diff.	Lat.	R′	Diff.	S′	Diff.	T′	Diff.
° ′		+		+		+	° ′		+		+		+
10 0	$\bar{7}\cdot62037$	688	$\bar{7}\cdot92909$	733	$\bar{6}\cdot40393$	64	15 0	$\bar{7}\cdot78518$	435	$\bar{6}\cdot11093$	503	$\bar{6}\cdot42742$	93
10	62725	675	93642	722	40457	66	10	78953	428	11596	498	42835	94
20	63400	664	94364	711	40523	66	20	79381	423	12094	494	42929	95
30	64064	652	95075	700	40589	67	30	79804	417	12588	488	43024	95
40	64716	641	95775	689	40656	68	40	80221	412	13076	484	43119	97
50	65357		96464		40724		50	80633		13560		43216	
11 0	$\bar{7}\cdot65988$	631	$\bar{7}\cdot97144$	680	$\bar{6}\cdot40793$	69	16 0	$\bar{7}\cdot81040$	407	$\bar{6}\cdot14040$	480	$\bar{6}\cdot43313$	97
10	66608	620	97814	670	40864	71	10	81441	401	14515	475	43411	98
20	67217	609	98475	661	40935	71	20	81837	396	14986	471	43510	99
30	67817	600	99126	651	41007	72	30	82228	391	15452	466	43610	100
40	68407	590	99769	643	41080	73	40	82614	386	15914	462	43711	101
50	68988	581	$\bar{6}\cdot00403$	634	41154	74	50	82996	382	16373	459	43813	102
12 0	$\bar{7}\cdot69560$	572	$\bar{6}\cdot01028$	625	$\bar{6}\cdot41229$	75	17 0	$\bar{7}\cdot83372$	376	$\bar{6}\cdot16827$	454	$\bar{6}\cdot43916$	103
10	70122	562	01646	618	41305	76	10	83744	372	17277	450	44019	103
20	70676	554	02255	609	41382	77	20	84111	367	17724	447	44123	104
30	71222	546	02857	602	41460	78	30	84474	363	18167	443	44229	106
40	71759	537	03452	595	41539	79	40	84832	358	18606	439	44335	106
50	72289	530	04039	587	41619	80	50	85186	354	19041	435	44442	107
13 0	$\bar{7}\cdot72810$	521	$\bar{6}\cdot04619$	580	$\bar{6}\cdot41700$	81	18 0	$\bar{7}\cdot85535$	349	$\bar{6}\cdot19473$	432	$\bar{6}\cdot44549$	107
10	73324	514	05193	574	41781	81	10	85880	345	19902	429	44658	109
20	73831	507	05759	566	41864	83	20	86221	341	20327	425	44767	109
30	74330	499	06319	560	41948	84	30	86558	337	20749	422	44878	111
40	74822	492	06873	554	42032	84	40	86891	333	21168	419	44989	111
50	75307	485	07421	548	42118	86	50	87220	329	21584	416	45101	112
14 0	$\bar{7}\cdot75785$	478	$\bar{6}\cdot07962$	541	$\bar{6}\cdot42204$	86	19 0	$\bar{7}\cdot87544$	324	$\bar{6}\cdot21996$	412	$\bar{6}\cdot45213$	112
10	76256	471	08498	536	42292	88	10	87865	321	22405	409	45327	114
20	76721	465	09028	530	42380	88	20	88182	317	22812	407	45441	114
30	77180	459	09552	524	42469	89	30	88496	314	23215	403	45557	116
40	77632	452	10071	519	42559	90	40	88805	309	23616	401	45673	116
50	78078	446	10585	514	42650	91	50	89111	306	24014	398	45789	116
15 0	78518	440	11093	508	42742	92	20 0	89414	303	24409	395	45907	118

Lat.	U′	Diff.	Y′	Diff.	V′	Diff.	X′	Diff.	W′	Diff.	Z′	Diff.
°		+		+		+		+		+		+
10	$\bar{12}\cdot927$	8	$\bar{13}\cdot373$	82	$\bar{9}\cdot917$	39	$\bar{12}\cdot618$	6	$\bar{12}\cdot542$	44	$\bar{13}\cdot846$	43
11	935	9	455	75	956	36	624	5	586	41	889	40
12	944	9	530	68	992	33	629	6	627	38	929	37
13	953	10	598	63	$\bar{8}\cdot025$	29	635	6	665	36	966	35
14	963		661		054		641		701		$\bar{12}\cdot001$	
15	$\bar{12}\cdot973$	10	$\bar{13}\cdot720$	59	$\bar{8}\cdot082$	28	$\bar{12}\cdot648$	7	$\bar{12}\cdot735$	34	$\bar{12}\cdot034$	33
16	984	11	775	55	107	25	654	6	768	33	065	31
17	996	12	826	51	130	23	662	8	799	31	095	30
18	$\bar{11}\cdot008$	12	874	48	152	22	669	7	829	30	123	28
19	021	13	919	45	172	20	676	7	857	28	149	26
20	034	13	962	43	191	19	684	8	885	28	175	26

TABLE VIII.—For calculating Azimuths and Distances of Points of which the Latitudes and Longitudes are known.

Lat.	R′	Diff.	S′	Diff.	T′	Diff.	Lat.	R′	Diff.	S′	Diff.	T′	Diff.
° ′		+		+		+	° ′		+		+		+
20 0	$\bar{7}\cdot89414$	299	$\bar{6}\cdot24409$	392	$\bar{6}\cdot45907$	118	25 0	$\bar{7}\cdot97015$	210	$\bar{6}\cdot35187$	330	$\bar{6}\cdot49792$	141
10	89713	295	24801	389	46025	120	10	97225	207	35517	328	49933	141
20	90008	292	25190	387	46145	120	20	97432	206	35845	326	50074	142
30	90300	288	25577	385	46265	120	30	97638	202	36171	325	50216	143
40	90588	285	25962	382	46385	122	40	97840	201	36496	324	50359	144
50	90873	282	26344	379	46507	122	50	98041	198	36820	322	50503	144
21 0	$\bar{7}\cdot91155$	278	$\bar{6}\cdot26723$	377	$\bar{6}\cdot46629$	124	26 0	$\bar{7}\cdot98239$	195	$\bar{6}\cdot37142$	320	$\bar{6}\cdot50647$	145
10	91433	275	27100	375	46753	123	10	98434	193	37462	320	50792	146
20	91708	272	27475	372	46876	125	20	98627	191	37782	317	50938	146
30	91980	269	27847	370	47001	126	30	98818	189	38099	317	51084	147
40	92249	266	28217	367	47127	126	40	99007	186	38416	315	51231	147
50	92515	262	28584	366	47253	127	50	99193	184	38731	313	51378	149
22 0	$\bar{7}\cdot92777$	260	$\bar{6}\cdot28950$	363	$\bar{6}\cdot47380$	128	27 0	$\bar{7}\cdot99377$	182	$\bar{6}\cdot39044$	313	$\bar{6}\cdot51527$	149
10	93037	256	29313	361	47508	128	10	99559	179	39357	311	51676	149
20	93293	254	29674	359	47636	129	20	99738	178	39668	309	51825	150
30	93547	251	30033	357	47765	130	30	99916	175	39977	309	51975	151
40	93798	247	30390	355	47895	131	40	$\bar{6}\cdot00091$	173	40286	307	52126	152
50	94045	245	30745	352	48026	132	50	00264	171	40593	306	52278	152
23 0	$\bar{7}\cdot94290$	242	$\bar{6}\cdot31097$	351	$\bar{6}\cdot48158$	132	28 0	$\bar{6}\cdot00435$	168	$\bar{6}\cdot40899$	305	$\bar{6}\cdot52430$	153
10	94532	239	31448	349	48290	133	10	00603	167	41204	304	52583	153
20	94771	237	31797	347	48423	133	20	00770	164	41508	302	52736	154
30	95008	233	32144	345	48556	134	30	00934	163	41810	302	52890	155
40	95241	231	32489	344	48690	136	40	01097	160	42112	300	53045	156
50	95472	228	32833	341	48826	136	50	01257	158	42412	299	53201	155
24 0	$\bar{7}\cdot95700$	226	$\bar{6}\cdot33174$	340	$\bar{6}\cdot48962$	136	29 0	$\bar{6}\cdot01415$	156	$\bar{6}\cdot42711$	298	$\bar{6}\cdot53356$	157
10	95926	223	33514	338	49098	138	10	01571	154	43009	297	53513	157
20	96149	220	33852	336	49236	138	20	01725	152	43306	296	53670	158
30	96369	218	34188	335	49374	138	30	01877	150	43602	295	53828	159
40	96587	215	34523	333	49512	140	40	02027	149	43897	294	53987	159
50	96802	213	34856	331	49652	140	50	02176	146	44191	293	54146	160
25 0	97015		35187		49792		30 0	02322		44484		54306	

Lat.	U′	Diff.	Y′	Diff.	V′	Diff.	X′	Diff.	W′	Diff.	Z′	Diff.
°		+		+		+		+		+		+
20	$\bar{11}\cdot034$	14	$\bar{13}\cdot962$	41	$\bar{8}\cdot191$	18	$\bar{12}\cdot684$	8	$\bar{12}\cdot885$	27	$\bar{12}\cdot175$	25
21	048	14	$\bar{12}\cdot003$	38	209	16	692	8	912	26	200	24
22	062	15	041	37	225	15	700	9	938	26	224	23
23	077	15	078	35	240	14	709	8	964	25	247	22
24	092		113		254		717		989		269	
25	$\bar{11}\cdot107$	15	$\bar{12}\cdot146$	33	$\bar{8}\cdot267$	13	$\bar{12}\cdot726$	9	$\bar{11}\cdot014$	25	$\bar{12}\cdot290$	21
26	123	16	178	32	280	13	734	8	038	24	311	21
27	140	17	208	30	291	11	743	9	062	24	331	20
28	156	16	237	29	302	11	752	9	086	24	351	20
29	173	17	265	28	312	10	760	8	109	23	370	19
30	191	18	292	27	321	9	769	9	133	24	389	19

TABLE VIII.—For calculating Azimuths and Distances of Points of which the Latitudes and Longitudes are known.

Lat.	R′	Diff.	S′	Diff.	T′	Diff.	Lat.	R′	Diff.	S′	Diff.	T′	Diff.
° ′		+		+		+	° ′		+		+		+
30 0	$\bar{6}\cdot02322$	144	$\bar{6}\cdot44484$	292	$\bar{6}\cdot54306$	160	35 0	$\bar{6}\cdot05844$	91	$\bar{6}\cdot52886$	269	$\bar{6}\cdot59374$	178
10	02466	142	44776	291	54466	161	10	05935	88	53155	269	59552	178
20	02608	140	45067	290	54627	162	20	06023	87	53424	268	59730	179
30	02748	139	45357	290	54789	161	30	06110	86	53692	268	59909	180
40	02887	136	45647	288	54950	164	40	06196	84	53960	267	60089	180
50	03023		45935		55114		50	06280		54227		60269	
31 0	$\bar{6}\cdot03158$	135	$\bar{6}\cdot46222$	287	$\bar{6}\cdot55277$	163	36 0	$\bar{6}\cdot06362$	82	$\bar{6}\cdot54494$	267	$\bar{6}\cdot60450$	181
10	03290	132	46509	287	55441	164	10	06442	80	54760	266	60631	181
20	03421	131	46794	285	55606	165	20	06521	79	55026	266	60813	182
30	03550	129	47079	285	55771	165	30	06598	77	55291	265	60995	182
40	03677	127	47363	284	55937	166	40	06674	76	55556	265	61178	183
50	03802	125	47646	283	56103	166	50	06748	74	55820	264	61361	183
32 0	$\bar{6}\cdot03926$	124	$\bar{6}\cdot47928$	282	$\bar{6}\cdot56270$	167	37 0	$\bar{6}\cdot06820$	72	$\bar{6}\cdot56084$	264	$\bar{6}\cdot61545$	184
10	04047	121	48210	282	56437	167	10	06891	71	56348	264	61729	184
20	04167	120	48490	280	56606	169	20	06960	69	56611	263	61915	186
30	04285	118	48770	280	56774	168	30	07028	68	56873	262	62100	185
40	04401	116	49049	279	56944	170	40	07094	66	57135	262	62286	186
50	04516	115	49328	279	57113	169	50	07159	65	57397	262	62473	187
33 0	$\bar{6}\cdot04628$	112	$\bar{6}\cdot49606$	278	$\bar{6}\cdot57284$	171	38 0	$\bar{6}\cdot07222$	63	$\bar{6}\cdot57659$	262	$\bar{6}\cdot62660$	187
10	04739	111	49883	277	57455	171	10	07283	61	57920	261	62848	188
20	04848	109	50159	276	57627	172	20	07343	60	58180	260	63036	188
30	04955	107	50434	275	57799	172	30	07401	58	58441	261	63225	189
40	05061	106	50709	275	57971	172	40	07458	57	58701	260	63415	190
50	05165	104	50984	275	58145	174	50	07513	55	58960	259	63604	189
34 0	$\bar{6}\cdot05267$	102	$\bar{6}\cdot51257$	273	$\bar{6}\cdot58319$	174	39 0	$\bar{6}\cdot07567$	54	$\bar{6}\cdot59220$	260	$\bar{6}\cdot63795$	191
10	05368	101	51530	273	58493	174	10	07619	52	59479	259	63986	191
20	05466	98	51803	273	58669	176	20	07670	51	59737	258	64178	192
30	05563	97	52074	271	58844	175	30	07719	49	59996	259	64370	192
40	05659	96	52345	271	59020	176	40	07766	47	60254	258	64562	192
50	05752	93	52616	271	59197	177	50	07812	46	60511	257	64756	194
35 0	05844	92	52886	270	59374	177	40 0	07857	45	60769	258	64950	194

Lat.	U′	Diff.	Y′	Diff.	V′	Diff.	X′	Diff.	W′	Diff.	Z′	Diff.
°		+		+		+		+		+		+
30	$\bar{11}\cdot191$	17	$\bar{12}\cdot292$	26	$\bar{8}\cdot321$	8	$\bar{12}\cdot769$	9	$\bar{11}\cdot133$	23	$\bar{12}\cdot389$	18
31	208	19	318	24	329	8	778	9	156	23	407	18
32	227	18	342	24	337	7	787	8	179	23	425	17
33	245	19	366	23	344	7	795	9	202	23	442	17
34	264		389		351		804		225		459	
35	$\bar{11}\cdot283$	19	$\bar{12}\cdot411$	22	$\bar{8}\cdot357$	6	$\bar{12}\cdot813$	9	$\bar{11}\cdot248$	23	$\bar{12}\cdot475$	16
36	302	19	432	21	362	5	821	8	270	22	491	16
37	322	20	453	21	367	5	830	9	294	24	507	16
38	342	20	473	20	371	4	838	8	316	22	522	15
39	363	21	492	19	374	3	846	8	340	24	537	15
40	384	21	510	18	377	3	855	9	363	23	551	14

TABLE IX.—Computation of Heights.—Correction to Log. Distance in Feet between two Stations A and B to reduce to the Level of Station A.

Correction to the 7th place of decimals.

Latitude	Height in Feet of Station A									
	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
°										
0	208·3	416·5	624·8	833·0	1041·3	1249·6	1457·8	1666·1	1874·4	2082·6
1	3	5	8	0	3	6	8	1	4	6
2	3	5	8	0	3	6	8	1	3	6
3	3	5	8	0	3	5	8	1	3	6
4	3	5	8	0	3	5	8	0	3	6
5	208·3	416·5	624·8	833·0	1041·3	1249·5	1457·8	1666·0	1874·3	2082·5
6	2	5	7	0	2	5	7	0	2	5
7	2	5	7	0	2	5	7	1665·9	2	4
8	2	5	7	832·9	2	4	6	9	1	3
9	2	5	7	9	1	4	6	8	1	3
10	208·2	416·4	624·7	832·9	1041·1	1249·3	1457·5	1665·8	1874·0	2082·2
11	2	4	6	9	1	3	5	7	1873·9	1
12	2	4	6	8	0	2	4	6	8	0
13	2	4	6	8	0	1	3	5	7	2081·9
14	2	4	5	7	1040·9	1	3	4	6	8
15	208·2	416·3	624·5	832·7	1040·9	1249·0	1457·2	1665·4	1873·5	2081·7
16	2	3	5	6	8	1248·9	1	3	4	6
17	1	3	4	6	7	9	0	1	3	4
18	1	3	4	5	6	8	1456·9	0	2	3
19	1	2	3	5	6	7	8	1664·9	0	1
20	208·1	416·2	624·3	832·4	1040·5	1248·6	1456·7	1664·8	1872·9	2081·0
21	1	2	3	3	4	5	6	7	8	2080·8
22	1	1	2	3	4	4	5	6	6	7
23	1	1	2	2	3	3	4	4	5	5
24	0	1	1	1	2	2	2	3	3	3
25	208·0	416·0	624·0	832·1	1040·1	1248·1	1456·1	1664·1	1872·1	2080·1
26	0	0	0	0	0	0	0	0	0	0
27	0	415·9	623·9	831·9	1039·9	1247·8	1455·8	1663·8	1871·8	2079·7
28	0	9	9	8	8	7	7	6	6	6
29	207·9	9	8	7	7	6	6	5	4	4
30	207·9	415·8	623·8	831·7	1039·6	1247·5	1455·4	1663·3	1871·3	2079·2
31	9	8	7	6	5	4	3	1	0	2078·9
32	9	7	6	5	4	2	1	0	1870·9	7
33	9	7	6	4	3	1	0	1662·8	7	5
34	8	7	5	3	2	0	1454·8	6	5	3
35	207·8	415·6	623·4	831·2	1039·0	1246·8	1454·6	1662·5	1870·3	2078·1
36	8	6	3	1	1038·9	7	5	3	0	2077·8
37	8	5	3	0	8	6	3	1	1869·8	6
38	7	5	2	830·9	7	4	2	1661·9	6	4
39	7	4	1	9	6	3	0	7	4	1
40	7	4	1	8	5	1	1453·8	5	2	2076·9

Correction to the 5th place of decimals

for any latitude between 0° and 40°.

	2	4	6	8	10	12	15	17	19	21

TABLE X.—Computation of Heights.—For converting Geodetic Distance in Miles into Seconds of Contained Arc.

Latitude	Geodetic Distance in Miles									Latitude
	10	20	30	40	50	60	70	80	90	
°	"	"	"	"	"	"	"	"	"	°
0	522·3	1044·5	1566·8	2089·0	2611·3	3133·5	3655·8	4178·1	4700·3	0
1	3	5	8	0	3	5	8	1	3	1
2	3	5	8	0	3	5	8	0	3	2
3	2	5	7	0	2	5	7	0	2	3
4	2	5	7	0	2	4	7	4177·9	2	4
5	522·2	1044·5	1566·7	2088·9	2611·2	3133·4	3655·6	4177·9	4700·1	5
6	2	4	7	9	1	3	5	8	0	6
7	2	4	6	8	0	2	4	7	4699·9	7
8	2	4	6	8	0	1	3	5	7	8
9	2	3	5	7	2610·9	0	2	4	6	9
10	522·2	1044·3	1566·5	2088·6	2610·8	3132·9	3655·1	4177·2	4699·4	10
11	1	3	4	5	7	8	3654·9	1	2	11
12	1	2	3	4	5	6	8	4176·9	0	12
13	1	2	2	3	4	5	6	7	4698·7	13
14	1	1	2	2	3	3	4	4	5	14
15	522·0	1044·1	1566·1	2088·1	2610·1	3132·2	3654·2	4176·2	4698·2	15
16	0	0	0	0	0	0	0	0	4697·9	16
17	0	1043·9	1565·9	2087·8	2609·8	3131·8	3653·7	4175·7	7	17
18	521·9	9	8	7	6	6	5	4	3	18
19	9	8	7	6	4	3	2	1	0	19
20	521·9	1043·7	1565·6	2087·4	2609·3	3131·1	3653·0	4174·8	4696·7	20
21	8	6	4	2	1	3130·9	3652·7	5	3	21
22	8	5	3	1	2608·9	6	4	2	4695·9	22
23	7	5	2	2086·9	6	4	1	4173·8	6	23
24	7	4	1	7	4	1	3651·8	5	2	24
25	521·6	1043·3	1564·9	2086·6	2608·2	3129·8	3651·5	4173·1	4694·7	25
26	6	2	8	4	0	5	1	4172·7	3	26
27	5	1	6	2	2607·7	3	3650·8	3	4693·9	27
28	5	0	5	0	5	0	4	4171·9	4	28
29	4	1042·9	3	2085·8	2	3128·7	1	5	0	29
30	521·4	1042·8	1564·2	2085·6	2607·0	3128·3	3649·7	4171·1	4692·5	30
31	3	7	0	3	2606·7	0	4	4170·7	0	31
32	3	6	1563·8	1	4	3127·7	0	3	4691·5	32
33	2	5	7	2084·9	1	4	3648·6	4169·8	1	33
34	2	3	5	7	2605·9	0	2	4	4690·6	34
35	521·1	1042·2	1563·3	2084·5	2605·6	3126·7	3647·8	4168·9	4690·0	35
36	1	1	2	2	3	4	4	5	4689·5	36
37	0	0	0	0	0	0	0	0	0	37
38	520·9	1041·9	1562·8	2083·8	2604·7	3125·7	3646·6	4167·5	4688·5	38
39	9	8	6	5	4	3	2	1	4687·9	39
40	8	6	5	3	1	3124·9	3645·8	4166·6	4	40

Mile	·00	·01	·02	·03	·04	·05	·06	·07	·08	·09	Mile
	"	"	"	"	"	"	"	"	"	"	
·0		·5	1·0	1·6	2·1	2·6	3·1	3·7	4·2	4·7	·0
·1	5·2	5·7	6·3	6·8	7·3	7·8	8·3	8·9	9·4	9·9	·1
·2	10·4	11·0	11·5	12·0	12·5	13·0	13·6	14·1	14·6	15·1	·2
·3	15·6	16·2	16·7	17·2	17·7	18·3	18·8	19·3	19·8	20·3	·3
·4	20·9	21·4	21·9	22·4	23·0	23·5	24·0	24·5	25·0	25·6	·4
·5	26·1	26·6	27·1	27·6	28·2	28·7	29·2	29·7	30·3	30·8	·5
·6	31·3	31·8	32·3	32·9	33·4	33·9	34·4	35·0	35·5	36·0	·6
·7	36·5	37·0	37·6	38·1	38·6	39·1	39·6	40·2	40·7	41·2	·7
·8	41·7	42·3	42·8	43·3	43·8	44·3	44·9	45·4	45·9	46·4	·8
·9	46·9	47·5	48·0	48·5	49·0	49·6	50·1	50·6	51·1	51·6	·9

TABLE XI.—Computation of Heights.—For converting Geodetic Distance in Feet into Seconds of Contained Arc.

Lat.	Geodetic Distance in Feet								
	1000	2000	3000	4000	5000	6000	7000	8000	9000
°	"	"	"	"	"	"	"	"	"
0	−0·109	−0·218	−0·326	−0·435	−0·544	−0·65	−0·76	−0·87	−0·98
1	109	218	326	435	544	65	76	87	98
2	109	218	326	435	544	65	76	87	98
3	109	218	327	436	545	65	76	87	98
4	109	218	327	436	545	65	76	87	98
5	109	219	328	437	546	66	76	87	98
6	109	219	328	438	547	66	77	88	99
7	110	219	329	439	549	66	77	88	99
8	110	220	330	440	550	66	77	88	99
9	110	221	331	441	552	66	77	88	99
10	111	221	332	443	554	66	78	89	1·00
11	111	222	333	445	556	67	78	89	1·00
12	112	223	335	446	558	67	78	89	1·00
13	112	224	336	448	560	67	78	90	1·01
14	113	225	338	450	563	68	79	90	1·01
15	113	226	339	453	566	68	79	91	1·02
16	114	228	341	455	569	68	80	91	1·02
17	114	229	343	457	572	69	80	91	1·03
18	115	230	345	460	575	69	81	92	1·04
19	116	231	347	463	579	69	81	93	1·04
20	116	233	349	466	582	70	82	93	1·05
21	117	234	352	469	586	70	82	94	1·05
22	118	236	354	472	590	71	83	94	1·06
23	119	238	356	475	594	71	83	95	1·07
24	120	239	359	479	598	72	84	96	1·08
25	121	241	362	482	603	72	84	96	1·08
26	121	243	364	486	607	73	85	97	1·09
27	122	245	367	489	612	73	86	98	1·10
28	123	246	370	493	616	74	86	99	1·11
29	124	248	373	497	621	75	87	99	1·12
30	125	250	376	501	626	75	88	1·00	1·13
31	126	252	379	505	631	76	88	1·01	1·14
32	127	254	382	509	636	76	89	1·02	1·14
33	128	257	385	513	641	77	90	1·03	1·15
34	129	259	388	517	647	78	91	1·03	1·16
35	130	261	391	522	652	78	91	1·04	1·17
36	131	263	394	526	657	79	92	1·05	1·18
37	133	265	398	530	663	80	93	1·06	1·19
38	134	267	401	535	668	80	94	1·07	1·20
39	135	270	404	539	674	81	94	1·08	1·21
40	136	272	408	544	680	82	95	1·09	1·22

TABLE XII.—Computation of Heights.—For obtaining the Quantity β'' in the formula for finding the Terrestrial Refraction.

β''	Values of γ in feet																								β''
	0·5	1	1·5	2	2·5	3	3·5	4	4·5	5	5·5	6	6·5	7	7·5	8	8·5	9	9·5	10	10·5	11	11·5	12	
″									Distance between Stations A and B in Miles																″
29·5																								7·9	29·5
28·5																								8·2	28·5
27·5																						7·8	8·2	8·5	27·5
26·5																						8·1	8·5	8·8	26·5
25·5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8·4	8·8	9·2	25·5
24·5																				8·0	8·4	8·8	9·2	9·6	24·5
23·5																				8·3	8·7	9·1	9·6	10·0	23·5
22·5																		7·8	8·2	8·7	9·1	9·5	10·0	10·4	22·5
21·5																	7·7	8·2	8·6	9·1	9·5	10·0	10·4	10·9	21·5
20·5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7·6	8·1	8·6	9·1	9·5	10·0	10·5	11·0	11·4	20·5
19·5																8·0	8·5	9·0	9·5	10·0	10·5	11·0	11·5	12·0	19·5
18·5															7·9	8·4	9·0	9·5	10·0	10·6	11·1	11·6	12·1	12·7	18·5
17·5														7·8	8·4	8·9	9·5	10·0	10·6	11·2	11·7	12·3	12·8	13·4	17·5
16·5													7·7	8·3	8·9	9·5	10·1	10·7	11·2	11·8	12·4	13·0	13·6	14·2	16·5
15·5	...	...	...	...	...	...	...	...	...	...	...	7·6	8·2	8·8	9·5	10·1	10·7	11·3	12·0	12·6	13·2	13·9	14·5	15·1	15·5
14·5												8·1	8·8	9·4	10·1	10·8	11·5	12·1	12·8	13·5	14·1	14·8	15·5	16·2	14·5
13·5											8·0	8·7	9·4	10·1	10·9	11·6	12·3	13·0	13·7	14·5	15·2	15·9	16·6	17·4	13·5
12·5										7·8	8·6	9·4	10·2	10·9	11·7	12·5	13·3	14·1	14·8	15·6	16·4	17·2	18·0	18·8	12·5
11·5									7·6	8·5	9·3	10·2	11·0	11·9	12·7	13·6	14·4	15·3	16·1	17·0	17·8	18·7	19·5	20·4	11·5
10·5	...	...	...	...	...	...	...	7·4	8·4	9·3	10·2	11·2	12·1	13·0	14·0	14·9	15·8	16·7	17·7	18·6	19·5	20·5	21·4	22·3	10·5
9·5							7·2	8·2	9·3	10·3	11·3	12·3	13·4	14·4	15·4	16·4	17·5	18·5	19·5	20·6	21·6	22·6	23·6	24·7	9·5
8·5							8·0	9·2	10·3	11·5	12·6	13·8	14·9	16·1	17·2	18·4	19·5	20·7	21·8	23·0	24·1	25·3	26·4	27·6	8·5
7·5						7·8	9·1	10·4	11·7	13·0	14·3	15·6	16·9	18·2	19·5	20·8	22·1	23·4	24·7	26·0	27·3	28·6	30·0	31·3	7·5
6·5					7·5	9·0	10·5	12·0	13·5	15·0	16·5	18·0	19·5	21·0	22·5	24·0	25·5	27·0	28·5	30·1	31·6	33·1	34·6	36·1	6·5
5·5	...	...	...	7·1	8·9	10·7	12·4	14·2	16·0	17·8	19·5	21·3	23·1	24·9	26·6	28·4	30·2	32·0	33·7	35·5	37·3	39·1	40·8	42·6	5·5
4·5			6·5	8·7	10·9	13·0	15·2	17·4	19·5	21·7	23·9	26·0	28·2	30·4	32·6	34·7	36·9	39·1	41·2	43·4	45·6	47·7	49·9	52·1	4·5
3·5			8·4	11·2	14·0	16·7	19·5	22·3	25·1	27·9	30·7	33·5	36·3	39·1	41·9	44·6	47·4	50·2	53·0	55·8	58·6	61·4	64·2	67·0	3·5
2·5		7·8	11·7	15·6	19·5	23·4	27·3	31·3	35·2	39·1	43·0	46·9	50·8	54·7	58·6	62·5	66·4	70·3	74·2	78·1	82·0	85·9	89·9	93·8	2·5
1·5	6·5	13·0	19·5	26·0	32·6	39·1	45·6	52·1	58·6	65·1	71·6	78·1	84·6	91·2	97·7	104·2	...	...	...	...	...	...	...	...	1·5
0·5	19·5	39·1	58·6	78·1	97·7	117·2	136·7	156·3	175·8	195·3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·5

This table makes provision for values of γ up to 12 feet and of the distance to 195·3 miles: when these limits are exceeded β'' should be computed by the following formula:—$\beta'' = 19·53 \dfrac{\gamma}{\text{Dist. in miles}}$.

TABLE XIII.—Computation of Heights.—Log. secant of Observed Angle at Station B.

Angle			Log. secant	Angle			Log. secant	Angle			Log. secant
°	′	″		°	′	″		°	′	″	
0	16	25	0·00000,5	1	15	35	0·00010,5	1	45	37	0·00020,5
0	28	32	1,5	1	19	6	11,5	1	48	10	21,5
0	36	51	2,5	1	22	28	12,5	1	50	39	22,5
0	43	37	3,5	1	25	42	13,5	1	53	5	23,5
0	49	28	4,5	1	28	49	14,5	1	55	28	24,5
0	54	42	5,5	1	31	50	15,5	1	57	47	25,5
0	59	28	6,5	1	34	45	16,5	2	0	5	26,5
1	3	52	7,5	1	37	35	17,5	2	2	19	27,5
1	8	0	8,5	1	40	20	18,5	2	4	32	28,5
1	11	54	9,5	1	43	0	19,5	2	6	42	29,5

TABLE XIV.—Computation of Heights.—To facilitate finding the Subtended Angle when only one angle has been observed and the Distance between Stations A and B is given in Log. Feet.

Lat.	Adopted Refraction expressed in Decimals of Contained Arc									Lat.
	0·20	0·10	0·09	0·08	0·07	0·06	0·05	0·04	0·03	
°										°
0	2·5276	2·4027	2·3920	2·3815	2·3713	2·3613	2·3515	2·3420	2·3327	0
5	5277	4027	3920	3815	3713	3613	3516	3420	3327	5
10	5277	4028	3921	3816	3714	3614	3516	3421	3327	10
15	5278	4029	3922	3817	3715	3615	3517	3422	3328	15
20	5280	4030	3923	3818	3716	3616	3519	3423	3330	20
25	5281	4032	3925	3820	3718	3618	3521	3425	3332	25
30	5284	4034	3927	3822	3720	3620	3523	3427	3334	30
35	5286	4036	3929	3825	3722	3623	3525	3429	3336	35
40	5288	4039	3932	3827	3725	3625	3527	3432	3338	40

TABLE XV.—Computation of Heights.—To facilitate finding the Subtended Angle when only one angle has been observed and the Distance between Stations A and B is given in Feet.

Contained Arc in Feet	Adopted Refraction expressed in Decimals of Contained Arc													
	0·5	0·4	0·3	0·2	0·1	0·09	0·08	0·07	0·06	0·05	0·04	0·03	0·02	0·01	0·00
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
100	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	0 0
200	0 0	0 0	0 0	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1
300	0 0	0 0	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1
400	0 0	0 0	0 1	0 1	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2
500	0 0	0 0	0 1	0 1	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2
600	0 0	0 1	0 1	0 2	0 2	0 2	0 2	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3
700	0 0	0 1	0 1	0 2	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3
800	0 0	0 1	0 2	0 2	0 3	0 3	0 3	0 3	0 3	0 4	0 4	0 4	0 4	0 4	0 4
900	0 0	0 1	0 2	0 3	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4
1 000	0 0	0 1	0 2	0 3	0 4	0 4	0 4	0 4	0 4	0 4	0 5	0 5	0 5	0 5	0 5
2 000	0 0	0 2	0 4	0 6	0 8	0 8	0 8	0 9	0 9	0 9	0 9	0 9	0 9	0 10	0 10
3 000	0 0	0 3	0 6	0 9	0 11	0 12	0 12	0 13	0 13	0 13	0 14	0 14	0 14	0 15	0 15
4 000	0 0	0 4	0 8	0 12	0 16	0 16	0 17	0 17	0 17	0 18	0 18	0 19	0 19	0 19	0 20
5 000	0 0	0 5	0 10	0 15	0 20	0 20	0 21	0 21	0 22	0 22	0 23	0 23	0 24	0 24	0 25
6 000	0 0	0 6	0 12	0 18	0 24	0 24	0 25	0 26	0 26	0 27	0 27	0 28	0 28	0 29	0 30
7 000	0 0	0 7	0 14	0 21	0 28	0 28	0 29	0 30	0 30	0 31	0 32	0 33	0 33	0 34	0 35
8 000	0 0	0 8	0 16	0 24	0 32	0 32	0 33	0 34	0 35	0 36	0 36	0 37	0 38	0 39	0 40
9 000	0 0	0 9	0 18	0 27	0 36	0 36	0 37	0 38	0 39	0 40	0 41	0 42	0 43	0 44	0 44
10 000	0 0	0 10	0 20	0 30	0 40	0 41	0 42	0 43	0 43	0 44	0 45	0 46	0 47	0 48	0 49
20 000	0 0	0 20	0 40	0 59	1 19	1 21	1 23	1 25	1 27	1 29	1 31	1 33	1 35	1 37	1 39
30 000	0 0	0 30	0 59	1 29	1 59	2 2	2 5	2 8	2 10	2 13	2 16	2 19	2 22	2 25	2 28
40 000	0 0	0 40	1 19	1 59	2 38	2 42	2 46	2 50	2 54	2 58	3 2	3 6	3 10	3 14	3 18
50 000	0 0	0 49	1 39	2 28	3 18	3 23	3 28	3 33	3 37	3 42	3 47	3 52	3 57	4 2	4 7
60 000	0 0	0 59	1 59	2 58	3 57	4 3	4 9	4 15	4 21	4 27	4 33	4 39	4 45	4 51	4 57
70 000	0 0	1 9	2 18	3 28	4 37	4 44	4 51	4 58	5 4	5 11	5 18	5 25	5 32	5 39	5 46
80 000	0 0	1 19	2 38	3 57	5 16	5 24	5 32	5 40	5 48	5 56	6 4	6 12	6 20	6 27	6 35
90 000	0 0	1 29	2 58	4 27	5 56	6 5	6 14	6 23	6 31	6 40	6 49	6 58	7 7	7 16	7 25
100 000	0 0	1 39	3 18	4 56	6 35	6 45	6 55	7 5	7 15	7 25	7 35	7 45	7 54	8 4	8 14
200 000	0 0	3 18	6 35	9 53	13 11	13 30	13 50	14 10	14 30	14 50	15 9	15 29	15 49	16 9	16 28
300 000	0 0	4 57	9 53	14 50	19 46	20 16	20 45	21 15	21 45	22 14	22 44	23 14	23 43	24 13	24 43
400 000	0 0	6 35	13 11	19 46	26 21	27 1	27 41	28 20	29 0	29 39	30 19	30 58	31 38	32 17	32 57

TABLE XVI.—Computation of Heights.—Natural Tangents to 5 places of Decimals.

′	0°	1°	2°	3°	4°	5°	6°	7°	′
0	0·00000	0·01746	0·03492	0·05241	0·06993	0·08749	0·10510	0·12278	0
1	029	775	521	270	·07022	778	540	308	1
2	058	804	550	299	051	807	569	338	2
3	087	833	579	328	080	837	599	367	3
4	116	862	609	357	110	866	628	397	4
5	145	891	638	387	139	895	658	426	5
6	175	920	667	416	168	925	687	456	6
7	204	949	696	445	197	954	716	485	7
8	233	978	725	474	227	983	746	515	8
9	262	·02007	754	503	256	·09013	775	544	9
10	291	037	783	533	285	042	805	574	10
11	0·00320	0·02066	0·03812	0·05562	0·07314	0·09071	0·10834	0·12603	11
12	349	095	842	591	344	101	863	633	12
13	378	124	871	620	373	130	893	662	13
14	407	153	900	649	402	159	922	692	14
15	436	182	929	678	431	189	952	722	15
16	465	211	958	708	461	218	981	751	16
17	495	240	987	737	490	247	·11011	781	17
18	524	269	·04016	766	519	277	040	810	18
19	553	298	046	795	548	306	070	840	19
20	582	328	075	824	578	335	099	869	20
21	0·00611	0·02357	0·04104	0·05854	0·07607	0·09365	0·11128	0·12899	21
22	640	386	133	883	636	394	158	929	22
23	669	415	162	912	665	423	187	958	23
24	698	444	191	941	695	453	217	988	24
25	727	473	220	970	724	482	246	·13017	25
26	756	502	250	999	753	511	276	047	26
27	785	531	279	·06029	782	541	305	076	27
28	815	560	308	058	812	570	335	106	28
29	844	589	337	087	841	600	364	136	29
30	873	619	366	116	870	629	394	165	30
31	0·00902	0·02648	0·04395	0·06145	0·07899	0·09658	0·11423	0·13195	31
32	931	677	424	175	929	688	453	224	32
33	960	706	454	204	958	717	482	254	33
34	989	735	483	233	987	746	511	284	34
35	·01018	764	512	262	·08017	776	541	313	35
36	047	793	541	291	046	805	570	343	36
37	076	822	570	321	075	834	600	372	37
38	105	851	599	350	104	864	629	402	38
39	135	881	628	379	134	893	659	432	39
40	164	910	658	408	163	923	688	461	40
41	0·01193	0·02939	0·04687	0·06438	0·08192	0·09952	0·11718	0·13491	41
42	222	968	716	467	222	981	747	521	42
43	251	997	745	496	251	·10011	777	550	43
44	280	·03026	774	525	280	040	806	580	44
45	309	055	803	554	309	069	836	609	45
46	338	084	833	584	339	099	865	639	46
47	367	114	862	613	368	128	895	669	47
48	396	143	891	642	397	158	924	698	48
49	425	172	920	671	427	187	954	728	49
50	455	201	949	700	456	216	983	758	50
51	0·01484	0·03230	0·04978	0·06730	0·08485	0·10246	0·12013	0·13787	51
52	513	259	·05007	759	514	275	042	817	52
53	542	288	037	788	544	305	072	847	53
54	571	317	066	817	573	334	101	876	54
55	600	346	095	847	602	363	131	906	55
56	629	376	124	876	632	393	160	935	56
57	658	405	153	905	661	422	190	965	57
58	687	434	182	934	690	452	219	995	58
59	716	463	212	963	720	481	249	·14024	59
60	746	492	241	993	749	510	278	054	60

TABLE XVI.—Computation of Heights.—Natural Tangents to 5 places of Decimals.

′	8°	9°	10°	11°	12°	13°	14°	15°	′
0	0·14054	0·15838	0·17633	0·19438	0·21256	0·23087	0·24933	0·26795	0
1	084	868	663	468	286	117	964	826	1
2	113	898	693	498	316	148	995	857	2
3	143	928	723	529	347	179	·25026	888	3
4	173	958	753	559	377	209	056	920	4
5	202	988	783	589	408	240	087	951	5
6	232	·16017	813	619	438	271	118	982	6
7	262	047	843	649	469	301	149	·27013	7
8	291	077	873	680	499	332	180	044	8
9	321	107	903	710	529	363	211	076	9
10	351	137	933	740	560	393	242	107	10
11	0·14381	0·16167	0·17963	0·19770	0·21590	0·23424	0·25273	0·27138	11
12	410	196	993	801	621	455	304	169	12
13	440	226	·18023	831	651	485	335	201	13
14	470	256	053	861	682	516	366	232	14
15	499	286	083	891	712	547	397	263	15
16	529	316	113	921	743	578	428	294	16
17	559	346	143	952	773	608	459	326	17
18	588	376	173	982	804	639	490	357	18
19	618	406	203	·20012	834	670	521	388	19
20	648	435	233	042	864	700	552	419	20
21	0·14678	0·16465	0·18263	0·20073	0·21895	0·23731	0·25583	0·27451	21
22	707	495	293	103	925	762	614	482	22
23	737	525	323	133	956	793	645	513	23
24	767	555	353	164	986	823	676	545	24
25	796	585	384	194	·22017	854	707	576	25
26	826	615	414	224	047	885	738	607	26
27	856	645	444	254	078	916	769	639	27
28	886	674	474	285	108	946	800	670	28
29	915	704	504	315	139	977	831	701	29
30	945	734	534	345	169	·24008	862	732	30
31	0·14975	0·16764	0·18564	0·20376	0·22200	0·24039	0·25893	0·27764	31
32	·15005	794	594	406	231	069	924	795	32
33	034	824	624	436	261	100	955	826	33
34	064	854	654	466	292	131	986	858	34
35	094	884	684	497	322	162	·26017	889	35
36	124	914	714	527	353	193	048	921	36
37	153	944	745	557	383	223	079	952	37
38	183	974	775	588	414	254	110	983	38
39	213	·17004	805	618	444	285	141	·28015	39
40	243	033	835	648	475	316	172	046	40
41	0·15272	0·17063	0·18865	0·20679	0·22505	0·24347	0·26203	0·28077	41
42	302	093	895	709	536	377	235	109	42
43	332	123	925	739	567	408	266	140	43
44	362	153	955	770	597	439	297	172	44
45	391	183	986	800	628	470	328	203	45
46	421	213	·19016	830	658	501	359	234	46
47	451	243	046	861	689	532	390	266	47
48	481	273	076	891	719	562	421	297	48
49	511	303	106	921	750	593	452	329	49
50	540	333	136	952	781	624	483	360	50
51	0·15570	0·17363	0·19166	0·20982	0·22811	0·24655	0·26515	0·28391	51
52	600	393	197	·21013	842	686	546	423	52
53	630	423	227	043	872	717	577	454	53
54	660	453	257	073	903	748	608	486	54
55	689	483	287	104	934	778	639	517	55
56	719	513	317	134	964	809	670	549	56
57	749	543	347	164	995	840	701	580	57
58	779	573	378	195	·23026	871	733	612	58
59	809	603	408	225	056	902	764	643	59
60	838	633	438	256	087	933	795	675	60

TABLE XVII.—Computation of Heights.—Correction for Curvature and Refraction in determining Heights with the Clinometer.

Adopted Refraction expressed in Decimals of Contained Arc					
0·10		0·07		0·05	
Distance in feet	Correction in feet	Distance in feet	Correction in feet	Distance in feet	Correction in feet
5 100	0·5	4 900	0·5	4 808	0·5
8 834	1·5	8 487	1·5	8 328	1·5
11 404	2·5	10 957	2·5	10 752	2·5
13 493	3·5	12 964	3·5	12 722	3·5
15 300	4·5	14 700	4·5	14 425	4·5
16 915	5·5	16 251	5·5	15 948	5·5
18 388	6·5	17 667	6·5	17 337	6·5
19 752	7·5	18 977	7·5	18 623	7·5
21 028	8·5	20 203	8·5	19 825	8·5
22 231	9·5	21 358	9·5	20 959	9·5
23 371	10·5	22 454	10·5	22 035	10·5
24 459	11·5	23 499	11·5	23 060	11·5
25 500	12·5	24 500	12·5	24 042	12·5
26 501	13·5	25 461	13·5	24 985	13·5
27 465	14·5	26 387	14·5	25 894	14·5
28 396	15·5	27 282	15·5	26 772	15·5
29 297	16·5	28 148	16·5	27 622	16·5
30 172	17·5	28 989	17·5	28 447	17·5
31 022	18·5	29 805	18·5	29 248	18·5
31 850	19·5	30 600	19·5	30 028	19·5
32 656	20·5	31 375	20·5	30 789	20·5
33 443	21·5	32 131	21·5	31 531	21·5
34 212	22·5	32 870	22·5	32 255	22·5
34 964	23·5	33 592	23·5	32 964	23·5
35 700	24·5	34 300	24·5	33 659	24·5
36 422	25·5	34 993	25·5	34 339	25·5
37 129	26·5	35 672	26·5	35 005	26·5
37 823	27·5	36 339	27·5	35 660	27·5
38 504	28·5	36 994	28·5	36 302	28·5
39 174	29·5	37 637	29·5	36 934	29·5
39 833	30·5	38 270	30·5	37 554	30·5
40 480	31·5	38 892	31·5	38 165	31·5
41 118	32·5	39 505	32·5	38 766	32·5
41 746	33·5	40 108	33·5	39 358	33·5
42 364	34·5	40 702	34·5	39 941	34·5
42 974	35·5	41 288	35·5	40 516	35·5
43 575	36·5	41 865	36·5	41 083	36·5
44 168	37·5	42 435	37·5	41 642	37·5
44 753	38·5	42 997	38·5	42 193	38·5
45 330	39·5	43 552	39·5	42 738	39·5
45 900	40·5	44 100	40·5	43 275	40·5
46 464	41·5	44 641	41·5	43 806	41·5
47 020	42·5	45 175	42·5	44 331	42·5
47 570	43·5	45 704	43·5	44 849	43·5
48 114	44·5	46 226	44·5	45 362	44·5
48 651	45·5	46 743	45·5	45 869	45·5
49 183	46·5	47 253	46·5	46 370	46·5
49 709	47·5	47 759	47·5	46 866	47·5
50 230	48·5	48 259	48·5	47 357	48·5
50 745	49·5	48 754	49·5	47 843	49·5
51 255	50·5	49 244	50·5	48 323	50·5

TABLE XVIII.—Computation of Heights.—For determining Differences of Height with the Barometer.—BAILY.

PART I.—Thermometers in the Open Air in degrees Fahrenheit.

t+t′	A	t+t′	A	t+t′	A	t+t′	A	t+t′	A
°		°		°		°		°	
1	4·74913	37	4·76742	73	4·78497	109	4·80183	145	4·81807
2	74965	38	76791	74	78544	110	80229	146	81851
3	75016	39	76841	75	78592	111	80275	147	81896
4	75068	40	76891	76	78640	112	80321	148	81940
5	75120	41	76940	77	78687	113	80367	149	81984
6	4·75171	42	4·76990	78	4·78735	114	4·80413	150	4·82028
7	75223	43	77039	79	78782	115	80458	151	82072
8	75274	44	77089	80	78830	116	80504	152	82116
9	75326	45	77138	81	78877	117	80550	153	82160
10	75377	46	77187	82	78925	118	80595	154	82204
11	4·75429	47	4·77236	83	4·78972	119	4·80641	155	4·82248
12	75480	48	77285	84	79019	120	80686	156	82291
13	75531	49	77335	85	79066	121	80731	157	82335
14	75582	50	77384	86	79113	122	80777	158	82379
15	75633	51	77433	87	79160	123	80822	159	82423
16	4·75684	52	4·77482	88	4·79207	124	4·80867	160	4·82466
17	75735	53	77530	89	79254	125	80913	161	82510
18	75786	54	77579	90	79301	126	80958	162	82553
19	75837	55	77628	91	79348	127	81003	163	82597
20	75888	56	77677	92	79395	128	81048	164	82640
21	4·75938	57	4·77725	93	4·79442	129	4·81093	165	4·82684
22	75989	58	77774	94	79489	130	81138	166	82727
23	76040	59	77823	95	79535	131	81183	167	82770
24	76090	60	77871	96	79582	132	81228	168	82814
25	76141	61	77919	97	79628	133	81273	169	82857
26	4·76191	62	4·77968	98	4·79675	134	4·81317	170	4·82900
27	76241	63	78016	99	79721	135	81362	171	82943
28	76292	64	78065	100	79768	136	81407	172	82986
29	76342	65	78113	101	79814	137	81452	173	83029
30	76392	66	78161	102	79861	138	81496	174	83072
31	4·76442	67	4·78209	103	4·79907	139	4·81541	175	4·83115
32	76492	68	78257	104	79953	140	81585	176	83158
33	76542	69	78305	105	79999	141	81630	177	83201
34	76592	70	78353	106	80045	142	81674	178	83244
35	76642	71	78401	107	80091	143	81719	179	83287
36	76692	72	78449	108	80137	144	81763	180	83330

PART II.—Attached Thermometers.

T−T′	B	T−T′	B	T−T′	B
°		°		°	
0	0·00000	20	0·00087	40	0·00174
1	004	21	091	41	178
2	009	22	096	42	182
3	013	23	100	43	187
4	017	24	104	44	191
5	0·00022	25	0·00109	45	0·00195
6	026	26	113	46	200
7	030	27	117	47	204
8	035	28	122	48	208
9	039	29	126	49	212
10	0·00043	30	0·00130	50	0·00217
11	048	31	135	51	221
12	052	32	139	52	225
13	056	33	143	53	230
14	061	34	148	54	234
15	0·00065	35	0·00152	55	0·00238
16	069	36	156	56	243
17	074	37	161	57	247
18	078	38	165	58	251
19	083	39	169	59	256

PART III.—Lat. of the Place.

Latitude	C
°	
0	0·00117
5	115
10	110
15	101
20	090
25	0·00075
30	058
35	040
40	020
45	000
50	1·99980
55	960
60	942
65	925
70	910
75	1·99900
80	890
85	885
90	883

TABLE XIX.—Computation of Heights.—For determining Differences of Height with the Barometer.—Loomis.

Part I.

Argument:—The observed Height of the Barometer at either Station.

Baro. in Inches	Feet	Diff.	Baro. in Inches	Feet	Diff.	Baro. in Inches	Feet	Diff.	Baro. in Inches	Feet	Diff.
11·0	1396·9	236·4	16·0	11186·3	162·8	21·0	18291·0	124·1	26·0	23871·0	100·3
11·1	1633·3	234·3	16·1	11349·1	161·8	21·1	18415·1	123·6	26·1	23971·3	99·9
11·2	1867·6	232·3	16·2	11510·9	160·8	21·2	18538·7	122·9	26·2	24071·2	99·5
11·3	2099·9	230·2	16·3	11671·7	159·8	21·3	18661·6	122·4	26·3	24170·7	99·1
11·4	2330·1	228·2	16·4	11831·5	158·8	21·4	18784·0	121·8	26·4	24269·8	98·8
11·5	2558·3	226·2	16·5	11990·3	157·9	21·5	18905·8	121·2	26·5	24368·6	98·4
11·6	2784·5	224·2	16·6	12148·2	156·9	21·6	19027·0	120·7	26·6	24467·0	98·1
11·7	3008·7	222·4	16·7	12305·1	155·9	21·7	19147·7	120·1	26·7	24565·1	97·6
11·8	3231·1	220·5	16·8	12461·0	155·1	21·8	19267·8	119·6	26·8	24662·7	97·3
11·9	3451·6	218·6	16·9	12616·1	154·1	21·9	19387·4	119·0	26·9	24760·0	97·0
12·0	3670·2	216·8	17·0	12770·2	153·3	22·0	19506·4	118·5	27·0	24857·0	96·6
12·1	3887·0	215·0	17·1	12923·5	152·3	22·1	19624·9	118·0	27·1	24953·6	96·2
12·2	4102·0	213·3	17·2	13075·8	151·5	22·2	19742·9	117·4	27·2	25049·8	95·9
12·3	4315·3	211·6	17·3	13227·3	150·6	22·3	19860·3	116·9	27·3	25145·7	95·5
12·4	4526·9	209·8	17·4	13377·9	149·7	22·4	19977·2	116·4	27·4	25241·2	95·2
12·5	4736·7	208·2	17·5	13527·6	148·9	22·5	20093·6	115·8	27·5	25336·4	94·8
12·6	4944·9	206·5	17·6	13676·5	148·0	22·6	20209·4	115·4	27·6	25431·2	94·5
12·7	5151·4	205·0	17·7	13824·5	147·2	22·7	20324·8	114·8	27·7	25525·7	94·2
12·8	5356·4	203·3	17·8	13971·7	146·3	22·8	20439·6	114·4	27·8	25619·9	93·8
12·9	5559·7	201·7	17·9	14118·0	145·6	22·9	20554·0	113·8	27·9	25713·7	93·4
13·0	5761·4	200·2	18·0	14263·6	144·7	23·0	20667·8	113·3	28·0	25807·1	93·2
13·1	5961·6	198·7	18·1	14408·3	144·0	23·1	20781·1	112·9	28·1	25900·3	92·8
13·2	6160·3	197·2	18·2	14552·3	143·1	23·2	20894·0	112·4	28·2	25993·1	92·5
13·3	6357·5	195·7	18·3	14695·4	142·4	23·3	21006·4	111·9	28·3	26085·6	92·1
13·4	6553·2	194·3	18·4	14837·8	141·6	23·4	21118·3	111·4	28·4	26177·7	91·9
13·5	6747·5	192·8	18·5	14979·4	140·9	23·5	21229·7	110·9	28·5	26269·6	91·5
13·6	6940·3	191·4	18·6	15120·3	140·0	23·6	21340·6	110·5	28·6	26361·1	91·2
13·7	7131·7	190·0	18·7	15260·3	139·4	23·7	21451·1	110·0	28·7	26452·3	90·9
13·8	7321·7	188·6	18·8	15399·7	138·6	23·8	21561·1	109·5	28·8	26543·2	90·5
13·9	7510·3	187·3	18·9	15538·3	137·9	23·9	21670·6	109·1	28·9	26633·7	90·3
14·0	7697·6	186·0	19·0	15676·2	137·1	24·0	21779·7	108·7	29·0	26724·0	89·9
14·1	7883·6	184·6	19·1	15813·3	136·5	24·1	21888·4	108·2	29·1	26813·9	89·6
14·2	8068·2	183·3	19·2	15949·8	135·7	24·2	21996·6	107·7	29·2	26903·5	89·3
14·3	8251·5	182·1	19·3	16085·5	135·0	24·3	22104·3	107·3	29·3	26992·8	89·1
14·4	8433·6	180·8	19·4	16220·5	134·3	24·4	22211·6	106·8	29·4	27081·9	88·7
14·5	8614·4	179·6	19·5	16354·8	133·7	24·5	22318·4	106·4	29·5	27170·6	88·4
14·6	8794·0	178·3	19·6	16488·5	132·9	24·6	22424·8	106·0	29·6	27259·0	88·1
14·7	8972·3	177·2	19·7	16621·4	132·3	24·7	22530·8	105·6	29·7	27347·1	87·8
14·8	9149·5	176·0	19·8	16753·7	131·6	24·8	22636·4	105·1	29·8	27434·9	87·6
14·9	9325·5	174·8	19·9	16885·3	131·0	24·9	22741·5	104·8	29·9	27522·5	87·2
15·0	9500·3	173·5	20·0	17016·3	130·3	25·0	22846·3	104·3	30·0	27609·7	86·9
15·1	9673·8	172·4	20·1	17146·6	129·7	25·1	22950·6	103·8	30·1	27696·6	86·7
15·2	9846·2	171·3	20·2	17276·3	129·0	25·2	23054·4	103·5	30·2	27783·3	86·4
15·3	10017·5	170·2	20·3	17405·3	128·4	25·3	23157·9	103·1	30·3	27869·7	86·0
15·4	10187·7	169·1	20·4	17533·7	127·7	25·4	23261·0	102·6	30·4	27955·7	85·8
15·5	10356·8	168·0	20·5	17661·4	127·2	25·5	23363·6	102·3	30·5	28041·5	85·6
15·6	10524·8	167·0	20·6	17788·6	126·5	25·6	23465·9	101·8	30·6	28127·1	85·2
15·7	10691·8	165·9	20·7	17915·1	125·9	25·7	23567·7	101·5	30·7	28212·3	85·0
15·8	10857·7	164·8	20·8	18041·0	125·3	25·8	23669·2	101·1	30·8	28297·3	84·7
15·9	11022·5	163·8	20·9	18166·3	124·7	25·9	23770·3	100·7	30·9	28382·0	84·4
16·0	11186·3		21·0	18291·0		26·0	23871·0		31·0	28466·4	

TABLE XIX.—Computation of Heights.—(*Continued*).

Part II.

Correction due to T − T′, or the Difference of the Temperatures, in degrees Fahrenheit, of the Barometers at the two Stations.

Negative when the Temperature at the Upper Station is the lower, and vice versâ.

T − T′	Correction	T − T′	Correction	T − T′	Correction	T − T′	Correction	T − T′	Correction	T − T′	Correction
°	Feet	°	Feet	°	Feet	°	Feet	°	Feet	°	Feet
1	2·3	14	32·8	27	63·2	40	93·6	53	124·1	66	154·5
2	4·7	15	35·1	28	65·5	41	96·0	54	126·4	67	156·8
3	7·0	16	37·5	29	67·9	42	98·3	55	128·7	68	159·2
4	9·4	17	39·8	30	70·2	43	100·7	56	131·1	69	161·5
5	11·7	18	42·1	31	72·6	44	103·0	57	133·4	70	163·9
6	14·0	19	44·5	32	74·9	45	105·3	58	135·8	71	166·2
7	16·4	20	46·8	33	77·3	46	107·7	59	138·1	72	168·6
8	18·7	21	49·2	34	79·6	47	110·0	60	140·4	73	170·9
9	21·1	22	51·5	35	81·9	48	112·4	61	142·8	74	173·3
10	23·4	23	53·8	36	84·3	49	114·7	62	145·1	75	175·6
11	25·8	24	56·2	37	86·6	50	117·0	63	147·5	76	177·9
12	28·1	25	58·5	38	89·0	51	119·4	64	149·8	77	180·3
13	30·4	26	60·9	39	91·3	52	121·7	65	152·2	78	182·6

Approximate Height of Station	Part III. Correction due to the Change of Gravity from the Latitude of 45° to the Latitude of the Place of Observation. *Positive from Latitude 0° to 45°; Negative from Latitude 45° to 90°.* Latitude.						Part IV. Correction for Decrease of Gravity on a Vertical. *Always Positive.*	Part V. Correction due to the Height of the Lower Station. *Always Positive.* Height of Barometer at Lower Station.							Approximate Height of Station
	0° 90°	10° 80°	20° 70°	30° 60°	40° 50°	45°		16 in.	18 in.	20 in.	22 in.	24 in.	26 in.	28 in.	
Feet	Feet	Feet	Feet	Feet	Feet	Feet	Feet	Feet	Feet	Feet	Feet	Feet	Feet	Feet	Feet
1 000	2·6	2·5	2·0	1·3	0·5	0	2·5	1·6	1·3	1·0	0·8	0·6	0·4	0·2	1 000
2 000	5·3	5·0	4·1	2·6	0·9	0	5·2	3·1	2·5	2·0	1·5	1·1	0·7	0·3	2 000
3 000	7·9	7·5	6·1	4·0	1·4	0	7·9	4·7	3·8	3·0	2·3	1·7	1·1	0·5	3 000
4 000	10·6	10·0	8·1	5·3	1·8	0	10·8	6·3	5·1	4·0	3·1	2·2	1·4	0·7	4 000
5 000	13·2	12·4	10·1	6·6	2·3	0	13·7	7·8	6·4	5·0	3·8	2·8	1·8	0·8	5 000
6 000	15·9	14·9	12·2	7·9	2·8	0	16·7	9·4	7·6	6·0	4·6	3·3	2·1	1·0	6 000
7 000	18·5	17·4	14·2	9·3	3·2	0	19·9	11·0	8·9	7·1	5·4	3·9	2·5	1·2	7 000
8 000	21·2	19·9	16·2	10·6	3·7	0	23·1	12·5	10·2	8·1	6·2	4·4	2·8	1·3	8 000
9 000	23·8	22·4	18·3	11·9	4·1	0	26·4	14·1	11·4	9·1	6·9	5·0	3·2	1·5	9 000
10 000	26·5	24·9	20·3	13·2	4·6	0	29·8	15·7	12·7	10·1	7·7	5·5	3·5	1·7	10 000
11 000	29·1	27·4	22·3	14·6	5·1	0	33·3	17·2	14·0	11·1	8·5	6·1	3·9	1·8	11 000
12 000	31·8	29·9	24·4	15·9	5·5	0	36·9	18·8	15·3	12·1	9·2	6·6	4·2	2·0	12 000
13 000	34·4	32·4	26·4	17·2	6·0	0	40·6	20·4	16·5	13·1	10·0	7·2	4·6	2·2	13 000
14 000	37·1	34·9	28·4	18·5	6·4	0	44·4	21·9	17·8	14·1	10·8	7·7	4·9	2·3	14 000
15 000	39·7	37·3	30·4	19·9	6·9	0	48·3	23·5	19·1	15·1	11·5	8·3	5·3	2·5	15 000
16 000	42·4	39·8	32·5	21·2	7·4	0	52·3	25·1	20·3	16·1	12·3	8·8	5·6	2·7	16 000
17 000	45·0	42·3	34·5	22·5	7·8	0	56·4	26·6	21·6	17·1	13·1	9·4	6·0	2·8	17 000
18 000	47·7	44·8	36·5	23·8	8·3	0	60·5	28·2	22·9	18·1	13·8	9·9	6·3	3·0	18 000
19 000	50·3	47·3	38·6	25·2	8·7	0	64·8	29·8	24·1	19·2	14·6	10·5	6·7	3·2	19 000
20 000	53·0	49·8	40·6	26·5	9·2	0	69·2	31·3	25·4	20·2	15·4	11·0	7·0	3·3	20 000
21 000	55·6	52·3	42·6	27·8	9·7	0	73·6	32·9	26·7	21·2	16·1	11·6	7·4	3·5	21 000
22 000	58·3	54·8	44·7	29·1	10·1	0	78·2	34·5	28·0	22·2	16·9	12·1	7·7	3·7	22 000
23 000	60·9	57·3	46·7	30·5	10·6	0	82·9	36·0	29·2	23·2	17·7	12·7	8·1	3·8	23 000
24 000	63·6	59·8	48·7	31·8	11·0	0	87·6	37·6	30·5	24·2	18·5	13·2	8·4	4·0	24 000
25 000	66·2	62·2	50·7	33·1	11·5	0	92·5	39·1	31·8	25·2	19·2	13·8	8·8	4·1	25 000

TABLE XX.—Computation of Heights.—For determining Heights with the Boiling Point Thermometer.

PART I.—Approximate Height in Feet corresponding to the Observed Boiling Point in degrees Fahrenheit.

Boiling Point	Barometer	Approx. Height	Boiling Point	Barometer	Approx. Height	Boiling Point	Barometer	Approx. Height	Boiling Point	Barometer	Approx. Height
°	Inches	Feet	°	Inches	Feet	°	Inches	Feet	°	Inches	Feet
170·0	12·188	23466	174·0	13·350	21086	178·0	14·606	18738	182·0	15·963	16416
1	216	23406	1	380	21028	1	639	18679	1	998	16358
2	244	23346	2	410	20969	2	672	18619	2	16·033	16302
3	272	23286	3	440	20911	3	705	18561	3	068	16245
4	300	23226	4	470	20852	4	738	18503	4	103	16188
5	328	23166	5	500	20794	5	771	18444	5	138	16131
6	356	23108	6	531	20734	6	804	18385	6	174	16073
7	384	23048	7	562	20675	7	837	18327	7	210	16015
8	412	22990	8	593	20615	8	870	18269	8	246	15957
9	440	22931	9	624	20556	9	903	18211	9	282	15899
171·0	12·468	22872	175·0	13·655	20496	179·0	14·936	18153	183·0	16·318	15841
1	497	22811	1	686	20437	1	969	18096	1	354	15784
2	526	22751	2	717	20378	2	15·002	18038	2	390	15726
3	555	22690	3	748	20319	3	035	17981	3	426	15669
4	584	22630	4	779	20260	4	068	17924	4	462	15612
5	613	22570	5	810	20201	5	102	17865	5	498	15555
6	642	22510	6	841	20142	6	136	17806	6	534	15498
7	671	22450	7	872	20084	7	170	17747	7	570	15441
8	700	22390	8	903	20026	8	204	17689	8	606	15384
9	729	22330	9	934	19968	9	238	17631	9	642	15328
172·0	12·758	22271	176·0	13·965	19909	180·0	15·272	17572	184·0	16·678	15271
1	787	22212	1	996	19851	1	306	17514	1	715	15213
2	816	22152	2	14·028	19792	2	340	17456	2	752	15155
3	845	22093	3	060	19732	3	374	17398	3	789	15098
4	874	22035	4	092	19673	4	408	17341	4	826	15040
5	903	21976	5	124	19614	5	442	17283	5	863	14983
6	932	21917	6	156	19554	6	476	17225	6	900	14926
7	961	21859	7	188	19495	7	510	17168	7	937	14868
8	990	21800	8	220	19437	8	544	17111	8	974	14811
9	13·020	21740	9	252	19378	9	578	17054	9	17·011	14755
173·0	13·050	21680	177·0	14·284	19319	181·0	15·613	16995	185·0	17·048	14698
1	080	21620	1	316	19261	1	648	16937	1	085	14641
2	110	21560	2	348	19202	2	683	16878	2	122	14585
3	140	21500	3	380	19144	3	718	16820	3	160	14527
4	170	21441	4	412	19086	4	753	16762	4	197	14470
5	200	21381	5	444	19028	5	788	16704	5	235	14413
6	230	21322	6	476	18970	6	823	16646	6	272	14357
7	260	21263	7	508	18913	7	858	16588	7	310	14299
8	290	21204	8	540	18855	8	893	16531	8	348	14242
9	320	21145	9	573	18796	9	928	16473	9	385	14186
174·0	13·350	21086	178·0	14·606	18738	182·0	15·963	16416	186·0	17·423	14129

TABLE XX.—Computation of Heights.—For determining Heights with the Boiling Point Thermometer.—(*Continued*).

PART I.—(*Continued*).

Boiling Point	Barometer	Approx. Height	Boiling Point	Barometer	Approx. Height	Boiling Point	Barometer	Approx Height	Boiling Point	Barometer	Approx. Height
°	Inches	Feet	°	Inches	Feet	°	Inches	Feet	°	Inches	Feet
186·0	17·423	14129	190·0	18·996	11871	194·0	20·685	9646	198·0	22·498	7450
1	461	14072	1	19·036	11816	1	729	9590	1	545	7396
2	499	14015	2	077	11760	2	773	9535	2	592	7342
3	537	13959	3	118	11704	3	817	9479	3	639	7287
4	575	13902	4	159	11648	4	861	9424	4	686	7233
5	614	13845	5	200	11592	5	905	9369	5	734	7178
6	652	13788	6	241	11536	6	949	9314	6	781	7124
7	690	13732	7	283	11479	7	993	9259	7	829	7069
8	729	13675	8	324	11424	8	21·038	9204	8	876	7015
9	767	13619	9	365	11368	9	082	9149	9	924	6960
187·0	17·806	13561	191·0	19·407	11312	195·0	21·126	9095	199·0	22·971	6907
1	844	13506	1	448	11257	1	171	9039	1	23·019	6852
2	883	13448	2	490	11200	2	216	8983	2	067	6798
3	922	13392	3	532	11144	3	260	8929	3	115	6744
4	961	13335	4	573	11089	4	305	8874	4	163	6689
5	18·000	13278	5	615	11033	5	350	8819	5	211	6635
6	039	13222	6	657	10977	6	395	8764	6	259	6581
7	078	13165	7	699	10922	7	440	8709	7	308	6526
8	117	13109	8	741	10866	8	485	8654	8	356	6473
9	156	13053	9	783	10810	9	530	8599	9	405	6418
188·0	18·195	12997	192·0	19·825	10755	196·0	21·576	8544	200·0	23·453	6364
1	235	12939	1	868	10699	1	621	8489	1	502	6310
2	274	12883	2	910	10643	2	666	8435	2	550	6257
3	314	12826	3	952	10588	3	712	8380	3	599	6202
4	353	12771	4	995	10532	4	758	8324	4	648	6148
5	393	12714	5	20·037	10477	5	803	8270	5	697	6094
6	432	12658	6	080	10421	6	849	8215	6	746	6040
7	472	12602	7	123	10365	7	895	8160	7	795	5986
8	512	12545	8	166	10310	8	941	8105	8	845	5931
9	552	12489	9	208	10255	9	987	8051	9	894	5878
189·0	18·592	12433	193·0	20·251	10200	197·0	22·033	7996	201·0	23·943	5824
1	632	12377	1	294	10144	1	079	7941	1	993	5770
2	672	12321	2	338	10088	2	125	7887	2	24·042	5716
3	712	12265	3	381	10032	3	172	7831	3	092	5662
4	753	12208	4	424	9977	4	218	7777	4	142	5608
5	793	12152	5	467	9922	5	264	7723	5	191	5555
6	833	12096	6	511	9866	6	311	7668	6	241	5501
7	874	12040	7	554	9812	7	358	7613	7	291	5447
8	914	11984	8	598	9756	8	404	7560	8	341	5393
9	955	11927	9	641	9701	9	451	7505	9	391	5340
190·0	18·996	11871	194·0	20·685	9646	198·0	22·498	7450	202·0	24·442	5285

TABLE XX.—Computation of Heights.—For determining Heights with the Boiling Point Thermometer.—(*Continued*).

PART I.—(*Continued*).

Boiling Point	Barometer	Approx. Height	Boiling Point	Barometer	Approx. Height	Boiling Point	Barometer	Approx. Height	Boiling Point	Barometer	Approx. Height
°	Inches	Feet	°	Inches	Feet	°	Inches	Feet	°	Inches	Feet
202·0	24·442	5285	204·5	25·726	3948	207·0	27·066	2621	209·5	28·464	1305
1	492	5232	6	779	3894	1	121	2568	6	521	1253
2	542	5178	7	831	3841	2	176	2515	7	579	1200
3	593	5124	8	884	3788	3	231	2462	8	636	1148
4	644	5070	9	937	3734	4	286	2409	9	693	1096
5	694	5017	205·0	25·990	3681	5	341	2357	210·0	28·751	1043
6	745	4963	1	26·043	3628	6	397	2303	1	809	990
7	796	4909	2	096	3575	7	452	2251	2	866	939
8	847	4856	3	149	3522	8	507	2199	3	924	886
9	898	4802	4	202	3469	9	563	2146	4	982	834
203·0	24·949	4749	5	255	3416	208·0	27·618	2094	5	29·040	782
1	25·000	4695	6	309	3362	1	674	2041	6	098	730
2	051	4642	7	362	3310	2	730	1988	7	156	678
3	103	4588	8	416	3256	3	786	1935	8	215	625
4	154	4535	9	470	3203	4	842	1882	9	273	573
5	206	4481	206·0	26·523	3151	5	898	1830	211·0	29·331	521
6	257	4428	1	577	3097	6	954	1778	1	390	469
7	309	4375	2	631	3044	7	28·011	1724	2	449	416
8	361	4321	3	685	2991	8	067	1672	3	508	364
9	413	4267	4	740	2938	9	123	1620	4	566	313
204·0	25·465	4214	5	794	2885	209·0	28·180	1567	5	625	261
1	517	4161	6	848	2832	1	237	1514	6	684	209
2	569	4108	7	903	2779	2	293	1463	7	744	156
3	621	4054	8	957	2726	3	350	1410	8	803	104
4	674	4000	9	27·012	2673	4	407	1357	9	862	52
204·5	25·726	3948	207·0	27·066	2621	209·5	28·464	1305	212·0	29·922	0

PART II.—Multipliers for Mean Temperature (Fahrenheit) of the Stratum of Air passed through.

Mean Temp.	Multiplier	Mean Temp.	Multiplier	Mean Temp.	Multiplier	Mean Temp.	Multiplier	Mean Temp.	Multiplier	Mean Temp.	Multiplier
0°	0·933	7°5	0·949	15°	0·965	22°5	0·980	30°	0·996	37°5	1·011
0·5	934	8	950	15·5	966	23	981	30·5	997	38	013
1	935	8·5	951	16	967	23·5	982	31	998	38·5	014
1·5	936	9	952	16·5	968	24	983	31·5	999	39	015
2	938	9·5	953	17	969	24·5	984	32	1·000	39·5	016
2·5	939	10	954	17·5	970	25	985	32·5	001	40	017
3	940	10·5	955	18	971	25·5	986	33	002	40·5	018
3·5	941	11	956	18·5	972	26	988	33·5	003	41	019
4	942	11·5	957	19	973	26·5	989	34	004	41·5	020
4·5	943	12	958	19·5	974	27	990	34·5	005	42	021
5	0·944	12·5	0·959	20	0·975	27·5	0·991	35	1·006	42·5	1·022
5·5	945	13	960	20·5	976	28	992	35·5	007	43	023
6	946	13·5	961	21	977	28·5	993	36	008	43·5	024
6·5	947	14	963	21·5	978	29	994	36·5	009	44	025
7	948	14·5	964	22	979	29·5	995	37	010	44·5	026
7·5	0·949	15	0·965	22·5	0·980	30	0·996	37·5	1·011	45	1·027

TABLE XX.—Computation of Heights.—For determining Heights with the Boiling Point Thermometer.—(*Continued*).

PART II.—(*Continued*).

Mean Temp.	Multiplier	Mean Temp.	Multiplier	Mean Temp.	Multiplier	Mean Temp.	Multiplier	Mean Temp.	Multiplier	Mean Temp.	Multiplier
45°	1·027	55°	1·048	65°	1·069	75°	1·090	85°	1·110	95°	1·131
45·5	028	55·5	049	65·5	070	75·5	091	85·5	111	95·5	132
46	029	56	050	66	071	76	092	86	113	96	133
46·5	030	56·5	051	66·5	072	76·5	093	86·5	114	96·5	134
47	031	57	052	67	073	77	094	87	115	97	135
47·5	032	57·5	053	67·5	074	77·5	095	87·5	116	97·5	136
48	033	58	054	68	075	78	096	88	117	98	137
48·5	034	58·5	055	68·5	076	78·5	097	88·5	118	98·5	139
49	035	59	056	69	077	79	098	89	119	99	140
49·5	036	59·5	057	69·5	078	79·5	099	89·5	120	99·5	141
50	1·038	60	1·058	70	1·079	80	1·100	90	1·121	100	142
50·5	039	60·5	059	70·5	080	80·5	101	90·5	122		
51	040	61	060	71	081	81	102	91	123		
51·5	041	61·5	061	71·5	082	81·5	103	91·5	124		
52	042	62	062	72	083	82	104	92	125		
52·5	043	62·5	063	72·5	084	82·5	105	92·5	126		
53	044	63	065	73	085	83	106	93	127		
53·5	045	63·5	066	73·5	086	83·5	107	93·5	128		
54	046	64	067	74	087	84	108	94	129		
54·5	047	64·5	068	74·5	089	84·5	109	94·5	130		
55	1·048	65	1·069	75	1·090	85	1·110	95	1·131		

TABLE XXI.—Parallax of the Sun.

Altitude	January	February and December	March and November	April and October	May and September	June and August	July	Altitude
°	″	″	″	″	″	″	″	°
0	9·0	9·0	8·9	8·8	8·8	8·7	8·7	0
5	9·0	8·9	8·9	8·8	8·7	8·7	8·7	5
10	8·9	8·8	8·8	8·7	8·6	8·6	8·6	10
15	8·7	8·7	8·6	8·5	8·5	8·4	8·4	15
20	8·5	8·4	8·4	8·3	8·3	8·2	8·2	20
25	8·2	8·1	8·1	8·0	8·0	7·9	7·9	25
30	7·8	7·8	7·7	7·7	7·6	7·6	7·5	30
35	7·4	7·3	7·3	7·2	7·2	7·1	7·1	35
40	6·9	6·9	6·8	6·8	6·7	6·7	6·7	40
45	6·4	6·3	6·3	6·2	6·2	6·2	6·2	45
50	5·8	5·8	5·7	5·7	5·6	5·6	5·6	50
55	5·2	5·1	5·1	5·1	5·0	5·0	5·0	55
60	4·5	4·5	4·5	4·4	4·4	4·4	4·4	60
65	3·8	3·8	3·8	3·7	3·7	3·7	3·7	65
70	3·1	3·1	3·0	3·0	3·0	3·0	3·0	70
75	2·3	2·3	2·3	2·3	2·3	2·3	2·3	75
80	1·6	1·6	1·6	1·5	1·5	1·5	1·5	80
85	0·8	0·8	0·8	0·8	0·8	0·8	0·8	85
90	0·0	0·0	0·0	0·0	0·0	0·0	0·0	90

NOTE.—Parallax is *additive* to Altitude and *subtractive* from Zenith Distance.

TABLE XXII.—Astronomical Refractions.

Apparent Zenith Distance	Mean Refraction for Baro. 30 in. and Temp. 50° Fahrenheit	Diff. for 1′ Z. D.	Diff. for 1 inch Barometer	Diff. for 1° Temp.	Apparent Zenith Distance	Mean Refraction for Baro 30 in. and Temp. 50° Fahrenheit	Diff. for 1′ Z. D.	Diff. for 1 inch Barometer	Diff. for 1° Temp.
°	′ ″	″	″	″	° ′	′ ″	″	″	″
0	0 0·0	+ 0·017	0·00	0·000	46	1 0·3	+ 0·035	2·04	0·121
1	1·0	·017	·03	·002	47	1 2·4	·037	·12	·125
2	2·0	·017	·07	·004	48	1 4·7	·038	·19	·129
3	3·1	·017	·11	·006	49	1 7·0	·039	·27	·134
4	4·1	·017	·14	·008	50	1 9·4	·041	·35	·139
5	5·1	·017	·17	·010					
6	6·1	·017	·21	·012	51	1 11·9	·042	·44	·144
7	7·2	·017	·24	·014	52	1 14·5	·044	·53	·149
8	8·2	·017	·28	·016	53	1 17·2	·047	·62	·154
9	9·2	·017	·31	·018	54	1 20·1	·049	·72	·160
10	10·3	·017	·35	·021	55	1 23·1	·051	·82	·166
11	0 11·3	0·017	0·38	0·023	56	1 26·2	0·054	2·92	0·172
12	12·4	·018	·42	·025	57	1 29·5	·057	3·03	·179
13	13·5	·018	·46	·027	58	1 33·0	·060	·15	·186
14	14·5	·018	·49	·029	59	1 36·7	·064	·28	·193
15	15·6	·018	·53	·031	60	1 40·6	·068	·41	·201
16	16·7	·018	·57	·033	61	1 44·8	·072	·55	·210
17	17·8	·018	·60	·036	62	1 49·2	·076	·70	·218
18	18·9	·019	·64	·038	63	1 53·9	·081	·86	·228
19	20·1	·019	·68	·040	64	1 58·9	·088	4·03	·238
20	21·2	·019	·72	·042	65	2 4·4	·095	·22	·249
21	0 22·4	0·019	0·76	0·045	66	2 10·2	0·101	4·41	0·260
22	23·6	·019	·80	·047	67	2 16·5	·109	·63	·273
23	24·7	·020	·84	·049	68	2 23·3	·118	·86	·287
24	26·0	·020	·88	·052	69	2 30·7	·129	5·11	·301
25	27·2	·020	·92	·054	70	2 38·8	·142	·38	·318
26	28·4	·021	·96	·057	71	2 47·7	·155	·68	·335
27	29·7	·022	1·01	·059					
28	31·0	·022	·05	·062	72 0	2 57·4	·171	6·01	·355
29	32·3	·023	·09	·065	30	3 2·8	·182	·20	·366
30	33·7	·023	·14	·067	73 0	3 8·3	·190	·38	·377
31	0 35·0	0·023	1·19	0·070	30	3 14·2	·204	·58	·388
32	36·4	·023	·23	·073	74 0	3 20·5	·215	·80	·401
33	37·8	·024	·28	·076	30	3 27·1	·227	7·02	·414
34	39·3	·025	·33	·079	75 0	3 34·1	0·237	7·26	0·428
35	40·8	·025	·38	·082	10	3 36·5	·245	·34	·433
36	42·3	·026	·43	·085	20	3 39·0	·253	·42	·438
37	43·9	·027	·49	·088	30	3 41·6	·257	·51	·443
38	45·5	·028	·54	·091	40	3 44·2	·263	·60	·448
39	47·2	·028	·60	·094	50	3 46·8	·268	·69	·454
40	48·9	·028	·66	·098					
41	0 50·6	0·029	1·72	0·101	76 0	3 49·6	·275	·78	·459
42	52·4	·031	·78	·105	10	3 52·3	·280	·87	·465
43	54·3	·032	·84	·109	20	3 55·2	·287	·97	·470
44	56·2	·033	·91	·112	30	3 58·1	·295	8·07	·476
45	58·2	·034	·97	·116	40	4 1·0	·300	·17	·482
					50	4 4·1	·310	·27	·488

NOTES.—1. Refraction is *additive* to Apparent Zenith Distance and *subtractive* from Apparent Altitude.

2. Correction for barometer is $\frac{\textit{subtractive from}}{\textit{additive to}}$ Mean Refraction if barometer reads $\frac{\textit{less}}{\textit{more}}$ than 30 Inches.

3. Correction for temperature is $\frac{\textit{subtractive from}}{\textit{additive to}}$,, temperature is $\frac{\textit{higher}}{\textit{lower}}$ than 50° Fahr.

TABLE XXII.—Astronomical Refractions.—(*Continued*).

Apparent Zenith Distance	Mean Refraction for Baro. 30 in. and Temp. 50° Fahrenheit	Diff. for 1′ Z. D.	Diff. for 1 inch Barometer	Diff. for 1° Temp.	Apparent Zenith Distance	Mean Refraction for Baro. 30 in. and Temp. 50° Fahrenheit	Diff. for 1′ Z. D.	Diff. for 1 inch Barometer	Diff. for 1° Temp.
° ′	′ ″	″	″	″	° ′	′ ″	″	″	″
77 0	4 7·2	+ 0·315	8·40	0·494	84 30	9 7·0	+ 1·395	18·71	1·203
10	4 10·4	·320	·51	·526	40	9 21·3	·460	19·25	·235
20	4 13·6	·330	·62	·532	50	9 36·2	·535	·76	·268
30	4 17·0	·340	·74	·540					
40	4 20·4	·345	·85	·547	85 0	9 52·0	1·620	20·31	1·302
50	4 23·9	·355	·97	·554	10	10 9	·70	·9	·34
78 0	4 27·5	·365	9·09	·562	20	10 26	·79	21·5	·44
10	4 31·2	·375	·22	·570	30	10 44	·89	22·1	·48
20	4 35·0	·385	·35	·578	40	11 4	·99	·9	·53
30	4 38·9	·395	·48	·586	50	11 24	2·11	23·6	·57
40	4 42·9	·405	·62	·594					
50	4 47·0	·415	·76	·603	86 0	11 46	·21	24·4	·62
					5	11 57	·29	·7	·65
79 0	4 51·2	0·430	9·90	0·612	10	12 9	·36	25·1	·68
10	4 55·6	·440	10·05	·621	15	12 21	·43	·6	·70
20	5 0·0	·450	·20	·630	20	12 33	·50	26·0	·73
30	5 4·6	·465	·36	·640	25	12 46	·58	·4	·76
40	5 9·3	·480	·52	·650					
50	5 14·2	·495	·68	·660	86 30	12 59	2·66	26·9	1·87
					35	13 12	·75	27·5	·90
80 0	5 19·2	·505	10·85	·670	40	13 26	·84	28·0	·94
10	5 24·3	·520	11·03	·681	45	13 41	·92	·5	·97
20	5 29·6	·540	·21	·692	50	13 56	3·02	29·0	2·01
30	5 35·1	·560	·39	·704	55	14 11	·13	·5	·04
40	5 40·8	·575	·62	·716					
50	5 46·6	·590	·82	·728	87 0	14 27	·23	30·1	·08
					5	14 43	·33	·7	·12
81 0	5 52·6	0·610	12·02	0·740	10	15 0	·45	31·2	·25
10	5 58·8	·635	·24	·753	15	15 18	·58	·8	·29
20	6 5·3	·655	·46	·767	20	15 36	·71	32·5	·34
30	6 11·9	·675	·68	·781	25	15 55	·83	33·1	·39
40	6 18·8	·700	·92	·795					
50	6 25·9	·725	13·16	·810	87 30	16 14	3·96	33·8	2·44
					35	16 34	4·12	34·9	·49
82 0	6 33·3	·755	13·41	·826	40	16 55	·29	35·6	·54
10	6 41·0	·780	·67	·842	45	17 17	·44	36·4	·59
20	6 48·9	·810	·94	·858	50	17 40	·60	37·2	·76
30	6 57·2	·840	14·23	·876	55	18 3	·79	38·0	·82
40	7 5·7	·870	·56	·894					
50	7 14·6	·910	·86	·913	88 0	18 28	4·99	·9	·88
					5	18 53	5·19	39·8	·95
83 0	7 23·9	0·945	15·18	0·932	10	19 20	·40	40·7	3·02
10	7 33·5	·980	·51	·998	15	19 47	·63	41·7	·09
20	7 43·5	1·025	·85	1·020	20	20 16	·86	42·7	·28
30	7 54·0	·070	16·21	·043	25	20 46	6·11	43·7	·36
40	8 4·9	·110	·58	·067					
50	8 16·2	·160	·97	·092	88 30	21 17	6·38	44·8	3·45
					35	21 50	·67	46·4	·54
84 0	8 28·1	1·215	17·38	1·118	40	22 24	·98	47·8	·76
10	8 40·5	·265	·80	·145					
20	8 53·4	·325	18·24	·173					

NOTES.—1. Refraction is *additive* to Apparent Zenith Distance and *subtractive* from Apparent Altitude.

2. Correction for barometer is $\frac{\textit{subtractive from}}{\textit{additive to}}$ Mean Refraction if barometer reads $\frac{\textit{less}}{\textit{more}}$ than 30 Inches.

3. Correction for temperature is $\frac{\textit{subtractive from}}{\textit{additive to}}$ " temperature is $\frac{\textit{higher}}{\textit{lower}}$ than 50° Fahr.

TABLE XXIII.—Values of $\frac{2\,\mathrm{Sin}^2\,\frac{1}{2}t}{\mathrm{Sin}\ 1''}$ for Computation of Circumpolar Azimuths.

Seconds	Hour Angles in Time									
	0m	1m	2m	3m	4m	5m	6m	7m	8m	9m
	″	″	″	″	″	″	″	″	″	″
0	0·00	1·96	7·85	17·67	31·42	49·09	70·68	96·20	125·65	159·02
1	0·00	2·03	7·98	17·87	31·68	49·41	71·07	96·66	126·17	159·61
2	0·00	2·10	8·12	18·07	31·94	49·74	71·47	97·12	126·70	160·20
3	0·00	2·16	8·25	18·27	32·20	50·07	71·86	97·58	127·22	160·80
4	0·01	2·23	8·39	18·47	32·47	50·40	72·26	98·04	127·75	161·39
5	0·01	2·31	8·52	18·67	32·74	50·73	72·66	98·50	128·28	161·98
6	0·02	2·38	8·66	18·87	33·01	51·07	73·06	98·97	128·81	162·58
7	0·02	2·45	8·80	19·07	33·27	51·40	73·46	99·43	129·34	163·17
8	0·03	2·52	8·94	19·28	33·54	51·74	73·86	99·90	129·87	163·77
9	0·04	2·60	9·08	19·48	33·81	52·07	74·26	100·37	130·40	164·37
10	0·05	2·67	9·22	19·69	34·09	52·41	74·66	100·84	130·94	164·97
11	0·06	2·75	9·36	19·90	34·36	52·75	75·06	101·31	131·47	165·57
12	0·08	2·83	9·50	20·11	34·64	53·09	75·47	101·78	132·01	166·17
13	0·09	2·91	9·64	20·32	34·91	53·43	75·88	102·25	132·55	166·77
14	0·11	2·99	9·79	20·53	35·19	53·77	76·29	102·72	133·09	167·37
15	0·12	3·07	9·94	20·74	35·46	54·11	76·69	103·20	133·63	167·97
16	0·14	3·15	10·09	20·95	35·74	54·46	77·10	103·67	134·17	168·58
17	0·16	3·23	10·24	21·16	36·02	54·80	77·51	104·15	134·71	169·19
18	0·18	3·32	10·39	21·38	36·30	55·15	77·93	104·63	135·25	169·80
19	0·20	3·40	10·54	21·60	36·58	55·50	78·34	105·10	135·80	170·41
20	0·22	3·49	10·69	21·82	36·87	55·84	78·75	105·58	136·34	171·02
21	0·24	3·58	10·84	22·03	37·15	56·19	79·16	106·06	136·88	171·63
22	0·26	3·67	11·00	22·25	37·44	56·55	79·58	106·55	137·43	172·24
23	0·28	3·76	11·15	22·47	37·72	56·90	80·00	107·03	137·98	172·85
24	0·31	3·85	11·31	22·70	38·01	57·25	80·42	107·51	138·53	173·47
25	0·34	3·94	11·47	22·92	38·30	57·60	80·84	107·99	139·08	174·08
26	0·37	4·03	11·63	23·14	38·59	57·96	81·26	108·48	139·63	174·70
27	0·40	4·12	11·79	23·37	38·88	58·32	81·68	108·97	140·18	175·32
28	0·43	4·22	11·95	23·60	39·17	58·68	82·10	109·46	140·74	175·94
29	0·46	4·32	12·11	23·82	39·46	59·03	82·52	109·95	141·29	176·56
30	0·49	4·42	12·27	24·05	39·76	59·40	82·95	110·44	141·85	177·18
31	0·52	4·52	12·43	24·28	40·05	59·75	83·38	110·93	142·40	177·80
32	0·56	4·62	12·60	24·51	40·35	60·11	83·81	111·43	142·96	178·43
33	0·59	4·72	12·76	24·74	40·65	60·47	84·23	111·92	143·52	179·05
34	0·63	4·82	12·93	24·98	40·95	60·84	84·66	112·41	144·08	179·68
35	0·67	4·92	13·10	25·21	41·25	61·20	85·09	112·90	144·64	180·30
36	0·71	5·03	13·27	25·45	41·55	61·57	85·52	113·40	145·20	180·93
37	0·75	5·13	13·44	25·68	41·85	61·94	85·95	113·90	145·76	181·56
38	0·79	5·24	13·62	25·92	42·15	62·31	86·39	114·40	146·33	182·19
39	0·83	5·34	13·79	26·16	42·45	62·68	86·82	114·90	146·89	182·82
40	0·87	5·45	13·96	26·40	42·76	63·05	87·26	115·40	147·46	183·46
41	0·91	5·56	14·13	26·64	43·06	63·42	87·70	115·90	148·03	184·09
42	0·96	5·67	14·31	26·88	43·37	63·79	88·14	116·40	148·60	184·72
43	1·01	5·78	14·49	27·12	43·68	64·16	88·57	116·90	149·17	185·35
44	1·06	5·90	14·67	27·37	43·99	64·54	89·01	117·41	149·74	185·99
45	1·10	6·01	14·85	27·61	44·30	64·91	89·45	117·92	150·31	186·63
46	1·15	6·13	15·03	27·86	44·61	65·29	89·89	118·43	150·88	187·27
47	1·20	6·24	15·21	28·10	44·92	65·67	90·33	118·94	151·45	187·91
48	1·26	6·36	15·39	28·35	45·24	66·05	90·78	119·45	152·03	188·55
49	1·31	6·48	15·57	28·60	45·55	66·43	91·23	119·96	152·61	189·19
50	1·36	6·60	15·76	28·85	45·87	66·81	91·68	120·47	133·19	189·83
51	1·42	6·72	15·95	29·10	46·18	67·19	92·12	120·98	153·77	190·47
52	1·48	6·84	16·14	29·36	46·50	67·58	92·57	121·49	154·35	191·12
53	1·53	6·96	16·32	29·61	46·82	67·96	93·02	122·01	154·93	191·76
54	1·59	7·09	16·51	29·86	47·14	68·35	93·47	122·53	155·51	192·41
55	1·65	7·21	16·70	30·12	47·46	68·73	93·92	123·05	156·09	193·06
56	1·71	7·34	16·89	30·38	47·79	69·12	94·38	123·57	156·67	193·71
57	1·77	7·46	17·08	30·64	48·11	69·51	94·83	124·09	157·25	194·36
58	1·83	7·60	17·28	30·90	48·43	69·90	95·29	124·61	157·84	195·01
59	1·89	7·72	17·47	31·16	48·76	70·29	95·74	125·13	158·43	195·66

TABLE XXIII.—Values of $\frac{2 \operatorname{Sin}^2 \frac{1}{2} t}{\operatorname{Sin} 1''}$ for Computation of Circumpolar Azimuths.

Seconds	Hour Angles in Time.									
	10^m	11^m	12^m	13^m	14^m	15^m	16^m	17^m	18^m	19^m
	″	″	″	″	″	″	″	″	″	″
0	196·32	237·54	282·68	331·74	384·74	441·63	502·46	567·19	635·84	708·42
1	196·97	238·26	283·47	332·59	385·65	442·62	503·50	568·30	637·03	709·66
2	197·63	238·98	284·26	333·44	386·56	443·60	504·55	569·42	638·20	710·90
3	198·28	239·70	285·04	334·29	387·48	444·58	505·60	570·53	639·38	712·15
4	198·94	240·42	285·83	335·15	388·40	445·56	506·65	571·65	640·56	713·39
5	199·60	241·14	286·62	336·00	389·32	446·55	507·70	572·76	641·74	714·64
6	200·26	241·87	287·41	336·86	390·24	447·54	508·76	573·88	642·92	715·90
7	200·92	242·60	288·20	337·72	391·16	448·53	509·81	575·00	644·11	717·13
8	201·59	243·33	289·00	338·58	392·09	449·51	510·86	576·12	645·30	718·39
9	202·25	244·06	289·79	339·44	393·01	450·50	511·92	577·24	646·49	719·63
10	202·92	244·79	290·58	340·30	393·94	451·50	512·98	578·36	647·66	720·89
11	203·58	245·52	291·38	341·16	394·86	452·49	514·03	579·48	648·86	722·14
12	204·25	246·25	292·18	342·02	395·79	453·48	515·09	580·60	650·04	723·40
13	204·92	246·98	292·98	342·88	396·72	454·48	516·15	581·73	651·24	724·65
14	205·59	247·72	293·78	343·75	397·65	455·47	517·21	582·85	652·42	725·91
15	206·26	248·45	294·58	344·62	398·58	456·47	518·27	583·98	653·63	727·18
16	206·93	249·19	295·38	345·49	399·52	457·47	519·34	585·11	654·82	728·43
17	207·60	249·93	296·18	346·36	400·45	458·47	520·40	586·25	656·01	729·69
18	208·27	250·67	296·99	347·23	401·38	459·47	521·47	587·38	657·20	730·95
19	208·94	251·41	297·79	348·10	402·32	460·47	522·53	588·50	658·40	732·22
20	209·62	252·15	298·60	348·97	403·26	461·47	523·60	589·64	659·60	733·48
21	210·30	252·89	299·40	349·84	404·20	462·48	524·67	590·77	660·80	734·73
22	210·98	253·63	300·21	350·71	405·14	463·48	525·74	591·90	662·00	736·00
23	211·66	254·37	301·02	351·58	406·08	464·48	526·81	593·05	663·21	737·28
24	212·34	255·12	301·83	352·46	407·02	465·49	527·89	594·18	664·40	738·53
25	213·02	255·87	302·64	353·34	407·96	466·50	528·96	595·32	665·61	739·81
26	213·70	256·62	303·46	354·22	408·90	467·51	530·03	596·46	666·81	741·07
27	214·38	257·37	304·27	355·10	409·84	468·52	531·11	597·60	668·02	742·35
28	215·07	258·12	305·09	355·98	410·79	469·53	532·18	598·74	669·22	743·62
29	215·75	258·87	305·90	356·86	411·73	470·54	533·26	599·89	670·44	744·89
30	216·44	259·62	306·72	357·74	412·68	471·55	534·33	601·02	671·65	746·17
31	217·12	260·37	307·54	358·62	413·63	472·57	535·41	602·17	672·85	747·45
32	217·81	261·12	308·36	359·51	414·59	473·58	536·50	603·32	674·06	748·72
33	218·50	261·88	309·18	360·39	415·54	474·60	537·58	604·46	675·27	750·00
34	219·19	262·64	310·00	361·28	416·49	475·62	538·67	605·62	676·49	751·28
35	219·88	263·39	310·82	362·17	417·44	476·64	539·75	606·76	677·70	752·56
36	220·58	264·15	311·65	363·07	418·40	477·65	540·83	607·91	678·92	753·84
37	221·27	264·91	312·47	363·96	419·35	478·67	541·91	609·06	680·13	755·13
38	221·97	265·68	313·30	364·85	420·31	479·70	543·00	610·21	681·35	756·40
39	222·66	266·44	314·12	365·75	421·27	480·72	544·09	611·36	682·57	757·69
40	223·36	267·20	314·95	366·64	422·23	481·74	545·18	612·52	683·79	758·96
41	224·06	267·96	315·78	367·53	423·19	482·77	546·27	613·68	685·01	760·26
42	224·76	268·73	316·61	368·42	424·15	483·79	547·36	614·84	686·23	761·54
43	225·46	269·49	317·44	369·31	425·11	484·82	548·45	616·00	687·46	762·83
44	226·16	270·26	318·27	370·21	426·07	485·85	549·55	617·15	688·68	764·12
45	226·86	271·02	319·10	371·11	427·04	486·88	550·64	618·32	689·91	765·42
46	227·57	271·79	319·94	372·01	428·01	487·91	551·73	619·47	691·13	766·71
47	228·27	272·56	320·78	372·91	428·97	488·94	552·83	620·64	692·36	768·00
48	228·98	273·34	321·62	373·82	429·93	489·97	553·93	621·80	693·59	769·29
49	229·68	274·11	322·45	374·72	430·90	491·01	555·03	622·96	694·82	770·58
50	230·39	274·88	323·29	375·62	431·87	492·05	556·13	624·14	696·05	771·88
51	231·10	275·65	324·13	376·52	432·84	493·08	557·24	625·30	697·28	773·18
52	231·81	276·43	324·97	377·43	433·82	494·12	558·34	626·47	698·51	774·48
53	232·52	277·20	325·81	378·34	434·79	495·15	559·44	627·64	699·75	775·78
54	233·24	277·98	326·66	379·26	435·76	496·19	560·55	628·81	700·99	777·07
55	233·95	278·76	327·50	380·17	436·73	497·23	561·65	629·97	702·21	778·38
56	234·67	279·55	328·35	381·08	437·71	498·28	562·76	631·15	703·46	779·69
57	235·38	280·33	329·19	381·99	438·69	499·32	563·87	632·32	704·69	780·98
58	236·10	281·12	330·04	382·90	439·67	500·37	564·98	633·49	705·93	782·29
59	236·82	281·90	330·89	383·82	440·65	501·41	566·08	634·67	707·18	783·59

TABLE XXIV.—Computation of Circumpolar Azimuths.—To Facilitate the Calculation of the Corrections—for Instrumental Errors of *Collimation*, *Inclination* and *Deviation*—to the Observed Times of Transit.

Zenith Distance	Cos.	Sin.	Zenith Distance	Zenith Distance	Cos.	Sin.	Zenith Distance	Declination N. or S.	$\frac{1}{15 \sin. N.P.D.}$
°			°	°			°	°	
0	1·000		90	45	0·707		45	0	0·067
1	1·000		89	46	695		44	1	067
2	0·999		88	47	682		43	2	067
3	999		87	48	669		42	3	067
4	998		86	49	656		41	4	067
5	996		85	50	643		40	5	067
6	0·995		84	51	0·629		39	6	0·067
7	993		83	52	616		38	7	067
8	990		82	53	602		37	8	067
9	988		81	54	588		36	9	067
10	985		80	55	574		35	10	068
11	0·982		79	56	0·559		34	11	0·068
12	978		78	57	545		33	12	068
13	974		77	58	530		32	13	068
14	970		76	59	515		31	14	069
15	966		75	60	500		30	15	069
16	0·961		74	61	0·485		29	16	0·069
17	956		73	62	469		28	17	070
18	951		72	63	454		27	18	070
19	946		71	64	438		26	19	071
20	940		70	65	423		25	20	071
21	0·934		69	66	0·407		24	21	0·071
22	927		68	67	391		23	22	072
23	921		67	68	375		22	23	072
24	914		66	69	358		21	24	073
25	906		65	70	342		20	25	074
26	0·899		64	71	0·326		19	26	0·074
27	891		63	72	309		18	27	075
28	883		62	73	292		17	28	076
29	875		61	74	276		16	29	076
30	866		60	75	259		15	30	077
31	0·857		59	76	0·242		14	31	0·078
32	848		58	77	225		13	32	079
33	839		57	78	208		12	33	079
34	829		56	79	191		11	34	080
35	819		55	80	174		10	35	081
36	0·809		54	81	0·156		9	36	0·082
37	799		53	82	139		8	37	083
38	788		52	83	122		7	38	085
39	777		51	84	105		6	39	086
40	766		50	85	087		5	40	087
41	0·755		49	86	0·070		4	41	0·088
42	743		48	87	052		3	42	090
43	731		47	88	035		2	43	091
44	719		46	89	017		1	44	093
45	707		45	90	000		0	45	094

TABLE XXV.—Computation of Circumpolar Azimuths.—To Facilitate the Computation of δA or the Reduction to Elongation.

PART I.

2 $\sin^2$ N. P. D. $\sin^2 \frac{1}{2}$ δP.—Natural Numbers.

δP	N. P. D.										
	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°
m											
0	·00000	·00000	·00000	·00000	·00000	·00000	·00000	·00000	·00000	·00000	·00000
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	1	1
6	0	0	0	0	0	0	0	1	1	1	1
7	0	0	0	0	0	0	1	1	1	1	1
8	0	0	0	0	0	0	1	1	1	1	2
9	0	0	0	0	0	1	1	1	1	2	2
10	0	0	0	0	0	1	1	1	2	2	3
11	0	0	0	0	1	1	1	2	2	3	3
12	0	0	0	0	1	1	1	2	3	3	4
13	0	0	0	0	1	1	2	2	3	4	5
14	0	0	0	1	1	1	2	3	4	5	6
15	0	0	0	1	1	2	2	3	4	5	6
16	0	0	0	1	1	2	3	4	5	6	7
17	0	0	0	1	1	2	3	4	5	7	8
18	0	0	0	1	2	2	3	5	6	8	9
19	0	0	0	1	2	3	4	5	7	8	10
20	0	0	0	1	2	3	4	6	7	9	11
21	0	0	1	1	2	3	5	6	8	10	13
22	0	0	1	1	2	3	5	7	9	11	14
23	0	0	1	1	2	4	5	7	10	12	15
24	0	0	1	2	3	4	6	8	11	13	17
25	0	0	1	2	3	5	6	9	12	15	18
26	0	0	1	2	3	5	7	10	12	16	19
27	0	0	1	2	3	5	8	10	13	17	21
28	0	0	1	2	4	6	8	11	14	18	22
29	0	0	1	2	4	6	9	12	15	20	24
30	·00000	·00000	·00001	·00002	·00004	·00006	·00009	·00013	·00017	·00021	·00026

TABLE XXV.—Computation of Circumpolar Azimuths.—(*Continued*).

PART II.

Cot P sin δ P.—Natural Numbers.

P	δ P										
	0m	1m	2m	3m	4m	5m	6m	7m	8m	9m	10m
° ′											
82 0		0·00061	0·00123	0·00184	0·00245	0·00307	0·00368	0·00429	0·00490	0·00552	0·00613
10		60	120	180	240	300	360	420	480	540	600
20		59	117	176	235	294	352	411	470	528	587
30		57	115	172	230	287	345	402	459	517	574
40		56	112	168	225	281	337	393	449	505	561
50		55	110	165	219	274	329	384	439	494	548
83 0		0·00054	0·00107	0·00161	0·00214	0·00268	0·00321	0·00375	0·00429	0·00482	0·00536
10		52	105	157	209	261	314	366	418	470	523
20		51	102	153	204	255	306	357	408	459	510
30		50	099	149	199	249	298	348	398	447	497
40		48	097	145	194	242	291	339	387	436	484
50		47	094	141	189	236	283	330	377	424	471
84 0		0·00046	0·00092	0·00138	0·00183	0·00229	0·00275	0·00321	0·00367	0·00413	0·00458
10		45	089	134	178	223	267	312	357	401	446
20		43	087	130	173	216	260	303	346	390	433
30		42	084	126	168	210	252	294	336	378	420
40		41	081	122	163	204	244	285	326	367	407
50		39	079	118	158	197	237	276	316	355	394
85 0		0·00038	0·00076	0·00115	0·00153	0·00191	0·00229	0·00267	0·00305	0·00343	0·00382
10		37	074	111	148	184	221	258	295	332	369
20		36	071	107	142	178	214	249	285	320	356
30		34	069	103	137	172	206	240	275	309	343
40		33	066	099	132	165	198	231	264	297	331
50	0·00000	32	064	095	127	159	191	222	254	286	318
86 0	0·00000	0·00031	0·00061	0·00092	0·00122	0·00153	0·00183	0·00214	0·00244	0·00275	0·00305
10	0	29	058	088	117	146	175	205	234	263	292
20		28	056	084	112	140	168	196	224	252	280
30		27	053	080	107	133	160	187	213	240	267
40		25	051	076	102	127	152	178	203	229	254
50		24	048	072	097	121	145	169	193	217	241
87 0		0·00023	0·00046	0·00069	0·00091	0·00114	0·00137	0·00160	0·00183	0·00206	0·00229
10		22	043	065	086	108	130	151	173	194	216
20		20	041	061	081	102	122	142	163	183	203
30		19	038	057	076	095	114	133	152	171	190
40		18	036	053	071	089	107	124	142	160	178
50		16	033	050	066	083	099	116	132	149	165
88 0		0·00015	0·00030	0·00046	0·00061	0·00076	0·00091	0·00107	0·00122	0·00137	0·00152
10		14	028	042	056	070	084	098	112	126	140
20		13	025	038	051	063	076	089	102	114	127
30		11	023	034	046	057	069	080	091	103	114
40		10	020	030	041	051	061	071	081	091	102
50		09	018	027	036	044	053	062	071	080	089
89 0		0·00008	0·00015	0·00023	0·00030	0·00038	0·00046	0·00053	0·00061	0·00069	0·00076
10		06	013	019	025	032	038	044	051	057	063
20		05	010	015	020	025	030	036	041	046	051
30		04	008	011	015	019	023	027	030	034	038
40		03	005	008	010	013	015	018	020	023	025
50		01	003	004	005	006	008	009	010	011	013
90 0		0·00000	0·00000	0·00000	0·00000	0·00000	0·00000	0·00000	0·00000	0·00000	0·00000

TABLE XXV.—Computation of Circumpolar Azimuths.—(*Continued*).

PART II.

Cot P sin δP.—Natural Numbers.

P	δ P									
	11m	12m	13m	14m	15m	16m	17m	18m	19m	20m
° ′										
82 0	0·00674	0·00736	0·00797	0·00858	0·00919	0·00980	0·01042	0·01103	0·01164	0·01225
10	660	720	780	840	900	960	1020	1079	1139	1199
20	646	705	763	822	880	939	0998	1056	1115	1173
30	632	689	746	804	861	918	0976	1033	1090	1147
40	617	674	730	786	842	898	0954	1010	1066	1122
50	603	658	713	768	822	877	0932	0987	1041	1096
83 0	0·00589	0·00643	0·00696	0·00750	0·00803	0·00857	0·00910	0·00963	0·01017	0·01070
10	575	627	679	732	784	836	0888	0940	0992	1044
20	561	612	663	714	764	815	0866	0917	0968	1019
30	547	596	646	696	745	795	0844	0894	0943	0993
40	533	581	629	678	726	774	0823	0871	0919	0967
50	518	565	613	660	707	754	0801	0848	0895	0942
84 0	0·00504	0·00550	0·00596	0·00642	0·00687	0·00733	0·00779	0·00825	0·00870	0·00916
10	490	535	579	624	668	713	0757	0802	0846	0890
20	476	519	563	606	649	692	0735	0779	0822	0865
30	462	504	546	588	630	672	0714	0755	0797	0839
40	448	489	529	570	611	651	0692	0732	0773	0814
50	434	473	513	552	591	631	0670	0709	0749	0788
85 0	0·00420	0·00458	0·00496	0·00534	0·00572	0·00610	0·00648	0·00686	0·00724	0·00763
10	406	443	479	516	553	590	0627	0663	0700	0737
20	392	427	463	498	534	569	0605	0640	0676	0711
30	378	412	446	480	515	549	0583	0617	0652	0686
40	364	397	430	463	496	529	0562	0595	0627	0660
50	350	381	413	445	476	508	0540	0572	0603	0635
86 0	0·00335	0·00366	0·00396	0·00427	0·00457	0·00488	0·00518	0·00549	0·00579	0·00609
10	321	351	380	409	438	467	0497	0526	0555	0584
20	307	335	363	391	419	447	0475	0503	0531	0559
30	293	320	347	373	400	427	0453	0480	0506	0533
40	279	305	330	356	381	406	0432	0457	0482	0508
50	265	290	314	338	362	386	0410	0434	0458	0482
87 0	0·00251	0·00274	0·00297	0·00320	0·00343	0·00366	0·00388	0·00411	0·00434	0·00457
10	237	259	281	302	324	345	0367	0388	0410	0431
20	223	244	264	284	305	325	0345	0365	0386	0406
30	209	229	248	267	286	305	0324	0343	0362	0381
40	195	213	231	249	266	284	0302	0320	0337	0355
50	182	198	214	231	247	264	0280	0297	0313	0330
88 0	0·00168	0·00183	0·00198	0·00213	0·00228	0·00244	0·00259	0·00274	0·00289	0·00304
10	154	168	181	195	209	223	0237	0251	0265	0279
20	140	152	165	178	190	203	0216	0228	0241	0254
30	126	137	148	160	171	183	0194	0205	0217	0228
40	112	122	132	142	152	162	0172	0183	0193	0203
50	098	107	115	124	133	142	0151	0160	0169	0177
89 0	0·00084	0·00091	0·00099	0·00107	0·00114	0·00122	0·00129	0·00137	0·00145	0·00152
10	070	076	082	089	095	101	0108	0114	0120	0127
20	056	061	066	071	076	081	0086	0091	0096	0101
30	042	046	049	053	057	061	0065	0068	0072	0076
40	028	030	033	036	038	041	0043	0046	0048	0051
50	014	015	016	018	019	020	0022	0023	0024	0025
90 0	0·00000	0·00000	0·00000	0·00000	0·00000	0·00000	0·00000	0·00000	0·00000	0·00000

TABLE XXV.—Computation of Circumpolar Azimuths.—(*Continued*).

PART II.

Cot P sin δP.—Natural Numbers.

P	δP									
	21m	22m	23m	24m	25m	26m	27m	28m	29m	30m
° ′										
82 0	0·01286	0·01347	0·01408	0·01469	0·01530	0·01591	0·01652	0·01713	0·01774	0·01834
10	1259	1319	1378	1438	1498	1557	1617	1677	1736	1796
20	1232	1290	1349	1407	1465	1524	1582	1641	1699	1757
30	1205	1262	1319	1376	1433	1490	1547	1604	1661	1718
40	1178	1233	1289	1345	1401	1457	1513	1568	1624	1680
50	1151	1205	1260	1314	1369	1423	1478	1532	1587	1641
83 0	6·01123	0·01177	0·01230	0·01283	0·01337	0·01390	0·01443	0·01496	0·01550	0·01603
10	1096	1149	1201	1253	1305	1357	1408	1460	1512	1564
20	1070	1120	1171	1222	1272	1323	1374	1424	1475	1526
30	1043	1092	1141	1191	1240	1290	1339	1389	1438	1487
40	1016	1064	1112	1160	1208	1256	1305	1353	1401	1449
50	0989	1036	1082	1129	1176	1223	1270	1317	1364	1410
84 0	0·00962	0·01007	0·01053	0·01099	0·01144	0·01190	0·01235	0·01281	0·01326	0·01372
10	0935	0979	1024	1068	1112	1157	1201	1245	1289	1334
20	0908	0951	0994	1037	1080	1123	1166	1209	1252	1295
30	0881	0923	0965	1006	1048	1090	1132	1173	1215	1257
40	0854	0895	0935	0976	1016	1057	1097	1138	1178	1219
50	0827	0867	0906	0945	0984	1024	1063	1102	1141	1180
85 0	0·00801	0·00839	0·00877	0·00915	0·00952	0·00990	0·01028	0·01066	0·01104	0·01142
10	0774	0810	0847	0884	0921	0957	0994	1031	1067	1104
20	0747	0782	0818	0853	0889	0924	0959	0995	1030	1065
30	0720	0754	0789	0823	0857	0891	0925	0959	0993	1027
40	0693	0726	0759	0792	0825	0858	0891	0923	0956	0989
50	0667	0698	0730	0761	0793	0825	0856	0888	0919	0951
86 0	0·00640	0·00670	0·00701	0·00731	0·00761	0·00792	0·00822	0·00852	0·00882	0·00913
10	0613	0642	0671	0700	0729	0759	0788	0817	0846	0875
20	0586	0614	0642	0670	0698	0725	0753	0781	0809	0836
30	0560	0586	0613	0639	0666	0692	0719	0745	0772	0798
40	0533	0558	0584	0609	0634	0659	0685	0710	0735	0760
50	0506	0530	0554	0578	0602	0626	0650	0674	0698	0722
87 0	0·00480	0·00502	0·00525	0·00548	0·00571	0·00593	0·00616	0·00639	0·00661	0·00684
10	0453	0474	0496	0517	0539	0560	0582	0603	0625	0646
20	0426	0446	0467	0487	0507	0527	0547	0568	0588	0608
30	0400	0418	0437	0456	0475	0494	0513	0532	0551	0570
40	0373	0391	0408	0426	0444	0461	0479	0497	0514	0532
50	0346	0363	0379	0395	0412	0428	0445	0461	0477	0494
88 0	0·00320	0·00335	0·00350	0·00365	0·00380	0·00395	0·00410	0·00426	0·00441	0·00456
10	0293	0307	0321	0335	0348	0362	0376	0390	0404	0418
20	0266	0279	0292	0304	0317	0329	0342	0355	0367	0380
30	0240	0251	0262	0274	0285	0296	0308	0319	0330	0342
40	0213	0223	0233	0243	0253	0263	0274	0284	0294	0304
50	0186	0195	0204	0213	0222	0231	0239	0248	0257	0266
89 0	0·00160	0·00167	0·00175	0·00182	0·00190	0·00198	0·00205	0·00213	0·00220	0·00228
10	0133	0139	0146	0152	0158	0165	0171	0177	0184	0190
20	0106	0112	0117	0122	0127	0132	0137	0142	0147	0152
30	0080	0084	0087	0091	0095	0099	0103	0106	0110	0114
40	0053	0056	0058	0061	0063	0066	0068	0071	0073	0076
50	0027	0028	0029	0030	0032	0033	0034	0035	0037	0038
90 0	0·00000	0·00000	0·00000	0·00000	0·00000	0·00000	0·00000	0·00000	0·00000	0·00000

TABLE XXV.—Computation of Circumpolar Azimuths.—(*Continued*).

PART III. Log $2 \sin^2 \frac{1}{2} \delta P \operatorname{cosec} 1''$ for each Second of Time of δP.

s	δP 0m	1m	2m	3m	4m	5m	6m	7m	8m	9m	s
0	− Infinite	0·29303	0·89509	1·24727	1·49714	1·69095	1·84931	1·98319	2·09917	2·20146	0
1	$\bar{4}$·73673	30739	90230	25208	50075	69384	85172	98526	10097	20307	1
2	$\bar{3}$·33879	32151	90944	25686	50435	69672	85412	98732	10278	20467	2
3	69097	33541	91653	26162	50793	69960	85652	98937	10458	20627	3
4	− 94085	34909	92357	26636	51150	70246	85890	99142	10637	20787	4
5	$\bar{2}$·13467	36255	93054	27106	51505	70531	86129	99347	10817	20946	5
6	29303	37581	93747	27575	51859	70815	86366	99551	10995	21106	6
7	42692	38888	94433	28040	52211	71099	86603	99755	11174	21264	7
8	54291	40174	95114	28504	52562	71381	86840	99958	11352	21423	8
9	64521	41442	95790	28964	52911	71663	87075	2·00161	11530	21581	9
10	$\bar{2}$·73673	0·42692	0·96461	1·29423	1·53260	1·71943	1·87310	2·00363	2·11707	2·21739	10
11	81951	43924	97127	29879	53606	72223	87545	00565	11884	21897	11
12	89509	45139	97787	30332	53952	72502	87779	00766	12061	22055	12
13	− 96461	46337	98443	30783	54296	72780	88012	00967	12237	22212	13
14	$\bar{1}$·02898	47519	99093	31232	54638	73057	88244	01167	12413	22369	14
15	08891	48685	99739	31679	54980	73333	88476	01367	12589	22525	15
16	14497	49835	1·00380	32123	55319	73608	88708	01566	12764	22682	16
17	19763	50971	01016	32565	55658	73883	88938	01765	12939	22838	17
18	24727	52092	01648	33005	55995	74156	89168	01964	13114	22994	18
19	29423	53198	02275	33443	56331	74429	89398	02162	13288	23149	19
20	$\bar{1}$·33879	0·54291	1·02898	1·33878	1·56666	1·74701	1·89627	2·02360	2·13462	2·23304	20
21	38117	55370	03516	34311	57000	74972	89855	02557	13635	23459	21
22	42157	56435	04130	34742	57332	75242	90083	02753	13809	23614	22
23	46018	57488	04740	35171	57663	75511	90310	02950	13981	23768	23
24	49715	58528	05345	35598	57992	75780	90536	03146	14154	23922	24
25	53261	59556	05946	36023	58321	76047	90762	03341	14326	24076	25
26	56667	60572	06543	36445	58648	76314	90987	03536	14498	24230	26
27	59945	61576	07136	36866	58974	76580	91212	03730	14669	24383	27
28	63104	62569	07725	37285	59298	76845	91436	03924	14841	24536	28
29	66152	63551	08310	37701	59622	77110	91660	04118	15011	24689	29
30	$\bar{1}$·69097	0·64521	1·08891	1·38116	1·59944	1·77373	1·91883	2·04311	2·15182	2·24841	30
31	71945	65481	09468	38528	60265	77636	92105	04504	15352	24994	31
32	74703	66430	10041	38939	60585	77898	92327	04697	15522	25146	32
33	77376	67369	10611	39348	60904	78159	92548	04888	15691	25297	33
34	79968	68298	11176	39755	61221	78420	92769	05080	15860	25449	34
35	82486	69217	11739	40160	61538	78680	92989	05271	16029	25600	35
36	84933	70127	12297	40563	61853	78938	93209	05462	16198	25751	36
37	87313	71027	12852	40964	62167	79197	93428	05652	16366	25902	37
38	89629	71918	13404	41363	62480	79454	93646	05842	16534	26052	38
39	91886	72800	13952	41761	62792	79710	93864	06031	16701	26202	39
40	$\bar{1}$·94085	0·73673	1·14496	1·42156	1·63103	1·79966	1·94082	2·06220	2·16868	2·26352	40
41	96229	74537	15037	42550	63412	80221	94299	06409	17035	26502	41
42	98323	75393	15575	42942	63721	80476	94515	06597	17202	26651	42
43	0·00366	76240	16110	43333	64028	80729	94731	06785	17368	26800	43
44	02363	77079	16641	43721	64335	80982	94946	06972	17534	26949	44
45	04315	77910	17169	44108	64640	81234	95161	07159	17699	27097	45
46	06224	78734	17694	44493	64944	81486	95375	07346	17865	27246	46
47	08092	79549	18215	44877	65248	81736	95588	07532	18030	27394	47
48	09921	80357	18734	45259	65550	81986	95802	07718	18194	27542	48
49	11712	81158	19250	45639	65851	82235	96014	07903	18359	27689	49
50	0·13467	0·81951	1·19762	1·46017	1·66151	1·82484	1·96226	2·08088	2·18523	2·27836	50
51	15187	82737	20271	46394	66450	82732	96438	08273	18686	27984	51
52	16873	83516	20778	46769	66748	82979	96649	08457	18850	28130	52
53	18528	84288	21281	47143	67045	83225	96859	08641	19013	28277	53
54	20151	85053	21782	47515	67341	83471	97070	08824	19176	28423	54
55	21745	85812	22280	47885	67635	83716	97279	09007	19338	28569	55
56	23310	86564	22775	48254	67929	83960	97488	09190	19500	28715	56
57	24848	87310	23267	48621	68222	84204	97697	09372	19662	28861	57
58	26358	88049	23756	48987	68514	84447	97905	09554	19824	29006	58
59	27843	88782	24243	49351	68805	84689	98112	09735	19985	29151	59
60	0·29303	0·89509	1·24727	1·49714	1·69095	1·84931	1·98319	2·09917	2·20146	2·29296	60

TABLE XXV.—Computation of Circumpolar Azimuths.—(*Continued*).

PART III. Log 2 $\sin^2 \frac{1}{2}$ δ P cosec 1″ for each Second of Time of δ P.

s	δ P 10m	11m	12m	13m	14m	15m	16m	17m	18m	19m	s
0	2·29296	2·37573	2·45129	2·52080	2·58515	2·64506	2·70109	2·75373	2·80335	2·85029	0
1	29441	37705	45250	52191	58618	64602	70200	75458	80410	85105	1
2	29585	37836	45370	52302	58722	64698	70290	75543	80496	85181	2
3	29729	37967	45490	52413	58825	64795	70380	75628	80576	85257	3
4	29873	38098	45610	52524	58928	64891	70470	75713	80656	85333	4
5	30017	38229	45730	52635	59030	64987	70560	75797	80736	85409	5
6	30160	38359	45850	52745	59133	65083	70650	75882	80816	85485	6
7	30303	38489	45970	52856	59236	65178	70740	75967	80896	85560	7
8	30446	38619	46089	52966	59338	65274	70830	76051	80976	85636	8
9	30589	38749	46208	53076	59440	65370	70920	76136	81056	85711	9
10	2·30732	2·38879	2·46327	2·53186	2·59543	2·65465	2·71009	2·76220	2·81135	2·85787	10
11	30874	39009	46446	53296	59645	65561	71099	76304	81215	85862	11
12	31016	39138	46565	53406	59747	65656	71188	76388	81294	85938	12
13	31158	39267	46683	53515	59849	65751	71277	76472	81374	86013	13
14	31299	39396	46802	53625	59950	65846	71366	76556	81453	86088	14
15	31441	39525	46920	53734	60052	65941	71455	76640	81533	86164	15
16	31582	39653	47038	53843	60153	66036	71544	76724	81612	86239	16
17	31722	39782	47156	53952	60255	66131	71633	76808	81691	86314	17
18	31863	39910	47274	54061	60356	66225	71722	76892	81770	86389	18
19	32004	40038	47391	54170	60457	66320	71811	76975	81849	86464	19
20	2·32144	2·40166	2·47509	2·54278	2·60558	2·66414	2·71900	2·77059	2·81928	2·86539	20
21	32284	40293	47626	54387	60659	66508	71988	77142	82007	86613	21
22	32423	40421	47743	54495	60760	66603	72077	77225	82086	86688	22
23	32563	40548	47860	54604	60861	66697	72165	77309	82165	86763	23
24	32702	40675	47977	54712	60961	66791	72253	77392	82243	86837	24
25	32841	40802	48093	54820	61062	66885	72341	77475	82322	86912	25
26	32980	40929	48210	54927	61162	66979	72430	77558	82400	86986	26
27	33119	41055	48326	55035	61262	67072	72518	77641	82479	87061	27
28	33257	41181	48442	55143	61362	67166	72605	77724	82557	87135	28
29	33395	41307	48558	55250	61462	67259	72693	77807	82636	87209	29
30	2·33533	2·41433	2·48674	2·55357	2·61562	2·67353	2·72781	2·77889	2·82714	2·87284	30
31	33671	41559	48790	55464	61662	67446	72869	77972	82792	87358	31
32	33809	41685	48905	55571	61761	67539	72956	78055	82870	87432	32
33	33946	41810	49021	55678	61861	67632	73044	78137	82948	87506	33
34	34083	41935	49136	55785	61960	67725	73131	78220	83026	87580	34
35	34220	42060	49251	55892	62060	67818	73218	78302	83104	87654	35
36	34356	42185	49366	55998	62159	67911	73306	78384	83182	87728	36
37	34493	42310	49481	56104	62258	68004	73393	78466	83259	87802	37
38	34629	42434	49596	56211	62357	68096	73480	78548	83337	87875	38
39	34765	42559	49710	56317	62456	68189	73567	78630	83415	87949	39
40	2·34901	2·42683	2·49824	2·56423	2·62554	2·68281	2·73654	2·78712	2·83492	2·88022	40
41	35036	42807	49939	56528	62653	68374	73740	78794	83570	88096	41
42	35172	42931	50053	56634	62752	68466	73827	78876	83647	88169	42
43	35307	43054	50167	56740	62850	68558	73914	78958	83725	88243	43
44	35442	43178	50280	56845	62948	68650	74000	79039	83802	88316	44
45	35577	43301	50394	56951	63046	68742	74087	79121	83879	88390	45
46	35711	43424	50507	57056	63144	68834	74173	79202	83956	88463	46
47	35846	43547	50621	57161	63242	68926	74259	79284	84033	88536	47
48	35980	43670	50734	57266	63340	69017	74345	79365	84110	88609	48
49	36114	43792	50847	57370	63438	69109	74431	79446	84187	88682	49
50	2·36247	2·43915	2·50960	2·57475	2·63536	2·69200	2·74517	2·79528	2·84264	2·88755	50
51	36381	44037	51072	57580	63633	69292	74603	79609	84341	88828	51
52	36514	44159	51185	57684	63730	69383	74689	79690	84417	88901	52
53	36647	44281	51297	57788	63828	69174	74775	79771	84494	88974	53
54	36780	44403	51409	57893	63925	69565	74861	79852	84571	89046	54
55	36913	44524	51522	57997	64022	69656	74946	79932	84647	89119	55
56	37045	44646	51634	58101	64119	69747	75032	80013	84724	89192	56
57	37178	44767	51745	58204	64216	69838	75117	80094	84800	89264	57
58	37310	44888	51857	58308	64313	69928	75202	80174	84876	89337	58
59	37442	45009	51969	58412	64409	70019	75288	80255	84953	89409	59
60	2·37573	2·45129	2·52080	2·58515	2·64506	2·70109	2·75373	2·80335	2·85029	2·89481	60

TABLE XXV.—Computation of Circumpolar Azimuths.—(*Continued*).

PART III. Log 2 $\sin^2 \frac{1}{2}$ δ P cosec 1″ for each Second of Time of δ P.

s	δ P 20m	21m	22m	23m	24m	25m	26m	27m	28m	29m	s
0	2·89481	2·93716	2·97754	3·01612	3·05306	3·08848	3·12251	3·15526	3·18681	3·21725	0
1	89554	93785	97820	01675	05366	08906	12307	15579	18732	21774	1
2	89626	93854	97886	01738	05426	08964	12362	15633	18784	21824	2
3	89698	93923	97951	01801	05486	09021	12418	15686	18835	21874	3
4	89770	93992	98017	01863	05546	09079	12473	15739	18887	21924	4
5	89842	94060	98082	01926	05606	09137	12529	15793	18938	21974	5
6	89914	94129	98148	01989	05666	09194	12584	15846	18990	22023	6
7	89986	94197	98213	02051	05726	09252	12640	15900	19041	22073	7
8	90058	94266	98279	02114	05786	09309	12695	15953	19093	22123	8
9	90130	94334	98344	02176	05846	09367	12750	16006	19144	22172	9
10	2·90202	2·94403	2·98409	3·02239	3·05906	3·09424	3·12805	3·16059	3·19195	3·22222	10
11	90273	94471	98474	02301	05966	09482	12861	16113	19247	22271	11
12	90345	94539	98540	02363	06026	09539	12916	16166	19298	22321	12
13	90417	94607	98605	02426	06085	09597	12971	16219	19349	22370	13
14	90488	94676	98670	02488	06145	09654	13026	16272	19400	22420	14
15	90560	94744	98735	02550	06205	09711	13081	16325	19452	22469	15
16	90631	94812	98800	02613	06264	09769	13136	16378	19503	22519	16
17	90703	94880	98865	02675	06324	09826	13191	16431	19554	22568	17
18	90774	94948	98930	02737	06384	09883	13246	16484	19605	22617	18
19	90845	95016	98995	02799	06443	09940	13301	16537	19656	22667	19
20	2·90916	2·95083	2·99059	3·02861	3·06503	3·09997	3·13356	3·16590	3·19707	3·22716	20
21	90987	95151	99124	02923	06562	10054	13411	16643	19758	22765	21
22	91058	95219	99189	02985	06621	10111	13466	16696	19809	22814	22
23	91129	95287	99253	03047	06681	10168	13521	16749	19860	22864	23
24	91200	95354	99318	03108	06740	10225	13576	16801	19911	22913	24
25	91271	95422	99383	03170	06799	10282	13631	16854	19962	22962	25
26	91342	95489	99447	03232	06858	10339	13685	16907	20013	23011	26
27	91413	95557	99512	03294	06918	10396	13740	16960	20064	23060	27
28	91484	95624	99576	03355	06977	10453	13795	17012	20114	23109	28
29	91554	95692	99640	03417	07036	10509	13849	17065	20165	23158	29
30	2·91625	2·95759	2·99705	3·03479	3·07095	3·10566	3·13904	3·17117	3·20216	3·23207	30
31	91695	95826	99769	03540	07154	10623	13958	17170	20267	23256	31
32	91766	95893	99833	03602	07213	10680	14013	17223	20317	23305	32
33	91836	95960	99897	03663	07272	10736	14067	17275	20368	23354	33
34	91907	96028	99961	03724	07331	10793	14122	17327	20419	23403	34
35	91977	96095	3·00025	03786	07389	10849	14176	17380	20469	23452	35
36	92047	96162	00089	03847	07448	10906	14231	17432	20520	23501	36
37	92117	96229	00153	03908	07507	10962	14285	17485	20570	23550	37
38	92188	96295	00217	03969	07566	11019	14339	17537	20621	23599	38
39	92258	96362	00281	04031	07625	11075	14393	17589	20671	23647	39
40	2·92328	2·96429	3·00345	3·04092	3·07683	3·11131	3·14448	3·17642	3·20722	3·23696	40
41	92398	96496	00409	04153	07742	11188	14502	17694	20772	23745	41
42	92468	96562	00473	04214	07800	11244	14556	17746	20823	23793	42
43	92537	96629	00536	04275	07859	11300	14610	17798	20873	23841	43
44	92607	96696	00600	04336	07917	11357	14664	17850	20923	23891	44
45	92677	96762	00664	04397	07976	11413	14718	17903	20974	23939	45
46	92747	96829	00727	04458	08034	11469	14772	17955	21024	23988	46
47	92816	96895	00791	04519	08093	11525	14826	18007	21074	24037	47
48	92886	96962	00854	04579	08151	11581	14880	18059	21124	24085	48
49	92955	97028	00918	04640	08209	11637	14934	18111	21175	24134	49
50	2·93025	2·97094	3·00981	3·04701	3·08267	3·11693	3·14988	3·18163	3·21225	3·24182	50
51	93094	97160	01044	04761	08326	11749	15042	18215	21275	24230	51
52	93164	97227	01108	04822	08384	11805	15096	18266	21325	24279	52
53	93233	97293	01171	04883	08442	11861	15150	18318	21375	24327	53
54	93302	97359	01234	04943	08500	11917	15204	18370	21425	24376	54
55	93371	97425	01297	05004	08558	11973	15257	18422	21475	24424	55
56	93440	97491	01360	05064	08616	12028	15311	18474	21525	24472	56
57	93510	97557	01423	05125	08674	12084	15365	18526	21575	24521	57
58	93579	97623	01486	05185	08732	12140	15418	18577	21625	24569	58
59	93648	97688	01549	05245	08790	12195	15472	18629	21675	24617	59
60	2·93716	2·97754	3·01612	3·05306	3·08848	3·12251	3·15526	3·18681	3·21725	3·24665	60

TABLE XXVI.—Linear Value in Feet of one Second of Arc and its Logarithm, measured along the Meridian.

Latitude	Length in feet	Logarithm	Diff.	Latitude	Length in feet	Logarithm	Diff.
° ′			+	° ′			+
0 0	100·7639	2·0033050	0	4 0	100·7688	2·0033260	9
5	7639	3050	1	5	7690	3269	9
10	7639	3051	0	10	7692	3278	10
15	7639	3051	0	15	7694	3288	9
20	7639	3051	1	20	7696	3297	9
25	7640	3052	2	25	7699	3306	10
30	7640	3054	0	30	7701	3316	10
35	7640	3054	2	35	7703	3326	10
40	7640	3056	1	40	7706	3336	11
45	7641	3057	2	45	7708	3347	10
50	7641	3059	2	50	7710	3357	11
55	7642	3061	2	55	7713	3368	11
1 0	100·7642	2·0033063	2	5 0	100·7715	2·0033379	11
5	7643	3065	3	5	7718	3390	11
10	7643	3068	2	10	7720	3401	11
15	7644	3070	3	15	7723	3412	12
20	7645	3073	3	20	7726	3424	11
25	7645	3076	4	25	7729	3435	13
30	7646	3080	3	30	7731	3448	11
35	7647	3083	4	35	7734	3459	13
40	7648	3087	3	40	7737	3472	12
45	7648	3090	4	45	7740	3484	13
50	7649	3094	4	50	7743	3497	13
55	7650	3098	5	55	7746	3510	12
2 0	100·7651	2·0033103	4	6 0	100·7749	2·0033522	14
5	7652	3107	5	5	7752	3536	13
10	7653	3112	4	10	7755	3549	14
15	7655	3116	6	15	7758	3563	13
20	7656	3122	5	20	7761	3576	14
25	7657	3127	5	25	7764	3590	14
30	7658	3132	6	30	7768	3604	14
35	7660	3138	5	35	7771	3618	15
40	7661	3143	6	40	7774	3633	14
45	7662	3149	7	45	7778	3647	16
50	7664	3156	6	50	7781	3663	14
55	7665	3162	7	55	7785	3677	15
3 0	100·7667	2·0033169	6	7 0	100·7788	2·0033692	16
5	7668	3175	7	5	7792	3708	15
10	7670	3182	7	10	7795	3723	16
15	7671	3189	7	15	7799	3739	16
20	7673	3196	8	20	7803	3755	15
25	7675	3204	7	25	7806	3770	17
30	7676	3211	8	30	7810	3787	16
35	7678	3219	8	35	7814	3803	17
40	7680	3227	8	40	7818	3820	16
45	7682	3235	9	45	7822	3836	17
50	7684	3244	7	50	7826	3853	18
55	7686	3251	9	55	7830	3871	16
60	7688	3260		60	7833	3887	

TABLE XXVI.—Linear Value in Feet of one Second of Arc and its Logarithm, measured along the Meridian.

Latitude	Length in feet	Logarithm	Diff.	Latitude	Length in feet	Logarithm	Diff.
° ′			+	° ′			+
8 0	100·7833	2·0033887	18	12 0	100·8073	2·0034919	26
5	7838	3905	18	5	8079	4945	26
10	7842	3923	17	10	8085	4971	26
15	7846	3940	19	15	8091	4997	26
20	7850	3959	18	20	8097	5023	26
25	7854	3977	18	25	8103	5049	27
30	7858	3995	18	30	8109	5076	26
35	7863	4013	19	35	8115	5102	28
40	7867	4032	19	40	8122	5130	26
45	7871	4051	19	45	8128	5156	28
50	7876	4070	19	50	8134	5184	27
55	7880	4089	19	55	8141	5211	28
9 0	100·7885	2·0034108	20	13 0	100·8147	2·0035239	27
5	7889	4128	19	5	8153	5266	28
10	7894	4147	21	10	8160	5294	28
15	7898	4168	20	15	8166	5322	28
20	7903	4188	20	20	8173	5350	28
25	7908	4208	20	25	8179	5378	29
30	7913	4228	21	30	8186	5407	29
35	7917	4249	20	35	8193	5436	28
40	7922	4269	21	40	8199	5464	29
45	7927	4290	21	45	8206	5493	29
50	7932	4311	22	50	8213	5522	30
55	7937	4333	21	55	8220	5552	30
10 0	100·7942	2·0034354	22	14 0	100·8227	2·0035582	29
5	7947	4376	22	5	8233	5611	30
10	7952	4398	21	10	8240	5641	30
15	7957	4419	23	15	8247	5671	30
20	7962	4442	22	20	8254	5701	30
25	7967	4464	22	25	8261	5731	31
30	7972	4486	23	30	8268	5762	30
35	7978	4509	23	35	8275	5792	31
40	7983	4532	22	40	8283	5823	31
45	7988	4554	24	45	8290	5854	31
50	7994	4578	23	50	8297	5885	31
55	7999	4601	24	55	8304	5916	32
11 0	100·8005	2·0034625	23	15 0	100·8312	2·0035948	31
5	8010	4648	24	5	8319	5979	32
10	8016	4672	24	10	8326	6011	31
15	8021	4696	24	15	8334	6042	32
20	8027	4720	25	20	8341	6074	33
25	8032	4745	24	25	8349	6107	32
30	8038	4769	25	30	8356	6139	33
35	8044	4794	25	35	8364	6172	32
40	8050	4819	25	40	8371	6204	33
45	8055	4844	25	45	8379	6237	33
50	8061	4869	25	50	8386	6270	33
55	8067	4894	25	55	8394	6303	33
60	8073	4919		60	8402	6336	

TABLE XXVI.—Linear Value in Feet of one Second of Arc and its Logarithm, measured along the Meridian.

Latitude	Length in feet	Logarithm	Diff.	Latitude	Length in feet	Logarithm	Diff.
° ′			+	° ′			+
16 0	100·8402	2·0036336	34	20 0	100·8814	2·0038110	41
5	8410	6370	33	5	8823	8151	41
10	8417	6403	34	10	8833	8192	40
15	8425	6437	34	15	8842	8232	41
20	8433	6471	33	20	8852	8273	41
25	8441	6504	35	25	8861	8314	42
30	8449	6539	34	30	8871	8356	41
35	8457	6573	35	35	8880	8397	41
40	8465	6608	34	40	8890	8438	42
45	8473	6642	36	45	8900	8480	42
50	8481	6678	35	50	8909	8522	42
55	8489	6713	34	55	8919	8564	42
17 0	100·8497	2·0036747	36	21 0	100·8929	2·0038606	42
5	8506	6783	35	5	8939	8648	42
10	8514	6818	36	10	8949	8690	43
15	8522	6854	35	15	8958	8733	43
20	8530	6889	36	20	8968	8776	42
25	8539	6925	36	25	8978	8818	43
30	8547	6961	36	30	8988	8861	43
35	8555	6997	37	35	8998	8904	43
40	8564	7034	36	40	9008	8947	43
45	8572	7070	37	45	9018	8990	44
50	8581	7107	37	50	9028	9034	43
55	8589	7144	37	55	9038	9077	44
18 0	100·8598	2·0037181	37	22 0	100·9049	2·0039121	44
5	8607	7218	37	5	9059	9165	44
10	8615	7255	37	10	9069	9209	44
15	8624	7292	38	15	9079	9253	44
20	8633	7330	37	20	9090	9297	44
25	8641	7367	38	25	9100	9341	45
30	8650	7405	38	30	9110	9386	44
35	8659	7443	38	35	9121	9430	45
40	8668	7481	38	40	9131	9475	45
45	8677	7519	39	45	9141	9520	45
50	8686	7558	38	50	9152	9565	45
55	8694	7596	39	55	9162	9610	46
19 0	100·8703	2·0037635	39	23 0	100·9173	2·0039655	46
5	8713	7674	39	5	9183	9701	45
10	8722	7713	39	10	9194	9746	45
15	8731	7752	39	15	9204	9791	46
20	8740	7791	39	20	9215	9837	46
25	8749	7830	40	25	9226	9883	46
30	8758	7870	40	30	9236	·9929	46
35	8767	7910	40	35	9247	·9975	46
40	8777	7950	40	40	9258	2·0040021	47
45	8786	7990	40	45	9269	0068	46
50	8795	8030	40	50	9279	0114	47
55	8805	8070	40	55	9290	0161	46
60	8814	8110		60	9301	0207	

TABLE XXVI.—Linear Value in Feet of one Second of Arc and its Logarithm, measured along the Meridian.

Latitude	Length in feet	Logarithm	Diff.	Latitude	Length in feet	Logarithm	Diff.
° ′			+	° ′			+
24 0	100·9301	2·0040207	47	28 0	100·9854	2·0042588	52
5	9312	0254	48	5	9867	2640	52
10	9323	0302	47	10	9879	2692	53
15	9334	0349	47	15	9891	2745	52
20	9345	0396	47	20	9903	2797	53
25	9356	0443	47	25	9915	2850	53
30	9367	0490	48	30	9928	2903	53
35	9378	0538	48	35	9940	2956	53
40	9389	0586	48	40	9952	3009	53
45	9400	0634	48	45	9965	3062	53
50	9411	0682	47	50	9977	3115	53
55	9422	0729	49	55	9989	3168	53
25 0	100·9434	2·0040778	48	29 0	101·0002	2·0043221	54
5	9445	0826	49	5	0014	3275	54
10	9456	0875	48	10	0027	3329	53
15	9467	0923	49	15	0039	3382	54
20	9479	0972	49	20	0052	3436	54
25	9490	1021	48	25	0064	3490	54
30	9501	1069	50	30	0077	3544	54
35	9513	1119	48	35	0089	3598	54
40	9524	1167	49	40	0102	3652	54
45	9536	1216	50	45	0115	3706	54
50	9547	1266	49	50	0127	3760	55
55	9559	1315	50	55	0140	3815	54
26 0	100·9570	2·0041365	50	30 0	101·0153	2·0043869	55
5	9582	1415	49	5	0165	3924	55
10	9593	1464	50	10	0178	3979	55
15	9605	1514	50	15	0191	4034	54
20	9617	1564	51	20	0203	4088	56
25	9628	1615	50	25	0216	4144	54
30	9640	1665	50	30	0229	4198	56
35	9652	1715	51	35	0242	4254	55
40	9663	1766	50	40	0255	4309	55
45	9675	1816	51	45	0268	4364	55
50	9687	1867	51	50	0280	4419	56
55	9699	1918	50	55	0293	4475	56
27 0	100·9710	2·0041968	51	31 0	101·0306	2·0044531	55
5	9722	2019	52	5	0319	4586	56
10	9734	2071	51	10	0332	4642	56
15	9746	2122	51	15	0345	4698	56
20	9758	2173	52	20	0358	4754	56
25	9770	2225	51	25	0371	4810	56
30	9782	2276	51	30	0384	4866	56
35	9794	2327	53	35	0397	4922	56
40	9806	2380	51	40	0410	4978	57
45	9818	2431	53	45	0424	5035	56
50	9830	2484	51	50	0437	5091	57
55	9842	2535	53	55	0450	5148	56
60	9854	2588		60	0463	5204	

TABLE XXVI.—Linear Value in Feet of one Second of Arc and its Logarithm, measured along the Meridian.

Latitude	Length in feet	Logarithm	Diff.	Latitude	Length in feet	Logarithm	Diff.
° ′			+	° ′			+
32 0	101·0463	2·0045264	57	36 0	101·1115	2·0048007	60
5	0476	5261	57	5	1129	8067	60
10	0489	5318	57	10	1143	8127	60
15	0503	5375	56	15	1157	8187	60
20	0516	5431	57	20	1171	8247	60
25	0529	5488	57	25	1185	8307	61
30	0542	5545	58	30	1199	8368	60
35	0556	5603	57	35	1213	8428	61
40	0569	5660	57	40	1227	8489	60
45	0582	5717	57	45	1242	8549	60
50	0596	5774	58	50	1256	8609	61
55	0609	5832	58	55	1270	8670	60
33 0	101·0623	2·0045890	57	37 0	101·1284	2·0048730	61
5	0636	5947	58	5	1298	8791	60
10	0649	6005	57	10	1312	8851	61
15	0663	6062	58	15	1326	8912	60
20	0676	6120	58	20	1340	8972	61
25	0690	6178	58	25	1354	9033	61
30	0703	6236	58	30	1369	9094	61
35	0717	6294	58	35	1383	9155	61
40	0730	6352	59	40	1397	9216	61
45	0744	6411	58	45	1411	9277	61
50	0757	6469	58	50	1425	9338	61
55	0771	6527	58	55	1440	9399	62
34 0	101·0784	2·0046585	59	38 0	101·1454	2·0049461	61
5	0798	6644	59	5	1468	9522	61
10	0812	6703	58	10	1482	9583	61
15	0825	6761	59	15	1497	9644	62
20	0839	6820	58	20	1511	9706	62
25	0853	6878	60	25	1525	9768	60
30	0866	6938	58	30	1540	9828	62
35	0880	6996	59	35	1554	9890	62
40	0894	7055	60	40	1568	9952	61
45	0908	7115	58	45	1583	2·0050013	61
50	0921	7173	59	50	1597	0074	62
55	0935	7232	60	55	1611	0136	62
35 0	101·0949	2·0047292	59	39 0	101·1626	2·0050198	62
5	0963	7351	60	5	1640	0260	61
10	0977	7411	58	10	1654	0321	62
15	0990	7469	60	15	1669	0383	61
20	1004	7529	59	20	1683	0444	63
25	1018	7588	60	25	1698	0507	61
30	1032	7648	60	30	1712	0568	63
35	1046	7708	59	35	1726	0631	61
40	1060	7767	60	40	1741	0692	63
45	1074	7827	60	45	1755	0755	62
50	1087	7887	60	50	1770	0817	62
55	1101	7947	60	55	1784	0879	62
60	1115	8007		60	1799	0941	

TABLE XXVII.—Linear Value in Feet of one Second of Arc and its Logarithm, measured along Parallels of Latitude.

Latitude	Length in feet	Diff.	Logarithm	Diff.
° ′		—		—
0 0	101·4372	1	2·0061974	4
5	4371	3	61970	14
10	4368	5	61956	23
15	4363	8	61933	32
20	4355	9	61901	41
25	4346	12	61860	50
30	4334	14	61810	59
35	4320	16	61751	69
40	4304	18	61682	77
45	4286	20	61605	87
50	4266	23	61518	96
55	4243	24	61422	105
1 0	101·4219	27	2·0061317	114
5	4192	29	61203	123
10	4163	30	61080	133
15	4133	33	60947	141
20	4100	36	60806	151
25	4064	37	60655	159
30	4027	39	60496	169
35	3988	42	60327	178
40	3946	44	60149	187
45	3902	45	59962	197
50	3857	48	59765	205
55	3809	50	59560	215
2 0	101·3759	53	2·0059345	223
5	3706	54	59122	233
10	3652	56	58889	242
15	3596	57	58647	251
20	3539	63	58396	260
25	3476	63	58136	270
30	3413	65	57866	278
35	3348	67	57588	288
40	3281	69	57300	297
45	3212	71	57003	306
50	3141	74	56697	315
55	3067	76	56382	324
3 0	101·2991	77	2·0056058	334
5	2914	80	55724	342
10	2834	82	55382	352
15	2752	84	55030	361
20	2668	87	54669	370
25	2581	88	54299	379
30	2493	91	53920	389
35	2402	92	53531	397
40	2310	95	53134	407
45	2215	97	52727	416
50	2118	99	52311	425
55	2019	101	51886	434
60	1918		51452	

Latitude	Length in feet	Diff.	Logarithm	Diff.
° ′		—		—
4 0	101·1918	104	2·0051452	443
5	1814	105	51009	453
10	1709	108	50556	461
15	1601	109	50095	471
20	1492	112	49624	480
25	1380	114	49144	490
30	1266	116	48654	498
35	1150	118	48156	508
40	1032	120	47648	516
45	0912	123	47132	527
50	0789	124	46605	535
55	0665	127	46070	544
5 0	101·0538	129	2·0045526	554
5	0409	131	44972	563
10	0278	133	44409	572
15	0145	135	43837	581
20	0010	137	43256	590
25	100·9873	140	42666	600
30	9733	141	42066	609
35	9592	144	41457	618
40	9448	146	40839	627
45	9302	148	40212	636
50	9154	150	39576	646
55	9004	152	38930	655
6 0	100·8852	154	2·0038275	664
5	8698	157	37611	673
10	8541	158	36938	683
15	8383	161	36255	692
20	8222	162	35563	701
25	8060	165	34862	710
30	7895	167	34152	720
35	7728	169	33432	729
40	7559	172	32703	738
45	7387	173	31965	747
50	7214	175	31218	757
55	7039	178	30461	766
7 0	100·6861	180	2·0029695	775
5	6681	181	28920	784
10	6500	184	28136	794
15	6316	186	27342	803
20	6130	189	26539	812
25	5941	190	25727	822
30	5751	192	24905	830
35	5559	195	24075	841
40	5364	196	23234	849
45	5168	199	22385	859
50	4969	201	21526	868
55	4768	203	20658	877
60	4565		19781	

TABLE XXVII.—Linear Value in Feet of one Second of Arc and its Logarithm, measured along Parallels of Latitude.

Latitude	Length in feet	Diff.	Logarithm	Diff.	Latitude	Length in feet	Diff.	Logarithm	Diff.
° ′		—		—	° ′		—		—
8 0	100·4565	205	2·0019781	887	12 0	99·2348	306	1·9966641	1339
5	4360	207	18894	896	5	2042	308	65302	1348
10	4153	209	17998	905	10	1734	310	63954	1358
15	3944	212	17093	914	15	1424	312	62596	1368
20	3732	213	16179	924	20	1112	314	61228	1377
25	3519	216	15255	933	25	0798	316	59851	1386
30	3303	218	14322	943	30	0482	319	58465	1397
35	3085	219	13379	952	35	0163	320	57068	1406
40	2866	222	12427	961	40	98·9843	323	55662	1415
45	2644	224	11466	971	45	9520	324	54247	1425
50	2420	227	10495	980	50	9196	327	52822	1435
55	2193		09515		55	8869		51387	
9 0	100·1965	228	2·0008526	989	13 0	98·8540	329	1·9949943	1444
5	1735	230	07527	999	5	8209	331	48489	1454
10	1502	233	06519	1008	10	7876	333	47025	1464
15	1268	234	05502	1017	15	7541	335	45552	1473
20	1031	237	04475	1027	20	7204	337	44069	1483
25	0792	239	03439	1036	25	6865	339	42577	1492
30	0551	241	02394	1045	30	6524	341	41075	1502
35	0308	243	01339	1055	35	6180	344	39563	1512
40	0063	245	00274	1065	40	5835	345	38042	1521
45	99·9816	247	1·9999201	1073	45	5487	348	36511	1531
50	9567	249	98118	1083	50	5138	349	34970	1541
55	9315	252	97025	1093	55	4786	352	33419	1551
10 0	99·9062	253	1·9995923	1102	14 0	98·4432	354	1·9931859	1560
5	8806	256	94812	1111	5	4077	355	30289	1570
10	8548	258	93691	1121	10	3719	358	28709	1580
15	8289	259	92561	1130	15	3359	360	27120	1589
20	8027	262	91422	1139	20	2997	362	25521	1599
25	7763	264	90273	1149	25	2633	364	23912	1609
30	7497	266	89114	1159	30	2267	366	22294	1618
35	7228	269	87946	1168	35	1898	369	20666	1628
40	6958	270	86769	1177	40	1528	370	19027	1639
45	6686	272	85582	1187	45	1156	372	17380	1647
50	6411	275	84386	1196	50	0781	375	15722	1658
55	6135	276	83180	1206	55	0405	376	14055	1667
11 0	99·5856	279	1·9981965	1215	15 0	98·0026	379	1·9912378	1677
5	5575	281	80740	1225	5	97·9646	380	10691	1687
10	5292	283	79506	1234	10	9263	383	08994	1697
15	5007	285	78262	1244	15	8878	385	07287	1707
20	4720	287	77009	1253	20	8492	386	05571	1716
25	4431	289	75746	1263	25	8103	389	03845	1726
30	4140	291	74474	1272	30	7712	391	02109	1736
35	3846	294	73192	1282	35	7319	393	00363	1746
40	3551	295	71901	1291	40	6924	395	1·9898607	1756
45	3253	298	70601	1300	45	6527	397	96842	1765
50	2954	299	69290	1311	50	6128	399	95066	1776
55	2652	302	67971	1319	55	5726	402	93281	1785
60	2348	304	66641	1330	60	5323	403	91486	1795

TABLE XXVII.—Linear Value in Feet of one Second of Arc and its Logarithm, measured along Parallels of Latitude.

Latitude	Length in feet	Diff.	Logarithm	Diff.	Latitude	Length in feet	Diff.	Logarithm	Diff.
° ′		—		—	° ′		—		—
16 0	97·5323	405	1·9891486	1805	20 0	95·3569	503	1·9793519	2291
5	4918	407	89681	1815	5	3066	505	91228	2301
10	4511	410	87866	1825	10	2561	507	88927	2311
15	4101	411	86041	1835	15	2054	509	86616	2322
20	3690	414	84206	1845	20	1545	511	84294	2332
25	3276	415	82361	1854	25	1034	513	81962	2343
30	2861	418	80507	1865	30	0521	515	79619	2353
35	2443	420	78642	1874	35	0006	516	77266	2364
40	2023	421	76768	1885	40	94·9490	519	74902	2374
45	1602	424	74883	1894	45	8971	521	72528	2384
50	1178	426	72989	1905	50	8450	523	70144	2395
55	0752	428	71084	1914	55	7927	525	67749	2406
17 0	97·0324	429	1·9869170	1925	21 0	94·7402	527	1·9765343	2416
5	96·9895	432	67245	1934	5	6875	529	62927	2426
10	9463	434	65311	1945	10	6346	531	60501	2437
15	9029	436	63366	1954	15	5815	532	58064	2447
20	8593	438	61412	1965	20	5283	535	55617	2458
25	8155	440	59447	1974	25	4748	537	53159	2469
30	7715	443	57473	1985	30	4211	539	50690	2479
35	7272	444	55488	1994	35	3672	541	48211	2490
40	6828	446	53494	2005	40	3131	543	45721	2500
45	6382	448	51489	2015	45	2588	544	43221	2511
50	5934	450	49474	2025	50	2044	547	40710	2522
55	5484	453	47449	2035	55	1497	549	38188	2532
18 0	96·5031	454	1·9845414	2045	22 0	94·0948	551	1·9735656	2542
5	4577	456	43369	2055	5	0397	552	33114	2554
10	4121	459	41314	2065	10	93·9845	555	30560	2564
15	3662	460	39249	2076	15	9290	557	27996	2575
20	3202	463	37173	2086	20	8733	559	25421	2585
25	2739	464	35087	2095	25	8174	560	22836	2597
30	2275	467	32992	2106	30	7614	563	20239	2607
35	1808	468	30886	2116	35	7051	565	17632	2617
40	1340	471	28770	2127	40	6486	566	15015	2629
45	0869	472	26643	2136	45	5920	569	12386	2639
50	0397	475	24507	2147	50	5351	570	09747	2650
55	95·9922		22360		55	4781		07097	
19 0	95·9445	477	1·9820203	2157	23 0	93·4208	573	1·9704437	2660
5	8967	478	18036	2167	5	3634	574	01765	2672
10	8486	481	15858	2178	10	3057	577	1·9699083	2682
15	8003	483	13671	2187	15	2479	578	96390	2693
20	7519	484	11473	2198	20	1898	581	93686	2704
25	7032	487	09265	2208	25	1316	582	90971	2715
30	6543	489	07046	2219	30	0732	584	88245	2726
35	6053	490	04818	2228	35	0145	587	85508	2737
40	5560	493	02578	2240	40	92·9557	588	82761	2747
45	5065	495	00329	2249	45	8967	590	80002	2759
50	4568	497	1·9798069	2260	50	8375	592	77233	2769
55	4069	499	95799	2270	55	7781	594	74453	2780
60	3569	500	93519	2280	60	7184	597	71662	2791

TABLE XXVII.—Linear Value in Feet of one Second of Arc and its Logarithm, measured along Parallels of Latitude.

Latitude		Length in feet	Diff.	Logarithm	Diff.	Latitude		Length in feet	Diff.	Logarithm	Diff.
°	′		—		—	°	′		—		—
24	0	92·7184	598	1·9671662	2803	28	0	89·6294	691	1·9524503	3348
	5	6586	600	68859	2813		5	5603	692	21155	3358
	10	5986	602	66046	2824		10	4911	695	17797	3371
	15	5384	603	63222	2835		15	4216	696	14426	3382
	20	4781	606	60387	2846		20	3520	698	11044	3395
	25	4175	608	57541	2858		25	2822	700	07649	3406
	30	3567	610	54683	2868		30	2122	702	04243	3418
	35	2957	612	51815	2879		35	1420	703	00825	3429
	40	2345	613	48936	2891		40	0717	706	1·9497396	3442
	45	1732	616	46045	2901		45	0011	707	93954	3454
	50	1116	617	43144	2913		50	88·9304	710	90500	3465
	55	0499		40231			55	8594		87035	
25	0	91·9879	620	1·9637307	2924	29	0	88·7883	711	1·9483557	3478
	5	9258	621	34372	2935		5	7170	713	80068	3489
	10	8634	624	31426	2946		10	6455	715	76566	3502
	15	8009	625	28469	2957		15	5738	717	73053	3513
	20	7382	627	25500	2969		20	5019	719	69527	3526
	25	6752	630	22521	2979		25	4299	720	65989	3538
	30	6121	631	19530	2991		30	3576	723	62440	3549
	35	5488	633	16528	3002		35	2852	724	58878	3562
	40	4853	635	13514	3014		40	2126	726	55304	3574
	45	4216	637	10489	3025		45	1397	729	51718	3586
	50	3577	639	07453	3036		50	0668	729	48120	3598
	55	2937	640	04406	3047		55	87·9936	732	44509	3611
26	0	91·2294	643	1·9601348	3058	30	0	87·9202	734	1·9440887	3622
	5	1649	645	1·9598278	3070		5	8467	735	37252	3635
	10	1003	646	95196	3082		10	7729	738	33605	3647
	15	0354	649	92104	3092		15	6990	739	29946	3659
	20	90·9704	650	89000	3104		20	6249	741	26274	3672
	25	9051	653	85884	3116		25	5506	743	22590	3684
	30	8397	654	82757	3127		30	4761	745	18894	3696
	35	7741	656	79619	3138		35	4014	747	15186	3708
	40	7083	658	76470	3149		40	3266	748	11465	3721
	45	6423	660	73308	3162		45	2515	751	07731	3734
	50	5761	662	70136	3172		50	1763	752	03986	3745
	55	5097	664	66951	3185		55	1009	754	00227	3759
27	0	90·4431	666	1·9563756	3195	31	0	87·0253	756	1·9396457	3770
	5	3764	667	60549	3207		5	86·9496	757	92674	3783
	10	3094	670	57330	3219		10	8736	760	88878	3796
	15	2423	671	54099	3231		15	7975	761	85070	3808
	20	1749	674	50857	3242		20	7211	764	81250	3820
	25	1074	675	47604	3253		25	6446	765	77416	3834
	30	0397	677	44339	3265		30	5679	767	73571	3845
	35	89·9718	679	41062	3277		35	4911	768	69712	3859
	40	9037	681	37773	3289		40	4140	771	65841	3871
	45	8354	683	34473	3300		45	3368	772	61957	3884
	50	7669	685	31161	3312		50	2593	775	58061	3896
	55	6982	687	27838	3323		55	1817	776	54152	3909
	60	6294	688	24503	3335		60	1039	778	50230	3922

TABLE XXVII.—Linear Value in Feet of one Second of Arc and its Logarithm, measured along Parallels of Latitude.

Latitude	Length in feet	Diff.	Logarithm	Diff.	Latitude	Length in feet	Diff.	Logarithm	Diff.
° ′		—		—	° ′		—		—
32 0	86·1039	779	1·9350230	3934	36 0	82·1587	865	1·9146536	4576
5	0260	782	46296	3948	5	0722	867	41960	4590
10	85·9478	783	42348	3960	10	81·9855	869	37370	4605
15	8695	785	38388	3972	15	8986	870	32765	4618
20	7910	787	34416	3986	20	8116	873	28147	4633
25	7123	789	30430	3999	25	7243	874	23514	4647
30	6334	791	26431	4011	30	6369	875	18867	4661
35	5543	792	22420	4025	35	5494	878	14206	4675
40	4751	794	18395	4037	40	4616	879	09531	4690
45	3957	796	14358	4050	45	3737	881	04841	4703
50	3161	798	10308	4064	50	2856	882	00138	4719
55	2363	800	06244	4076	55	1974	885	1·9095419	4732
33 0	85·1563	801	1·9302168	4089	37 0	81·1089	886	1·9090687	4747
5	0762	804	1·9298079	4103	5	0203	887	85940	4761
10	84·9958	805	93976	4115	10	80·9316	890	81179	4776
15	9153	807	89861	4129	15	8426	891	76403	4790
20	8346	808	85732	4142	20	7535	893	71613	4805
25	7538	811	81590	4155	25	6642	895	66808	4819
30	6727	812	77435	4168	30	5747	896	61989	4834
35	5915	814	73267	4181	35	4851	898	57155	4848
40	5101	816	69086	4195	40	3953	900	52307	4864
45	4285	817	64891	4207	45	3053	901	47443	4877
50	3468	820	60684	4222	50	2152	903	42566	4893
55	2648	821	56462	4234	55	1249	905	37673	4907
34 0	84·1827	823	1·9252228	4248	38 0	80·0344	907	1·9032766	4922
5	1004	825	47980	4261	5	79·9437	908	27844	4937
10	0179	826	43719	4274	10	8529	910	22907	4952
15	83·9353	829	39445	4288	15	7619	912	17955	4966
20	8524	830	35157	4302	20	6707	913	12989	4982
25	7694	832	30855	4315	25	5794	915	08007	4996
30	6862	833	26540	4328	30	4879	917	03011	5012
35	6029	836	22212	4342	35	3962	918	1·8997999	5026
40	5193	837	17870	4355	40	3044	920	92973	5042
45	4356	839	13515	4370	45	2124	922	87931	5056
50	3517	841	09145	4382	50	1202	923	82875	5072
55	2676	842	04763	4397	55	0279	925	77803	5087
35 0	83·1834	844	1·9200366	4410	39 0	78·9354	927	1·8972716	5102
5	0990	846	1·9195956	4423	5	8427	929	67614	5117
10	0144	848	91533	4438	10	7498	930	62497	5133
15	82·9296	850	87095	4451	15	6568	932	57364	5148
20	8446	851	82644	4465	20	5636	933	52216	5163
25	7595	853	78179	4479	25	4703	935	47053	5179
30	6742	855	73700	4492	30	3768	937	41874	5194
35	5887	856	69208	4507	35	2831	939	36680	5209
40	5031	859	64701	4520	40	1892	940	31471	5225
45	4172	860	60181	4534	45	0952	941	26246	5241
50	3312	861	55647	4549	50	0011	944	21005	5256
55	2451	864	51098	4562	55	77·9067	945	15749	5271
60	1587		46536		60	8122		10478	

TABLE XXVIII.—Arc-versines of Spheroidal Arcs of Parallel 1° in length.

Parallel of Latitude	Arc-versine in seconds	Arc-versine in feet	Arc-ver. in sec. $\frac{}{(3600)^2}$ Logarithm	Parallel of Latitude	Arc-versine in seconds	Arc-versine in feet	Arc-ver. in sec. $\frac{}{(3600)^2}$ Logarithm
° ′				° ′			
0 0	0·00	0·0	−Infinite	4 0	2·20	221·8	$\overline{7}$·2299
5	05	4·6	$\overline{9}$·5501	5	25	226·3	2388
10	09	9·3	8512	10	29	230·9	2476
15	14	13·9	$\overline{8}$·0273	15	34	235·5	2561
20	18	18·5	1522	20	38	240·1	2645
25	23	23·2	2491	25	43	244·7	2727
30	28	27·8	3283	30	47	249·3	2807
35	32	32·4	3952	35	52	253·8	2886
40	37	37·1	4532	40	56	258·4	2964
45	41	41·7	5043	45	61	263·0	3040
50	46	46·3	5501	50	66	267·6	3115
55	51	51·0	5915	55	70	272·1	3188
1 0	0·55	55·6	$\overline{8}$·6292	5 0	2·75	276·7	$\overline{7}$·3261
5	60	60·2	6640	5	79	281·3	3332
10	64	64·9	6961	10	84	285·8	3401
15	69	69·5	7261	15	88	290·4	3470
20	74	74·1	7541	20	93	294·9	3538
25	78	78·8	7804	25	97	299·5	3604
30	83	83·4	8052	30	3·02	304·0	3670
35	87	88·0	8287	35	06	308·6	3734
40	92	92·6	8509	40	11	313·1	3798
45	97	97·3	8721	45	15	317·7	3860
50	1·01	101·9	8923	50	20	322·2	3922
55	06	106·5	9115	55	24	326·8	3983
2 0	1·10	111·1	$\overline{8}$·9300	6 0	3·29	331·3	$\overline{7}$·4043
5	15	115·8	9477	5	33	335·8	4102
10	19	120·4	9647	10	38	340·4	4160
15	24	125·0	9810	15	42	344·9	4217
20	29	129·6	9968	20	47	349·4	4274
25	33	134·3	$\overline{7}$·0120	25	51	353·9	4329
30	38	138·9	0267	30	56	358·4	4385
35	42	143·5	0409	35	60	363·0	4439
40	47	148·1	0546	40	65	367·5	4493
45	52	152·7	0680	45	69	372·0	4545
50	56	157·3	0809	50	74	376·5	4598
55	61	161·9	0934	55	78	381·0	4649
3 0	1·65	166·6	$\overline{7}$·1056	7 0	3·83	385·5	$\overline{7}$·4700
5	70	171·2	1175	5	87	390·0	4751
10	74	175·8	1290	10	91	394·5	4800
15	79	180·4	1403	15	96	399·0	4850
20	84	185·0	1512	20	4·00	403·5	4898
25	88	189·6	1619	25	05	407·9	4946
30	93	194·2	1723	30	09	412·4	4994
35	97	198·8	1825	35	14	416·9	5040
40	2·02	203·4	1924	40	18	421·4	5087
45	06	208·0	2021	45	23	425·8	5132
50	11	212·6	2116	50	27	430·3	5178
55	16	217·2	2209	55	31	434·8	5223
60	20	221·8	2299	60	36	439·2	5267

TABLE XXVIII.—Arc-versines of Spheroidal Arcs of Parallel 1° in length.

Parallel of Latitude	Arc-versine in seconds	Arc-versine in feet	Arc-ver. in sec. $\frac{}{(3600)^2}$ Logarithm	Parallel of Latitude	Arc-versine in seconds	Arc-versine in feet	Arc-ver. in sec. $\frac{}{(3600)^2}$ Logarithm
° ′				° ′			
8 0	4·36	439·2	$\bar{7}$·5267	12 0	6·43	648·2	$\bar{7}$·6956
5	40	443·7	5311	5	47	652·4	6984
10	45	448·1	5354	10	51	656·6	7012
15	49	452·6	5397	15	56	660·9	7040
20	53	457·0	5439	20	60	665·1	7068
25	58	461·4	5481	25	64	669·3	7095
30	62	465·9	5523	30	68	673·5	7122
35	67	470·3	5564	35	72	677·7	7149
40	71	474·7	5605	40	76	681·9	7176
45	75	479·2	5645	45	81	686·1	7202
50	80	483·6	5685	50	85	690·2	7229
55	84	488·0	5724	55	89	694·4	7255
9 0	4·89	492·4	$\bar{7}$·5763	13 0	6·93	698·6	$\bar{7}$·7281
5	93	496·8	5802	5	97	702·8	7307
10	97	501·2	5840	10	7·01	706·9	7332
15	5·02	505·6	5878	15	05	711·1	7358
20	06	510·0	5916	20	09	715·2	7383
25	10	514·4	5953	25	14	719·4	7408
30	15	518·8	5990	30	18	723·5	7433
35	19	523·2	6026	35	22	727·6	7458
40	23	527·6	6062	40	26	731·7	7482
45	28	531·9	6098	45	30	735·9	7506
50	32	536·3	6134	50	34	740·0	7531
55	36	540·7	6169	55	38	744·1	7555
10 0	5·41	545·0	$\bar{7}$·6204	14 0	7·42	748·2	$\bar{7}$·7578
5	45	549·4	6238	5	46	752·3	7602
10	49	553·7	6272	10	50	756·4	7626
15	54	558·1	6306	15	54	760·4	7649
20	58	562·4	6340	20	58	764·5	7672
25	62	566·7	6373	25	62	768·6	7695
30	67	571·1	6406	30	66	772·6	7718
35	71	575·4	6439	35	70	776·7	7741
40	75	579·7	6472	40	74	780·7	7763
45	79	584·0	6504	45	78	784·8	7786
50	84	588·3	6536	50	82	788·8	7808
55	88	592·7	6567	55	86	792·8	7830
11 0	5·92	597·0	$\bar{7}$·6599	15 0	7·90	796·8	$\bar{7}$·7852
5	96	601·2	6630	5	94	800·9	7874
10	6·01	605·5	6661	10	98	804·9	7895
15	05	609·8	6691	15	8·02	808·9	7917
20	09	614·1	6722	20	06	812·9	7938
25	13	618·4	6752	25	10	816·8	7959
30	18	622·7	6782	30	14	820·8	7980
35	22	626·9	6811	35	18	824·8	8001
40	26	631·2	6841	40	22	828·8	8022
45	30	635·4	6870	45	26	832·7	8043
50	35	639·7	6899	50	30	836·7	8063
55	39	643·9	6927	55	34	840·6	8084
60	43	648·2	6956	60	38	844·6	8104

TABLE XXVIII.—Arc-versines of Spheroidal Arcs of Parallel 1° in length.

Parallel of Latitude	Arc-versine in seconds	Arc-versine in feet	Arc-ver. in sec. $\frac{}{(3600)^2}$ Logarithm	Parallel of Latitude	Arc-versine in seconds	Arc-versine in feet	Arc-ver. in sec. $\frac{}{(3600)^2}$ Logarithm
° ′				° ′			
16 0	8·38	844·6	$\bar{7}$·8104	20 0	10·16	1024·6	$\bar{7}$·8941
5	41	848·5	8124	5	19	1028·1	8956
10	45	852·4	8144	10	23	1031·7	8971
15	49	856·3	8164	15	26	1035·2	8986
20	53	860·2	8184	20	30	1038·7	9001
25	57	864·1	8203	25	33	1042·2	9015
30	61	868·0	8223	30	37	1045·7	9030
35	65	871·9	8242	35	40	1049·2	9044
40	68	875·8	8261	40	43	1052·7	9059
45	72	879·7	8280	45	47	1056·2	9073
50	76	883·5	8299	50	50	1059·7	9087
55	80	887·4	8318	55	54	1063·1	9101
17 0	8·84	891·2	$\bar{7}$·8337	21 0	10·57	1066·6	$\bar{7}$·9115
5	88	895·1	8356	5	61	1070·0	9129
10	91	898·9	8374	10	64	1073·5	9143
15	95	902·7	8393	15	67	1076·9	9157
20	99	906·6	8411	20	71	1080·3	9171
25	9·03	910·4	8429	25	74	1083·7	9184
30	06	914·2	8447	30	77	1087·1	9198
35	10	918·0	8465	35	81	1090·5	9211
40	14	921·8	8483	40	84	1093·9	9225
45	18	925·5	8501	45	87	1097·3	9238
50	21	929·3	8518	50	91	1100·6	9251
55	25	933·1	8536	55	94	1104·0	9265
18 0	9·29	936·8	$\bar{7}$·8553	22 0	10·97	1107·3	$\bar{7}$·9278
5	33	940·6	8571	5	11·01	1110·7	9291
10	36	944·3	8588	10	04	1114·0	9304
15	40	948·1	8605	15	07	1117·3	9316
20	44	951·8	8622	20	11	1120·6	9329
25	47	955·5	8639	25	14	1123·9	9342
30	51	959·2	8656	30	17	1127·2	9355
35	55	962·9	8672	35	20	1130·5	9367
40	58	966·6	8689	40	23	1133·7	9380
45	62	970·3	8705	45	27	1137·0	9392
50	66	974·0	8722	50	30	1140·3	9404
55	69	977·6	8738	55	33	1143·5	9417
19 0	9·73	981·3	$\bar{7}$·8754	23 0	11·36	1146·7	$\bar{7}$·9429
5	76	984·9	8770	5	39	1149·9	9442
10	80	988·6	8786	10	43	1153·1	9453
15	84	992·2	8802	15	46	1156·3	9465
20	87	995·9	8818	20	49	1159·5	9477
25	91	999·5	8834	25	52	1162·7	9489
30	94	1003·1	8849	30	55	1165·9	9501
35	98	1006·7	8865	35	58	1169·1	9512
40	10·01	1010·3	8880	40	61	1172·2	9524
45	05	1013·9	8896	45	65	1175·4	9536
50	09	1017·4	8911	50	68	1178·5	9547
55	12	1021·0	8926	55	71	1181·6	9559
60	16	1024·6	8941	60	74	1184·7	9570

TABLE XXVIII.—Arc-versines of Spheroidal Arcs of Parallel 1° in length.

Parallel of Latitude	Arc-versine in seconds	Arc-versine in feet	Arc-ver. in sec. $\frac{}{(3600)^2}$ Logarithm	Parallel of Latitude	Arc-versine in seconds	Arc-versine in feet	Arc-ver. in sec. $\frac{}{(3600)^2}$ Logarithm
° ′				° ′			
24 0	11·74	1184·7	$\bar{7}$·9570	28 0	13·09	1321·9	$\bar{6}$·0043
5	77	1187·8	9581	5	12	1324·5	0052
10	80	1190·9	9592	10	14	1327·1	0060
15	83	1194·0	9604	15	17	1329·6	0069
20	86	1197·1	9615	20	19	1332·2	0077
25	89	1200·1	9626	25	22	1334·7	0085
30	92	1203·2	9637	30	24	1337·3	0093
35	95	1206·2	9648	35	27	1339·8	0101
40	98	1209·3	9659	40	29	1342·3	0109
45	12·01	1212·3	9669	45	32	1344·8	0118
50	04	1215·3	9680	50	34	1347·3	0126
55	07	1218·3	9691	55	36	1349·8	0133
25 0	12·10	1221·3	$\bar{7}$·9701	29 0	13·39	1352·3	$\bar{6}$·0141
5	13	1224·3	9712	5	41	1354·7	0149
10	16	1227·2	9722	10	44	1357·2	0157
15	19	1230·2	9733	15	46	1359·6	0165
20	22	1233·1	9743	20	48	1362·0	0172
25	24	1236·1	9753	25	51	1364·4	0180
30	27	1239·0	9764	30	53	1366·8	0188
35	30	1241·9	9774	35	56	1369·2	0195
40	33	1244·8	9784	40	58	1371·6	0203
45	36	1247·7	9794	45	60	1374·0	0210
50	39	1250·6	9804	50	63	1376·3	0217
55	42	1253·5	9814	55	65	1378·7	0225
26 0	12·44	1256·4	$\bar{7}$·9824	30 0	13·67	1381·0	$\bar{6}$·0232
5	47	1259·2	9834	5	69	1383·3	0239
10	50	1262·1	9843	10	72	1385·6	0246
15	53	1264·9	9853	15	74	1387·9	0254
20	56	1267·7	9863	20	76	1390·2	0261
25	58	1270·5	9872	25	78	1392·5	0268
30	61	1273·3	9882	30	81	1394·7	0275
35	64	1276·1	9891	35	83	1397·0	0282
40	67	1278·9	9901	40	85	1399·2	0289
45	69	1281·7	9910	45	87	1401·4	0295
50	72	1284·4	9919	50	89	1403·7	0302
55	75	1287·2	9928	55	92	1405·9	0309
27 0	12·78	1289·9	$\bar{7}$·9937	31 0	13·94	1408·1	$\bar{6}$·0316
5	80	1292·6	9947	5	96	1410·2	0322
10	83	1295·3	9956	10	98	1412·4	0329
15	86	1298·1	9965	15	14·00	1414·5	0335
20	88	1300·7	9974	20	02	1416·7	0342
25	91	1303·4	9983	25	04	1418·8	0348
30	93	1306·1	9991	30	06	1420·9	0355
35	96	1308·8	$\bar{6}$·0000	35	08	1423·0	0361
40	99	1311·4	0009	40	10	1425·1	0368
45	13·01	1314·0	0018	45	13	1427·2	0374
50	04	1316·7	0026	50	15	1429·3	0380
55	06	1319·3	0035	55	17	1431·4	0386
60	09	1321·9	0043	60	19	1433·4	0392

TABLE XXVIII.—Arc-versines of Spheroidal Arcs of Parallel 1° in length.

Parallel of Latitude		Arc-versine in seconds	Arc-versine in feet	Arc-ver. in sec. $\frac{}{(3600)^2}$ Logarithm	Parallel of Latitude		Arc-versine in seconds	Arc-versine in feet	Arc-ver. in sec. $\frac{}{(3600)^2}$ Logarithm
°	′				°	′			
32	0	14·19	1433·4	$\bar{6}$·0392	36	0	15·00	1517·1	$\bar{6}$·0636
	5	21	1435·4	0399		5	02	1518·7	0641
	10	23	1437·5	0405		10	03	1520·1	0645
	15	25	1439·5	0411		15	05	1521·5	0649
	20	26	1441·5	0417		20	06	1522·9	0652
	25	28	1443·4	0422		25	07	1524·3	0656
	30	30	1445·4	0428		30	09	1525·7	0660
	35	32	1447·4	0434		35	10	1527·0	0664
	40	34	1449·3	0440		40	11	1528·4	0668
	45	36	1451·3	0446		45	13	1529·7	0672
	50	38	1453·2	0451		50	14	1531·0	0675
	55	40	1455·1	0457		55	15	1532·3	0679
33	0	14·42	1457·0	$\bar{6}$·0463	37	0	15·17	1533·6	$\bar{6}$·0682
	5	44	1458·9	0468		5	18	1534·9	0686
	10	45	1460·8	0474		10	19	1536·2	0690
	15	47	1462·6	0479		15	20	1537·4	0693
	20	49	1464·5	0485		20	21	1538·7	0696
	25	51	1466·3	0490		25	23	1539·9	0700
	30	53	1468·1	0495		30	24	1541·1	0703
	35	54	1470·0	0501		35	25	1542·3	0707
	40	56	1471·7	0506		40	26	1543·5	0710
	45	58	1473·5	0511		45	27	1544·7	0713
	50	60	1475·3	0516		50	28	1545·8	0716
	55	61	1477·1	0521		55	29	1547·0	0719
34	0	14·63	1478·8	$\bar{6}$·0527	38	0	15·31	1548·1	$\bar{6}$·0723
	5	65	1480·6	0532		5	32	1549·2	0726
	10	66	1482·3	0537		10	33	1550·4	0729
	15	68	1484·0	0542		15	34	1551·5	0732
	20	70	1485·7	0546		20	35	1552·5	0735
	25	71	1487·4	0551		25	36	1553·6	0738
	30	73	1489·1	0556		30	37	1554·7	0740
	35	75	1490·7	0561		35	38	1555·7	0743
	40	76	1492·4	0566		40	39	1556·7	0746
	45	78	1494·0	0570		45	40	1557·8	0749
	50	79	1495·6	0575		50	41	1558·8	0752
	55	81	1497·3	0580		55	42	1559·8	0754
35	0	14·83	1498·9	$\bar{6}$·0584	39	0	15·43	1560·7	$\bar{6}$·0757
	5	84	1500·5	0589		5	44	1561·7	0760
	10	86	1502·0	0593		10	45	1562·7	0762
	15	87	1503·6	0598		15	46	1563·6	0765
	20	89	1505·1	0602		20	46	1564·5	0767
	25	90	1506·7	0607		25	47	1565·4	0770
	30	92	1508·2	0611		30	48	1566·3	0772
	35	93	1509·7	0615		35	49	1567·2	0775
	40	95	1511·2	0619		40	50	1568·1	0777
	45	96	1512·7	0624		45	51	1568·9	0779
	50	98	1514·2	0628		50	52	1569·8	0782
	55	99	1515·6	0632		55	52	1570·6	0784
	60	15·00	1517·1	0636		60	53	1571·4	0786

TABLE XXIX.—Linear Value in Miles of a Degree of Arc measured along the Meridian.

Mean Latitude	Meridional Degrees, in Miles	Difference	Mean Latitude	Meridional Degrees in Miles	Difference
°		+	°		+
0	68·7027	2	23	68·8072	88
1	68·7029	6	24	68·8160	90
2	68·7035	10	25	68·8250	93
3	68·7045	15	26	68·8343	96
4	68·7060	18	27	68·8439	98
5	68·7078	23	28	68·8537	101
6	68·7101	27	29	68·8638	102
7	68·7128	31	30	68·8740	105
8	68·7159	35	31	68·8845	107
9	68·7194	39	32	68·8952	109
10	68·7233	43	33	68·9061	110
11	68·7276	46	34	68·9171	112
12	68·7322	51	35	68·9283	114
13	68·7373	54	36	68·9397	114
14	68·7427	58	37	68·9511	117
15	68·7485	62	38	68·9628	117
16	68·7547	65	39	68·9745	117
17	68·7612	68	40	68·9862	120
18	68·7680	72	41	68·9982	119
19	68·7752	76	42	69·0101	119
20	68·7828	78	43	69·0220	121
21	68·7906	82	44	69·0341	120
22	68·7988	84	45	69·0461	120
23	68·8072		46	69·0581	

TABLE XXX.—Linear Value in Miles of a Degree of Arc measured along Parallels of Latitude.

Latitude	Longitudinal Degrees in Miles	Difference	Latitude	Longitudinal Degrees in Miles	Difference
°		—	°		—
0	69·1618	105	23	63·6960	4789
1	69·1513	314	24	63·2171	4981
2	69·1199	523	25	62·7190	5171
3	69·0676	732	26	62·2019	5361
4	68·9944	941	27	61·6658	5549
5	68·9003	1149	28	61·1109	5734
6	68·7854	1358	29	60·5375	5919
7	68·6496	1565	30	59·9456	6101
8	68·4931	1773	31	59·3355	6283
9	68·3158	1979	32	58·7072	6461
10	68·1179	2186	33	58·0611	6638
11	67·8993	2392	34	57·3973	6813
12	67·6601	2596	35	56·7160	6987
13	67·4005	2801	36	56·0173	7158
14	67·1204	3004	37	55·3015	7326
15	66·8200	3207	38	54·5689	7493
16	66·4993	3408	39	53·8196	7658
17	66·1585	3609	40	53·0538	7820
18	65·7976	3808	41	52·2718	7981
19	65·4168	4008	42	51·4737	8137
20	65·0160	4204	43	50·6600	8293
21	64·5956	4400	44	49·8307	8446
22	64·1556	4596	45	48·9861	8596
23	63·6960		46	48·1265	

TABLE XXXI.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{16}$th of a Degree of Latitude and Longitude, on the Scale of 4 Inches = 1 Mile, or 1 Inch to $\frac{1}{4}$ of a Mile.

Latitude							Length in Inches			
							m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
	°	′	″		°	′	″				
From	8	0	0	to	8	3	45	17·179	17·123	17·121	24·255
		3	45	,,		7	30	·179	·121	·118	·253
		7	30	,,		11	15	·179	·118	·116	·251
		11	15	,,		15	0	·179	·116	·113	·249
		15	0	,,		18	45	·179	·113	·110	·247
		18	45	,,		22	30	·179	·110	·107	·245
		22	30	,,		26	15	·179	·107	·105	·243
		26	15	,,		30	0	·179	·105	·102	·241
		30	0	,,		33	45	·179	·102	·099	·240
		33	45	,,		37	30	·179	·099	·096	·238
		37	30	,,		41	15	·180	·096	·094	·236
		41	15	,,		45	0	·180	·094	·091	·234
		45	0	,,		48	45	·180	·091	·088	·232
		48	45	,,		52	30	·180	·088	·085	·230
		52	30	,,		56	15	·180	·085	·082	·228
	8	56	15	,,	9	0	0	·180	·082	·079	·226
	9	0	0	,,	9	3	45	17·180	17·079	17·076	24·224
		3	45	,,		7	30	·180	·076	·073	·222
		7	30	,,		11	15	·180	·073	·070	·220
		11	15	,,		15	0	·180	·070	·067	·217
		15	0	,,		18	45	·180	·067	·064	·215
		18	45	,,		22	30	·180	·064	·061	·213
		22	30	,,		26	15	·180	·061	·058	·211
		26	15	,,		30	0	·180	·058	·055	·209
		30	0	,,		33	45	·180	·055	·052	·207
		33	45	,,		37	30	·180	·052	·049	·205
		37	30	,,		41	15	·181	·049	·046	·203
		41	15	,,		45	0	·181	·046	·042	·201
		45	0	,,		48	45	·181	·042	·039	·199
		48	45	,,		52	30	·181	·039	·036	·197
		52	30	,,		56	15	·181	·036	·033	·195
	9	56	15	,,	10	0	0	·181	·033	·029	·192
	10	0	0	,,	10	3	45	17·181	17·029	17·026	24·190
		3	45	,,		7	30	·181	·026	·023	·188
		7	30	,,		11	15	·181	·023	·020	·186
		11	15	,,		15	0	·181	·020	·016	·183
		15	0	,,		18	45	·181	·016	·013	·181
		18	45	,,		22	30	·181	·013	·010	·179
		22	30	,,		26	15	·181	·010	·007	·176
		26	15	,,		30	0	·181	·007	·003	·173
		30	0	,,		33	45	·181	·003	·000	·171
		33	45	,,		37	30	·181	·000	16·996	·169
		37	30	,,		41	15	·182	16·996	·993	·167
		41	15	,,		45	0	·182	·993	·989	·164
		45	0	,,		48	45	·182	·989	·986	·162
		48	45	,,		52	30	·182	·986	·982	·160
		52	30	,,		56	15	·182	·982	·979	·157
	10	56	15	,,	11	0	0	·182	·979	·975	·154

TABLE XXXI.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{16}$th of a Degree of Latitude and Longitude, on the Scale of 4 Inches = 1 Mile, or 1 Inch to $\frac{1}{4}$ of a Mile.

Latitude								Length in Inches			
								m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
	°	′	″		°	′	″				
From	11	0	0	to	11	3	45	17·182	16·975	16·972	24·152
		3	45	„		7	30	·182	·972	·968	·150
		7	30	„		11	15	·182	·968	·964	·147
		11	15	„		15	0	·182	·964	·960	·144
		15	0	„		18	45	·182	·960	·957	·142
		18	45	„		22	30	·182	·957	·953	·140
		22	30	„		26	15	·182	·953	·950	·137
		26	15	„		30	0	·182	·950	·946	·134
		30	0	„		33	45	·183	·946	·942	·132
		33	45	„		37	30	·183	·942	·938	·130
		37	30	„		41	15	·183	·938	·934	·127
		41	15	„		45	0	·183	·934	·930	·124
		45	0	„		48	45	·183	·930	·927	·122
		48	45	„		52	30	·183	·927	·923	·119
		52	30	„		56	15	·183	·923	·919	·116
	11	56	15	„	12	0	0	·183	·919	·915	·113
	12	0	0	„	12	3	45	17·183	16·915	16·911	24·110
		3	45	„		7	30	·183	·911	·907	·108
		7	30	„		11	15	·183	·907	·903	·105
		11	15	„		15	0	·183	·903	·899	·102
		15	0	„		18	45	·183	·899	·895	·099
		18	45	„		22	30	·183	·895	·891	·097
		22	30	„		26	15	·184	·891	·887	·095
		26	15	„		30	0	·184	·887	·883	·092
		30	0	„		33	45	·184	·883	·879	·089
		33	45	„		37	30	·184	·879	·875	·086
		37	30	„		41	15	·184	·875	·871	·083
		41	15	„		45	0	·184	·871	·867	·080
		45	0	„		48	45	·184	·867	·863	·077
		48	45	„		52	30	·184	·863	·859	·074
		52	30	„		56	15	·184	·859	·855	·071
	12	56	15	„	13	0	0	·184	·855	·850	·068
	13	0	0	„	13	3	45	17·184	16·850	16·846	24·065
		3	45	„		7	30	·184	·846	·842	·063
		7	30	„		11	15	·185	·842	·838	·060
		11	15	„		15	0	·185	·838	·833	·057
		15	0	„		18	45	·185	·833	·829	·054
		18	45	„		22	30	·185	·829	·824	·051
		22	30	„		26	15	·185	·824	·820	·048
		26	15	„		30	0	·185	·820	·816	·045
		30	0	„		33	45	·185	·816	·812	·042
		33	45	„		37	30	·185	·812	·807	·039
		37	30	„		41	15	·185	·807	·803	·036
		41	15	„		45	0	·185	·803	·798	·033
		45	0	„		48	45	·185	·798	·794	·030
		48	45	„		52	30	·185	·794	·789	·027
		52	30	„		56	15	·186	·789	·785	·024
	13	56	15	„	14	0	0	·186	·785	·780	·021

TABLE XXXI.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{16}$th of a Degree of Latitude and Longitude, on the Scale of 4 Inches = 1 Mile, or 1 Inch to $\frac{1}{4}$ of a Mile.

Latitude							Length in Inches			
							m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
	°	′	″		°	′	″				
From	14	0	0	to	14	3	45	17·186	16·780	16·776	24·018
		3	45	„		7	30	·186	·776	·771	·015
		7	30	„		11	15	·186	·771	·767	·012
		11	15	„		15	0	·186	·767	·762	·009
		15	0	„		18	45	·186	·762	·758	·005
		18	45	„		22	30	·186	·758	·753	·002
		22	30	„		26	15	·186	·753	·748	23·999
		26	15	„		30	0	·186	·748	·743	·996
		30	0	„		33	45	·186	·743	·739	·992
		33	45	„		37	30	·186	·739	·734	·989
		37	30	„		41	15	·187	·734	·729	·986
		41	15	„		45	0	·187	·729	·724	·983
		45	0	„		48	45	·187	·724	·720	·980
		48	45	„		52	30	·187	·720	·715	·977
		52	30	„		56	15	·187	·715	·710	·974
	14	56	15	„	15	0	0	·187	·710	·705	·970
	15	0	0	„	15	3	45	17·187	16·705	16·700	23·966
		3	45	„		7	30	·187	·700	·695	·963
		7	30	„		11	15	·187	·695	·690	·960
		11	15	„		15	0	·187	·690	·685	·957
		15	0	„		18	45	·188	·685	·681	·953
		18	45	„		22	30	·188	·681	·676	·950
		22	30	„		26	15	·188	·676	·671	·947
		26	15	„		30	0	·188	·671	·666	·943
		30	0	„		33	45	·188	·666	·661	·939
		33	45	„		37	30	·188	·661	·655	·936
		37	30	„		41	15	·188	·655	·650	·933
		41	15	„		45	0	·188	·650	·645	·929
		45	0	„		48	45	·188	·645	·640	·925
		48	45	„		52	30	·189	·640	·635	·922
		52	30	„		56	15	·189	·635	·630	·919
	15	56	15	„	16	0	0	·189	·630	·625	·915
	16	0	0	„	16	3	45	17·189	16·625	16·620	23·912
		3	45	„		7	30	·189	·620	·614	·909
		7	30	„		11	15	·189	·614	·609	·905
		11	15	„		15	0	·189	·609	·604	·901
		15	0	„		18	45	·189	·604	·599	·897
		18	45	„		22	30	·189	·599	·593	·894
		22	30	„		26	15	·189	·593	·588	·891
		26	15	„		30	0	·189	·588	·583	·887
		30	0	„		33	45	·190	·583	·578	·883
		33	45	„		37	30	·190	·578	·572	·880
		37	30	„		41	15	·190	·572	·567	·876
		41	15	„		45	0	·190	·567	·561	·872
		45	0	„		48	45	·190	·561	·556	·868
		48	45	„		52	30	·190	·556	·551	·865
		52	30	„		56	15	·190	·551	·546	·861
	16	56	15	„	17	0	0	·190	·546	·540	·857

TABLE XXXI.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{16}$th of a Degree of Latitude and Longitude, on the Scale of 4 Inches = 1 Mile, or 1 Inch to $\frac{1}{4}$ of a Mile.

Latitude								Length in Inches			
								m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
	°	′	″		°	′	″				
From	17	0	0	to	17	3	45	17·190	16·540	16·535	23·853
		3	45	„		7	30	·190	·535	·529	·850
		7	30	„		11	15	·191	·529	·524	·846
		11	15	„		15	0	·191	·524	·518	·842
		15	0	„		18	45	·191	·518	·512	·838
		18	45	„		22	30	·191	·512	·506	·835
		22	30	„		26	15	·191	·506	·501	·831
		26	15	„		30	0	·191	·501	·495	·827
		30	0	„		33	45	·191	·495	·490	·823
		33	45	„		37	30	·191	·490	·484	·820
		37	30	„		41	15	·191	·484	·478	·816
		41	15	„		45	0	·191	·478	·472	·812
		45	0	„		48	45	·192	·472	·467	·808
		48	45	„		52	30	·192	·467	·461	·804
		52	30	„		56	15	·192	·461	·455	·800
	17	56	15	„	18	0	0	·192	·455	·449	·796
	18	0	0	„	18	3	45	17·192	16·449	16·444	23·792
		3	45	„		7	30	·192	·444	·438	·788
		7	30	„		11	15	·192	·438	·432	·784
		11	15	„		15	0	·192	·432	·426	·780
		15	0	„		18	45	·193	·426	·420	·776
		18	45	„		22	30	·193	·420	·414	·772
		22	30	„		26	15	·193	·414	·408	·768
		26	15	„		30	0	·193	·408	·402	·764
		30	0	„		33	45	·193	·402	·396	·760
		33	45	„		37	30	·193	·396	·390	·756
		37	30	„		41	15	·193	·390	·384	·752
		41	15	„		45	0	·193	·384	·378	·748
		45	0	„		48	45	·193	·378	·372	·743
		48	45	„		52	30	·193	·372	·366	·739
		52	30	„		56	15	·194	·366	·360	·735
	18	56	15	„	19	0	0	·194	·360	·354	·731
	19	0	0	„	19	3	45	17·194	16·354	16·348	23·727
		3	45	„		7	30	·194	·348	·342	·723
		7	30	„		11	15	·194	·342	·336	·719
		11	15	„		15	0	·194	·336	·330	·715
		15	0	„		18	45	·194	·330	·324	·711
		18	45	„		22	30	·194	·324	·317	·707
		22	30	„		26	15	·195	·317	·311	·703
		26	15	„		30	0	·195	·311	·305	·699
		30	0	„		33	45	·195	·305	·299	·694
		33	45	„		37	30	·195	·299	·292	·690
		37	30	„		41	15	·195	·292	·286	·686
		41	15	„		45	0	·195	·286	·280	·682
		45	0	„		48	45	·195	·280	·274	·677
		48	45	„		52	30	·195	·274	·267	·673
		52	30	„		56	15	·196	·267	·261	·669
	19	56	15	„	20	0	0	·196	·261	·254	·665

TABLE XXXI.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{16}$th of a Degree of Latitude and Longitude, on the Scale of 4 Inches = 1 Mile, or 1 Inch to $\frac{1}{4}$ of a Mile.

Latitude							Length in Inches			
							m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
	°	′	″		°	′	″				
From	20	0	0	to	20	3	45	17·196	16·254	16·248	23·660
		3	45	„		7	30	·196	·248	·241	·656
		7	30	„		11	15	·196	·241	·235	·652
		11	15	„		15	0	·196	·235	·228	·647
		15	0	„		18	45	·196	·228	·222	·642
		18	45	„		22	30	·196	·222	·215	·638
		22	30	„		26	15	·197	·215	·209	·634
		26	15	„		30	0	·197	·209	·202	·630
		30	0	„		33	45	·197	·202	·196	·625
		33	45	„		37	30	·197	·196	·189	·621
		37	30	„		41	15	·197	·189	·183	·617
		41	15	„		45	0	·197	·183	·176	·612
		45	0	„		48	45	·197	·176	·169	·607
		48	45	„		52	30	·197	·169	·162	·603
		52	30	„		56	15	·198	·162	·156	·599
	20	56	15	„	21	0	0	·198	·156	·149	·594
	21	0	0	„	21	3	45	17·198	16·149	16·142	23·589
		3	45	„		7	30	·198	·142	·135	·585
		7	30	„		11	15	·198	·135	·129	·581
		11	15	„		15	0	·198	·129	·122	·576
		15	0	„		18	45	·198	·122	·115	·571
		18	45	„		22	30	·198	·115	·108	·567
		22	30	„		26	15	·199	·108	·102	·563
		26	15	„		30	0	·199	·102	·095	·558
		30	0	„		33	45	·199	·095	·088	·553
		33	45	„		37	30	·199	·088	·081	·549
		37	30	„		41	15	·199	·081	·074	·544
		41	15	„		45	0	·199	·074	·067	·539
		45	0	„		48	45	·199	·067	·060	·534
		48	45	„		52	30	·199	·060	·053	·530
		52	30	„		56	15	·200	·053	·046	·525
	21	56	15	„	22	0	0	·200	·046	·039	·520
	22	0	0	„	22	3	45	17·200	16·039	16·032	23·515
		3	45	„		7	30	·200	·032	·025	·511
		7	30	„		11	15	·200	·025	·018	·506
		11	15	„		15	0	·200	·018	·011	·501
		15	0	„		18	45	·200	·011	·004	·496
		18	45	„		22	30	·200	·004	15·996	·492
		22	30	„		26	15	·201	15·996	·989	·487
		26	15	„		30	0	·201	·989	·982	·482
		30	0	„		33	45	·201	·982	·975	·477
		33	45	„		37	30	·201	·975	·968	·473
		37	30	„		41	15	·201	·968	·961	·468
		41	15	„		45	0	·201	·961	·953	·463
		45	0	„		48	45	·201	·953	·946	·458
		48	45	„		52	30	·201	·946	·939	·454
		52	30	„		56	15	·202	·939	·932	·449
	22	56	15	„	23	0	0	·202	·932	·924	·444

TABLE XXXI.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{16}$th of a Degree of Latitude and Longitude, on the Scale of 4 Inches = 1 Mile, or 1 Inch to $\frac{1}{4}$ of a Mile.

Latitude							Length in Inches			
							m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
	°	′	″		°	′	″				
From	23	0	0	to	23	3	45	17·202	15·924	15·917	23·439
		3	45	„		7	30	·202	·917	·909	·434
		7	30	„		11	15	·202	·909	·902	·429
		11	15	„		15	0	·202	·902	·895	·424
		15	0	„		18	45	·202	·895	·888	·419
		18	45	„		22	30	·202	·888	·880	·414
		22	30	„		26	15	·203	·880	·873	·409
		26	15	„		30	0	·203	·873	·865	·404
		30	0	„		33	45	·203	·865	·858	·399
		33	45	„		37	30	·203	·858	·850	·395
		37	30	„		41	15	·203	·850	·843	·390
		41	15	„		45	0	·203	·843	·835	·385
		45	0	„		48	45	·204	·835	·828	·380
		48	45	„		52	30	·204	·828	·820	·375
		52	30	„		56	15	·204	·820	·812	·370
	23	56	15	„	24	0	0	·204	·812	·804	·364
	24	0	0	„	24	3	45	17·204	15·804	15·797	23·359
		3	45	„		7	30	·204	·797	·789	·354
		7	30	„		11	15	·204	·789	·782	·349
		11	15	„		15	0	·204	·782	·774	·344
		15	0	„		18	45	·205	·774	·766	·339
		18	45	„		22	30	·205	·766	·758	·334
		22	30	„		26	15	·205	·758	·751	·329
		26	15	„		30	0	·205	·751	·743	·323
		30	0	„		33	45	·205	·743	·735	·318
		33	45	„		37	30	·205	·735	·727	·313
		37	30	„		41	15	·206	·727	·719	·308
		41	15	„		45	0	·206	·719	·711	·303
		45	0	„		48	45	·206	·711	·704	·298
		48	45	„		52	30	·206	·704	·696	·293
		52	30	„		56	15	·206	·696	·688	·288
	24	56	15	„	25	0	0	·206	·688	·680	·282
	25	0	0	„	25	3	45	17·206	15·680	15·672	23·277
		3	45	„		7	30	·206	·672	·664	·272
		7	30	„		11	15	·207	·664	·656	·267
		11	15	„		15	0	·207	·656	·648	·261
		15	0	„		18	45	·207	·648	·640	·256
		18	45	„		22	30	·207	·640	·632	·251
		22	30	„		26	15	·207	·632	·624	·245
		26	15	„		30	0	·207	·624	·616	·239
		30	0	„		33	45	·208	·616	·608	·234
		33	45	„		37	30	·208	·608	·600	·229
		37	30	„		41	15	·208	·600	·592	·224
		41	15	„		45	0	·208	·592	·583	·218
		45	0	„		48	45	·208	·583	·575	·213
		48	45	„		52	30	·208	·575	·567	·208
		52	30	„		56	15	·208	·567	·559	·203
	25	56	15	„	26	0	0	·208	·559	·550	·197

TABLE XXXI.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{16}$th of a Degree of Latitude and Longitude, on the Scale of 4 Inches = 1 Mile, or 1 Inch to $\frac{1}{4}$ of a Mile.

Latitude							Length in Inches			
							m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
	°	′	″		°	′	″				
From	26	0	0	to	26	3	45	17·209	15·550	15·542	23·192
		3	45	„		7	30	·209	·542	·534	·187
		7	30	„		11	15	·209	·534	·526	·181
		11	15	„		15	0	·209	·526	·517	·175
		15	0	„		18	45	·209	·517	·509	·170
		18	45	„		22	30	·209	·509	·501	·165
		22	30	„		26	15	·210	·501	·493	·159
		26	15	„		30	0	·210	·493	·484	·153
		30	0	„		33	45	·210	·484	·476	·148
		33	45	„		37	30	·210	·476	·467	·143
		37	30	„		41	15	·210	·467	·459	·137
		41	15	„		45	0	·210	·459	·450	·131
		45	0	„		48	45	·211	·450	·442	·126
		48	45	„		52	30	·211	·442	·433	·121
		52	30	„		56	15	·211	·433	·425	·115
	26	56	15	„	27	0	0	·211	·425	·416	·109
	27	0	0	„	27	3	45	17·211	15·416	15·408	23·104
		3	45	„		7	30	·211	·408	·399	·098
		7	30	„		11	15	·211	·399	·391	·092
		11	15	„		15	0	·211	·391	·382	·086
		15	0	„		18	45	·212	·382	·374	·081
		18	45	„		22	30	·212	·374	·365	·076
		22	30	„		26	15	·212	·365	·357	·070
		26	15	„		30	0	·212	·357	·348	·064
		30	0	„		33	45	·212	·348	·339	·059
		33	45	„		37	30	·212	·339	·330	·054
		37	30	„		41	15	·213	·330	·322	·048
		41	15	„		45	0	·213	·322	·313	·042
		45	0	„		48	45	·213	·313	·304	·036
		48	45	„		52	30	·213	·304	·295	·030
		52	30	„		56	15	·213	·295	·287	·024
	27	56	15	„	28	0	0	·213	·287	·278	·018
	28	0	0	„	28	3	45	17·214	15·278	15·269	23·013
		3	45	„		7	30	·214	·269	·260	·008
		7	30	„		11	15	·214	·260	·251	·002
		11	15	„		15	0	·214	·251	·242	22·996
		15	0	„		18	45	·214	·242	·234	·991
		18	45	„		22	30	·214	·234	·225	·985
		22	30	„		26	15	·215	·225	·216	·979
		26	15	„		30	0	·215	·216	·207	·973
		30	0	„		33	45	·215	·207	·198	·967
		33	45	„		37	30	·215	·198	·189	·961
		37	30	„		41	15	·215	·189	·180	·955
		41	15	„		45	0	·215	·180	·171	·949
		45	0	„		48	45	·215	·171	·162	·943
		48	45	„		52	30	·215	·162	·153	·937
		52	30	„		56	15	·216	·153	·144	·931
	28	56	15	„	29	0	0	·216	·144	·134	·925

TABLE XXXI.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{16}$th of a Degree of Latitude and Longitude, on the Scale of 4 Inches = 1 Mile, or 1 Inch to $\frac{1}{4}$ of a Mile.

Latitude								Length in Inches			
								m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
°	°	′	″		°	′	″				
From	29	0	0	to	29	3	45	17·216	15·134	15·125	22·920
		3	45	„		7	30	·216	·125	·116	·914
		7	30	„		11	15	·216	·116	·107	·908
		11	15	„		15	0	·216	·107	·098	·902
		15	0	„		18	45	·217	·098	·089	·896
		18	45	„		22	30	·217	·089	·079	·890
		22	30	„		26	15	·217	·079	·070	·883
		26	15	„		30	0	·217	·070	·061	·876
		30	0	„		33	45	·217	·061	·052	·871
		33	45	„		37	30	·217	·052	·042	·866
		37	30	„		41	15	·218	·042	·033	·860
		41	15	„		45	0	·218	·033	·024	·854
		45	0	„		48	45	·218	·024	·015	·848
		48	45	„		52	30	·218	·015	·005	·842
		52	30	„		56	15	·218	·005	14·996	·836
	29	56	15	„	30	0	0	·218	14·996	·986	·830
	30	0	0	„	30	3	45	17·219	14·986	14·977	22·824
		3	45	„		7	30	·219	·977	·968	·818
		7	30	„		11	15	·219	·968	·959	·812
		11	15	„		15	0	·219	·959	·949	·806
		15	0	„		18	45	·219	·949	·940	·800
		18	45	„		22	30	·219	·940	·930	·794
		22	30	„		26	15	·220	·930	·921	·788
		26	15	„		30	0	·220	·921	·911	·782
		30	0	„		33	45	·220	·911	·902	·776
		33	45	„		37	30	·220	·902	·892	·770
		37	30	„		41	15	·220	·892	·882	·763
		41	15	„		45	0	·220	·882	·872	·756
		45	0	„		48	45	·221	·872	·863	·750
		48	45	„		52	30	·221	·863	·853	·744
		52	30	„		56	15	·221	·853	·844	·738
	30	56	15	„	31	0	0	·221	·844	·834	·732
	31	0	0	„	31	3	45	17·221	14·834	14·824	22·726
		3	45	„		7	30	·221	·824	·814	·720
		7	30	„		11	15	·222	·814	·805	·714
		11	15	„		15	0	·222	·805	·795	·708
		15	0	„		18	45	·222	·795	·785	·702
		18	45	„		22	30	·222	·785	·775	·696
		22	30	„		26	15	·222	·775	·766	·689
		26	15	„		30	0	·222	·766	·756	·682
		30	0	„		33	45	·223	·756	·746	·676
		33	45	„		37	30	·223	·746	·736	·670
		37	30	„		41	15	·223	·736	·726	·664
		41	15	„		45	0	·223	·726	·716	·657
		45	0	„		48	45	·223	·716	·707	·651
		48	45	„		52	30	·223	·707	·697	·645
		52	30	„		56	15	·224	·697	·687	·639
	31	56	15	„	32	0	0	·224	·687	·677	·632

TABLE XXXI.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{16}$th of a Degree of Latitude and Longitude, on the Scale of 4 Inches = 1 Mile, or 1 Inch to $\frac{1}{4}$ of a Mile.

Latitude							Length in Inches			
							m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
	°	′	″		°	′	″				
From	32	0	0	to	32	3	45	17·224	14·677	14·667	22·626
		3	45	„		7	30	·224	·667	·657	·620
		7	30	„		11	15	·224	·657	·647	·614
		11	15	„		15	0	·224	·647	·637	·607
		15	0	„		18	45	·225	·637	·627	·601
		18	45	„		22	30	·225	·627	·617	·595
		22	30	„		26	15	·225	·617	·607	·588
		26	15	„		30	0	·225	·607	·597	·581
		30	0	„		33	45	·225	·597	·587	·575
		33	45	„		37	30	·225	·587	·576	·569
		37	30	„		41	15	·226	·576	·566	·563
		41	15	„		45	0	·226	·566	·556	·556
		45	0	„		48	45	·226	·556	·546	·550
		48	45	„		52	30	·226	·546	·536	·544
		52	30	„		56	15	·226	·536	·526	·537
	32	56	15	„	33	0	0	·226	·526	·515	·530
	33	0	0	„	33	3	45	17·227	14·515	14·505	22·524
		3	45	„		7	30	·227	·505	·495	·518
		7	30	„		11	15	·227	·495	·485	·511
		11	15	„		15	0	·227	·485	·474	·504
		15	0	„		18	45	·227	·474	·464	·498
		18	45	„		22	30	·227	·464	·454	·492
		22	30	„		26	15	·228	·454	·444	·485
		26	15	„		30	0	·228	·444	·433	·478
		30	0	„		33	45	·228	·433	·423	·472
		33	45	„		37	30	·228	·423	·412	·465
		37	30	„		41	15	·228	·412	·402	·458
		41	15	„		45	0	·228	·402	·391	·451
		45	0	„		48	45	·229	·391	·381	·445
		48	45	„		52	30	·229	·381	·370	·439
		52	30	„		56	15	·229	·370	·360	·432
	33	56	15	„	34	0	0	·229	·360	·349	·425
	34	0	0	„	34	3	45	17·229	14·349	14·339	22·419
		3	45	„		7	30	·229	·339	·328	·413
		7	30	„		11	15	·230	·328	·318	·406
		11	15	„		15	0	·230	·318	·307	·399
		15	0	„		18	45	·230	·307	·297	·393
		18	45	„		22	30	·230	·297	·286	·387
		22	30	„		26	15	·231	·286	·276	·380
		26	15	„		30	0	·231	·276	·265	·373
		30	0	„		33	45	·231	·265	·254	·367
		33	45	„		37	30	·231	·254	·243	·360
		37	30	„		41	15	·231	·243	·233	·353
		41	15	„		45	0	·231	·233	·222	·346
		45	0	„		48	45	·232	·222	·212	·340
		48	45	„		52	30	·232	·212	·201	·333
		52	30	„		56	15	·232	·201	·190	·326
	34	56	15	„	35	0	0	·232	·190	·179	·319

TABLE XXXI.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{16}$th of a Degree of Latitude and Longitude, on the Scale of 4 Inches = 1 Mile, or 1 Inch to $\frac{1}{4}$ of a Mile.

Latitude								Length in Inches			
								m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
°	°	′	″		°	′	″				
From	35	0	0	to	35	3	45	17·232	14·179	14·168	22·313
		3	45	„		7	30	·232	·168	·157	·307
		7	30	„		11	15	·233	·157	·147	·300
		11	15	„		15	0	·233	·147	·136	·293
		15	0	„		18	45	·233	·136	·125	·286
		18	45	„		22	30	·233	·125	·114	·279
		22	30	„		26	15	·233	·114	·103	·272
		26	15	„		30	0	·233	·103	·092	·265
		30	0	„		33	45	·234	·092	·081	·259
		33	45	„		37	30	·234	·081	·070	·252
		37	30	„		41	15	·234	·070	·059	·245
		41	15	„		45	0	·234	·059	·048	·238
		45	0	„		48	45	·234	·048	·037	·232
		48	45	„		52	30	·234	·037	·026	·225
		52	30	„		56	15	·235	·026	·015	·218
	35	56	15	„	36	0	0	·235	·015	·004	·211
	36	0	0	„	36	3	45	17·235	14·004	13·993	22·204
		3	45	„		7	30	·235	13·993	·982	·198
		7	30	„		11	15	·235	·982	·971	·191
		11	15	„		15	0	·235	·971	·960	·184
		15	0	„		18	45	·236	·960	·949	·177
		18	45	„		22	30	·236	·949	·938	·170
		22	30	„		26	15	·236	·938	·927	·163
		26	15	„		30	0	·236	·927	·915	·156
		30	0	„		33	45	·237	·915	·904	·149
		33	45	„		37	30	·237	·904	·893	·143
		37	30	„		41	15	·237	·893	·882	·136
		41	15	„		45	0	·237	·882	·871	·129
		45	0	„		48	45	·237	·871	·860	·122
		48	45	„		52	30	·237	·860	·848	·115
		52	30	„		56	15	·238	·848	·837	·108
	36	56	15	„	37	0	0	·238	·837	·825	·101
	37	0	0	„	37	3	45	17·238	13·825	13·814	22·094
		3	45	„		7	30	·238	·814	·803	·088
		7	30	„		11	15	·238	·803	·792	·081
		11	15	„		15	0	·238	·792	·780	·074
		15	0	„		18	45	·239	·780	·769	·067
		18	45	„		22	30	·239	·769	·757	·060
		22	30	„		26	15	·239	·757	·746	·053
		26	15	„		30	0	·239	·746	·734	·046
		30	0	„		33	45	·239	·734	·723	·038
		33	45	„		37	30	·239	·723	·711	·031
		37	30	„		41	15	·240	·711	·700	·024
		41	15	„		45	0	·240	·700	·688	·017
		45	0	„		48	45	·240	·688	·677	·010
		48	45	„		52	30	·240	·677	·665	·003
		52	30	„		56	15	·241	·665	·654	21·996
	37	56	15	„	38	0	0	·241	·654	·642	·989

TABLE XXXI.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{16}$th of a Degree of Latitude and Longitude, on the Scale of 4 Inches = 1 Mile, or 1 Inch to $\frac{1}{4}$ of a Mile.

Latitude							Length in Inches			
							m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
	°	′	″		°	′	″				
From	38	0	0	to	38	3	45	17·241	13·642	13·631	21·982
		3	45	„		7	30	·241	·631	·619	·975
		7	30	„		11	15	·241	·619	·608	·968
		11	15	„		15	0	·241	·608	·596	·961
		15	0	„		18	45	·242	·596	·584	·954
		18	45	„		22	30	·242	·584	·572	·947
		22	30	„		26	15	·242	·572	·561	·940
		26	15	„		30	0	·242	·561	·549	·933
		30	0	„		33	45	·242	·549	·538	·925
		33	45	„		37	30	·242	·538	·526	·918
		37	30	„		41	15	·243	·526	·514	·911
		41	15	„		45	0	·243	·514	·502	·904
		45	0	„		48	45	·243	·502	·491	·897
		48	45	„		52	30	·243	·491	·479	·890
		52	30	„		56	15	·243	·479	·467	·883
	38	56	15	„	39	0	0	·243	·467	·455	·876
	39	0	0	„	39	3	45	17·244	13·455	13·443	21·869
		3	45	„		7	30	·244	·443	·431	·862
		7	30	„		11	15	·244	·431	·419	·855
		11	15	„		15	0	·244	·419	·407	·848
		15	0	„		18	45	·245	·407	·396	·840
		18	45	„		22	30	·245	·396	·384	·833
		22	30	„		26	15	·245	·384	·372	·826
		26	15	„		30	0	·245	·372	·360	·819
		30	0	„		33	45	·245	·360	·348	·811
		33	45	„		37	30	·245	·348	·336	·804
		37	30	„		41	15	·246	·336	·324	·797
		41	15	„		45	0	·246	·324	·312	·790
		45	0	„		48	45	·246	·312	·300	·782
		48	45	„		52	30	·246	·300	·288	·775
		52	30	„		56	15	·246	·288	·276	·768
	39	56	15	„	40	0	0	·246	·276	·263	·760

TABLE XXXII.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{8}$th of a Degree of Latitude and Longitude, on the Scale of 1 Inch to $\frac{1}{2}$ a Mile.

Latitude								Length in Inches			
								m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
°	°	′	″		°	′	″				
From	0	0	0	to	0	7	30	17·176	17·290	17·290	24·371
		7	30	„		15	0	176	290	290	371
		15	0	„		22	30	176	290	290	371
		22	30	„		30	0	176	290	290	371
		30	0	„		37	30	176	290	289	371
		37	30	„		45	0	176	289	289	370
		45	0	„		52	30	176	289	288	370
	0	52	30	„	1	0	0	176	288	288	370
	1	0	0	„	1	7	30	17·176	17·288	17·287	24·369
		7	30	„		15	0	176	287	286	369
		15	0	„		22	30	176	286	285	368
		22	30	„		30	0	176	285	285	368
		30	0	„		37	30	176	285	284	367
		37	30	„		45	0	176	284	282	366
		45	0	„		52	30	176	282	281	365
	1	52	30	„	2	0	0	176	281	280	365
	2	0	0	„	2	7	30	17·176	17·280	17·279	24·364
		7	30	„		15	0	176	279	277	363
		15	0	„		22	30	176	277	276	362
		22	30	„		30	0	176	276	274	361
		30	0	„		37	30	176	274	272	359
		37	30	„		45	0	176	272	271	358
		45	0	„		52	30	176	271	269	357
	2	52	30	„	3	0	0	176	269	267	356
	3	0	0	„	3	7	30	17·176	17·267	17·265	24·354
		7	30	„		15	0	176	265	263	353
		15	0	„		22	30	176	263	261	351
		22	30	„		30	0	176	261	258	350
		30	0	„		37	30	176	258	256	348
		37	30	„		45	0	176	256	254	347
		45	0	„		52	30	176	254	251	345
	3	52	30	„	4	0	0	176	251	249	343
	4	0	0	„	4	7	30	17·177	17·249	17·246	24·341
		7	30	„		15	0	177	246	243	339
		15	0	„		22	30	177	243	240	338
		22	30	„		30	0	177	240	237	336
		30	0	„		37	30	177	237	235	334
		37	30	„		45	0	177	235	231	331
		45	0	„		52	30	177	231	228	329
	4	52	30	„	5	0	0	177	228	225	327
	5	0	0	„	5	7	30	17·177	17·225	17·222	24·325
		7	30	„		15	0	177	222	218	322
		15	0	„		22	30	177	218	215	320
		22	30	„		30	0	177	215	211	318
		30	0	„		37	30	177	211	208	315
		37	30	„		45	0	177	208	204	313
		45	0	„		52	30	177	204	200	310
	5	52	30	„	6	0	0	177	200	196	307

TABLE XXXII.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{8}$th of a Degree of Latitude and Longitude, on the Scale of 1 Inch to $\frac{1}{2}$ a Mile.

Latitude							Length in Inches			
							m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
	°	′	″		°	′	″				
From	6	0	0	to	6	7	30	17·178	17·196	17·192	24·305
		7	30	„		15	0	178	192	188	302
		15	0	„		22	30	178	188	184	299
		22	30	„		30	0	178	184	180	296
		30	0	„		37	30	178	180	176	293
		37	30	„		45	0	178	176	171	290
		45	0	„		52	30	178	171	167	287
	6	52	30	„	7	0	0	178	167	162	284
	7	0	0	„	7	7	30	17·178	17·162	17·158	24·281
		7	30	„		15	0	178	158	153	278
		15	0	„		22	30	178	153	148	274
		22	30	„		30	0	179	148	143	271
		30	0	„		37	30	179	143	139	268
		37	30	„		45	0	179	139	134	264
		45	0	„		52	30	179	134	128	261
	7	52	30	„	8	0	0	179	128	123	257
	8	0	0	„	8	7	30	17·179	17·123	17·118	24·254
		7	30	„		15	0	179	118	113	250
		15	0	„		22	30	179	113	107	246
		22	30	„		30	0	179	107	102	242
		30	0	„		37	30	179	102	096	239
		37	30	„		45	0	180	096	091	235
		45	0	„		52	30	180	091	085	231
	8	52	30	„	9	0	0	180	085	079	227
	9	0	0	„	9	7	30	17·180	17·079	17·073	24·223
		7	30	„		15	0	180	073	067	219
		15	0	„		22	30	180	067	061	214
		22	30	„		30	0	180	061	055	210
		30	0	„		37	30	180	055	049	206
		37	30	„		45	0	181	049	042	202
		45	0	„		52	30	181	042	036	197
	9	52	30	„	10	0	0	181	036	029	193
	10	0	0	„	10	7	30	17·181	17·029	17·023	24·188
		7	30	„		15	0	181	023	016	184
		15	0	„		22	30	181	016	010	179
		22	30	„		30	0	181	010	003	175
		30	0	„		37	30	181	003	16·996	170
		37	30	„		45	0	182	16·996	989	165
		45	0	„		52	30	182	989	982	160
	10	52	30	„	11	0	0	182	982	975	155
	11	0	0	„	11	7	30	17·182	16·975	16·968	24·150
		7	30	„		15	0	182	968	960	145
		15	0	„		22	30	182	960	953	140
		22	30	„		30	0	182	953	946	135
		30	0	„		37	30	183	946	938	130
		37	30	„		45	0	183	938	930	125
		45	0	„		52	30	183	930	923	120
	11	52	30	„	12	0	0	183	923	915	114

TABLE XXXII.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{8}$th. of a Degree of Latitude and Longitude, on the Scale of 1 Inch to $\frac{1}{2}$ a Mile.

Latitude							Length in Inches			
							m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
	°	′	″		°	′	″				
From	12	0	0	to	12	7	30	17·183	16·915	16·907	24·109
		7	30	„		15	0	183	907	899	104
		15	0	„		22	30	183	899	891	098
		22	30	„		30	0	184	891	883	093
		30	0	„		37	30	184	883	875	087
		37	30	„		45	0	184	875	867	081
		45	0	„		52	30	184	867	859	076
	12	52	30	„	13	0	0	184	859	850	070
	13	0	0	„	13	7	30	17·184	16·850	16·842	24·064
		7	30	„		15	0	185	842	833	058
		15	0	„		22	30	185	833	824	052
		22	30	„		30	0	185	824	816	047
		30	0	„		37	30	185	816	807	041
		37	30	„		45	0	185	807	798	035
		45	0	„		52	30	185	798	789	028
	13	52	30	„	14	0	0	186	789	780	022
	14	0	0	„	14	7	30	17·186	16·780	16·771	24·016
		7	30	„		15	0	186	771	762	010
		15	0	„		22	30	186	762	753	003
		22	30	„		30	0	186	753	743	23·997
		30	0	„		37	30	186	743	734	991
		37	30	„		45	0	187	734	724	984
		45	0	„		52	30	187	724	715	978
	14	52	30	„	15	0	0	187	715	705	971
	15	0	0	„	15	7	30	17·187	16·705	16·695	23·964
		7	30	„		15	0	187	695	685	958
		15	0	„		22	30	188	685	676	951
		22	30	„		30	0	188	676	666	944
		30	0	„		37	30	188	666	655	937
		37	30	„		45	0	188	655	645	931
		45	0	„		52	30	188	645	635	924
	15	52	30	„	16	0	0	189	635	625	917
	16	0	0	„	16	7	30	17·189	16·625	16·614	23·910
		7	30	„		15	0	189	614	604	902
		15	0	„		22	30	189	604	593	895
		22	30	„		30	0	189	593	583	888
		30	0	„		37	30	190	583	572	881
		37	30	„		45	0	190	572	561	874
		45	0	„		52	30	190	561	551	866
	16	52	30	„	17	0	0	190	551	540	859
	17	0	0	„	17	7	30	17·190	16·540	16·529	23·851
		7	30	„		15	0	191	529	518	844
		15	0	„		22	30	191	518	506	836
		22	30	„		30	0	191	506	495	829
		30	0	„		37	30	191	495	484	821
		37	30	„		45	0	191	484	472	813
		45	0	„		52	30	192	472	461	806
	17	52	30	„	18	0	0	192	461	449	798

TABLE XXXII.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{8}$th of a Degree of Latitude and Longitude, on the Scale of 1 Inch to $\frac{1}{2}$ a Mile.

Latitude							Length in Inches			
							m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
	°	′	″		°	′	″				
From	18	0	0	to	18	7	30	17·192	16·449	16·438	23·790
		7	30	„		15	0	192	438	426	782
		15	0	„		22	30	193	426	414	774
		22	30	„		30	0	193	414	402	766
		30	0	„		37	30	193	402	390	758
		37	30	„		45	0	193	390	378	750
		45	0	„		52	30	193	378	366	742
	18	52	30	„	19	0	0	194	366	354	734
	19	0	0	„	19	7	30	17·194	16·354	16·342	23·725
		7	30	„		15	0	194	342	330	717
		15	0	„		22	30	194	330	317	709
		22	30	„		30	0	195	317	305	700
		30	0	„		37	30	195	305	292	692
		37	30	„		45	0	195	292	280	683
		45	0	„		52	30	195	280	267	675
	19	52	30	„	20	0	0	196	267	254	666
	20	0	0	„	20	7	30	17·196	16·254	16·241	23·658
		7	30	„		15	0	196	241	228	649
		15	0	„		22	30	196	228	215	640
		22	30	„		30	0	197	215	202	631
		30	0	„		37	30	197	202	189	623
		37	30	„		45	0	197	189	176	614
		45	0	„		52	30	197	176	162	605
	20	52	30	„	21	0	0	198	162	149	596
	21	0	0	„	21	7	30	17·198	16·149	16·135	23·587
		7	30	„		15	0	198	135	122	578
		15	0	„		22	30	198	122	108	569
		22	30	„		30	0	199	108	095	559
		30	0	„		37	30	199	095	081	550
		37	30	„		45	0	199	081	067	541
		45	0	„		52	30	199	067	053	532
	21	52	30	„	22	0	0	200	053	039	522
	22	0	0	„	22	7	30	17·200	16·039	16·025	23·513
		7	30	„		15	0	200	025	011	503
		15	0	„		22	30	200	011	15·996	494
		22	30	„		30	0	201	15·996	982	484
		30	0	„		37	30	201	982	968	475
		37	30	„		45	0	201	968	953	465
		45	0	„		52	30	201	953	939	455
	22	52	30	„	23	0	0	202	939	924	446
	23	0	0	„	23	7	30	17·202	15·924	15·909	23·436
		7	30	„		15	0	202	909	895	426
		15	0	„		22	30	202	895	880	416
		22	30	„		30	0	203	880	865	406
		30	0	„		37	30	203	865	850	397
		37	30	„		45	0	203	850	835	387
		45	0	„		52	30	204	835	820	376
	23	52	30	„	24	0	0	204	820	804	366

TABLE XXXII.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{8}$th of a Degree of Latitude and Longitude, on the Scale of 1 Inch to $\frac{1}{2}$ a Mile.

Latitude							Length in Inches			
							m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
	°	′	″		°	′	″				
From	24	0	0	to	24	7	30	17·204	15·804	15·789	23·356
		7	30	„		15	0	204	789	774	346
		15	0	„		22	30	205	774	758	336
		22	30	„		30	0	205	758	743	326
		30	0	„		37	30	205	743	727	315
		37	30	„		45	0	206	727	711	305
		45	0	„		52	30	206	711	696	295
	24	52	30	„	25	0	0	206	696	680	284
	25	0	0	„	25	7	30	17·206	15·680	15·664	23·274
		7	30	„		15	0	207	664	648	263
		15	0	„		22	30	207	648	632	253
		22	30	„		30	0	207	632	616	242
		30	0	„		37	30	208	616	600	231
		37	30	„		45	0	208	600	583	221
		45	0	„		52	30	208	583	567	210
	25	52	30	„	26	0	0	208	567	550	199
	26	0	0	„	26	7	30	17·209	15·550	15·534	23·188
		7	30	„		15	0	209	534	517	178
		15	0	„		22	30	209	517	501	167
		22	30	„		30	0	210	501	484	156
		30	0	„		37	30	210	484	467	145
		37	30	„		45	0	210	467	450	134
		45	0	„		52	30	211	450	433	123
	26	52	30	„	27	0	0	211	433	416	112
	27	0	0	„	27	7	30	17·211	15·416	15·399	23·100
		7	30	„		15	0	211	399	382	089
		15	0	„		22	30	212	382	365	078
		22	30	„		30	0	212	365	348	067
		30	0	„		37	30	212	348	330	055
		37	30	„		45	0	213	330	313	044
		45	0	„		52	30	213	313	295	033
	27	52	30	„	28	0	0	213	295	278	021
	28	0	0	„	28	7	30	17·214	15·278	15·260	23·010
		7	30	„		15	0	214	260	242	22·998
		15	0	„		22	30	214	242	225	987
		22	30	„		30	0	215	225	207	975
		30	0	„		37	30	215	207	189	963
		37	30	„		45	0	215	189	171	952
		45	0	„		52	30	215	171	153	940
	28	52	30	„	29	0	0	216	153	134	928
	29	0	0	„	29	7	30	17·216	15·134	15·116	22·917
		7	30	„		15	0	216	116	098	905
		15	0	„		22	30	217	098	079	893
		22	30	„		30	0	217	079	061	881
		30	0	„		37	30	217	061	042	869
		37	30	„		45	0	218	042	024	857
		45	0	„		52	30	218	024	005	845
	29	52	30	„	30	0	0	218	005	14·986	833

TABLE XXXII.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{8}$th of a Degree of Latitude and Longitude, on the Scale of 1 Inch to $\frac{1}{2}$ a Mile.

Latitude							Length in Inches			
							m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
	°	′	″		°	′	″				
From	30	0	0	to	30	7	30	17·219	14·986	14·968	22·821
		7	30	„		15	0	219	968	949	809
		15	0	„		22	30	219	949	930	797
		22	30	„		30	0	220	930	911	784
		30	0	„		37	30	220	911	892	772
		37	30	„		45	0	220	892	872	760
		45	0	„		52	30	221	872	853	748
	30	52	30	„	31	0	0	221	853	834	735
	31	0	0	„	31	7	30	17·221	14·834	14·814	22·723
		7	30	„		15	0	222	814	795	710
		15	0	„		22	30	222	795	775	698
		22	30	„		30	0	222	775	756	686
		30	0	„		37	30	223	756	736	673
		37	30	„		45	0	223	736	716	660
		45	0	„		52	30	223	716	697	648
	31	52	30	„	32	0	0	224	697	677	635
	32	0	0	„	32	7	30	17·224	14·677	14·657	22·623
		7	30	„		15	0	224	657	637	610
		15	0	„		22	30	225	637	617	597
		22	30	„		30	0	225	617	597	584
		30	0	„		37	30	225	597	576	572
		37	30	„		45	0	226	576	556	559
		45	0	„		52	30	226	556	536	546
	32	52	30	„	33	0	0	226	536	515	533
	33	0	0	„	33	7	30	17·227	14·515	14·495	22·520
		7	30	„		15	0	227	495	474	507
		15	0	„		22	30	227	474	454	494
		22	30	„		30	0	228	454	433	481
		30	0	„		37	30	228	433	412	468
		37	30	„		45	0	228	412	391	455
		45	0	„		52	30	229	391	370	442
	33	52	30	„	34	0	0	229	370	349	429
	34	0	0	„	34	7	30	17·229	14·349	14·328	22·416
		7	30	„		15	0	230	328	307	402
		15	0	„		22	30	230	307	286	389
		22	30	„		30	0	231	286	265	376
		30	0	„		37	30	231	265	243	362
		37	30	„		45	0	231	243	222	349
		45	0	„		52	30	232	222	201	336
	34	52	30	„	35	0	0	232	201	179	322
	35	0	0	„	35	7	30	17·232	14·179	14·157	22·309
		7	30	„		15	0	233	157	136	295
		15	0	„		22	30	233	136	114	282
		22	30	„		30	0	233	114	092	268
		30	0	„		37	30	234	092	070	255
		37	30	„		45	0	234	070	048	241
		45	0	„		52	30	234	048	026	228
	35	52	30	„	36	0	0	235	026	004	214

TABLE XXXII.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{8}$th of a Degree of Latitude and Longitude, on the Scale of 1 Inch to $\frac{1}{2}$ a Mile.

Latitude							Length in Inches			
							m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
	°	′	″		°	′	″				
From	36	0	0	to	36	7	30	17·235	14·004	13·982	22·200
		7	30	„		15	0	235	13·982	960	187
		15	0	„		22	30	236	960	938	173
		22	30	„		30	0	236	938	915	159
		30	0	„		37	30	237	915	893	146
		37	30	„		45	0	237	893	871	132
		45	0	„		52	30	237	871	848	118
	36	52	30	„	37	0	0	238	848	825	104
	37	0	0	„	37	7	30	17·238	13·825	13·803	22·090
		7	30	„		15	0	238	803	780	076
		15	0	„		22	30	239	780	757	062
		22	30	„		30	0	239	757	734	048
		30	0	„		37	30	239	734	711	034
		37	30	„		45	0	240	711	688	020
		45	0	„		52	30	240	688	665	006
	37	52	30	„	38	0	0	241	665	642	21·992
	38	0	0	„	38	7	30	17·241	13·642	13·619	21·978
		7	30	„		15	0	241	619	596	964
		15	0	„		22	30	242	596	572	950
		22	30	„		30	0	242	572	549	936
		30	0	„		37	30	242	549	526	922
		37	30	„		45	0	243	526	502	907
		45	0	„		52	30	243	502	479	893
	38	52	30	„	39	0	0	243	479	455	879
	39	0	0	„	39	7	30	17·244	13·455	13·431	21·865
		7	30	„		15	0	244	431	407	850
		15	0	„		22	30	245	407	384	836
		22	30	„		30	0	245	384	360	822
		30	0	„		37	30	245	360	336	807
		37	30	„		45	0	246	336	312	793
		45	0	„		52	30	246	312	288	779
	39	52	30	„	40	0	0	246	288	263	764

TABLE XXXIII A.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{8}$th of a Degree of Latitude and Longitude, on the Scale of 1 Inch to $\frac{2}{3}$ of a Mile.

Latitude							Length in Inches			
							m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
	°	′	″		°	′	″				
From	0	0	0	to	0	7	30	12·882	12·967	12·967	18·278
		7	30	„		15	0	882	967	967	278
		15	0	„		22	30	882	967	967	278
		22	30	„		30	0	882	967	967	278
		30	0	„		37	30	882	967	967	278
		37	30	„		45	0	882	967	967	277
		45	0	„		52	30	882	967	966	277
	0	52	30	„	1	0	0	882	966	966	277
	1	0	0	„	1	7	30	12·882	12·966	12·965	18·277
		7	30	„		15	0	882	965	964	277
		15	0	„		22	30	882	964	964	276
		22	30	„		30	0	882	964	964	276
		30	0	„		37	30	882	964	963	275
		37	30	„		45	0	882	963	961	274
		45	0	„		52	30	882	961	961	274
	1	52	30	„	2	0	0	882	961	960	274
	2	0	0	„	2	7	30	12·882	12·960	12·959	18·273
		7	30	„		15	0	882	959	958	272
		15	0	„		22	30	882	958	957	271
		22	30	„		30	0	882	957	955	271
		30	0	„		37	30	882	955	954	269
		37	30	„		45	0	882	954	953	268
		45	0	„		52	30	882	953	952	268
	2	52	30	„	3	0	0	882	952	950	267
	3	0	0	„	3	7	30	12·882	12·950	12·949	18·265
		7	30	„		15	0	882	949	947	265
		15	0	„		22	30	882	947	946	263
		22	30	„		30	0	882	946	943	262
		30	0	„		37	30	882	943	942	261
		37	30	„		45	0	882	942	940	260
		45	0	„		52	30	882	940	938	259
	3	52	30	„	4	0	0	882	938	937	257
	4	0	0	„	4	7	30	12·883	12·937	12·934	18·256
		7	30	„		15	0	883	934	932	254
		15	0	„		22	30	883	932	930	253
		22	30	„		30	0	883	930	928	252
		30	0	„		37	30	883	928	926	250
		37	30	„		45	0	883	926	923	248
		45	0	„		52	30	883	923	921	247
	4	52	30	„	5	0	0	883	921	919	245
	5	0	0	„	5	7	30	12·883	12·919	12·916	18·244
		7	30	„		15	0	883	916	913	241
		15	0	„		22	30	883	913	911	240
		22	30	„		30	0	883	911	908	238
		30	0	„		37	30	883	908	906	236
		37	30	„		45	0	883	906	903	235
		45	0	„		52	30	883	903	900	232
	5	52	30	„	6	0	0	883	900	897	230
	6	0	0	„	6	7	30	12·883	12·897	12·894	18·229
		7	30	„		15	0	883	894	891	227
		15	0	„		22	30	883	891	888	224
		22	30	„		30	0	883	888	885	222
		30	0	„		37	30	883	885	882	220
		37	30	„		45	0	883	882	878	217
		45	0	„		52	30	883	878	875	215
	6	52	30	„	7	0	0	883	875	871	213

TABLE XXXIII A.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{8}$th of a Degree of Latitude and Longitude, on the Scale of 1 Inch to $\frac{2}{3}$ of a Mile.

Latitude							Length in Inches			
							m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
	°	′	″		°	′	″				
From	7	0	0	to	7	7	30	12·883	12·871	12·868	18·211
		7	30	„		15	0	883	868	865	208
		15	0	„		22	30	883	865	861	205
		22	30	„		30	0	884	861	857	203
		30	0	„		37	30	884	857	854	201
		37	30	„		45	0	884	854	851	198
		45	0	„		52	30	884	851	846	196
	7	52	30	„	8	0	0	884	846	842	193
	8	0	0	„	8	7	30	12·884	12·842	12·838	18·190
		7	30	„		15	0	884	838	835	187
		15	0	„		22	30	884	835	830	184
		22	30	„		30	0	884	830	826	181
		30	0	„		37	30	884	826	822	179
		37	30	„		45	0	885	822	818	176
		45	0	„		52	30	885	818	814	173
	8	52	30	„	9	0	0	885	814	809	170
	9	0	0	„	9	7	30	12·885	12·809	12·805	18·167
		7	30	„		15	0	885	805	800	164
		15	0	„		22	30	885	800	796	161
		22	30	„		30	0	885	796	791	157
		30	0	„		37	30	885	791	787	154
		37	30	„		45	0	886	787	781	151
		45	0	„		52	30	886	781	777	148
	9	52	30	„	10	0	0	886	777	772	145
	10	0	0	„	10	7	30	12·886	12·772	12·767	18·141
		7	30	„		15	0	886	767	762	138
		15	0	„		22	30	886	762	757	134
		22	30	„		30	0	886	757	752	131
		30	0	„		37	30	886	752	747	127
		37	30	„		45	0	886	747	742	124
		45	0	„		52	30	886	742	736	120
	10	52	30	„	11	0	0	886	736	731	116
	11	0	0	„	11	7	30	12·886	12·731	12·726	18·112
		7	30	„		15	0	886	726	720	109
		15	0	„		22	30	886	720	715	105
		22	30	„		30	0	886	715	709	101
		30	0	„		37	30	887	709	703	098
		37	30	„		45	0	887	703	697	094
		45	0	„		52	30	887	697	692	090
	11	52	30	„	12	0	0	887	692	686	085
	12	0	0	„	12	7	30	12·887	12·686	12·680	18·082
		7	30	„		15	0	887	680	674	078
		15	0	„		22	30	887	674	668	073
		22	30	„		30	0	888	668	662	070
		30	0	„		37	30	888	662	656	065
		37	30	„		45	0	888	656	650	061
		45	0	„		52	30	888	650	644	057
	12	52	30	„	13	0	0	888	644	637	052
	13	0	0	„	13	7	30	12·888	12·637	12·631	18·048
		7	30	„		15	0	889	631	625	043
		15	0	„		22	30	889	625	618	039
		22	30	„		30	0	889	618	612	035
		30	0	„		37	30	889	612	605	031
		37	30	„		45	0	889	605	598	026
		45	0	„		52	30	889	598	592	021
	13	52	30	„	14	0	0	889	592	585	016

TABLE XXXIII A.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{8}$th of a Degree of Latitude and Longitude, on the Scale of 1 Inch to $\frac{2}{3}$ of a Mile.

Latitude							Length in Inches			
							m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
	°	′	″		°	′	″				
From	14	0	0	to	14	7	30	12·889	12·585	12·578	18·012
		7	30	,,		15	0	889	578	571	007
		15	0	,,		22	30	889	571	565	002
		22	30	,,		30	0	889	565	557	17·998
		30	0	,,		37	30	889	557	550	993
		37	30	,,		45	0	890	550	543	988
		45	0	,,		52	30	890	543	536	983
	14	52	30	,,	15	0	0	890	536	529	978
	15	0	0	,,	15	7	30	12·890	12·529	12·521	17·973
		7	30	,,		15	0	890	521	514	968
		15	0	,,		22	30	891	514	507	963
		22	30	,,		30	0	891	507	499	958
		30	0	,,		37	30	891	499	491	953
		37	30	,,		45	0	891	491	484	948
		45	0	,,		52	30	891	484	476	943
	15	52	30	,,	16	0	0	892	476	469	938
	16	0	0	,,	16	7	30	12·892	12·469	12·460	17·932
		7	30	,,		15	0	892	460	453	926
		15	0	,,		22	30	892	453	445	921
		22	30	,,		30	0	892	445	437	916
		30	0	,,		37	30	892	437	429	911
		37	30	,,		45	0	892	429	421	905
		45	0	,,		52	30	892	421	413	899
	16	52	30	,,	17	0	0	892	413	405	894
	17	0	0	,,	17	7	30	12·892	12·405	12·397	17·888
		7	30	,,		15	0	893	397	388	883
		15	0	,,		22	30	893	388	379	877
		22	30	,,		30	0	893	379	371	872
		30	0	,,		37	30	893	371	363	866
		37	30	,,		45	0	893	363	354	860
		45	0	,,		52	30	894	354	346	854
	17	52	30	,,	18	0	0	894	346	337	848
	18	0	0	,,	18	7	30	12·894	12·337	12·329	17·843
		7	30	,,		15	0	894	329	320	837
		15	0	,,		22	30	895	320	311	831
		22	30	,,		30	0	895	311	302	825
		30	0	,,		37	30	895	302	293	819
		37	30	,,		45	0	895	293	284	813
		45	0	,,		52	30	895	284	275	807
	18	52	30	,,	19	0	0	895	275	266	801
	19	0	0	,,	19	7	30	12·895	12·266	12·257	17·794
		7	30	,,		15	0	895	257	248	788
		15	0	,,		22	30	895	248	238	782
		22	30	,,		30	0	896	238	229	775
		30	0	,,		37	30	896	229	219	769
		37	30	,,		45	0	896	219	210	762
		45	0	,,		52	30	896	210	200	756
	19	52	30	,,	20	0	0	897	200	191″	750
	20	0	0	,,	20	7	30	12·897	12·191	12·181	17·744
		7	30	,,		15	0	897	181	171	737
		15	0	,,		22	30	897	171	161	730
		22	30	,,		30	0	898	161	151	723
		30	0	,,		37	30	898	151	142	717
		37	30	,,		45	0	898	142	132	711
		45	0	,,		52	30	898	132	122	704
	20	52	30	,,	21	0	0	898	122	112	697

TABLE XXXIII A.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{6}$th of a Degree of Latitude and Longitude, on the Scale of 1 Inch to $\frac{2}{3}$ of a Mile.

Latitude							Length in Inches			
							m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
	°	′	″		°	′	″				
From	21	0	0	to	21	7	30	12·898	12·112	12·101	17·690
		7	30	„		15	0	898	101	092	684
		15	0	„		22	30	898	092	081	677
		22	30	„		30	0	899	081	071	669
		30	0	„		37	30	899	071	061	663
		37	30	„		45	0	899	061	050	656
		45	0	„		52	30	899	050	040	649
	21	52	30	„	22	0	0	900	040	029	642
	22	0	0	„	22	7	30	12·900	12·029	12·019	17·635
		7	30	„		15	0	900	019	008	627
		15	0	„		22	30	900	008	11·997	621
		22	30	„		30	0	901	11·997	987	613
		30	0	„		37	30	901	987	976	606
		37	30	„		45	0	901	976	965	599
		45	0	„		52	30	901	965	954	591
	22	52	30	„	23	0	0	901	954	943	585
	23	0	0	„	23	7	30	12·901	11·943	11·932	17·577
		7	30	„		15	0	901	932	921	570
		15	0	„		22	30	901	921	910	562
		22	30	„		30	0	902	910	899	555
		30	0	„		37	30	902	899	888	548
		37	30	„		45	0	902	888	876	540
		45	0	„		52	30	903	876	865	532
	23	52	30	„	24	0	0	903	865	853	525
	24	0	0	„	24	7	30	12·903	11·853	11·842	17·517
		7	30	„		15	0	903	842	831	510
		15	0	„		22	30	904	831	819	502
		22	30	„		30	0	904	819	807	495
		30	0	„		37	30	904	807	795	486
		37	30	„		45	0	905	795	783	479
		45	0	„		52	30	905	783	772	471
	24	52	30	„	25	0	0	905	772	760	463
	25	0	0	„	25	7	30	12·905	11·760	11·748	17·456
		7	30	„		15	0	905	748	736	447
		15	0	„		22	30	905	736	724	440
		22	30	„		30	0	905	724	712	432
		30	0	„		37	30	906	712	700	423
		37	30	„		45	0	906	700	687	416
		45	0	„		52	30	906	687	675	408
	25	52	30	„	26	0	0	906	675	663	399
	26	0	0	„	26	7	30	12·907	11·663	11·651	17·391
		7	30	„		15	0	907	651	638	384
		15	0	„		22	30	907	638	626	375
		22	30	„		30	0	908	626	613	367
		30	0	„		37	30	908	613	600	359
		37	30	„		45	0	908	600	588	351
		45	0	„		52	30	908	588	575	342
	26	52	30	„	27	0	0	908	575	562	334
	27	0	0	„	27	7	30	12·908	11·562	11·549	17·325
		7	30	„		15	0	908	549	537	317
		15	0	„		22	30	909	537	524	309
		22	30	„		30	0	909	524	511	300
		30	0	„		37	30	909	511	498	291
		37	30	„		45	0	910	498	485	283
		45	0	„		52	30	910	485	471	275
	27	52	30	„	28	0	0	910	471	459	266

TABLE XXXIII A.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{8}$th of a Degree of Latitude and Longitude, on the Scale of 1 Inch to $\frac{2}{3}$ of a Mile.

Latitude							Length in Inches			
							m on Meridian	n on Lower Parallel	p on Upper Parallel	q on Diagonal
	°	′	″		°	′	″				
From	28	0	0	to	28	7	30	12·910	11·459	11·445	17·258
		7	30	„		15	0	910	445	432	249
		15	0	„		22	30	910	432	419	240
		22	30	„		30	0	911	419	405	231
		30	0	„		37	30	911	405	392	222
		37	30	„		45	0	911	392	378	214
		45	0	„		52	30	911	378	365	205
	28	52	30	„	29	0	0	912	365	351	196
	29	0	0	„	29	7	30	12·912	11·351	11·337	17·188
		7	30	„		15	0	912	337	324	179
		15	0	„		22	30	913	324	309	170
		22	30	„		30	0	913	309	296	161
		30	0	„		37	30	913	296	282	152
		37	30	„		45	0	914	282	268	143
		45	0	„		52	30	914	268	254	134
	29	52	30	„	30	0	0	914	254	240	125
	30	0	0	„	30	7	30	12·914	11·240	11·226	17·116
		7	30	„		15	0	914	226	212	107
		15	0	„		22	30	914	212	198	098
		22	30	„		30	0	915	198	183	088
		30	0	„		37	30	915	183	169	079
		37	30	„		45	0	915	169	154	070
		45	0	„		52	30	916	154	140	061
	30	52	30	„	31	0	0	916	140	126	051
	31	0	0	„	31	7	30	12·916	11·126	11·111	17·042
		7	30	„		15	0	917	111	096	033
		15	0	„		22	30	917	096	081	024
		22	30	„		30	0	917	081	067	015
		30	0	„		37	30	917	067	052	005
		37	30	„		45	0	917	052	037	16·995
		45	0	„		52	30	917	037	023	986
	31	52	30	„	32	0	0	918	023	008	976
	32	0	0	„	32	7	30	12·918	11·008	10·993	16·967
		7	30	„		15	0	918	10·993	978	958
		15	0	„		22	30	919	978	963	948
		22	30	„		30	0	919	963	948	938
		30	0	„		37	30	919	948	932	929
		37	30	„		45	0	920	932	917	919
		45	0	„		52	30	920	917	902	910
	32	52	30	„	33	0	0	920	902	886	900
	33	0	0	„	33	7	30	12·920	10·886	10·871	16·890
		7	30	„		15	0	920	871	856	880
		15	0	„		22	30	920	856	841	871
		22	30	„		30	0	921	841	825	861
		30	0	„		37	30	921	825	809	851
		37	30	„		45	0	921	809	793	841
		45	0	„		52	30	922	793	778	832
	33	52	30	„	34	0	0	922	778	762	822
	34	0	0	„	34	7	30	12·922	10·762	10·746	16·812
		7	30	„		15	0	923	746	730	802
		15	0	„		22	30	923	730	715	792
		22	30	„		30	0	923	715	699	782
		30	0	„		37	30	923	699	682	772
		37	30	„		45	0	923	682	667	762
		45	0	„		52	30	924	667	651	752
	34	52	30	„	35	0	0	924	651	634	742

TABLE XXXIII A.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{3}$th of a Degree of Latitude and Longitude, on the Scale of 1 Inch to $\frac{2}{3}$ of a Mile.

Latitude							Length in Inches			
							m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
	°	′	″		°	′	″				
From	35	0	0	to	35	7	30	12·924	10·634	10·618	16·732
		7	30	,,		15	0	925	618	602	721
		15	0	,,		22	30	925	602	586	712
		22	30	,,		30	0	925	586	569	701
		30	0	,,		37	30	926	569	553	691
		37	30	,,		45	0	926	553	536	681
		45	0	,,		52	30	926	536	520	671
	35	52	30	,,	36	0	0	926	520	503	661
	36	0	0	,,	36	7	30	12·926	10·503	10·487	16·650
		7	30	,,		15	0	926	487	470	640
		15	0	,,		22	30	927	470	454	630
		22	30	,,		30	0	927	454	436	619
		30	0	,,		37	30	928	436	420	610
		37	30	,,		45	0	928	420	403	599
		45	0	,,		52	30	928	403	386	589
	36	52	30	,,	37	0	0	929	386	369	578
	37	0	0	,,	37	7	30	12·929	10·369	10·352	16·568
		7	30	,,		15	0	929	352	335	557
		15	0	,,		22	30	929	335	318	547
		22	30	,,		30	0	929	318	301	536
		30	0	,,		37	30	929	301	283	526
		37	30	,,		45	0	930	283	266	515
		45	0	,,		52	30	930	266	249	505
	37	52	30	,,	38	0	0	931	249	232	494
	38	0	0	,,	38	7	30	12·931	10·232	10·214	16·484
		7	30	,,		15	0	931	214	197	473
		15	0	,,		22	30	932	197	179	463
		22	30	,,		30	0	932	179	162	452
		30	0	,,		37	30	932	162	145	442
		37	30	,,		45	0	932	145	127	430
		45	0	,,		52	30	932	127	109	420
	38	52	30	,,	39	0	0	932	109	091	409
	39	0	0	,,	39	7	30	12·933	10·091	10·073	16·399
		7	30	,,		15	0	933	073	055	388
		15	0	,,		22	30	934	055	038	377
		22	30	,,		30	0	934	038	020	367
		30	0	,,		37	30	934	020	002	355
		37	30	,,		45	0	935	002	9·984	345
		45	0	,,		52	30	935	9·984	966	334
	39	52	30	,,	40	0	0	935	966	947	323

TABLE XXXIII B.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{8}$th of a Degree of Latitude and Longitude, on the Scale of 1 Inch to 1 Mile.

Latitude							Length in Inches			
							m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
	°	′	″		°	′	″				
From	0.	0	0	to	0	7	30	8·588	8·645	8·645	12·186
		7	30	„		15	0	588	645	645	186
		15	0	„		22	30	588	645	645	186
		22	30	„		30	0	588	645	645	186
		30	0	„		37	30	588	645	645	186
		37	30	„		45	0	588	645	645	185
		45	0	„		52	30	588	645	644	185
	0	52	30	„	1	0	0	588	644	644	185
	1	0	0	„	1	7	30	8·588	8·644	8·644	12·185
		7	30	„		15	0	588	644	643	185
		15	0	„		22	30	588	643	643	184
		22	30	„		30	0	588	643	643	184
		30	0	„		37	30	588	643	642	184
		37	30	„		45	0	588	642	641	183
		45	0	„		52	30	588	641	641	183
	1	52	30	„	2	0	0	588	641	640	183
	2	0	0	„	2	7	30	8·588	8·640	8·640	12·182
		7	30	„		15	0	588	640	639	182
		15	0	„		22	30	588	639	638	181
		22	30	„		30	0	588	638	637	181
		30	0	„		37	30	588	637	636	180
		37	30	„		45	0	588	636	636	179
		45	0	„		52	30	588	636	635	179
	2	52	30	„	3	0	0	588	635	634	178
	3	0	0	„	3	7	30	8·588	8·634	8·633	12·177
		7	30	„		15	0	588	633	632	177
		15	0	„		22	30	588	632	631	176
		22	30	„		30	0	588	631	629	175
		30	0	„		37	30	588	629	628	174
		37	30	„		45	0	588	628	627	174
		45	0	„		52	30	588	627	626	173
	3	52	30	„	4	0	0	588	626	625	172
	4	0	0	„	4	7	30	8·589	8·625	8·623	12·171
		7	30	„		15	0	589	623	622	170
		15	0	„		22	30	589	622	620	169
		22	30	„		30	0	589	620	619	168
		30	0	„		37	30	589	619	618	167
		37	30	„		45	0	589	618	616	166
		45	0	„		52	30	589	616	614	165
	4	52	30	„	5	0	0	589	614	613	164
	5	0	0	„	5	7	30	8·589	8·613	8·611	12·163
		7	30	„		15	0	589	611	609	161
		15	0	„		22	30	589	609	608	160
		22	30	„		30	0	589	608	606	159
		30	0	„		37	30	589	606	604	158
		37	30	„		45	0	589	604	602	157
		45	0	„		52	30	589	602	600	155
	5	52	30	„	6	0	0	589	600	598	154
	6	0	0	„	6	7	30	8·589	8·598	8·596	12·153
		7	30	„		15	0	589	596	594	151
		15	0	„		22	30	589	594	592	150
		22	30	„		30	0	589	592	590	148
		30	0	„		37	30	589	590	588	147
		37	30	„		45	0	589	588	586	145
		45	0	„		52	30	589	586	584	144
	6	52	30	„	7	0	0	589	584	581	142

TABLE XXXIII B.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{8}$th of a Degree of Latitude and Longitude, on the Scale of 1 Inch to 1 Mile.

Latitude							Length in Inches			
							m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
	°	′	″		°	′	″				
From	7	0	0	to	7	7	30	8·589	8·581	8·579	12·141
		7	30	„		15	0	589	579	577	139
		15	0	„		22	30	589	577	574	137
		22	30	„		30	0	590	574	572	136
		30	0	„		37	30	590	572	570	134
		37	30	„		45	0	590	570	567	132
		45	0	„		52	30	590	567	564	131
	7	52	30	„	8	0	0	590	564	562	129
	8	0	0	„	8	7	30	8·590	8·562	8·559	12·127
		7	30	„		15	0	590	559	557	125
		15	0	„		22	30	590	557	554	123
		22	30	„		30	0	590	554	551	121
		30	0	„		37	30	590	551	548	120
		37	30	„		45	0	590	548	546	118
		45	0	„		52	30	590	546	543	116
	8	52	30	„	9	0	0	590	543	540	114
	9	0	0	„	9	7	30	8·590	8·540	8·537	12·112
		7	30	„		15	0	590	537	534	110
		15	0	„		22	30	590	534	531	107
		22	30	„		30	0	590	531	528	105
		30	0	„		37	30	590	528	525	103
		37	30	„		45	0	591	525	521	101
		45	0	„		52	30	591	521	518	099
	9	52	30	„	10	0	0	591	518	515	097
	10	0	0	„	10	7	30	8·591	8·515	8·512	12·094
		7	30	„		15	0	591	512	508	092
		15	0	„		22	30	591	508	505	090
		22	30	„		30	0	591	505	502	088
		30	0	„		37	30	591	502	498	085
		37	30	„		45	0	591	498	495	083
		45	0	„		52	30	591	495	491	080
	10	52	30	„	11	0	0	591	491	488	078
	11	0	0	„	11	7	30	8·591	8·488	8·484	12·075
		7	30	„		15	0	591	484	480	073
		15	0	„		22	30	591	480	477	070
		22	30	„		30	0	591	477	473	068
		30	0	„		37	30	592	473	469	065
		37	30	„		45	0	592	469	465	063
		45	0	„		52	30	592	465	462	060
	11	52	30	„	12	0	0	592	462	458	057
	12	0	0	„	12	7	30	8·592	8·458	8·454	12·055
		7	30	„		15	0	592	454	450	052
		15	0	„		22	30	592	450	446	049
		22	30	„		30	0	592	446	442	047
		30	0	„		37	30	592	442	438	044
		37	30	„		45	0	592	438	434	041
		45	0	„		52	30	592	434	430	038
	12	52	30	„	13	0	0	592	430	425	035
	13	0	0	„	13	7	30	8·592	8·425	8·421	12·032
		7	30	„		15	0	593	421	417	029
		15	0	„		22	30	593	417	412	026
		22	30	„		30	0	593	412	408	024
		30	0	„		37	30	593	408	404	021
		37	30	„		45	0	593	404	399	018
		45	0	„		52	30	593	399	395	014
	13	52	30	„	14	0	0	593	395	390	011

TABLE XXXIII B.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{8}$th of a Degree of Latitude and Longitude, on the Scale of 1 Inch to 1 Mile.

Latitude							Length in Inches			
							m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
	°	′	″		°	′	″				
From	14	0	0	to	14	7	30	8·593	8·390	8·386	12·008
		7	30	,,		15	0	593	386	381	005
		15	0	,,		22	30	593	381	377	002
		22	30	,,		30	0	593	377	372	11·999
		30	0	,,		37	30	593	372	367	996
		37	30	,,		45	0	594	367	362	992
		45	0	,,		52	30	594	362	358	989
	14	52	30	,,	15	0	0	594	358	353	986
	15	0	0	,,	15	7	30	8·594	8·353	8·348	11·982
		7	30	,,		15	0	594	348	343	979
		15	0	,,		22	30	594	343	338	976
		22	30	,,		30	0	594	338	333	972
		30	0	,,		37	30	594	333	328	969
		37	30	,,		45	0	594	328	323	966
		45	0	,,		52	30	594	323	318	962
	15	52	30	,,	16	0	0	595	318	313	959
	16	0	0	,,	16	7	30	8·595	8·313	8·307	11·955
		7	30	,,		15	0	595	307	302	951
		15	0	,,		22	30	595	302	297	948
		22	30	,,		30	0	595	297	292	944
		30	0	,,		37	30	595	292	286	941
		37	30	,,		45	0	595	286	281	937
		45	0	,,		52	30	595	281	276	933
	16	52	30	,,	17	0	0	595	276	270	930
	17	0	0	,,	17	7	30	8·595	8·270	8·265	11·926
		7	30	,,		15	0	596	265	259	922
		15	0	,,		22	30	596	259	253	918
		22	30	,,		30	0	596	253	248	915
		30	0	,,		37	30	596	248	242	911
		37	30	,,		45	0	596	242	236	907
		45	0	,,		52	30	596	236	231	903
	17	52	30	,,	18	0	0	596	231	225	899
	18	0	0	,,	18	7	30	8·596	8·225	8·219	11·895
		7	30	,,		15	0	596	219	213	891
		15	0	,,		22	30	597	213	207	887
		22	30	,,		30	0	597	207	201	883
		30	0	,,		37	30	597	201	195	879
		37	30	,,		45	0	597	195	189	875
		45	0	,,		52	30	597	189	183	871
	18	52	30	,,	19	0	0	597	183	177	867
	19	0	0	,,	19	7	30	8·597	8·177	8·171	11·863
		7	30	,,		15	0	597	171	165	859
		15	0	,,		22	30	597	165	159	855
		22	30	,,		30	0	598	159	153	850
		30	0	,,		37	30	598	153	146	846
		37	30	,,		45	0	598	146	140	842
		45	0	,,		52	30	598	140	134	838
	19	52	30	,,	20	0	0	598	134	127	833
	20	0	0	,,	20	7	30	8·598	8·127	8·121	11·829
		7	30	,,		15	0	598	121	114	825
		15	0	,,		22	30	598	114	108	820
		22	30	,,		30	0	599	108	101	816
		30	0	,,		37	30	599	101	095	812
		37	30	,,		45	0	599	095	088	807
		45	0	,,		52	30	599	088	081	803
	20	52	30	,,	21	0	0	599	081	075	798

TABLE XXXIII B.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{8}$th of a Degree of Latitude and Longitude, on the Scale of 1 Inch to 1 Mile.

	Latitude							Length in Inches			
								m on Meridian	n on Lower Parallel	p on Upper Parallel	q on Diagonal
	°	′	″		°	′	″				
From	21	0	0	to	21	7	30	8·599	8·075	8·068	11·794
		7	30	,,		15	0	599	068	061	789
		15	0	,,		22	30	599	061	054	785
		22	30	,,		30	0	600	054	048	780
		30	0	,,		37	30	600	048	041	775
		37	30	,,		45	0	600	041	034	771
		45	0	,,		52	30	600	034	027	766
	21	52	30	,,	22	0	0	600	027	020	761
	22	0	0	,,	22	7	30	8·600	8·020	8·013	11·757
		7	30	,,		15	0	600	013	006	752
		15	0	,,		22	30	600	006	7·998	747
		22	30	,,		30	0	601	7·998	991	742
		30	0	,,		37	30	601	991	984	738
		37	30	,,		45	0	601	984	977	733
		45	0	,,		52	30	601	977	970	728
	22	52	30	,,	23	0	0	601	970	962	723
	23	0	0	,,	23	7	30	8·601	7·962	7·955	11·718
		7	30	,,		15	0	601	955	948	713
		15	0	,,		22	30	601	948	940	708
		22	30	,,		30	0	602	940	933	703
		30	0	,,		37	30	602	933	925	699
		37	30	,,		45	0	602	925	918	694
		45	0	,,		52	30	602	918	910	688
	23	52	30	,,	24	0	0	602	910	902	683
	24	0	0	,,	24	7	30	8·602	7·902	7·895	11·678
		7	30	,,		15	0	602	895	887	673
		15	0	,,		22	30	603	887	879	668
		22	30	,,		30	0	603	879	872	663
		30	0	,,		37	30	603	872	864	658
		37	30	,,		45	0	603	864	856	653
		45	0	,,		52	30	603	856	848	648
	24	52	30	,,	25	0	0	603	848	840	642
	25	0	0	,,	25	7	30	8·603	7·840	7·832	11·637
		7	30	,,		15	0	604	832	824	632
		15	0	,,		22	30	604	824	816	627
		22	30	,,		30	0	604	816	808	621
		30	0	,,		37	30	604	808	800	616
		37	30	,,		45	0	604	800	792	611
		45	0	,,		52	30	604	792	784	605
	25	52	30	,,	26	0	0	604	784	775	600
	26	0	0	,,	26	7	30	8·605	7·775	7·767	11·594
		7	30	,,		15	0	605	767	759	589
		15	0	,,		22	30	605	759	751	584
		22	30	,,		30	0	605	751	742	578
		30	0	,,		37	30	605	742	734	573
		37	30	,,		45	0	605	734	725	567
		45	0	,,		52	30	606	725	717	562
	26	52	30	,,	27	0	0	606	717	708	556
	27	0	0	,,	27	7	30	8·606	7·708	7·700	11·550
		7	30	,,		15	0	606	700	691	545
		15	0	,,		22	30	606	691	683	539
		22	30	,,		30	0	606	683	674	534
		30	0	,,		37	30	606	674	665	528
		37	30	,,		45	0	607	665	657	522
		45	0	,,		52	30	607	657	648	517
	27	52	30	,,	28	0	0	607	648	639	511

TABLE XXXIII B.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{8}$th of a Degree of Latitude and Longitude, on the Scale of 1 Inch to 1 Mile.

	Latitude						Length in Inches			
							m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
	°	′	″		°	′	″				
From	28	0	0	to	28	7	30	8·607	7·639	7·630	11·505
		7	30	,,		15	0	607	630	621	499
		15	0	,,		22	30	607	621	613	494
		22	30	,,		30	0	608	613	604	488
		30	0	,,		37	30	608	604	595	482
		37	30	,,		45	0	608	595	586	476
		45	0	,,		52	30	608	586	577	470
	28	52	30	,,	29	0	0	608	577	567	464
	29	0	0	,,	29	7	30	8·608	7·567	7·558	11·459
		7	30	,,		15	0	608	558	549	453
		15	0	,,		22	30	609	549	540	447
		22	30	,,		30	0	609	540	531	441
		30	0	,,		37	30	609	531	521	435
		37	30	,,		45	0	609	521	512	429
		45	0	,,		52	30	609	512	503	423
	29	52	30	,,	30	0	0	609	503	493	417
	30	0	0	,,	30	7	30	8·610	7·493	7·484	11·411
		7	30	,,		15	0	610	484	475	405
		15	0	,,		22	30	610	475	465	399
		22	30	,,		30	0	610	465	456	392
		30	0	,,		37	30	610	456	446	386
		37	30	,,		45	0	610	446	436	380
		45	0	,,		52	30	611	436	427	374
	30	52	30	,,	31	0	0	611	427	417	368
	31	0	0	,,	31	7	30	8·611	7·417	7·407	11·362
		7	30	,,		15	0	611	407	398	355
		15	0	,,		22	30	611	398	388	349
		22	30	,,		30	0	611	388	378	343
		30	0	,,		37	30	612	378	368	337
		37	30	,,		45	0	612	368	358	330
		45	0	,,		52	30	612	358	349	324
	31	52	30	,,	32	0	0	612	349	339	318
	32	0	0	,,	32	7	30	8·612	7·339	7·329	11·312
		7	30	,,		15	0	612	329	319	305
		15	0	,,		22	30	613	319	309	299
		22	30	,,		30	0	613	309	299	292
		30	0	,,		37	30	613	299	288	286
		37	30	,,		45	0	613	288	278	280
		45	0	,,		52	30	613	278	268	273
	32	52	30	,,	33	0	0	613	268	258	267
	33	0	0	,,	33	7	30	8·614	7·258	7·248	11·260
		7	30	,,		15	0	614	248	237	254
		15	0	,,		22	30	614	237	227	247
		22	30	,,		30	0	614	227	217	241
		30	0	,,		37	30	614	217	206	234
		37	30	,,		45	0	614	206	196	228
		45	0	,,		52	30	615	196	185	221
	33	52	30	,,	34	0	0	615	185	175	215
	34	0	0	,,	34	7	30	8·615	7·175	7·164	11·208
		7	30	,,		15	0	615	164	154	201
		15	0	,,		22	30	615	154	143	195
		22	30	,,		30	0	616	143	133	188
		30	0	,,		37	30	616	133	122	181
		37	30	,,		45	0	616	122	111	175
		45	0	,,		52	30	616	111	101	168
	34	52	30	,,	35	0	0	616	101	090	161

TABLE XXXIII B.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{8}$th of a Degree of Latitude and Longitude, on the Scale of 1 Inch to 1 Mile.

Latitude							Length in Inches			
							m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
	°	′	″		°	′	″				
From	35	0	0	to	35	7	30	8·616	7·090	7·079	11·155
		7	30	„		15	0	617	079	068	148
		15	0	„		22	30	617	068	057	141
		22	30	„		30	0	617	057	046	134
		30	0	„		37	30	617	046	035	128
		37	30	„		45	0	617	035	024	121
		45	0	„		52	30	617	024	013	114
	35	52	30	„	36	0	0	618	013	002	107
	36	0	0	„	36	7	30	8·618	7·002	6·991	11·100
		7	30	„		15	0	618	6·991	980	094
		15	0	„		22	30	618	980	969	087
		22	30	„		30	0	618	969	958	080
		30	0	„		37	30	619	958	947	073
		37	30	„		45	0	619	947	936	066
		45	0	„		52	30	619	936	924	059
	36	52	30	„	37	0	0	619	924	913	052
	37	0	0	„	37	7	30	8·619	6·913	6·902	11·045
		7	30	„		15	0	619	902	890	038
		15	0	„		22	30	620	890	879	031
		22	30	„		30	0	620	879	867	024
		30	0	„		37	30	620	867	856	017
		37	30	„		45	0	620	856	844	010
		45	0	„		52	30	620	844	833	003
	37	52	30	„	38	0	0	621	833	821	10·996
	38	0	0	„	38	7	30	8·621	6·821	6·810	10·989
		7	30	„		15	0	621	810	798	982
		15	0	„		22	30	621	798	786	975
		22	30	„		30	0	621	786	775	968
		30	0	„		37	30	621	775	763	961
		37	30	„		45	0	622	763	751	954
		45	0	„		52	30	622	751	740	947
	38	52	30	„	39	0	0	622	740	728	940
	39	0	0	„	39	7	30	8·622	6·728	6·716	10·933
		7	30	„		15	0	622	716	704	925
		15	0	„		22	30	623	704	692	918
		22	30	„		30	0	623	692	680	911
		30	0	„		37	30	623	680	668	904
		37	30	„		45	0	623	668	656	897
		45	0	„		52	30	623	656	644	890
	39	52	30	„	40	0	0	623	644	632	882

TABLE XXXIV.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{2}$ of a Degree of Latitude and Longitude, on the Scale of 1 Inch to 2 Miles.

Latitude					Length in Inches			
					m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
	°	′		° ′				
From	0	0	to	0 30	17·176	17·290	17·290	24·372
		30	„	1 0	176	290	288	370
	1	0	„	30	176	288	284	368
		30	„	2 0	176	284	280	366
	2	0	„	30	176	280	274	362
		30	„	3 0	176	274	266	358
	3	0	„	30	176	266	258	352
		30	„	4 0	176	258	248	346
	4	0	„	30	176	248	238	338
		30	„	5 0	176	238	226	330
	5	0	„	5 30	17·178	17·226	17·212	24·322
		30	„	6 0	178	212	196	312
	6	0	„	30	178	196	180	300
		30	„	7 0	178	180	162	288
	7	0	„	30	178	162	144	276
		30	„	8 0	178	144	124	262
	8	0	„	30	180	124	102	248
		30	„	9 0	180	102	078	232
	9	0	„	30	180	078	054	216
		30	„	10 0	180	054	030	200
	10	0	„	10 30	17·182	17·030	17·002	24·182
		30	„	11 0	182	002	16·974	162
	11	0	„	30	182	16·974	946	142
		30	„	12 0	182	946	916	122
	12	0	„	30	184	916	884	100
		30	„	13 0	184	884	850	078
	13	0	„	30	184	850	816	056
		30	„	14 0	186	816	780	032
	14	0	„	30	186	780	744	006
		30	„	15 0	186	744	706	23·980
	15	0	„	15 30	17·188	16·706	16·666	23·954
		30	„	16 0	188	666	624	926
	16	0	„	30	190	624	582	898
		30	„	17 0	190	582	540	870
	17	0	„	30	190	540	496	840
		30	„	18 0	192	496	450	810
	18	0	„	30	192	450	402	778
		30	„	19 0	194	402	354	746
	19	0	„	30	194	354	304	712
		30	„	20 0	196	304	254	680

TABLE XXXIV.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{2}$ of a Degree of Latitude and Longitude, on the Scale of 1 Inch to 2 Miles.

Latitude						Length in Inches			
						m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
	°	′		°	′				
From	20	0	to	20	30	17·196	16·254	16·202	23·644
		30	„	21	0	198	202	148	610
	21	0	„		30	198	148	094	572
		30	„	22	0	200	094	038	536
	22	0	„		30	200	038	15·982	498
		30	„	23	0	202	15·982	924	460
	23	0	„		30	202	924	864	422
		30	„	24	0	204	864	804	382
	24	0	„		30	204	804	742	340
		30	„	25	0	206	742	680	300
	25	0	„	25	30	17·206	15·680	15·616	23·258
		30	„	26	0	208	616	550	216
	26	0	„		30	210	550	484	172
		30	„	27	0	210	484	416	128
	27	0	„		30	212	416	348	084
		30	„	28	0	212	348	278	038
	28	0	„		30	214	278	206	22·992
		30	„	29	0	216	206	134	946
	29	0	„		30	216	134	060	898
		30	„	30	0	218	060	14·986	850
	30	0	„	30	30	17·220	14·986	14·910	22·802
		30	„	31	0	220	910	834	754
	31	0	„		30	222	834	756	704
		30	„	32	0	224	756	676	654
	32	0	„		30	224	676	596	604
		30	„	33	0	226	596	516	552
	33	0	„		30	228	516	432	500
		30	„	34	0	228	432	350	448
	34	0	„		30	230	350	264	396
		30	„	35	0	232	264	180	342
	35	0	„	35	30	17·232	14·180	14·092	22·288
		30	„	36	0	234	092	004	234
	36	0	„		30	236	004	13·914	180
		30	„	37	0	238	13·914	826	126
	37	0	„		30	238	826	734	068
		30	„	38	0	240	734	642	014
	38	0	„		30	242	642	548	21·956
		30	„	39	0	242	548	454	898
	39	0	„		30	244	454	360	842
		30	„	40	0	246	360	264	786

TABLE XXXV A.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{2}$ of a Degree of Latitude and Longitude, on the Scale of 1 Inch to 3 Miles.

Latitude					Length in Inches			
					m on Meridian	n on Lower Parallel	p on Upper Parallel	q on Diagonal
	°	′		° ′				
From	0	0	to	0 30	11·451	11·527	11·527	16·248
		30	„	1 0	451	527	525	247
	1	0	„	30	451	525	523	245
		30	„	2 0	451	523	520	244
	2	0	„	30	451	520	516	241
		30	„	3 0	451	516	511	239
	3	0	„	30	451	511	505	235
		30	„	4 0	451	505	499	231
	4	0	„	30	451	499	492	225
		30	„	5 0	451	492	484	220
	5	0	„	5 30	11·452	11·484	11·475	16·215
		30	„	6 0	452	475	464	208
	6	0	„	30	452	464	453	200
		30	„	7 0	452	453	441	192
	7	0	„	30	452	441	429	184
		30	„	8 0	452	429	416	175
	8	0	„	30	453	416	401	165
		30	„	9 0	453	401	385	155
	9	0	„	30	453	385	369	144
		30	„	10 0	453	369	353	133
	10	0	„	10 30	11·455	11·353	11·335	16·121
		30	„	11 0	455	335	316	108
	11	0	„	30	455	316	297	095
		30	„	12 0	455	297	277	081
	12	0	„	30	456	277	256	067
		30	„	13 0	456	256	233	052
	13	0	„	30	456	233	211	037
		30	„	14 0	457	211	187	021
	14	0	„	30	457	187	163	004
		30	„	15 0	457	163	137	15·987
	15	0	„	15 30	11·459	11·137	11·111	15·969
		30	„	16 0	459	111	083	951
	16	0	„	30	460	083	055	932
		30	„	17 0	460	055	027	913
	17	0	„	30	460	027	10·997	893
		30	„	18 0	461	10·997	967	873
	18	0	„	30	461	967	935	852
		30	„	19 0	463	935	903	831
	19	0	„	30	463	903	869	808
		30	„	20 0	464	869	836	787

TABLE XXXV A.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{2}$ of a Degree of Latitude and Longitude, on the Scale of 1 Inch to 3 Miles.

Latitude						Length in Inches			
						m on Meridian	n on Lower Parallel	p on Upper Parallel	q on Diagonal
	°	′		°	′				
From	20	0	to	20	30	11·464	10·836	10·801	15·763
		30	,,	21	0	465	801	765	740
	21	0	,,		30	465	765	729	715
		30	,,	22	0	467	729	692	691
	22	0	,,		30	467	692	655	665
		30	,,	23	0	468	655	616	640
	23	0	,,		30	468	616	576	615
		30	,,	24	0	469	576	536	588
	24	0	,,		30	469	536	495	560
		30	,,	25	0	471	495	453	533
	25	0	,,	25	30	11·471	10·453	10·411	15·505
		30	,,	26	0	472	411	367	477
	26	0	,,		30	473	367	323	448
		30	,,	27	0	473	323	277	419
	27	0	,,		30	475	277	232	389
		30	,,	28	0	475	232	185	359
	28	0	,,		30	476	185	137	328
		30	,,	29	0	477	137	089	297
	29	0	,,		30	477	089	040	265
		30	,,	30	0	479	040	9·991	233
	30	0	,,	30	30	11·480	9·991	9·940	15·201
		30	,,	31	0	480	940	889	169
	31	0	,,		30	481	889	837	136
		30	,,	32	0	483	837	784	103
	32	0	,,		30	483	784	731	069
		30	,,	33	0	484	731	677	035
	33	0	,,		30	485	677	621	000
		30	,,	34	0	485	621	567	14·965
	34	0	,,		30	487	567	509	931
		30	,,	35	0	488	509	453	895
	35	0	,,	35	30	11·488	9·453	9·395	14·859
		30	,,	36	0	489	395	336	823
	36	0	,,		30	491	336	276	787
		30	,,	37	0	492	276	217	751
	37	0	,,		30	492	217	156	712
		30	,,	38	0	493	156	095	676
	38	0	,,		30	495	095	032	637
		30	,,	39	0	495	032	8·969	599
	39	0	,,		30	496	8·969	907	561
		30	,,	40	0	497	907	843	524

TABLE XXXV B.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{2}$ of a Degree of Latitude and Longitude, on the Scale of 1 Inch to 4 Miles.

Latitude					Length in Inches			
					m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
	°	′		° ′				
From	0	0	to	0 30	8·588	8·645	8·645	12·186
		30	„	1 0	588	645	644	185
	1	0	„	30	588	644	642	184
		30	„	2 0	588	642	640	183
	2	0	„	30	588	640	637	181
		30	„	3 0	588	637	633	179
	3	0	„	30	588	633	629	176
		30	„	4 0	588	629	624	173
	4	0	„	30	588	624	619	169
		30	„	5 0	588	619	613	165
	5	0	„	5 30	8·589	8·613	8·606	12·161
		30	„	6 0	589	606	598	156
	6	0	„	30	589	598	590	150
		30	„	7 0	589	590	581	144
	7	0	„	30	589	581	572	138
		30	„	8 0	589	572	562	131
	8	0	„	30	590	562	551	124
		30	„	9 0	590	551	539	116
	9	0	„	30	590	539	527	108
		30	„	10 0	590	527	515	100
	10	0	„	10 30	8·591	8·515	8·501	12·091
		30	„	11 0	591	501	487	081
	11	0	„	30	591	487	473	071
		30	„	12 0	591	473	458	061
	12	0	„	30	592	458	442	050
		30	„	13 0	592	442	425	039
	13	0	„	30	592	425	408	028
		30	„	14 0	593	408	390	016
	14	0	„	30	593	390	372	003
		30	„	15 0	593	372	353	11·990
	15	0	„	15 30	8·594	8·353	8·333	11·977
		30	„	16 0	594	333	312	963
	16	0	„	30	595	312	291	949
		30	„	17 0	595	291	270	935
	17	0	„	30	595	270	248	920
		30	„	18 0	596	248	225	905
	18	0	„	30	596	225	201	889
		30	„	19 0	597	201	177	873
	19	0	„	30	597	177	152	856
		30	„	20 0	598	152	127	840

TABLE XXXV B.—Graticules of maps.—Sides and Diagonals of Squares of $\frac{1}{2}$ of a Degree of Latitude and Longitude, on the Scale of 1 Inch to 4 Miles.

Latitude						Length in Inches			
						m on Meridian	n on Lower Parallel	p' on Upper Parallel	q on Diagonal
	°	′		°	′				
From	20	0	to	20	30	8·598	8·127	8·101	11·822
		30	„	21	0	599	101	074	805
	21	0	„		30	599	074	047	786
		30	„	22	0	600	047	019	768
	22	0	„		30	600	019	7·991	749
		30	„	23	0	601	7·991	962	730
	23	0	„		30	601	962	932	711
		30	„	24	0	602	932	902	691
	24	0	„		30	602	902	871	670
		30	„	25	0	603	871	840	650
	25	0	„	25	30	8·603	7·840	7·808	11·629
		30	„	26	0	604	808	775	608
	26	0	„		30	605	775	742	586
		30	„	27	0	605	742	708	564
	27	0	„		30	606	708	674	542
		30	„	28	0	606	674	639	519
	28	0	„		30	607	639	603	496
		30	„	29	0	608	603	567	473
	29	0	„		30	608	567	530	449
		30	„	30	0	609	530	493	425
	30	0	„	30	30	8·610	7·493	7·455	11·401
		30	„	31	0	610	455	417	377
	31	0	„		30	611	417	378	352
		30	„	32	0	612	378	338	327
	32	0	„		30	612	338	298	302
		30	„	33	0	613	298	258	276
	33	0	„		30	614	258	216	250
		30	„	34	0	614	216	175	224
	34	0	„		30	615	175	132	198
		30	„	35	0	616	132	090	171
	35	0	„	35	30	8·616	7·090	7·046	11·144
		30	„	36	0	617	046	002	117
	36	0	„		30	618	002	6·957	090
		30	„	37	0	619	6·957	913	063
	37	0	„		30	619	913	867	034
		30	„	38	0	620	867	821	007
	38	0	„		30	621	821	774	10·978
		30	„	39	0	621	774	727	949
	39	0	„		30	622	727	680	921
		30	„	40	0	623	680	632	893

TABLE XXXVI.—Graticules of maps.—Sides and Diagonals of Squares of 1 Degree of Latitude and Longitude, on the Scale of 1 Inch to 8 Miles.

Latitude				Length in Inches			
				m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
	°		°				
From	0	to	1	8·588	8·645	8·644	12·185
	1	„	2	588	644	640	183
	2	„	3	588	640	633	180
	3	„	4	588	633	624	174
	4	„	5	588	624	613	167
	5	„	6	589	613	598	158
	6	„	7	589	598	581	147
	7	„	8	589	581	562	134
	8	„	9	590	562	539	120
	9	„	10	590	539	515	104
	10	„	11	8·591	8·515	8·487	12·086
	11	„	12	591	487	458	066
	12	„	13	592	458	425	045
	13	„	14	593	425	390	022
	14	„	15	593	390	353	11·997
	15	„	16	594	353	312	970
	16	„	17	595	312	270	942
	17	„	18	596	270	225	912
	18	„	19	596	225	177	881
	19	„	20	597	177	127	848
	20	„	21	8·598	8·127	8·074	11·813
	21	„	22	599	074	019	777
	22	„	23	600	019	7·962	740
	23	„	24	601	7·962	902	701
	24	„	25	603	902	840	660
	25	„	26	604	840	775	618
	26	„	27	605	775	708	575
	27	„	28	606	708	639	530
	28	„	29	607	639	567	484
	29	„	30	609	567	493	437
	30	„	31	8·610	7·493	7·417	11·389
	31	„	32	611	417	338	339
	32	„	33	613	338	258	289
	33	„	34	614	258	175	237
	34	„	35	615	175	090	184
	35	„	36	617	090	002	131
	36	„	37	618	002	6·913	076
	37	„	38	620	6·913	821	021
	38	„	39	621	821	727	10·964
	39	„	40	623	727	632	907

TABLE XXXVII.—Graticules of maps.—Sides and Diagonals of Squares of 2 Degrees of Latitude and Longitude, on the Scale of 1 Inch to 12 Miles.

Latitude				Length in Inches			
				m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
	°		°				
From	0	to	2	11·451	11·527	11·520	16·245
	2	„	4	451	520	499	235
	4	„	6	451	499	464	216
	6	„	8	452	464	416	187
	8	„	10	453	416	353	149
	10	„	12	455	353	277	101
	12	„	14	456	277	187	044
	14	„	16	458	187	083	15·977
	16	„	18	11·460	11·083	10·966	15·902
	18	„	20	463	10·966	836	818
	20	„	22	465	836	693	726
	22	„	24	468	693	536	626
	24	„	26	471	536	367	518
	26	„	28	474	367	185	403
	28	„	30	477	185	9·991	280
	30	„	32	481	9·991	785	151
	32	„	34	11·484	9·785	9·566	15·016
	34	„	36	488	566	336	14·876
	36	„	38	492	336	095	730
	38	„	40	496	095	8·842	580
	40	„	42	500	8·842	579	426
	42	„	44	504	579	305	268
	44	„	46	508	305	021	108

TABLE XXXVIII.—Graticules of maps.—Sides and Diagonals of Squares of 2 Degrees of Latitude and Longitude, on the Scale of 1 : 1000,000.

Latitude				Length in Inches			
				m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal
	°		°				
From	0	to	2	8·706	8·764	8·759	12·352
	2	„	4	706	759	743	345
	4	„	6	706	743	716	329
	6	„	8	707	716	680	307
	8	„	10	708	680	632	278
	10	„	12	709	632	574	242
	12	„	14	710	574	505	199
	14	„	16	712	505	426	148
	16	„	18	8·713	8·426	8·338	12·091
	18	„	20	715	338	239	027
	20	„	22	717	239	129	11·957
	22	„	24	719	129	011	881
	24	„	26	721	011	7·882	799
	26	„	28	724	7·882	744	711
	28	„	30	726	744	596	618
	30	„	32	729	596	439	520
	32	„	34	8·732	7·439	7·274	11·417
	34	„	36	735	274	098	311
	36	„	38	738	098	6·915	200
	38	„	40	741	6·915	723	085
	40	„	42	744	723	523	10·968
	42	„	44	747	523	315	848
	44	„	46	750	315	099	727

TABLE XXXIX.—Graticules of maps.—Sides and Diagonals of Squares of 2 Degrees of Latitude and Longitude, on the Scale of 1 Inch to 28 Miles.

Latitude				Length in Inches			
				m on Meridian	n on Lower Parallel	p on Upper Parallel	q on Diagonal
	°		°				
From	0	to	2	4·907	5·255	5·186	7·165
	2	„	4	907	186	117	115
	4	„	6	907	117	048	065
	6	„	8	909	048	4·979	016
	8	„	10	909	4·979	911	6·968
	10	„	12	909	911	841	919
	12	„	14	910	841	773	871
	14	„	16	911	773	704	824
	16	„	18	4·912	4·704	4·635	6·777
	18	„	20	912	635	566	730
	20	„	22	913	566	497	683
	22	„	24	914	497	429	638
	24	„	26	917	429	360	594
	26	„	28	918	360	290	550
	28	„	30	919	290	222	504
	30	„	32	920	222	153	461
	32	„	34	4·922	4·153	4·083	6·418
	34	„	36	923	083	015	375
	36	„	38	925	015	3·945	331
	38	„	40	927	3·945	877	290
	40	„	42	928	877	808	249
	42	„	44	930	808	738	209

TABLE XL.—Graticules of maps.—Sides and Diagonals of Squares of 2 Degrees of Latitude and Longitude, on the Scale of 1 Inch to 32 Miles.

Latitude				Length in Inches				
				m on Meridian	n on Lower Parallel	p on Upper Parallel	q on Diagonal	Check Diagonal
	°		°					
From	0	to	2	4·294	4·598	4·538	6·269	
	2	„	4	294	538	477	226	
	4	„	6	294	477	417	182	
	6	„	8	295	417	357	139	
	8	„	10	295	357	297	097	
	10	„	12	295	297	236	054	24·127
	12	„	14	296	236	176	012	
	14	„	16	297	176	116	5·971	
	16	„	18	4·298	4·116	4·056	5·930	
	18	„	20	298	056	3·995	889	
	20	„	22	299	3·995	935	848	23·309
	22	„	24	300	935	875	808	
	24	„	26	302	875	815	770	
	26	„	28	303	815	754	731	
	28	„	30	304	754	694	691	
	30	„	32	305	694	634	653	
	32	„	34	4·307	3·634	3·573	5·616	
	34	„	36	308	573	513	578	
	36	„	38	309	513	452	540	22·379
	38	„	40	311	452	392	504	
	40	„	42	312	392	332	468	
	42	„	44	314	332	271	433	

TABLE XLI.—Graticules of maps.—Sides and Diagonals of Squares of 4 Degrees of Latitude and Longitude, on the Scale of 1 Inch to 64 Miles.

Latitude				Length in Inches				
				m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal	Check Diagonal
	°		°					
From	0	to	4	4·294	4·597	4·477	6·247	
	4	„	8	4·294	4·477	4·357	6·160	
	8	„	12	4·295	4·357	4·236	6·075	24·108
	12	„	16	4·296	4·236	4·116	5·991	
	16	„	20	4·298	4·116	3·995	5·909	
	20	„	24	4·300	3·995	3·875	5·828	
	24	„	28	4·302	3·875	3·754	5·750	22·817
	28	„	32	4·305	3·754	3·633	5·672	
	32	„	36	4·307	3·633	3·513	5·596	
	36	„	40	4·310	3·513	3·392	5·522	

TABLE XLII.—Graticules of maps.—Sides and Diagonals of Squares of 4 Degrees of Latitude and Longitude, on the Scale of 1 Inch to 80 Miles.

Latitude				Length in Inches				
				m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal	Check Diagonal
	°		°					
From	0	to	4	3·435	3·678	3·582	4·998	
	4	„	8	3·435	3·582	3·486	4·928	
	8	„	12	3·436	3·486	3·389	4·860	19·286
	12	„	16	3·437	3·389	3·293	4·793	
	16	„	20	3·438	3·293	3·196	4·727	
	20	„	24	3·440	3·196	3·100	4·662	
	24	„	28	3·442	3·100	3·003	4·600	
	28	„	32	3·444	3·003	2·906	4·538	18·254
	32	„	36	3·446	2·906	2·810	4·477	
	36	„	40	3·448	2·810	2·714	4·418	

TABLE XLIII.—Graticules of maps.—Sides and Diagonals of Squares of 4 Degrees of Latitude and Longitude, on the Scale of 1 Inch to 96 Miles.

Latitude				Length in Inches				
				m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal	Check Diagonal
	°		°					
From	0	to	4	2·863	3·065	2·985	4·165	
	4	„	8	2·863	2·985	2·905	4·107	16·072
	8	„	12	2·863	2·905	2·824	4·050	
	12	„	16	2·864	2·824	2·744	3·994	
	16	„	20	2·865	2·744	2·663	3·939	
	20	„	24	2·867	2·663	2·583	3·885	15·211
	24	„	28	2·868	2·583	2·503	3·833	
	28	„	32	2·870	2·503	2·422	3·781	
	32	„	36	2·871	2·422	2·342	3·731	
	36	„	40	2·873	2·342	2·261	3·681	

TABLE XLIV.—Graticules of maps.—Sides and Diagonals of Squares of 4 Degrees of Latitude and Longitude, on the Scale of 1 Inch to 192 Miles.

Latitude				Length in Inches				
				m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal	Check Diagonal
	°		°					
From	0	to	4	1·431	1·532	1·492	2·082	
	4	„	8	1·431	1·492	1·452	2·053	
	8	„	12	1·432	1·452	1·412	2·025	8·036
	12	„	16	1·432	1·412	1·372	1·997	
	16	„	20	1·433	1·372	1·332	1·970	
	20	„	24	1·433	1·332	1·292	1·943	
	24	„	28	1·434	1·292	1·251	1·917	7·606
	28	„	32	1·435	1·251	1·211	1·891	
	32	„	36	1·436	1·211	1·171	1·865	
	36	„	40	1·437	1·171	1·131	1·841	

TABLE XLV.—Graticules of maps.—Sides and Diagonals of Squares of 4 Degrees of Latitude and Longitude, on the Scale of 1 Inch to 256 Miles.

Latitude				Length in Inches				
				m on Meridian	*n* on Lower Parallel	*p* on Upper Parallel	*q* on Diagonal	Check Diagonal
	°		°					
From	0	to	4	1·074	1·149	1·119	1·562	
	4	„	8	1·074	1·119	1·089	1·540	6·027
	8	„	12	1·074	1·089	1·059	1·519	
	12	„	16	1·074	1·059	1·029	1·498	
	16	„	20	1·075	1·029	0·999	1·477	
	20	„	24	1·075	0·999	0·969	1·457	5·704
	24	„	28	1·076	0·969	0·939	1·438	
	28	„	32	1·076	0·939	0·908	1·418	
	32	„	36	1·077	0·908	0·878	1·399	
	36	„	40	1·078	0·878	0·848	1·381	

TABLE XLVI.—Rectangular Co-ordinates in Chains of the Corners of $\frac{1}{8}$th Degree Squares, referred to the centre of the Degree as Origin.

Latitude	N. and S. of Origin	Distances in Arc E. or W. of Origin								
		30′ 0″		22′ 30″		15′ 0″		7′ 30″		0′ 0″
		Perpendicular	Meridian	Perpendicular	Meridian	Perpendicular	Meridian	Perpendicular	Meridian	Meridian
° ′ ″										
40 0 0		2122·15	2765·29	1591·61	2762·68	1061·08	2760·82	530·54	2759·71	2759·33
39 52 30	North	2126·02	2075·43	1594·51	2072·83	1063·01	2070·97	531·50	2069·85	2069·48
45 0		2129·87	1385·58	1597·40	1382·98	1064·94	1381·12	532·47	1380·01	1379·64
37 30		2133·72	695·75	1600·29	693·15	1066·86	691·30	533·43	690·18	689·81
30 0		2137·55	5·93	1603·16	3·34	1068·77	1·48	534·39	0·37	ORIGIN
22 30		2141·37	683·87	1606·03	686·46	1070·69	688·31	535·34	689·43	689·80
15 0		2145·19	1373·66	1608·89	1376·25	1072·59	1378·10	536·30	1379·21	1379·58
7 30	South	2148·99	2063·43	1611·74	2066·01	1074·49	2067·87	537·25	2068·97	2069·34
39 0 0		2152·78	2753·19	1614·59	2755·77	1076·39	2757·62	538·20	2758·73	2759·10
39 0 0		2152·78	2764·77	1614·59	2762·19	1076·39	2760·34	538·20	2759·23	2758·86
38 52 30	North	2156·56	2075·03	1617·42	2072·45	1078·28	2070·60	539·14	2069·49	2069·12
45 0		2160·34	1385·30	1620·26	1382·72	1080·17	1380·88	540·09	1379·77	1379·40
37 30		2164·10	695·59	1623·08	693·01	1082·05	691·17	541·03	690·06	689·69
30 0		2167·85	5·89	1625·89	3·31	1083·93	1·47	541·96	0·37	ORIGIN
22 30		2171·59	683·80	1628·69	686·37	1085·80	688·21	542·90	689·31	689·68
15 0		2175·32	1373·47	1631·49	1376·04	1087·66	1377·87	543·83	1378·98	1379·34
7 30	South	2179·04	2063·12	1634·28	2065·69	1089·52	2067·53	544·76	2068·63	2068·99
38 0 0		2182·76	2752·76	1637·07	2755·32	1091·38	2757·16	545·69	2758·26	2758·63
38 0 0		2182·76	2764·26	1637·07	2761·70	1091·38	2759·86	545·69	2758·76	2758·39
37 52 30	North	2186·46	2074·63	1639·84	2072·07	1093·23	2070·24	546·61	2069·14	2068·77
45 0		2190·14	1385·02	1642·61	1382·46	1095·07	1380·63	547·54	1379·53	1379·17
37 30		2193·82	695·42	1645·37	692·86	1096·91	691·04	548·46	689·94	689·58
30 0		2197·49	5·84	1648·12	3·29	1098·75	1·46	549·37	0·37	ORIGIN
22 30		2201·15	683·73	1650·86	686·29	1100·58	688·10	550·29	689·20	689·56
15 0		2204·80	1373·29	1653·60	1375·83	1102·40	1377·65	551·20	1378·75	1379·11
7 30	South	2208·44	2062·83	1656·33	2065·37	1104·22	2067·19	552·11	2068·28	2068·64
37 0 0		2212·06	2752·35	1659·05	2754·90	1106·03	2756·71	553·02	2757·80	2758·16
37 0 0		2212·06	2763·74	1659·05	2761·20	1106·03	2759·38	553·02	2758·30	2757·93
36 52 30	North	2215·68	2074·23	1661·76	2071·70	1107·84	2069·88	553·92	2068·79	2068·43
45 0		2219·28	1384·73	1664·46	1382·20	1109·64	1380·39	554·82	1379·30	1378·94
37 30		2222·88	695·25	1667·16	692·72	1111·44	690·91	555·72	689·82	689·46
30 0		2226·46	5·78	1669·85	3·25	1113·23	1·45	556·62	0·36	ORIGIN
22 30		2230·04	683·68	1672·53	686·20	1115·02	688·00	557·51	689·09	689·45
15 0		2233·60	1373·12	1675·20	1375·64	1116·80	1377·44	558·40	1378·52	1378·88
7 30	South	2237·15	2062·54	1677·86	2065·06	1118·57	2066·86	559·29	2067·94	2068·30
36 0 0		2240·69	2751·96	1680·52	2754·47	1120·35	2756·27	560·17	2757·34	2757·70

TABLE XLVI.—Rectangular Co-ordinates in Chains of the Corners of $\frac{1}{8}$th Degree Squares, referred to the centre of the Degree as Origin.

Latitude	N. and S. of Origin	Distances in Arc°E. or W. of Origin								
		30′ 0″		22′ 30″		15′ 0″		7′ 30″		0′ 0″
		Perpendicular	Meridian	Perpendicular	Meridian	Perpendicular	Meridian	Perpendicular	Meridian	Meridian
° ′ ″										
36 0 0		2240·69	2763·22	1680·52	2760·70	1120·35	2758·91	560·17	2757·83	2757·47
35 52 30	North	2244·22	2073·82	1683·17	2071·32	1122·11	2069·52	561·06	2068·44	2068·08
45 0		2247·74	1384·44	1685·81	1381·93	1123·87	1380·14	561·94	1379·07	1378·71
37 30		2251·25	695·07	1688·44	692·57	1125·63	690·78	562·81	689·71	689·35
30 0		2254·75	5·71	1691·06	3·21	1127·38	1·43	563·69	0·36	ORIGIN
22 30		2258·24	683·63	1693·68	686·12	1129·12	687·91	564·56	688·98	689·33
15 0	South	2261·72	1372·96	1696·29	1375·45	1130·86	1377·23	565·43	1378·30	1378·65
7 30		2265·18	2062·27	1698·89	2064·76	1132·59	2066·53	566·30	2067·60	2067·96
35 0 0		2268·64	2751·57	1701·48	2754·05	1134·32	2755·83	567·16	2756·89	2757·25
35 0 0		2268·64	2762·70	1701·48	2760·22	1134·32	2758·44	567·16	2757·38	2757·02
34 52 30	North	2272·08	2073·41	1704·06	2070·93	1136·04	2069·16	568·02	2068·10	2067·75
45 0		2275·52	1384·14	1706·64	1381·67	1137·76	1379·90	568·88	1378·84	1378·48
37 30		2278·94	694·88	1709·21	692·41	1139·47	690·65	569·74	689·59	689·23
30 0		2282·35	5·64	1711·76	3·18	1141·18	1·41	570·59	0·35	ORIGIN
22 30		2285·75	683·59	1714·31	686·05	1142·88	687·81	571·44	688·87	689·22
15 0	South	2289·14	1372·80	1716·86	1375·27	1144·57	1377·02	572·29	1378·08	1378·43
7 30		2292·52	2062·01	1719·39	2064·46	1146·26	2066·22	573·13	2067·27	2067·62
34 0 0		2295·89	2751·19	1721·92	2753·65	1147·95	2755·40	573·97	2756·45	2756·80
34 0 0		2295·89	2762·18	1721·92	2759·72	1147·95	2757·98	573·97	2756·92	2756·57
33 52 30	North	2299·25	2073·00	1724·44	2070·56	1149·62	2068·81	574·81	2067·76	2067·41
45 0		2302·60	1383·84	1726·95	1381·40	1151·30	1379·66	575·65	1378·61	1378·26
37 30		2305·93	694·70	1729·45	692·26	1152·97	690·52	576·48	689·47	689·12
30 0		2309·26	5·56	1731·94	3·13	1154·63	1·39	577·31	0·35	ORIGIN
22 30		2312·57	683·56	1734·43	685·99	1156·28	687·72	578·14	688·76	689·11
15 0	South	2315·87	1372·66	1736·90	1375·09	1157·94	1376·82	578·97	1377·86	1378·20
7 30		2319·16	2061·76	1739·37	2064·17	1159·58	2065·90	579·79	2066·94	2067·29
33 0 0		2322·44	2750·83	1741·83	2753·25	1161·22	2754·97	580·61	2756·01	2756·35
33 0 0		2322·44	2761·65	1741·83	2759·24	1161·22	2757·51	580·61	2756·48	2756·13
32 52 30	North	2325·71	2072·59	1744·28	2070·18	1162·86	2068·46	581·43	2067·42	2067·08
45 0		2328·97	1383·54	1746·73	1381·14	1164·49	1379·42	582·24	1378·38	1378·04
37 30		2332·22	694·50	1749·17	692·10	1166·11	690·39	583·06	689·36	689·01
30 0		2335·46	5·48	1751·59	3·08	1167·73	1·37	583·86	0·34	ORIGIN
22 30		2338·68	683·54	1754·01	685·92	1169·34	687·63	584·67	688·66	689·00
15 0	South	2341·90	1372·53	1756·42	1374·92	1170·95	1376·62	585·47	1377·64	1377·99
7 30		2345·10	2061·52	1758·82	2063·90	1172·55	2065·60	586·27	2066·62	2066·96
32 0 0		2348·29	2750·49	1761·22	2752·87	1174·14	2754·56	587·07	2755·58	2755·92

TABLE XLVI.—Rectangular Co-ordinates in Chains of the Corners of $\frac{1}{8}$th Degree Squares, referred to the centre of the Degree as Origin.

Latitude			N. and S. of Origin	Distances in Arc E. or W. of Origin									
				30′ 0″		22′ 30″		15′ 0″		7′ 30″		0′ 0″	
				Perpendicular	Meridian	Perpendicular	Meridian	Perpendicular	Meridian	Perpendicular	Meridian	Meridian	
°	′	″											
32	0	0		2348·29	2761·13	1761·22	2758·75	1174·14	2757·06	587·07	2756·04	2755·70	
31	52	30		2351·47	2072·17	1763·60	2069·81	1175·73	2068·11	587·87	2067·09	2066·76	
	45	0		2354·64	1383·23	1765·98	1380·87	1177·32	1379·18	588·66	1378·16	1377·82	
	37	30		2357·80	694·30	1768·35	691·94	1178·90	690·25	589·45	689·24	688·91	
	30	0	North	2360·94	5·38	1770·71	3·02	1180·47	1·35	590·24	0·34	ORIGIN	
	22	30		2364·08	683·52	1773·06	685·87	1182·04	687·55	591·02	688·55	688·89	
	15	0		2367·20	1372·41	1775·40	1374·76	1183·60	1376·43	591·80	1377·44	1377·77	
	7	30		2370·32	2061·29	1777·74	2063·63	1185·16	2065·30	592·58	2066·30	2066·64	
31	0	0		2373·42	2750·15	1780·07	2752·49	1186·71	2754·15	593·36	2755·15	2755·49	
31	0	0		2373·42	2760·61	1780·07	2758·27	1186·71	2756·61	593·36	2755·61	2755·28	
30	52	30		2376·51	2071·76	1782·38	2069·43	1188·25	2067·77	594·13	2066·77	2066·44	
	45	0		2379·59	1382·92	1784·69	1380·60	1189·79	1378·94	594·90	1377·94	1377·61	
	37	30		2382·66	694·10	1786·99	691·78	1191·33	690·12	595·66	689·13	688·80	
	30	0	North	2385·71	5·28	1789·28	2·97	1192·86	1·32	596·43	0·33	ORIGIN	
	22	30		2388·76	683·52	1791·57	685·83	1194·38	687·47	597·19	688·46	688·79	
	15	0		2391·79	1372·30	1793·84	1374·60	1195·90	1376·24	597·95	1377·23	1377·56	
	7	30		2394·81	2061·07	1796·11	2063·37	1197·41	2065·01	598·70	2065·99	2066·32	
30	0	0		2397·82	2749·84	1798·37	2752·12	1198·91	2753·76	599·46	2754·74	2755·07	
30	0	0		2397·82	2760·09	1798·37	2757·80	1198·91	2756·17	599·46	2755·19	2754·86	
29	52	30		2400·82	2071·34	1800·62	2069·06	1200·41	2067·43	600·21	2066·45	2066·13	
	45	0		2403·81	1382·61	1802·86	1380·33	1201·91	1378·70	600·95	1377·73	1377·40	
	37	30		2406·79	693·89	1805·09	691·61	1203·39	689·99	601·70	689·02	688·70	
	30	0	North	2409·75	5·18	1807·31	2·92	1204·88	1·30	602·44	0·32	ORIGIN	
	22	30		2412·71	683·52	1809·53	685·78	1206·35	687·39	603·18	688·36	688·68	
	15	0		2415·65	1372·20	1811·74	1374·45	1207·82	1376·06	603·91	1377·03	1377·35	
	7	30		2418·58	2060·87	1813·94	2063·12	1209·29	2064·73	604·65	2065·69	2066·01	
29	0	0		2421·50	2749·53	1816·13	2751·77	1210·75	2753·37	605·38	2754·33	2754·65	
29	0	0		2421·50	2759·57	1816·13	2757·33	1210·75	2755·73	605·38	2754·77	2754·45	
28	52	30		2424·41	2070·93	1818·31	2068·69	1212·20	2067·10	606·10	2066·14	2065·82	
	45	0		2427·30	1382·29	1820·48	1380·06	1213·65	1378·47	606·83	1377·52	1377·20	
	37	30		2430·19	693·67	1822·64	691·46	1215·09	689·86	607·55	688·91	688·59	
	30	0	North	2433·06	5·07	1824·80	2·85	1216·53	1·27	608·27	0·32	ORIGIN	
	22	30		2435·92	683·53	1826·94	685·74	1217·96	687·32	608·98	688·27	688·58	
	15	0		2438·77	1372·11	1829·08	1374·31	1219·39	1375·89	609·69	1376·83	1377·15	
	7	80		2441·61	2060·68	1831·21	2062·88	1220·80	2064·45	610·40	2065·39	2065·71	
28	0	0		2444·44	2749·24	1833·33	2751·43	1222·22	2753·00	611·11	2753·94	2754·25	

TABLE XLVI.—Rectangular Co-ordinates in Chains of the Corners of $\frac{1}{8}$th Degree Squares, referred to the centre of the Degree as Origin.

Latitude			N. and S. of Origin	Distances in Arc E. or W. of Origin									
				30′ 0″		22′ 30″		15′ 0″		7′ 30″		0′ 0″	
				Perpendicular	Meridian	Perpendicular	Meridian	Perpendicular	Meridian	Perpendicular	Meridian	Meridian	
°	′	″											
28	0	0		2444·44	2759·06	1833·33	2756·87	1222·22	2755·30	611·11	2754·36	2754·05	
27	52	30	North	2447·25	2070·51	1835·44	2068·33	1223·63	2066·77	611·81	2065·83	2065·52	
	45	0		2450·06	1381·98	1837·54	1379·80	1225·03	1378·25	612·51	1377·31	1377·00	
	37	30		2452·85	693·46	1839·64	691·28	1226·42	689·74	613·21	688·80	688·49	
	30	0		2455·63	4·93	1841·72	2·78	1227·81	1·24	613·91	0·31	ORIGIN	
	22	30		2458·40	683·55	1843·80	685·71	1229·20	687·25	614·60	688·17	688·48	
	15	0	South	2461·15	1372·03	1845·86	1374·19	1230·58	1375·72	615·29	1376·64	1376·95	
	7	30		2463·90	2060·51	1847·92	2062·65	1231·95	2064·18	615·97	2065·10	2065·41	
27	0	0		2466·63	2748·97	1849·97	2751·11	1233·32	2752·63	616·66	2753·55	2753·85	
27	0	0		2466·63	2758·55	1849·97	2756·40	1233·32	2754·88	616·66	2753·96	2753·66	
26	52	30		2469·35	2070·10	1852·01	2067·96	1234·68	2066·45	617·34	2065·53	2065·23	
	45	0	North	2472·06	1381·66	1854·05	1379·53	1236·03	1378·02	618·02	1377·11	1376·81	
	37	30		2474·76	693·24	1856·07	691·12	1237·38	689·61	618·69	688·70	688·40	
	30	0		2477·45	4·82	1858·09	2·71	1238·72	1·21	619·36	0·30	ORIGIN	
	22	30		2480·12	683·58	1860·09	685·68	1240·06	687·18	620·03	688·08	688·39	
	15	0	South	2482·78	1371·97	1862·09	1374·07	1241·39	1375·56	620·70	1376·46	1376·76	
	7	30		2485·44	2060·34	1864·08	2062·44	1242·72	2063·93	621·36	2064·82	2065·12	
26	0	0		2488·08	2748·71	1866·06	2750·80	1244·04	2752·28	622·02	2753·17	2753·47	
26	0	0		2488·08	2758·04	1866·06	2755·95	1244·04	2754·47	622·02	2753·58	2753·28	
25	52	30		2490·70	2069·69	1868·03	2067·61	1245·35	2066·13	622·68	2065·24	2064·94	
	45	0	North	2493·32	1381·34	1869·99	1379·27	1246·66	1377·80	623·33	1376·91	1376·62	
	37	30		2495·92	693·01	1871·94	690·95	1247·96	689·48	623·98	688·60	688·30	
	30	0		2498·51	4·69	1873·88	2·64	1249·26	1·17	624·63	0·29	ORIGIN	
	22	30		2501·09	683·61	1875·82	685·66	1250·55	687·12	625·27	688·00	688·29	
	15	0	South	2503·66	1371·91	1877·75	1373·95	1251·83	1375·41	625·92	1376·28	1376·57	
	7	30		2506·22	2060·20	1879·66	2062·23	1253·11	2063·68	626·55	2064·55	2064·84	
25	0	0		2508·76	2748·47	1881·57	2750·49	1254·38	2751·94	627·19	2752·80	2753·09	
25	0	0		2508·76	2757·54	1881·57	2755·51	1254·38	2754·07	627·19	2753·20	2752·91	
24	52	30		2511·29	2069·27	1883·47	2067·26	1255·65	2065·82	627·82	2064·95	2064·67	
	45	0	North	2513·81	1381·02	1885·36	1379·02	1256·91	1377·58	628·45	1376·72	1376·43	
	37	30		2516·32	692·79	1887·24	690·78	1258·16	689·35	629·08	688·50	688·21	
	30	0		2518·82	4·56	1889·12	2·57	1259·41	1·14	629·71	0·29	ORIGIN	
	22	30		2521·30	683·66	1890·98	685·64	1260·65	687·06	630·33	687·92	688·20	
	15	0	South	2523·78	1373·86	1892·83	1373·84	1261·89	1375·26	630·94	1376·10	1376·39	
	7	30		2526·24	2060·06	1894·68	2062·03	1263·12	2063·44	631·56	2064·28	2064·56	
24	0	0		2528·68	2748·24	1896·51	2750·20	1264·34	2751·61	632·17	2752·45	2752·73	

TABLE XLVI.—Rectangular Co-ordinates in Chains of the Corners of $\frac{1}{8}$th Degree Squares, referred to the centre of the Degree as Origin.

Latitude			N. and S. of Origin	Distances in Arc E. or W. of Origin									
				30′ 0″		22′ 30″		15′ 0″		7′ 30″		0′ 0″	
				Perpendicular	Meridian	Perpendicular	Meridian	Perpendicular	Meridian	Perpendicular	Meridian	Meridian	
°	′	″											
24	0	0		2528·68	2757·04	1896·51	2755·08	1264·34	2753·67	632·17	2752·83	2752·55	
23	52	30		2531·12	2068·87	1898·34	2066·91	1265·56	2065·52	632·78	2064·68	2064·40	
	45	0		2533·55	1380·71	1900·16	1378·76	1266·77	1377·37	633·39	1376·53	1376·25	
	37	30		2535·96	692·56	1901·97	690·61	1267·98	689·23	633·99	688·40	688·12	
	30	0	North	2538·36	4·42	1903·77	2·48	1269·18	1·10	634·59	0·28	ORIGIN	
	22	30		2540·75	683·71	1905·56	685·64	1270·37	687·01	635·19	687·84	688·11	
	15	0		2543·12	1371·83	1907·34	1373·74	1271·56	1375·12	635·78	1375·94	1376·21	
	7	30		2545·49	2059·94	1909·12	2061·84	1272·74	2063·21	636·37	2064·03	2064·30	
23	0	0		2547·84	2748·03	1910·88	2749·93	1273·92	2751·29	636·96	2752·10	2752·38	
23	0	0		2547·84	2756·55	1910·88	2754·65	1273·92	2753·29	636·96	2752·48	2752·20	
22	52	30		2550·18	2068·46	1912·64	2066·57	1275·09	2065·22	637·55	2064·41	2064·14	
	45	0		2552·51	1380·39	1914·38	1378·50	1276·25	1377·16	638·13	1376·35	1376·08	
	37	30		2554·82	692·32	1916·12	690·45	1277·41	689·11	638·71	688·30	688·04	
	30	0	North	2557·13	4·27	1917·85	2·40	1278·56	1·07	639·28	0·27	ORIGIN	
	22	30		2559·42	683·77	1919·57	685·63	1279·71	686·96	639·86	687·76	688·02	
	15	0		2561·70	1371·81	1921·28	1373·65	1280·85	1374·98	640·43	1375·77	1376·04	
	7	30		2563·96	2059·83	1922·97	2061·68	1281·98	2062·99	640·99	2063·78	2064·04	
22	0	0		2566·22	2747·84	1924·67	2749·68	1283·11	2750·99	641·56	2751·77	2752·04	
22	0	0		2566·22	2756·06	1924·67	2754·23	1283·11	2752·92	641·56	2752·13	2751·87	
21	52	30		2568·46	2068·06	1926·35	2066·24	1284·23	2064·93	642·12	2064·15	2063·89	
	45	0		2570·70	1380·07	1928·02	1378·25	1285·35	1376·95	642·67	1376·17	1375·91	
	37	30		2572·91	692·09	1929·68	690·28	1286·46	688·99	643·23	688·21	687·95	
	30	0	North	2575·12	4·12	1931·34	2·31	1287·56	1·03	643·78	0·26	ORIGIN	
	22	30		2577·32	683·84	1932·99	685·64	1288·66	686·92	644·33	687·69	687·94	
	15	0		2579·50	1371·79	1934·62	1373·58	1289·75	1374·85	644·87	1375·62	1375·87	
	7	30		2581·66	2059·73	1936·25	2061·51	1290·83	2062·78	645·42	2063·54	2063·79	
21	0	0		2583·82	2747·67	1937·87	2749·43	1291·91	2750·70	645·96	2751·45	2751·71	
21	0	0		2583·82	2755·59	1937·87	2753·82	1291·91	2752·56	645·96	2751·80	2751·55	
20	52	30		2585·97	2067·67	1939·48	2065·90	1292·98	2064·65	646·49	2063·90	2063·64	
	45	0		2588·10	1379·75	1941·08	1378·00	1294·05	1376·75	647·03	1376·00	1375·75	
	37	30		2590·22	691·85	1942·67	690·11	1295·11	688·87	647·56	688·12	687·87	
	30	0	North	2592·33	3·96	1944·25	2·23	1296·17	0·99	648·08	0·25	ORIGIN	
	22	30		2594·43	683·92	1945·82	685·65	1297·21	686·88	648·61	687·62	687·86	
	15	0		2596·51	1371·79	1947·38	1373·51	1298·26	1374·73	649·13	1375·47	1375·71	
	7	30		2598·58	2059·66	1948·94	2061·36	1299·29	2062·58	649·65	2063·31	2063·56	
20	0	0		2600·64	2747·51	1950·48	2749·20	1300·32	2750·42	650·16	2751·15	2751·39	

TABLE XLVI.—Rectangular Co-ordinates in Chains of the Corners of $\frac{1}{8}$th Degree Squares, referred to the centre of the Degree as Origin.

Latitude			N. and S. of Origin	Distances in Arc E. or W. of Origin								
				30′ 0″		22′ 30″		15′ 0″		7′ 30″		0′ 0″
				Perpendicular	Meridian	Perpendicular	Meridian	Perpendicular	Meridian	Perpendicular	Meridian	Meridian
°	′	″										
20	0	0		2600·64	2755·12	1950·48	2753·42	1300·32	2752·20	650·16	2751·48	2751·23
19	52	30	North	2602·69	2067·27	1952·02	2065·58	1301·34	2064·38	650·67	2063·65	2063·41
	45	0		2604·72	1379·44	1953·54	1377·76	1302·36	1376·56	651·18	1375·84	1375·60
	37	30		2606·74	691·61	1955·06	689·95	1303·37	688·75	651·69	688·03	687·79
	30	0		2608·76	3·86	1956·57	2·14	1304·38	0·95	652·19	0·24	ORIGIN
	22	30		2610·75	684·01	1958·06	685·66	1305·38	686·84	652·69	687·55	687·79
	15	0		2612·74	1371·80	1959·55	1373·45	1306·37	1374·62	653·18	1375·33	1375·56
	7	30	South	2614·71	2059·59	1961·03	2061·22	1307·35	2062·39	653·68	2063·09	2063·33
19	0	0		2616·67	2747·37	1962·50	2749·00	1308·33	2750·10	654·17	2750·85	2751·08
19	0	0		2616·67	2754·65	1962·50	2753·02	1308·33	2751·87	654·17	2751·17	2750·94
18	52	30		2618·62	2066·89	1963·96	2065·27	1309·31	2064·11	654·65	2063·42	2063·19
	45	0		2620·55	1379·13	1965·41	1377·52	1310·28	1376·37	655·14	1375·68	1375·45
	37	30	North	2622·48	691·38	1966·86	689·77	1311·24	688·63	655·62	687·95	687·72
	30	0		2624·39	3·63	1968·29	2·04	1312·19	0·91	656·10	0·23	ORIGIN
	22	30		2626·28	684·10	1969·71	685·68	1313·14	686·81	656·57	687·49	687·71
	15	0		2628·17	1371·82	1971·13	1373·40	1314·09	1374·52	657·04	1375·19	1375·41
	7	30	South	2630·04	2059·54	1972·53	2061·10	1315·02	2062·22	657·51	2062·89	2063·11
18	0	0		2631·90	2747·24	1973·93	2748·79	1315·95	2749·91	657·98	2750·57	2750·79
18	0	0		2631·90	2754·20	1973·93	2752·65	1315·95	2751·54	657·98	2750·87	2750·65
17	52	30		2633·75	2066·50	1975·31	2064·96	1316·88	2063·86	658·44	2063·20	2062·98
	45	0		2635·59	1378·82	1976·69	1377·28	1317·79	1376·19	658·90	1375·53	1375·31
	37	30	North	2637·41	691·13	1978·06	689·61	1318·71	688·52	659·35	687·87	687·65
	30	0		2639·22	3·46	1979·42	1·94	1319·61	0·87	659·81	0·22	ORIGIN
	22	30		2641·02	684·20	1980·77	685·71	1320·51	686·78	660·26	687·43	687·64
	15	0		2642·80	1371·85	1982·10	1373·35	1321·40	1374·42	660·70	1375·06	1375·27
	7	30	South	2644·58	2059·50	1983·44	2060·99	1322·29	2062·05	661·15	2062·69	2062·90
17	0	0		2646·34	2747·14	1984·76	2748·62	1323·17	2749·67	661·59	2750·30	2750·52
17	0	0		2646·34	2753·76	1984·76	2752·28	1323·17	2751·22	661·59	2750·59	2750·38
16	52	30		2648·09	2066·13	1986·07	2064·66	1324·04	2063·61	662·02	2062·98	2062·77
	45	0		2649·82	1378·51	1987·37	1377·05	1324·91	1376·01	662·46	1375·38	1375·17
	37	30	North	2651·54	690·89	1988·66	689·45	1325·77	688·41	662·89	687·79	687·58
	30	0		2653·26	3·29	1989·94	1·83	1326·63	0·82	663·31	0·21	ORIGIN
	22	30		2654·95	684·31	1991·21	685·74	1327·48	686·76	663·74	687·37	687·58
	15	0		2656·64	1371·90	1992·48	1373·31	1328·32	1374·33	664·16	1374·94	1375·14
	7	30	South	2658·31	2059·48	1993·73	2060·89	1329·16	2061·89	664·58	2062·50	2062·70
16	0	0		2659·97	2747·05	1994·98	2748·45	1329·99	2749·45	664·99	2750·05	2750·25

TABLE XLVI.—Rectangular Co-ordinates in Chains of the Corners of $\frac{1}{8}$th Degree Squares, referred to the centre of the Degree as Origin.

Latitude	N. and S. of Origin	Distances in Arc E. or W. of Origin								
		30′ 0″		22′ 30″		15′ 0″		7′ 30″		0′ 0″
		Perpendicular	Meridian	Perpendicular	Meridian	Perpendicular	Meridian	Perpendicular	Meridian	Meridian
° ′ ″										
16 0 0	North	2659·97	2753·32	1994·98	2751·92	1329·99	2750·92	664·99	2750·32	2750·12
15 52 30		2661·62	2065·76	1996·22	2064·37	1330·81	2063·38	665·41	2062·78	2062·58
45 0		2663·26	1378·20	1997·44	1376·82	1331·63	1375·84	665·81	1375·24	1375·05
37 30		2664·88	690·65	1998·66	689·28	1332·44	688·30	666·22	687·72	687·52
30 0		2666·49	3·11	1999·87	1·75	1333·24	0·78	666·62	0·19	ORIGIN
22 30	South	2668·08	684·43	2001·06	685·78	1334·04	686·74	667·02	687·32	687·51
15 0		2669·67	1371·95	2002·25	1373·29	1334·83	1374·25	667·42	1374·82	1375·92
7 30		2671·24	2059·47	2003·43	2060·80	1335·62	2061·75	667·81	2062·32	2062·51
15 0 0		2672·80	2746·98	2004·60	2748·30	1336·40	2749·25	668·20	2749·81	2750·00
15 0 0	North	2672·80	2752·90	2004·60	2751·58	1336·40	2750·64	668·20	2750·07	2749·88
14 52 30		2674·34	2065·40	2005·76	2064·08	1337·17	2063·15	668·59	2062·59	2062·40
45 0		2675·88	1377·90	2006·91	1376·60	1337·94	1375·67	668·97	1375·11	1374·93
37 30		2677·40	690·41	2008·05	689·12	1338·70	688·20	669·35	687·64	687·46
30 0		2678·91	2·93	2009·18	1·65	1339·45	0·73	669·73	0·18	ORIGIN
22 30	South	2680·40	684·55	2010·30	685·81	1340·20	686·73	670·10	687·27	687·45
15 0		2681·89	1372·02	2011·42	1373·28	1340·94	1374·18	670·47	1374·72	1374·90
7 30		2683·36	2059·48	2012·52	2060·73	1341·68	2061·62	670·84	2062·16	2062·34
14 0 0		2684·82	2746·93	2013·61	2748·17	1342·41	2749·06	671·20	2749·59	2749·77
14 0 0	North	2684·82	2752·49	2013·61	2751·25	1342·41	2750·36	671·20	2749·83	2749·65
13 52 30		2686·26	2065·04	2014·70	2063·81	1343·13	2062·93	671·57	2062·41	2062·23
45 0		2687·69	1377·60	2015·77	1376·38	1343·85	1375·51	671·92	1374·99	1374·81
37 30		2689·11	690·17	2016·83	688·96	1344·56	688·09	672·28	687·58	687·40
30 0		2690·52	2·74	2017·89	1·54	1345·26	0·69	672·63	0·17	ORIGIN
22 30	South	2691·91	684·68	2018·93	685·87	1345·96	686·72	672·98	687·23	687·40
15 0		2693·30	1372·09	2019·97	1373·27	1346·65	1374·11	673·32	1374·62	1374·79
7 30		2694·66	2059·50	2021·00	2060·67	1347·33	2061·50	673·67	2062·00	2062·17
13 0 0		2696·02	2746·90	2022·02	2748·06	1348·01	2748·88	674·01	2749·38	2749·55
13 0 0	North	2696·02	2752·09	2022·02	2750·93	1348·01	2750·10	674·01	2749·61	2749·44
12 52 30		2697·36	2064·69	2023·02	2063·55	1348·68	2062·73	674·34	2062·24	2062·07
45 0		2698·69	1377·31	2024·02	1376·17	1349·35	1375·36	674·67	1374·87	1374·71
37 30		2700·01	689·93	2025·01	688·80	1350·00	687·99	675·00	687·51	687·35
30 0		2701·32	2·55	2025·99	1·43	1350·66	0·64	675·33	0·16	ORIGIN
22 30	South	2702·60	684·82	2026·95	685·92	1351·30	686·71	675·65	687·19	687·34
15 0		2703·88	1372·18	2027·91	1373·28	1351·94	1374·06	675·97	1374·53	1374·68
7 30		2705·15	2059·54	2028·86	2060·62	1352·58	2061·39	676·29	2061·86	2062·01
12 0 0		2706·40	2746·88	2029·80	2747·96	1353·20	2748·73	676·60	2749·19	2749·34

TABLE XLVI.—Rectangular Co-ordinates in Chains of the Corners of $\frac{1}{8}$th Degree Squares, referred to the centre of the Degree as Origin.

Latitude			N. and S. of Origin	Distances in Arc E. or W. of Origin									
				30′ 0″		22′ 30″		15′ 0″		7′ 30″		0′ 0″	
				Perpendicular	Meridian	Perpendicular	Meridian	Perpendicular	Meridian	Perpendicular	Meridian	Meridian	
°	′	″											
12	0	0		2706·40	2751·70	2029·80	2750·62	1353·20	2749·86	676·60	2749·40	2749·24	
11	52	30	North	2707·64	2064·35	2030·73	2063·29	1353·82	2062·53	676·91	2062·08	2061·92	
	45	0		2708·87	1377·02	2031·65	1375·96	1354·44	1375·21	677·22	1374·76	1374·61	
	37	30		2710·09	689·69	2032·57	688·64	1355·04	687·90	677·52	687·45	687·30	
	30	0		2711·29	2·36	2033·47	1·32	1355·65	0·59	677·82	0·15	ORIGIN	
	22	30		2712·48	684·96	2034·36	685·98	1356·24	686·71	678·12	687·15	687·30	
	15	0	South	2713·66	1372·28	2035·24	1373·29	1356·83	1374·01	678·41	1374·44	1374·59	
	7	30		2714·82	2059·58	2036·12	2060·58	1357·41	2061·30	678·71	2061·73	2061·87	
11	0	0		2715·97	2746·89	2036·98	2747·88	1357·99	2748·58	678·99	2749·01	2749·15	
11	0	0		2715·97	2751·32	2036·98	2750·33	1357·99	2749·62	678·99	2749·20	2749·06	
10	52	30		2717·11	2064·02	2037·83	2063·05	1358·55	2062·35	679·28	2061·93	2061·79	
	45	0	North	2718·23	1376·73	2038·67	1375·76	1359·12	1375·07	679·56	1374·66	1374·52	
	37	30		2719·34	689·45	2039·51	688·49	1359·67	687·80	679·84	687·39	687·26	
	30	0		2720·44	2·16	2040·33	1·22	1360·22	0·54	680·11	0·14	ORIGIN	
	22	30		2721·53	685·11	2041·15	686·05	1360·77	686·72	680·38	687·12	687·25	
	15	0		2722·60	1372·38	2041·95	1373·31	1361·30	1373·97	680·65	1374·37	1374·50	
	7	30	South	2723·66	2059·65	2042·75	2060·56	1361·83	2061·22	680·92	2061·61	2061·74	
10	0	0		2724·71	2746·91	2043·53	2747·81	1362·36	2748·46	681·18	2748·84	2748·97	
10	0	0		2724·71	2750·96	2043·53	2750·05	1362·36	2749·41	681·18	2749·02	2748·89	
9	52	30		2725·75	2063·70	2044·31	2062·81	1362·87	2062·17	681·44	2061·79	2061·66	
	45	0	North	2726·77	1376·45	2045·08	1375·57	1363·39	1374·94	681·69	1374·56	1374·44	
	37	30		2727·78	689·21	2045·84	688·33	1363·89	687·71	681·95	687·34	687·22	
	30	0		2728·78	1·97	2046·58	1·11	1364·39	0·49	682·19	0·12	ORIGIN	
	22	30		2729·76	685·27	2047·32	686·12	1364·88	686·73	682·44	687·09	687·21	
	15	0		2730·73	1372·50	2048·05	1373·34	1365·37	1373·94	682·68	1374·30	1374·42	
	7	30	South	2731·69	2059·73	2048·77	2060·56	1365·84	2061·15	682·92	2061·50	2061·62	
9	0	0		2732·63	2746·95	2049·47	2747·76	1366·32	2748·35	683·16	2748·70	2748·82	
9	0	0		2732·63	2750·61	2049·47	2749·79	1366·32	2749·21	683·16	2748·86	2748·74	
8	52	30		2733·56	2063·39	2050·17	2062·58	1366·78	2062·01	683·39	2061·66	2061·55	
	45	0	North	2734·48	1376·18	2050·86	1375·38	1367·24	1374·82	683·62	1374·47	1374·36	
	37	30		2735·39	688·97	2051·54	688·19	1367·69	687·63	683·85	687·29	687·18	
	30	0		2736·28	1·77	2052·21	0·99	1368·14	0·44	684·07	0·11	ORIGIN	
	22	30		2737·16	685·43	2052·87	686·19	1368·58	686·74	684·29	687·07	687·17	
	15	0		2738·03	1372·63	2053·52	1373·38	1369·01	1373·92	684·51	1374·24	1374·34	
	7	30	South	2738·88	2059·82	2054·16	2060·56	1369·44	2061·09	684·72	2061·40	2061·51	
8	0	0		2739·72	2747·01	2054·79	2747·73	1369·86	2748·25	684·93	2748·57	2748·67	

TABLE XLVI.—Rectangular Co-ordinates in Chains of the Corners of $\frac{1}{8}$th Degree Squares, referred to the centre of the Degree as Origin.

Latitude			N. and S. of Origin	Distances in Arc E. or W. of Origin									
				30′ 0″		22′ 30″		15′ 0″		7′ 30″		0′ 0″
				Perpendicular	Meridian	Perpendicular	Meridian	Perpendicular	Meridian	Perpendicular	Meridian	Meridian
°	′	″										
8	0	0		2739·72	2750·27	2054·79	2749·54	1369·86	2749·02	684·93	2748·71	2748·60
7	52	30	North	2740·55	2063·09	2055·41	2062·37	1370·28	2061·86	685·14	2061·55	2061·45
	45	0		2741·37	1375·91	2056·03	1375·20	1370·68	1374·70	685·34	1374·40	1374·30
	37	30		2742·17	688·73	2056·63	688·04	1371·08	687·54	685·54	687·24	687·15
	30	0		2742·96	1·56	2057·22	0·88	1371·48	0·39	685·74	0·10	ORIGIN
	22	30		2743·73	685·60	2057·80	686·28	1371·87	686·76	685·93	687·05	687·14
	15	0	South	2744·50	1372·77	2058·37	1373·43	1372·25	1373·90	686·12	1374·19	1374·28
	7	30		2745·25	2059·93	2058·94	2060·58	1372·62	2061·04	686·31	2061·32	2061·41
7	0	0		2745·98	2747·08	2059·49	2747·72	1372·99	2748·18	686·50	2748·45	2748·54
7	0	0		2745·98	2749·95	2059·49	2749·30	1372·99	2748·85	686·50	2748·58	2748·49
6	52	30		2746·71	2062·79	2060·03	2062·17	1373·35	2061·72	686·68	2061·45	2061·36
	45	0	North	2747·42	1375·65	2060·57	1375·03	1373·71	1374·59	686·86	1374·32	1374·24
	37	30		2748·12	688·50	2061·09	687·89	1374·06	687·46	687·03	687·20	687·12
	30	0		2748·80	1·36	2061·60	0·77	1374·40	0·34	687·20	0·09	ORIGIN
	22	30		2749·48	685·78	2062·11	686·37	1374·74	686·78	687·37	687·03	687·11
	15	0	South	2750·14	1372·92	2062·60	1373·48	1375·07	1373·90	687·53	1374·14	1374·22
	7	30		2750·78	2060·05	2063·09	2060·61	1375·39	2061·01	687·70	2061·25	2061·33
6	0	0		2751·42	2747·18	2063·56	2747·73	1375·71	2748·12	687·85	2748·35	2748·43
6	0	0		2751·42	2749·64	2063·56	2749·08	1375·71	2748·70	687·85	2748·46	2748·38
5	52	30		2752·04	2062·51	2064·03	2061·98	1376·02	2061·59	688·01	2061·36	2061·28
	45	0	North	2752·64	1375·39	2064·48	1374·86	1376·32	1374·49	688·16	1374·26	1374·19
	37	30		2753·24	688·27	2064·93	687·76	1376·62	687·39	688·31	687·17	687·09
	30	0		2753·82	1·15	2065·36	0·65	1376·91	0·29	688·45	0·07	ORIGIN
	22	30		2754·38	685·96	2065·79	686·46	1377·19	686·81	688·60	687·02	687·09
	15	0	South	2754·94	1373·07	2066·21	1373·55	1377·47	1373·90	688·74	1374·11	1374·17
	7	30		2755·48	2060·18	2066·61	2060·65	1377·74	2060·99	688·87	2061·19	2061·26
5	0	0		2756·01	2747·29	2067·01	2747·74	1378·01	2748·07	689·00	2748·27	2748·34
5	0	0		2756·01	2749·34	2067·01	2748·89	1378·01	2748·56	689·00	2748·36	2748·30
4	52	30		2756·53	2062·24	2067·40	2061·79	1378·26	2061·47	689·13	2061·28	2061·22
	45	0	North	2757·03	1375·14	2067·77	1374·70	1378·52	1374·39	689·26	1374·20	1374·14
	37	30		2757·52	688·04	2068·14	687·62	1378·76	687·31	689·38	687·13	687·07
	30	0		2758·00	0·94	2068·50	0·53	1379·00	0·24	689·50	0·06	ORIGIN
	22	30		2758·46	686·15	2068·85	686·56	1379·23	686·84	689·62	687·01	687·07
	15	0	South	2758·91	1373·24	2069·18	1373·63	1379·46	1373·91	689·73	1374·08	1374·13
	7	30		2759·35	2060·33	2069·51	2060·71	1379·68	2060·98	689·84	2061·14	2061·20
4	0	0		2759·78	2747·42	2069·83	2747·78	1379·89	2748·05	689·94	2748·21	2748·26

TABLE XLVI.—Rectangular Co-ordinates in Chains of the Corners of $\frac{1}{8}$th Degree Squares, referred to the centre of the Degree as Origin.

Latitude			N. and S. of Origin	Distances in Arc E. or W. of Origin									
				30′ 0″		22′ 30″		15′ 0″		7′ 30″		0′ 0″	
				Perpendicular	Meridian	Perpendicular	Meridian	Perpendicular	Meridian	Perpendicular	Meridian	Meridian	
°	′	″											
4	0	0		2759·78	2749·06	2069·83	2748·70	1379·89	2748·43	689·94	2748·28	2748·22	
3	52	30		2760·19	2061·98	2070·14	2061·62	1380·09	2061·37	690·05	2061·22	2061·17	
	45	0		2760·59	1374·90	2070·44	1374·55	1380·29	1374·31	690·15	1374·16	1374·11	
	37	30		2760·97	687·82	2070·73	687·49	1380·49	687·24	690·24	687·10	687·05	
	30	0		2761·34	0·74	2071·01	0·41	1380·67	0·18	690·34	0·05	ORIGIN	
	22	30		2761·70	686·34	2071·28	686·66	1380·85	686·87	690·43	687·01	687·05	
	15	0		2762·05	1373·42	2071·54	1373·71	1381·03	1373·93	690·51	1374·06	1374·10	
	7	30		2762·38	2060·49	2071·79	2060·78	1381·19	2060·99	690·60	2061·11	2061·15	
3	0	0	South	2762·70	2747·56	2072·03	2747·84	1381·35	2748·04	690·68	2748·16	2748·20	
3	0	0		2762·70	2748·80	2072·03	2748·52	1381·35	2748·33	690·68	2748·21	2748·17	
2	52	30		2763·01	2061·73	2072·26	2061·47	1381·51	2061·28	690·75	2061·16	2061·13	
	45	0		2763·30	1374·66	2072·48	1374·41	1381·65	1374·23	690·83	1374·12	1374·08	
	37	30		2763·59	687·59	2072·69	687·36	1381·79	687·18	690·90	687·08	687·04	
	30	0		2763·86	0·53	2072·89	0·30	1381·93	0·13	690·96	0·03	ORIGIN	
	22	30		2764·11	686·54	2073·08	686·76	1382·05	686·91	691·03	687·01	687·04	
	15	0		2764·35	1373·60	2073·26	1373·81	1382·18	1373·96	691·09	1374·05	1374·08	
	7	30		2764·58	2060·67	2073·44	2060·86	1382·29	2061·00	691·15	2061·09	2061·11	
2	0	0	South	2764·80	2747·73	2073·60	2747·92	1382·40	2748·04	691·20	2748·12	2748·15	
2	0	0		2764·80	2748·55	2073·60	2748·37	1382·40	2748·24	691·20	2748·16	2748·13	
1	52	30		2765·00	2061·49	2073·75	2061·32	1382·50	2061·20	691·25	2061·12	2061·10	
	45	0		2765·19	1374·43	2073·89	1374·27	1382·59	1374·16	691·30	1374·09	1374·07	
	37	30		2765·36	687·37	2074·02	687·22	1382·68	687·12	691·34	687·05	687·03	
	30	0		2765·53	0·32	2074·15	0·18	1382·76	0·08	691·38	0·02	ORIGIN	
	22	30		2765·68	686·74	2074·26	686·87	1382·84	686·96	691·42	687·01	687·03	
	15	0		2765·82	1373·80	2074·36	1373·92	1382·91	1374·00	691·45	1374·05	1374·06	
	7	30		2765·94	2060·86	2074·46	2060·96	1382·97	2061·03	691·49	2061·08	2061·09	
1	0	0	South	2766·05	2747·91	2074·54	2748·00	1383·03	2748·07	691·51	2748·11	2748·12	
1	0	0		2766·05	2748·32	2074·54	2748·23	1383·03	2748·16	691·51	2748·12	2748·11	
0	52	30		2766·15	2061·27	2074·61	2061·19	1383·07	2061·13	691·54	2061·10	2061·08	
	45	0		2766·24	1374·21	2074·68	1374·15	1383·12	1374·09	691·56	1374·07	1374·06	
	37	30		2766·31	687·16	2074·73	687·10	1383·15	687·06	691·58	687·04	687·03	
	30	0		2766·36	0·11	2074·77	0·06	1383·18	0·03	691·59	0·01	ORIGIN	
	22	30		2766·41	686·95	2074·81	686·98	1383·21	687·01	691·60	687·02	687·03	
	15	0		2766·44	1374·00	2074·83	1374·03	1383·22	1374·04	691·61	1374·05	1374·05	
	7	30		2766·46	2061·06	2074·85	2061·06	1383·23	2061·07	691·62	2061·08	2061·08	
0	0	0	South	2766·47	2748·11	2074·85	2748·11	1383·24	2748·11	691·62	2748·11	2748·11	

TABLE XLVII.—Convergency between Meridians 1 Mile apart measured on Parallels of Latitude.

Latitude													
	0′	5′	10′	15′	20′	25′	30′	35′	40′	45′	50′	55′	60′
°	″	″	″	″	″	″	″	″	″	″	″	″	″
0	0·0	0·1	0·2	0·2	0·3	0·4	0·5	0·5	0·6	0·7	0·8	0·8	0·9
1	0·9	1·0	1·1	1·1	1·2	1·3	1·4	1·4	1·5	1·6	1·7	1·7	1·8
2	1·8	1·9	2·0	2·0	2·1	2·2	2·3	2·3	2·4	2·5	2·6	2·7	2·7
3	2·7	2·8	2·9	3·0	3·0	3·1	3·2	3·3	3·3	3·4	3·5	3·6	3·6
4	3·6	3·7	3·8	3·9	3·9	4·0	4·1	4·2	4·2	4·3	4·4	4·5	4·6
5	4·6	4·6	4·7	4·8	4·9	4·9	5·0	5·1	5·2	5·2	5·3	5·4	5·5
6	5·5	5·5	5·6	5·7	5·8	5·9	5·9	6·0	6·1	6·2	6·2	6·3	6·4
7	6·4	6·5	6·5	6·6	6·7	6·8	6·9	6·9	7·0	7·1	7·2	7·2	7·3
8	7·3	7·4	7·5	7·5	7·6	7·7	7·8	7·9	7·9	8·0	8·1	8·2	8·2
9	8·2	8·3	8·4	8·5	8·6	8·6	8·7	8·8	8·9	8·9	9·0	9·1	9·2
10	9·2	9·3	9·3	9·4	9·5	9·6	9·6	9·7	9·8	9·9	10·0	10·0	10·1
11	10·1	10·2	10·3	10·4	10·4	10·5	10·6	10·7	10·7	10·8	10·9	11·0	11·1
12	11·1	11·1	11·2	11·3	11·4	11·5	11·5	11·6	11·7	11·8	11·9	11·9	12·0
13	12·0	12·1	12·2	12·3	12·3	12·4	12·5	12·6	12·7	12·7	12·8	12·9	13·0
14	13·0	13·1	13·1	13·2	13·3	13·4	13·5	13·5	13·6	13·7	13·8	13·9	13·9
15	13·9	14·0	14·1	14·2	14·3	14·3	14·4	14·5	14·6	14·7	14·8	14·8	14·9
16	14·9	15·0	15·1	15·2	15·3	15·3	15·4	15·5	15·6	15·7	15·7	15·8	15·9
17	15·9	16·0	16·1	16·2	16·2	16·3	16·4	16·5	16·6	16·7	16·7	16·8	16·9
18	16·9	17·0	17·1	17·2	17·2	17·3	17·4	17·5	17·6	17·7	17·7	17·8	17·9
19	17·9	18·0	18·1	18·2	18·3	18·3	18·4	18·5	18·6	18·7	18·8	18·8	18·9
20	18·9	19·0	19·1	19·2	19·3	19·4	19·5	19·5	19·6	19·7	19·8	19·9	20·0
21	20·0	20·1	20·1	20·2	20·3	20·4	20·5	20·6	20·7	20·8	20·8	20·9	21·0
22	21·0	21·1	21·2	21·3	21·4	21·5	21·5	21·6	21·7	21·8	21·9	22·0	22·1
23	22·1	22·2	22·3	22·4	22·4	22·5	22·6	22·7	22·8	22·9	23·0	23·1	23·2
24	23·2	23·2	23·3	23·4	23·5	23·6	23·7	23·8	23·9	24·0	24·1	24·2	24·3
25	24·3	24·3	24·4	24·5	24·6	24·7	24·8	24·9	25·0	25·1	25·2	25·3	25·4
26	25·4	25·5	25·6	25·7	25·7	25·8	25·9	26·0	26·1	26·2	26·3	26·4	26·5
27	26·5	26·6	26·7	26·8	26·9	27·0	27·1	27·2	27·3	27·4	27·5	27·6	27·7
28	27·7	27·8	27·8	27·9	28·0	28·1	28·2	28·3	28·4	28·5	28·6	28·7	28·8
29	28·8	28·9	29·0	29·1	29·2	29·3	29·4	29·5	29·6	29·7	29·8	29·9	30·0
30	30·0	30·1	30·2	30·3	30·4	30·5	30·6	30·7	30·8	30·9	31·0	31·1	31·2
31	31·2	31·4	31·5	31·6	31·7	31·8	31·9	32·0	32·1	32·2	32·3	32·4	32·5
32	32·5	32·6	32·7	32·8	32·9	33·0	33·1	33·2	33·3	33·5	33·6	33·7	33·8
33	33·8	33·9	34·0	34·1	34·2	34·3	34·4	34·5	34·6	34·7	34·9	35·0	35·1
34	35·1	35·2	35·3	35·4	35·5	35·6	35·7	35·8	36·0	36·1	36·2	36·3	36·4
35	36·4	36·5	36·6	36·7	36·9	37·0	37·1	37·2	37·3	37·4	37·5	37·7	37·8
36	37·8	37·9	38·0	38·1	38·2	38·3	38·5	38·6	38·7	38·8	38·9	39·1	39·2
37	39·2	39·3	39·4	39·5	39·6	39·8	39·9	40·0	40·1	40·3	40·4	40·5	40·6
38	40·6	40·7	40·9	41·0	41·1	41·2	41·3	41·5	41·6	41·7	41·8	42·0	42·1
39	42·1	42·2	42·3	42·5	42·6	42·7	42·8	43·0	43·1	43·2	43·4	43·5	43·6

TABLE XLVIII.—Lengths of Circular Arcs.

Degrees	Arc	Degrees	Arc	Degrees	Arc	Minutes	Arc	Seconds	Arc	Seconds	Arc	Seconds	Arc
1	0·0174533	61	1·0646508	121	2·1118484	1	0·0002909	1	0·0000048	·01	0·0000000	·61	0·0000030
2	0349066	62	0821041	122	1293017	2	05818	2	097	·02	1	·62	30
3	0523599	63	0995574	123	1467550	3	08727	3	145	·03	1	·63	31
4	0698132	64	1170107	124	1642083	4	11636	4	194	·04	2	·64	31
5	0872665	65	1344640	125	1816616	5	14544	5	242	·05	2	·65	32
6	0·1047198	66	1·1519173	126	2·1991149	6	0·0017453	6	0·0000291	·06	0·0000003	·66	0·0000032
7	1221730	67	1693706	127	2165682	7	20362	7	339	·07	3	·67	32
8	1396263	68	1868239	128	2340214	8	23271	8	388	·08	4	·68	33
9	1570796	69	2042772	129	2514747	9	26180	9	436	·09	4	·69	33
10	1745329	70	2217305	130	2689280	10	29089	10	485	·10	5	·70	34
11	0·1919862	71	1·2391838	131	2·2863813	11	0·0031998	11	0·0000533	·11	0·0000005	·71	0·0000034
12	2094395	72	2566371	132	3038346	12	34907	12	582	·12	6	·72	35
13	2268928	73	2740904	133	3212879	13	37815	13	630	·13	6	·73	35
14	2443461	74	2915436	134	3387412	14	40724	14	679	·14	7	·74	36
15	2617994	75	3089969	135	3561945	15	43633	15	727	·15	7	·75	36
16	0·2792527	76	1·3264502	136	2·3736478	16	0·0046542	16	0·0000776	·16	0·0000008	·76	0·0000037
17	2967060	77	3439035	137	3911011	17	49451	17	824	·17	8	·77	37
18	3141593	78	3613568	138	4085544	18	52360	18	873	·18	9	·78	38
19	3316126	79	3788101	139	4260077	19	55269	19	921	·19	9	·79	38
20	3490659	80	3962634	140	4434610	20	58178	20	970	·20	10	·80	39
21	0·3665191	81	1·4137167	141	2·4609142	21	0·0061087	21	0·0001018	·21	0·0000010	·81	0·0000039
22	3839724	82	4311700	142	4783675	22	63995	22	1067	·22	11	·82	40
23	4014257	83	4486233	143	4958208	23	66904	23	1115	·23	11	·83	40
24	4188790	84	4660766	144	5132741	24	69813	24	1164	·24	12	·84	41
25	4363323	85	4835299	145	5307274	25	72722	25	1212	·25	12	·85	41
26	0·4537856	86	1·5009832	146	2·5481807	26	0·0075631	26	0·0001261	·26	0·0000013	·86	0·0000042
27	4712389	87	5184364	147	5656340	27	78540	27	1309	·27	13	·87	42
28	4886922	88	5358897	148	5830873	28	81449	28	1357	·28	14	·88	43
29	5061455	89	5533430	149	6005406	29	84358	29	1406	·29	14	·89	43
30	5235988	90	5707963	150	6179939	30	87266	30	1454	·30	15	·90	44
31	0·5410521	91	1·5882496	151	2·6354472	31	0·0090175	31	0·0001503	·31	0·0000015	·91	0·0000044
32	5585054	92	6057029	152	6529005	32	93084	32	1551	·32	16	·92	45
33	5759587	93	6231562	153	6703538	33	95993	33	1600	·33	16	·93	45
34	5934119	94	6406095	154	6878070	34	98902	34	1648	·34	16	·94	46
35	6108652	95	6580628	155	7052603	35	0·0101811	35	1697	·35	17	·95	46
36	0·6283185	96	1·6755161	156	2·7227136	36	0·0104720	36	0·0001745	·36	0·0000017	·96	0·0000047
37	6457718	97	6929694	157	7401669	37	107629	37	1794	·37	18	·97	47
38	6632251	98	7104227	158	7576202	38	110538	38	1842	·38	18	·98	48
39	6806784	99	7278760	159	7750735	39	113446	39	1891	·39	19	·99	48
40	6981317	100	7453293	160	7925268	40	116355	40	1939	·40	19		
41	0·7155850	101	1·7627825	161	2·8099801	41	0·0119264	41	0·0001988	·41	0·0000020		
42	7330383	102	7802358	162	8274334	42	122173	42	2036	·42	20		
43	7504916	103	7976891	163	8448867	43	125082	43	2085	·43	21		
44	7679449	104	8151424	164	8623400	44	127991	44	2133	·44	21		
45	7853982	105	8325957	165	8797933	45	130900	45	2182	·45	22		
46	0·8028515	106	1·8500490	166	2·8972466	46	0·0133809	46	0·0002230	·46	0·0000022		
47	8203047	107	8675023	167	9146999	47	136717	47	2279	·47	23		
48	8377580	108	8849556	168	9321531	48	139626	48	2327	·48	23		
49	8552113	109	9024089	169	9496064	49	142535	49	2376	·49	24		
50	8726646	110	9198622	170	9670597	50	145444	50	2424	·50	24		
51	0·8901179	111	1·9373155	171	2·9845130	51	0·0148353	51	0·0002473	·51	0·0000025		
52	9075712	112	9547688	172	3·0019663	52	151262	52	2521	·52	25		
53	9250245	113	9722221	173	0194196	53	154171	53	2570	·53	26		
54	9424778	114	9896753	174	0368729	54	157080	54	2618	·54	26		
55	9599311	115	2·0071286	175	0543262	55	159989	55	2666	·55	27		
56	0·9773844	116	2·0245819	176	3·0717795	56	0·0162897	56	0·0002715	·56	0·0000027		
57	9948377	117	0420352	177	0892328	57	165806	57	2763	·57	28		
58	1·0122910	118	0594885	178	1066861	58	168715	58	2812	·58	28		
59	0297443	119	0769418	179	1241394	59	171624	59	2860	·59	29		
60	0471976	120	0943951	180	1415927	60	174533	60	2909	·60	29		

TABLE XLIX.—Gauss's Sum and Difference Logarithms.

A	B										C									
	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
0·00	0·30103	0053	0003	9953	9903	9854	9804	9754	9705	9655	0·30103	0153	0203	0253	0303	0354	0404	0454	0505	0555
0·01	0·29606	9556	9507	9458	9409	9359	9310	9261	9212	9163		0606	0656	0707	0758	0809	0859	0910	0961	1012 1063
0·02		9115	9066	9017	8968	8920	8871	8822	8774	8726 8677		1115	1166	1217	1268	1320	1371	1422	1474	1526 1577
0·03		8629	8581	8532	8484	8436	8388	8340	8292	8245 8197		1629	1681	1732	1784	1836	1888	1940	1992	2045 2097
0·04		8149	8101	8054	8006	7959	7911	7864	7817	7769 7722		2149	2201	2254	2306	2359	2411	2464	2517	2569 2622
0·05		7675	7628	7581	7534	7487	7440	7393	7346	7300 7253		2675	2728	2781	2834	2887	2940	2993	3046	3100 3153
0·06		7207	7160	7114	7067	7021	6974	6928	6882	6836 6790		3207	3260	3314	3367	3421	3474	3528	3582	3636 3690
0·07		6744	6698	6652	6606	6560	6515	6469	6423	6378 6332		3744	3798	3852	3906	3960	4015	4069	4123	4178 4232
0·08		6287	6242	6196	6151	6106	6061	6016	5970	5926 5881		4287	4342	4396	4451	4506	4561	4616	4670	4726 4781
0·09		5836	5791	5746	5701	5657	5612	5568	5523	5479 5434		4836	4891	4946	5001	5057	5112	5168	5223	5279 5334
0·10	0·25390	5346	5302	5258	5214	5170	5126	5082	5038	4994	0·35390	5446	5502	5558	5614	5670	5726	5782	5838	5894
0·11		4950	4907	4863	4819	4776	4733	4689	4646	4603 4559		5950	6007	6063	6119	6176	6233	6289	6346	6403 6459
0·12		4516	4473	4430	4387	4344	4301	4258	4216	4173 4130		6516	6573	6630	6687	6744	6801	6858	6916	6973 7030
0·13		4088	4045	4003	3960	3918	3875	3833	3791	3749 3707		7088	7145	7203	7260	7318	7375	7433	7491	7549 7607
0·14		3665	3623	3581	3539	3497	3455	3414	3372	3330 3289		7665	7723	7781	7839	7897	7955	8014	8072	8130 8189
0·15		3247	3206	3165	3123	3082	3041	3000	2959	2918 2877		8247	8306	8365	8423	8482	8541	8600	8659	8718 8777
0·16		2836	2795	2754	2713	2673	2632	2591	2551	2510 2470		8836	8895	8954	9013	9073	9132	9191	9251	9310 9370
0·17		2430	2389	2349	2309	2269	2229	2189	2149	2109 2069		9430	9489	9549	9609	9669	9729	9789	9849	9909 9969
0·18		2029	1989	1949	1910	1870	1831	1791	1752	1712 1673	0·40029	0089	0149	0210	0270	0331	0391	0452	0512	0573
0·19		1634	1595	1556	1516	1477	1438	1399	1361	1322 1283		0634	0695	0756	0816	0877	0938	0999	1061	1122 1183
0·20	0·21244	1206	1167	1128	1090	1052	1013	0975	0937	0898	0·41244	1306	1367	1428	1490	1552	1613	1675	1737	1798
0·21		0860	0822	0784	0746	0708	0670	0632	0594	0557 0519		1860	1922	1984	2046	2108	2170	2232	2294	2357 2419
0·22		0481	0444	0406	0369	0331	0294	0257	0220	0182 0145		2481	2544	2606	2669	2731	2794	2857	2920	2982 3045
0·23		0108	0071	0034	9997	9960	9923	9887	9850	9813 9777		3108	3171	3234	3297	3360	3423	3487	3550	3613 3677
0·24	0·19740	9704	9667	9631	9595	9558	9522	9486	9450	9414		3740	3804	3867	3931	3995	4058	4122	4186	4250 4314
0·25		9378	9342	9306	9270	9234	9198	9163	9127	9091 9056		4378	4442	4506	4570	4634	4698	4763	4827	4891 4956
0·26		9020	8985	8949	8914	8879	8844	8808	8773	8738 8703		5020	5085	5149	5214	5279	5344	5408	5473	5538 5603
0·27		8668	8633	8599	8564	8529	8494	8460	8425	8390 8356		5668	5733	5799	5864	5929	5994	6060	6125	6190 6256
0·28		8322	8287	8253	8218	8184	8150	8116	8082	8048 8014		6322	6387	6453	6518	6584	6650	6716	6782	6848 6914
0·29		7980	7946	7912	7878	7845	7811	7777	7744	7710 7677		6980	7046	7112	7178	7245	7311	7377	7444	7510 7577
0·30	0·17643	7610	7577	7544	7510	7477	7444	7411	7378	7345	0·47643	7710	7777	7844	7910	7977	8044	8111	8178	8245
0·31		7312	7279	7247	7214	7181	7148	7116	7083	7051 7018		8312	8379	8447	8514	8581	8648	8716	8783	8851 8918
0·32		6986	6954	6921	6889	6857	6825	6793	6761	6729 6697		8986	9054	9121	9189	9257	9325	9393	9461	9529 9597
0·33		6665	6633	6601	6569	6538	6506	6474	6443	6411 6380		9665	9733	9801	9869	9938	0006	0074	0143	0211 0280
0·34		6349	6317	6286	6255	6224	6192	6161	6130	6099 6068	0·50349	0417	0486	0555	0624	0692	0761	0830	0899	0968
0·35		6037	6007	5976	5945	5914	5884	5853	5822	5792 5761		1037	1107	1176	1245	1314	1384	1453	1522	1592 1661
0·36		5731	5701	5670	5640	5610	5580	5550	5520	5489 5460		1731	1801	1870	1940	2010	2080	2150	2220	2289 2360
0·37		5430	5400	5370	5340	5310	5281	5251	5221	5192 5162		2430	2500	2570	2640	2710	2781	2851	2921	2992 3062
0·38		5133	5104	5074	5045	5016	4986	4957	4928	4899 4870		3133	3204	3274	3345	3416	3486	3557	3628	3699 3770
0·39		4841	4812	4783	4755	4726	4697	4668	4640	4611 4583		3841	3912	3983	4055	4126	4197	4268	4340	4411 4483
0·40	0·14554	4526	4497	4469	4441	4412	4384	4356	4328	4300	0·54554	4626	4697	4769	4841	4912	4984	5056	5128	5200
0·41		4272	4244	4216	4188	4160	4132	4104	4077	4049 4021		5272	5344	5416	5488	5560	5632	5704	5777	5849 5921
0·42		3994	3966	3939	3911	3884	3857	3829	3802	3775 3748		5994	6066	6139	6211	6284	6357	6429	6502	6575 6648
0·43		3721	3694	3667	3640	3613	3586	3559	3532	3505 3479		6721	6794	6867	6940	7013	7086	7159	7232	7305 7379
0·44		3452	3425	3399	3372	3346	3319	3293	3267	3240 3214		7452	7525	7599	7672	7746	7819	7893	7967	8040 8114
0·45		3188	3162	3136	3110	3084	3058	3032	3006	2980 2954		8188	8262	8336	8410	8484	8558	8632	8706	8780 8854
0·46		2928	2903	2877	2851	2826	2800	2775	2749	2724 2698		8928	9003	9077	9151	9226	9300	9375	9449	9524 9598
0·47		2673	2648	2622	2597	2572	2547	2522	2497	2472 2447		9673	9748	9822	9897	9972	0047	0122	0197	0272 0347
0·48		2422	2397	2372	2348	2323	2298	2274	2249	2224 2200	0·60422	0497	0572	0648	0723	0798	0874	0949	1024	1100
0·49		2175	2151	2127	2102	2078	2054	2030	2005	1981 1957		1175	1251	1327	1402	1478	1554	1630	1705	1781 1857
	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9

TABLE XLIX.—Gauss's Sum and Difference Logarithms.

A	B										C									
	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
0·50	0·11933	1909	1885	1861	1837	1814	1790	1766	1742	1719	0·61933	2009	2085	2161	2237	2314	2390	2466	2542	2619
0·51	1695	1671	1648	1624	1601	1577	1554	1531	1507	1484	2695	2771	2848	2924	3001	3077	3154	3231	3307	3384
0·52	1461	1438	1415	1392	1368	1345	1323	1300	1277	1254	3461	3538	3615	3692	3768	3845	3923	4000	4077	4154
0·53	1231	1208	1186	1163	1140	1118	1095	1073	1050	1028	4231	4308	4386	4463	4540	4618	4695	4773	4850	4928
0·54	1005	0983	0960	0938	0916	0894	0872	0849	0827	0805	5005	5083	5160	5238	5316	5394	5472	5549	5627	5705
0·55	9783	0761	0739	0718	0696	0674	0652	0630	0609	0587	5783	5861	5939	6018	6096	6174	6252	6330	6409	6487
0·56	0565	0544	0522	0501	0479	0458	0437	0415	0394	0373	6565	6644	6722	6801	6879	6958	7037	7115	7194	7273
0·57	0351	0330	0309	0288	0267	0246	0225	0204	0183	0162	7351	7430	7509	7588	7667	7746	7825	7904	7983	8062
0·58	0141	0120	0100	0079	0058	0038	0017	9996	9976	9955	8141	8220	8300	8379	8458	8538	8617	8696	8776	8855
0·59	0·09935	9914	9894	9874	9853	9833	9813	9793	9773	9752	8935	9014	9094	9174	9253	9333	9413	9493	9573	9652
0·60	0·09732	9712	9692	9672	9652	9632	9612	9593	9573	9553	0·69732	9812	9892	9972	0052	0132	0212	0293	0373	0453
0·61	9533	9514	9494	9474	9455	9435	9416	9396	9377	9357	0·70533	0614	0694	0774	0855	0935	1016	1096	1177	1257
0·62	9338	9319	9299	9280	9261	9242	9223	9204	9184	9165	1338	1419	1499	1580	1661	1742	1823	1904	1984	2065
0·63	9146	9127	9108	9090	9071	9052	9033	9014	8996	8977	2146	2227	2308	2390	2471	2552	2633	2714	2796	2877
0·64	8958	8940	8921	8902	8884	8865	8847	8829	8810	8792	2958	3040	3121	3202	3284	3365	3447	3529	3610	3692
0·65	8774	8755	8737	8719	8701	8683	8664	8646	8628	8610	3774	3855	3937	4019	4101	4183	4264	4346	4428	4510
0·66	8592	8574	8557	8539	8521	8503	8485	8468	8450	8432	4592	4674	4757	4839	4921	5003	5085	5168	5250	5332
0·67	8415	8397	8379	8362	8344	8327	8309	8292	8275	8257	5415	5497	5579	5662	5744	5827	5909	5992	6075	6157
0·68	8240	8223	8206	8188	8171	8154	8137	8120	8103	8086	6240	6323	6406	6488	6571	6654	6737	6820	6903	6986
0·69	8069	8052	8035	8018	8001	7985	7968	7951	7934	7918	7069	7152	7235	7318	7401	7485	7568	7651	7734	7818
0·70	0·07901	7884	7868	7851	7835	7818	7802	7785	7769	7753	0·77901	7984	8068	8151	8235	8318	8402	8485	8569	8653
0·71	7736	7720	7704	7687	7671	7655	7639	7623	7607	7591	8736	8820	8904	8987	9071	9155	9239	9323	9407	9491
0·72	7575	7559	7543	7527	7511	7495	7479	7463	7448	7432	9575	9659	9743	9827	9911	9995	0079	0163	0248	0332
0·73	7416	7400	7385	7369	7354	7338	7322	7307	7291	7276	0·80416	0500	0585	0669	0754	0838	0922	1007	1091	1176
0·74	7261	7245	7230	7215	7199	7184	7169	7154	7138	7123	1261	1345	1430	1515	1599	1684	1769	1854	1938	2023
0·75	7108	7093	7078	7063	7048	7033	7018	7003	6988	6973	2108	2193	2278	2363	2448	2533	2618	2703	2788	2873
0·76	6959	6944	6929	6914	6900	6885	6870	6856	6841	6827	2959	3044	3129	3214	3300	3385	3470	3556	3641	3727
0·77	6812	6798	6783	6769	6754	6740	6725	6711	6697	6683	3812	3898	3983	4069	4154	4240	4325	4411	4497	4583
0·78	6668	6654	6640	6626	6612	6597	6583	6569	6555	6541	4668	4754	4840	4926	5012	5097	5183	5269	5355	5441
0·79	6527	6513	6500	6486	6472	6458	6444	6430	6417	6403	5527	5613	5700	5786	5872	5958	6044	6130	6217	6303
0·80	0·06389	6376	6362	6348	6335	6321	6308	6294	6281	6267	0·86389	6476	6562	6648	6735	6821	6908	6994	7081	7167
0·81	6254	6240	6227	6214	6200	6187	6174	6161	6147	6134	7254	7340	7427	7514	7600	7687	7774	7861	7947	8034
0·82	6121	6108	6095	6082	6069	6056	6043	6030	6017	6004	8121	8208	8295	8382	8469	8556	8643	8730	8817	8904
0·83	5991	5978	5965	5952	5939	5927	5914	5901	5889	5876	8991	9078	9165	9252	9339	9427	9514	9601	9689	9776
0·84	5863	5851	5838	5825	5813	5800	5788	5775	5763	5751	9863	9951	0038	0125	0213	0300	0388	0475	0563	0651
0·85	5738	5726	5714	5701	5689	5677	5664	5652	5640	5628	0·90738	0826	0914	1001	1089	1177	1264	1352	1440	1528
0·86	5616	5604	5591	5579	5567	5555	5543	5531	5519	5508	1616	1704	1791	1879	1967	2055	2143	2231	2319	2408
0·87	5496	5484	5472	5460	5448	5436	5425	5413	5401	5390	2496	2584	2672	2760	2848	2936	3025	3113	3201	3290
0·88	5378	5366	5355	5343	5332	5320	5308	5297	5286	5274	3378	3466	3555	3643	3732	3820	3908	3997	4086	4174
0·89	5263	5251	5240	5229	5217	5206	5195	5183	5172	5161	4263	4351	4440	4529	4617	4706	4795	4883	4972	5061
0·90	0·05150	5139	5127	5116	5105	5094	5083	5072	5061	5050	0·95150	5239	5327	5416	5505	5594	5683	5772	5861	5950
0·91	5039	5028	5017	5006	4995	4985	4974	4963	4952	4941	6039	6128	6217	6306	6395	6485	6574	6663	6752	6841
0·92	4931	4920	4909	4898	4888	4877	4867	4856	4845	4835	6931	7020	7109	7198	7288	7377	7467	7556	7645	7735
0·93	4824	4814	4803	4793	4782	4772	4762	4751	4741	4731	7824	7914	8003	8093	8182	8272	8362	8451	8541	8631
0·94	4720	4710	4700	4689	4679	4669	4659	4649	4639	4628	8720	8810	8900	8989	9079	9169	9259	9349	9439	9528
0·95	4618	4608	4598	4588	4578	4568	4558	4548	4538	4528	9618	9708	9798	9888	9978	0068	0158	0248	0338	0428
0·96	4519	4509	4499	4489	4479	4469	4460	4450	4440	4430	1·00519	0609	0699	0789	0879	0969	1060	1150	1240	1330
0·97	4421	4411	4401	4392	4382	4373	4363	4353	4344	4334	1421	1511	1601	1692	1782	1873	1963	2053	2144	2234
0·98	4325	4315	4306	4297	4287	4278	4268	4259	4250	4240	2325	2415	2506	2597	2687	2778	2868	2959	3050	3140
0·99	4231	4222	4213	4203	4194	4185	4176	4167	4157	4148	3231	3322	3413	3503	3594	3685	3776	3867	3957	4048
	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9

TABLE XLIX.—Gauss's Sum and Difference Logarithms.

A	B										C									
	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1·00	0·04139	4130	4121	4112	4103	4094	4085	4076	4067	4058	1·04139	4230	4321	4412	4503	4594	4685	4776	4867	4958
1·01	4049	4040	4032	4023	4014	4005	3996	3987	3979	3970	5049	5140	5232	5323	5414	5505	5596	5687	5779	5870
1·02	3961	3953	3944	3935	3926	3918	3909	3901	3892	3883	5961	6053	6144	6235	6326	6418	6509	6601	6692	6784
1·03	3875	3866	3858	3849	3841	3832	3824	3816	3807	3799	6875	6966	7058	7149	7241	7332	7424	7516	7607	7699
1·04	3790	3782	3774	3765	3757	3749	3741	3732	3724	3716	7790	7882	7974	8065	8157	8249	8341	8432	8524	8616
1·05	3708	3700	3691	3683	3675	3667	3659	3651	3643	3635	8708	8800	8891	8983	9075	9167	9259	9351	9443	9535
1·06	3627	3619	3611	3603	3595	3587	3579	3571	3563	3555	9627	9719	9811	9903	9995	0087	0179	0271	0363	0455
1·07	3548	3540	3532	3524	3516	3509	3501	3493	3485	3478	1·10548	0640	0732	0824	0916	1009	1101	1193	1285	1378
1·08	3470	3462	3455	3447	3439	3432	3424	3417	3409	3401	1470	1562	1655	1747	1839	1932	2024	2117	2209	2301
1·09	3394	3386	3379	3371	3364	3357	3349	3342	3334	3327	2394	2486	2579	2671	2764	2857	2949	3042	3134	3227
1·10	0·03320	3312	3305	3298	3290	3283	3276	3268	3261	3254	1·13320	3412	3505	3598	3690	3783	3876	3968	4061	4154
1·11	3247	3240	3232	3225	3218	3211	3204	3197	3190	3183	4247	4340	4432	4525	4618	4711	4804	4897	4990	5083
1·12	3175	3168	3161	3154	3147	3140	3133	3126	3120	3113	5175	5268	5361	5454	5547	5640	5733	5826	5920	6013
1·13	3106	3099	3092	3085	3078	3071	3065	3058	3051	3044	6106	6199	6292	6385	6478	6571	6665	6758	6851	6944
1·14	3037	3031	3024	3017	3011	3004	2997	2991	2984	2977	7037	7131	7224	7317	7411	7504	7597	7691	7784	7877
1·15	2971	2964	2957	2951	2944	2938	2931	2925	2918	2912	7971	8064	8157	8251	8344	8438	8531	8625	8718	8812
1·16	2905	2899	2892	2886	2879	2873	2867	2860	2854	2848	8905	8999	9092	9186	9279	9373	9467	9560	9654	9748
1·17	2841	2835	2829	2822	2816	2810	2803	2797	2791	2785	9841	9935	0029	0122	0216	0310	0403	0497	0591	0685
1·18	2779	2772	2766	2760	2754	2748	2742	2735	2729	2723	1·20779	0872	0966	1060	1154	1248	1342	1435	1529	1623
1·19	2717	2711	2705	2699	2693	2687	2681	2675	2669	2663	1717	1811	1905	1999	2093	2187	2281	2375	2469	2563
1·20	0·02657	2651	2645	2639	2634	2628	2622	2616	2610	2604	1·22657	2751	2845	2939	3034	3128	3222	3316	3410	3504
1·21	2599	2593	2587	2581	2575	2570	2564	2558	2552	2547	3599	3693	3787	3881	3975	4070	4164	4258	4352	4447
1·22	2541	2535	2530	2524	2518	2513	2507	2502	2496	2490	4541	4635	4730	4824	4918	5013	5107	5202	5296	5390
1·23	2485	2479	2474	2468	2463	2457	2452	2446	2441	2435	5485	5579	5674	5768	5863	5957	6052	6146	6241	6335
1·24	2430	2424	2419	2414	2408	2403	2397	2392	2387	2381	6430	6524	6619	6714	6808	6903	6997	7092	7187	7281
1·25	2376	2371	2365	2360	2355	2350	2344	2339	2334	2329	7376	7471	7565	7660	7755	7850	7944	8039	8134	8229
1·26	2323	2318	2313	2308	2303	2297	2292	2287	2282	2277	8323	8418	8513	8608	8703	8797	8892	8987	9082	9177
1·27	2272	2267	2262	2257	2252	2246	2241	2236	2231	2226	9272	9367	9462	9557	9652	9746	9841	9936	0031	0126
1·28	2221	2216	2211	2207	2202	2197	2192	2187	2182	2177	1·30221	0316	0411	0507	0602	0697	0792	0887	0982	1077
1·29	2172	2167	2162	2158	2153	2148	2143	2138	2133	2129	1172	1267	1362	1458	1553	1648	1743	1838	1933	2029
1·30	0·02124	2119	2114	2110	2105	2100	2095	2091	2086	2081	1·32124	2219	2314	2410	2505	2600	2695	2791	2886	2981
1·31	2077	2072	2067	2063	2058	2053	2049	2044	2040	2035	3077	3172	3267	3363	3458	3553	3649	3744	3840	3935
1·32	2030	2026	2021	2017	2012	2008	2003	1999	1994	1990	4030	4126	4221	4317	4412	4508	4603	4699	4794	4890
1·33	1985	1981	1976	1972	1967	1963	1959	1954	1950	1945	4985	5081	5176	5272	5367	5463	5559	5654	5750	5845
1·34	1941	1937	1932	1928	1924	1919	1915	1911	1906	1902	5941	6037	6132	6228	6324	6419	6515	6611	6706	6802
1·35	1898	1894	1889	1885	1881	1877	1872	1868	1864	1860	6898	6994	7089	7185	7281	7377	7472	7568	7664	7760
1·36	1856	1851	1847	1843	1839	1835	1831	1827	1822	1818	7856	7951	8047	8143	8239	8335	8431	8527	8622	8718
1·37	1814	1810	1806	1802	1798	1794	1790	1786	1782	1778	8814	8910	9006	9102	9198	9294	9390	9486	9582	9678
1·38	1774	1770	1766	1762	1758	1754	1750	1746	1742	1738	9774	9870	9966	0062	0158	0254	0350	0446	0542	0638
1·39	1734	1730	1726	1722	1719	1715	1711	1707	1703	1699	1·40734	0830	0926	1022	1119	1215	1311	1407	1503	1599
1·40	0·01695	1692	1688	1684	1680	1676	1673	1669	1665	1661	1·41695	1792	1888	1984	2080	2176	2273	2369	2465	2561
1·41	1658	1654	1650	1646	1643	1639	1635	1632	1628	1624	2658	2754	2850	2946	3043	3139	3235	3332	3428	3524
1·42	1621	1617	1613	1610	1606	1602	1599	1595	1591	1588	3621	3717	3813	3910	4006	4102	4199	4295	4391	4488
1·43	1584	1581	1577	1574	1570	1566	1563	1559	1556	1552	4584	4681	4777	4874	4970	5066	5163	5259	5356	5452
1·44	1549	1545	1542	1538	1535	1531	1528	1525	1521	1518	5549	5645	5742	5838	5935	6031	6128	6225	6321	6418
1·45	1514	1511	1507	1504	1501	1497	1494	1490	1487	1484	6514	6611	6707	6804	6901	6997	7094	7190	7287	7384
1·46	1480	1477	1474	1470	1467	1464	1460	1457	1454	1450	7480	7577	7674	7770	7867	7964	8060	8157	8254	8350
1·47	1447	1444	1441	1437	1434	1431	1428	1424	1421	1418	8447	8544	8641	8737	8834	8931	9028	9124	9221	9318
1·48	1415	1412	1408	1405	1402	1399	1396	1393	1389	1386	9415	9512	9608	9705	9802	9899	9996	0093	0189	0286
1·49	1383	1380	1377	1374	1371	1368	1364	1361	1358	1355	1·50383	0480	0577	0674	0771	0868	0964	1061	1158	1255
	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9

TABLE XLIX.—Gauss's Sum and Difference Logarithms.

A	B										C									
	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1·50	0·01352	1349	1346	1343	1340	1337	1334	1331	1328	1325	1·51352	1449	1546	1643	1740	1837	1934	2031	2128	2225
1·51		1322	1319	1316	1313	1310	1307	1304	1301	1298	1295	2322	2419	2516	2613	2710	2807	2904	3001	3098	3195
1·52		1292	1289	1286	1283	1280	1278	1275	1272	1269	1266	3292	3389	3486	3583	3680	3778	3875	3972	4069	4166
1·53		1263	1260	1257	1255	1252	1249	1246	1243	1240	1238	4263	4360	4457	4555	4652	4749	4846	4943	5040	5138
1·54		1235	1232	1229	1226	1224	1221	1218	1215	1213	1210	5235	5332	5429	5526	5624	5721	5818	5915	6013	6110
1·55		1207	1204	1202	1199	1196	1193	1191	1188	1185	1183	6207	6304	6402	6499	6596	6693	6791	6888	6985	7083
1·56		1180	1177	1175	1172	1169	1167	1164	1161	1159	1156	7180	7277	7375	7472	7569	7667	7764	7861	7959	8056
1·57		1153	1151	1148	1146	1143	1140	1138	1135	1133	1130	8153	8251	8348	8446	8543	8640	8738	8835	8933	9030
1·58		1128	1125	1122	1120	1117	1115	1112	1110	1107	1105	9128	9225	9322	9420	9517	9615	9712	9810	9907	0005
1·59		1102	1100	1097	1095	1092	1090	1087	1085	1082	1080	1·60102	0200	0297	0395	0492	0590	0687	0785	0882	0980
1·60	0·01077	1075	1073	1070	1068	1065	1063	1060	1058	1056	1·61077	1175	1273	1370	1468	1565	1663	1760	1858	1956
1·61		1053	1051	1048	1046	1044	1041	1039	1037	1034	1032	2053	2151	2248	2346	2444	2541	2639	2737	2834	2932
1·62		1030	1027	1025	1022	1020	1018	1016	1013	1011	1009	3030	3127	3225	3322	3420	3518	3616	3713	3811	3909
1·63		1006	1004	1002	0999	0997	0995	0993	0990	0988	0986	4006	4104	4202	4299	4397	4495	4593	4690	4788	4886
1·64		0984	0981	0979	0977	0975	0973	0970	0968	0966	0964	4984	5081	5179	5277	5375	5473	5570	5668	5766	5864
1·65	0·00962	0959	0957	0955	0953	0951	0948	0946	0944	0942	5962	6059	6157	6255	6353	6451	6548	6646	6744	6842
1·66		0940	0938	0936	0933	0931	0929	0927	0925	0923	0921	6940	7038	7136	7233	7331	7429	7527	7625	7723	7821
1·67		0919	0917	0915	0912	0910	0908	0906	0904	0902	0900	7919	8017	8115	8212	8310	8408	8506	8604	8702	8800
1·68		0898	0896	0894	0892	0890	0888	0886	0884	0882	0880	8898	8996	9094	9192	9290	9388	9486	9584	9682	9780
1·69		0878	0876	0874	0872	0870	0868	0866	0864	0862	0860	9878	9976	0074	0172	0270	0368	0466	0564	0662	0760
1·70	0·00858	0856	0854	0852	0850	0848	0846	0844	0842	0841	1·70858	0956	1054	1152	1250	1348	1446	1544	1642	1741
1·71		0839	0837	0835	0833	0831	0829	0827	0825	0823	0822	1839	1937	2035	2133	2231	2329	2427	2525	2623	2722
1·72		0820	0818	0816	0814	0812	0810	0809	0807	0805	0803	2820	2918	3016	3114	3212	3310	3409	3507	3605	3703
1·73		0801	0799	0798	0796	0794	0792	0790	0789	0787	0785	3801	3899	3998	4096	4194	4292	4390	4489	4587	4685
1·74		0783	0781	0780	0778	0776	0774	0773	0771	0769	0767	4783	4881	4980	5078	5176	5274	5373	5471	5569	5667
1·75	0·00766	0764	0762	0760	0759	0757	0755	0753	0752	0750	5766	5864	5962	6060	6159	6257	6355	6453	6552	6650
1·76		0748	0747	0745	0743	0741	0740	0738	0736	0735	0733	6748	6847	6945	7043	7141	7240	7338	7436	7535	7633
1·77		0731	0730	0728	0726	0725	0723	0721	0720	0718	0716	7731	7830	7928	8026	8125	8223	8321	8420	8518	8616
1·78		0715	0713	0712	0710	0708	0707	0705	0703	0702	0700	8715	8813	8912	9010	9108	9207	9305	9403	9502	9600
1·79		0699	0697	0696	0694	0692	0691	0689	0688	0686	0684	9699	9797	9896	9994	0092	0191	0289	0388	0486	0584
1·80	0·00683	0681	0680	0678	0677	0675	0674	0672	0671	0669	1·80683	0781	0880	0978	1077	1175	1274	1372	1471	1569
1·81		0667	0666	0664	0663	0661	0660	0658	0657	0655	0654	1667	1766	1864	1963	2061	2160	2258	2357	2455	2554
1·82		0652	0651	0649	0648	0646	0645	0644	0642	0641	0639	2652	2751	2849	2948	3046	3145	3244	3342	3441	3539
1·83		0638	0636	0635	0633	0632	0630	0629	0628	0626	0625	3638	3736	3835	3933	4032	4130	4229	4328	4426	4525
1·84		0623	0622	0620	0619	0618	0616	0615	0613	0612	0611	4623	4722	4820	4919	5018	5116	5215	5313	5412	5511
1·85		0609	0608	0606	0605	0604	0602	0601	0599	0598	0597	5609	5708	5806	5905	6004	6102	6201	6299	6398	6497
1·86		0595	0594	0593	0591	0590	0589	0587	0586	0585	0583	6595	6694	6793	6891	6990	7089	7187	7286	7385	7483
1·87		0582	0581	0579	0578	0577	0575	0574	0573	0571	0570	7582	7681	7779	7878	7977	8075	8174	8273	8371	8470
1·88		0569	0567	0566	0565	0564	0562	0561	0560	0558	0557	8569	8667	8766	8865	8964	9062	9161	9260	9358	9457
1·89		0556	0555	0553	0552	0551	0550	0548	0547	0546	0545	9556	9655	9753	9852	9951	0050	0148	0247	0346	0445
1·90	0·00543	0542	0541	0540	0538	0537	0536	0535	0533	0532	1·90543	0642	0741	0840	0938	1037	1136	1235	1333	1432
1·91		0531	0530	0529	0527	0526	0525	0524	0523	0521	0520	1531	1630	1729	1827	1926	2025	2124	2223	2321	2420
1·92		0519	0518	0517	0515	0514	0513	0512	0511	0510	0508	2519	2618	2717	2815	2914	3013	3112	3211	3310	3408
1·93		0507	0506	0505	0504	0503	0502	0500	0499	0498	0497	3507	3606	3705	3804	3903	4002	4100	4199	4298	4397
1·94		0496	0495	0494	0492	0491	0490	0489	0488	0487	0486	4496	4595	4694	4792	4891	4990	5089	5188	5287	5386
1·95		0485	0483	0482	0481	0480	0479	0478	0477	0476	0475	5485	5583	5682	5781	5880	5979	6078	6177	6276	6375
1·96		0474	0473	0471	0470	0469	0468	0467	0466	0465	0464	6474	6573	6671	6770	6869	6968	7067	7166	7265	7364
1·97		0463	0462	0461	0460	0459	0158	0457	0456	0454	0453	7463	7562	7661	7760	7859	7958	8057	8156	8254	8353
1·98		0452	0451	0450	0449	0448	0447	0446	0445	0444	0443	8452	8551	8650	8749	8848	8947	9046	9145	9244	9343
1·99		0442	0441	0440	0439	0438	0437	0436	0435	0434	0433	9442	9541	9640	9739	9838	9937	0036	0135	0234	0333
	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9

TABLE XLIX.—Gauss's Sum and Difference Logarithms.

A	B	C	A	B	C	A	B	C	A	B	C
2·00	0·00432	2·00432	2·40	0·00173	2·40173	2·80	0·00069	2·80069	3·20	0·00027	3·20027
2·01	0422	1422	2·41	0169	1169	2·81	0067	1067	3·21	0027	1027
2·02	0413	2413	2·42	0165	2165	2·82	0066	2066	3·22	0026	2026
2·03	0403	3403	2·43	0161	3161	2·83	0064	3064	3·23	0026	3026
2·04	0394	4394	2·44	0157	4157	2·84	0063	4063	3·24	0025	4025
2·05	0385	5385	2·45	0154	5154	2·85	0061	5061	3·25	0024	5024
2·06	0377	6377	2·46	0150	6150	2·86	0060	6060	3·26	0024	6024
2·07	0368	7368	2·47	0147	7147	2·87	0059	7059	3·27	0023	7023
2·08	0360	8360	2·48	0144	8144	2·88	0057	8057	3·28	0023	8023
2·09	0352	9352	2·49	0140	9140	2·89	0056	9056	3·29	0022	9022
2·10	0·00344	2·10344	2·50	0·00137	2·50137	2·90	0·00055	2·90055	3·30	0·00022	3·30022
2·11	0336	1336	2·51	0134	1134	2·91	0053	1053	3·31	0021	1021
2·12	0328	2328	2·52	0131	2131	2·92	0052	2052	3·32	0021	2021
2·13	0321	3321	2·53	0128	3128	2·93	0051	3051	3·33	0020	3020
2·14	0313	4313	2·54	0125	4125	2·94	0050	4050	3·34	0020	4020
2·15	0306	5306	2·55	0122	5122	2·95	0049	5049	3·35	0019	5019
2·16	0299	6299	2·56	0119	6119	2·96	0048	6048	3·36	0019	6019
2·17	0293	7293	2·57	0117	7117	2·97	0047	7047	3·37	0019	7019
2·18	0286	8286	2·58	0114	8114	2·98	0045	8045	3·38	0018	8018
2·19	0280	9280	2·59	0111	9111	2·99	0044	9044	3·39	0018	9018
2·20	0·00273	2·20273	2·60	0·00109	2·60109	3·00	0·00043	3·00043	3·4	0·00017	3·40017
2·21	0267	1267	2·61	0106	1106	3·01	0042	1042	3·5	0014	50014
2·22	0261	2261	2·62	0104	2104	3·02	0041	2041	3·6	0011	60011
2·23	0255	3255	2·63	0102	3102	3·03	0041	3041	3·7	0009	70009
2·24	0249	4249	2·64	0099	4099	3·04	0040	4040	3·8	0007	80007
2·25	0244	5244	2·65	0097	5097	3·05	0039	5039	3·9	0005	90005
2·26	0238	6238	2·66	0095	6095	3·06	0038	6038	4·0	0004	4·00004
2·27	0233	7233	2·67	0093	7093	3·07	0037	7037	4·1	0003	10003
2·28	0227	8227	2·68	0091	8091	3·08	0036	8036	4·2	0003	20003
2·29	0222	9222	2·69	0089	9089	3·09	0035	9035	4·3	0002	30002
2·30	0·00217	2·30217	2·70	0·00087	2·70087	3·10	0·00034	3·10034	4·4	0·00002	4·40002
2·31	0212	1212	2·71	0085	1085	3·11	0034	1034	4·5	0001	50001
2·32	0207	2207	2·72	0083	2083	3·12	0033	2033	4·6	0001	60001
2·33	0203	3203	2·73	0081	3081	3·13	0032	3032	4·7	0001	70001
2·34	0198	4198	2·74	0079	4079	3·14	0031	4031	4·8	0001	80001
2·35	0194	5194	2·75	0077	5077	3·15	0031	5031	4·9	0·00001	90001
2·36	0189	6189	2·76	0075	6075	3·16	0030	6030	5·0	0·00000	5·00000
2·37	0185	7185	2·77	0074	7074	3·17	0029	7029			
2·38	0181	8181	2·78	0072	8072	3·18	0029	8029			
2·39	0177	9177	2·79	0070	9070	3·19	0028	9028			

TABLE L.—Common Logarithms to 4 places of Decimals.

No.	Log.	No.	Log.	No.	Log.	No.	Log.	No.	Log.	No.	Log.	No.	Log.
100	·0000	145	·1614	190	·2788	235	·3711	280	·4472	325	·5119	370	·5682
101	·0043	146	·1644	191	·2810	236	·3729	281	·4487	326	·5132	371	·5694
102	·0086	147	·1673	192	·2833	237	·3747	282	·4502	327	·5145	372	·5705
103	·0128	148	·1703	193	·2856	238	·3766	283	·4518	328	·5159	373	·5717
104	·0170	149	·1732	194	·2878	239	·3784	284	·4533	329	·5172	374	·5729
105	·0212	150	·1761	195	·2900	240	·3802	285	·4548	330	·5185	375	·5740
106	·0253	151	·1790	196	·2923	241	·3820	286	·4564	331	·5198	376	·5752
107	·0294	152	·1818	197	·2945	242	·3838	287	·4579	332	·5211	377	·5763
108	·0334	153	·1847	198	·2967	243	·3856	288	·4594	333	·5224	378	·5775
109	·0374	154	·1875	199	·2989	244	·3874	289	·4609	334	·5237	379	·5786
110	·0414	155	·1903	200	·3010	245	·3892	290	·4624	335	·5250	380	·5798
111	·0453	156	·1931	201	·3032	246	·3909	291	·4639	336	·5263	381	·5809
112	·0492	157	·1959	202	·3054	247	·3927	292	·4654	337	·5276	382	·5821
113	·0531	158	·1987	203	·3075	248	·3945	293	·4669	338	·5289	383	·5832
114	·0569	159	·2014	204	·3096	249	·3962	294	·4683	339	·5302	384	·5843
115	·0607	160	·2041	205	·3118	250	·3979	295	·4698	340	·5315	385	·5855
116	·0645	161	·2068	206	·3139	251	·3997	296	·4713	341	·5328	386	·5866
117	·0682	162	·2095	207	·3160	252	·4014	297	·4728	342	·5340	387	·5877
118	·0719	163	·2122	208	·3181	253	·4031	298	·4742	343	·5353	388	·5888
119	·0755	164	·2148	209	·3201	254	·4048	299	·4757	344	·5366	389	·5899
120	·0792	165	·2175	210	·3222	255	·4065	300	·4771	345	·5378	390	·5911
121	·0828	166	·2201	211	·3243	256	·4082	301	·4786	346	·5391	391	·5922
122	·0864	167	·2227	212	·3263	257	·4099	302	·4800	347	·5403	392	·5933
123	·0899	168	·2253	213	·3284	258	·4116	303	·4814	348	·5416	393	·5944
124	·0934	169	·2279	214	·3304	259	·4133	304	·4829	349	·5428	394	·5955
125	·0969	170	·2304	215	·3324	260	·4150	305	·4843	350	·5441	395	·5966
126	·1004	171	·2330	216	·3345	261	·4166	306	·4857	351	·5453	396	·5977
127	·1038	172	·2355	217	·3365	262	·4183	307	·4871	352	·5465	397	·5988
128	·1072	173	·2380	218	·3385	263	·4200	308	·4886	353	·5478	398	·5999
129	·1106	174	·2405	219	·3404	264	·4216	309	·4900	354	·5490	399	·6010
130	·1139	175	·2430	220	·3424	265	·4232	310	·4914	355	·5502	400	·6021
131	·1173	176	·2455	221	·3444	266	·4249	311	·4928	356	·5515	401	·6031
132	·1206	177	·2480	222	·3464	267	·4265	312	·4942	357	·5527	402	·6042
133	·1239	178	·2504	223	·3483	268	·4281	313	·4955	358	·5539	403	·6053
134	·1271	179	·2529	224	·3502	269	·4298	314	·4969	359	·5551	404	·6064
135	·1303	180	·2553	225	·3522	270	·4314	315	·4983	360	·5563	405	·6075
136	·1335	181	·2577	226	·3541	271	·4330	316	·4997	361	·5575	406	·6085
137	·1367	182	·2601	227	·3560	272	·4346	317	·5011	362	·5587	407	·6096
138	·1399	183	·2625	228	·3579	273	·4362	318	·5024	363	·5599	408	·6107
139	·1430	184	·2648	229	·3598	274	·4378	319	·5038	364	·5611	409	·6117
140	·1461	185	·2672	230	·3617	275	·4393	320	·5052	365	·5623	410	·6138
141	·1492	186	·2695	231	·3636	276	·4409	321	·5065	366	·5635	411	·6138
142	·1523	187	·2718	232	·3655	277	·4425	322	·5079	367	·5647	412	·6149
143	·1553	188	·2742	233	·3674	278	·4440	323	·5092	368	·5658	413	·6160
144	·1584	189	·2765	234	·3692	279	·4456	324	·5105	369	·5670	414	·6170

TABLE L.—Common Logarithms to 4 places of Decimals.

No.	Log.	No.	Log.	No.	Log.	No.	Log.	No.	Log.	No.	Log.	No.	Log.
415	·6180	460	·6628	505	·7033	550	·7404	595	·7745	640	·8062	685	·8357
416	·6191	461	·6637	506	·7042	551	·7412	596	·7752	641	·8069	686	·8363
417	·6201	462	·6646	507	·7050	552	·7419	597	·7760	642	·8075	687	·8370
418	·6212	463	·6656	508	·7059	553	·7427	598	·7767	643	·8082	688	·8376
419	·6222	464	·6665	509	·7067	554	·7435	599	·7774	644	·8089	689	·8382
420	·6232	465	·6675	510	·7076	555	·7443	600	·7782	645	·8096	690	·8388
421	·6243	466	·6684	511	·7084	556	·7451	601	·7789	646	·8102	691	·8395
422	·6253	467	·6693	512	·7093	557	·7459	602	·7796	647	·8109	692	·8401
423	·6263	468	·6702	513	·7101	558	·7466	603	·7803	648	·8116	693	·8407
424	·6274	469	·6712	514	·7110	559	·7474	604	·7810	649	·8122	694	·8414
425	·6284	470	·6721	515	·7118	560	·7482	605	·7818	650	·8129	695	·8420
426	·6294	471	·6730	516	·7126	561	·7490	606	·7825	651	·8136	696	·8426
427	·6304	472	·6739	517	·7135	562	·7497	607	·7832	652	·8142	697	·8432
428	·6314	473	·6749	518	·7143	563	·7505	608	·7839	653	·8149	698	·8439
429	·6325	474	·6758	519	·7152	564	·7513	609	·7846	654	·8156	699	·8445
430	·6335	475	·6767	520	·7160	565	·7520	610	·7853	655	·8162	700	·8451
431	·6345	476	·6776	521	·7168	566	·7528	611	·7860	656	·8169	701	·8457
432	·6355	477	·6785	522	·7177	567	·7536	612	·7868	657	·8176	702	·8463
433	·6365	478	·6794	523	·7185	568	·7543	613	·7875	658	·8182	703	·8470
434	·6375	479	·6803	524	·7193	569	·7551	614	·7882	659	·8189	704	·8476
435	·6385	480	·6812	525	·7202	570	·7559	615	·7889	660	·8195	705	·8482
436	·6395	481	·6821	526	·7210	571	·7566	616	·7896	661	·8202	706	·8488
437	·6405	482	·6830	527	·7218	572	·7574	617	·7903	662	·8209	707	·8494
438	·6415	483	·6839	528	·7226	573	·7582	618	·7910	663	·8215	708	·8500
439	·6425	484	·6848	529	·7235	574	·7589	619	·7917	664	·8222	709	·8506
440	·6435	485	·6857	530	·7243	575	·7597	620	·7924	665	·8228	710	·8513
441	·6444	486	·6866	531	·7251	576	·7604	621	·7931	666	·8235	711	·8519
442	·6454	487	·6875	532	·7259	577	·7612	622	·7938	667	·8241	712	·8525
443	·6464	488	·6884	533	·7267	578	·7619	623	·7945	668	·8248	713	·8531
444	·6474	489	·6893	534	·7275	579	·7627	624	·7952	669	·8254	714	·8537
445	·6484	490	·6902	535	·7284	580	·7634	625	·7959	670	·8261	715	·8543
446	·6493	491	·6911	536	·7292	581	·7642	626	·7966	671	·8267	716	·8549
447	·6503	492	·6920	537	·7300	582	·7649	627	·7973	672	·8274	717	·8555
448	·6513	493	·6928	538	·7308	583	·7657	628	·7980	673	·8280	718	·8561
449	·6522	494	·6937	539	·7316	584	·7664	629	·7987	674	·8287	719	·8567
450	·6532	495	·6946	540	·7324	585	·7672	630	·7993	675	·8293	720	·8573
451	·6542	496	·6955	541	·7332	586	·7679	631	·8000	676	·8299	721	·8579
452	·6551	497	·6964	542	·7340	587	·7686	632	·8007	677	·8306	722	·8585
453	·6561	498	·6972	543	·7348	588	·7694	633	·8014	678	·8312	723	·8591
454	·6571	499	·6981	544	·7356	589	·7701	634	·8021	679	·8319	724	·8597
455	·6580	500	·6990	545	·7364	590	·7709	635	·8028	680	·8325	725	·8603
456	·6590	501	·6998	546	·7372	591	·7716	636	·8035	681	·8331	726	·8609
457	·6599	502	·7007	547	·7380	592	·7723	637	·8041	682	·8338	727	·8615
458	·6609	503	·7016	548	·7388	593	·7731	638	·8048	683	·8344	728	·8621
459	·6618	504	·7024	549	·7396	594	·7738	639	·8055	684	·8351	729	·8627

TABLE L.—Common Logarithms to 4 places of Decimals.

No.	Log.	No.	Log.	No.	Log.	No.	Log.	No.	Log.	No.	Log.	No.	Log.
730	·8633	770	·8865	810	·9085	850	·9294	890	·9494	930	·9685	970	·9868
731	·8639	771	·8871	811	·9090	851	·9299	891	·9499	931	·9689	971	·9872
732	·8645	772	·8876	812	·9096	852	·9304	892	·9504	932	·9694	972	·9877
733	·8651	773	·8882	813	·9101	853	·9309	893	·9509	933	·9699	973	·9881
734	·8657	774	·8887	814	·9106	854	·9315	894	·9513	934	·9703	974	·9886
735	·8663	775	·8893	815	·9112	855	·9320	895	·9518	935	·9708	975	·9890
736	·8669	776	·8899	816	·9117	856	·9325	896	·9523	936	·9713	976	·9894
737	·8675	777	·8904	817	·9122	857	·9330	897	·9528	937	·9717	977	·9899
738	·8681	778	·8910	818	·9128	858	·9335	898	·9533	938	·9722	978	·9903
739	·8686	779	·8915	819	·9133	859	·9340	899	·9538	939	·9727	979	·9908
740	·8692	780	·8921	820	·9138	860	·9345	900	·9542	940	·9731	980	·9912
741	·8698	781	·8927	821	·9143	861	·9350	901	·9547	941	·9736	981	·9917
742	·8704	782	·8932	822	·9149	862	·9355	902	·9552	942	·9741	982	·9921
743	·8710	783	·8938	823	·9154	863	·9360	903	·9557	943	·9745	983	·9926
744	·8716	784	·8943	824	·9159	864	·9365	904	·9562	944	·9750	984	·9930
745	·8722	785	·8949	825	·9165	865	·9370	905	·9566	945	·9754	985	·9934
746	·8727	786	·8954	826	·9170	866	·9375	906	·9571	946	·9759	986	·9939
747	·8733	787	·8960	827	·9175	867	·9380	907	·9576	947	·9764	987	·9943
748	·8739	788	·8965	828	·9180	868	·9385	908	·9581	948	·9768	988	·9948
749	·8745	789	·8971	829	·9186	869	·9390	909	·9586	949	·9773	989	·9952
750	·8751	790	·8976	830	·9191	870	·9395	910	·9590	950	·9777	990	·9956
751	·8756	791	·8982	831	·9196	871	·9400	911	·9595	951	·9782	991	·9961
752	·8762	792	·8987	832	·9201	872	·9405	912	·9600	952	·9786	992	·9965
753	·8768	793	·8993	833	·9206	873	·9410	913	·9605	953	·9791	993	·9969
754	·8774	794	·8998	834	·9212	874	·9415	914	·9609	954	·9795	994	·9974
755	·8779	795	·9004	835	·9217	875	·9420	915	·9614	955	·9800	995	·9978
756	·8785	796	·9009	836	·9222	876	·9425	916	·9619	956	·9805	996	·9983
757	·8791	797	·9015	837	·9227	877	·9430	917	·9624	957	·9809	997	·9987
758	·8797	798	·9020	838	·9232	878	·9435	918	·9628	958	·9814	998	·9991
759	·8802	799	·9025	839	·9238	879	·9440	919	·9633	959	·9818	999	·9996
760	·8808	800	·9031	840	·9243	880	·9445	920	·9638	960	·9823		
761	·8814	801	·9036	841	·9248	881	·9450	921	·9643	961	·9827		
762	·8820	802	·9042	842	·9253	882	·9455	922	·9647	962	·9832		
763	·8825	803	·9047	843	·9258	883	·9460	923	·9652	963	·9836		
764	·8831	804	·9053	844	·9263	884	·9465	924	·9657	964	·9841		
765	·8837	805	·9058	845	·9269	885	·9469	925	·9661	965	·9845		
766	·8842	806	·9063	846	·9274	886	·9474	926	·9666	966	·9850		
767	·8848	807	·9069	847	·9279	887	·9479	927	·9671	967	·9854		
768	·8854	808	·9074	848	·9284	888	·9484	928	·9675	968	·9859		
769	·8859	809	·9079	849	·9289	889	·9489	929	·9680	969	·9863		

TABLE LI.—Common Logarithms to 5 places of Decimals.

No.	Logarithm 0 1 2 3 4 5 6 7 8 9
100	00000 043 087 130 173 217 260 303 346 389
101	432 475 518 561 604 647 689 732 775 817
102	860 903 945 988 030 072 115 157 199 242
103	01284 326 368 410 452 494 536 578 620 662
104	703 745 787 828 870 912 953 995 036 078
105	02119 160 202 243 284 325 366 407 449 490
106	531 572 612 653 694 735 776 816 857 898
107	938 979 019 060 100 141 181 222 262 302
108	03342 383 423 463 503 543 583 623 663 703
109	743 782 822 862 902 941 981 021 060 100
110	04139 179 218 258 297 336 376 415 454 493
111	532 571 610 650 689 727 766 805 844 883
112	922 961 999 038 077 115 154 192 231 269
113	05308 346 385 423 461 500 538 576 614 652
114	690 729 767 805 843 881 918 956 994 032
115	06070 108 145 183 221 258 296 333 371 408
116	446 483 521 558 595 633 670 707 744 781
117	819 856 893 930 967 004 041 078 115 151
118	07188 225 262 298 335 372 408 445 482 518
119	555 591 628 664 700 737 773 809 846 882
120	918 954 990 027 063 099 135 171 207 243
121	08279 314 350 386 422 458 493 529 565 600
122	636 672 707 743 778 814 849 884 920 955
123	991 026 061 096 132 167 202 237 272 307
124	09342 377 412 447 482 517 552 587 621 656
125	691 726 760 795 830 864 899 934 968 003
126	10037 072 106 140 175 209 243 278 312 346
127	380 415 449 483 517 551 585 619 653 687
128	721 755 789 823 857 890 924 958 992 025
129	11059 093 126 160 193 227 261 294 327 361
130	394 428 461 494 528 561 594 628 661 694
131	727 760 793 826 860 893 926 959 992 024
132	12057 090 123 156 189 222 254 287 320 352
133	385 418 450 483 516 548 581 613 646 678
134	710 743 775 808 840 872 905 937 969 001
135	13033 066 098 130 162 194 226 258 290 322
136	354 386 418 450 481 513 545 577 609 640
137	672 704 735 767 799 830 862 893 925 956
138	988 019 051 082 114 145 176 208 239 270
139	14301 333 364 395 426 457 489 520 551 582
140	613 644 675 706 737 768 799 829 860 891
141	922 953 983 014 045 076 106 137 168 198
142	15229 259 290 320 351 381 412 442 473 503
143	534 564 594 625 655 685 715 746 776 806
144	836 866 897 927 957 987 017 047 077 107

No.	Logarithm 0 1 2 3 4 5 6 7 8 9
145	16137 167 197 227 256 286 316 346 376 406
146	435 465 495 524 554 584 613 643 673 702
147	732 761 791 820 850 879 909 938 967 997
148	17026 056 085 114 143 173 202 231 260 289
149	319 348 377 406 435 464 493 522 551 580
150	609 638 667 696 725 754 782 811 840 869
151	898 926 955 984 013 041 070 099 127 156
152	18184 213 241 270 298 327 355 384 412 441
153	469 498 526 554 583 611 639 667 696 724
154	752 780 808 837 865 893 921 949 977 005
155	19033 061 089 117 145 173 201 229 257 285
156	312 340 368 396 424 451 479 507 535 562
157	590 618 645 673 700 728 756 783 811 838
158	866 893 921 948 976 003 030 058 085 112
159	20140 167 194 222 249 276 303 330 358 385
160	412 439 466 493 520 548 575 602 629 656
161	683 710 737 763 790 817 844 871 898 925
162	952 978 005 032 059 085 112 139 165 192
163	21219 245 272 299 325 352 378 405 431 458
164	484 511 537 564 590 617 643 669 696 722
165	748 775 801 827 854 880 906 932 958 985
166	22011 037 063 089 115 141 167 194 220 246
167	272 298 324 350 376 401 427 453 479 505
168	531 557 583 608 634 660 686 712 737 763
169	789 814 840 866 891 917 943 968 994 019
170	23045 070 096 121 147 172 198 223 249 274
171	300 325 350 376 401 426 452 477 502 528
172	553 578 603 629 654 679 704 729 754 779
173	805 830 855 880 905 930 955 980 005 030
174	24055 080 105 130 155 180 204 229 254 279
175	304 329 353 378 403 428 452 477 502 527
176	551 576 601 625 650 674 699 724 748 773
177	797 822 846 871 895 920 944 969 993 018
178	25042 066 091 115 139 164 188 212 237 261
179	285 310 334 358 382 406 431 455 479 503
180	527 551 575 600 624 648 672 696 720 744
181	768 792 816 840 864 888 912 935 959 983
182	26007 031 055 079 102 126 150 174 198 221
183	245 269 293 316 340 364 387 411 435 458
184	482 505 529 553 576 600 623 647 670 694
185	717 741 764 788 811 834 858 881 905 928
186	951 975 998 021 045 068 091 114 138 161
187	27184 207 231 254 277 300 323 346 370 393
188	416 439 462 485 508 531 554 577 600 623
189	646 669 692 715 738 761 784 807 830 852

Pro. Parts	
D.	44 42
1	4·4 4·2
2	8·8 8·4
3	13·2 12·6
4	17·6 16·8
5	22·0 21·0
6	26·4 25·2
7	30·8 29·4
8	35·2 33·6
9	39·6 37·8
D.	40 38
1	4·0 3·8
2	8·0 7·6
3	12·0 11·4
4	16·0 15·2
5	20·0 19·0
6	24·0 22·8
7	28·0 26·6
8	32·0 30·4
9	36·0 34·2
D.	36 34
1	3·6 3·4
2	7·2 6·8
3	10·8 10·2
4	14·4 13·6
5	18·0 17·0
6	21·6 20·4
7	25·2 23·8
8	28·8 27·2
9	32·4 30·6
D.	32 30
1	3·2 3·0
2	6·4 6·0
3	9·6 9·0
4	12·8 12·0
5	16·0 15·0
6	19·2 18·0
7	22·4 21·0
8	25·6 24·0
9	28·8 27·0
D.	28 26
1	2·8 2·6
2	5·6 5·2
3	8·4 7·8
4	11·2 10·4
5	14·0 13·0
6	16·8 15·6
7	19·6 18·2
8	22·4 20·8
9	25·2 23·4
D.	24 22
1	2·4 2·2
2	4·8 4·4
3	7·2 6·6
4	9·6 8·8
5	12·0 11·0
6	14·4 13·2
7	16·8 15·4
8	19·2 17·6
9	21·6 19·8

TABLE LI.—Common Logarithms to 5 places of Decimals.

No.	Logarithm 0 1 2 3 4 5 6 7 8 9
190	27875 898 921 944 967 989 012 035 058 081
191	28103 126 149 171 194 217 240 262 285 307
192	330 353 375 398 421 443 466 488 511 533
193	556 578 601 623 646 668 691 713 735 758
194	780 803 825 847 870 892 914 937 959 981
195	29003 026 048 070 092 115 137 159 181 203
196	226 248 270 292 314 336 358 380 403 425
197	447 469 491 513 535 557 579 601 623 645
198	667 688 710 732 754 776 798 820 842 863
199	885 907 929 951 973 994 016 038 060 081
200	30103 125 146 168 190 211 233 255 276 298
201	320 341 363 384 406 428 449 471 492 514
202	535 557 578 600 621 643 664 685 707 728
203	750 771 792 814 835 856 878 899 920 942
204	963 984 006 027 048 069 091 112 133 154
205	31175 197 218 239 260 281 302 323 345 366
206	387 408 429 450 471 492 513 534 555 576
207	597 618 639 660 681 702 723 744 765 785
208	806 827 848 869 890 911 931 952 973 994
209	32015 035 056 077 098 118 139 160 181 201
210	222 243 263 284 305 325 346 366 387 408
211	428 449 469 490 510 531 552 572 593 613
212	634 654 675 695 715 736 756 777 797 818
213	838 858 879 899 919 940 960 980 001 021
214	33041 062 082 102 122 143 163 183 203 224
215	244 264 284 304 325 345 365 385 405 425
216	445 465 486 506 526 546 566 586 606 626
217	646 666 686 706 726 746 766 786 806 826
218	846 866 885 905 925 945 965 985 005 025
219	34044 064 084 104 124 143 163 183 203 223
220	242 262 282 301 321 341 361 380 400 420
221	439 459 479 498 518 537 557 577 596 616
222	635 655 674 694 713 733 753 772 792 811
223	830 850 869 889 908 928 947 967 986 005
224	35025 044 064 083 102 122 141 160 180 199
225	218 238 257 276 295 315 334 353 372 392
226	411 430 449 468 488 507 526 545 564 583
227	603 622 641 660 679 698 717 736 755 774
228	793 813 832 851 870 889 908 927 946 965
229	984 003 021 040 059 078 097 116 135 154
230	36173 192 211 229 248 267 286 305 324 342
231	361 380 399 418 436 455 474 493 511 530
232	549 568 586 605 624 642 661 680 698 717
233	736 754 773 791 810 829 847 866 884 903
234	922 940 959 977 996 014 033 051 070 088

No.	Logarithm 0 1 2 3 4 5 6 7 8 9
235	37107 125 144 162 181 199 218 236 254 273
236	291 310 328 346 365 383 401 420 438 457
237	475 493 511 530 548 566 585 603 621 639
238	658 676 694 712 731 749 767 785 803 822
239	840 858 876 894 912 931 949 967 985 003
240	38021 039 057 075 093 112 130 148 166 184
241	202 220 238 256 274 292 310 328 346 364
242	382 399 417 435 453 471 489 507 525 543
243	561 578 596 614 632 650 668 686 703 721
244	739 757 775 792 810 828 846 863 881 899
245	917 934 952 970 987 005 023 041 058 076
246	39094 111 129 146 164 182 199 217 235 252
247	270 287 305 322 340 358 375 393 410 428
248	445 463 480 498 515 533 550 568 585 602
249	620 637 655 672 690 707 724 742 759 777
250	794 811 829 846 863 881 898 915 933 950
251	967 985 002 019 037 054 071 088 106 123
252	40140 157 175 192 209 226 243 261 278 295
253	312 329 346 364 381 398 415 432 449 466
254	483 500 518 535 552 569 586 603 620 637
255	654 671 688 705 722 739 756 773 790 807
256	824 841 858 875 892 909 926 943 960 976
257	993 010 027 044 061 078 095 111 128 145
258	41162 179 196 212 229 246 263 280 296 313
259	330 347 363 380 397 414 430 447 464 481
260	497 514 531 547 564 581 597 614 631 647
261	664 681 697 714 731 747 764 780 797 814
262	830 847 863 880 896 913 929 946 963 979
263	996 012 029 045 062 078 095 111 127 144
264	42160 177 193 210 226 243 259 275 292 308
265	325 341 357 374 390 406 423 439 455 472
266	488 504 521 537 553 570 586 602 619 635
267	651 667 684 700 716 732 749 765 781 797
268	813 830 846 862 878 894 911 927 943 959
269	975 991 008 024 040 056 072 088 104 120
270	43136 152 169 185 201 217 233 249 265 281
271	297 313 329 345 361 377 393 409 425 441
272	457 473 489 505 521 537 553 569 584 600
273	616 632 648 664 680 696 712 727 743 759
274	775 791 807 823 838 854 870 886 902 917
275	933 949 965 981 996 012 028 044 059 075
276	44091 107 122 138 154 170 185 201 217 232
277	248 264 279 295 311 326 342 358 373 389
278	404 420 436 451 467 483 498 514 529 545
279	560 576 592 607 623 638 654 669 685 700

Pro. Parts		
D.	20	19
1	2·0	1·9
2	4·0	3·8
3	6·0	5·7
4	8·0	7·6
5	10·0	9·5
6	12·0	11·4
7	14·0	13·3
8	16·0	15·2
9	18·0	17·1
D.	18	17
1	1·8	1·7
2	3·6	3·4
3	5·4	5·1
4	7·2	6·8
5	9·0	8·5
6	10·8	10·2
7	12·6	11·9
8	14·4	13·6
9	16·2	15·3
D.	16	15
1	1·6	1·5
2	3·2	3·0
3	4·8	4·5
4	6·4	6·0
5	8·0	7·5
6	9·6	9·0
7	11·2	10·5
8	12·8	12·0
9	14·4	13·5

TABLE LI.—Common Logarithms to 5 places of Decimals.

No.	Logarithm 0 1 2 3 4 5 6 7 8 9
280	44716 731 747 762 778 793 809 824 840 855
281	871 886 902 917 932 948 963 979 994 010
282	45025 040 056 071 086 102 117 133 148 163
283	179 194 209 225 240 255 271 286 301 317
284	332 347 362 378 393 408 423 439 454 469
285	484 500 515 530 545 561 576 591 606 621
286	637 652 667 682 697 712 728 743 758 773
287	788 803 818 834 849 864 879 894 909 924
288	939 954 969 984 000 015 030 045 060 075
289	46090 105 120 135 150 165 180 195 210 225
290	240 255 270 285 300 315 330 345 359 374
291	389 404 419 434 449 464 479 494 509 523
292	538 553 568 583 598 613 627 642 657 672
293	687 702 716 731 746 761 776 790 805 820
294	835 850 864 879 894 909 923 938 953 967
295	982 997 012 026 041 056 070 085 100 114
296	47129 144 159 173 188 202 217 232 246 261
297	276 290 305 319 334 349 363 378 392 407
298	422 436 451 465 480 494 509 524 538 553
299	567 582 596 611 625 640 654 669 683 698
300	712 727 741 756 770 784 799 813 828 842
301	857 871 885 900 914 929 943 958 972 986
302	48001 015 029 044 058 073 087 101 116 130
303	144 159 173 187 202 216 230 244 259 273
304	287 302 316 330 344 359 373 387 401 416
305	430 444 458 473 487 501 515 530 544 558
306	572 586 601 615 629 643 657 671 686 700
307	714 728 742 756 770 785 799 813 827 841
308	855 869 883 897 911 926 940 954 968 982
309	996 010 024 038 052 066 080 094 108 122
310	49136 150 164 178 192 206 220 234 248 262
311	276 290 304 318 332 346 360 374 388 402
312	415 429 443 457 471 485 499 513 527 541
313	554 568 582 596 610 624 638 651 665 679
314	693 707 721 734 748 762 776 790 803 817
315	831 845 859 872 886 900 914 927 941 955
316	969 982 996 010 024 037 051 065 079 092
317	50106 120 133 147 161 174 188 202 215 229
318	243 256 270 284 297 311 325 338 352 365
319	379 393 406 420 433 447 461 474 488 501
320	515 529 542 556 569 583 596 610 623 637
321	651 664 678 691 705 718 732 745 759 772
322	786 799 813 826 840 853 866 880 893 907
323	920 934 947 961 974 987 001 014 028 041
324	51055 068 081 095 108 121 135 148 162 175
	0 1 2 3 4 5 6 7 8 9

No.	Logarithm 0 1 2 3 4 5 6 7 8 9
325	51188 202 215 228 242 255 268 282 295 308
326	322 335 348 362 375 388 402 415 428 441
327	455 468 481 495 508 521 534 548 561 574
328	587 601 614 627 640 654 667 680 693 706
329	720 733 746 759 772 786 799 812 825 838
330	851 865 878 891 904 917 930 943 957 970
331	983 996 009 022 035 048 061 075 088 101
332	52114 127 140 153 166 179 192 205 218 231
333	244 257 270 284 297 310 323 336 349 362
334	375 388 401 414 427 440 453 466 479 492
335	504 517 530 543 556 569 582 595 608 621
336	634 647 660 673 686 699 711 724 737 750
337	763 776 789 802 815 827 840 853 866 879
338	892 905 917 930 943 956 969 982 994 007
339	53020 033 046 058 071 084 097 110 122 135
340	148 161 173 186 199 212 224 237 250 263
341	275 288 301 314 326 339 352 364 377 390
342	403 415 428 441 453 466 479 491 504 517
343	529 542 555 567 580 593 605 618 631 643
344	656 668 681 694 706 719 732 744 757 769
345	782 794 807 820 832 845 857 870 882 895
346	908 920 933 945 958 970 983 995 008 020
347	54033 045 058 070 083 095 108 120 133 145
348	158 170 183 195 208 220 233 245 258 270
349	283 295 307 320 332 345 357 370 382 394
350	407 419 432 444 456 469 481 494 506 518
351	531 543 555 568 580 593 605 617 630 642
352	654 667 679 691 704 716 728 741 753 765
353	777 790 802 814 827 839 851 864 876 888
354	900 913 925 937 949 962 974 986 998 011
355	55023 035 047 060 072 084 096 108 121 133
356	145 157 169 182 194 206 218 230 242 255
357	267 279 291 303 315 328 340 352 364 376
358	388 400 413 425 437 449 461 473 485 497
359	509 522 534 546 558 570 582 594 606 618
360	630 642 654 666 678 691 703 715 727 739
361	751 763 775 787 799 811 823 835 847 859
362	871 883 895 907 919 931 943 955 967 979
363	991 003 015 027 038 050 062 074 086 098
364	56110 122 134 146 158 170 182 194 205 217
365	229 241 253 265 277 289 301 312 324 336
366	348 360 372 384 396 407 419 431 443 455
367	467 478 490 502 514 526 538 549 561 573
368	585 597 608 620 632 644 656 667 679 691
369	703 714 726 738 750 761 773 785 797 808
	0 1 2 3 4 5 6 7 8 9

Pro. Parts		
D.	14	13
1	1·4	1·3
2	2·8	2·6
3	4·2	3·9
4	5·6	5·2
5	7·0	6·5
6	8·4	7·8
7	9·8	9·1
8	11·2	10·4
9	12·6	11·7
D.	12	11
1	1·2	1·1
2	2·4	2·2
3	3·6	3·3
4	4·8	4·4
5	6·0	5·5
6	7·2	6·6
7	8·4	7·7
8	9·6	8·8
9	10·8	9·9

TABLE LI.—Common Logarithms to 5 places of Decimals.

No.	Logarithm 0 1 2 3 4 5 6 7 8 9
370	56820 832 844 855 867 879 891 902 914 926
371	937 949 961 972 984 996 008 019 031 043
372	57054 066 078 089 101 113 124 136 148 159
373	171 183 194 206 217 229 241 252 264 276
374	287 299 310 322 334 345 357 368 380 392
375	403 415 426 438 449 461 473 484 496 507
376	519 530 542 553 565 576 588 600 611 623
377	634 646 657 669 680 692 703 715 726 738
378	749 761 772 784 795 807 818 830 841 852
379	864 875 887 898 910 921 933 944 955 967
380	978 990 001 013 024 035 047 058 070 081
381	58092 104 115 127 138 149 161 172 184 195
382	206 218 229 240 252 263 274 286 297 309
383	320 331 343 354 365 377 388 399 410 422
384	433 444 456 467 478 490 501 512 524 535
385	546 557 569 580 591 602 614 625 636 647
386	659 670 681 692 704 715 726 737 749 760
387	771 782 794 805 816 827 838 850 861 872
388	883 894 906 917 928 939 950 961 973 984
389	995 006 017 028 040 051 062 073 084 095
390	59106 118 129 140 151 162 173 184 195 207
391	218 229 240 251 262 273 284 295 306 318
392	329 340 351 362 373 384 395 406 417 428
393	439 450 461 472 483 494 506 517 528 539
394	550 561 572 583 594 605 616 627 638 649
395	660 671 682 693 704 715 726 737 748 759
396	770 780 791 802 813 824 835 846 857 868
397	879 890 901 912 923 934 945 956 966 977
398	988 999 010 021 032 043 054 065 076 086
399	60097 108 119 130 141 152 163 173 184 195
400	206 217 228 239 249 260 271 282 293 304
401	314 325 336 347 358 369 379 390 401 412
402	423 433 444 455 466 477 487 498 509 520
403	531 541 552 563 574 584 595 606 617 627
404	638 649 660 670 681 692 703 713 724 735
405	746 756 767 778 788 799 810 821 831 842
406	853 863 874 885 895 906 917 927 938 949
407	959 970 981 991 002 013 023 034 045 055
408	61066 077 087 098 109 119 130 140 151 162
409	172 183 194 204 215 225 236 247 257 268
410	278 289 300 310 321 331 342 352 363 374
411	384 395 405 416 426 437 448 458 469 479
412	490 500 511 521 532 542 553 563 574 584
413	595 606 616 627 637 648 658 669 679 690
414	700 711 721 731 742 752 763 773 784 794

No.	Logarithm 0 1 2 3 4 5 6 7 8 9
415	61805 815 826 836 847 857 868 878 888 899
416	909 920 930 941 951 962 972 982 993 003
417	62014 024 034 045 055 066 076 086 097 107
418	118 128 138 149 159 170 180 190 201 211
419	221 232 242 252 263 273 284 294 304 315
420	325 335 346 356 366 377 387 397 408 418
421	428 439 449 459 469 480 490 500 511 521
422	531 542 552 562 572 583 593 603 613 624
423	634 644 655 665 675 685 696 706 716 726
424	737 747 757 767 778 788 798 808 818 829
425	839 849 859 870 880 890 900 910 921 931
426	941 951 961 972 982 992 002 012 022 033
427	63043 053 063 073 083 094 104 114 124 134
428	144 155 165 175 185 195 205 215 225 236
429	246 256 266 276 286 296 306 317 327 337
430	347 357 367 377 387 397 407 417 428 438
431	448 458 468 478 488 498 508 518 528 538
432	548 558 568 579 589 599 609 619 629 639
433	649 659 669 679 689 699 709 719 729 739
434	749 759 769 779 789 799 809 819 829 839
435	849 859 869 879 889 899 909 919 929 939
436	949 959 969 979 988 998 008 018 028 038
437	64048 058 068 078 088 098 108 118 128 137
438	147 157 167 177 187 197 207 217 227 237
439	246 256 266 276 286 296 306 316 326 335
440	345 355 365 375 385 395 404 414 424 434
441	444 454 464 473 483 493 503 513 523 532
442	542 552 562 572 582 591 601 611 621 631
443	640 650 660 670 680 689 699 709 719 729
444	738 748 758 768 777 787 797 807 816 826
445	836 846 856 865 875 885 895 904 914 924
446	933 943 953 963 972 982 992 002 011 021
447	65031 040 050 060 070 079 089 099 108 118
448	128 137 147 157 167 176 186 196 205 215
449	225 234 244 254 263 273 283 292 302 312
450	321 331 341 350 360 369 379 389 398 408
451	418 427 437 447 456 466 475 485 495 504
452	514 523 533 543 552 562 571 581 591 600
453	610 619 629 639 648 658 667 677 686 696
454	706 715 725 734 744 753 763 772 782 792
455	801 811 820 830 839 849 858 868 877 887
456	896 906 916 925 935 944 954 963 973 982
457	992 001 011 020 030 039 049 058 068 077
458	66087 096 106 115 124 134 143 153 162 172
459	181 191 200 210 219 229 238 247 257 266

Pro. Parts	
D.	12
1	1·2
2	2·4
3	3·6
4	4·8
5	6·0
6	7·2
7	8·4
8	9·6
9	10·8
D.	11
1	1·1
2	2·2
3	3·3
4	4·4
5	5·5
6	6·6
7	7·7
8	8·8
9	9·9
D.	10
1	1·0
2	2·0
3	3·0
4	4·0
5	5·0
6	6·0
7	7·0
8	8·0
9	9·0
D.	9
1	0·9
2	1·8
3	2·7
4	3·6
5	4·5
6	5·4
7	6·3
8	7·2
9	8·1

TABLE LI.—Common Logarithms to 5 places of Decimals.

No.	Logarithm 0 1 2 3 4 5 6 7 8 9
460	66276 285 295 304 314 323 332 342 351 361
461	370 380 389 398 408 417 427 436 445 455
462	464 474 483 492 502 511 521 530 539 549
463	558 567 577 586 596 605 614 624 633 642
464	652 661 671 680 689 699 708 717 727 736
465	745 755 764 773 783 792 801 811 820 829
466	839 848 857 867 876 885 894 904 913 922
467	932 941 950 960 969 978 987 997 006 015
468	67025 034 043 052 062 071 080 089 099 108
469	117 127 136 145 154 164 173 182 191 201
470	210 219 228 237 247 256 265 274 284 293
471	302 311 321 330 339 348 357 367 376 385
472	394 403 413 422 431 440 449 459 468 477
473	486 495 504 514 523 532 541 550 560 569
474	578 587 596 605 614 624 633 642 651 660
475	669 679 688 697 706 715 724 733 742 752
476	761 770 779 788 797 806 815 825 834 843
477	852 861 870 879 888 897 906 916 925 934
478	943 952 961 970 979 988 997 006 015 024
479	68034 043 052 061 070 079 088 097 106 115
480	124 133 142 151 160 169 178 187 196 205
481	215 224 233 242 251 260 269 278 287 296
482	305 314 323 332 341 350 359 368 377 386
483	395 404 413 422 431 440 449 458 467 476
484	485 494 502 511 520 529 538 547 556 565
485	574 583 592 601 610 619 628 637 646 655
486	664 673 681 690 699 708 717 726 735 744
487	753 762 771 780 789 797 806 815 824 833
488	842 851 860 869 878 886 895 904 913 922
489	931 940 949 958 966 975 984 993 002 011
490	69020 028 037 046 055 064 073 082 090 099
491	108 117 126 135 144 152 161 170 179 188
492	197 205 214 223 232 241 249 258 267 276
493	285 294 302 311 320 329 338 346 355 364
494	373 381 390 399 408 417 425 434 443 452
495	461 469 478 487 496 504 513 522 531 539
496	548 557 566 574 583 592 601 609 618 627
497	636 644 653 662 671 679 688 697 705 714
498	723 732 740 749 758 767 775 784 793 801
499	810 819 827 836 845 854 862 871 880 888
500	897 906 914 923 932 940 949 958 966 975
501	984 992 001 010 018 027 036 044 053 062
502	70070 079 088 096 105 114 122 131 140 148
503	157 165 174 183 191 200 209 217 226 234
504	243 252 260 269 278 286 295 303 312 321

No.	Logarithm 0 1 2 3 4 5 6 7 8 9
505	70329 338 346 355 364 372 381 389 398 406
506	415 424 432 441 449 458 467 475 484 492
507	501 509 518 526 535 544 552 561 569 578
508	586 595 603 612 621 629 638 646 655 663
509	672 680 689 697 706 714 723 731 740 749
510	757 766 774 783 791 800 808 817 825 834
511	842 851 859 868 876 885 893 902 910 919
512	927 935 944 952 961 969 978 986 995 003
513	71012 020 029 037 046 054 063 071 079 088
514	096 105 113 122 130 139 147 155 164 172
515	181 189 198 206 214 223 231 240 248 257
516	265 273 282 290 299 307 315 324 332 341
517	349 357 366 374 383 391 399 408 416 425
518	433 441 450 458 466 475 483 492 500 508
519	517 525 533 542 550 559 567 575 584 592
520	600 609 617 625 634 642 650 659 667 675
521	684 692 700 709 717 725 734 742 750 759
522	767 775 784 792 800 809 817 825 834 842
523	850 858 867 875 883 892 900 908 917 925
524	933 941 950 958 966 975 983 991 999 008
525	72016 024 032 041 049 057 066 074 082 090
526	099 107 115 123 132 140 148 156 165 173
527	181 189 198 206 214 222 230 239 247 255
528	263 272 280 288 296 304 313 321 329 337
529	346 354 362 370 378 387 395 403 411 419
530	428 436 444 452 460 469 477 485 493 501
531	509 518 526 534 542 550 558 567 575 583
532	591 599 607 616 624 632 640 648 656 665
533	673 681 689 697 705 713 722 730 738 746
534	754 762 770 779 787 795 803 811 819 827
535	835 843 852 860 868 876 884 892 900 908
536	916 925 933 941 949 957 965 973 981 989
537	997 006 014 022 030 038 046 054 062 070
538	73078 086 094 102 111 119 127 135 143 151
539	159 167 175 183 191 199 207 215 223 231
540	239 247 255 263 272 280 288 296 304 312
541	320 328 336 344 352 360 368 376 384 392
542	400 408 416 424 432 440 448 456 464 472
543	480 488 496 504 512 520 528 536 544 552
544	560 568 576 584 592 600 608 616 624 632
545	640 648 656 664 672 679 687 695 703 711
546	719 727 735 743 751 759 767 775 783 791
547	799 807 815 823 830 838 846 854 862 870
548	878 886 894 902 910 918 926 933 941 949
549	957 965 973 981 989 997 005 013 020 028

Pro. Parts	
D.	10
1	1·0
2	2·0
3	3·0
4	4·0
5	5·0
6	6·0
7	7·0
8	8·0
9	9·0
D.	9
1	0·9
2	1·8
3	2·7
4	3·6
5	4·5
6	5·4
7	6·3
8	7·2
9	8·1
D.	8
1	0·8
2	1·6
3	2·4
4	3·2
5	4·0
6	4·8
7	5·6
8	6·4
9	7·2
D.	7
1	0·7
2	1·4
3	2·1
4	2·8
5	3·5
6	4·2
7	4·9
8	5·6
9	6·3

TABLE LI.—Common Logarithms to 5 places of Decimals.

No.	Logarithm 0 1 2 3 4 5 6 7 8 9
550	74036 044 052 060 068 076 084 092 099 107
551	115 123 131 139 147 155 162 170 178 186
552	194 202 210 218 225 233 241 249 257 265
553	273 280 288 296 304 312 320 327 335 343
554	351 359 367 374 382 390 398 406 414 421
555	429 437 445 453 461 468 476 484 492 500
556	507 515 523 531 539 547 554 562 570 578
557	586 593 601 609 617 624 632 640 648 656
558	663 671 679 687 695 702 710 718 726 733
559	741 749 757 764 772 780 788 796 803 811
560	819 827 834 842 850 858 865 873 881 889
561	896 904 912 920 927 935 943 950 958 966
562	974 981 989 997 005 012 020 028 035 043
563	75051 059 066 074 082 089 097 105 113 120
564	128 136 143 151 159 166 174 182 189 197
565	205 213 220 228 236 243 251 259 266 274
566	282 289 297 305 312 320 328 335 343 351
567	358 366 374 381 389 397 404 412 420 427
568	435 442 450 458 465 473 481 488 496 504
569	511 519 526 534 542 549 557 565 572 580
570	587 595 603 610 618 626 633 641 648 656
571	664 671 679 686 694 702 709 717 724 732
572	740 747 755 762 770 778 785 793 800 808
573	815 823 831 838 846 853 861 868 876 884
574	891 899 906 914 921 929 937 944 952 959
575	967 974 982 989 997 005 012 020 027 035
576	76042 050 057 065 072 080 087 095 103 110
577	118 125 133 140 148 155 163 170 178 185
578	193 200 208 215 223 230 238 245 253 260
579	268 275 283 290 298 305 313 320 328 335
580	343 350 358 365 373 380 388 395 403 410
581	418 425 433 440 448 455 462 470 477 485
582	492 500 507 515 522 530 537 545 552 559
583	567 574 582 589 597 604 612 619 626 634
584	641 649 656 664 671 678 686 693 701 708
585	716 723 730 738 745 753 760 768 775 782
586	790 797 805 812 819 827 834 842 849 856
587	864 871 879 886 893 901 908 916 923 930
588	938 945 953 960 967 975 982 989 997 004
589	77012 019 026 034 041 048 056 063 070 078
590	085 093 100 107 115 122 129 137 144 151
591	159 166 173 181 188 195 203 210 217 225
592	232 240 247 254 262 269 276 283 291 298
593	305 313 320 327 335 342 349 357 364 371
594	379 386 393 401 408 415 422 430 437 444
595	77452 459 466 474 481 488 495 503 510 517
596	525 532 539 546 554 561 568 576 583 590
597	597 605 612 619 627 634 641 648 656 663
598	670 677 685 692 699 706 714 721 728 735
599	743 750 757 764 772 779 786 793 801 808
600	815 822 830 837 844 851 859 866 873 880
601	887 895 902 909 916 924 931 938 945 952
602	960 967 974 981 988 996 003 010 017 025
603	78032 039 046 053 061 068 075 082 089 097
604	104 111 118 125 132 140 147 154 161 168
605	176 183 190 197 204 211 219 226 233 240
606	247 254 262 269 276 283 290 297 305 312
607	319 326 333 340 347 355 362 369 376 383
608	390 398 405 412 419 426 433 440 447 455
609	462 469 476 483 490 497 504 512 519 526
610	533 540 547 554 561 569 576 583 590 597
611	604 611 618 625 633 640 647 654 661 668
612	675 682 689 696 704 711 718 725 732 739
613	746 753 760 767 774 781 789 796 803 810
614	817 824 831 838 845 852 859 866 873 880
615	888 895 902 909 916 923 930 937 944 951
616	958 965 972 979 986 993 000 007 014 021
617	79029 036 043 050 057 064 071 078 085 092
618	099 106 113 120 127 134 141 148 155 162
619	169 176 183 190 197 204 211 218 225 232
620	239 246 253 260 267 274 281 288 295 302
621	309 316 323 330 337 344 351 358 365 372
622	379 386 393 400 407 414 421 428 435 442
623	449 456 463 470 477 484 491 498 505 511
624	518 525 532 539 546 553 560 567 574 581
625	588 595 602 609 616 623 630 637 644 650
626	657 664 671 678 685 692 699 706 713 720
627	727 734 741 748 754 761 768 775 782 789
628	796 803 810 817 824 831 837 844 851 858
629	865 872 879 886 893 900 906 913 920 927
630	934 941 948 955 962 969 975 982 989 996
631	80003 010 017 024 030 037 044 051 058 065
632	072 079 085 092 099 106 113 120 127 134
633	140 147 154 161 168 175 182 188 195 202
634	209 216 223 229 236 243 250 257 264 271
635	277 284 291 298 305 312 318 325 332 339
636	346 353 359 366 373 380 387 393 400 407
637	414 421 428 434 441 448 455 462 468 475
638	482 489 496 502 509 516 523 530 536 543
639	550 557 564 570 577 584 591 598 604 611

Pro. Parts	
D.	8
1	0·8
2	1·6
3	2·4
4	3·2
5	4·0
6	4·8
7	5·6
8	6·4
9	7·2
D.	7
1	0·7
2	1·4
3	2·1
4	2·8
5	3·5
6	4·2
7	4·9
8	5·6
9	6·3
D.	6
1	0·6
2	1·2
3	1·8
4	2·4
5	3·0
6	3·6
7	4·2
8	4·8
9	5·4

0 1 2 3 4 5 6 7 8 9

TABLE LI.—Common Logarithms to 5 places of Decimals.

No.	Logarithm 0 1 2 3 4 5 6 7 8 9
640	80618 625 632 638 645 652 659 665 672 679
641	686 693 699 706 713 720 726 733 740 747
642	754 760 767 774 781 787 794 801 808 814
643	821 828 835 841 848 855 862 868 875 882
644	889 895 902 909 916 922 929 936 943 949
645	956 963 969 976 983 990 996 003 010 017
646	81023 030 037 043 050 057 064 070 077 084
647	090 097 104 111 117 124 131 137 144 151
648	158 164 171 178 184 191 198 204 211 218
649	224 231 238 245 251 258 265 271 278 285
650	291 298 305 311 318 325 331 338 345 351
651	358 365 371 378 385 391 398 405 411 418
652	425 431 438 445 451 458 465 471 478 485
653	491 498 505 511 518 525 531 538 544 551
654	558 564 571 578 584 591 598 604 611 617
655	624 631 637 644 651 657 664 671 677 684
656	690 697 704 710 717 723 730 737 743 750
657	757 763 770 776 783 790 796 803 809 816
658	823 829 836 842 849 856 862 869 875 882
659	889 895 902 908 915 921 928 935 941 948
660	954 961 968 974 981 987 994 000 007 014
661	82020 027 033 040 046 053 060 066 073 079
662	086 092 099 105 112 119 125 132 138 145
663	151 158 164 171 178 184 191 197 204 210
664	217 223 230 236 243 249 256 263 269 276
665	282 289 295 302 308 315 321 328 334 341
666	347 354 360 367 373 380 387 393 400 406
667	413 419 426 432 439 445 452 458 465 471
668	478 484 491 497 504 510 517 523 530 536
669	543 549 556 562 569 575 582 588 595 601
670	607 614 620 627 633 640 646 653 659 666
671	672 679 685 692 698 705 711 718 724 730
672	737 743 750 756 763 769 776 782 789 795
673	802 808 814 821 827 834 840 847 853 860
674	866 872 879 885 892 898 905 911 918 924
675	930 937 943 950 956 963 969 975 982 988
676	995 001 008 014 020 027 033 040 046 052
677	83059 065 072 078 085 091 097 104 110 117
678	123 129 136 142 149 155 161 168 174 181
679	187 193 200 206 213 219 225 232 238 245
680	251 257 264 270 276 283 289 296 302 308
681	315 321 327 334 340 347 353 359 366 372
682	378 385 391 398 404 410 417 423 429 436
683	442 448 455 461 467 474 480 487 493 499
684	506 512 518 525 531 537 544 550 556 563

No.	Logarithm 0 1 2 3 4 5 6 7 8 9
685	83569 575 582 588 594 601 607 613 620 626
686	632 639 645 651 658 664 670 677 683 689
687	696 702 708 715 721 727 734 740 746 753
688	759 765 771 778 784 790 797 803 809 816
689	822 828 835 841 847 853 860 866 872 879
690	885 891 897 904 910 916 923 929 935 942
691	948 954 960 967 973 979 985 992 998 004
692	84011 017 023 029 036 042 048 055 061 067
693	073 080 086 092 098 105 111 117 123 130
694	136 142 148 155 161 167 173 180 186 192
695	198 205 211 217 223 230 236 242 248 255
696	261 267 273 280 286 292 298 305 311 317
697	323 330 336 342 348 354 361 367 373 379
698	386 392 398 404 410 417 423 429 435 442
699	448 454 460 466 473 479 485 491 497 504
700	510 516 522 528 535 541 547 553 559 566
701	572 578 584 590 597 603 609 615 621 628
702	634 640 646 652 658 665 671 677 683 689
703	696 702 708 714 720 726 733 739 745 751
704	757 763 770 776 782 788 794 800 807 813
705	819 825 831 837 844 850 856 862 868 874
706	880 887 893 899 905 911 917 924 930 936
707	942 948 954 960 967 973 979 985 991 997
708	85003 009 016 022 028 034 040 046 052 058
709	065 071 077 083 089 095 101 107 114 120
710	126 132 138 144 150 156 163 169 175 181
711	187 193 199 205 211 217 224 230 236 242
712	248 254 260 266 272 278 285 291 297 303
713	309 315 321 327 333 339 345 352 358 364
714	370 376 382 388 394 400 406 412 418 425
715	431 437 443 449 455 461 467 473 479 485
716	491 497 503 509 516 522 528 534 540 546
717	552 558 564 570 576 582 588 594 600 606
718	612 618 625 631 637 643 649 655 661 667
719	673 679 685 691 697 703 709 715 721 727
720	733 739 745 751 757 763 769 775 781 788
721	794 800 806 812 818 824 830 836 842 848
722	854 860 866 872 878 884 890 896 902 908
723	914 920 926 932 938 944 950 956 962 968
724	974 980 986 992 998 004 010 016 022 028
725	86034 040 046 052 058 064 070 076 082 088
726	094 100 106 112 118 124 130 136 141 147
727	153 159 165 171 177 183 189 195 201 207
728	213 219 225 231 237 243 249 255 261 267
729	273 279 285 291 297 303 308 314 320 326

Pro. Parts	
D.	7
1	0·7
2	1·4
3	2·1
4	2·8
5	3·5
6	4·2
7	4·9
8	5·6
9	6·3
D.	6
1	0·6
2	1·2
3	1·8
4	2·4
5	3·0
6	3·6
7	4·2
8	4·8
9	5·4
D.	5
1	0·5
2	1·0
3	1·5
4	2·0
5	2·5
6	3·0
7	3·5
8	4·0
9	4·5

TABLE LI.—Common Logarithms to 5 places of Decimals.

No.	Logarithm 0	1	2	3	4	5	6	7	8	9
730	86332	338	344	350	356	362	368	374	380	386
731	392	398	404	410	415	421	427	433	439	445
732	451	457	463	469	475	481	487	493	499	504
733	510	516	522	528	534	540	546	552	558	564
734	570	576	581	587	593	599	605	611	617	623
735	629	635	641	646	652	658	664	670	676	682
736	688	694	700	705	711	717	723	729	735	741
737	747	753	759	764	770	776	782	788	794	800
738	806	812	817	823	829	835	841	847	853	859
739	864	870	876	882	888	894	900	906	911	917
740	923	929	935	941	947	953	958	964	970	976
741	982	988	994	999	005	011	017	023	029	035
742	87040	046	052	058	064	070	075	081	087	093
743	099	105	111	116	122	128	134	140	146	151
744	157	163	169	175	181	186	192	198	204	210
745	216	221	227	233	239	245	251	256	262	268
746	274	280	286	291	297	303	309	315	320	326
747	332	338	344	349	355	361	367	373	379	384
748	390	396	402	408	413	419	425	431	437	442
749	448	454	460	466	471	477	483	489	495	500
750	506	512	518	523	529	535	541	547	552	558
751	564	570	576	581	587	593	599	604	610	616
752	622	628	633	639	645	651	656	662	668	674
753	679	685	691	697	703	708	714	720	726	731
754	737	743	749	754	760	766	772	777	783	789
755	795	800	806	812	818	823	829	835	841	846
756	852	858	864	869	875	881	887	892	898	904
757	910	915	921	927	933	938	944	950	955	961
758	967	973	978	984	990	996	001	007	013	018
759	88024	030	036	041	047	053	058	064	070	076
760	081	087	093	098	104	110	116	121	127	133
761	138	144	150	156	161	167	173	178	184	190
762	195	201	207	213	218	224	230	235	241	247
763	252	258	264	270	275	281	287	292	298	304
764	309	315	321	326	332	338	343	349	355	360
765	366	372	377	383	389	395	400	406	412	417
766	423	429	434	440	446	451	457	463	468	474
767	480	485	491	497	502	508	513	519	525	530
768	536	542	547	553	559	564	570	576	581	587
769	593	598	604	610	615	621	627	632	638	643
770	649	655	660	666	672	677	683	689	694	700
771	705	711	717	722	728	734	739	745	750	756
772	762	767	773	779	784	790	795	801	807	812
773	818	824	829	835	840	846	852	857	863	868
774	874	880	885	891	897	902	908	913	919	925
	0	1	2	3	4	5	6	7	8	9

No.	Logarithm 0	1	2	3	4	5	6	7	8	9
775	88930	936	941	947	953	958	964	969	975	981
776	986	992	997	003	009	014	020	025	031	037
777	89042	048	053	059	064	070	076	081	087	092
778	098	104	109	115	120	126	131	137	143	148
779	154	159	165	170	176	182	187	193	198	204
780	209	215	221	226	232	237	243	248	254	260
781	265	271	276	282	287	293	298	304	310	315
782	321	326	332	337	343	348	354	360	365	371
783	376	382	387	393	398	404	409	415	421	426
784	432	437	443	448	454	459	465	470	476	481
785	487	492	498	504	509	515	520	526	531	537
786	542	548	553	559	564	570	575	581	586	592
787	597	603	609	614	620	625	631	636	642	647
788	653	658	664	669	675	680	686	691	697	702
789	708	713	719	724	730	735	741	746	752	757
790	763	768	774	779	785	790	796	801	807	812
791	818	823	829	834	840	845	851	856	862	867
792	873	878	883	889	894	900	905	911	916	922
793	927	933	938	944	949	955	960	966	971	977
794	982	988	993	998	004	009	015	020	026	031
795	90037	042	048	053	059	064	069	075	080	086
796	091	097	102	108	113	119	124	129	135	140
797	146	151	157	162	168	173	179	184	189	195
798	200	206	211	217	222	227	233	238	244	249
799	255	260	266	271	276	282	287	293	298	304
800	309	314	320	325	331	336	342	347	352	358
801	363	369	374	380	385	390	396	401	407	412
802	417	423	428	434	439	445	450	455	461	466
803	472	477	482	488	493	499	504	509	515	520
804	526	531	536	542	547	553	558	563	569	574
805	580	585	590	596	601	607	612	617	623	628
806	634	639	644	650	655	660	666	671	677	682
807	687	693	698	703	709	714	720	725	730	736
808	741	747	752	757	763	768	773	779	784	789
809	795	800	806	811	816	822	827	832	838	843
810	849	854	859	865	870	875	881	886	891	897
811	902	907	913	918	924	929	934	940	945	950
812	956	961	966	972	977	982	988	993	998	004
813	91009	014	020	025	030	036	041	046	052	057
814	062	068	073	078	084	089	094	100	105	110
815	116	121	126	132	137	142	148	153	158	164
816	169	174	180	185	190	196	201	206	212	217
817	222	228	233	238	243	249	254	259	265	270
818	275	281	286	291	297	302	307	312	318	323
819	328	334	339	344	350	355	360	365	371	376
	0	1	2	3	4	5	6	7	8	9

Pro. Parts	
D.	6
1	0·6
2	1·2
3	1·8
4	2·4
5	3·0
6	3·6
7	4·2
8	4·8
9	5·4
D.	5
1	0·5
2	1·0
3	1·5
4	2·0
5	2·5
6	3·0
7	3·5
8	4·0
9	4·5

TABLE LI.—Common Logarithms to 5 places of Decimals.

No.	Logarithm 0 1 2 3 4 5 6 7 8 9
820	91381 387 392 397 403 408 413 418 424 429
821	434 440 445 450 455 461 466 471 477 482
822	487 492 498 503 508 514 519 524 529 535
823	540 545 551 556 561 566 572 577 582 587
824	593 598 603 609 614 619 624 630 635 640
825	645 651 656 661 666 672 677 682 687 693
826	698 703 709 714 719 724 730 735 740 745
827	751 756 761 766 772 777 782 787 793 798
828	803 808 814 819 824 829 834 840 845 850
829	855 861 866 871 876 882 887 892 897 903
830	908 913 918 924 929 934 939 944 950 955
831	960 965 971 976 981 986 991 997 002 007
832	92012 018 023 028 033 038 044 049 054 059
833	065 070 075 080 085 091 096 101 106 111
834	117 122 127 132 137 143 148 153 158 163
835	169 174 179 184 189 195 200 205 210 215
836	221 226 231 236 241 247 252 257 262 267
837	273 278 283 288 293 298 304 309 314 319
838	324 330 335 340 345 350 355 361 366 371
839	376 381 387 392 397 402 407 412 418 423
840	428 433 438 443 449 454 459 464 469 474
841	480 485 490 495 500 505 511 516 521 526
842	531 536 542 547 552 557 562 567 572 578
843	583 588 593 598 603 609 614 619 624 629
844	634 639 645 650 655 660 665 670 675 681
845	686 691 696 701 706 711 716 722 727 732
846	737 742 747 752 758 763 768 773 778 783
847	788 793 799 804 809 814 819 824 829 834
848	840 845 850 855 860 865 870 875 881 886
849	891 896 901 906 911 916 921 927 932 937
850	942 947 952 957 962 967 973 978 983 988
851	993 998 003 008 013 018 024 029 034 039
852	93044 049 054 059 064 069 075 080 085 090
853	095 100 105 110 115 120 125 131 136 141
854	146 151 156 161 166 171 176 181 186 192
855	197 202 207 212 217 222 227 232 237 242
856	247 252 258 263 268 273 278 283 288 293
857	298 303 308 313 318 323 328 334 339 344
858	349 354 359 364 369 374 379 384 389 394
859	399 404 409 414 420 425 430 435 440 445
860	450 455 460 465 470 475 480 485 490 495
861	500 505 510 515 520 526 531 536 541 546
862	551 556 561 566 571 576 581 586 591 596
863	601 606 611 616 621 626 631 636 641 646
864	651 656 661 666 671 676 682 687 692 697
	0 1 2 3 4 5 6 7 8 9

No.	Logarithm 0 1 2 3 4 5 6 7 8 9
865	93702 707 712 717 722 727 732 737 742 747
866	752 757 762 767 772 777 782 787 792 797
867	802 807 812 817 822 827 832 837 842 847
868	852 857 862 867 872 877 882 887 892 897
869	902 907 912 917 922 927 932 937 942 947
870	952 957 962 967 972 977 982 987 992 997
871	94002 007 012 017 022 027 032 037 042 047
872	052 057 062 067 072 077 082 086 091 096
873	101 106 111 116 121 126 131 136 141 146
874	151 156 161 166 171 176 181 186 191 196
875	201 206 211 216 221 226 231 236 240 245
876	250 255 260 265 270 275 280 285 290 295
877	300 305 310 315 320 325 330 335 340 345
878	349 354 359 364 369 374 379 384 389 394
879	399 404 409 414 419 424 429 433 438 443
880	448 453 458 463 468 473 478 483 488 493
881	498 503 507 512 517 522 527 532 537 542
882	547 552 557 562 567 571 576 581 586 591
883	596 601 606 611 616 621 626 630 635 640
884	645 650 655 660 665 670 675 680 685 689
885	694 699 704 709 714 719 724 729 734 738
886	743 748 753 758 763 768 773 778 783 787
887	792 797 802 807 812 817 822 827 832 836
888	841 846 851 856 861 866 871 876 880 885
889	890 895 900 905 910 915 919 924 929 934
890	939 944 949 954 959 963 968 973 978 983
891	988 993 998 002 007 012 017 022 027 032
892	95036 041 046 051 056 061 066 071 075 080
893	085 090 095 100 105 109 114 119 124 129
894	134 139 143 148 153 158 163 168 173 177
895	182 187 192 197 202 207 211 216 221 226
896	231 236 240 245 250 255 260 265 270 274
897	279 284 289 294 299 303 308 313 318 323
898	328 332 337 342 347 352 357 361 366 371
899	376 381 386 390 395 400 405 410 415 419
900	424 429 434 439 444 448 453 458 463 468
901	472 477 482 487 492 497 501 506 511 516
902	521 525 530 535 540 545 550 554 559 564
903	569 574 578 583 588 593 598 602 607 612
904	617 622 626 631 636 641 646 650 655 660
905	665 670 674 679 684 689 694 698 703 708
906	713 718 722 727 732 737 742 746 751 756
907	761 766 770 775 780 785 789 794 799 804
908	809 813 818 823 828 832 837 842 847 852
909	856 861 866 871 875 880 885 890 895 899
	0 1 2 3 4 5 6 7 8 9

Pro. Parts	
D.	6
1	0·6
2	1·2
3	1·8
4	2·4
5	3·0
6	3·6
7	4·2
8	4·8
9	5·4
D.	5
1	0·5
2	1·0
3	1·5
4	2·0
5	2·5
6	3·0
7	3·5
8	4·0
9	4·5
D.	4
1	0·4
2	0·8
3	1·2
4	1·6
5	2·0
6	2·4
7	2·8
8	3·2
9	3·6

TABLE LI.—Common Logarithms to 5 places of Decimals.

No.	Logarithm 0	1	2	3	4	5	6	7	8	9
910	95904	909	914	918	923	928	933	938	942	947
911	952	957	961	966	971	976	980	985	990	995
912	999	004	009	014	019	023	028	033	038	042
913	96047	052	057	061	066	071	076	080	085	090
914	095	099	104	109	114	118	123	128	133	137
915	142	147	152	156	161	166	171	175	180	185
916	190	194	199	204	209	213	218	223	227	232
917	237	242	246	251	256	261	265	270	275	280
918	284	289	294	298	303	308	313	317	322	327
919	332	336	341	346	350	355	360	365	369	374
920	379	384	388	393	398	402	407	412	417	421
921	426	431	435	440	445	450	454	459	464	468
922	473	478	483	487	492	497	501	506	511	515
923	520	525	530	534	539	544	548	553	558	562
924	567	572	577	581	586	591	595	600	605	609
925	614	619	624	628	633	638	642	647	652	656
926	661	666	670	675	680	685	689	694	699	703
927	708	713	717	722	727	731	736	741	745	750
928	755	759	764	769	774	778	783	788	792	797
929	802	806	811	816	820	825	830	834	839	844
930	848	853	858	862	867	872	876	881	886	890
931	895	900	904	909	914	918	923	928	932	937
932	942	946	951	956	960	965	970	974	979	984
933	988	993	997	002	007	011	016	021	025	030
934	97035	039	044	049	053	058	063	067	072	077
935	081	086	090	095	100	104	109	114	118	123
936	128	132	137	142	146	151	155	160	165	169
937	174	179	183	188	192	197	202	206	211	216
938	220	225	230	234	239	243	248	253	257	262
939	267	271	276	280	285	290	294	299	304	308
940	313	317	322	327	331	336	340	345	350	354
941	359	364	368	373	377	382	387	391	396	400
942	405	410	414	419	424	428	433	437	442	447
943	451	456	460	465	470	474	479	483	488	493
944	497	502	506	511	516	520	525	529	534	539
945	543	548	552	557	562	566	571	575	580	585
946	589	594	598	603	607	612	617	621	626	630
947	635	640	644	649	653	658	663	667	672	676
948	681	685	690	695	699	704	708	713	717	722
949	727	731	736	740	745	749	754	759	763	768
950	772	777	782	786	791	795	800	804	809	813
951	818	823	827	832	836	841	845	850	855	859
952	864	868	873	877	882	886	891	896	900	905
953	909	914	918	923	928	932	937	941	946	950
954	955	959	964	968	973	978	982	987	991	996
	0	1	2	3	4	5	6	7	8	9

No.	Logarithm 0	1	2	3	4	5	6	7	8	9
955	98000	005	009	014	019	023	028	032	037	041
956	046	050	055	059	064	068	073	078	082	087
957	091	096	100	105	109	114	118	123	127	132
958	137	141	146	150	155	159	164	168	173	177
959	182	186	191	195	200	204	209	214	218	223
960	227	232	236	241	245	250	254	259	263	268
961	272	277	281	286	290	295	299	304	308	313
962	318	322	327	331	336	340	345	349	354	358
963	363	367	372	376	381	385	390	394	399	403
964	408	412	417	421	426	430	435	439	444	448
965	453	457	462	466	471	475	480	484	489	493
966	498	502	507	511	516	520	525	529	534	538
967	543	547	552	556	561	565	570	574	579	583
968	588	592	597	601	605	610	614	619	623	628
969	632	637	641	646	650	655	659	664	668	673
970	677	682	686	691	695	700	704	709	713	717
971	722	726	731	735	740	744	749	753	758	762
972	767	771	776	780	784	789	793	798	802	807
973	811	816	820	825	829	834	838	843	847	851
974	856	860	865	869	874	878	883	887	892	896
975	900	905	909	914	918	923	927	932	936	941
976	945	949	954	958	963	967	972	976	981	985
977	989	994	998	003	007	012	016	021	025	029
978	99034	038	043	047	052	056	061	065	069	074
979	078	083	087	092	096	100	105	109	114	118
980	123	127	131	136	140	145	149	154	158	162
981	167	171	176	180	185	189	193	198	202	207
982	211	216	220	224	229	233	238	242	247	251
983	255	260	264	269	273	277	282	286	291	295
984	300	304	308	313	317	322	326	330	335	339
985	344	348	352	357	361	366	370	374	379	383
986	388	392	396	401	405	410	414	419	423	427
987	432	436	441	445	449	454	458	463	467	471
988	476	480	484	489	493	498	502	506	511	515
989	520	524	528	533	537	542	546	550	555	559
990	564	568	572	577	581	585	590	594	599	603
991	607	612	616	621	625	629	634	638	642	647
992	651	656	660	664	669	673	677	682	686	691
993	695	699	704	708	712	717	721	726	730	734
994	739	743	747	752	756	760	765	769	774	778
995	782	787	791	795	800	804	808	813	817	822
996	826	830	835	839	843	848	852	856	861	865
997	870	874	878	883	887	891	896	900	904	909
998	913	917	922	926	930	935	939	944	948	952
999	957	961	965	970	974	978	983	987	991	996
	0	1	2	3	4	5	6	7	8	9

Pro. Parts	
D.	5
1	0·5
2	1·0
3	1·5
4	2·0
5	2·5
6	3·0
7	3·5
8	4·0
9	4·5
D.	4
1	0·4
2	0·8
3	1·2
4	1·6
5	2·0
6	2·4
7	2·8
8	3·2
9	3·6

TABLE LII.—Logarithmic Sines and Cosines to 5 places of Decimals.

′	0° Sin.	0° Cos.	1° Sin.	1° Cos.	2° Sin.	2° Cos.	3° Sin.	3° Cos.	4° Sin.	4° Cos.	′
0	Inf. neg.	10·00000	8·24186	9·99993	8·54282	9·99974	8·71880	9·99940	8·84358	9·99894	60
1	6·46373	0	24903	93	54642	73	72120	40	84539	93	59
2	76476	0	25609	93	54999	73	72359	39	84718	92	58
3	94085	0	26304	93	55354	72	72597	38	84897	91	57
4	7·06579	0	26988	92	55705	72	72834	38	85075	91	56
5	16270	0	27661	92	56054	71	73069	37	85252	90	55
6	24188	0	28324	92	56400	71	73303	36	85429	89	54
7	30882	0	28977	92	56743	70	73535	36	85605	88	53
8	36682	0	29621	92	57084	70	73767	35	85780	87	52
9	41797	0	30255	91	57421	69	73997	34	85955	86	51
10	46373	0	30879	91	57757	69	74226	34	86128	85	50
11	7·50512	10·00000	8·31495	9·99991	8·58089	9·99968	8·74454	9·99933	8·86301	9·99884	49
12	54291	0	32103	90	58419	68	74680	32	86474	83	48
13	57767	0	32702	90	58747	67	74906	32	86645	82	47
14	60985	0	33292	90	59072	67	75130	31	86816	81	46
15	63982	0	33875	90	59395	67	75353	30	86987	80	45
16	66784	0	34450	89	59715	66	75575	29	87156	79	44
17	69417	9·99999	35018	89	60033	66	75795	29	87325	79	43
18	71900	99	35578	89	60349	65	76015	28	87494	78	42
19	74248	99	36131	89	60662	64	76234	27	87661	77	41
20	76475	99	36678	88	60973	64	76451	26	87829	76	40
21	7·78594	9·99999	8·37217	9·99988	8·61282	9·99963	8·76667	9·99926	8·87995	9·99875	39
22	80615	99	37750	88	61589	63	76883	25	88161	74	38
23	82545	99	38276	87	61894	62	77097	24	88326	73	37
24	84393	99	38796	87	62196	62	77310	23	88490	72	36
25	86166	99	39310	87	62497	61	77522	23	88654	71	35
26	87870	99	39818	86	62795	61	77733	22	88817	70	34
27	89509	99	40320	86	63091	60	77943	21	88980	69	33
28	91088	99	40816	86	63385	60	78152	20	89142	68	32
29	92612	98	41307	85	63678	59	78360	20	89304	67	31
30	94084	98	41792	85	63968	59	78568	19	89464	66	30
31	7·95508	9·99998	8·42272	9·99985	8·64256	9·99958	8·78774	9·99918	8·89625	9·99865	29
32	96887	98	42746	84	64543	58	78979	17	89784	64	28
33	98223	98	43216	84	64827	57	79183	17	89943	63	27
34	99520	98	43680	84	65110	56	79386	16	90102	62	26
35	8·00779	98	44139	83	65391	56	79588	15	90260	61	25
36	02002	98	44594	83	65670	55	79789	14	90417	60	24
37	03192	97	45044	83	65947	55	79990	13	90574	59	23
38	04350	97	45489	82	66223	54	80189	13	90730	58	22
39	05478	97	45930	82	66497	54	80388	12	90885	57	21
40	06578	97	46366	82	66769	53	80585	11	91040	56	20
41	8·07650	9·99997	8·46799	9·99981	8·67039	9·99952	8·80782	9·99910	8·91195	9·99855	19
42	08696	97	47226	81	67308	52	80978	09	91349	54	18
43	09718	97	47650	81	67575	51	81173	09	91502	53	17
44	10717	96	48069	80	67841	51	81367	08	91655	52	16
45	11693	96	48485	80	68104	50	81560	07	91807	51	15
46	12647	96	48896	79	68367	49	81752	06	91959	50	14
47	13581	96	49304	79	68627	49	81944	05	92110	48	13
48	14495	96	49708	79	68886	48	82134	04	92261	47	12
49	15391	96	50108	78	69144	48	82324	04	92411	46	11
50	16268	95	50504	78	69400	47	82513	03	92561	45	10
51	8·17128	9·99995	8·50897	9·99977	8·69654	9·99946	8·82701	9·99902	8·92710	9·99844	9
52	17971	95	51287	77	69907	46	82888	01	92859	43	8
53	18798	95	51673	77	70159	45	83075	00	93007	42	7
54	19610	95	52055	76	70409	44	83261	9·99899	93154	41	6
55	20407	94	52434	76	70658	44	83446	98	93301	40	5
56	21189	94	52810	75	70905	43	83630	98	93448	39	4
57	21958	94	53183	75	71151	42	83813	97	93594	38	3
58	22713	94	53552	74	71395	42	83996	96	93740	37	2
59	23456	94	53919	74	71638	41	84177	95	93885	36	1
60	24186	93	54282	74	71880	40	84358	94	94030	34	0
′	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	′
	89°		88°		87°		86°		85°		

TABLE LII.—Logarithmic Sines and Cosines to 5 places of Decimals.

′	5° Sin.	5° Cos.	6° Sin.	6° Cos.	7° Sin.	7° Cos.	8° Sin.	8° Cos.	9° Sin.	9° Cos.	′
0	8·94030	9·99834	9·01923	9·99761	9·08589	9·99675	9·14356	9·99575	9·19433	9·99462	60
1	94174	33	02043	60	08692	74	14445	74	19513	60	59
2	94317	32	02163	59	08795	72	14535	72	19592	58	58
3	94461	31	02283	57	08897	70	14624	70	19672	56	57
4	94603	30	02402	56	08999	69	14714	68	19751	54	56
5	94746	29	02520	55	09101	67	14803	66	19830	52	55
6	94887	28	02639	53	09202	66	14891	65	19909	50	54
7	95029	27	02757	52	09304	64	14980	63	19988	48	53
8	95170	25	02874	51	09405	63	15069	61	20067	46	52
9	95310	24	02992	49	09506	61	15157	59	20145	44	51
10	95450	23	03109	48	09606	59	15245	57	20223	42	50
11	8·95589	9·99822	9·03226	9·99747	9·09707	9·99658	9·15333	9·99556	9·20302	9·99440	49
12	95728	21	03342	45	09807	56	15421	54	20380	38	48
13	95867	20	03458	44	09907	55	15508	52	20458	36	47
14	96005	19	03574	42	10006	53	15596	50	20535	34	46
15	96143	17	03690	41	10106	51	15683	48	20613	32	45
16	96280	16	03805	40	10205	50	15770	46	20691	29	44
17	96417	15	03920	38	10304	48	15857	45	20768	27	43
18	96553	14	04034	37	10402	47	15944	43	20845	25	42
19	96689	13	04149	36	10501	45	16030	41	20922	23	41
20	96825	12	04262	34	10599	43	16116	39	20999	21	40
21	8·96960	9·99810	9·04376	9·99733	9·10697	9·99642	9·16203	9·99537	9·21076	9·99419	39
22	97095	09	04490	31	10795	40	16289	35	21153	17	38
23	97229	08	04603	30	10893	38	16374	33	21229	15	37
24	97363	07	04715	28	10990	37	16460	32	21306	13	36
25	97496	06	04828	27	11087	35	16545	30	21382	11	35
26	97629	04	04940	26	11184	33	16631	28	21458	09	34
27	97762	03	05052	24	11281	32	16716	26	21534	07	33
28	97894	02	05164	23	11377	30	16801	24	21610	04	32
29	98026	01	05275	21	11474	29	16886	22	21685	02	31
30	98157	00	05386	20	11570	27	16970	20	21761	00	30
31	8·98288	9·99798	9·05497	9·99718	9·11666	9·99625	9·17055	9·99518	9·21836	9·99398	29
32	98419	97	05607	17	11761	24	17139	17	21912	96	28
33	98549	96	05717	16	11857	22	17223	15	21987	94	27
34	98679	95	05827	14	11952	20	17307	13	22062	92	26
35	98808	93	05937	13	12047	18	17391	11	22137	90	25
36	98937	92	06046	11	12142	17	17474	09	22211	88	24
37	99066	91	06155	10	12236	15	17558	07	22286	85	23
38	99194	90	06264	08	12331	13	17641	05	22361	83	22
39	99322	88	06372	07	12425	12	17724	03	22435	81	21
40	99450	87	06481	05	12519	10	17807	01	22509	79	20
41	8·99577	9·99786	9·06589	9·99704	9·12612	9·99608	9·17890	9·99499	9·22583	9·99377	19
42	99704	85	06696	02	12706	07	17973	97	22657	75	18
43	99830	83	06804	01	12799	05	18055	95	22731	72	17
44	99956	82	06911	9·99699	12892	03	18137	94	22805	70	16
45	9·00082	81	07018	98	12985	01	18220	92	22878	68	15
46	00207	80	07124	96	13078	00	18302	90	22952	66	14
47	00332	78	07231	95	13171	9·99508	18383	88	23025	64	13
48	00456	77	07337	93	13263	96	18465	86	23098	62	12
49	00581	76	07442	92	13355	95	18547	84	23171	59	11
50	00704	75	07548	90	13447	93	18628	82	23244	57	10
51	9·00828	9·99773	9·07653	9·99689	9·13539	9·99591	9·18709	9·99480	9·23317	9·99355	9
52	00951	72	07758	87	13630	89	18790	78	23390	53	8
53	01074	71	07863	86	13722	88	18871	76	23462	51	7
54	01196	69	07968	84	13813	86	18952	74	23535	48	6
55	01318	68	08072	83	13904	84	19033	72	23607	46	5
56	01440	67	08176	81	13994	82	19113	70	23679	44	4
57	01561	65	08280	80	14085	81	19193	68	23752	42	3
58	01682	64	08383	78	14175	79	19273	66	23823	40	2
59	01803	63	08486	77	14266	77	19353	64	23895	37	1
60	01923	61	08589	75	14356	75	19433	62	23967	35	0
′	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	′
	84°		83°		82°		81°		80°		

TABLE LII.—Logarithmic Sines and Cosines to 5 places of Decimals.

′	10° Sin.	10° Cos.	11° Sin.	11° Cos.	12° Sin.	12° Cos.	13° Sin.	13° Cos.	14° Sin.	14° Cos.	′
0	9·23967	9·99335	9·28060	9·99195	9·31788	9·99040	9·35209	9·98872	9·38368	9·98690	60
1	24039	33	28125	93	31847	38	35263	69	38418	87	59
2	24110	31	28190	90	31907	35	35318	67	38469	84	58
3	24181	28	28254	87	31966	32	35373	64	38519	81	57
4	24253	26	28319	85	32025	30	35427	61	38570	78	56
5	24324	24	28384	82	32084	27	35481	58	38620	75	55
6	24395	22	28448	80	32143	24	35536	55	38670	71	54
7	24466	19	28512	77	32202	22	35590	52	38721	68	53
8	24536	17	28577	75	32261	19	35644	49	38771	65	52
9	24607	15	28641	72	32319	16	35698	46	38821	62	51
10	24677	13	28705	70	32378	13	35752	43	38871	59	50
11	9·24748	9·99310	9·28769	9·99167	9·32437	9·99011	9·35806	9·98840	9·38921	9·98656	49
12	24818	08	28833	65	32495	08	35860	37	38971	52	48
13	24888	06	28896	62	32553	05	35914	34	39021	49	47
14	24958	04	28960	60	32612	02	35968	31	39071	46	46
15	25028	01	29024	57	32670	00	36022	28	39121	43	45
16	25098	9·99299	29087	55	32728	9·98997	36075	25	39170	40	44
17	25168	97	29150	52	32786	94	36129	22	39220	36	43
18	25237	94	29214	50	32844	91	36182	19	39270	33	42
19	25307	92	29277	47	32902	89	36236	16	39319	30	41
20	25376	90	29340	45	32960	86	36289	13	39369	27	40
21	9·25445	9·99288	9·29403	9·99142	9·33018	9·98983	9·36342	9·98810	9·39418	9·98623	39
22	25514	85	29466	40	33075	80	36395	07	39467	20	38
23	25583	83	29529	37	33133	78	36449	04	39517	17	37
24	25652	81	29591	35	33190	75	36502	01	39566	14	36
25	25721	78	29654	32	33248	72	36555	9·98798	39615	10	35
26	25790	76	29716	30	33305	69	36608	795	39664	07	34
27	25858	74	29779	27	33362	67	36660	92	39713	04	33
28	25927	71	29841	24	33420	64	36713	89	39762	01	32
29	25995	69	29903	22	33477	61	36766	86	39811	9·98597	31
30	26063	67	29966	19	33534	58	36819	83	39860	94	30
31	9·26131	9·99264	9·30028	9·99117	9·33591	9·98955	9·36871	9·98780	9·39909	9·98591	29
32	26199	62	30090	14	33647	53	36924	77	39958	88	28
33	26267	60	30151	12	33704	50	36976	74	40006	84	27
34	26335	57	30213	09	33761	47	37028	71	40055	81	26
35	26403	55	30275	06	33818	44	37081	68	40103	78	25
36	26470	52	30336	04	33874	41	37133	65	40152	74	24
37	26538	50	30398	01	33931	38	37185	62	40200	71	23
38	26605	48	30459	9·99099	33987	36	37237	59	40249	68	22
39	26672	45	30521	96	34043	33	37289	56	40297	65	21
40	26739	43	30582	93	34100	30	37341	53	40346	61	20
41	9·26806	9·99241	9·30643	9·99091	9·34156	9·98927	9·37393	9·98750	9·40394	9·98558	19
42	26873	38	30704	88	34212	24	37445	46	40442	55	18
43	26940	36	30765	86	34268	21	37497	43	40490	51	17
44	27007	33	30826	83	34324	19	37549	40	40538	48	16
45	27073	31	30887	80	34380	16	37600	37	40586	45	15
46	27140	29	30947	78	34436	13	37652	34	40634	41	14
47	27206	26	31008	75	34491	10	37703	31	40682	38	13
48	27273	24	31068	72	34547	07	37755	28	40730	35	12
49	27339	21	31129	70	34602	04	37806	25	40778	31	11
50	27405	19	31189	67	34658	01	37858	22	40825	28	10
51	9·27471	9·99217	9·31250	9·99064	9·34713	9·98898	9·37909	9·98719	9·40873	9·98525	9
52	27537	14	31310	62	34769	96	37960	15	40921	21	8
53	27602	12	31370	59	34824	93	38011	12	40968	18	7
54	27668	09	31430	56	34879	90	38062	09	41016	15	6
55	27734	07	31490	54	34934	87	38113	06	41063	11	5
56	27799	04	31549	51	34989	84	38164	03	41111	08	4
57	27864	02	31609	48	35044	81	38215	00	41158	05	3
58	27930	00	31669	46	35099	78	38266	9·98697	41205	01	2
59	27995	9·99197	31728	43	35154	75	38317	94	41252	9·98498	1
60	28060	95	31788	40	35209	72	38368	90	41300	94	0
′	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	′
	79°		78°		77°		76°		75°		

TABLE LII.—Logarithmic Sines and Cosines to 5 places of Decimals.

′	15° Sin.	15° Cos.	16° Sin.	16° Cos.	17° Sin.	17° Cos.	18° Sin.	18° Cos.	19° Sin.	19° Cos.	′
0	9·41300	9·98494	9·44034	9·98284	9·46594	9·98060	9·48908	9·97821	9·51264	9·97567	60
1	41347	91	44078	81	46635	56	49037	17	51301	63	59
2	41394	88	44122	77	46676	52	49076	12	51338	58	58
3	41441	84	44166	73	46717	48	49115	08	51374	54	57
4	41488	81	44210	70	46758	44	49153	04	51411	50	56
5	41535	77	44253	66	46800	40	49192	00	51447	45	55
6	41582	74	44297	62	46841	36	49231	9·97796	51484	41	54
7	41628	71	44341	59	46882	32	49269	92	51520	36	53
8	41675	67	44385	55	46923	29	49308	88	51557	32	52
9	41722	64	44428	51	46964	25	49347	84	51593	28	51
10	41768	60	44472	48	47005	21	49385	79	51629	23	50
11	9·41815	9·98457	9·44516	9·98244	9·47045	9·98017	9·49424	9·97775	9·51666	9·97519	49
12	41861	53	44559	40	47086	13	49462	71	51702	15	48
13	41908	50	44602	37	47127	09	49500	67	51738	10	47
14	41954	47	44646	33	47168	05	49539	63	51774	06	46
15	42001	43	44689	29	47209	01	49577	59	51811	01	45
16	42047	40	44733	26	47249	9·97997	49615	54	51847	9·97497	44
17	42093	36	44776	22	47290	93	49654	50	51883	92	43
18	42140	33	44819	18	47330	89	49692	46	51919	88	42
19	42186	29	44862	15	47371	86	49730	42	51955	84	41
20	42232	26	44905	11	47411	82	49768	38	51991	79	40
21	9·42278	9·98422	9·44948	9·98207	9·47452	9·97978	9·49806	9·97734	9·52027	9·97475	39
22	42324	19	44992	04	47492	74	49844	29	52063	70	38
23	42370	15	45035	00	47533	70	49882	25	52099	66	37
24	42416	12	45077	9·98196	47573	66	49920	21	52135	61	36
25	42461	09	45120	92	47613	62	49958	17	52171	57	35
26	42507	05	45163	89	47654	58	49996	13	52207	53	34
27	42553	02	45206	85	47694	54	50034	08	52242	48	33
28	42599	9·98398	45249	81	47734	50	50072	04	52278	44	32
29	42644	95	45292	77	47774	46	50110	00	52314	39	31
30	42690	91	45334	74	47814	42	50148	9·97696	52350	35	30
31	9·42735	9·98388	9·45377	9·98170	9·47854	9·97938	9·50185	9·97691	9·52385	9·97430	29
32	42781	84	45419	66	47894	34	50223	87	52421	26	28
33	42826	81	45462	62	47934	30	50261	83	52456	21	27
34	42872	77	45504	59	47974	26	50298	79	52492	17	26
35	42917	73	45547	55	48014	22	50336	74	52527	12	25
36	42962	70	45589	51	48054	18	50374	70	52563	08	24
37	43008	66	45632	47	48094	14	50411	66	52598	03	23
38	43053	63	45674	44	48133	10	50449	62	52634	9·97399	22
39	43098	59	45716	40	48173	06	50486	57	52669	94	21
40	43143	56	45758	36	48213	02	50523	53	52705	90	20
41	9·43188	9·98352	9·45801	9·98132	9·48252	9·97898	9·50561	9·97649	9·52740	9·97385	19
42	43233	49	45843	29	48292	94	50598	45	52775	81	18
43	43278	45	45885	25	48332	90	50635	40	52811	76	17
44	43323	42	45927	21	48371	86	50673	36	52846	72	16
45	43367	38	45969	17	48411	82	50710	32	52881	67	15
46	43412	34	46011	13	48450	78	50747	28	52916	63	14
47	43457	31	46053	10	48490	74	50784	23	52951	58	13
48	43502	27	46095	06	48529	70	50821	19	52986	53	12
49	43546	24	46136	02	48568	66	50858	15	53021	49	11
50	43591	20	46178	9·98098	48607	61	50896	10	53056	44	10
51	9·43635	9·98317	9·46220	9·98094	9·48647	9·97857	9·50933	9·97606	9·53092	9·97340	9
52	43680	13	46262	90	48686	53	50970	02	53126	35	8
53	43724	09	46303	87	48725	49	51007	9·97597	53161	31	7
54	43769	06	46345	83	48764	45	51043	93	53196	26	6
55	43813	02	46386	79	48803	41	51080	89	53231	22	5
56	43857	9·98299	46428	75	48842	37	51117	84	53266	17	4
57	43901	95	46469	71	48881	33	51154	80	53301	12	3
58	43946	91	46511	67	48920	29	51191	76	53336	08	2
59	43990	88	46552	63	48959	25	51227	71	53370	03	1
60	44034	84	46594	60	48998	21	51264	67	53405	9·97299	0
′	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	′
	74°		73°		72°		71°		70°		

TABLE LII.—Logarithmic Sines and Cosines to 5 places of Decimals.

′	20° Sin.	20° Cos.	21° Sin.	21° Cos.	22° Sin.	22° Cos.	23° Sin.	23° Cos.	24° Sin.	24° Cos.	′
0	9·53405	9·97299	9·55433	9·97015	9·57358	9·96717	9·59188	9·96403	9·60931	9·96073	60
1	440	294	466	010	389	711	218	397	960	067	59
2	475	289	499	005	420	706	247	392	988	062	58
3	509	285	532	001	451	701	277	387	9·61016	056	57
4	544	280	564	9·96996	482	696	307	381	045	050	56
5	578	276	597	991	514	691	336	376	073	045	55
6	613	271	630	986	545	686	366	370	101	039	54
7	647	266	663	981	576	681	396	365	129	034	53
8	682	262	695	976	607	676	425	360	158	028	52
9	716	257	728	971	638	670	455	354	186	022	51
10	751	252	761	966	669	665	484	349	214	017	50
11	9·53785	9·97248	9·55793	9·96962	9·57700	9·96660	9·59514	9·96343	9·61242	9·96011	49
12	819	243	826	957	731	655	543	338	270	005	48
13	854	238	858	952	762	650	573	333	298	000	47
14	888	234	891	947	793	645	602	327	326	9·95994	46
15	922	229	923	942	824	640	632	322	354	988	45
16	957	224	956	937	855	634	661	316	382	982	44
17	991	220	988	932	885	629	690	311	411	977	43
18	9·54025	215	9·56021	927	916	624	720	305	438	971	42
19	059	210	053	922	947	619	749	300	466	965	41
20	093	206	085	917	978	614	778	294	494	960	40
21	9·54127	9·97201	9·56118	9·96912	9·58008	9·96608	9·59808	9·96289	9·61522	9·95954	39
22	161	196	150	907	039	603	837	284	550	948	38
23	195	192	182	903	070	598	866	278	578	942	37
24	229	187	215	898	101	593	895	273	606	937	36
25	263	182	247	893	131	588	924	267	634	931	35
26	297	178	279	888	162	582	954	262	662	925	34
27	331	173	311	883	192	577	983	256	689	920	33
28	365	168	343	878	223	572	9·60012	251	717	914	32
29	399	163	375	873	253	567	041	245	745	908	31
30	433	159	408	868	284	562	070	240	773	902	30
31	9·54466	9·97154	9·56440	9·96863	9·58314	9·96556	9·60099	9·96234	9·61800	9·95897	29
32	500	149	472	858	345	551	128	229	828	891	28
33	534	145	504	853	375	546	157	223	856	885	27
34	567	140	536	848	406	541	186	218	883	879	26
35	601	135	568	843	436	535	215	212	911	873	25
36	635	130	599	838	467	530	244	207	939	868	24
37	668	126	631	833	497	525	273	201	966	862	23
38	702	121	663	828	527	520	302	196	994	856	22
39	735	116	695	823	557	514	331	190	9·62021	850	21
40	769	111	727	818	588	509	359	185	049	844	20
41	9·54802	9·97107	9·56759	9·96813	9·58618	9·96504	9·60388	9·96179	9·62076	9·95839	19
42	836	102	790	808	648	498	417	174	104	833	18
43	869	097	822	803	678	493	446	168	131	827	17
44	903	092	854	798	709	488	474	162	159	821	16
45	936	087	886	793	739	483	503	157	186	815	15
46	969	083	917	788	769	477	532	151	214	810	14
47	9·55003	078	949	783	799	472	561	146	241	804	13
48	036	073	980	778	829	467	589	140	268	798	12
49	069	068	9·57012	772	859	461	618	135	296	792	11
50	102	063	044	767	889	456	646	129	323	786	10
51	9·55136	9·97059	9·57075	9·96762	9·58919	9·96451	9·60675	9·96123	9·62350	9·95780	9
52	169	054	107	757	949	445	704	118	377	775	8
53	202	049	138	752	979	440	732	112	405	769	7
54	235	044	169	747	9·59009	435	761	107	432	763	6
55	268	039	201	742	039	429	789	101	459	757	5
56	301	035	232	737	069	424	818	095	486	751	4
57	334	030	264	732	098	419	846	090	513	745	3
58	367	025	295	727	128	413	875	084	541	739	2
59	400	020	326	722	158	408	903	079	568	733	1
60	433	015	358	717	188	403	931	073	595	728	0
′	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	′
	69°		68°		67°		66°		65°		

TABLE LII.—Logarithmic Sines and Cosines to 5 places of Decimals.

′	25° Sin.	25° Cos.	26° Sin.	26° Cos.	27° Sin.	27° Cos.	28° Sin.	28° Cos.	29° Sin.	29° Cos.	′
0	9·62595	9·95728	9·64184	9·95366	9·65705	9·94988	9·67161	9·94593	9·68557	9·94182	60
1	622	722	210	360	729	982	185	587	580	175	59
2	649	716	236	354	754	975	208	580	603	168	58
3	676	710	262	348	779	969	232	573	625	161	57
4	703	704	288	341	804	962	256	567	648	154	56
5	730	698	313	335	828	956	280	560	671	147	55
6	757	692	339	329	853	949	303	553	694	140	54
7	784	686	365	323	878	943	327	546	716	133	53
8	811	680	391	317	902	936	350	540	739	126	52
9	838	674	417	310	927	930	374	533	762	119	51
10	865	668	442	304	952	923	398	526	784	112	50
11	9·62892	9·95663	9·64468	9·95298	9·65976	9·94917	9·67421	9·94519	9·68807	9·94105	49
12	918	657	494	292	9·66001	911	445	513	829	098	48
13	945	651	519	286	025	904	468	506	852	090	47
14	972	645	545	279	050	898	492	499	875	083	46
15	999	639	571	273	075	891	515	492	897	076	45
16	9·63026	633	596	267	099	885	539	485	920	069	44
17	052	627	622	261	124	878	562	479	942	062	43
18	079	621	647	254	148	871	586	472	965	055	42
19	106	615	673	248	173	865	609	465	987	048	41
20	133	609	698	242	197	858	633	458	9·69010	041	40
21	9·63159	9·95603	9·64724	9·95236	9·66221	9·94852	9·67656	9·94451	9·69032	9·94034	39
22	186	597	749	229	246	845	680	445	055	027	38
23	213	591	775	223	270	839	703	438	077	020	37
24	239	585	800	217	295	832	726	434	100	012	36
25	266	579	826	211	319	826	750	424	122	005	35
26	292	573	851	204	343	819	773	417	144	9·93998	34
27	319	567	877	198	368	813	796	410	167	991	33
28	345	561	902	192	392	806	820	404	189	984	32
29	372	555	927	185	416	799	843	397	212	977	31
30	398	549	953	179	441	793	866	390	234	970	30
31	9·63425	9·95543	9·64978	9·95173	9·66465	9·94786	9·67890	9·94383	9·69256	9·93963	29
32	451	537	9·65003	167	489	780	913	376	279	955	28
33	478	531	029	160	513	773	936	369	301	948	27
34	504	525	054	154	537	767	959	362	323	941	26
35	531	519	079	148	562	760	982	355	345	934	25
36	557	513	104	141	586	753	9·68006	349	368	927	24
37	583	507	130	135	610	747	029	342	390	920	23
38	610	500	155	129	634	740	052	335	412	912	22
39	636	494	180	122	658	734	075	328	434	905	21
40	662	488	205	116	682	727	098	321	456	898	20
41	9·63689	9·95482	9·65230	9·95110	9·66706	9·94720	9·68121	9·94314	9·69479	9·93891	19
42	715	476	255	103	731	714	144	307	501	884	18
43	741	470	281	097	755	707	167	300	523	876	17
44	767	464	306	090	779	700	190	293	545	869	16
45	794	458	331	084	803	694	213	286	567	862	15
46	820	452	356	078	827	687	237	279	589	855	14
47	846	446	381	071	851	680	260	273	611	847	13
48	872	440	406	065	875	674	283	266	633	840	12
49	898	434	431	059	899	667	305	259	655	833	11
50	924	427	456	052	922	660	328	252	677	826	10
51	9·63950	9·95421	9·65481	9·95046	9·66946	9·94654	9·68351	9·94245	9·69699	9·93819	9
52	976	415	506	039	970	647	374	238	721	811	8
53	9·64002	409	531	033	994	640	397	231	743	804	7
54	028	403	556	027	9·67018	634	420	224	765	797	6
55	054	397	580	020	042	627	443	217	787	789	5
56	080	391	605	014	066	620	466	210	809	782	4
57	106	384	630	007	090	614	489	203	831	775	3
58	132	378	655	001	113	607	512	196	853	768	2
59	158	372	680	9·94995	137	600	534	189	875	760	1
60	184	366	705	988	161	593	557	182	897	753	0
′	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	′
	64°		63°		62°		61°		60°		

TABLE LII.—Logarithmic Sines and Cosines to 5 places of Decimals.

′	30° Sin.	30° Cos.	31° Sin.	31° Cos.	32° Sin.	32° Cos.	33° Sin.	33° Cos.	34° Sin.	34° Cos.	′
0	9·69897	9·93753	9·71184	9·93307	9·72421	9·92842	9·73611	9·92359	9·74756	9·91857	60
1	919	746	205	299	441	834	630	351	775	849	59
2	941	738	226	291	461	826	650	343	794	840	58
3	963	731	247	284	482	818	669	335	812	832	57
4	984	724	268	276	502	810	689	326	831	823	56
5	9·70006	717	289	269	522	803	708	318	850	815	55
6	028	709	310	261	542	795	727	310	868	806	54
7	050	702	331	253	562	787	747	302	887	798	53
8	072	695	352	246	582	779	766	293	906	789	52
9	093	687	373	238	602	771	785	285	924	781	51
10	115	680	393	230	622	763	805	277	943	772	50
11	9·70137	9·93673	9·71414	9·93223	9·72643	9·92755	9·73824	9·92269	9·74961	9·91763	49
12	159	665	435	215	663	747	843	260	980	755	48
13	180	658	456	207	683	739	863	252	999	746	47
14	202	650	477	200	703	731	882	244	9·75017	738	46
15	224	643	498	192	723	723	901	235	036	729	45
16	245	636	519	184	743	715	921	227	054	720	44
17	267	628	539	177	763	707	940	219	073	712	43
18	288	621	560	169	783	699	959	211	091	703	42
19	310	614	581	161	803	691	978	202	110	695	41
20	332	606	602	154	823	683	997	194	128	686	40
21	9·70353	9·93599	9·71622	9·93146	9·72843	9·92675	9·74017	9·92186	9·75147	9·91677	39
22	375	591	643	138	863	667	036	177	165	669	38
23	396	584	664	131	883	659	055	169	184	660	37
24	418	577	685	123	902	651	074	161	202	651	36
25	439	569	705	115	922	643	093	152	221	643	35
26	461	562	726	108	942	635	113	144	239	634	34
27	482	554	747	100	962	627	132	136	258	625	33
28	504	547	767	092	982	619	151	127	276	617	32
29	525	539	788	084	9·73002	611	170	119	294	608	31
30	547	532	809	077	022	603	189	111	313	599	30
31	9·70568	9·93525	9·71829	9·93069	9·73041	9·92595	9·74208	9·92102	9·75331	9·91591	29
32	590	517	850	061	061	587	227	094	350	582	28
33	611	510	870	053	081	579	246	086	368	573	27
34	633	502	891	046	101	571	265	077	386	565	26
35	654	495	911	038	121	563	284	069	405	556	25
36	675	487	932	030	140	555	303	060	423	547	24
37	697	480	953	022	160	546	322	052	441	538	23
38	718	472	973	014	180	538	341	044	459	530	22
39	739	465	994	007	200	530	360	035	478	521	21
40	761	457	9·72014	9·92999	219	522	379	027	496	512	20
41	9·70782	9·93450	9·72034	9·92991	9·73239	9·92514	9·74398	9·92018	9·75514	9·91504	19
42	803	442	055	983	259	506	417	010	533	495	18
43	824	435	075	976	278	498	436	002	551	486	17
44	846	427	096	968	298	490	455	9·91993	569	477	16
45	867	420	116	960	318	482	474	985	587	469	15
46	888	412	137	952	337	473	493	976	605	460	14
47	909	405	157	944	357	465	512	968	624	451	13
48	931	397	177	936	377	457	531	959	642	442	12
49	952	390	198	929	396	449	549	951	660	433	11
50	973	382	218	921	416	441	568	942	678	425	10
51	9·70994	9·93375	9·72238	9·92913	9·73435	9·92433	9·74587	9·91931	9·75696	9·91416	9
52	9·71015	367	259	905	455	425	606	923	714	407	8
53	036	360	279	897	474	416	625	917	733	398	7
54	058	352	299	889	494	408	644	908	751	389	6
55	079	344	320	881	513	400	662	900	769	381	5
56	100	337	340	874	533	392	681	891	787	372	4
57	121	329	360	866	552	384	700	883	805	363	3
58	142	322	381	858	572	376	719	874	823	354	2
59	163	314	401	850	591	367	737	866	841	345	1
60	184	307	421	842	611	359	756	857	859	336	0
′	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	′
	59°		58°		57°		56°		55°		

TABLE LII.—Logarithmic Sines and Cosines to 5 places of Decimals.

′	35° Sin.	35° Cos.	36° Sin.	36° Cos.	37° Sin.	37° Cos.	38° Sin.	38° Cos.	39° Sin.	39° Cos.	′
0	9·75859	9·91336	9·76928	9·90796	9·77946	9·90235	9·78934	9·89653	9·79887	9·89050	60
1	877	328	939	787	963	225	950	643	903	040	59
2	895	319	957	777	980	216	967	633	918	030	58
3	913	310	974	768	997	206	983	624	934	020	57
4	931	301	991	759	9·78013	197	999	614	950	009	56
5	949	292	9·77009	750	030	187	9·79015	604	965	9·88999	55
6	967	283	026	741	047	178	031	594	981	989	54
7	985	274	043	731	063	168	047	584	996	978	53
8	9·76003	266	061	722	080	159	063	574	9·80012	968	52
9	021	257	078	713	097	149	079	564	027	958	51
10	039	248	095	704	113	139	095	554	043	948	50
11	9·76057	9·91239	9·77112	9·90694	9·78130	9·90130	9·79111	9·89544	9·80058	9·88937	49
12	075	230	130	685	147	120	128	534	074	927	48
13	093	221	147	676	163	111	144	524	089	917	47
14	111	212	164	667	180	101	160	514	105	906	46
15	129	203	181	657	197	091	176	504	120	896	45
16	146	194	199	648	213	082	192	495	136	886	44
17	164	185	216	639	230	072	208	485	151	875	43
18	182	176	233	630	246	063	224	475	166	865	42
19	200	167	250	620	263	053	240	465	182	855	41
20	218	158	268	611	280	043	256	455	197	844	40
21	9·76236	9·91149	9·77285	9·90602	9·78296	9·90034	9·79272	9·89445	9·80213	9·88834	39
22	253	141	302	592	313	024	288	435	228	824	38
23	271	132	319	583	329	014	304	425	244	813	37
24	289	123	336	574	346	005	319	415	259	803	36
25	307	114	353	565	362	9·89995	335	405	274	793	35
26	324	105	370	555	379	985	351	395	290	782	34
27	342	096	387	546	395	976	367	385	305	772	33
28	360	087	405	537	412	966	383	375	320	761	32
29	378	078	422	527	428	956	399	364	336	751	31
30	395	069	439	518	445	947	415	354	351	741	30
31	9·76413	9·91060	9·77456	9·90509	9·78461	9·89937	9·79431	9·89344	9·80366	9·88730	29
32	431	051	473	499	478	927	447	334	382	720	28
33	448	042	490	490	494	918	463	324	397	709	27
34	466	033	507	480	510	908	478	314	412	699	26
35	484	023	524	471	527	898	494	304	428	688	25
36	501	014	541	462	543	888	510	294	443	678	24
37	519	005	558	452	560	879	526	284	458	668	23
38	537	9·90996	575	443	576	869	542	274	473	657	22
39	554	987	592	434	592	859	558	264	489	647	21
40	572	978	609	424	609	849	573	254	504	636	20
41	9·76590	9·90969	9·77626	9·90415	9·78625	9·89840	9·79589	9·89244	9·80519	9·88626	19
42	607	960	643	405	642	830	605	233	534	615	18
43	625	951	660	396	658	820	621	223	550	605	17
44	642	942	677	386	674	810	636	213	565	594	16
45	660	933	694	377	691	801	652	203	580	584	15
46	677	924	711	368	707	791	668	193	595	573	14
47	695	915	728	358	723	781	684	183	610	563	13
48	712	906	744	349	739	771	699	173	625	552	12
49	730	896	761	339	756	761	715	162	641	542	11
50	747	887	778	330	772	752	731	152	656	531	10
51	9·76765	9·90878	9·77795	9·90320	9·78788	9·89742	9·79746	9·89142	9·80671	9·88521	9
52	782	869	812	311	805	732	762	132	686	510	8
53	800	860	829	301	821	722	778	122	701	499	7
54	817	851	846	292	837	712	793	112	716	489	6
55	835	842	862	282	853	702	809	101	731	478	5
56	852	832	879	273	869	693	825	091	746	468	4
57	870	823	896	263	886	683	840	081	762	457	3
58	887	814	913	254	902	673	856	071	777	447	2
59	904	805	930	244	918	663	872	060	792	436	1
60	922	796	946	235	934	653	887	050	807	425	0
′	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	′
	54°		53°		52°		51°		50°		

TABLE LII.—Logarithmic Sines and Cosines to 5 places of Decimals.

′	40° Sin.	40° Cos.	41° Sin.	41° Cos.	42° Sin.	42° Cos.	43° Sin.	43° Cos.	44° Sin.	44° Cos.	′
0	9·80807	9·88425	9·81694	9·87778	9·82551	9·87107	9·83378	9·86413	9·84177	9·85693	60
1	822	415	709	767	565	096	392	401	190	681	59
2	837	404	723	756	579	085	405	389	203	669	58
3	852	394	738	745	593	073	419	377	216	657	57
4	867	383	752	734	607	062	432	366	229	645	56
5	882	372	767	723	621	050	446	354	242	632	55
6	897	362	781	712	635	039	459	342	255	620	54
7	912	351	796	701	649	028	473	330	269	608	53
8	927	340	810	690	663	016	486	318	282	596	52
9	942	330	825	679	677	005	500	306	295	583	51
10	957	319	839	668	691	9·86993	513	295	308	571	50
11	9·80972	9·88308	9·81854	9·87657	9·82705	9·86982	9·83527	9·86283	9·84321	9·85559	49
12	987	298	868	646	719	970	540	271	334	547	48
13	9·81002	287	882	635	733	959	554	259	347	534	47
14	017	276	897	624	747	947	567	247	360	522	46
15	032	266	911	613	761	936	581	235	373	510	45
16	047	255	926	601	775	924	594	223	385	497	44
17	061	244	940	590	788	913	608	211	398	485	43
18	076	234	955	579	802	902	621	200	411	473	42
19	091	223	969	568	816	890	634	188	424	460	41
20	106	212	983	557	830	879	648	176	437	448	40
21	9·81121	9·88201	9·81998	9·87546	9·82844	9·86867	9·83661	9·86164	9·84450	9·85436	39
22	136	191	9·82012	535	858	855	674	152	463	423	38
23	151	180	026	524	872	844	688	140	476	411	37
24	166	169	041	513	885	832	701	128	489	399	36
25	180	158	055	501	899	821	715	116	502	386	35
26	195	148	069	490	913	809	728	104	515	374	34
27	210	137	084	479	927	798	741	092	528	361	33
28	225	126	098	468	941	786	755	080	540	349	32
29	240	115	112	457	955	775	768	068	553	337	31
30	254	105	126	446	968	763	781	056	566	324	30
31	9·81269	9·88094	9·82141	9·87434	9·82982	9·86752	9·83795	9·86044	9·84579	9·85312	29
32	284	083	155	423	996	740	808	032	592	299	28
33	299	072	169	412	9·83010	728	821	020	605	287	27
34	314	061	184	401	023	717	834	008	618	274	26
35	328	051	198	390	037	705	848	9·85996	630	262	25
36	343	040	212	378	051	694	861	984	643	250	24
37	358	029	226	367	065	682	874	972	656	237	23
38	372	018	240	356	078	670	887	960	669	225	22
39	387	007	255	345	092	659	901	948	682	212	21
40	402	9·87996	269	334	106	647	914	936	694	200	20
41	9·81417	9·87985	9·82283	9·87322	9·83120	9·86635	9·83927	9·85924	9·84707	9·85187	19
42	431	975	297	311	133	624	940	912	720	175	18
43	446	964	311	300	147	612	954	900	733	162	17
44	461	953	326	288	161	600	967	888	745	150	16
45	475	942	340	277	174	589	980	876	758	137	15
46	490	931	354	266	188	577	993	864	771	125	14
47	505	920	368	255	202	565	9·84006	851	784	112	13
48	519	909	382	243	215	554	020	839	796	100	12
49	5	898	396	232	229	542	033	827	809	087	11
50	549	887	410	221	242	530	046	815	822	074	10
51	9·81563	9·87877	9·82424	9·87209	9·83256	9·86518	9·84059	9·85803	9·84835	9·85062	9
52	578	866	439	198	270	507	072	791	847	049	8
53	592	855	453	187	283	495	085	779	860	037	7
54	607	844	467	175	297	483	098	766	873	024	6
55	622	833	481	164	310	472	112	754	885	012	5
56	636	822	495	153	324	460	125	742	898	9·84999	4
57	651	811	509	141	338	448	138	730	911	986	3
58	665	800	523	130	351	436	151	718	923	974	2
59	680	789	537	119	365	425	164	706	936	961	1
60	694	778	551	107	378	413	177	693	949	949	0
	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	Cos.	Sin.	′
	49°		48°		47°		46°		45°		

TABLE LIII.—Azimuth and Apparent Altitude of Polaris computed with North Polar Distance 1° 10′, and Mean Refraction.

Hour Angle before or after Culmination	Latitude 0°				Latitude 2°			
	Azimuth	Correction for Increment of 10″ in N.P.D.	Apparent Altitude	Correction for Increment of 10″ in N.P.D.	Azimuth	Correction for Increment of 10″ in N.P.D.	Apparent Altitude	Correction for Increment of 10″ in N.P.D.
h m	° ′ ″	″	° ′ ″	″	° ′ ″	″	° ′ ″	″
0 15	0 4 35	+ 0·65	1 31 23	+ 9·98	0 4 35	+ 0·66	3 23 13	+ 9·98
0 30	0 9 8	1·31	1 31 0	9·91	0 9 9	1·31	3 22 48	9·91
0 45	0 13 39	1·95	1 30 20	9·81	0 13 41	1·96	3 22 6	9·81
1 0	0 18 7	2·59	1 29 22	9·66	0 18 9	2·59	3 21 4	9·66
1 15	0 22 30	3·22	1 28 12	9·47	0 22 32	3·22	3 19 48	9·47
1 30	0 26 47	3·83	1 26 43	9·24	0 26 49	3·84	3 18 16	9·24
1 45	0 30 58	4·42	1 25 0	8·97	0 31 0	4·43	3 16 27	8·97
2 0	0 35 0	5·00	1 23 4	8·66	0 35 3	5·01	3 14 23	8·66
2 15	0 38 54	5·56	1 20 53	8·31	0 38 56	5·57	3 12 5	8·31
2 30	0 42 37	6·09	1 18 29	7·93	0 42 40	6·10	3 9 32	7·93
2 45	0 46 9	6·60	1 15 52	7·52	0 46 13	6·61	3 6 43	7·51
3 0	0 49 30	7·07	1 13 3	7·07	0 49 33	7·08	3 3 45	7·07
3 20	0 53 38	7·66	1 8 59	6·43	0 53 41	7·67	2 59 25	6·42
3 40	0 57 21	8·19	1 4 35	5·74	0 57 24	8·20	2 54 53	5·73
4 0	1 0 37	8·66	0 59 55	5·00	1 0 41	8·67	2 50 3	4·99
4 20	1 3 27	9·06	0 55 22	4·23	1 3 30	9·07	2 44 59	4·22
4 40	1 5 47	9·40	0 50 39	3·42	1 5 50	9·41	2 39 40	3·41
5 0	1 7 37	9·66	0 45 47	2·59	1 7 40	9·67	2 34 14	2·58
5 20	1 8 56	9·85	0 40 47	1·74	1 8 59	9·86	2 28 39	1·73
Elong.	1 10 0	10·00	0 30 32	0·00	1 10 3	10·01	2 17 13	0·01
	h m s	*s*			*h m s*	*s*		
Elong. at	6 0 0	0·00			5 59 50	− 0·02		
					° ′ ″	″		
6 40	...	...	...	...	1 8 58	+ 9·85	2 5 52	− 1·74
7 0	...	...	...	...	1 7 39	9·66	2 0 17	2·59
7 20	...	...	...	...	1 5 48	9·40	1 55 0	3·43
7 40	...	...	...	...	1 3 28	9·06	1 49 55	4·23
8 0	...	...	...	...	1 0 38	8·66	1 45 1	5·01
8 20	...	...	...	...	0 57 21	8·19	1 40 23	5·74
8 40	...	...	...	...	0 53 38	7·66	1 36 1	6·43
9 0	...	...	...	...	0 49 30	7·07	1 31 57	7·07
9 15	...	...	...	...	0 46 10	6·59	1 29 7	7·52
9 30	...	...	...	...	0 42 37	6·09	1 26 31	7·94
9 45	...	...	...	...	0 38 54	5·55	1 24 6	8·32
10 0	...	...	...	...	0 35 0	5·00	1 21 54	8·66
10 15	...	...	...	...	0 30 58	4·42	1 19 58	8·97
10 30	...	...	...	...	0 26 47	3·83	1 18 16	9·24
10 45	...	...	...	...	0 22 30	3·21	1 16 47	9·47
11 0	...	...	...	...	0 18 7	2·59	1 15 37	9·66
11 15	...	...	...	...	0 13 39	1·95	1 14 39	9·81
11 30	...	...	...	...	0 9 8	1·30	1 13 59	9·91
11 45	...	...	...	...	0 4 35	0·65	1 13 34	9·98

TABLE LIII.—Azimuth and Apparent Altitude of Polaris computed with North Polar Distance 1° 10′, and Mean Refraction.

Hour Angle before or after Culmination	Latitude 4°				Latitude 6°			
	Azimuth	Correction for Increment of 10′ in N.P.D.	Apparent Altitude	Correction for Increment of 10″ in N.P.D.	Azimuth	Correction for Increment of 10″ in N.P.D.	Apparent Altitude	Correction for Increment of 10″ in N.P.D.
h m	° ′ ″	″	° ′ ″	″	° ′ ″	″	° ′ ″	″
0 15	0 4 36	+ 0·66	5 19 12	+ 9·98	0 4 37	+ 0·66	7 16 58	+ 9·98
0 30	0 9 10	1·31	5 18 47	9·91	0 9 12	1·32	7 16 33	9·91
0 45	0 13 43	1·96	5 18 4	9·81	0 13 46	1·97	7 15 49	9·81
1 0	0 18 11	2·60	5 17 1	9·66	0 18 15	2·61	7 14 46	9·66
1 15	0 22 35	3·23	5 15 43	9·47	0 22 40	3·25	7 13 27	9·47
1 30	0 26 54	3·85	5 14 10	9·24	0 27 0	3·86	7 11 53	9·24
1 45	0 31 5	4·45	5 12 18	8·96	0 31 12	4·47	7 10 0	8·96
2 0	0 35 8	5·03	5 10 11	8·66	0 35 16	5·05	7 7 52	8·65
2 15	0 39 2	5·58	5 7 51	8·31	0 39 11	5·61	7 5 29	8·31
2 30	0 42 46	6·12	5 5 13	7·93	0 42 55	6·14	7 2 51	7·92
2 45	0 46 19	6·63	5 2 24	7·51	0 46 29	6·65	7 0 0	7·51
3 0	0 49 40	7·10	4 59 21	7·06	0 49 51	7·13	6 56 55	7·06
3 20	0 53 48	7·69	4 54 59	6·42	0 54 0	7·73	6 52 27	6·41
3 40	0 57 32	8·23	4 50 16	5·73	0 57 44	8·26	6 47 42	5·72
4 0	1 0 49	8·69	4 45 17	4·99	1 1 1	8·73	6 42 37	4·98
4 20	1 3 38	9·10	4 40 1	4·21	1 3 51	9·13	6 37 18	4·21
4 40	1 5 58	9·43	4 34 33	3·41	1 6 11	9·46	6 31 44	3·40
5 0	1 7 48	9·69	4 28 53	2·57	1 8 2	9·72	6 26 0	2·57
5 20	1 9 7	9·88	4 23 6	1·72	1 9 21	9·91	6 20 8	1·72
Elong.	1 10 10	10·03	4 11 25	0·01	1 10 23	10·06	6 8 22	0·02
	h m s	*s*			*h m s*	*s*		
Elong. at	5 59 40	− 0·05			5 59 31	− 0·07		
	° ′ ″	″			° ′ ″	″		
6 40	1 9 5	+ 9·87	3 59 32	− 1·75	1 9 17	+ 9·90	5 56 18	− 1·76
7 0	1 7 45	9·68	3 53 49	2·60	1 7 57	9·70	5 50 28	2·61
7 20	1 5 54	9·41	3 48 16	3·43	1 6 6	9·44	5 44 47	3·44
7 40	1 3 34	9·07	3 42 50	4·24	1 3 44	9·10	5 39 16	4·24
8 0	1 0 44	8·67	3 37 40	5·01	1 0 54	8·69	5 33 57	5·02
8 20	0 57 26	8·20	3 32 46	5·75	0 57 35	8·22	5 28 56	5·75
8 40	0 53 42	7·67	3 28 6	6·43	0 53 51	7·68	5 24 13	6·44
9 0	0 49 34	7·08	3 23 47	7·08	0 49 42	7·09	5 19 49	7·08
9 15	0 46 13	6·60	3 20 49	7·52	0 46 20	6·61	5 16 46	7·53
9 30	0 42 40	6·09	3 18 1	7·94	0 42 47	6·10	5 13 56	7·94
9 45	0 38 57	5·56	3 15 28	8·32	0 39 2	5·57	5 11 20	8·32
10 0	0 35 3	5·00	3 13 10	8·66	0 35 8	5·01	5 8 59	8·66
10 15	0 31 0	4·42	3 11 5	8·97	0 31 4	4·43	5 6 53	8·97
10 30	0 26 49	3·83	3 9 18	9·24	0 26 53	3·83	5 5 2	9·24
10 45	0 22 32	3·21	3 7 44	9·47	0 22 35	3·22	5 3 28	9·47
11 0	0 18 8	2·59	3 6 27	9·66	0 18 11	2·59	5 2 10	9·66
11 15	0 13 40	1·95	3 5 28	9·81	0 13 42	1·95	5 1 10	9·81
11 30	0 9 9	1·31	3 4 46	9·91	0 9 10	1·31	5 0 27	9·91
11 45	0 4 35	0·65	3 4 21	9·98	0 4 36	0·66	5 0 1	9·98

TABLE LIII.—Azimuth and Apparent Altitude of Polaris computed with North Polar Distance 1° 10′, and Mean Refraction.

Hour Angle before or after Culmination	Latitude 8°				Latitude 10°			
	Azimuth	Correction for Increment of 10″ in N.P.D.	Apparent Altitude	Correction for Increment of 10″ in N.P.D.	Azimuth	Correction for Increment of 10″ in N.P.D.	Apparent Altitude	Correction for Increment of 10″ in N.P.D.
h m	° ′ ″	″	° ′ ″	″	° ′ ″	″	° ′ ″	″
0 15	0 4 38	+ 0·66	9 15 37	+ 9·98	0 4 40	+ 0·67	11 14 37	+ 9·98
0 30	0 9 15	1·33	9 15 11	9·91	0 9 19	1·34	11 14 11	9·91
0 45	0 13 50	1·98	9 14 27	9·81	0 13 55	2·00	11 13 28	9·81
1 0	0 18 21	2·63	9 13 24	9·66	0 18 28	2·65	11 12 24	9·66
1 15	0 22 47	3·26	9 12 5	9·47	0 22 56	3·29	11 11 5	9·47
1 30	0 27 8	3·89	9 10 30	9·23	0 27 18	3·91	11 9 29	9·23
1 45	0 31 21	4·49	9 8 37	8·96	0 31 33	4·52	11 7 36	8·96
2 0	0 35 26	5·08	9 6 28	8·65	0 35 39	5·11	11 5 27	8·65
2 15	0 39 22	5·64	9 4 4	8·30	0 39 37	5·68	11 3 2	8·30
2 30	0 43 8	6·18	9 1 25	7·92	0 43 24	6·22	11 0 23	7·92
2 45	0 46 43	6·69	8 58 33	7·50	0 47 0	6·73	10 57 28	7·50
3 0	0 50 5	7·17	8 55 25	7·06	0 50 24	7·22	10 54 22	7·05
3 20	0 54 15	7·77	8 50 58	6·41	0 54 35	7·82	10 49 54	6·41
3 40	0 58 0	8·30	8 46 9	5·72	0 58 21	8·35	10 45 4	5·71
4 0	1 1 18	8·77	8 41 5	4·98	1 1 40	8·83	10 39 56	4·97
4 20	1 4 9	9·18	8 35 42	4·20	1 4 31	9·23	10 34 33	4·19
4 40	1 6 29	9·51	8 30 8	3·40	1 6 53	9·57	10 28 57	3·39
5 0	1 8 20	9·77	8 24 22	2·56	1 8 43	9·83	10 23 10	2·55
5 20	1 9 39	9·95	8 18 28	1·71	1 10 3	10·01	10 17 15	1·70
Elong.	1 10 41	10·10	8 6 39	0·03	1 11 5	10·16	10 5 27	0·04
	h m s	*s*			*h m s*	*s*		
Elong. at	5 59 21	− 0·09			5 59 11	− 0·12		
	° ′ ″	″			° ′ ″	″		
6 40	1 9 35	+ 9·94	7 54 23	− 1·76	1 9 57	+ 9·99	9 53 10	− 1·77
7 0	1 8 14	9·74	7 48 30	2·61	1 8 36	9·79	9 47 15	2·62
7 20	1 6 22	9·47	7 42 45	3·44	1 6 43	9·52	9 41 28	3·45
7 40	1 3 59	9·13	7 37 11	4·25	1 4 19	9·18	9 35 53	4·26
8 0	1 1 8	8·72	7 31 52	5·02	1 1 27	8·76	9 30 32	5·03
8 20	0 57 49	8·25	7 26 48	5·75	0 58 6	8·28	9 25 27	5·76
8 40	0 54 3	7·71	7 22 0	6·44	0 54 20	7·74	9 20 40	6·45
9 0	0 49 53	7·11	7 17 36	7·09	0 50 8	7·15	9 16 12	7·09
9 15	0 46 31	6·63	7 14 30	7·53	0 46 45	6·66	9 13 8	7·53
9 30	0 42 56	6·12	7 11 39	7·94	0 43 9	6·15	9 10 16	7·95
9 45	0 39 11	5·56	7 9 1	8·32	0 39 23	5·61	9 7 38	8·32
10 0	0 35 16	5·03	7 6 40	8·67	0 35 26	5·05	9 5 13	8·67
10 15	0 31 11	4·45	7 4 32	8·97	0 31 20	4·46	9 3 6	8·98
10 30	0 26 59	3·85	7 2 39	9·24	0 27 7	3·86	9 1 14	9·24
10 45	0 22 40	3·23	7 1 5	9·47	0 22 46	3·24	8 59 38	9·47
11 0	0 18 15	2·60	6 59 46	9·66	0 18 20	2·61	8 58 19	9·66
11 15	0 13 45	1·96	6 58 45	9·81	0 13 49	1·97	8 57 18	9·81
11 30	0 9 12	1·31	6 58 2	9·91	0 9 15	1·32	8 56 35	9·92
11 45	0 4 37	0·66	6 57 36	9·98	0 4 38	0·66	8 56 7	9·98

TABLE LIII.—Azimuth and Apparent Altitude of Polaris computed with North Polar Distance 1° 10′, and Mean Refraction.

Hour Angle before or after Culmination	Latitude 12°				Latitude 14°			
	Azimuth	Correction for Increment of 10″ in N.P.D.	Apparent Altitude	Correction for Increment of 10″ in N.P.D.	Azimuth	Correction for Increment of 10″ in N.P.D.	Apparent Altitude	Correction for Increment of 10″ in N.P.D.
h m	° ′ ″	″	° ′ ″	″	° ′ ″	″	° ′ ″	″
0 15	0 4 42	+ 0·67	13 13 54	+ 9·98	0 4 45	+ 0·68	15 13 22	+ 9·98
0 30	0 9 23	1·35	13 13 28	9·91	0 9 28	1·36	15 12 56	9·91
0 45	0 14 1	2·01	13 12 43	9·81	0 14 9	2·03	15 12 10	9·81
1 0	0 18 36	2·67	13 11 41	9·66	0 18 46	2·69	15 11 8	9·66
1 15	0 23 6	3·31	13 10 21	9·46	0 23 18	3·35	15 9 49	9·46
1 30	0 27 30	3·95	13 8 44	9·23	0 27 44	3·98	15 8 11	9·23
1 45	0 31 47	4·56	13 6 50	8·96	0 32 3	4·60	15 6 17	8·96
2 0	0 35 55	5·15	13 4 41	8·65	0 36 14	5·20	15 4 8	8·65
2 15	0 39 54	5·72	13 2 18	8·30	0 40 15	5·78	15 1 42	8·30
2 30	0 43 43	6·27	12 59 37	7·92	0 44 6	6·33	14 59 3	7·91
2 45	0 47 21	6·79	12 56 44	7·50	0 47 45	6·85	14 56 8	7·50
3 0	0 50 46	7·28	12 53 37	7·05	0 51 12	7·34	14 53 1	7·04
3 20	0 54 59	7·88	12 49 6	6·40	0 55 27	7·95	14 48 32	6·40
3 40	0 58 46	8·42	12 44 16	5·71	0 59 16	8·49	14 43 41	5·70
4 0	1 2 7	8·89	12 39 7	4·97	1 2 38	8·97	14 38 32	4·96
4 20	1 4 59	9·30	12 33 45	4·19	1 5 32	9·38	14 33 8	4·18
4 40	1 7 21	9·64	12 28 7	3·38	1 7 55	9·72	14 27 29	3·37
5 0	1 9 12	9·90	12 22 19	2·55	1 9 47	9·98	14 21 43	2·54
5 20	1 10 32	10·08	12 16 23	1·69	1 11 7	10·17	14 15 46	1·69
Elong.	1 11 34	10·23	12 4 36	0·04	1 12 9	10·31	14 4 0	0·05
	h m s	*s*			*h m s*	*s*		
Elong. at	5 59 0	− 0·14			5 58 50	− 0·17		
	° ′ ″	″			° ′ ″	″		
6 40	1 10 25	+10·05	11 52 14	− 1·78	1 10 59	+10·13	13 51 33	− 1·79
7 0	1 9 3	9·85	11 46 18	2·63	1 9 36	9·93	13 45 39	2·64
7 20	1 7 19	9·58	11 40 33	3·46	1 7 41	9·65	13 39 50	3·46
7 40	1 4 45	9·23	11 34 57	4·26	1 5 15	9·30	13 34 14	4·27
8 0	1 1 51	8·82	11 29 35	5·03	1 2 19	8·88	13 28 52	5·04
8 20	0 58 29	8·33	11 24 27	5·76	0 58 56	8·39	13 23 45	5·77
8 40	0 54 40	7·79	11 19 39	6·45	0 55 5	7·84	13 18 57	6·46
9 0	0 50 27	7·19	11 15 13	7·09	0 50 50	7·24	13 14 28	7·10
9 15	0 47 2	6·70	11 12 6	7·54	0 47 23	6·75	13 11 23	7·54
9 30	0 43 25	6·18	11 9 13	7·95	0 43 45	6·23	13 8 30	7·95
9 45	0 39 37	5·64	11 6 36	8·33	0 39 55	5·68	13 5 51	8·33
10 0	0 35 39	5·08	11 4 11	8·67	0 35 55	5·11	13 3 27	8·67
10 15	0 31 32	4·49	11 2 4	8·98	0 31 46	4·52	13 1 20	8·98
10 30	0 27 17	3·88	11 0 11	9·24	0 27 29	3·91	12 59 27	9·25
10 45	0 22 55	3·26	10 58 36	9·47	0 23 5	3·28	12 57 51	9·47
11 0	0 18 27	2·63	10 57 17	9·66	0 18 35	2·64	12 56 31	9·66
11 15	0 13 54	1·98	10 56 15	9·81	0 14 0	1·99	12 55 30	9·81
11 30	0 9 18	1·32	10 55 31	9·92	0 9 22	1·33	12 54 46	9·92
11 45	0 4 40	0·66	10 55 5	9·98	0 4 42	0·67	12 54 18	9·98

TABLE LIII.—Azimuth and Apparent Altitude of Polaris computed with North Polar Distance 1° 10′, and Mean Refraction.

Hour Angle before or after Culmination	Latitude 16°				Latitude 18°			
	Azimuth	Correction for Increment of 10″ in N.P.D.	Apparent Altitude	Correction for Increment of 10″ in N.P.D.	Azimuth	Correction for Increment of 10″ in N.P.D.	Apparent Altitude	Correction for Increment of 10″ in N.P.D.
h m	° ′ ″	″	° ′ ″	″	° ′ ″	″	° ′ ″	″
0 15	0 4 47	+ 0·69	17 12 56	+ 9·98	0 4 51	+ 0·70	19 12 36	+ 9·98
0 30	0 9 34	1·37	17 12 31	9·91	0 9 40	1·39	19 12 10	9·91
0 45	0 14 17	2·05	17 11 45	9·81	0 14 27	2·08	19 11 24	9·81
1 0	0 18 57	2·72	17 10 43	9·66	0 19 10	2·76	19 10 22	9·65
1 15	0 23 32	3·38	17 9 23	9·46	0 23 49	3·42	19 9 3	9·46
1 30	0 28 1	4·03	17 7 45	9·23	0 28 21	4·07	19 7 25	9·23
1 45	0 32 23	4·65	17 5 52	8·96	0 32 45	4·71	19 5 31	8·96
2 0	0 36 36	5·26	17 3 42	8·65	0 37 1	5·32	19 3 22	8·64
2 15	0 40 39	5·84	17 1 17	8·30	0 41 7	5·91	19 0 56	8·29
2 30	0 44 32	6·39	16 58 37	7·91	0 45 3	6·47	18 58 14	7·91
2 45	0 48 14	6·92	16 55 42	7·49	0 48 47	7·00	18 55 21	7·49
3 0	0 51 43	7·42	16 52 34	7·04	0 52 18	7·51	18 52 11	7·04
3 20	0 56 0	8·03	16 48 3	6·39	0 56 38	8·12	18 47 42	6·39
3 40	0 59 51	8·58	16 43 12	5·70	1 0 31	8·68	18 42 51	5·69
4 0	1 3 15	9·06	16 38 3	4·95	1 3 57	9·17	18 37 42	4·95
4 20	1 6 10	9·48	16 32 38	4·18	1 6 54	9·58	18 32 17	4·17
4 40	1 8 34	9·82	16 27 1	3·37	1 9 19	9·93	18 26 37	3·36
5 0	1 10 27	10·08	16 21 13	2·53	1 11 13	10·19	18 20 48	2·53
5 20	1 11 47	10·27	16 15 16	1·68	1 12 34	10·38	18 14 51	1·67
Elong.	1 12 49	10·41	16 3 32	0·06	1 13 36	10·52	18 3 11	0·07
	h m s	*s*			*h m s*	*s*		
Elong. at	5 58 40	− 0·19			5 58 29	− 0·22		
	° ′ ″	″			° ′ ″	″		
6 40	1 11 38	+10·22	15 51 1	− 1·79	1 12 24	+10·33	17 50 38	− 1·80
7 0	1 10 14	10·02	15 45 6	2·64	1 10 58	10·12	17 44 41	2·65
7 20	1 8 18	9·74	15 39 18	3·47	1 9 0	9·84	17 38 54	3·48
7 40	1 5 50	9·38	15 33 43	4·27	1 6 31	9·48	17 33 17	4·28
8 0	1 2 53	8·96	15 28 18	5·04	1 3 32	9·05	17 27 54	5·05
8 20	0 59 27	8·47	15 23 11	5·77	1 0 4	8·55	17 22 47	5·78
8 40	0 55 35	7·91	15 18 25	6·46	0 56 9	7·99	17 17 58	6·47
9 0	0 51 17	7·30	15 13 56	7·10	0 51 48	7·37	17 13 30	7·10
9 15	0 47 48	6·80	15 10 48	7·54	0 48 18	6·87	17 10 23	7·55
9 30	0 44 8	6·28	15 7 57	7·95	0 44 35	6·34	17 7 29	7·96
9 45	0 40 16	5·73	15 5 18	8·33	0 40 40	5·78	17 4 52	8·33
10 0	0 36 14	5·15	15 2 54	8·67	0 36 36	5·20	17 2 28	8·68
10 15	0 32 3	4·55	15 0 45	8·98	0 32 22	4·60	17 0 19	8·98
10 30	0 27 43	3·94	14 58 53	9·25	0 28 0	3·98	16 58 27	9·25
10 45	0 23 17	3·31	14 57 18	9·47	0 23 31	3·34	16 56 52	9·48
11 0	0 18 45	2·66	14 55 58	9·66	0 18 56	2·69	16 55 32	9·66
11 15	0 14 8	2·01	14 54 56	9·81	0 14 16	2·03	16 54 30	9·81
11 30	0 9 27	1·34	14 54 12	9·92	0 9 33	1·36	16 53 46	9·92
11 45	0 4 44	0·67	14 53 44	9·98	0 4 47	0·68	16 53 20	9·98

TABLE LIII.—Azimuth and Apparent Altitude of Polaris computed with North Polar Distance 1° 10′, and Mean Refraction.

Hour Angle before or after Culmination	Latitude 20°				Latitude 22°			
	Azimuth	Correction for Increment of 10″ in N.P.D.	Apparent Altitude	Correction for Increment of 10″ in N.P.D.	Azimuth	Correction for Increment of 10″ in N.P.D.	Apparent Altitude	Correction for Increment of 10″ in N.P.D.
h m	° ′ ″	″	° ′ ″	″	° ′ ″	″	° ′ ″	″
0 15	0 4 55	+ 0·71	21 12 19	+ 9·98	0 4 59	+ 0·72	23 12 5	+ 9·98
0 30	0 9 48	1·41	21 11 53	9·91	0 9 56	1·43	23 11 39	9·91
0 45	0 14 38	2·11	21 11 8	9·81	0 14 51	2·14	23 10 54	9·80
1 0	0 19 25	2·80	21 10 6	9·65	0 19 42	2·84	23 9 52	9·65
1 15	0 24 7	3·47	21 8 46	9·46	0 24 28	3·52	23 8 32	9·46
1 30	0 28 42	4·13	21 7 8	9·23	0 29 7	4·19	23 6 54	9·23
1 45	0 33 10	4·77	21 5 14	8·95	0 33 39	4·84	23 5 0	8·95
2 0	0 37 29	5·39	21 3 5	8·64	0 38 1	5·47	23 2 48	8·64
2 15	0 41 39	5·99	21 0 39	8·29	0 42 14	6·08	23 0 23	8·29
2 30	0 45 37	6·56	20 57 57	7·91	0 46 16	6·65	22 57 43	7·90
2 45	0 49 24	7·10	20 55 2	7·49	0 50 6	7·20	22 54 47	7·48
3 0	0 52 57	7·61	20 51 54	7·03	0 53 42	7·72	22 51 40	7·03
3 20	0 57 20	8·23	20 47 23	6·38	0 58 9	8·35	22 47 8	6·38
3 40	1 1 17	8·79	20 42 31	5·69	1 2 8	8·92	22 42 17	5·68
4 0	1 4 45	9·29	20 37 22	4·94	1 5 39	9·42	22 37 5	4·94
4 20	1 7 44	9·71	20 31 57	4·17	1 8 40	9·84	22 31 40	4·16
4 40	1 10 11	10·05	20 26 17	3·35	1 11 9	10·19	22 26 2	3·35
5 0	1 12 6	10·32	20 20 28	2·52	1 13 5	10·46	22 20 11	2·51
5 20	1 13 27	10·51	20 14 31	1·66	1 14 27	10·65	22 14 14	1·66
Elong.	1 14 30	10·65	20 2 55	0·07	1 15 30	10·79	22 2 40	0·08
	h m s	*s*			*h m s*	*s*		
Elong. at	5 58 18	− 0·24			5 58 7	− 0·27		
	° ′ ″	″			° ′ ″	″		
6 40	1 13 16	+10·45	19 50 17	− 1·81	1 14 15	+10·59	21 49 59	− 1·82
7 0	1 11 49	10·24	19 44 19	2·66	1 12 46	10·37	21 44 2	2·66
7 20	1 9 49	9·95	19 38 32	3·49	1 10 45	10·08	21 38 14	3·49
7 40	1 7 18	9·58	19 32 55	4·29	1 8 11	9·71	21 32 37	4·29
8 0	1 4 17	9·15	19 27 32	5·06	1 5 7	9·26	21 27 16	5·06
8 20	1 0 46	8·64	19 22 25	5·79	1 1 33	8·75	21 22 8	5·79
8 40	0 56 48	8·08	19 17 37	6·47	0 57 32	8·18	21 17 19	6·47
9 0	0 52 24	7·45	19 13 8	7·11	0 53 5	7·54	21 12 51	7·11
9 15	0 48 51	6·94	19 10 2	7·55	0 49 29	7·03	21 9 44	7·55
9 30	0 45 5	6·40	19 7 9	7·96	0 45 40	6 48	21 6 52	7·96
9 45	0 41 8	5·84	19 4 31	8·34	0 41 40	5·91	21 4 12	8·34
10 0	0 37 1	5·25	19 2 6	8·68	0 37 29	5·32	21 1 49	8·68
10 15	0 32 44	4·65	18 59 58	8·98	0 33 9	4·70	20 59 41	8·98
10 30	0 28 19	4·02	18 58 6	9·25	0 28 41	4·07	20 57 49	9·25
10 45	0 23 47	3·37	18 56 31	9·48	0 24 5	3·41	20 56 14	9·48
11 0	0 19 9	2·72	18 55 11	9·66	0 19 23	2·75	20 54 54	9·66
11 15	0 14 26	2·05	18 54 9	9·81	0 14 37	2·07	20 53 52	9·81
11 30	0 9 39	1·37	18 53 25	9·92	0 9 47	1·39	20 53 8	9·92
11 45	0 4 50	0·69	18 52 57	9·98	0 4 54	0·69	20 52 40	9·98

TABLE LIII.—Azimuth and Apparent Altitude of Polaris computed with North Polar Distance 1° 10′, and Mean Refraction.

Hour Angle before or after Culmination	Latitude 24°				Latitude 26°			
	Azimuth	Correction for Increment of 10″ in N.P.D.	Apparent Altitude	Correction for Increment of 10″ in N.P.D.	Azimuth	Correction for Increment of 10″ in N.P.D.	Apparent Altitude	Correction for Increment of 10″ in N.P.D.
h m	° ′ ″	″	° ′ ″	″	° ′ ″	″	° ′ ″	″
0 15	0 5 3	+ 0·73	25 11 53	+ 9·98	0 5 9	+ 0·74	27 11 43	+ 9·98
0 30	0 10 6	1·46	25 11 27	9·91	0 10 16	1·48	27 11 17	9·91
0 45	0 15 5	2·17	25 10 42	9·80	0 15 21	2·21	27 10 31	9·80
1 0	0 20 1	2·88	25 9 40	9·65	0 20 21	2·94	27 9 29	9·65
1 15	0 24 51	3·58	25 8 20	9·46	0 25 17	3·65	27 8 7	9·46
1 30	0 29 34	4·26	25 6 42	9·23	0 30 5	4·34	27 6 32	9·22
1 45	0 34 10	4·92	25 4 48	8·95	0 34 46	5·01	27 4 36	8·95
2 0	0 38 37	5·56	25 2 36	8·64	0 39 17	5·66	27 2 26	8·63
2 15	0 42 54	6·18	25 0 11	8·29	0 43 38	6·29	27 0 0	8·28
2 30	0 46 59	6·76	24 57 29	7·90	0 47 48	6·88	26 57 18	7·90
2 45	0 50 52	7·32	24 54 35	7·48	0 51 44	7·45	26 54 23	7·47
3 0	0 54 32	7·84	24 51 25	7·02	0 55 28	7·98	26 51 15	7·02
3 20	0 59 3	8·48	24 46 54	6·37	1 0 3	8·63	26 46 43	6·37
3 40	1 3 6	9·06	24 42 2	5·67	1 4 10	9·22	26 41 50	5·67
4 0	1 6 40	9·57	24 36 53	4·93	1 7 47	9·73	26 36 40	4·92
4 20	1 9 43	10·00	24 31 27	4·15	1 10 53	10·17	26 31 14	4·14
4 40	1 12 14	10·35	24 25 48	3·34	1 13 26	10·53	26 25 35	3·33
5 0	1 14 11	10·62	24 19 58	2·50	1 15 25	10·80	26 19 45	2·50
5 20	1 15 35	10·81	24 13 59	1·65	1 16 50	10·99	26 13 46	1·64
Elong.	1 16 38	10·95	24 2 29	0·09	1 17 53	11·13	26 2 20	0·10
	h m s	*s*			*h m s*	*s*		
Elong. at	5 57 55	− 0·30			5 57 43	− 0·33		
	° ′ ″	″			° ′ ″	″		
6 40	1 15 20	+10·75	23 49 43	− 1·82	1 16 34	+10·92	25 49 30	− 1·83
7 0	1 13 50	10·52	23 43 48	2·67	1 15 2	10·69	25 43 35	2·68
7 20	1 11 47	10·22	23 37 59	3·50	1 12 56	10·38	25 37 47	3·51
7 40	1 9 11	9·85	23 32 23	4·30	1 10 17	10·00	25 32 10	4·31
8 0	1 6 4	9·40	23 27 0	5·07	1 7 7	9·54	25 26 46	5·07
8 20	1 2 27	8·88	23 21 52	5·80	1 3 26	9·01	25 21 41	5·80
8 40	0 58 22	8·29	23 17 5	6·48	0 59 17	8·42	25 16 51	6·49
9 0	0 53 50	7·64	23 12 35	7·12	0 54 41	7·76	25 12 23	7·12
9 15	0 50 11	7·12	23 9 30	7·56	0 50 58	7·23	25 9 18	7·56
9 30	0 46 19	6·57	23 6 38	7·97	0 47 3	6·67	25 6 24	7·97
9 45	0 42 15	5·99	23 3 58	8·34	0 42 55	6·08	25 3 46	8·34
10 0	0 38 1	5·39	23 1 34	8·68	0 38 37	5·47	25 1 22	8·68
10 15	0 33 37	4·77	22 59 27	8·99	0 34 9	4·84	24 59 15	8·99
10 30	0 29 5	4·12	22 57 35	9·25	0 29 32	4·18	24 57 21	9·25
10 45	0 24 25	3·46	22 55 59	9·48	0 24 48	3·51	24 55 45	9·48
11 0	0 19 40	2·79	22 54 39	9·67	0 19 58	2·83	24 54 27	9·67
11 15	0 14 49	2·10	22 53 37	9·81	0 15 3	2·13	24 53 25	9·81
11 30	0 9 55	1·40	22 52 53	9·92	0 10 4	1·42	24 52 41	9·92
11 45	0 4 58	0·70	22 52 25	9·98	0 5 3	0·71	24 52 13	9·98

TABLE LIII.—Azimuth and Apparent Altitude of Polaris computed with North Polar Distance 1° 10′, and Mean Refraction.

Hour Angle before or after Culmination	Latitude 28°				Latitude 30°			
	Azimuth	Correction for Increment of 10″ in N.P.D.	Apparent Altitude	Correction for Increment of 10″ in N.P.D.	Azimuth	Correction for Increment of 10″ in N.P.D.	Apparent Altitude	Correction for Increment of 10″ in N.P.D.
h m	° ′ ″	″	° ′ ″	″	° ′ ″	″	° ′ ″	″
0 15	0 5 15	+ 0·76	29 11 34	+ 9·98	0 5 21	+ 0·77	31 11 26	+ 9·98
0 30	0 10 28	1·51	29 11 8	9·91	0 10 41	1·54	31 11 0	9·91
0 45	0 15 38	2·26	29 10 22	9·80	0 15 57	2·31	31 10 14	9·80
1 0	0 20 44	2·99	29 9 20	9·65	0 21 10	3·06	31 9 12	9·65
1 15	0 25 45	3·72	29 7 58	9·46	0 26 17	3·80	31 7 50	9·46
1 30	0 30 39	4·42	29 6 20	9·22	0 31 17	4·52	31 6 12	9·22
1 45	0 35 25	5·11	29 4 27	8·95	0 36 8	5·22	31 4 19	8·95
2 0	0 40 1	5·77	29 2 17	8·63	0 40 50	5·89	31 2 7	8·63
2 15	0 44 27	6·41	28 59 51	8·28	0 45 21	6·54	30 59 41	8·28
2 30	0 48 41	7·02	28 57 9	7·89	0 49 40	7·16	30 56 59	7·89
2 45	0 52 42	7·59	28 54 13	7·47	0 53 46	7·75	30 54 3	7·47
3 0	0 56 30	8·13	28 51 4	7·02	0 57 38	8·30	30 50 55	7·01
3 20	1 1 10	8·80	28 46 32	6·36	1 2 24	8·98	30 46 22	6·36
3 40	1 5 21	9·39	28 41 40	5·66	1 6 40	9·59	30 41 30	5·65
4 0	1 9 2	9·92	28 36 29	4·92	1 10 25	10·12	30 36 20	4·91
4 20	1 12 11	10·36	28 31 3	4·14	1 13 37	10·57	30 30 53	4·13
4 40	1 14 46	10·72	28 25 23	3·32	1 16 16	10·94	30 25 13	3·32
5 0	1 16 47	11·00	28 19 34	2·49	1 18 19	11·22	30 19 23	2·48
5 20	1 18 13	11·19	28 13 36	1·63	1 19 46	11·42	30 13 26	1·62
Elong.	1 19 17	11·33	28 2 12	0·11	1 20 50	11·55	30 2 6	0·12
	h m s	*s*			*h m s*	*s*		
Elong. at	5 57 31	− 0·35			5 57 18	− 0·39		
	° ′ ″	″			° ′ ″	″		
6 40	1 17 56	+11·11	27 49 18	− 1·84	1 19 26	+11·32	29 49 7	− 1·85
7 0	1 16 22	10·88	27 43 23	2·69	1 17 50	11·09	29 43 12	2·70
7 20	1 14 13	10·56	27 37 35	3·52	1 15 39	10·76	29 37 24	3·52
7 40	1 11 31	10·17	27 31 57	4·31	1 12 54	10·36	29 31 47	4·32
8 0	1 8 17	9·70	27 26 36	5·08	1 9 35	9·88	29 26 25	5·09
8 20	1 4 33	9·16	27 21 28	5·81	1 5 46	9·33	29 21 17	5·81
8 40	1 0 19	8·56	27 16 41	6·49	1 1 27	8·71	29 16 30	6·49
9 0	0 55 38	7·89	27 12 11	7·12	0 56 41	8·03	29 12 2	7·13
9 15	0 51 51	7·35	27 9 5	7·56	0 52 50	7·48	29 8 56	7·57
9 30	0 47 51	6·78	27 6 14	7·97	0 48 45	6·90	29 6 3	7·98
9 45	0 43 39	6·18	27 3 36	8·35	0 44 29	6·29	29 3 25	8·35
10 0	0 39 17	5·56	27 1 12	8·69	0 40 1	5·66	29 1 1	8·69
10 15	0 34 44	4·91	26 59 2	8·99	0 35 23	5·00	28 58 53	8·99
10 30	0 30 3	4·25	26 57 10	9·25	0 30 36	4·33	28 57 1	9·26
10 45	0 25 14	3·57	26 55 34	9·48	0 25 42	3·63	28 55 25	9·48
11 0	0 20 19	2·87	26 54 16	9·67	0 20 41	2·92	28 54 7	9·67
11 15	0 15 18	2·16	26 53 15	9·81	0 15 35	2·20	28 53 5	9·81
11 30	0 10 14	1·45	26 52 31	9·92	0 10 26	1·47	28 52 21	9·92
11 45	0 5 8	0·73	26 52 3	9·98	0 5 14	0·74	28 51 53	9·98

TABLE LIII.—Azimuth and Apparent Altitude of Polaris computed with North Polar Distance 1° 10′, and Mean Refraction.

Hour Angle before or after Culmination	Latitude 32°				Latitude 34°			
	Azimuth	Correction for Increment of 10″ in N.P.D.	Apparent Altitude	Correction for Increment of 10″ in N.P.D.	Azimuth	Correction for Increment of 10″ in N.P.D.	Apparent Altitude.	Correction for Increment of 10″ in N.P.D.
h m	° ′ ″	″	° ′ ″	″	° ′ ″	″	° ′ ″	″
0 15	0 5 28	+ 0·79	33 11 19	+ 9·98	0 5 36	+ 0·81	35 11 13	+ 9·98
0 30	0 10 55	1·58	33 10 53	9·91	0 11 10	1·62	35 10 47	9·91
0 45	0 16 19	2·36	33 10 7	9·80	0 16 42	2·42	35 10 1	9·80
1 0	0 21 38	3·13	33 9 5	9·65	0 22 9	3·21	35 8 57	9·65
1 15	0 26 52	3·88	33 7 43	9·46	0 27 30	3·98	35 7 37	9·45
1 30	0 31 58	4·62	33 6 5	9·22	0 32 44	4·74	35 5 59	9·22
1 45	0 36 56	5·34	33 4 11	8·94	0 37 49	5·47	35 4 5	8·94
2 0	0 41 44	6·03	33 1 59	8·63	0 42 44	6·18	35 1 53	8·63
2 15	0 46 21	6·69	32 59 34	8·27	0 47 27	6·86	34 59 27	8·27
2 30	0 50 46	7·33	32 56 52	7·89	0 51 58	7·51	34 56 45	7·88
2 45	0 54 57	7·93	32 53 56	7·46	0 56 15	8·12	34 53 47	7·46
3 0	0 58 54	8·49	32 50 46	7·00	1 0 18	8·70	34 50 40	7·00
3 20	1 3 45	9·18	32 46 14	6·35	1 5 16	9·41	34 46 6	6·35
3 40	1 8 7	9·80	32 41 21	5·65	1 9 43	10·04	34 41 14	5·64
4 0	1 11 56	10·34	32 36 11	4·90	1 13 38	10·59	34 36 2	4·90
4 20	1 15 13	10·80	32 30 43	4·12	1 16 58	11·06	34 30 37	4·11
4 40	1 17 54	11·18	32 25 4	3·31	1 19 43	11·44	34 24 55	3·30
5 0	1 19 59	11·46	32 19 14	2·47	1 21 51	11·73	34 19 5	2·46
5 20	1 21 28	11·66	32 13 16	1·61	1 23 21	11·93	34 13 8	1·60
Elong.	1 22 33	11·80	32 2 0	0·13	1 24 26	12·07	34 1 55	0·14
	h m s	*s*			*h m s*	*s*		
Elong. at	5 57 5	− 0·42			5 56 51	− 0·45		
	° ′ ″	″			° ′ ″	″		
6 40	1 21 6	+11·56	31 48 58	− 1·86	1 22 57	+11·82	33 48 49	− 1·87
7 0	1 19 28	11·31	31 43 2	2·71	1 21 16	11·57	33 42 53	2·71
7 20	1 17 14	10·98	31 37 14	3·53	1 18 58	11·23	33 37 6	3·54
7 40	1 14 24	10·57	31 31 39	4·33	1 16 5	10·81	33 31 30	4·34
8 0	1 11 2	10·08	31 26 15	5·09	1 12 37	10·30	33 26 6	5·10
8 20	1 7 8	9·52	31 21 10	5·82	1 8 38	9·73	33 21 0	5·83
8 40	1 2 43	8·89	31 16 20	6·50	1 4 7	9·08	33 16 13	6·51
9 0	0 57 51	8·19	31 11 54	7·13	0 59 8	8·37	33 11 45	7·14
9 15	0 53 55	7·63	31 8 46	7·57	0 55 6	7·79	33 8 39	7·58
9 30	0 49 45	7·04	31 5 54	7·98	0 50 51	7·19	33 5 47	7·98
9 45	0 45 23	6·42	31 3 17	8·35	0 46 23	6·55	33 3 9	8·36
10 0	0 40 50	5·77	31 0 53	8·69	0 41 44	5·89	33 0 46	8·69
10 15	0 36 6	5·10	30 58 45	8·99	0 36 54	5·21	32 58 38	8·99
10 30	0 31 13	4·41	30 56 53	9·26	0 31 55	4·50	32 56 46	9·26
10 45	0 26 13	3·70	30 55 17	9·48	0 26 48	3·78	32 55 10	9·48
11 0	0 21 6	2·98	30 53 59	9·67	0 21 34	3·04	32 53 52	9·67
11 15	0 15 54	2·25	30 52 57	9·81	0 16 15	2·29	32 52 50	9·81
11 30	0 10 38	1·50	30 52 13	9·92	0 10 52	1·53	32 52 6	9·92
11 45	0 5 20	0·75	30 51 45	9·98	0 5 27	0·77	32 51 38	9·98

TABLE LIII.—Azimuth and Apparent Altitude of Polaris computed with North Polar Distance 1° 10′, and Mean Refraction.

Hour Angle before or after Culmination	Latitude 36°				Latitude 38°			
	Azimuth	Correction for Increment of 10″ in N.P.D.	Apparent Altitude	Correction for Increment of 10″ in N.P.D.	Azimuth	Correction for Increment of 10″ in N.P.D.	Apparent Altitude	Correction for Increment of 10″ in N.P.D.
h m	° ′ ″	″	° ′ ″	″	° ′ ″	″	° ′ ″	″
0 15	0 5 45	+ 0·83	37 11 7	+ 9·98	0 5 54	+ 0·86	39 11 1	+ 9·98
0 30	0 11 28	1·66	37 10 41	9·91	0 11 47	1·71	39 10 35	9·91
0 45	0 17 8	2·48	37 9 55	9·80	0 17 36	2·56	39 9 50	9·80
1 0	0 22 43	3·29	37 8 51	9·65	0 23 21	3·39	39 8 46	9·65
1 15	0 28 13	4·09	37 7 31	9·45	0 29 0	4·21	39 7 26	9·45
1 30	0 33 34	4·86	37 5 53	9·22	0 34 30	5·00	39 5 48	9·21
1 45	0 38 47	5·62	37 3 57	8·94	0 39 52	5·78	39 3 52	8·94
2 0	0 43 50	6·34	37 1 47	8·62	0 45 2	6·53	39 1 40	8·62
2 15	0 48 40	7·04	36 59 19	8·27	0 50 1	7·24	38 59 14	8·26
2 30	0 53 18	7·71	36 56 37	7·88	0 54 46	7·93	38 56 32	7·87
2 45	0 57 42	8·34	36 53 42	7·45	0 59 17	8·57	38 53 34	7·45
3 0	1 1 50	8·93	36 50 32	7·00	1 3 32	9·18	38 50 24	6·99
3 20	1 6 55	9·65	36 46 0	6·34	1 8 45	9·92	38 45 53	6·33
3 40	1 11 29	10·30	36 41 6	5·64	1 13 26	10·59	38 40 59	5·63
4 0	1 15 29	10·86	36 35 54	4·89	1 17 33	11·17	38 35 47	4·88
4 20	1 18 55	11·34	36 30 29	4·10	1 21 3	11·66	38 30 21	4·09
4 40	1 21 43	11·73	36 24 47	3·29	1 23 56	12·05	38 24 39	3·28
5 0	1 23 54	12·03	36 18 57	2·45	1 26 9	12·36	38 18 50	2·44
5 20	1 25 25	12·23	36 12 58	1·59	1 27 43	12·56	38 12 50	1·58
Elong.	1 26 32	12·37	36 1 51	0·15	1 28 50	12·70	38 1 47	0·16
	h m s	*s*			*h m s*	*s*		
Elong. at	5 56 37	− 0·48			5 56 21	− 0·52		
	° ′ ″	″			° ′ ″	″		
6 40	1 24 59	+12·11	35 48 41	− 1·88	1 27 14	+12·43	37 48 33	− 1·89
7 0	1 23 15	11·85	35 42 45	2·73	1 25 27	12·16	37 42 37	2·73
7 20	1 20 54	11·50	35 36 57	3·55	1 23 1	11·79	37 36 50	3·56
7 40	1 17 56	11·06	35 31 22	4·35	1 19 58	11·35	37 31 14	4·35
8 0	1 14 23	10·55	35 25 58	5·11	1 16 19	10·82	37 25 52	5·12
8 20	1 10 17	9·96	35 20 52	5·83	1 12 6	10·21	37 20 44	5·84
8 40	1 5 40	9·29	35 16 4	6·51	1 7 22	9·53	37 15 59	6·52
9 0	1 0 33	8·56	35 11 37	7·14	1 2 7	8·78	37 11 31	7·15
9 15	0 56 25	7·97	35 8 31	7·58	0 57 53	8·17	37 8 25	7·59
9 30	0 52 4	7·35	35 5 39	7·99	0 53 24	7·54	37 5 33	7·99
9 45	0 47 29	6·70	35 3 1	8·36	0 48 43	6·87	37 2 55	8·36
10 0	0 42 43	6·03	35 0 39	8·70	0 43 49	6·18	37 0 31	8·70
10 15	0 37 46	5·33	34 58 31	9·00	0 38 44	5·46	36 58 23	9·00
10 30	0 32 40	4·61	34 56 39	9·26	0 33 30	4·72	36 56 31	9·26
10 45	0 27 26	3·87	34 55 3	9·48	0 28 8	3·96	36 54 58	9·49
11 0	0 22 5	3·11	34 53 45	9·67	0 22 39	3·19	36 53 38	9·67
11 15	0 16 38	2·34	34 52 44	9·81	0 17 4	2·49	36 52 38	9·81
11 30	0 11 8	1·57	34 52 0	9·92	0 11 25	1·61	36 51 54	9·92
11 35	0 5 35	0·79	34 51 32	9·98	0 5 43	0·80	36 51 26	9·98

TABLE LIII.—Azimuth and Apparent Altitude of Polaris computed with North Polar Distance 1° 10′, and Mean Refraction.

Hour Angle before or after Culmination	Latitude 40°			
	Azimuth	Correction for Increment of 10″ in N.P.D.	Apparent Altitude	Correction for Increment of 10″ in N.P.D.
h m	° ′ ″	″	° ′ ″	″
0 15	0 6 5	+ 0·88	41 10 57	+ 9·98
0 30	0 12 8	1·76	41 10 31	9·91
0 45	0 18 8	2·64	41 9 45	9·80
1 0	0 24 3	3·49	41 8 41	9·65
1 15	0 29 52	4·34	41 7 21	9·45
1 30	0 35 32	5·16	41 5 41	9·21
1 45	0 41 3	5·96	41 3 47	8·93
2 0	0 46 23	6·73	41 1 35	8·62
2 15	0 51 30	7·46	40 59 7	8·26
2 30	0 56 24	8·17	40 56 25	7·87
2 45	1 1 2	8·83	40 53 29	7·44
3 0	1 5 24	9·46	40 50 19	6·98
3 20	1 10 47	10·22	40 45 46	6·32
3 40	1 15 36	10·91	40 40 52	5·62
4 0	1 19 49	11·50	40 35 40	4·87
4 20	1 23 25	12·00	40 30 14	4·08
4 40	1 26 22	12·41	40 24 32	3·27
5 0	1 28 39	12·72	40 18 43	2·43
5 20	1 30 15	12·93	40 12 43	1·57
Elong.	1 31 23	13·06	40 1 45	0·17
	h m s	*s*		
Elong. at	5 56 5	− 0·56		
	° ′ ″	″		
6 40	1 29 43	+12·78	39 48 26	− 1·90
7 0	1 27 52	12·50	39 42 30	2·75
7 20	1 25 22	12·12	39 36 42	3·57
7 40	1 22 13	11·66	39 31 7	4·37
8 0	1 18 28	11·11	39 25 45	5·13
8 20	1 14 8	10·49	39 20 39	5·85
8 40	1 9 14	9·78	39 15 51	6·53
9 0	1 3 51	9·01	39 11 23	7·15
9 15	0 59 29	8·39	39 8 18	7·59
9 30	0 54 53	7·74	39 5 26	8·00
9 45	0 50 4	7·05	39 2 50	8·37
10 0	0 45 2	6·34	39 0 26	8·70
10 15	0 39 49	5·60	38 58 18	9·00
10 30	0 34 26	4·84	38 56 26	9·26
10 45	0 28 55	4·06	38 54 52	9·49
11 0	0 23 16	3·27	38 53 32	9·67
11 15	0 17 32	2·46	38 52 32	9·81
11 30	0 11 44	1·65	38 51 48	9·92
11 45	0 5 53	0·83	38 51 20	9·98

TABLE LIV.—Elements of Circumpolar Stars for 1st January 1910.

Number	Star's Name	Magnitude	Mean Right Ascension Jan. 1, 1910	Annual Precession in Right Ascension	Secular Variation of Precession in Right Ascension	$\frac{d^2\alpha}{dt^2}$	Annual Proper Motion in Right Ascension	Mean Declination Jan. 1, 1910	Annual Precession in Declination	Secular Variation of Precession in Declination	$\frac{d^2\delta}{dt^2}$	Annual Proper Motion in Declination
			h m s	*s*	*s*	*s*	*s*	° ′ ″	″	″	″	″
1	Bradley 48	6·3	0 32 55·81	+ 4·434	+ 0·400	+ 8	−0·053	81 59 48·93	+19·839	−0·101	− 3	+0·09
2	Bradley 74	5·5	0 46 23·07	+ 5·332	+ 0·608	+ 14	+0·028	83 13 8·60	+19·637	−0·163	− 5	−0·02
3	43 H. Cephei	4·5	0 56 16·13	+ 7·469	+ 1·512	+ 56	+0·071	85 46 29·29	+19·445	−0·271	− 11	0·00
4	1 B. Urs. Min.	6·5	0 58 16·00	+16·275	+10·849	+1166	+0·171	88 32 29·95	+19·402	−0·600	− 66	−0·02
5	Bradley 95	7·5	1 0 36·92	+ 9·071	+ 2·441	+ 113	+0·055	86 40 0·41	+19·349	−0·357	− 18	−0·02
6	α URS. MIN. (*Polaris*)	2·1	1 26 56 *	...	...	...	...	88 49 34 *	...	...	...	...
7	Piazzi II. 60	8·4	2 24 24·44	+ 8·187	+ 0·684	+ 8	...	81 14 48·23	+16·197	−0·707	− 12	...
8	Bradley 396	6·0	2 57 40·92	+ 9·062	+ 0·675	+ 5	−0·023	81 7 25·97	+14·317	−0·933	− 13	0·00
9	Bradley 402	5·9	3 10 49·13	+13·520	+ 1·660	+ 16	+0·044	84 35 41·49	+13·490	−1·466	− 31	−0·12
10	Groom. 642	5·8	3 37 16·58	+20·161	+ 3·328	+ 21	+0·165	86 21 54·75	+11·692	−2·389	− 64	−0·06
11	Groom. 766	5·4	4 7 13·91	+13·559	+ 0·987	− 6	...	83 35 28·19	+ 9·470	−1·745	− 22	...
12	151 H¹. Cephei	6·7	4 7 59·67	+17·480	+ 1·778	− 13	+0·012	85 19 4·72	+ 9·411	−2·254	− 38	+0·04
13	Groom. 774	5·8	4 10 7·42	+12·909	+ 0·850	− 6	−0·039	83 7 34·63	+ 9·247	−1·673	− 19	+0·10
14	Groom. 856	5·5	4 43 28·06	+11·086	+ 0·391	− 7	...	81 2 47·58	+ 6·570	−1·528	− 10	...
15	Lalande F. 693	6·4	4 59 45·67	+20·836	+ 1·334	− 62	...	85 50 41·04	+ 5·208	−2·937	− 30	...
16	158 H¹. Cephei	6·4	5 33 1·50	+18·727	+ 0·460	− 52	+0·013	85 9 14·48	+ 2·354	−2·713	− 11	0·00
17	Groom. 1004	7·0	6 12 29·17	+26·629	− 0·460	− 165	...	86 45 28·30	− 1·092	−3·877	+ 11	...
18	CEPHEI 51 (HEV.)	5·2	6 58 39 *	...	...	...	...	87 11 31 *	...	...	...	...
19	Piazzi VI. 285	6·3	7 8 19·89	+11·542	− 0·383	− 8	...	81 25 23·84	− 5·889	−1·607	+ 10	...
20	25 H. Camelop	5·3	7 12 12·46	+12·839	− 0·528	− 11	+0·014	82 35 14·36	− 6·212	−1·778	+ 13	−0·05
21	Piazzi VI. 334	7·0	7 18 18·51	+11·096	− 0·401	− 7	...	81 4 52·76	− 6·717	−1·523	+ 10	...
22	Groom., 1359	6·5	7 55 30·99	+14·839	− 1·268	− 6	...	84 19 14·39	− 9·682	−1·886	+ 28	...
23	Groom. 1391	6·5	8 7 12·38	+11·953	− 0·841	− 2	...	82 42 42·04	−10·564	−1·478	+ 19	...
24	B.A.C. 2320 (Grom. 1119)	7·0	8 8 41 *	...	...	...	...	88 54 17 *	...	...	...	...
25	Groom. 1418	7·5	8 28 4·58	+16·263	− 2·140	+ 13	...	85 22 30·42	−12·069	−1·889	+ 42	...
26	Groom. 1431	7·0	8 30 11·85	+11·185	− 0·883	+ 3	...	82 33 33·07	−12·217	−1·289	+ 18	...
27	Lalande F. 1347	7·0	8 46 24·57	+11·319	− 1·049	+ 7	...	83 5 24·81	−13·310	−1·232	+ 21	...
28	Radcliffe 2218	6·2	8 56 44·04	+13·107	− 1·650	+ 19	...	84 32 39·23	−13·971	−1·362	+ 30	...
29	Groom. 1480	6·7	8 57 50·13	+ 9·228	− 0·683	+ 4	...	81 11 26·70	−14·040	−0·953	+ 13	...
30	1 H. Draconis	4·5	9 24 20·03	+ 8·845	− 0·767	+ 8	−0·006	81 43 31·07	−15·597	−0·806	+ 14	−0·03
31	29 H. Camelop.	5·6	10 16 42·62	+ 9·360	− 1·482	+ 37	−0·093	84 42 36·38	−18·044	−0·584	+ 18	−0·05
32	30 H. Camelop.	5·3	10 20 11·64	+ 7·675	− 0·889	+ 17	−0·047	83 1 1·34	−18·175	−0·466	+ 11	+0·01
33	Bradley 1439	6·2	10 26 48·60	+ 6·394	− 0·549	+ 8	−0·006	80 57 32·15	−18·412	−0·360	+ 7	0·00
34	Bradley 1458	6·2	10 34 39·38	+ 6·107	− 0·519	+ 8	+0·011	80 53 49·59	−18·672	−0·314	+ 6	+0·01
35	Groom. 1782	6·1	11 25 31·61	+ 4·432	− 0·376	+ 7	−0·069	81 37 22·30	−19·820	−0·087	+ 3	+0·03
36	Groom. 1845	6·2	11 55 38·49	+ 3·240	− 0·214	+ 4	...	81 21 19·33	−20·042	0·000	+ 1	...
37	Groom. 1850	5·7	12 0 13·24	+ 3·054	− 0·429	+ 19	−0·056	86 5 9·07	−20·046	+0·009	+ 1	+0·08
38	Groom. 1858	6·3	12 6 58·26	+ 2·775	− 0·173	+ 4	−0·019	82 12 38·00	−20·037	+0·021	+ 1	+0·03
39	Bradley 1656	6·3	12 14 14·49	+ 1·522	− 0·001	+ 2	+0·276	86 56 9·17	−20·007	+0·022	0	−0·02
40	B.A.C. 4165 (Brad. 1672)	6·3	12 14 26 *	...	...	...	...	88 11 56 *	...	...	...	...

* *See* Nautical Almanac.

TABLE LIV.—Elements of Circumpolar Stars for 1st January 1910.

Number	Star's Name	Magnitude	Mean Right Ascension Jan. 1, 1910	Annual Precession in Right Ascension	Secular Variation of Precession in Right Ascension	$\frac{d^3\alpha}{dt^3}$	Annual Proper Motion in Right Ascension	Mean Declination Jan. 1, 1910	Annual Precession in Declination	Secular Variation of Precession in Declination	$\frac{d^3\delta}{dt^3}$	Annual Proper Motion in Declination
			h m s	s	s	s	s	° ′ ″	″	″	″	″
41	Groom. 1892	6·0	12 21 3·29	+ 1·920	− 0·067	+ 2	+0·003	83 55 37·55	−19·961	+0·034	0	−0·04
42	Groom. 1923	6·0	12 37 58·14	+ 0·926	+ 0·119	− 3	−0·002	84 8 15·74	−19·771	+0·031	0	+0·02
43	Groom. 1927	6·0	12 42 8·38	+ 1·510	+ 0·007	0	+0·023	81 6 52·93	−19·708	+0·049	0	−0·01
44	Bradley 1730	5·4	12 48 20·04	+ 0·452	− 0·196	− 5	−0·017	83 54 25·72	−19·602	+0·022	+ 1	+0·02
45	32³ H. Camelop	5·2	12 48 27·37	+ 0·447	+ 0·195	− 5	−0·019	83 54 7·55	−19·600	+0·023	+ 1	+0·02
46	Groom. 2006	8·0	13 3 6·92	− 8·076	+ 5·515	− 464	...	88 7 58·93	−19·291	−0·311	+ 28	...
47	Groom. 1977	6·3	13 11 36·53	+ 0·494	+ 0·129	− 2	...	80 56 50·97	−19·075	+0·030	+ 1	...
48	Groom. 2007	7·0	13 18 14·47	− 2·234	+ 0·843	− 27	−0·110	85 13 29·54	−18·889	−0·102	+ 5	+0·03
49	Piaz. XIII. 263	6·3	13 44 51·07	− 1·881	+ 0·510	− 11	...	83 12 15·88	−17·984	−0·114	+ 4	...
50	Groom. 2071	6·8	13 52 17·41	− 0·995	+ 0·289	− 5	+0·025	81 12 38·76	−17·688	−0·060	+ 2	−0·01
51	Groom. 2210	6·8	14 47 49·42	−10·826	+ 2·794	− 75	...	86 19 18·25	−14·907	−1·051	+ 37	...
52	Groom. 2196	5·8	14 56 20·21	− 4·373	+ 0·672	− 9	+0·091	82 52 55·73	−14·399	−0·436	+ 8	−0·24
53	Groom. 2213	7·5	15 0 36·12	− 6·416	+ 1·104	− 18	...	84 17 52·15	−14·137	−0·660	+ 15	...
54	B.A.C. 5140 (Groom. 2283)	7·1	15 5 59 *	...	...	...	...	87 34 47 *	...	...	...	...
55	LalandeF.2690	6·8	15 35 19·03	− 3·794	+ 0·400	− 3	...	81 4 16·83	−11·831	−0·440	+ 6	...
56	ε Urs. Min.	4·4	16 55 9 *	...	...	...	...	82 11 12 *	...	...	...	...
57	δ Urs. Min.	4·4	18 1 18 *	...	...	...	...	86 36 51 *	...	...	...	...
58	24 Urs. Min.	5·9	18 4 4·82	−22·386	− 0·142	+ 144	+0·069	86 59 44·02	+ 0·357	−3·264	− 3	+0·01
59	Bradley 2412	6·2	18 36 3·93	− 7·851	− 0·232	+ 8	+0·022	83 6 37·09	+ 3·142	−1·132	− 4	−0·03
60	LalandeF.3178	7·0	18 44 36·11	−18·939	− 1·294	+ 78	...	86 35 27·97	+ 3·877	−2·709	− 26	...
61	LalandeF.3177	6·5	19 2 33·65	− 8·745	− 0·494	+ 8	...	83 47 5·87	+ 5·404	−1·229	− 9	...
62	LalandeF.3154	6·9	19 3 37·54	− 6·362	− 0·308	+ 3	...	82 14 31·99	+ 5·494	−0·893	− 5	...
63	λ Urs. Min.	6·6	19 10 58 *	...	...	...	...	89 0 22 *	...	...	...	...
64	LalandeF.3268	6·3	19 26 42·79	− 7·482	− 0·550	+ 2	...	83 17 21·16	+ 7·405	−1·016	− 10	...
65	Cephei 24	Var.	19 49 51·71	−56·119	−25·801	+ 292	...	88 51 8·49	+ 9·246	−7·261	−488	...
66	Groom. 3212	6·7	20 12 36·90	− 8·355	− 1·075	− 7	...	84 24 29·54	+10·963	−1·022	− 17	...
67	75 Draconis	5·6	20 33 55·56	− 3·620	− 0·401	− 3	+0·009	81 6 54·74	+12·474	−0·418	− 5	−0·01
68	LalandeF.3616-7	6·2	20 38 8·40	− 5·721	− 0·767	− 8	...	83 18 52·70	+12·760	−0·650	− 11	...
69	76 Draconis	5·7	20 49 9·54	− 4·143	− 0·544	− 6	+0·013	82 11 55·37	+13·489	−0·454	− 7	+0·03
70	B.A.C. 7504 (Groom. 3548)	7·4	21 17 38 *	...	...	...	...	86 39 58 *	...	...	...	...
71	Bradley 2935	7·5	22 1 29·47	− 1·903	− 0·441	− 8	−0·071	82 26 12·83	+17·425	−0·147	− 4	−0·03
72	Groom. 3709	8·0	22 1 36·53	− 1·900	− 0·438	− 8	−0·064	82 26 17·47	+17·430	−0·143	− 3	+0·01
73	Bradley 2993	5·4	22 20 36·12	− 4·320	− 1·354	− 45	+0·053	85 39 19·82	+18·190	−0·270	− 10	+0·04
74	Bradley 2997	6·5	22 20 57·76	− 4·494	− 1·438	− 49	+0·025	85 46 10·75	+18·203	−0·282	− 11	+0·01
75	Bradley 3038	4·8	22 47 51·55	− 0·147	− 0·242	− 5	+0·006	82 40 34·89	+19·061	−0·014	− 1	+0·04
76	Bradley 3058	5·0	22 55 9·39	− 0·398	− 0·337	− 9	+0·060	83 51 52·52	+19·249	−0·025	− 1	+0·01
77	B.A.C. 8213 (Brad. 3147)	5·6	23 27 46 *	...	...	...	...	86 48 40 *	...	...	...	...
78	Bradley 3187	6·3	23 52 12·90	+ 2·719	+ 0·179	+ 4	+0·024	82 41 23·99	+20·034	+0·005	− 1	0·00
79	Bradley 3194	8·0	23 55 12·78	+ 2·652	+ 0·323	+ 14	+0·022	86 12 18·93	+20·042	0·000	− 1	−0·03
80	Bradley 3203	7·0	23 58 3·92	+ 2·987	+ 0·215	+ 5	−0·014	82 28 19·20	+20·045	−0·005	− 1	−0·01

* *See* Nautical Almanac.

TABLE LV.—Values of $\frac{2 \operatorname{Sin}^2 \frac{1}{2} t}{\operatorname{Sin} 1''}$ for the Reduction of Circum-meridian Observations for Latitude.

Seconds	Hour Angles in Time																		
	0m	1m	2m	3m	4m	5m	6m	7m	8m	9m	10m	11m	12m	13m	14m	15m	16m	17m	18m	19m
0	0	2	8	18	31	49	71	96	126	159	196	238	283	332	385	442	502	567	636	708
1	0	2	8	18	32	49	71	97	126	160	197	238	283	333	386	443	504	568	637	710
2	0	2	8	18	32	50	71	97	127	160	198	239	284	333	387	444	505	569	638	711
3	0	2	8	18	32	50	72	98	127	161	198	240	285	334	387	445	506	571	639	712
4	0	2	8	18	32	50	72	98	128	161	199	240	286	335	388	446	507	572	641	713
5	0	2	9	19	33	51	73	99	128	162	200	241	287	336	389	447	508	573	642	715
6	0	2	9	19	33	51	73	99	129	163	200	242	287	337	390	448	509	574	643	716
7	0	2	9	19	33	51	73	99	129	163	201	243	288	338	391	449	510	575	644	717
8	0	3	9	19	34	52	74	100	130	164	202	243	289	339	392	450	511	576	645	718
9	0	3	9	19	34	52	74	100	130	164	202	244	290	339	393	451	512	577	646	720
10	0	3	9	20	34	52	75	101	131	165	203	245	291	340	394	452	513	578	648	721
11	0	3	9	20	34	53	75	101	131	166	204	246	291	341	395	452	514	579	649	722
12	0	3	10	20	35	53	75	102	132	166	204	246	292	342	396	453	515	581	650	723
13	0	3	10	20	35	53	76	102	133	167	205	247	293	343	397	454	516	582	651	725
14	0	3	10	21	35	54	76	103	133	167	206	248	294	344	398	455	517	583	652	726
15	0	3	10	21	35	54	77	103	134	168	206	248	295	345	399	456	518	584	654	727
16	0	3	10	21	36	54	77	104	134	169	207	249	295	345	400	457	519	585	655	728
17	0	3	10	21	36	55	78	104	135	169	208	250	296	346	400	458	520	586	656	730
18	0	3	10	21	36	55	78	105	135	170	208	251	297	347	401	459	521	587	657	731
19	0	3	11	22	37	55	78	105	136	170	209	251	298	348	402	460	523	589	658	732
20	0	3	11	22	37	56	79	106	136	171	210	252	299	349	403	461	524	590	660	733
21	0	4	11	22	37	56	79	106	137	172	210	253	299	350	404	462	525	591	661	735
22	0	4	11	22	37	57	80	107	137	172	211	254	300	351	405	463	526	592	662	736
23	0	4	11	22	38	57	80	107	138	173	212	254	301	352	406	464	527	593	663	737
24	0	4	11	23	38	57	80	108	139	173	212	255	302	352	407	465	528	594	664	739
25	0	4	11	23	38	58	81	108	139	174	213	256	303	353	408	466	529	595	666	740
26	0	4	12	23	39	58	81	108	140	175	214	257	303	354	409	468	530	596	667	741
27	0	4	12	23	39	58	82	109	140	175	214	257	304	355	410	469	531	598	668	742
28	0	4	12	24	39	59	82	109	141	176	215	258	305	356	411	470	532	599	669	744
29	0	4	12	24	39	59	83	110	141	177	216	259	306	357	412	471	533	600	670	745
30	0	4	12	24	40	59	83	110	142	177	216	260	307	358	413	472	534	601	672	746
31	1	5	12	24	40	60	83	111	142	178	217	260	308	359	414	473	535	602	673	747
32	1	5	13	25	40	60	84	111	143	178	218	261	308	360	415	474	537	603	674	749
33	1	5	13	25	41	60	84	112	144	179	219	262	309	360	416	475	538	604	675	750
34	1	5	13	25	41	61	85	112	144	180	219	263	310	361	416	476	539	606	676	751
35	1	5	13	25	41	61	85	113	145	180	220	263	311	362	417	477	540	607	678	753
36	1	5	13	25	42	62	86	113	145	181	221	264	312	363	418	478	541	608	679	754
37	1	5	13	26	42	62	86	114	146	182	221	265	312	364	419	479	542	609	680	755
38	1	5	14	26	42	62	86	114	146	182	222	266	313	365	420	480	543	610	681	756
39	1	5	14	26	42	63	87	115	147	183	223	266	314	366	421	481	544	611	683	758
40	1	5	14	26	43	63	87	115	147	183	223	267	315	367	422	482	545	613	684	759
41	1	6	14	27	43	63	88	116	148	184	224	268	316	368	423	483	546	614	685	760
42	1	6	14	27	43	64	88	116	149	185	225	269	317	368	424	484	547	615	686	762
43	1	6	14	27	44	64	89	117	149	185	225	269	317	369	425	485	548	616	687	763
44	1	6	15	27	44	65	89	117	150	186	226	270	318	370	426	486	550	617	689	764
45	1	6	15	28	44	65	89	118	150	187	227	271	319	371	427	487	551	618	690	765
46	1	6	15	28	45	65	90	118	151	187	228	272	320	372	428	488	552	619	691	767
47	1	6	15	28	45	66	90	119	151	188	228	273	321	373	429	489	553	621	692	768
48	1	6	15	28	45	66	91	119	152	189	229	273	322	374	430	490	554	622	694	769
49	1	6	16	29	46	66	91	120	153	189	230	274	322	375	431	491	555	623	695	771
50	1	7	16	29	46	67	92	120	153	190	230	275	323	376	432	492	556	624	696	772
51	1	7	16	29	46	67	92	121	154	190	231	276	324	377	433	493	557	625	697	773
52	1	7	16	29	47	68	93	121	154	191	232	276	325	377	434	494	558	626	699	774
53	2	7	16	30	47	68	93	122	155	192	233	277	326	378	435	495	559	628	700	776
54	2	7	17	30	47	68	93	123	156	192	233	278	327	379	436	496	561	629	701	777
55	2	7	17	30	47	69	94	123	156	193	234	279	328	380	437	497	562	630	702	778
56	2	7	17	30	48	69	94	124	157	194	235	280	328	381	438	498	563	631	703	780
57	2	7	17	31	48	70	95	124	157	194	235	280	329	382	439	499	564	632	705	781
58	2	8	17	31	48	70	95	125	158	195	236	281	330	383	440	500	565	634	706	782
59	2	8	17	31	49	70	96	125	158	196	237	282	331	384	441	501	566	635	707	784

TABLE LVI.—Factors for Bessel's Probable Error Formulæ.

n	$\frac{0\cdot6745}{\sqrt{(n-1)}}$	$\frac{0\cdot6745}{\sqrt{n(n-1)}}$	n	$\frac{0\cdot6745}{\sqrt{(n-1)}}$	$\frac{0\cdot6745}{\sqrt{n(n-1)}}$
			51	0·0954	0·0134
2	0·6745	0·4769	52	·0944	·0131
3	·4769	·2754	53	·0935	·0128
4	·3894	·1947	54	·0926	·0126
5	·3372	·1508	55	·0918	·0124
6	0·3016	0·1231	56	0·0909	0·0122
7	·2754	·1041	57	·0901	·0119
8	·2549	·0901	58	·0893	·0117
9	·2385	·0795	59	·0886	·0115
10	·2248	·0711	60	·0878	·0113
11	0·2133	0·0643	61	0·0871	0·0111
12	·2034	·0587	62	·0864	·0110
13	·1947	·0540	63	·0857	·0108
14	·1871	·0500	64	·0850	·0106
15	·1803	·0465	65	·0843	·0105
16	0·1742	0·0435	66	0·0837	0·0103
17	·1686	·0409	67	·0830	·0101
18	·1636	·0386	68	·0824	·0100
19	·1590	·0365	69	·0818	·0098
20	·1547	·0346	70	·0812	·0097
21	0·1508	0·0329	71	0·0806	0·0096
22	·1472	·0314	72	·0800	·0094
23	·1438	·0300	73	·0795	·0093
24	·1406	·0287	74	·0789	·0092
25	·1377	·0275	75	·0784	·0091
26	0·1349	0·0265	76	0·0779	0·0089
27	·1323	·0255	77	·0774	·0088
28	·1298	·0245	78	·0769	·0087
29	·1275	·0237	79	·0764	·0086
30	·1253	·0229	80	·0759	·0085
31	0·1231	0·0221	81	0·0754	0·0084
32	·1211	·0214	82	·0749	·0083
33	·1192	·0208	83	·0745	·0082
34	·1174	·0201	84	·0740	·0081
35	·1157	·0196	85	·0736	·0080
36	0·1140	0·0190	86	0·0732	0·0079
37	·1124	·0185	87	·0727	·0078
38	·1109	·0180	88	·0723	·0077
39	·1094	·0175	89	·0719	·0076
40	·1080	·0171	90	·0715	·0075
41	0·1066	0·0167	91	0·0711	0·0075
42	·1053	·0163	92	·0707	·0074
43	·1041	·0159	93	·0703	·0073
44	·1029	·0155	94	·0699	·0072
45	·1017	·0152	95	·0696	·0071
46	0·1005	0·0148	96	0·0692	0·0071
47	·0994	·0145	97	·0688	·0070
48	·0984	·0142	98	·0685	·0069
49	·0974	·0139	99	·0681	·0068
50	·0964	·0136	100	·0678	·0068

TABLE LVII.—Quadrilateral Surfaces of 15′ in Latitude and in Longitude on the Terrestrial Ellipsoid.

Latitude	Area in Square Miles	Latitude	Area in Square Miles	Latitude	Area in Square Miles
° ′ ° ′		° ′ ° ′		° ′ ° ′	
0 0 to 0 15	296·973	14 0 to 14 15	288·223	27 0 to 27 15	265·042
0 15 „ 0 30	296·967	14 15 „ 14 30	287·912	27 15 „ 27 30	264·459
0 30 „ 0 45	296·957	14 30 „ 14 45	287·595	27 30 „ 27 45	263·872
0 45 „ 1 0	296·940	14 45 „ 15 0	287·273	27 45 „ 28 0	263·279
1 0 „ 1 15	296·918	15 0 „ 15 15	286·946	28 0 „ 28 15	262·682
1 15 „ 1 30	296·891	15 15 „ 15 30	286·613	28 15 „ 28 30	262·079
1 30 „ 1 45	296·857	15 30 „ 15 45	286·275	28 30 „ 28 45	261·472
1 45 „ 2 0	296·819	15 45 „ 16 0	285·932	28 45 „ 29 0	260·860
2 0 „ 2 15	296·775	16 0 „ 16 15	285·583	29 0 „ 29 15	260·242
2 15 „ 2 30	296·725	16 15 „ 16 30	285·229	29 15 „ 29 30	259·620
2 30 „ 2 45	296·671	16 30 „ 16 45	284·869	29 30 „ 29 45	258·993
2 45 „ 3 0	296·610	16 45 „ 17 0	284·504	29 45 „ 30 0	258·361
3 0 „ 3 15	296·544	17 0 „ 17 15	284·135	30 0 „ 30 15	257·723
3 15 „ 3 30	296·472	17 15 „ 17 30	283·759	30 15 „ 30 30	257·081
3 30 „ 3 45	296·396	17 30 „ 17 45	283·379	30 30 „ 30 45	256·435
3 45 „ 4 0	296·313	17 45 „ 18 0	282·992	30 45 „ 31 0	255·783
4 0 „ 4 15	296·225	18 0 „ 18 15	282·601	31 0 „ 31 15	255·126
4 15 „ 4 30	296·132	18 15 „ 18 30	282·205	31 15 „ 31 30	254·465
4 30 „ 4 45	296·032	18 30 „ 18 45	281·802	31 30 „ 31 45	253·798
4 45 „ 5 0	295·928	18 45 „ 19 0	281·396	31 45 „ 32 0	253·127
5 0 „ 5 15	295·818	19 0 „ 19 15	280·983	32 0 „ 32 15	252·451
5 15 „ 5 30	295·702	19 15 „ 19 30	280·566	32 15 „ 32 30	251·770
5 30 „ 5 45	295·582	19 30 „ 19 45	280·142	32 30 „ 32 45	251·084
5 45 „ 6 0	295·455	19 45 „ 20 0	279·714	32 45 „ 33 0	250·394
6 0 „ 6 15	295·323	20 0 „ 20 15	279·281	33 0 „ 33 15	249·699
6 15 „ 6 30	295·186	20 15 „ 20 30	278·842	33 15 „ 33 30	248·999
6 30 „ 6 45	295·043	20 30 „ 20 45	278·398	33 30 „ 33 45	248·294
6 45 „ 7 0	294·894	20 45 „ 21 0	277·949	33 45 „ 34 0	247·584
7 0 „ 7 15	294·741	21 0 „ 21 15	277·494	34 0 „ 34 15	246·870
7 15 „ 7 30	294·581	21 15 „ 21 30	277·035	34 15 „ 34 30	246·151
7 30 „ 7 45	294·417	21 30 „ 21 45	276·570	34 30 „ 34 45	245·427
7 45 „ 8 0	294·247	21 45 „ 22 0	276·100	34 45 „ 35 0	244·699
8 0 „ 8 15	294·071	22 0 „ 22 15	275·625	35 0 „ 35 15	243·965
8 15 „ 8 30	293·890	22 15 „ 22 30	275·144	35 15 „ 35 30	243·228
8 30 „ 8 45	293·703	22 30 „ 22 45	274·659	35 30 „ 35 45	242·485
8 45 „ 9 0	293·511	22 45 „ 23 0	274·168	35 45 „ 36 0	241·738
9 0 „ 9 15	293·313	23 0 „ 23 15	273·672	36 0 „ 36 15	240·986
9 15 „ 9 30	293·110	23 15 „ 23 30	273·171	36 15 „ 36 30	240·230
9 30 „ 9 45	292·902	23 30 „ 23 45	272·665	36 30 „ 36 45	239·468
9 45 „ 10 0	292·688	23 45 „ 24 0	272·153	36 45 „ 37 0	238·703
10 0 „ 10 15	292·469	24 0 „ 24 15	271·637	37 0 „ 37 15	237·933
10 15 „ 10 30	292·244	24 15 „ 24 30	271·116	37 15 „ 37 30	237·158
10 30 „ 10 45	292·014	24 30 „ 24 45	270·589	37 30 „ 37 45	236·378
10 45 „ 11 0	291·778	24 45 „ 25 0	270·057	37 45 „ 38 0	235·594
11 0 „ 11 15	291·537	25 0 „ 25 15	269·520	38 0 „ 38 15	234·806
11 15 „ 11 30	291·291	25 15 „ 25 30	268·978	38 15 „ 38 30	234·013
11 30 „ 11 45	291·039	25 30 „ 25 45	268·431	38 30 „ 38 45	233·215
11 45 „ 12 0	290·782	25 45 „ 26 0	267·878	38 45 „ 39 0	232·413
12 0 „ 12 15	290·519	26 0 „ 26 15	267·321	39 0 „ 39 15	231·606
12 15 „ 12 30	290·251	26 15 „ 26 30	266·759	39 15 „ 39 30	230·795
12 30 „ 12 45	289·977	26 30 „ 26 45	266·192	39 30 „ 39 45	229·980
12 45 „ 13 0	289·699	26 45 „ 27 0	265·619	39 45 „ 40 0	229·160
13 0 „ 13 15	289·414				
13 15 „ 13 30	289·124				
13 30 „ 13 45	288·829				
13 45 „ 14 0	288·529				

TABLE LVIII.—Semi-diurnal and Semi-nocturnal Arcs, showing the time of the rising and setting of the Sun, Moon, or Equatorial Stars.

Latitude	Declination 0°	2°	4°	6°	8°	10°	12°	14°	16°	18°	20°	22°	23°	23° 27′	Latitude
°	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	h m	°
1	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	6 2	1
2	6 0	6 0	6 1	6 1	6 1	6 2	6 2	6 2	6 2	6 3	6 3	6 3	6 3	6 3	2
3	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	6 5	3
4	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	6 7	4
5	6 0	6 1	6 1	6 2	6 3	6 4	6 4	6 5	6 6	6 7	6 7	6 8	6 9	6 9	5
6	6 0	6 1	6 2	6 3	6 3	6 4	6 5	6 6	6 7	6 8	6 9	6 10	6 10	6 10	6
7	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	6 12	7
8	6 0	6 1	6 2	6 3	6 5	6 6	6 7	6 8	6 8	6 10	6 12	6 13	6 14	6 14	8
9	6 0	6 1	6 3	6 4	6 5	6 6	6 8	6 9	6 10	6 12	6 13	6 15	6 15	6 16	9
10	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 17	6 18	10
11	6 0	6 2	6 3	6 5	6 6	6 8	6 9	6 11	6 13	6 14	6 16	6 18	6 19	6 19	11
12	6 0	6 2	6 3	6 5	6 7	6 9	6 10	6 12	6 14	6 16	6 18	6 20	6 21	6 21	12
13	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 22	6 23	13
14	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 24	6 25	14
15	6 0	6 2	6 4	6 6	6 9	6 11	6 13	6 15	6 18	6 20	6 22	6 25	6 26	6 27	15
16	6 0	6 2	6 5	6 7	6 9	6 12	6 14	6 16	6 19	6 21	6 24	6 27	6 28	6 29	16
17	6 0	6 2	6 5	6 7	6 10	6 12	6 15	6 17	6 20	6 23	6 26	6 28	6 30	6 31	17
18	6 0	6 3	6 5	6 8	6 10	6 13	6 16	6 19	6 21	6 24	6 27	6 30	6 32	6 32	18
19	6 0	6 3	6 6	6 8	6 11	6 14	6 17	6 20	6 23	6 26	6 29	6 32	6 34	6 34	19
20	6 0	6 3	6 6	6 9	6 12	6 15	6 18	6 21	6 24	6 27	6 30	6 34	6 36	6 36	20
21	6 0	6 3	6 6	6 9	6 12	6 16	6 19	6 22	6 25	6 29	6 32	6 36	6 38	6 38	21
22	6 0	6 3	6 6	6 10	6 13	6 16	6 20	6 23	6 27	6 30	6 34	6 38	6 40	6 40	22
23	6 0	6 3	6 7	6 10	6 14	6 17	6 21	6 24	6 28	6 32	6 36	6 39	6 42	6 42	23
24	6 0	6 4	6 7	6 11	6 14	6 18	6 22	6 25	6 29	6 33	6 37	6 41	6 44	6 45	24
25	6 0	6 4	6 7	6 11	6 15	6 19	6 23	6 27	6 31	6 35	6 39	6 43	6 46	6 47	25
26	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 48	6 49	26
27	6 0	6 4	6 8	6 12	6 16	6 21	6 25	6 29	6 34	6 38	6 43	6 48	6 50	6 51	27
28	6 0	6 4	6 9	6 13	6 17	6 22	6 26	6 30	6 35	6 40	6 45	6 50	6 52	6 53	28
29	6 0	6 4	6 9	6 13	6 18	6 22	6 27	6 32	6 37	6 42	6 47	6 52	6 54	6 56	29
30	6 0	6 5	6 9	6 14	6 19	6 23	6 28	6 33	6 38	6 43	6 49	6 54	6 57	6 58	30
31	6 0	6 5	6 10	6 14	6 19	6 24	6 29	6 34	6 40	6 45	6 51	6 56	6 59	7 0	31
32	6 0	6 5	6 10	6 15	6 20	6 25	6 31	6 36	6 41	6 47	6 53	6 58	7 2	7 3	32
33	6 0	6 5	6 10	6 16	6 21	6 26	6 32	6 37	6 43	6 49	6 55	7 1	7 4	7 5	33
34	6 0	6 5	6 11	6 16	6 22	6 27	6 33	6 39	6 45	6 51	6 57	7 3	7 7	7 8	34
35	6 0	6 6	6 11	6 17	6 23	6 28	6 34	6 40	6 46	6 53	6 59	7 6	7 9	7 11	35
36	6 0	6 6	6 12	6 18	6 23	6 29	6 36	6 42	6 48	6 55	7 1	7 8	7 12	7 14	36
37	6 0	6 6	6 12	6 18	6 24	6 31	6 37	6 43	6 50	6 57	7 4	7 11	7 15	7 16	37
38	6 0	6 6	6 13	6 19	6 25	6 32	6 38	6 45	6 52	6 59	7 6	7 14	7 17	7 19	38
39	6 0	6 6	6 13	6 20	6 26	6 33	6 40	6 47	6 54	7 1	7 9	7 16	7 20	7 22	39
40	6 0	6 7	6 13	6 20	6 27	6 34	6 41	6 48	6 56	7 3	7 11	7 19	7 23	7 25	40
Dates corresponding to Sun's Declination	Sep. 23, Mar. 20	" 23, " 15	Oct. 3, " 10	" 8, " 5	" 13, Feb. 28	" 19, " 22	" 25, " 17	" 31, " 11	Nov. 6, " 5	" 13, Jan. 29	" 21, " 20	Dec. 2, " 10	" 11, " 1	December 22	S. Declination
	Sep. 23, Mar. 20	" 18, " 25	" 12, " 30	" 7, Apr. 5	" 2, " 10	Aug. 27, " 16	" 21, " 21	" 15, " 27	" 8, May 4	" 1, " 11	July 23, " 20	" 12, " 31	" 3, June 10	June 22	N. Declination

TABLE LIX.—Corrections for reducing Apparent to Mean Solar Time.

Day of Month	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
	m	m	m	m	m	m	m	m	m	m	m	m
1	+ 4	+ 14	+ 13	+ 4	− 3	− 2	+ 3	+ 6	− 0	− 10	− 16	− 11
2	4	14	12	4	3	2	4	6	0	10	16	11
3	4	14	12	3	3	2	4	6	1	11	16	10
4	5	14	12	3	3	2	4	6	1	11	16	10
5	5	14	12	3	3	2	4	6	1	11	16	9
6	6	14	12	3	3	2	4	6	2	12	16	9
7	6	14	11	2	4	1	5	6	2	12	16	9
8	7	14	11	2	4	1	5	6	2	12	16	8
9	7	14	11	2	4	1	5	5	3	13	16	8
10	8	14	11	1	4	1	5	5	3	13	16	7
11	8	14	10	1	4	1	5	5	3	13	16	7
12	8	14	10	1	4	1	5	5	4	13	16	6
13	9	14	10	1	4	0	5	5	4	14	16	6
14	9	14	9	0	4	0	6	5	4	14	16	5
15	9	14	9	0	4	0	6	4	5	14	15	5
16	10	14	9	0	4	0	6	4	5	14	15	4
17	10	14	9	0	4	+ 1	6	4	5	14	15	4
18	10	14	8	− 1	4	1	6	4	6	15	15	3
19	11	14	8	1	4	1	6	4	6	15	15	3
20	11	14	8	1	4	1	6	3	6	15	14	2
21	11	14	7	1	4	1	6	3	7	15	14	2
22	12	14	7	1	4	2	6	3	7	15	14	1
23	12	14	7	2	3	2	6	3	7	16	14	1
24	12	13	7	2	3	2	6	2	8	16	13	0
25	12	13	6	2	3	2	6	2	8	16	13	0
26	13	13	6	2	3	2	6	2	9	16	13	+ 1
27	13	13	6	2	3	3	6	2	9	16	12	1
28	13	13	5	3	3	3	6	1	9	16	12	1
29	13	13	5	3	3	3	6	1	10	16	12	2
30	13	...	5	3	3	3	6	1	10	16	11	2
31	14	...	4	...	3	...	6	0	...	16	...	3

TABLE LX.—Showing Links to be subtracted from each Chain, in an ascending or descending line, in order to reduce it to the Horizontal Measure.

Deg.	Links	Deg.	Links	Deg.	Links	Deg.	Links	Deg.	Links	Deg.	Links
1	0·02	6	0·55	11	1·84	16	3·87	21	6·64	26	10·12
2	0·06	7	0·75	12	2·19	17	4·37	22	7·28	27	10·90
3	0·14	8	0·97	13	2·56	18	4·89	23	7·95	28	11·71
4	0·24	9	1·23	14	2·97	19	5·45	24	8·65	29	12·54
5	0·38	10	1·52	15	3·41	20	6·03	25	9·37	30	13·40

TABLE LXI.—For the Conversion of Feet into Miles.

Tens of Thousands	Thousands										Tens of Thousands
	0	1	2	3	4	5	6	7	8	9	
	Miles	*Miles*	*Miles*	*Miles*	*Miles*	*Miles*	*Miles*	*Miles*	*Miles*	*Miles*	
0	...	0·1894	0·3788	0·5682	0·7576	0·9470	1·1364	1·3258	1·5152	1·7045	0
1	1·8939	2·0833	2·2727	2·4621	2·6515	2·8409	3·0303	3·2197	3·4091	3·5985	1
2	3·7879	3·9773	4·1667	4·3561	4·5455	4·7348	4·9242	5·1136	5·3030	5·4924	2
3	5·6818	5·8712	6·0606	6·2500	6·4394	6·6288	6·8182	7·0076	7·1970	7·3864	3
4	7·5758	7·7652	7·9545	8·1439	8·3333	8·5227	8·7121	8·9015	9·0909	9·2803	4
5	9·4697	9·6591	9·8485	10·0379	10·2273	10·4167	10·6061	10·7955	10·9848	11·1742	5
6	11·3636	11·5530	11·7424	11·9318	12·1212	12·3106	12·5000	12·6894	12·8788	13·0682	6
7	13·2576	13·4470	13·6364	13·8258	14·0152	14·2045	14·3939	14·5833	14·7727	14·9621	7
8	15·1515	15·3409	15·5303	15·7197	15·9091	16·0985	16·2879	16·4773	16·6667	16·8561	8
9	17·0455	17·2348	17·4242	17·6136	17·8030	17·9924	18·1818	18·3712	18·5606	18·7500	9

Hundreds	Tens										Hundreds
	0	1	2	3	4	5	6	7	8	9	
	Miles	*Miles*	*Miles*	*Miles*	*Miles*	*Miles*	*Miles*	*Miles*	*Miles*	*Miles*	
0	...	0·0019	0·0038	0·0057	0·0076	0·0095	0·0114	0·0133	0·0152	0·0170	0
1	0·0189	0208	0227	0246	0265	0284	0303	0322	0341	0360	1
2	0379	0398	0417	0436	0455	0473	0492	0511	0530	0549	2
3	0568	0587	0606	0625	0644	0663	0682	0701	0720	0739	3
4	0758	0777	0795	0814	0833	0852	0871	0890	0909	0928	4
5	0947	0966	0985	1004	1023	1042	1061	1080	1098	1117	5
6	1136	1155	1174	1193	1212	1231	1250	1269	1288	1307	6
7	1326	1345	1364	1383	1402	1420	1439	1458	1477	1496	7
8	1515	1534	1553	1572	1591	1610	1629	1648	1667	1686	8
9	1705	1723	1742	1761	1780	1799	1818	1837	1856	1875	9
Units	...	·0002	·0004	·0006	·0008	·0009	·0011	·0013	·0015	·0017	Units

TABLE LXII.—For the conversion of Miles into Feet.

Tens	Units										Tens
	0	1	2	3	4	5	6	7	8	9	
	Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	
0	...	5280	10560	15840	21120	26400	31680	36960	42240	47520	0
1	52800	58080	63360	68640	73920	79200	84480	89760	95040	100320	1
2	105600	110880	116160	121440	126720	132000	137280	142560	147840	153120	2
3	158400	163680	168960	174240	179520	184800	190080	195360	200640	205920	3
4	211200	216480	221760	227040	232320	237600	242880	248160	253440	258720	4
5	264000	269280	274560	279840	285120	290400	295680	300960	306240	311520	5
6	316800	322080	327360	332640	337920	343200	348480	353760	359040	364320	6
7	369600	374880	380160	385440	390720	396000	401280	406560	411840	417120	7
8	422400	427680	432960	438240	443520	448800	454080	459360	464640	469920	8
9	475200	480480	485760	491040	496320	501600	506880	512160	517440	522720	9

Tenths	Hundredths										Tenths
	0	1	2	3	4	5	6	7	8	9	
	Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	
0	...	52·8	105·6	158·4	211·2	264·0	316·8	369·6	422·4	475·2	0
1	528·0	580·8	633·6	686·4	739·2	792·0	844·8	897·6	950·4	1003·2	1
2	1056·0	1108·8	1161·6	1214·4	1267·2	1320·0	1372·8	1425·6	1478·4	1531·2	2
3	1584·0	1636·8	1689·6	1742·4	1795·2	1848·0	1900·8	1953·6	2006·4	2059·2	3
4	2112·0	2164·8	2217·6	2270·4	2323·2	2376·0	2428·8	2481·6	2534·4	2587·2	4
5	2640·0	2692·8	2745·6	2798·4	2851·2	2904·0	2956·8	3009·6	3062·4	3115·2	5
6	3168·0	3220·8	3273·6	3326·4	3379·2	3432·0	3484·8	3537·6	3590·4	3643·2	6
7	3696·0	3748·8	3801·6	3854·4	3907·2	3960·0	4012·8	4065·6	4118·4	4171·2	7
8	4224·0	4276·8	4329·6	4382·4	4435·2	4488·0	4540·8	4593·6	4646·4	4699·2	8
9	4752·0	4804·8	4857·6	4910·4	4963·2	5016·0	5068·8	5121·6	5174·4	5227·2	9

TABLE LXIII.—For the conversion of Links into Feet.

Tens of Thousands	Thousands										Tens of Thousands
	0	1	2	3	4	5	6	7	8	9	
	Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	
0	...	660	1320	1980	2640	3300	3960	4620	5280	5940	0
1	6600	7260	7920	8580	9240	9900	10560	11220	11880	12540	1
2	13200	13860	14520	15180	15840	16500	17160	17820	18480	19140	2
3	19800	20460	21120	21780	22440	23100	23760	24420	25080	25740	3
4	26400	27060	27720	28380	29040	29700	30360	31020	31680	32340	4
5	33000	33660	34320	34980	35640	36300	36960	37620	38280	38940	5
6	39600	40260	40920	41580	42240	42900	43560	44220	44880	45540	6
7	46200	46860	47520	48180	48840	49500	50160	50820	51480	52140	7
8	52800	53460	54120	54780	55440	56100	56760	57420	58080	58740	8
9	59400	60060	60720	61380	62040	62700	63360	64020	64680	65340	9

Hundreds	Tens										Hundreds
	0	1	2	3	4	5	6	7	8	9	
	Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	
0	...	6·6	13·2	19·8	26·4	33·0	39·6	46·2	52·8	59·4	0
1	66·0	72·6	79·2	85·8	92·4	99·0	105·6	112·2	118·8	125·4	1
2	132·0	138·6	145·2	151·8	158·4	165·0	171·6	178·2	184·8	191·4	2
3	198·0	204·6	211·2	217·8	224·4	231·0	237·6	244·2	250·8	257·4	3
4	264·0	270·6	277·2	283·8	290·4	297·0	303·6	310·2	316·8	323·4	4
5	330·0	336·6	343·2	349·8	356·4	363·0	369·6	376·2	382·8	389·4	5
6	396·0	402·6	409·2	415·8	422·4	429·0	435·6	442·2	448·8	455·4	6
7	462·0	468·6	475·2	481·8	488·4	495·0	501·6	508·2	514·8	521·4	7
8	528·0	534·6	541·2	547·8	554·4	561·0	567·6	574·2	580·8	587·4	8
9	594·0	600·6	607·2	613·8	620·4	627·0	633·6	640·2	646·8	653·4	9
Units	...	·66	1·32	1·98	2·64	3·30	3·96	4·62	5·28	5·94	Units

TABLE LXIV.—For the conversion of Feet into Links.

Tens of Thousands	Thousands										Tens of Thousands
	0	1	2	3	4	5	6	7	8	9	
	Links	*Links*	*Links*	*Links*	*Links*	*Links*	*Links*	*Links*	*Links*	*Links*	
0	...	1515·2	3030·3	4545·5	6060·6	7575·8	9090·9	10606·1	12121·2	13636·4	0
1	15151·5	16666·7	18181·8	19697·0	21212·1	22727·3	24242·4	25757·6	27272·7	28787·9	1
2	30303·0	31818·2	33333·3	34848·5	36363·6	37878·8	39393·9	40909·1	42424·2	43939·4	2
3	45454·5	46969·7	48484·8	50000·0	51515·2	53030·3	54545·5	56060·6	57575·8	59090·9	3
4	60606·1	62121·2	63636·4	65151·5	66666·7	68181·8	69697·0	71212·1	72727·3	74242·4	4
5	75757·6	77272·7	78787·9	80303·0	81818·2	83333·3	84848·5	86363·6	87878·8	89393·9	5
6	90909·1	92424·2	93939·4	95454·5	96969·7	98484·8	100000·0	101515·2	103030·3	104545·5	6
7	106060·6	107575·8	109090·9	110606·1	112121·2	113636·4	115151·5	116666·7	118181·8	119697·0	7
8	121212·1	122727·3	124242·4	125757·6	127272·7	128787·9	130303·0	131818·2	133333·3	134848·5	8
9	136363·6	137878·8	139393·9	140909·1	142424·2	143939·4	145454·5	146969·7	148484·8	150000·0	9

Hundreds	Tens										Hundreds
	0	1	2	3	4	5	6	7	8	9	
	Links	*Links*	*Links*	*Links*	*Links*	*Links*	*Links*	*Links*	*Links*	*Links*	
0	...	15·2	30·3	45·5	60·6	75·8	90·9	106·1	121·2	136·4	0
1	151·5	166·7	181·8	197·0	212·1	227·3	242·4	257·6	272·7	287·9	1
2	303·0	318·2	333·3	348·5	363·6	378·8	393·9	409·1	424·2	439·4	2
3	454·5	469·7	484·8	500·0	515·2	530·3	545·5	560·6	575·8	590·9	3
4	606·1	621·2	636·4	651·5	666·7	681·8	697·0	712·1	727·3	742·4	4
5	757·6	772·7	787·9	803·0	818·2	833·3	848·5	863·6	878·8	893·9	5
6	909·1	924·2	939·4	954·5	969·7	984·8	1000·0	1015·2	1030·3	1045·5	6
7	1060·6	1075·8	1090·9	1106·1	1121·2	1136·4	1151·5	1166·7	1181·8	1197·0	7
8	1212·1	1227·3	1242·4	1257·6	1272·7	1287·9	1303·0	1318·2	1333·3	1348·5	8
9	1363·6	1378·8	1393·9	1409·1	1424·2	1439·4	1454·5	1469·7	1484·3	1500·0	9
Units	...	1·5	3·0	4·5	6·1	7·6	9·1	10·6	12·1	13·6	Units

TABLE LXV.—For the conversion of Versts and Kilometres into Miles and *vice versâ*.

Versts	Miles	Kilometres	Miles	Miles	Versts	Kilometres
1	0·6629	1	0·6214	1	1·5086	1·6093
2	1·3258	2	1·2428	2	3·0171	3·2187
3	1·9886	3	1·8641	3	4·5257	4·8280
4	2·6515	4	2·4855	4	6·0343	6·4373
5	3·3144	5	3·1069	5	7·5429	8·0466
6	3·9773	6	3·7283	6	9·0514	9·6560
7	4·6402	7	4·3496	7	10·5600	11·2653
8	5·3030	8	4·9710	8	12·0686	12·8746
9	5·9659	9	5·5924	9	13·5771	14·4840
10	6·6288	10	6·2138	10	15·0857	16·0933

1 Mile = 1·6093296 Kilometres.

1 Verst = 3500 Feet.

TABLE LXVI.—For the conversion of French into English Measures.

Measure of Length	Measure of Weight or Mass
1 Millimetre = ·039370432 Inches or about $\frac{1}{25}$ inch.	1 Milligramme = ·015432349 Grains.
1 Centimetre = ·39370432 „	1 Centigramme = ·15432349 „
1 Decimetre = 3·9370432 „	1 Decigramme = 1·5432349 „
1 Metre = 39·370432* „ or 3·2809 ft. nearly.	1 Gramme = 15·432349 „
1 Kilometre = 39370·432 „ or 1093·6 yds. „	1 Kilogramme = 15432·349 „ or 2·20462125 lbs. Avoir.

Measure of Volume.

The Litre used for liquids = 1 cubic decimetre = 1·76168 Imperial pints.

* *See* "Comparison of the Standards of Lengths," by Captain A. R. Clarke, R.E., 1866, page 280.

TABLE LXVII.—For the conversion of English into French Measures.

Measure of Length		Measure of Weight or Mass	
1 Inch =	2·5399772 Centimetres.	1 Grain =	·064799 Grammes.
1 Foot =	30·4797264 „	1 oz. Avoir. =	28·34954 „
1 Yard =	91·4391792 „	1 lb. „ =	453·59265 „
1 Mile =	1·6093296 Kilometres.	1 Ton =	1016·05 Kilogrammes.

Measure of Volume.		
1 Pint =	·5676400	Litres.
1 Gallon =	4·54112	„
1 Bushel =	36·32896	„