THE NEW PRACTICAL NAVIGATOR;

BEING AN

EPITOME OF NAVIGATION,

CONTAINING

THE DIFFERENT METHODS OF WORKING THE

LUNAR OBSERVATIONS,

AND ALL THE REQUISITE TABLES USED WITH THE

NAUTICAL ALMANAC,

IN DETERMINING THE LATITUDE AND LONGITUDE AND

KEEPING A COMPLETE RECKONING AT SEA:

ILLUSTRATED BY PROPER RULES AND EXAMPLES.

THE WHOLE EXEMPLIFIED IN A

J O U R N A L

KEPT FROM

ENGLAND TO THE ISLAND OF TENERIFFE:

ALSO,

The Subſtance of INFORMATION every CANDIDATE for the AMERICAN NAVY ought to be acquainted with, previous to his being appointed: This, with the SEA TERMS, is particularly recommended to the attention of all YOUNG GENTLEMEN deſigned for, or belonging to, the SEA.

THE *FIRST* AMERICAN, FROM THE *THIRTEENTH* ENGLISH EDITION

OF

JOHN HAMILTON MOORE,

IMPROVED BY THE INTRODUCTION OF SEVERAL NEW TABLES, AND BY LARGE ADDITIONS TO THE FORMER TABLES, AND REVISED AND CORRECTED BY

A SKILFUL MATHEMATICIAN AND NAVIGATOR.

ILLUSTRATED WITH COPPER-PLATES.

TO WHICH ARE ADDED,

Some GENERAL INSTRUCTIONS and INFORMATION to MERCHANTS, MASTERS of VESSELS, and others concerned in NAVIGATION, relative to the MERCANTILE and MARITIME LAWS and CUSTOMS.

PUBLISHED AS DIRECTED BY ACT OF CONGRESS.

Printed at Newburyport by EDMUND M. BLUNT (*Proprietor*) 1799:
Sold by Meſſrs. *Thomas* and *Andrews*, *Samuel Hall*, *Caleb Bingham*, *Ebenezer Larkin*, *David Weſt*, *James White*, *John Boyle*, *W.* P. and *L. Blake*, *John Weſt*, *William T. Clap*, *W. Pelham*, Boſton; and by other Bookſellers and Ship-Chandlers throughout the Union.

ERRATA.

Page.	Line.	
16	31,	*For* 7+2×4 *read* 7÷2×4
29		At the lower corner of the figure add the letter C.
33	1,	*for* fixed *read* mixed.*
34	23,	†*for* log. 1.77415 *read* 1.77379
34	24,	†*for* log. 5.49206 *read* 5.49136
34	25,	†*for* log. 7.26621 *read* 7.26515
35	12,	†*for* 59.4 *read* 59.45
35	13,	†*for* .000031 *read* .00003105
35	13,	†*for* 5.49209 *read* 5.49206
36	7,	†from bot. *for* Place down the log. of the mean diameter, twice the log. of the length, *read* Place down twice the log. of the mean diameter, and the log. of the length.‖
60	7,	†from bot. *for* Rogue *read* St. Roque.
70	25,	†*for* 202.5 *read* 224.5
70	27,	†*for* 405 *read* 449
71	7,	†*for* 56° 10′ *read* 56° 16′
72	17,	†*for* 271 *read* 272
76	18,	†*for* S. W. by W. *read* S. W. by S.
78	9,	from bot. *for* 15.6 *read* 15.7
84	6,	from bot. *for* 5.3 *read* 3.5
86	5,	†*for* 47.38 *read* 47.28
86	10,	†*for* 29,19 *read* 29.09
90	16,	*for* 18° 4′ *read* 48° 4′
99	8,	*for* 49 39 *read* 49 30
105	7,	†*for* 50 05 *read* 51 05
106	8,	*for* 45 41 *read* 45 31
113	17,	*for* angel *read* angle.
113	25,	*for* 47° 44′ *read* 47° 54′
113	4,	from bot *for* 10.00000 *read* 10.17505.
113	2,	from bot. *for* 10.17505 *read* 10.00000.
113	12,	from bot. *for* 13.06547 *read* 13.06407,
116	1,	*for* latitude *read* longitude.
119	7,	*for* 9.92614 *read* 9.96614.
123	3,	†from bot. *for* 311.5 *read* 311.6.
123	1,	†from bot. *for* 276.2 *read* 276.3.
170		at bottom of the table *for* 2½ *read* 2¼.
180	18,	*for* 3052 *read* 3054.
183	25,	*for* 357.17 *read* 257.17.
184	16,	*for* 10° 26′ *read* 16° 26′.
187		In traverse table *for* S. S. W. ¼ W. *read* S. S. W. ½ W. In dep. col. *for* .1 *read* 48.1.
188	18,	*for* bearing of Funchal S. 28° 30′W. *read* S. 26° 39′ W.
189	9,	*for* zen. diſt. 28° 20′S. *read* 28° 20′N.
189	18,	*for* courſe 8° 30′W *read* S. 8° 30′W.
189		Bot. line, *for* dif. lat. 67 *read* 97.
190	10,	Put courſe S. by W. wind W. by S. and lee-way 1 pt. oppoſite to 4h. *inſtead of* 6h.
192	28,	*for* 40 04 *read* 46 04.
193	38,	*for* dif. lat. 20° 6′ *read* 10° 6′.
194	29,	*for* 2010 *read* 2910.
195	20,	*for* lat. 4° 30′N. *read* 42° 30′N.
196		†In traverſe table *for* dif. lat. 191.0 *read* 191.4.
196	[illegible],	†*for* mer. diſt. 6 21 *read* 6 20.
196	26,	†*for* 7 17 *read* 7 16, and on this account 1′ muſt be taken from the mer. diſt. in pages 197, 198, & 199.
198	13,	†*for* S. E. by E. *read* S. E. by S.
199	9,	†*for* P. M. *read* A. M.
199	13,	†*for* 4 knots, oppoſite 10h. A. M. *write* 3 K 5 F, and eraſe the 4 knots oppoſite 12h. A. M.
199		.†bot. *for* 16 25 E. *read* 16 25 W.
200	22,	†*for* 16 25 E. *read* 16 25 W.
201	13,	†*for* 2K 4F *read* 2K.
201	18,	*for* long. 15° 03′W. *read* 15° 53′W.
202	1,	†from bot. *for* 61° 33′ *read* 61° 32′.
203	3,	†*for* dif. 96 *read* 107.
203	11,	†*for* lat 39 47 *read* 39 46.
203	12,	†*for* 39 29 *read* 36 29, and *for* 39 36 *read* 36 36.
203	16,	†*for* bearing of Salvages S. 37 52 E. dif. 39 miles, *read* S. 34 E. diſtant 28 miles.
203	17,	*for* long. 15 35W. *read* 15 53W.
206	3,	†*for* 35 10 S. *read* 35 10 N.
206	10,	†from bot. *for* 35 4 S. *read* 35 4 N.
209	12,	†*for* 15 31 N. *read* 15 31 S.
209	21,	†The ſecond operation worked exactly and proportioning for the ſeconds, the time from noon will be found 1h. 28m. 7s. and the latitude 7 9 N. repeating the operation a third time and we have the latitude 7° 8′ for the true latitude, and not 7° 16′ as deduced from the ſecond operation of page 209.
209	21 & 23,	†*for* 30 ſeconds *read* 10. ſec
211	3,	†fr. bo. *for* 72 25 S. *read* 72 25 N.
212	11,	†*for* 72 23 S. *read* 72 23 N.
224		The method of correcting for the change of the ſun's declination in Example 2 of page 224 is erroneous.
227	16,	*for* 3 42 16 *read* 5 41 0.
230	24,	*for* 15 4 *read* 15 54.
230	27,	*for* 67 7 *read* 67 17.
230		Bottom, *eraſe the words*, And it may be noted that when the ſun paſſes the meridian to the northward the zenith diſtance is called north, otherwiſe ſouth.
232	19,	*for* eaſt or weſt, *read* weſt or eaſt. The ſame error is to be corrected in page 258, line 16, and in page 260, line 9th from bottom.
256	21,	†*for* correction of altitude, *read* correction to be applied to the firſt altitude.
256	29,	*for* N. C. *read* N. L.

† Errors copied from *John Hamilton Moore*. Many errors have eſcaped in his late Editions, ſeveral hundred of which are corrected in this work.

ERRATA.

Page.	Line.	
257		Erase the note at the bottom, and write, The comp. latitude is called by the same name as the latitude.
259	18,	*for* 36 37 *read* 36 39.
259	20,	†As Table 20 is calculated for every 10 seconds, we must take out the logs. for 3, 7, 40, and 3, 7, 50, and proportion their difference for the odd 4 seconds.
262	32,	†*for* sup. sine of ang. B C D 80°, *read* supp. sine of ang. B D C 80°, or sine B D C 100°.
263	14,	*for* sign angle C 50 14 *read* sine angle C 50 14, or 129 46.
263	22,	†*for* 59 17 *read* 50 14
263	25,	†*for* 120 43 *read* 129 46.
265	7,	*for* B D C *read* C B D.
266	26,	*for* B A C *read* B C A.
267	7,	†*for* 73° 0' *read* 73° 7'.
267	15,	*for* 72 27 easterly, *read* S. 72 27 easterly.
272	3,	After S. E. b. S. 38 miles, *add* or 20 miles whilst the ship sails 40 miles.
273	9,	*for* 70 miles *read* 71 miles.
279	2,	from bottom, *for* KT *read* K L.
279	1,	†from bottom, *for* NN *read* K N.
281	7,	†*for* B B *read* B A.
281	13,	†*for* find B C *read* to find B C.

TABLE I.*

Page.	*Line.*	
¼	3,	for lat. 60.6 read 60.9
	28,	for lat. 85.4 read 85.9
1¾	3,	for dif. 81 read 181
2	3,	for dif. 81 read 181
	13,	for lat. 10.0 read 10.2
2¼	33,	for dif. 61 read 91
	53,	for dif. 11 read 111
3	33,	for dif. 61 read 91
	53,	for dif. 11 read 111
3½	53,	for dif. 71 read 171
3½	53,	for dif. 71 read 171

TABLE II.

Deg.	*Line.*	
3	62,	for dif. 00 read 300
4	53,	for lat. 70.6 read 170.6
11	53,	for dif. 71 read 171
12	53,	for dif. 71 read 171
15	12,	for dif. 0 read 10
	53,	for dif. 11 read 111
16	53,	for dif. 11 read 111
17	53,	for dif. 11 read 111
18	53,	for dif. 11 read 111
20	10,	for dep. 43.1 read 43.8
	11,	for dep. 43 8 read 44.1
21	53,	for dif. 71 read 171
	9,	for dep. 57.0 read 67.0
22	53,	for dif. 71 read 171
24	39,	for dep. 08.3 read 88.3
	56,	for lat. 51.0 read 51.2
25	43,	for lat. 37. read 37 2
		for dep. 17.2 read 17.3
28	62,	for lat. 212.9 read 211.9
29	20,	for dep. 57.8 read 37.8
	22,	for dep. 58.8 read 38.8
33	33,	for dif. 61 read 91
35	3,	for dif. 81 read 181
36	3,	for dif. 81 read 181
37	4,	for lat. 193.1 read 193.3
	5,	for lat. 194.3 read 194.1
42	52,	for dep. 194.2 read 194.0
43	53,	for dif. 71 read 171
44	53,	for dif. 71 read 171

TABLE III.

Deg.	*Min.*	
24	30,	for 517 read 1517
29	40,	for 1765 read 1865
	50,	for 1777 read 1877
30	0,	for 888 read 1888
50	58,	for 6 read 66
	59,	for 6 read 67
53	50,	for 84 read 3848
	20,	for 3798 read 3797
54	50,	for 951 read 3951
82	10,	for 218 read 9218

TABLE IV.

Page.	*Line.*	
2	57,	for lat. of the mouth of Tay 57.27 read 56.26
3	bot.	for lon. Lundy I. 5.44 read 4.44
5	2,	from bot. for lat. Venice 42.26 read 45.26
	11,	for lat. Alicante 38.25 read 38.18
7	7,	for long. Palma 27.32 read 17.32
7	23,	for Cape-Vergue lat. 14.56 long. 9.52 read lat. 9.52 long. 14.56
8	33,	for lat. and long. of Trinidad write lat. 20.28 S. long. 29.0 W.
9	13,	for lat. Oracan 27.17 read 20.17
	14,	for long. Cheduba-Isle 90.37 read 93.37
10	1,	for lat. Cocol. 21.45 S. read 12.06 S.
11	32	for lat. of Naze of Norway 47.59 read 57.59
12	26	
13	37,	for long. St. Peter's 36.6 read 56.6
13	38,	for long. Langley I. 36 15 read 36 15

At the top of Table 8, erase the title in page 1, and read the same as in page 2.

* *All the errors which have escaped in the four following Tables were copied from* J. H. Moore's *last Edition, and not discovered in season. It is recommended to the Navigator to refer to and correct them in his Book, and the Editor assures them that no errors exist in the work but such as are pointed out.*

Preface to the First American Edition.

THE subsequent Edition of the "New Practical Navigator" is offered to the patronage and encouragement of a commercial public, under every advantage and improvement, which could be derived from the correcting observation of many years of faithful experience, and the theoretic knowledge of some of the most eminent professional men, both in Europe and America. As an Epitome of Navigation, the Editor is warranted to assert, it has no equal in compression of science, uniformity of method, facility of operation, scope of usefulness, or accuracy of printing. The original work, from which this treatise has been copied and improved, by its unprecedented sale, has extended itself to every part of the mercantile world; still, however, the Editor has reason to hope, that the many revisions of typography, corrections of material errors, and additions of important matter, which so considerably enrich and distinguish this First American Edition, will secure to it a general circulation, proportioned to the enterprize, which has attended its publication, and the decided superiority it possesses over every other treatise now extant on the subject.

The general design of Mr. Moore, in undertaking a work of so much labor and science, was to comprise every thing essential, both in the theory and practice of Navigation, to form the Teacher, instruct the Pupil, and assist the Mariner, so as to render them proficients in the Nautical Art. His very excellent compilation has already passed through thirteen Editions in London, each exhibiting honorary marks of review and improvement, progressively encreasing by incorporating the collective wisdom of other Authors with his own, as his knowledge became extended by investigation, and his judgment matured by experience.

To

To facilitate the acquisition of an art, which has been the object of all his pursuits in life, he has successfully studied to be concise, yet comprehensive; explanatory in his definitions; and perspicuous in his rules and examples. It was found necessary, in order to effect this important purpose, to peruse with unwearied attention, and compare with critical circumspection, all the writers who had preceded him on the subject, to enable him to discriminate with precision their merits from their defects. Most of their works had generally been considered too voluminous and elaborate for the young student, or the ordinary mariner; and the Tables, necessary to the practical part of Navigation, were scattered throughout so many different Books, that operations in the art were retarded and confused by the time and labor employed in referring to them. To bring these Tables therefore into one point of view, was a task both useful and acceptable: and the judgment and industry of Mr. MOORE have been happily exerted, in reducing them to a single volume, and numbering and arranging them in a methodical manner.

IN addition to this very desirable improvement, the Author has assisted the learner in acquiring that very essential branch of Navigation, the keeping of a complete reckoning at sea, by subjoining a compendium of oblique-angled Trigonometry, with its application in oblique and current sailing: and also the method of surveying coasts and harbors, and many other particulars necessary to be known by every practitioner in the art.

SUCH, says the Author, is the plan of a Work, which is intended to contain, in a small compass, every useful discovery and improvement, made through a long series of study, observation and practice; the whole of which is laid down in a manner as concise, plain, and intelligible, as the nature of the subject can possibly admit.

THE professional science and indefatigable assiduity, of Mr. MOORE having thus digested, in a succinct and perspicuous praxis, a system of Navigation more accurate and extensive, than had appeared in any prior publication, the American Editor has not presumed to revise and en-

large

large a work of ſuch high authority, without duly conſulting ſeveral Gentlemen of the firſt mathematical and nautical talents in our country. To their attentive and friendly aſſiſtance, he is indebted for the many important corrections, and uſeful additions, which in the ſubſequent volume are made to the original plan of the Author.

AMONG the many valuable originals and amendments, which the purchaſer will find in this new Edition, is given an exact method (inſtead of Mr. MOORE's erroneous one) of finding the Latitude by a ſingle altitude of the Sun, having alſo the true time of obſervation. The Tables of declination are alſo corrected; as Mr. MOORE, by reckoning the year 1800 as a leap year, has cauſed an error at times of 23′ in the declination. A new method of working a lunar obſervation is likewiſe inſerted, which has not that variety of caſes, incident to other methods. A very uſeful addition of two columns, is alſo made to table 25, which greatly facilitates the calculation to find the time from an obſerved altitude of any of the heavenly bodies. Table 20 is publiſhed for every 10 ſeconds of time, inſtead of 30 ſeconds. This alteration was deemed requiſite to render it ſufficiently convenient for uſe. Various other improvements of great utility have been made in many parts of the work. It will however ſuffice to obſerve, that about 300 errors (beſides thoſe noted in the errata annexed) have been corrected in the laſt, and moſt accurate edition of JOHN HAMILTON MOORE.

FOR ſeveral new tables and additions to this work, the Editor takes this public opportunity of returning his thanks to Mr. *Nathaniel Bowditch*, of Salem, *Fellow of the American Academy of Arts and Sciences*, whoſe acknowledged talents, both as a Theoretical and Practical Navigator, reflect high honor on the nautical character of his country. The note to table 14 was furniſhed by Mr. *William Bowditch*. The Editor is alſo indebted to *Nicolas Pike*, A. M. *Member of the American Academy of Arts and Sciences*, for the table in page 63, and the alterations depending thereon; and likewiſe for his correct examination of the work. He is alſo under obligations to a Friend in the

Profeſſion

Profeſſion of the Law for his polite attention in ſubjoining a ſupplement which contains a ſuccinct and comprehenſive Treatiſe on the Laws of Marine Inſurance, Bills of Exchange, &c. &c. It will be unneceſſary to recommend either to the Merchant or the Navigator, to the Owner or the Agent, the Freighter or the Shipper, the obvious and extenſive utility of this brief and ſimplified tract on ſo important a branch of juriſprudence, the knowledge of which is abſolutely eſſential to the ſecurity and promotion of commerce. The chapters on mercantile law are arranged and written in ſo clear an order and ſtyle, that they will be a deſirable guide to many, who may be in purſuit of information, but would ſhrink from the fatigues of an elaborate reſearch.

THE young Patriots, who have entered as midſhipmen in the American Navy, to educate themſelves for a future career of glory, will never, it is confided, diſappoint the hopes of their country, when her ſtandard is aſſailed, or her honor invaded. They are undoubtedly ſenſible that valor alone, without naval ſcience, is a very ineffectual engine, and often proves as fatal to its poſſeſſor, as to the enemy againſt whom it is directed.—It may not, therefore, be an indelicate office in a ſincere admirer of their noble public ſpirit, to remind them, that in England, whoſe maritime power has derived all its glory from its diſcipline, every candidate for a *Commiſſion* in the Royal Navy, or in the Eaſt India ſervice, muſt paſs a ſtrict examination in nautical tactics, previous to his appointment. The general ſubſtance of this examination is contained in a chapter of queſtions and anſwers, publiſhed in the "PRACTICAL NAVIGATOR."

HAVING thus curſorily touched on the original merits of the author's deſign, and pointed out ſome of the many ingenious improvements in this American impreſſion, the Editor cannot ſubmit the ſubſequent volume to public peruſal, without remarking, that, as the whole utility of a publication of this nature would be fruſtrated by typographical negligence or inaccuracy, he has devoted a year of intenſe application to the printing of the work, during which time neither labor nor expence has been ſpared to render it the moſt correct and uſeful treatiſe on Practical Navigation, that has iſſued from the preſs.

EDMUND M. BLUNT.

CONTENTS.

B

ARRANGEMENT OF THE TABLES.

GEOMETRICAL DEFINITIONS.

GEOMETRY is the Science which treats of the Defcription, Properties and Relations of Magnitudes in general ; of which there are three Kinds or Species, viz. a Line, which has only Length without either Breadth or Thicknefs ; a Superficies, comprehended by Length and Breadth ; and a Solid, which has Length, Breadth, and Thicknefs.

I.

A point confidered mathematically, is incapable of being divided, and therefore hath no parts, or it is the fmalleft part of fpace that can be affigned, and may be conceived fo infinitely fmall, as to be void of length, breadth, or thicknefs, being always denoted by a dot, as at A.

A .

II.

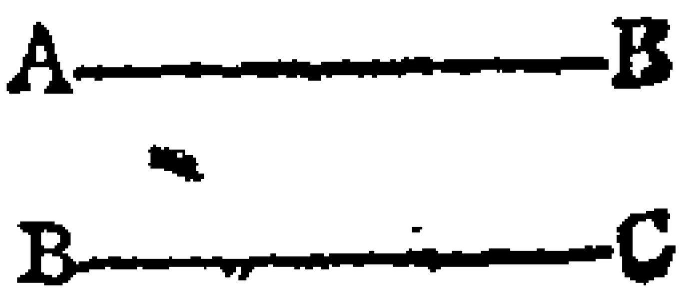
A right line is the neareft diftance between two points which limits its length, without any fuppofed breadth, or thicknefs, as A C ; it may be fuppofed to be the fluxion of a point.

III.

A plane fuperficies is that which lies evenly between its extreme points, refembling a fmooth table, or polifhed glafs ; bounded by lines having length and breadth : but is conceived to have no depth or thicknefs, and may be conceived to be generated by the fluxion of a right line.

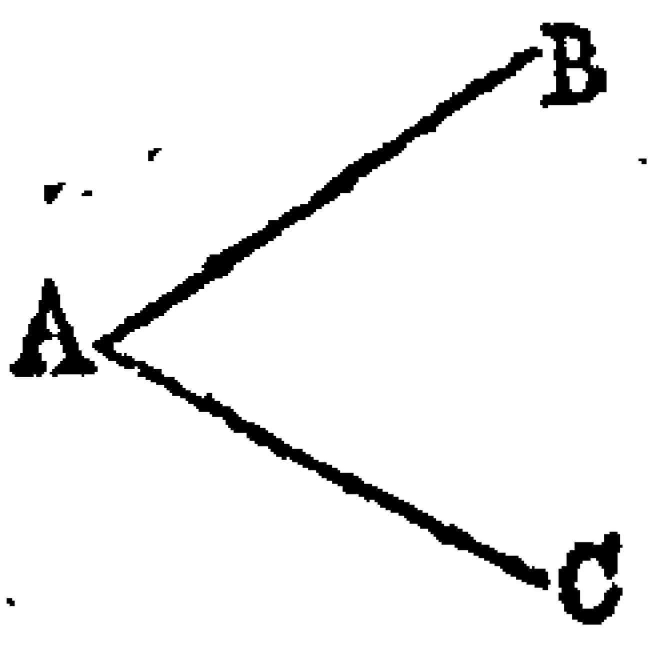
IV.

Parallel lines are fuch as are equally diftant in all their parts, which extended infinitely on the fame plane would never meet, as the lines A B, B C.



V.

A plane angle is the inclination or meeting of two right lines in one point ; the point where they meet is called the angular point, and the lines A B and A C are called fides or legs ; it is generally expreffed by three letters, the middle one always denotes the angular point, as A, and the other two the legs or fides that include it, as A B or A C.

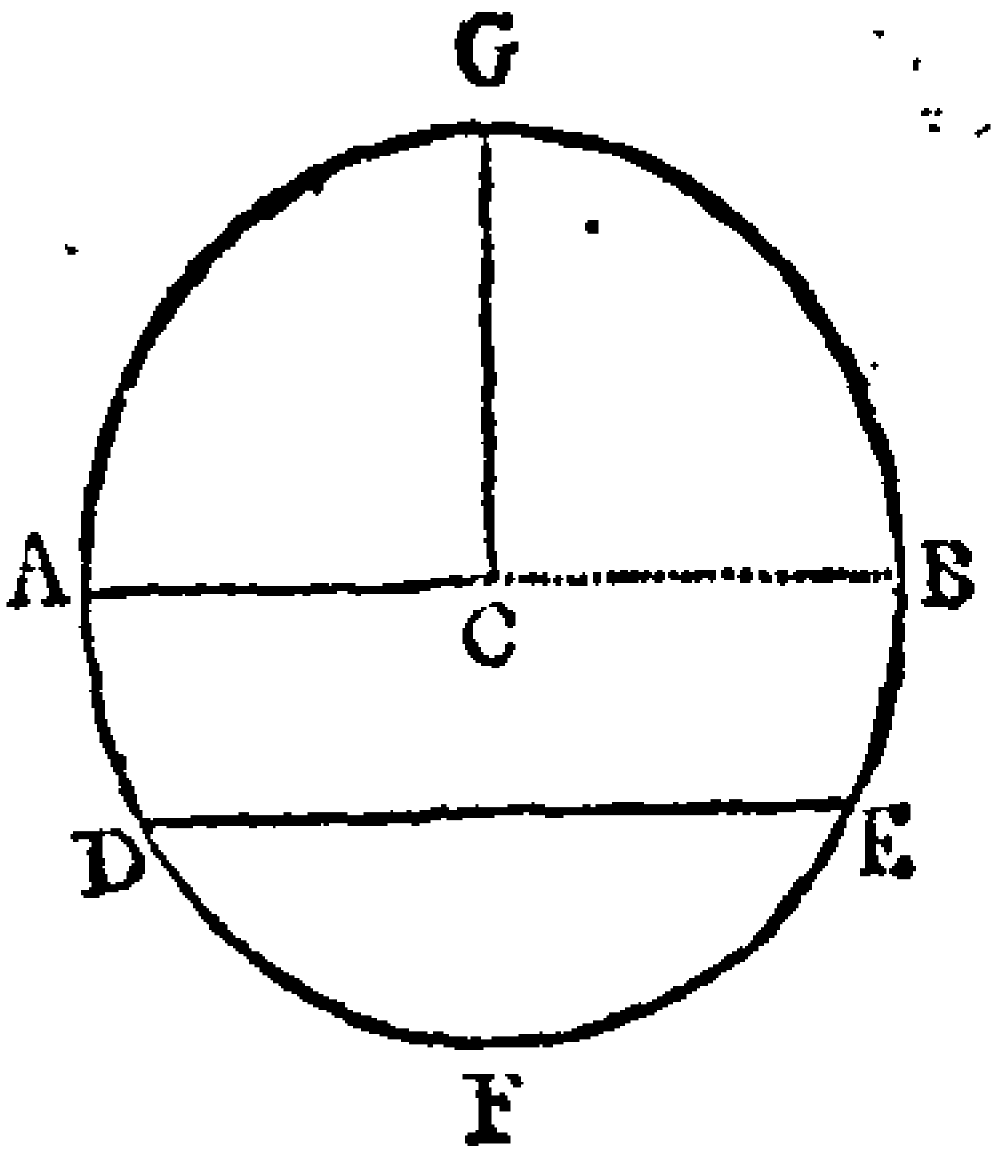


VI.

A circle is a plane figure, bounded by an uniform curve line, it is ordinarily defcribed by a right line, taken with a pair of compaffes; one point thereof being fixed, whilft the other is turned round to the place where the motion firft began; the fixed point is called the centre, and the line defcribed by the other point is called the circumference.

VII.

The radius of a circle, or femidiameter, is a right line drawn from the centre to the circumference, as A C; or it is that line which is taken between the points of the compaffes to defcribe the circle; and is half its diameter A B.



VIII.

An arch of a circle is any part or portion of the circumference, as D F E.

IX.

A chord of a circle is the fubtenfe of an arch, or it is a right line joining the ends of an arch; it divides the circle into two unequal parts, called fegments, and is a chord to them both, as D E is the chord of the arches D F E and D G E.

X.

A femicircle, or half a circle, is a figure contained under the diameter, as A G B or A F B.

XI.

A quadrant is half a femicircle, or one-fourth part of the whole circle, as the figure C A G.

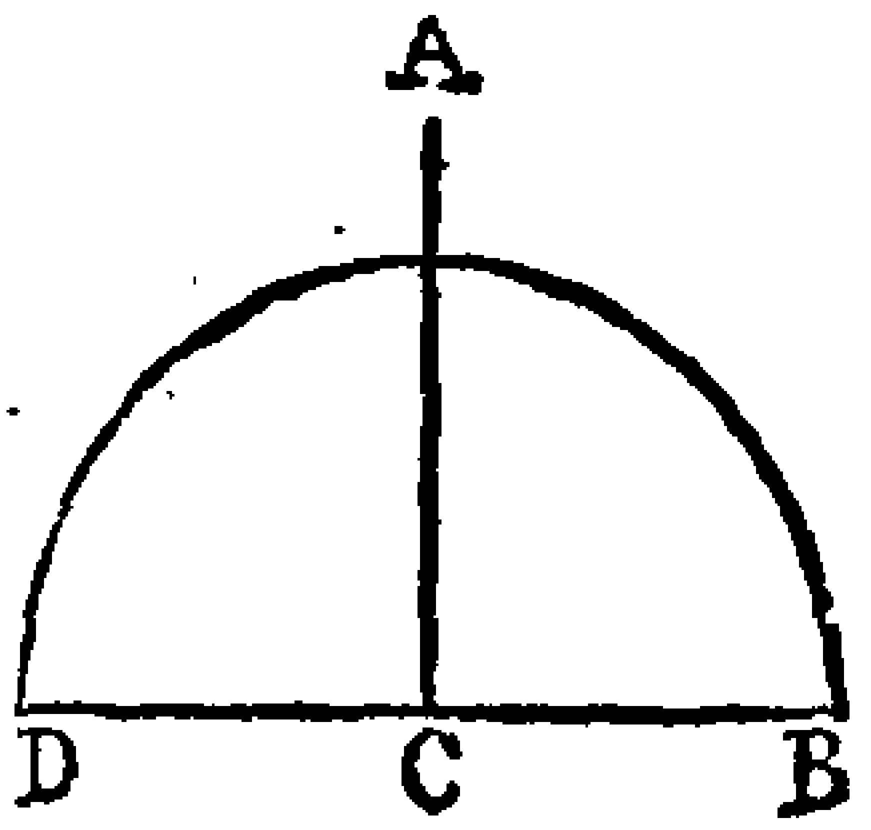
NOTE. All circles, whether great or fmall, are actually, or fuppofed to have their circumference divided into, 360 equal parts, called degrees, and each degree into 60 equal parts, called minutes, and each minute into 60 equal parts, called feconds, and fo on into thirds, fourths, &c.

All angles are meafured by an arch of a circle, defcribed round their angular points, with the chord of 60 degrees, taken from the line of chords on the plane fcale, and are eftimated greater or lefs according to the number of degrees contained betwixt their legs; and though legs be made longer or fhorter, ftill the angle between them continues the fame.

XII. A right

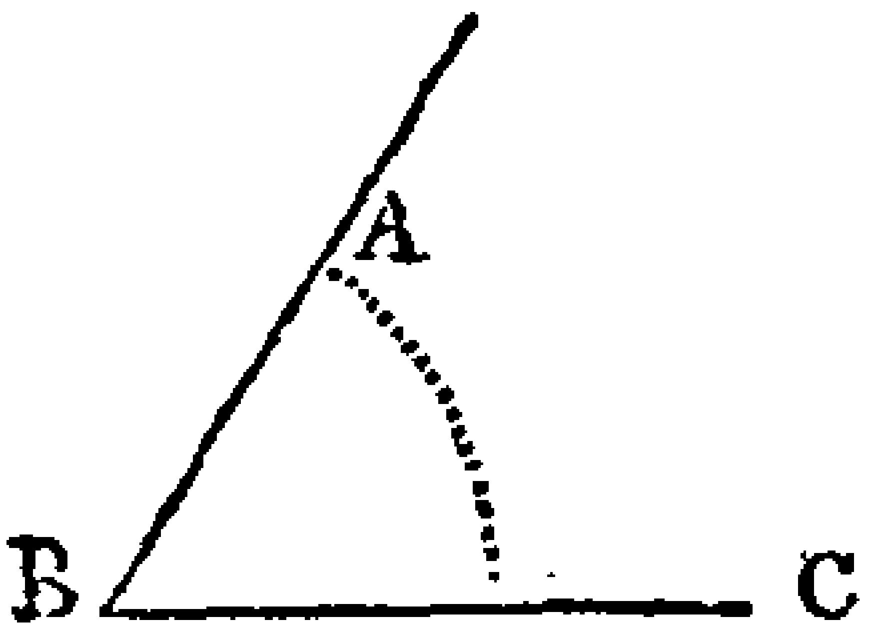
XII.

A right line is ſaid to be PERPENDICULAR to another line, when it falls upon it, ſo as to make the angles on each ſide of it equal, ſuch as the figure A B C D, where the angle ACD is equal to the angle A C B, each a quadrant, or right angle, containing 90 degrees.



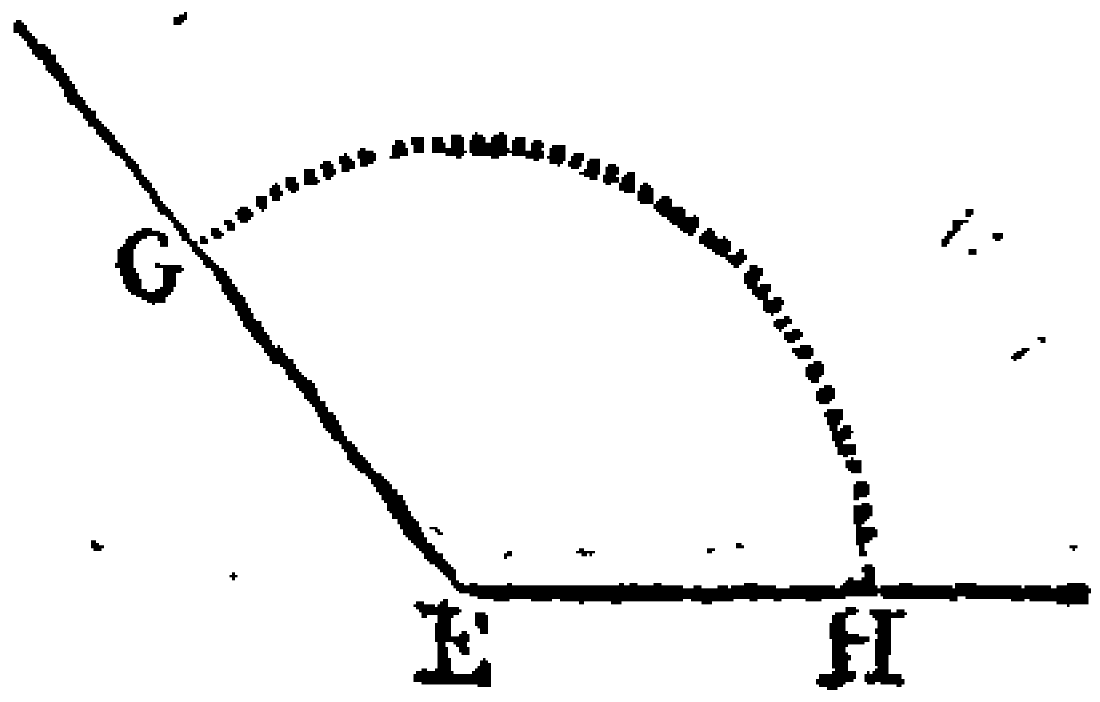
XIII.

An ACUTE ANGLE is leſs than a right angle, and is that which contains leſs than 90 degrees, A B C.



XIV.

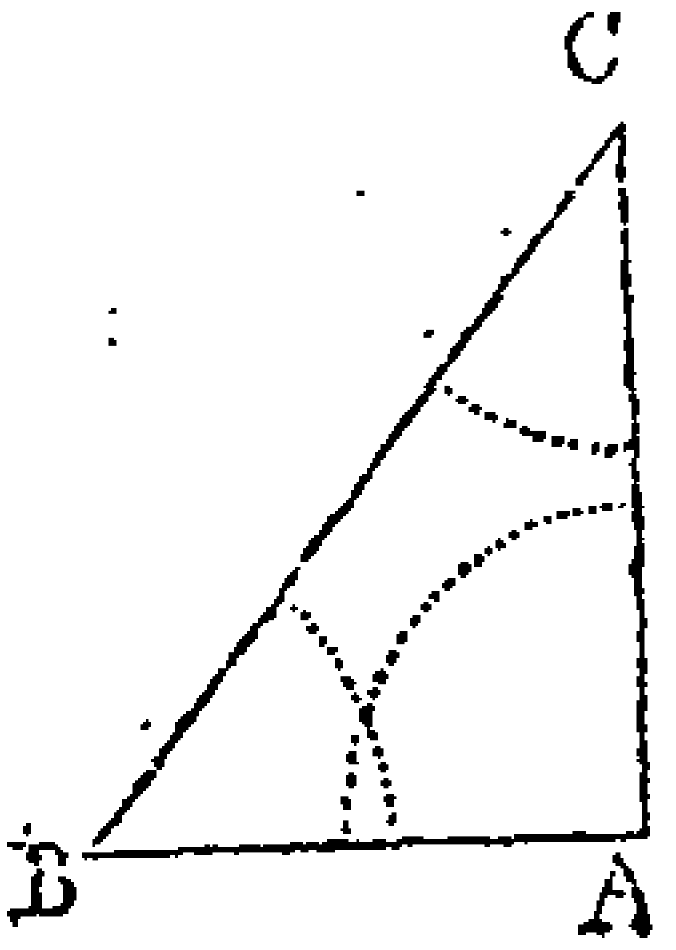
An OBTUSE ANGLE is greater than a right angle, and is that which contains more than 90 degrees, as the angle G E H.



The feweſt number of right lines that can include a ſpace, are three, which form a figure called a triangle, or three-cornered figure, and conſiſts of ſix parts, viz. three ſides and three angles: it is diſtinguiſhed into three ſorts, viz. a right-angled triangle, an obtuſe-angled triangle, and an acute-angled triangle.

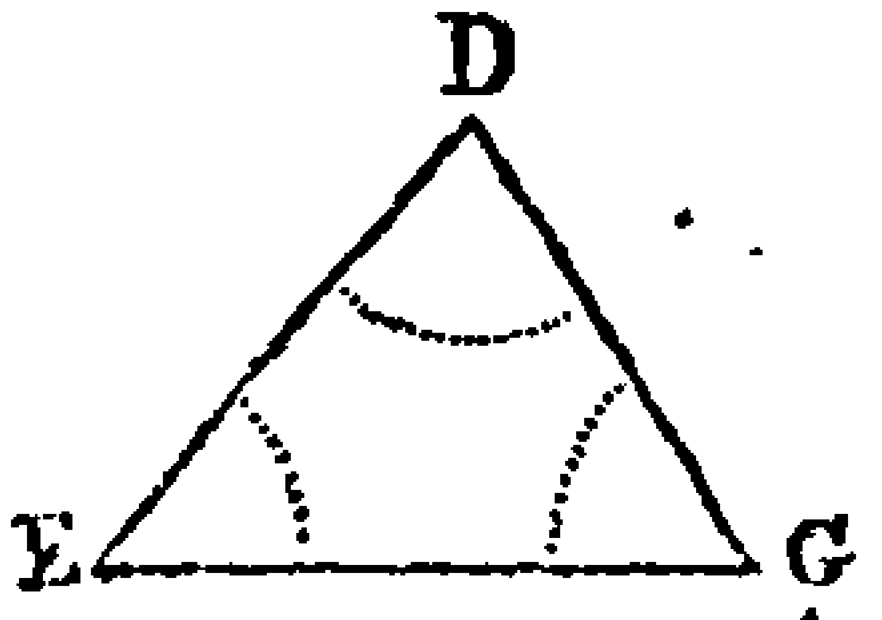
XV.

A RIGHT-ANGLED TRIANGLE has one of its angles right, or containing 90 degrees; the ſide oppoſite the right angle is called the hypothenuſe; and the other two ſides are called legs; that, which ſtands upright, is called the perpendicular, and the other the baſe; thus B C is the hypothenuſe, A C the perpendicular, and A B the baſe: the angles oppoſite the two legs are both acute.



XVI.

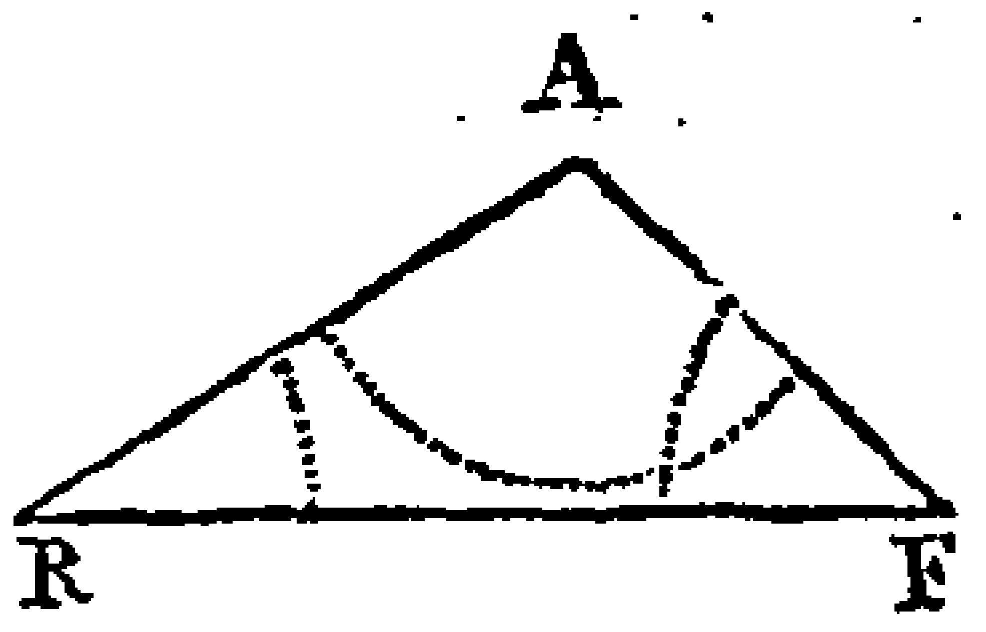
An ACUTE-ANGLED TRIANGLE has all its angles acute, or none of them equal to 90 degrees, as D E G.



An

XVII.

An OBTUSE-ANGLED TRIANGLE has one of its angles obtuse, or greater than 90 degrees, as R A F, the other two angles are acute, or less than 90 degrees, as in the triangle R A F.



NOTE. All triangles, that are not right-angled, whether they are acute or obtuse, are in general terms called oblique-angled triangles, without any other distinction. The sum of the two acute angles of a right-angled triangle make 90°, the sum of all the angles of any triangle 180°. If from 180 you take the sum of the other two angles, the remaining angle will be found; but in a right-angled triangle, if from 90 you subtract the one angle, the other angle shall remain.

MARKS OR CHARACTERS.

$+$ Signifies *more*, or the sign of Addition; it shews that whatever numbers or quantity follow this Sign must be added to those that go before it, thus $9+8$, that is, 9 added to 8. Or, $A+B$ implies that the quantities represented by A and B are added.

$-$ Signifies *less*, and is used as the Sign of Subtraction, it denotes that the number following it must be subtracted from those going before it, as $7-5$, or 5 subtracted from 7.

$\times$ The Sign of Multiplication, and shews that the numbers placed before and after are to be multiplied, thus 7×9, that is, 7 multiplied by 9, which makes 63, and $7\times8\times2$ which makes 112.

$\div$ This Mark stands for Division, and signifies that the Number that stands before it is to be divided by the number following it, as $72\div12$ shews that 72 is to be divided by 12. Or thus, $\frac{72}{12}$

$=$ The Sign of Equality; it shews that the numbers or quantities placed before it are equal to those following it, thus, $8\times12=96$. Or 8 multiplied by 12 is equal to 96, and $7+2\times4=36$.

: :: : Proportion, and is read thus, $7:14::10:20$ that is, as 7 is to 14 so is 10 to 20. Or, $A:B::C:D$ that is, as A is to B so is C to D.

° Signifies Degrees, thus 45° shews the number 45 degrees.

′ Signifies Minutes, thus 24′ or minutes.

″ Signifies Seconds, thus 44″ or 44 seconds.

S. Stands for Sine.

Sec. —— for Secant.

Tan. —— for Tangent.

Each of these last with Co. before them, signifies the compliment, as Co-sine, Co-tangent, Co-secant.

$\angle$ Signifies Angle.

$\angle$d Angled, with an s at top, Angles $\angle$s

$\triangle$ Signifies Triangle, or $\triangle$s Triangles.

Z Is frequently put to signify the sum of two lines or numbers.

X Signifies their difference.

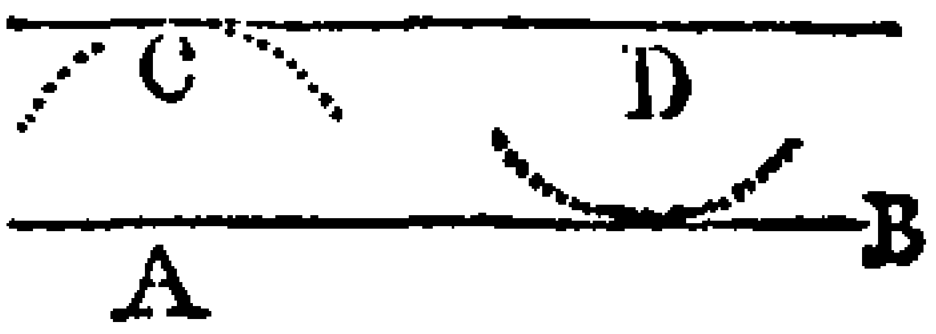
GEOMETRICAL PROBLEMS,

USEFUL IN NAVIGATION.

A PROBLEM *is a Practical* PROPOSITION, *in which something is proposed to be done or effected.*

PROBLEM I.

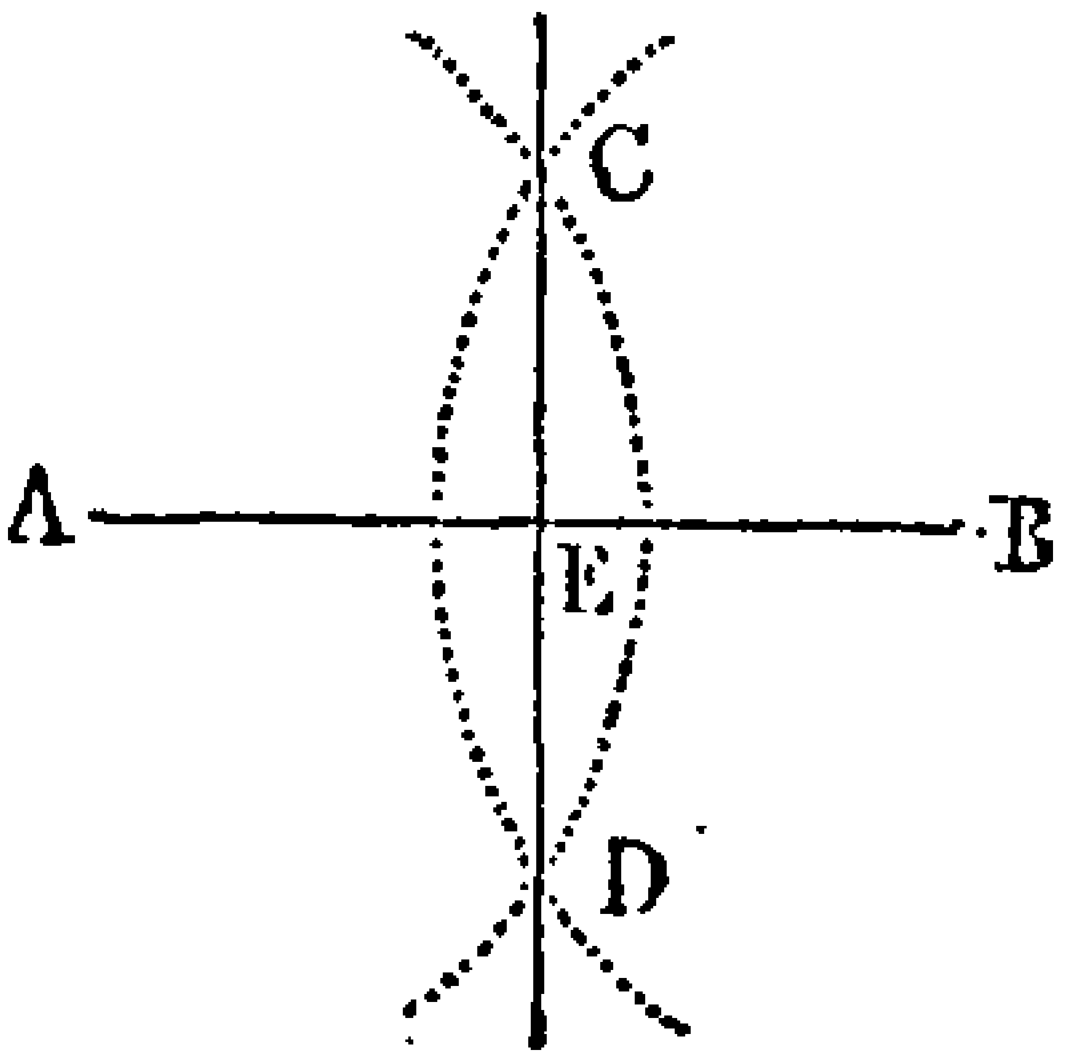
To draw a Right Line parallel to a given Right Line, at any given Distance, as at the Point D.



WITH a pair of compasses take the nearest distance between the point D and the given right line A B, with that distance set one foot of the compasses any where on the line AB, as at A, and draw the arch C, from the point D draw a line so as just to touch the arch C, and it is done, for the line C D will be parallel to the line A B, and at the distance of the point given D, as was required.

PROBLEM II.

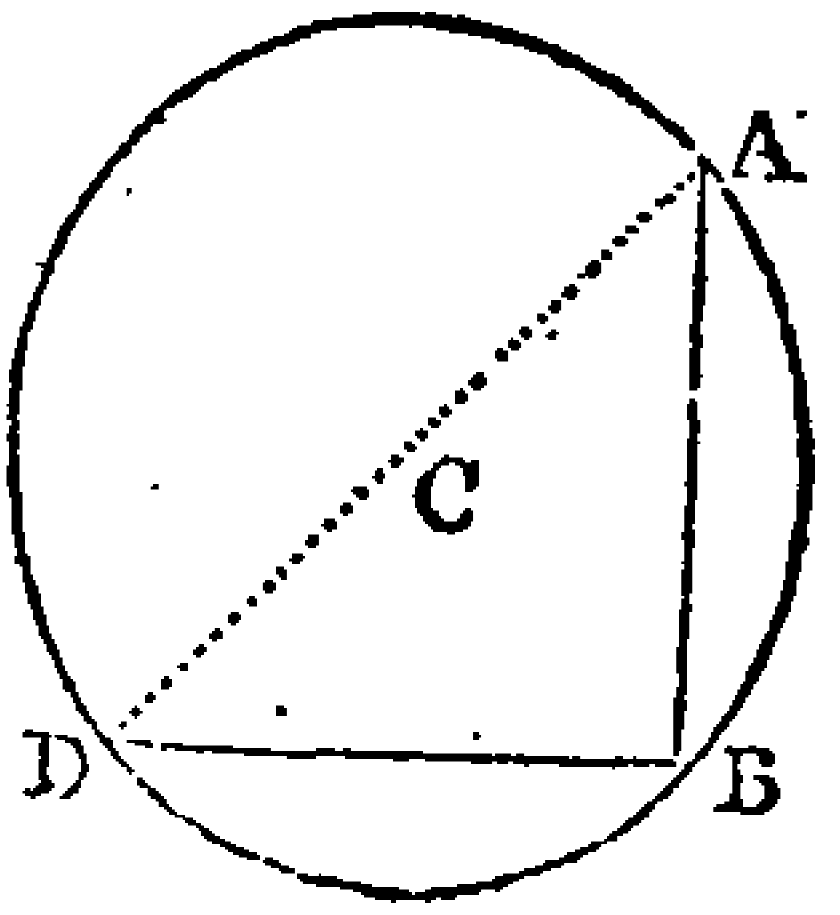
To bisect or divide a given Line into two equal Parts.



With any distance in your compasses greater than half the line A B, with one foot in B, describe an arch with the same distance, and one foot in A, describe an arch that will cut the former arch in C and D; through C and D draw a line, and that will cut AB in E; and the line A B will be divided at the point E into two equal parts.

PROBLEM III.

To erect a Perpendicular on the End of a given Right Line, as D B.

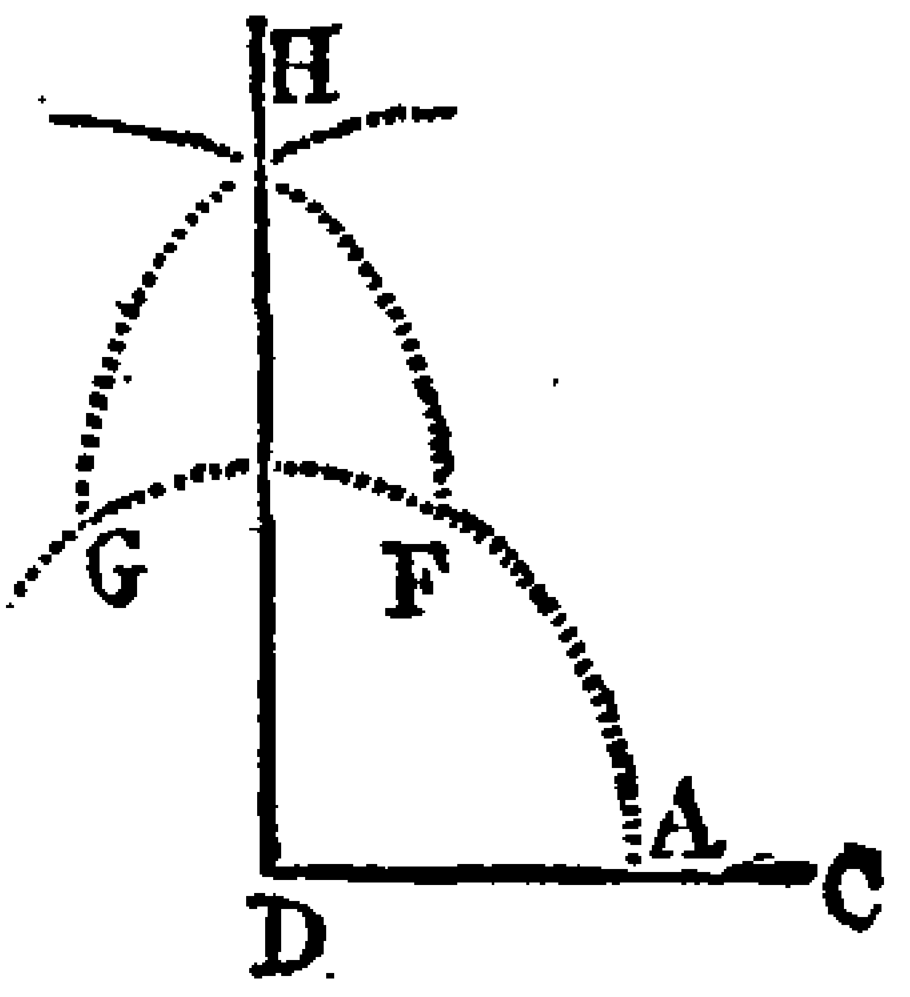


With any distance in your compasses, as from B to C, with one foot in C, describe the circle BDA, so that it may just touch the end of the given line, at B: from where the circle cuts the line, as at D, draw a line through the point C, to cut the circle in A, from A draw the line AB, which will be the perpendicular required.

Or thus,

With

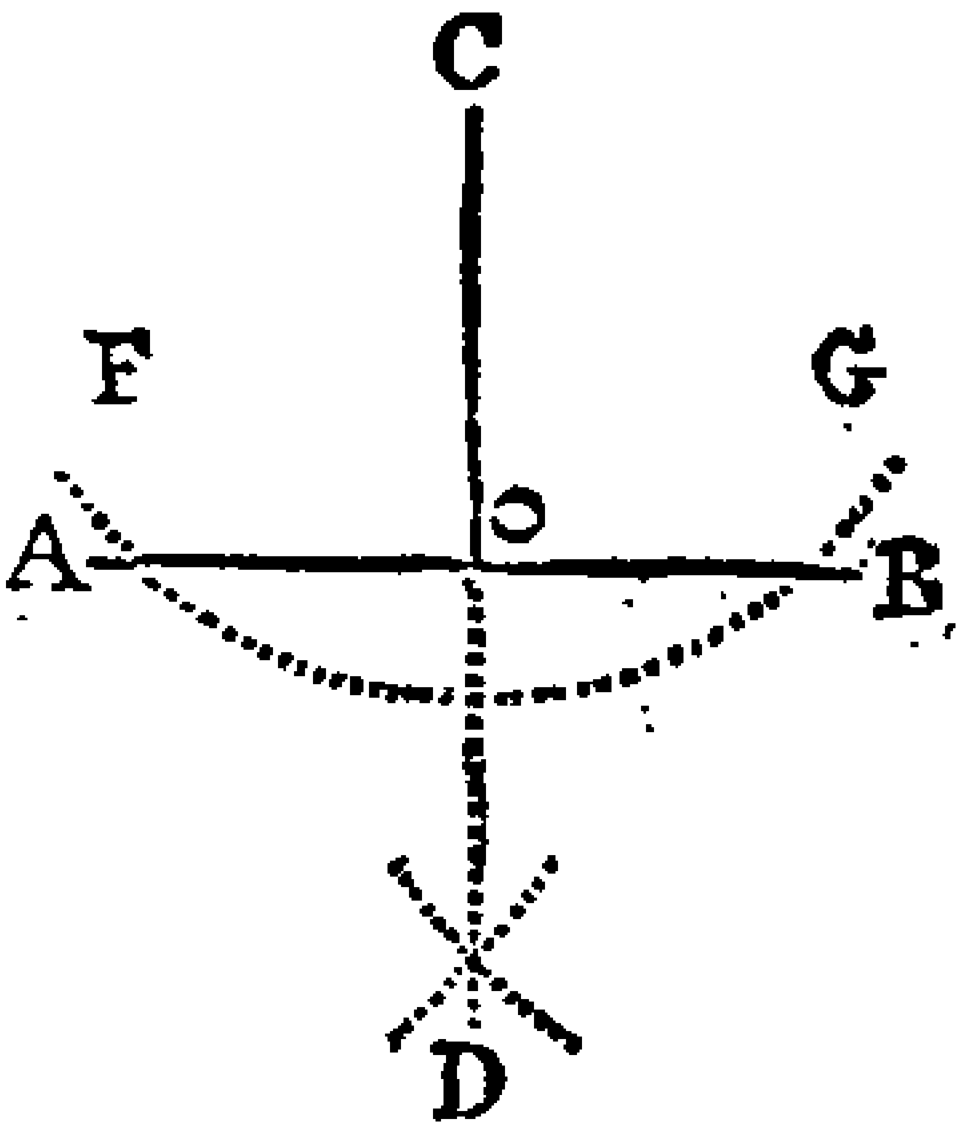
With any convenient diſtance in your compaſſes, as from D to A, with one foot in D, deſcribe the arch A F G, ſet off the ſame diſtance from A to F, and from F to G ; upon F and G deſcribe two arches interſecting one another in H ; draw a line from H to D, and it is done ; for H D will be the perpendicular required.



PROBLEM IV.

From a given Point, as C, *to let fall a Perpendicular on a given Right Line* A B.

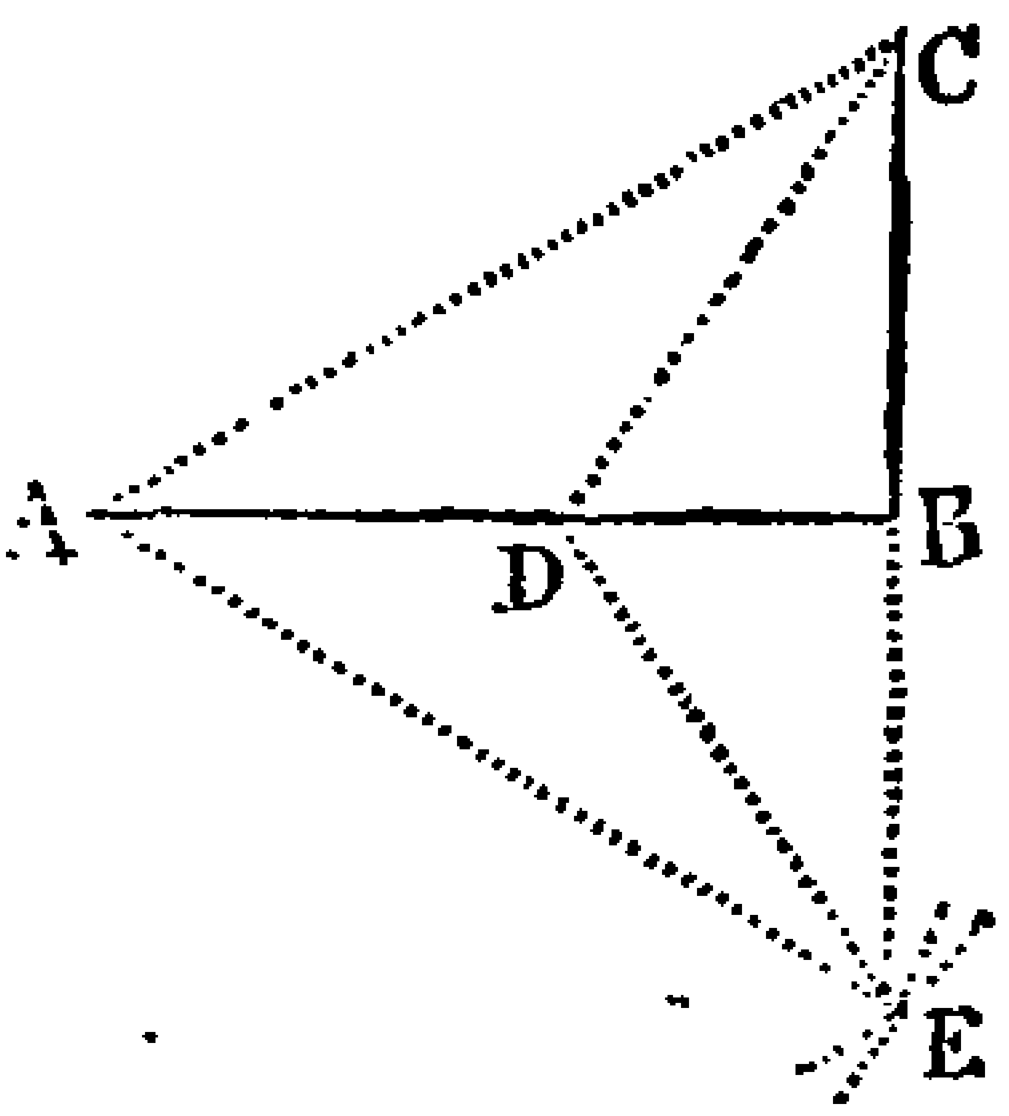
With one foot in C, deſcribe an arch to cut the given line A B in F and G, with one foot in G deſcribe an arch, and with the ſame diſtance, and one foot in F, deſcribe an arch to cut the former in D, from C to D draw a line, and it is done ; for C D will be the perpendicular required.



PROBLEM V.

From a given Point to let fall a Perpendicular on a given Line, when the ſaid Perpendicular is to fall ſo near the End of the given Line that it cannot be done as above, as at the Edge of a Sheet of Paper, &c.

Let C be the point from which the perpendicular is to be let fall on the line A B, from any point in the line A B, as at A ; with the diſtance A C, deſcribe an arch E, chuſe any other point in the line A B, as D, and with the diſtance D C deſcribe another arch interſecting the former in E, join C E, and it is done ; for C B will be the perpendicular required.

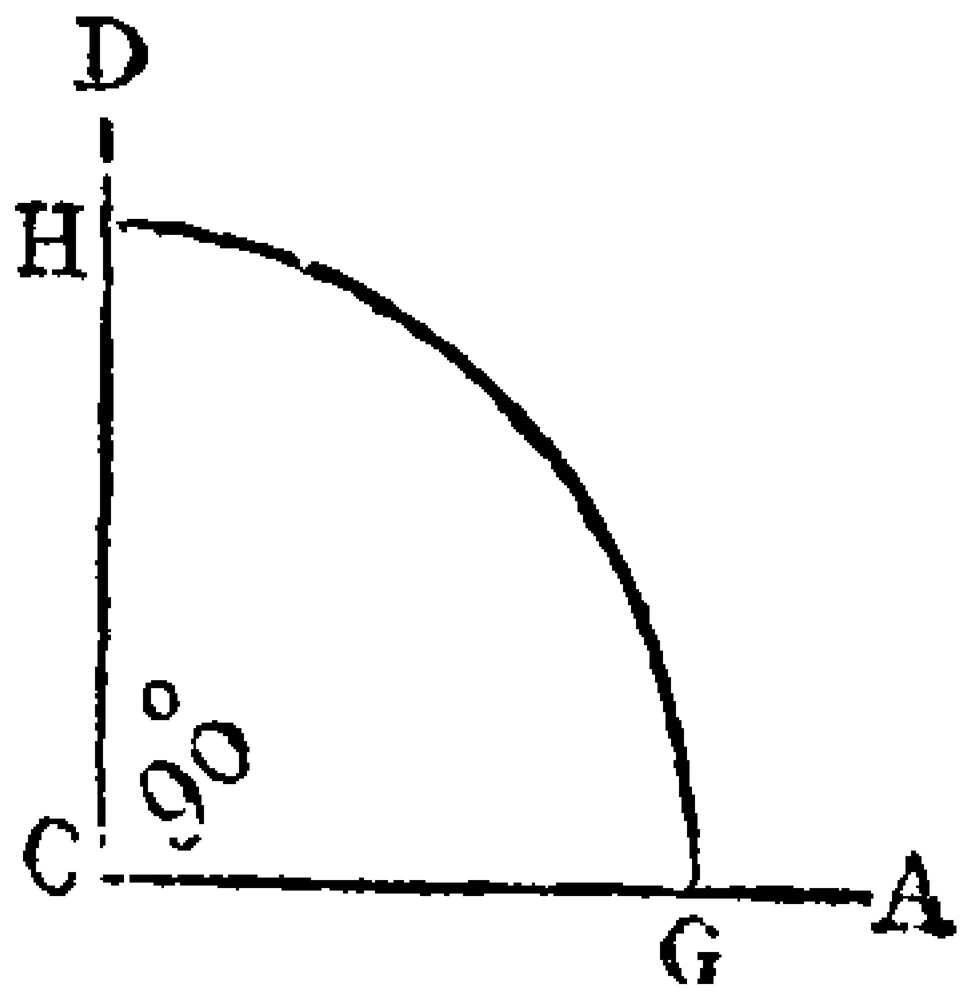


PROBLEM

PROBLEM VI.

To make Plane Angles, and first a Right Angle, containing 90 *Degrees.*

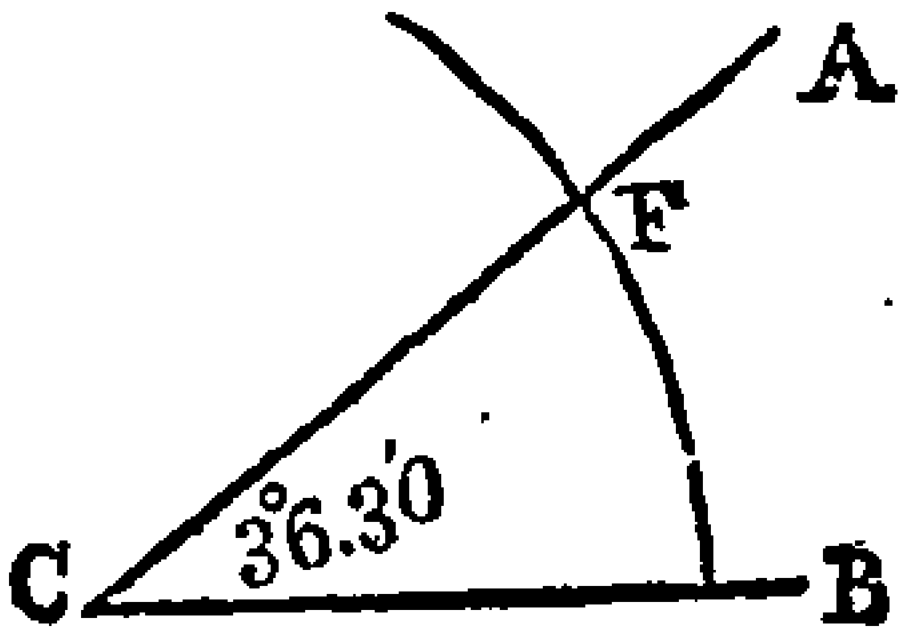
Draw the line C A; on C erect a perpendicular C D, and it is done; for the angle DCA is an angle of 90°. Or thus, On the point C, with the chord of 60° describe an arch G H, and set off thereon from G to H the distance of the chord of 90°, and from C through H draw C H D, which will form the angle DCA of 90° required.



PROBLEM VII.

To make an Acute Angle equal to any Number of Degrees. Suppose 36° 30′.

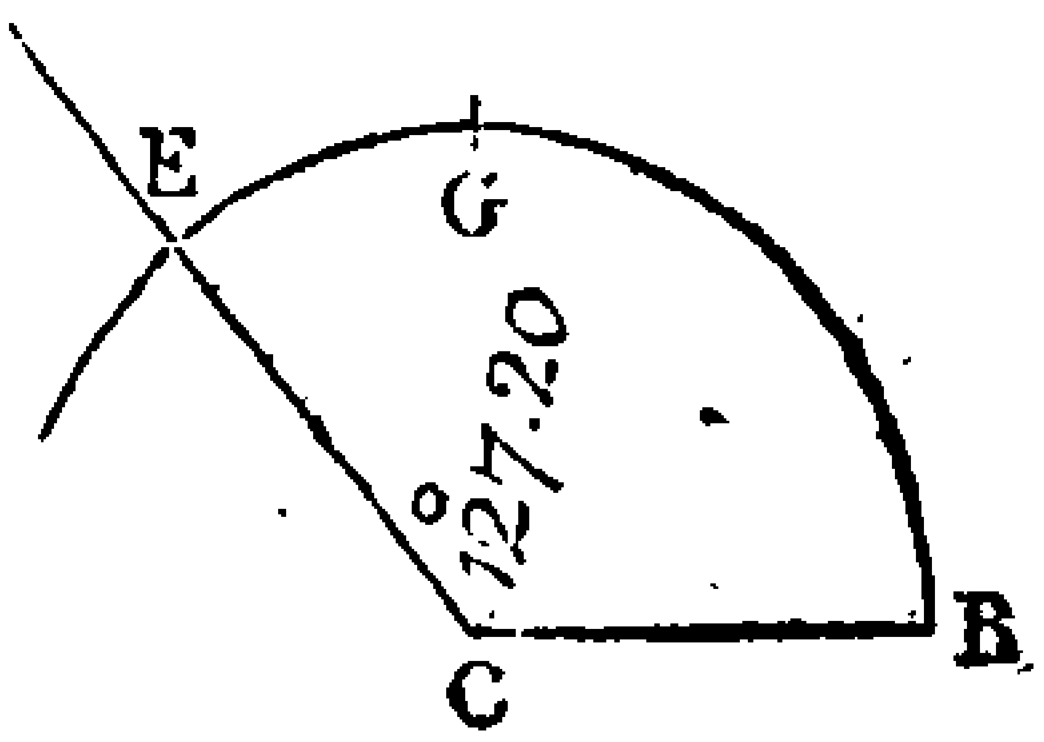
Draw the Line BC with the chord of 60° or radius, in your compasses, and one foot on C draw the arch FB, on which set off 36° 30′, or $36\frac{1}{2}$, from B to F, through F and the center C draw the right line A C and it is done; for the angle A C B will be an angle of 36° 30′, as was required.



PROBLEM VIII.

To make an Obtuse Angle that shall contain 127° 20′.

Draw C B; take the chord of 60° in your compasses, and with one foot on C describe an arch; now as we can take off only 90°, set off 90° from B to G, and from G to E set off the excess above 90°, which is 37° 20′, or $37\frac{1}{3}$; draw the line C E and it is done; for the angle E C B will be an angle of 127° 20′

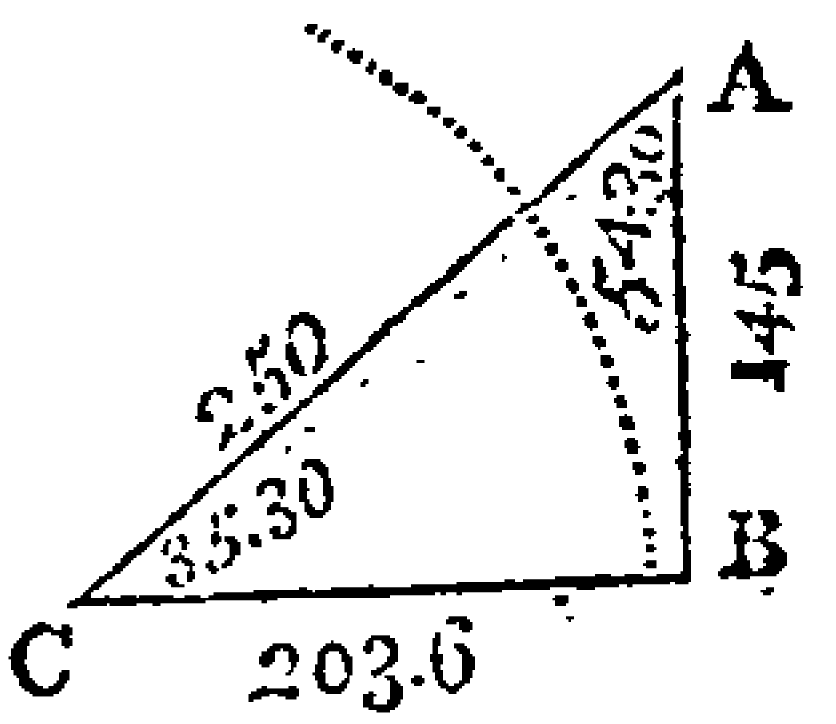


PROBLEM IX.

The Angles and Hypothenuse of a Right-angled Triangle given, to find either of the Legs.

Given the hypothenuse 250 leagues, the angle opposite the base 54° 30′, consequently the other angle 35° 30′; the base and perpendicular are required.

Draw the line C B, and at C make an angle equal to 35° 30′ by drawing the line CA, take 250 from any convenient scale of equal parts, and set it off from C to A, from A let fall the perpendicular A B, to cut the line C B, and it is done; for AB measured on the same scale, gives 145, and C B 203.6 leagues.



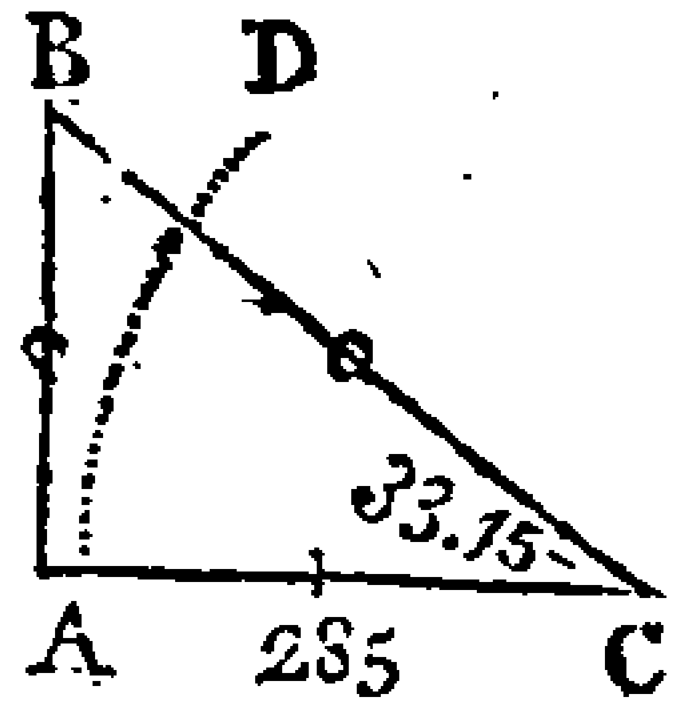
Note. The two acute angles of a right-angled triangle make 90 degrees.

PROBLEM X.

The Angles and one Leg of a Right-angled Triangle being given, to find the Hypothenuse and the other Leg.

The angle A C B 33° 15′, the leg A C 285 miles, to find the hypothenuse, and the other leg A B.

Draw the base A C, lay off on it 285 from your scale of equal parts, from A to C; on A erect the perpendicular A B, with the chord of 60° sweep the arch A D, and on it set off 33° ¼, from your line of chords from A to D, through D and C, draw the right line B C, then B C will measure 341 nearly, and B A 187 nearly, on the same scale of equal parts that A C was taken from.

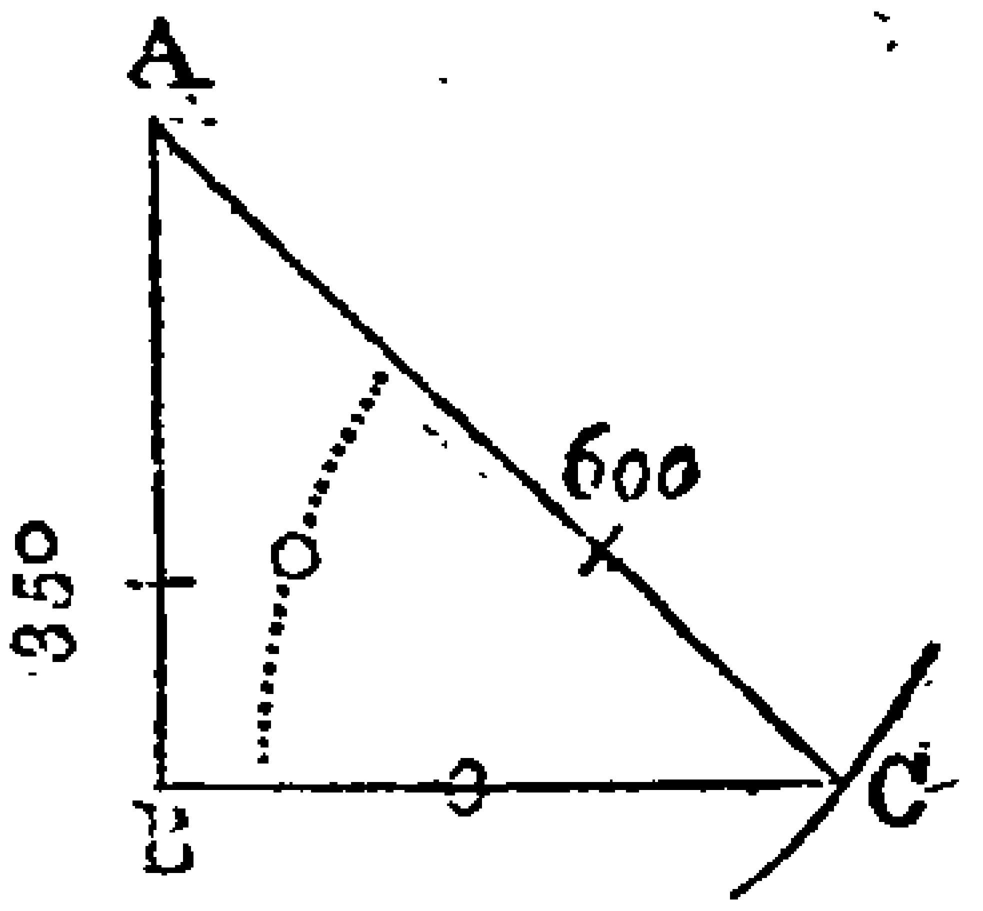


PROBLEM XI.

The Hypothenuse and one Leg given, to find the Angles and the other Leg.

The leg A B 350, the Hypothenuse 600 given, to find the angles and leg B C.

Draw the base C B, on B erect the perpendicular A B, on which set off 350 from B to A, on the point A with an opening of 600. Draw an arch to cut the line B C, in the point C, draw A C, and it is done; for the angle ACB will measure 35° 41′ on the line of chords, and B C will measure 487 nearly, on the same scale of equal parts before used.

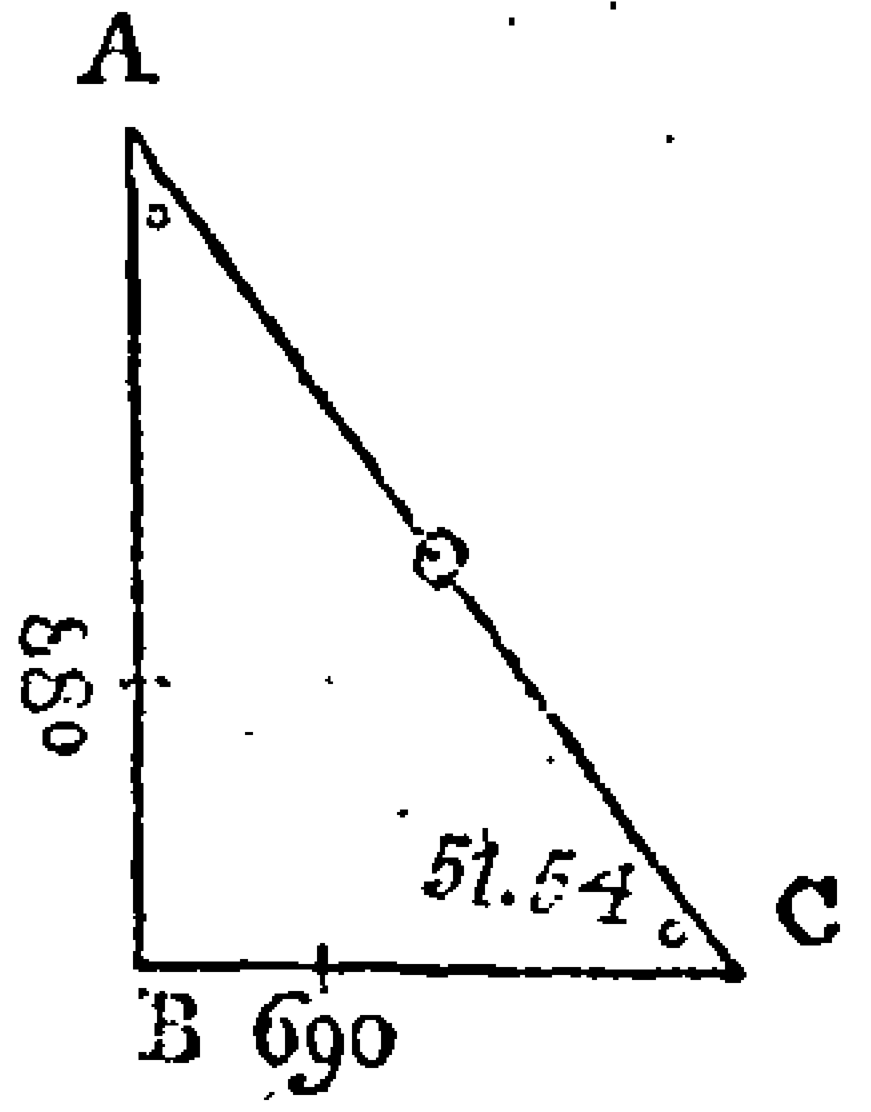


PROBLEM XII.

The legs given, to find the Angles and the Hypothenuse.

The leg A B 880 and B C 690 given, to find the angles A and C, and the hypothenuse AC.

Draw the base BC ; on B erect the perpendicular A B, make B C equal to 690, and AB equal to 880 ; join A C, and it is done ; for the angle C being measured as before, will be found as per figure, and the hypothenuse will measure 1118,2.

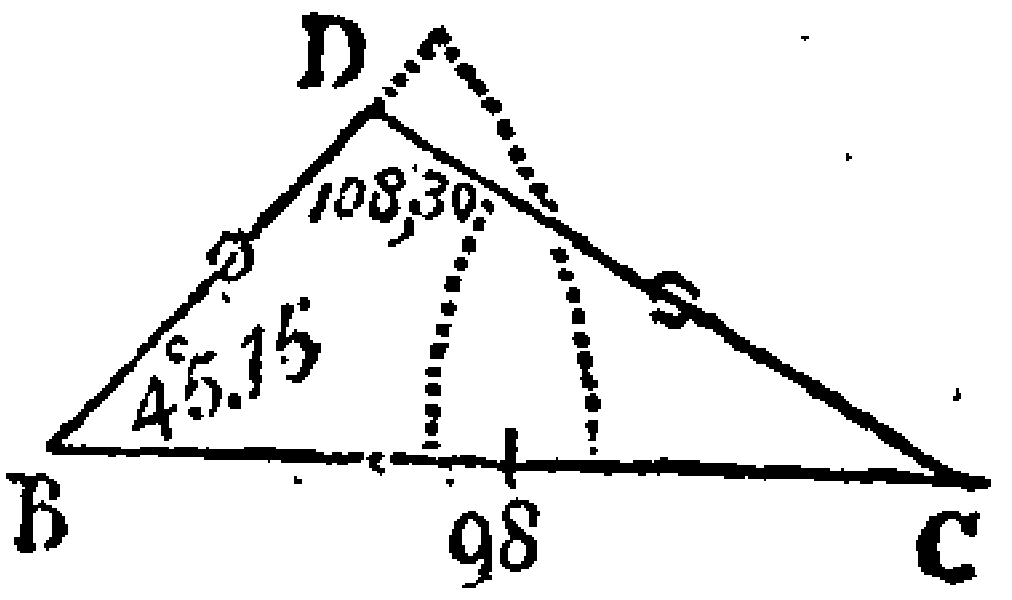


PROBLEM XIII.

Two angles and one Side, of an Oblique-angled Triangle given, to find either of the other Legs.

The angle BDC 108° 30', and CBD 45° 15' and consequently the angle BCD 26° 15', and the leg BC 98 given, to find the sides CD and BD.

Draw the line BC, which make equal to 98, on the point B describe an angle of 45° 15', then add 45° 15' to 108° 30', and the sum 153° 45' taken from 180, the remainder is the angle DCB = 26° 15' ; from the point C describe an arch with the chord of 60, and set off 26° 15', and it is done ; for the side DB will be 46 nearly, and DC 73,4, as was required.

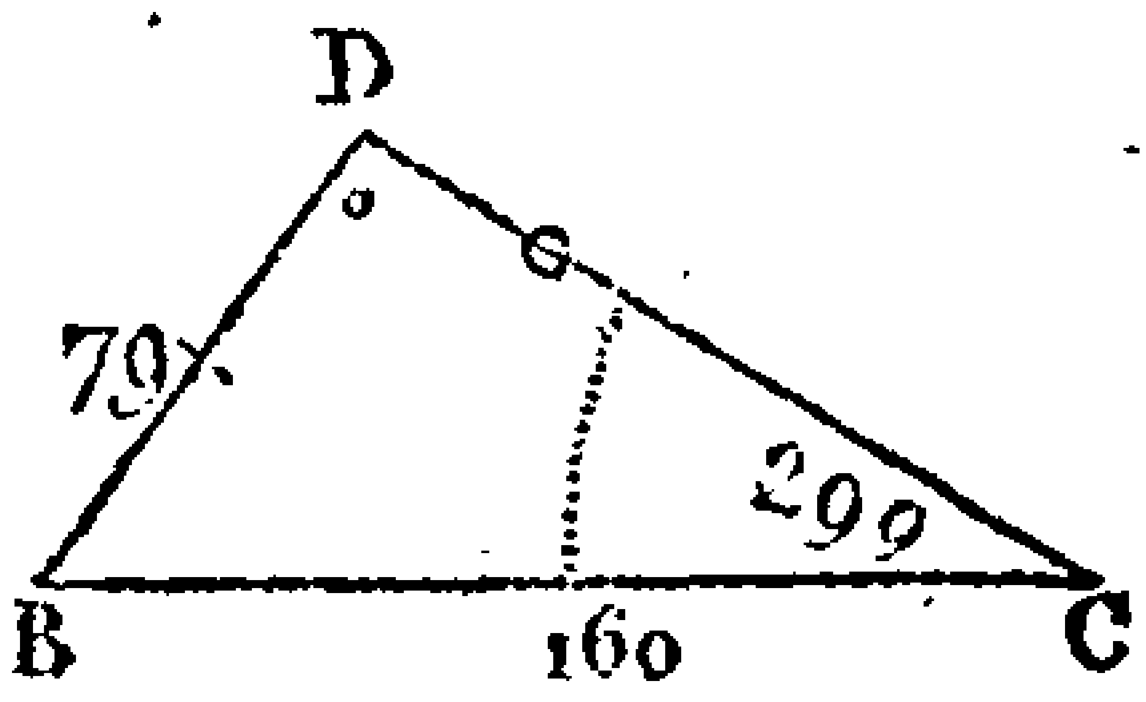


PROBLEM XIV.

Two Sides and an Angle opposite to one of them given, to find the other Angle and the third Side.

The side BC 160, and BD 79, and the angle C 29° 9' given, to find the angle D, and the side CD.

Draw the line BC equal to 160, on C make the angle DCB equal to 29° 9', take 79 in your compasses, and with one foot on B, lay the other upon the line CD, draw the line BD, and it is done ; for the angle D will be 99° 25' the angle B 51° 26', and the side DC 127 nearly.

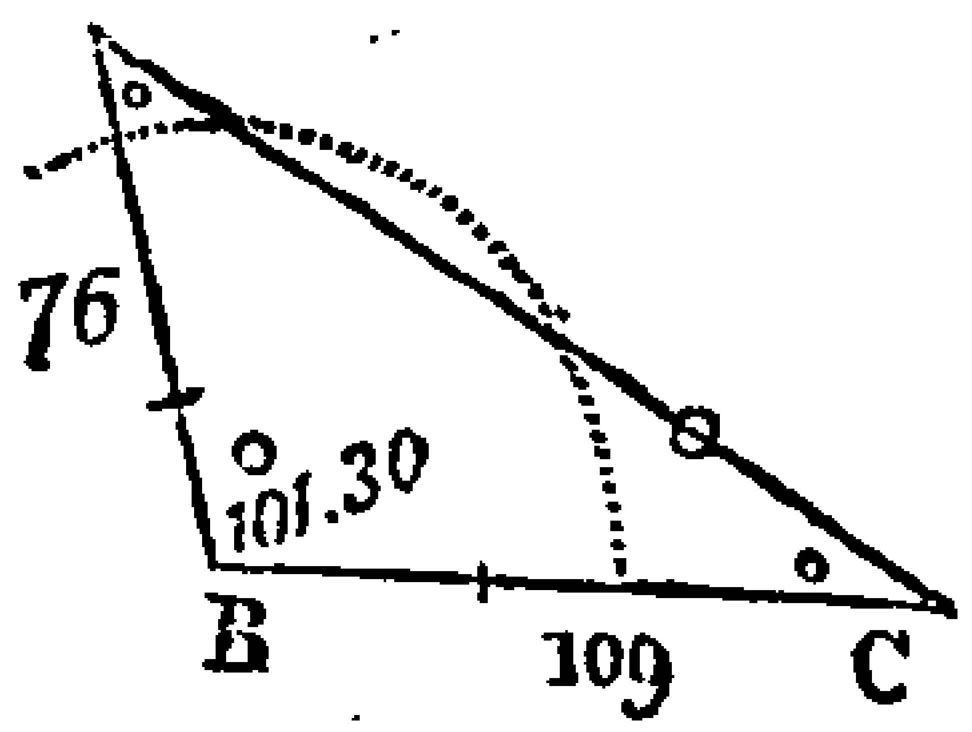


PROBLEM XV.

Two Sides and their contained Angle given, to find either of the other Angles, and the third Side.

The side BC 109, BD 76, and angle CBD 101° 30′ given, to find the angles BDC or BCD and the side CD.

Draw the line CB, which make equal to 109; on B describe an arch on which set off from BC towards D 101° 30′, then draw the line BD equal to 76, join DC, and it is done; for the angle BDC will be 47° 32′, the angle BCD 30° 58′, and the side DC will be 145, as was required.

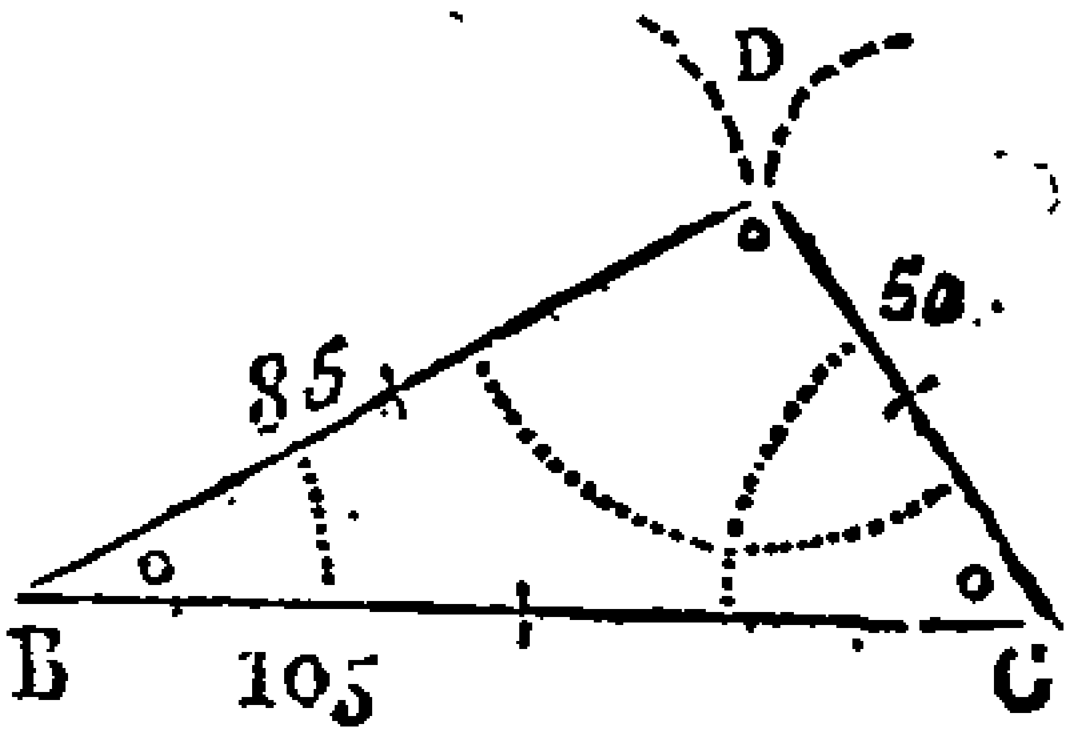


PROBLEM XVI.

Three Sides given, to find the Angles.

The sides BC 105, BD 85, and CD 50 miles given, to find the angles BDC, or BCD, and CBD.

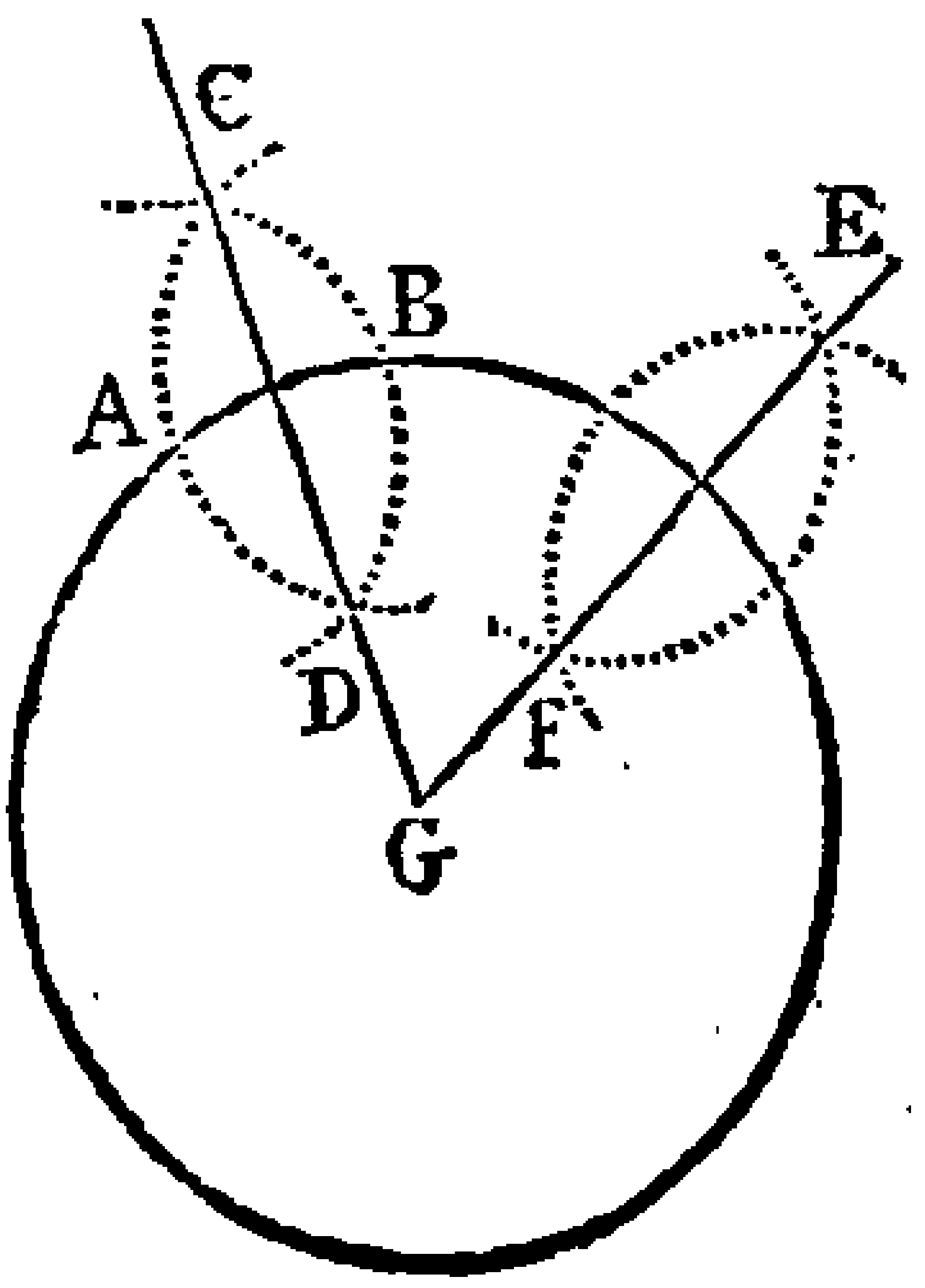
Draw the line BC equal to 105, take CD equal to 50 in your compasses, and with one foot in C describe an arch as at D, then take BD 85 in your compasses, and with one foot in B cut the former arch in D, join BD and DC, and it is done; for the angle B, being measured, will be found 28° 4′, the angle C 53° 8′, which, being added together, is 81° 12′, and their sum subtracted from 180°, leaves angle D 98° 48′, as was required.



PROBLEM XVII.

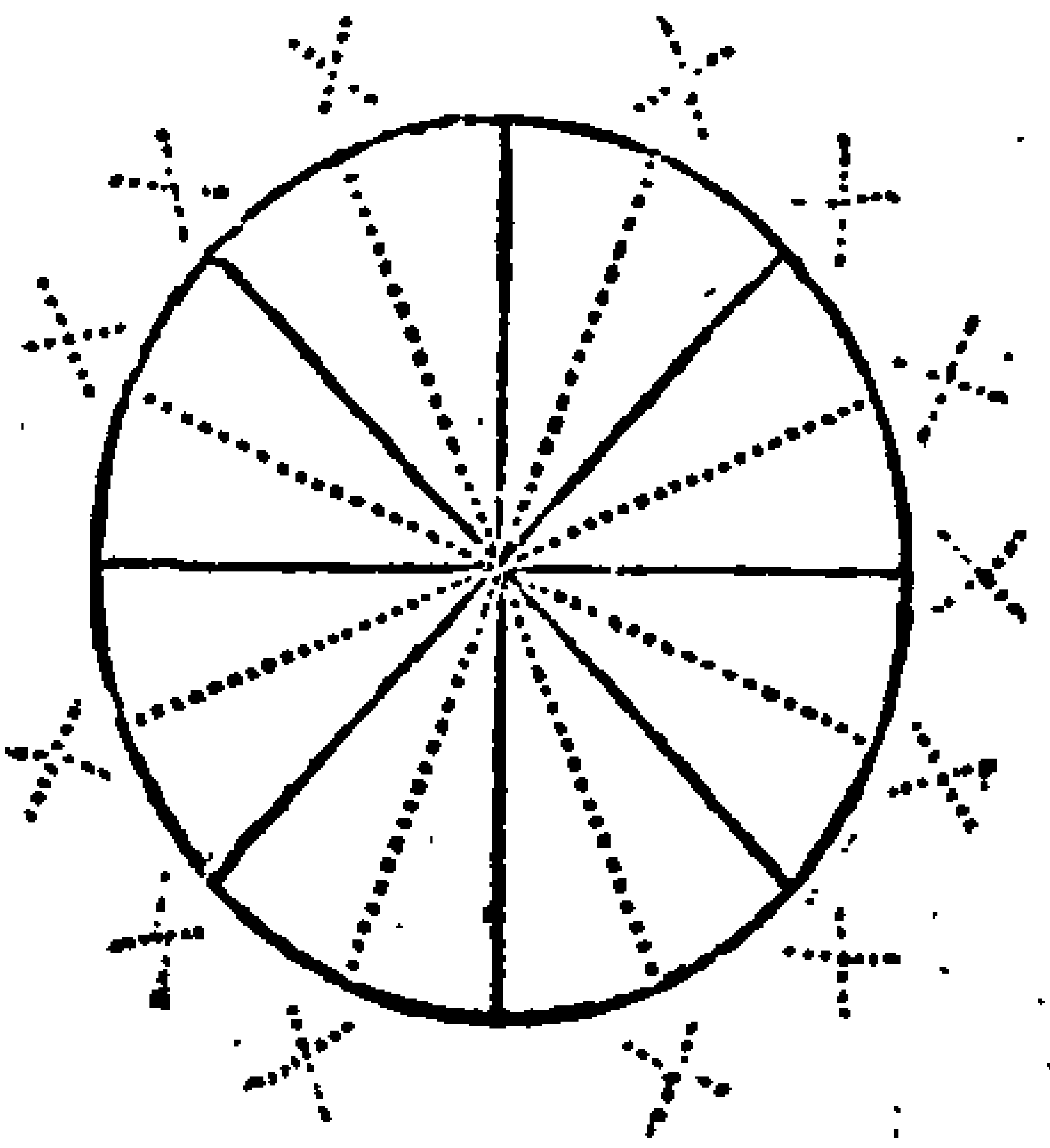
To find the Centre to a given Circle.

With any radius, and one foot in the circumference as at A, describe an arch of a circle, as CBD, then removing the foot from A to where it cuts the given circle, as at B, on B describe another arch, cutting or crossing the former, as C A D, and through the points of intersection draw the right line C D, which will give one right line passing through the centre; in like manner may another right line be drawn, as E F G, which shall cross the first right line at the centre required, for any two diameters will always cut or cross one another in the central point.



PROBLEM XVIII.

To divide a Circle into any Number of equal even Parts, as 4, 16, 32.



First draw the diameter through the center, which will divide it into two equal Parts, bisect the diameter with another right line perpendicular thereto, and the circle will be divided into four equal parts or quadrants; bisect each of these quadrants again by right lines drawn through the center and it will be divided into eight equal parts, and so may you continue on your bisections any number of times, that is, 8, 16, 32, &c. doubling the number of even parts. This problem is useful in constructing the Mariner's Compass.

PROJECTION

PROJECTION

OF THE LINES OF

SINES, TANGENTS, AND SECANTS,

ON THE PLANE SCALE.

1ſt. WITH the radius you intend for your ſcale, deſcribe a ſemicircle A D B C, and upon the center C raiſe the perpendicular C D, (which will divide the ſemicircle into two quadrants, A D, B D) continue CD directly to S, and upon B raiſe the perpendicular B T, then draw the right lines B D and A D.

2dly. Divide the quadrant B D into 9 equal parts; then will each of theſe be 10 degrees. Again you may ſubdivide each of theſe parts into ſingle degrees; and theſe again, if your radius admits it into minutes, or ſome aliquot parts of a degree greater than minutes.

3dly. Set one foot of the compaſſes in B and transfer each of the diviſions in the quadrant BD to the right line BD, then is B D a line of chords.

4thly. From the points 10, 20, 30, &c. in the quadrant BD, draw right lines parallel to C D, till they cut the radius C B, then is the line C B divided into a line of ſines, which muſt be numbered from C towards B.

5thly. If the ſame line of right ſines be numbered from B towards C, it will become a line of verſed ſines, which may be continued to 180°, if the ſame diviſions be transferred on the ſame line on the other ſide of the center C.

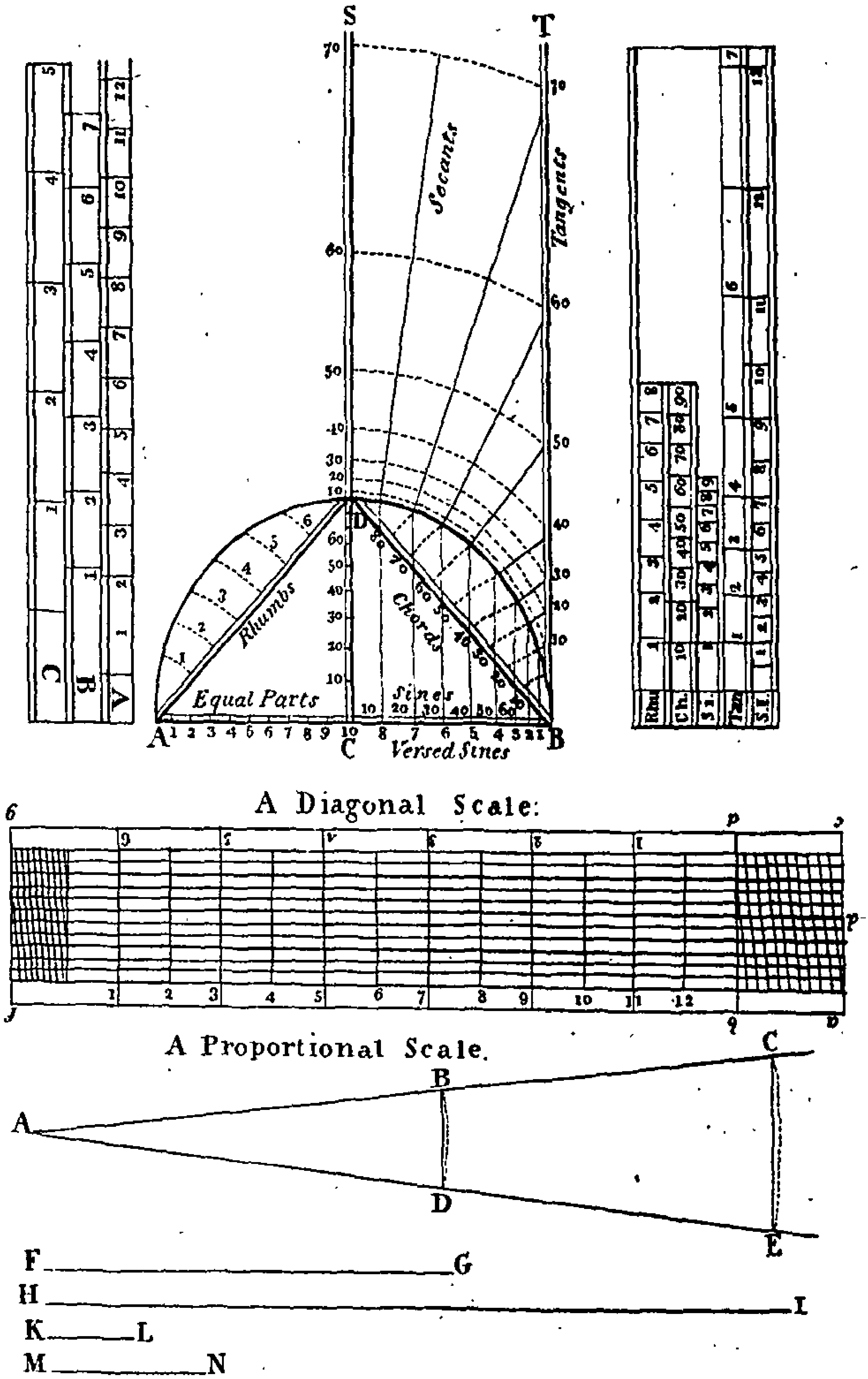
6thly. From the center C, through the ſeveral diviſions in the quadrant B D, draw right lines till they cut the tangent B T, ſo will the line B T become a line of tangents.

7thly. Setting one foot of the compaſſes in C, extend the other to the ſeveral diviſions 10, 20, 30, &c. in the tangent line B T, and transfer theſe extents ſeverally into the right line C S, then will the line C S be a line of ſecants.

8thly. Right lines drawn from A to the ſeveral diviſions 10, 20, 30, &c. in the quadrant B D, will divide the radius C D into a line of ſemitangents.

9thly. Divide the quadrant A D into eight equal parts, and from A transfer theſe diviſions ſeverally into the line A D, then is A D a line of rhumbs, each diviſion anſwering to 11° 15 upon the line of chords. The uſe of this line is for protracting and meaſuring angles, according to the common diviſion of the Mariner's compaſs. If the radius A C be divided into 100 or 1000, &c. equal parts, and the lengths of the ſeveral ſines, tangents, and ſecants, correſponding to the ſeveral arches of the

PROJECTION OF THE PLAIN SCALES, &c.



Newburyport Published by Edmund M Blunt.

the quadrant be meaſured thereby, and theſe numbers be ſet down in a table, each in its proper column, you will by theſe means have a triangular canon of numbers, by which the ſeveral caſes in Trigonometry may be ſolved, their right lines graduated as above, being placed ſeverally upon a ruler, form the inſtrument called the Plane Scale: by which the lines and angles of all triangles may be meaſured. All right lines, as the ſides of plain triangles, &c. when they are conſidered ſimply as ſuch without having any relation to a circle, are meaſured by ſcales of equal parts, one of which is ſubdivided equally into 10, and this ſerves as a common diviſion to all the reſt. In moſt ſcales an inch is taken for a common meaſure, to determine their largeneſs and number of parts: what an inch is divided into, is generally ſet at the end of the ſcale, as in the ſcales A, B, and C; the numbers 10, 20, 30, 45, ſhew that ſo many parts of the ſcales A, B, C, are contained in an inch. By any ſcale of equal parts, divided as above, any number leſs than 100 may be readily taken; but if the number ſhould conſiſt of three places of figures, the value of the third figure can only be gueſſed at; wherefore in theſe ſcales it is better to uſe ſuch a ſcale as D, called a diagonal ſcale, by which any number of three figures may be exactly found.

Having prepared a ruler of convenient breadth for your ſcale, (which may be an inch more or leſs) Firſt, near the edges thereof, draw two right lines, *af*, *cg*, parallel to each other; then divide one of theſe lines as *af*, into equal parts, according to the largeneſs you intend your ſcale; and through each of theſe diviſions draw perpendicular right lines as far as the line c g; next divide the breadth into 10 equal parts, and through each of theſe diviſions draw right lines parallel to the former af and cg; again divide the length a, b, c, d, each into 10 equal parts, and from the point to the firſt diviſion in the line d q, draw a right line; then, parallel to that line, draw right lines through all the other diviſions, and the ſcale is done.

Beſides the lines already mentioned, there is another on the plane ſcale marked ML, which is joined to a line of chords; and ſhews how many miles eaſting or weſting make a degree of longitude in every latitude; theſe ſeveral lines are generally put on one ſide of a ruler, two feet long; and on the other ſide are laid down a ſcale of the logarithms of the ſines, tangents, and numbers, which is commonly called Gunter's Scale, and as it is of general uſe, it requires a particular deſcription.

DESCRIPTION

DESCRIPTION AND USE OF *GUNTER'S SCALE.*

WHILE the reader is perusing the following, it is proper he should have a GUNTER'S SCALE before him.

Gunter's Scale hath set upon it these eight lines following.

1st. Sine Rhumbs marked (SR) is a line which contains the logarithms of the natural sine of every point and quarter point of the Mariner's Compass figured from the left hand towards the right, with 1, 2, 3, 4, 5, 6, 7, to 8, where is a brass pin, and where it can be done, into halves and quarters.

2d. Tangent rhumbs marked (TR) also corresponds to the logarithm of the tangent of every degree of the said compass, and is figured 1, 2, 3, 4, at the center, where there is a pin, and from thence towards the left hand with 5, 6, 7, it is also divided, where it can be done, into halves and quarters.

3d. The Line of numbers marked (Num.) contains the logarithms of the numbers, and is figured thus; near the left hand it begins at 1, and towards the right hand is 2, 3, 4, 5, 6, 7, 8, 9; and then 1 is the middle, at which is a brass center pin, going still on 2, 3, 4, 5, 6, 7, 8, 9, and 10 at the end, where there is another center pin; (as this line is generally much used, it requires a larger description). The first one may be counted for 1, or 10, or 100, or 1000, and then the next 2 is accordingly 2, or 20, or 200, or 2000, &c. Again, the first 1 may be reckoned 1 tenth, or 1 hundredth, or 1 thousandth part, &c. then the next is 2 tenth, or 2 hundredth, or 2 thousandth parts, &c. so that if the first 1 be esteemed 1, the middle one is then 10, and 2 to its right is 20, 3 is 30, 4 is 40, and 10 at the end is 100; again if the first 1 is 10, the next 2 is 20, 3 is 30, so on, making the middle 1 now 100, the next 2 is 200, 3 is 300, 4 is 400, and 10 at the end is now 1000. In like manner if the first 1 be esteemed 1 tenth part, the next 2 is 2 tenth parts, and the middle 1 is 1, and the next 2 is 2, and 10 at the end is now 10. Again, if the first 1 be counted 1 hundredth part, the next is 2 hundredth parts, the middle one is now 10 hundredth parts or one tenth part, and the next 2 is two tenth parts, and 10 at the end is now but one whole number or integer.

As the figures are increased or diminished in their value, so in like manner must all the intermediate strokes or subdivisions be increased or diminished; that is, if the first 1 at the left hand be counted 1, then 2 (on the right hand of it) is 2, and each subdivision between them now is 1 tenth part, and so all the way to the middle 1, which now is 10, the next 2 is 20, now the longer strokes between 1 and 2 are to be counted

from

from 1 thus 11, 12, (where is a braſs pin,) then 13, 14, 15, ſometimes a longer ſtroke than the reſt, then 16, 17, 18, 19, 20, at the figure 2; and all the ſhorter ſtrokes between them longer are now each to be counted for $\frac{1}{10}$ parts from the middle 1 to the next 2, now 20, from whence the longer ſtrokes between the figures are units, thus 21, 22, 23, &c. to 3, which now is 30, and the ſhorter ſtrokes each between them, now is the tenth part of an integer; from 3, each ſhort ſtroke or diviſion, is 1 tenth part of an unit. Again, if 1 at the left hand be 10, the figures between it and the middle 1 are common tens; and the ſubdiviſion between each figure are units; from the middle 1 to 10 at the end; each figure is ſo many hundredths; and between theſe figures each longer diviſion is 10; from the middle 1 to 2, each leſs diviſion is 2 units; and from 2 to the end, each ſhorter diviſion is 5 units. From this deſcription it will be eaſy to find the diviſions repreſenting any given number, thus: Suppoſe the point repreſenting the number 12 were required; Take the diviſion at the figure 1, in the middle for the firſt figure of 12; then for the ſecond figure count 2 tenths, or longer ſtrokes to the right hand, and this laſt is the point repreſenting 12, where the braſs pin is.

Again, ſuppoſe the number 22 were required, the firſt figure being 2, I take the diviſion to the figure 2, and for the 2d figure 2, count 2 tenths onwards, and that is the point repreſenting 22.

Again, Suppoſe 1728 were required; for the firſt figure 1, I take the middle 1, for the ſecond figure 7, count onwards as before, and that is 1700; then for the third 2 count 2 tenths from the laſt, and it repreſents 1720; laſtly, for the 4th, figure 8, eſtimate 8 parts out of 10 of the next ſmaller diviſion, or a little leſs than 10, this point, laſt found, repreſents 1728.

Required the Point, repreſenting the number 435; from the 4 in the 2d interval count towards 5 on the right, three of the larger diviſions, and one of the ſmaller, and that will be the diviſion expreſſing 435, and the like of other numbers, which by a little practice is readily done.

All fractions found in this line muſt be decimals; and if they are not, they muſt be reduced into decimals, which is eaſily done by extending the compaſſes from the denominator to the numerator; that extent laid upon 1 in the middle will reach to the decimal required.

Example. Required the decimal fraction equal to $\frac{3}{4}$, extend from 4 to 3, that extent will reach from 1 on the middle to 75, towards the left hand; the like may be obſerved of any other vulgar fraction.

Multiplication is performed on this line, by extending from 1 to the multiplier; that extent will reach from the multiplicand to the product.

Suppoſe, for example, it were required to find the product of 16 multiplied by 4, extend from 1 to 4, that extent will reach from 16 to 64, the product required.

Division being the reverſe of Multiplication, therefore extend from the diviſor to unity, that extent will reach from the dividend to the quotient.

Suppoſe 64 to be divided by 4, extend from 4 to 1, that extent will reach from 64 to 16, the quotient.

N. B. This

N. B. This extent in Division is to be taken backwards from the dividend to the quotient, but in Multiplication it is taken forward from the multiplicand to the product, they being contrary to one another.

PROPORTION, or the RULE OF THREE, being performed by Multiplication and Division, therefore extend from the first term to the second, that extent will reach from the third term to the fourth.

Example. If the diameter of a circle be 7 inches, and the circumference 22, what is the circumference of another circle the diameter of which is 14 inches?

Extend from 7 to 22, that extent will reach from 14 to 44, the same way.

In like manner may any other proportion of any denomination be worked, which makes this line of general use, particularly in measuring Superficies and Solids, which is done by extending from 1 to the breadth, that extent will reach from the length to the superficial content.

Example. Suppose a plank, or board 15 inches broad, and 27 feet long, the content of which is required.

Extend from 1 to 1 foot 3 inches; that extent will reach from 27 feet to 33,75 feet, the superficial content. Or extend from 12 inches to 15, &c.

The solid content of any bale, box, chest, &c. is found by extending from 1 to the breadth, that extent will reach from the depth to a fourth number, and the extent from 1 to that fourth number, will reach from the length to the solid content.

Example 1st. What is the content of a square pillar, whose length is 21 feet 9 inches, and breadth one foot three inches?

The extent from 1 to 1,25, will reach from 1,25, to 1,56, the content of 1 foot in length; again, the extent from 1 to 1,56 will reach from the length 21,75 to 33,98 or 34 the solid content in feet.

Example 2d. Suppose a square piece of timber, 1,25 feet broad, ,56 deep, and 36 long, be given to find the content;

Extend from 1 to 1,25, that extent will reach from ,56 to ,7, then extend from 1 to ,7, that extent will reach from 36 to 25,2 the solid content. In like manner may the contents of any bales, &c. be found, which divided by 40 will give the tonnage.

3dly. The line of Sines marked (Sin.) begins at the left hand, and is figured thus: 1, 2, 3, 4, 5, &c. to 10; then 20, 30, 40, &c. to 90, ending at the right hand, where a brass center pin, here, and in all lines under it, are called degrees.

4thly. The line of versed sines, marked (V.S.) begins at the right hand, against 90° on the sines, and from thence figured towards the left hand thus: 10, 20, 30, 40, &c. ending at the left hand—about 169°; each of the subdivisions, from 10 to 30, are 2 degrees, and from thence to 90, it is single degrees, and from thence to the end, each degree is divided into 15 minutes.

5thly. The line of tangents, marked (Tang.) begins at the left hand as do the sines; from thence it is figured to the right hand, thus: 1, 2, 3, &c. to 10, and so on 20, 30, 40, and 45, at the right hand, where is a little brass pin, just under and even with 90° in the sines; from thence

thence back again it is figured 50, 60, 70, 80, &c. to 89, ending at the left hand where it began at 1 degree. The ſubdiviſions of this line are the ſame as thoſe of the ſines.

6thly. The line of the meridional parts, marked (Mer.) begins at the right hand, and is numbered thus: 10, 20, 30, to the left hand, where it ends at 87 degrees. This line, with the line of equal parts marked (EP) under it, are uſed together, and only in Mercator's ſailing. The uppermoſt line contains the degrees of the meridian, or latitude, in a Mercator's chart; and the lower is the equator, and contains the degrees of longitude.

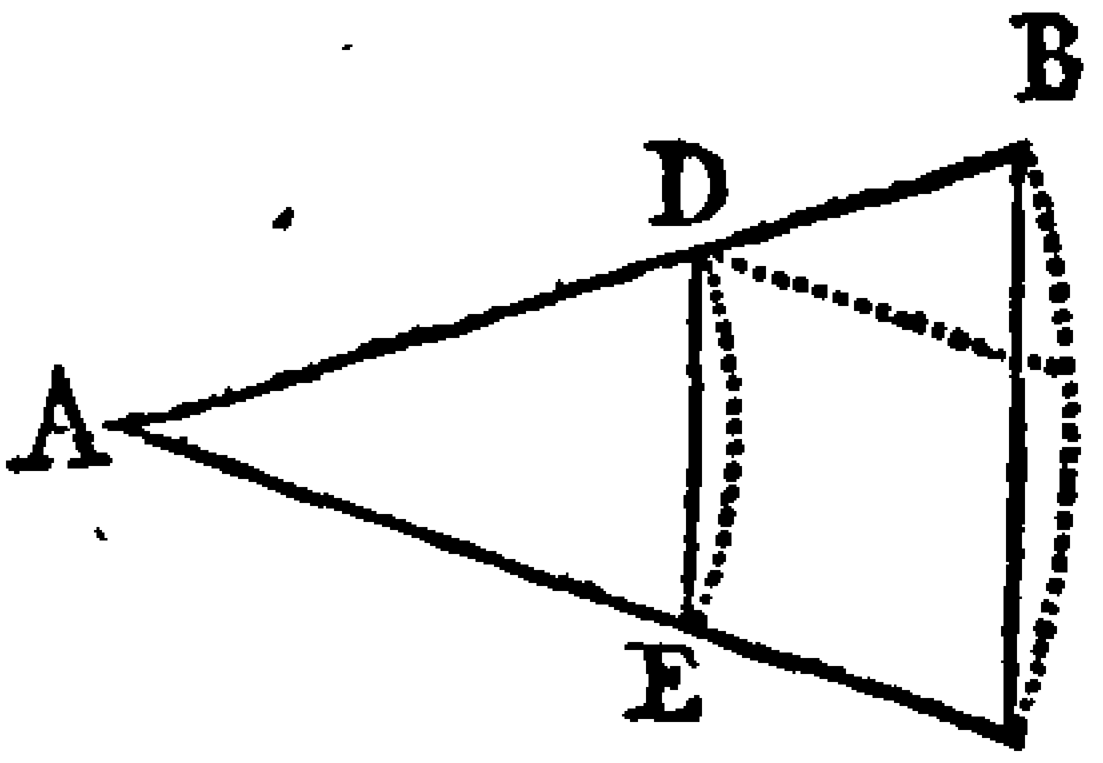
ON THE

USE OF THE SECTOR.

The Uſe of the Line of Lines, marked on the ſame ſide of the Sector (LL.)

THE uſe of the ſector is taken from the property of two equilateral ſimilar triangles, thus in the following figure:

AB and AC are equal legs, or radii, of an iſoſceles triangle, ſtanding on the baſe BC: Now, by the property of ſimilar ∠s, drawing DE parallel to BC, the two triangles ADE and ABC are ſimilar and proportional; or AD : DE : : AB : BC. AB : BC : : AD : DE.



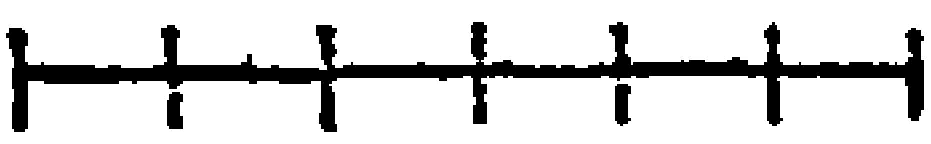
Now, ſuppoſing AB and AC to be divided each into 100 equal parts, and it is required to divide any opening of the legs, as BC, in the ſame ratio as AB or AC is divided into, it is inſtantly performed by taking laterally the diſtance DE in your compaſſes, and apply it from C to B, and the line BC will be divided in the ſame ratio as is the line AB or AC.

 PROBLEM I.

PROBLEM I.

To divide a given Line into any Number of Equal Parts.

Suppoſe DE is required to be divided into 6 equal parts; thus



Operation.—Take DE in your compaſſes, and open the legs of the ſector, ſo that the opening of the compaſſes DE ſhall juſt fall on the line of lines on each leg of the ſector, on 6.6; then take off 1.1 laterally, and ſet it from D to D 1, and D 1 will be the 1-ſixth part of the given line DE.

To this problem may be referred the method of making a ſcale of a given length, to contain a given number of equal parts.

PROBLEM II.

Suppoſe the ſcale to the map of a ſurvey is 6 inches long, and contains 140 poles, required to open the ſector, ſo that a correſponding ſcale may be taken from the line of lines?

Solution.—Make the tranſverſe diſtance 7 and 7, or 70.70; *viz.* $\frac{140}{2}$ equal to 3 inches$=\frac{6}{2}$; and this poſſeſſion of the lines will produce the given ſcale.

PROBLEM III.

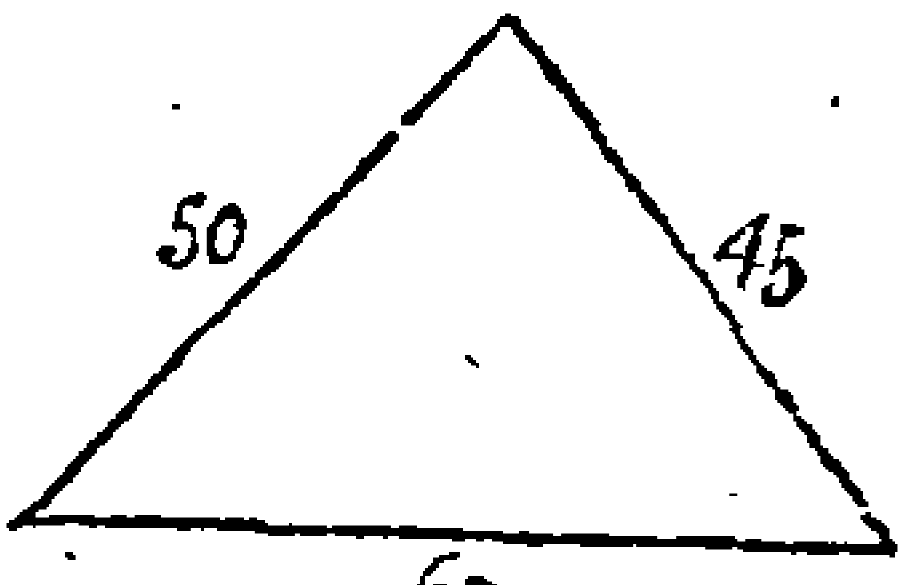
Let a ſcale of 4 inches to a degree in longitude, be reduced to another ſcale of 3 inches to a degree of longitude?

Solution.—Set off any diſtance on the 4-inch ſcale tranſverſely to 40.40 or 4.4, on the line of lines; with this opening take off 3.3 or 30.30, and it is done, this lateral diſtance being the proportional part required.

PROBLEM IV.

One ſide of any triangle being given, of any length, to meaſure the other two ſides on the ſame ſcale?

Let the triangle ABC be drawn. I would have the ſide AC meaſure 63. What are the meaſure of the other two ſides, AB, BC?



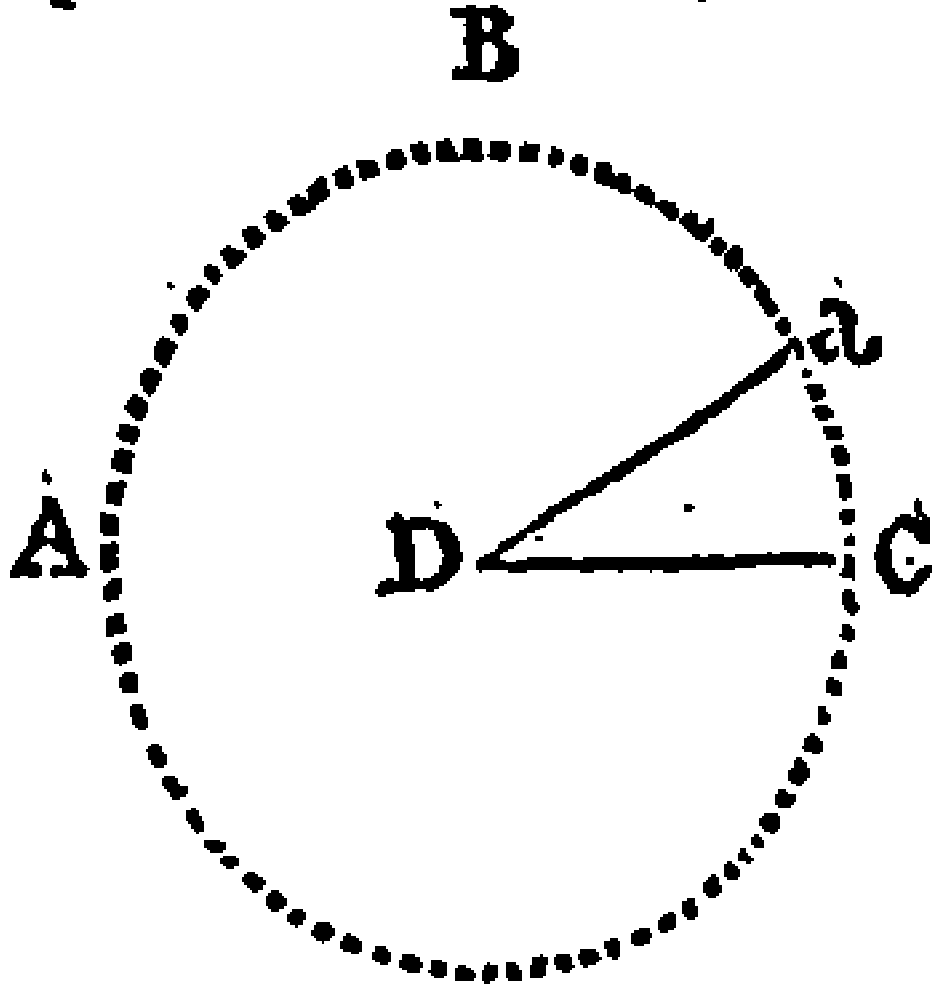
Solution.—Take AC in your compaſſes, and apply that diſtance tranſverſely to 6.3 or 63; to this opening of the ſector apply the diſtance AB in your compaſſes to the ſame number on both ſides of the rule tranſverſely; and where the two points fall will be the meaſure on the line of lines of the diſtance required; the diſtance AB will fall againſt 50.50, and BC againſt 45.45 on the lines LL on each ſide.

Use of the Line of Chords on the Sector, marked (CC) *on each side.*

The line of chords on the sector is laid down on both sides as far as 60°; each degree is divided in half or 30′; the use is only to lay down angles, or measure their arches to any given radius.

EXAMPLE I.

In the given circle ABC to lay off from the point C an ∠ of 30°.



SOLUTION.—Take the radius DC in your compasses, and open the sector until 60.60 on both sides fall on each point; with this opening take off 30.30 on both sides transversely, and apply it from C on the arch towards B, as at a, and it is done; and the ∠ a DC is an arch of 30° required.

In this manner, by setting 60.60 to radius on the chords, or 90.90 on the sines, or 45° 45° on the tangents, may the chord, sine, or tangent, of any angle, be found, set off, or known, to any given radius.

LOGARITHMS.

LOGARITHMS are a series of numbers, invented by Lord Napier, Baron of Marchinston in Scotland, by which the work of Multiplication may be performed by addition, and the operation of division may be done by subtraction; so that great time and trouble are saved thereby in the performance of all arithmetical operations; for if the logarithm of any two numbers be added together, the sum will be the logarithm of the product; and if from the logarithm of the dividend you substract the logarithm of the divisor, the remainder will be the logarithm of the quotient. Again, if the logarithm of any number be divided by 2, the quotient will be the logarithm of the square root of that number; or if the logarithm of any number be divided by 3, the quotient will be the logarithm of the cube root of that number, and so on.

The most convenient series now made use of is the following:

0	1	2	3	4	5	&c. logarithms.
1	10	100	1000	10000	1000000,	&c. logarithms.

By which you perceive the index of any logarithm always one less than the number of figures the integer contains.

To

To Find the Logarithm of any number containing lefs than 5 Figures.

EXAMPLES.

I would find the logarithm of 7?

Look in the table for the number 7 in the fide column, and againft it is 0.84510. This number having but one figure, the index thereto is 0.

I would find the logarithm of 79?

Look in the table for the number 79 in the fide column, and againft it is 89763; to which 1 is the index, becaufe the number contains two figures: Thus, 1.89763 is the log. of 79.

I would find the logarithm of 763?

Againft 763 in the firft fide column, is 88252; to which prefix the index 2, as the number contains 3 places of figures: Thus, 2.88252.

To find the Logarithm of 7634.

Find the logarithm of the three firft figures in the fide column as before; and cafting your eye on the numbers on the top line of the table, look for the remaining figure 4, bring your eye to bear down that column, and right againft 763 is the logarithm 88275, to which prefix the index 3, as it contains four places of figures, thus: 3.88275 is the logarithm of 7634.

To find the logarithm of any whole number to five places of figures.

Suppofe 76345?

Look out the logarithm of the three firft figures 763 in the fide column, and the next figure 4 in the top column as before, and againft the angle of meeting is 88275, as before. Take the difference between this logarithm and the next greater; that is, the difference between 275 and 281, which is 6; then fay, by the rule of three, if 10 gives 6, what will 5 give? that is its half or three; which, added to the logarithm 88275, makes 88278; to which prefix the index 4, as it contains five places of figures; and that makes the logarithm of 76845 to be 4.88278.

Again, to find the Logarithm of any Number to 6 places of figures, as 763458.

Find the logarithm of the 4 firft places of figures asbefore 88275, as above; then fay, if 100 gives 6 difference, what will 58 give? Anfwer 3; which added to 88275, makes 88278; to which prefix its index 5, makes the logarithm of 763458 to be 5.88278.

To

To find the Logarithm of any fixed Number, as 763.458.

Where the integer is 763, or has only three places of figures, the rule is: Find the logarithm to all the figures, the ſame as if they were whole numbers as before, to which prefix always the index of the integer, which in this number is 2; ſo that the log. of 763.458 is 2.88278 nearly the ſame as the above, only differing in its index.

To find the number anſwering to any logarithm to 4 places of figures.

Seek under the column o, at top of the table, the next leſs logarithm; note the number againſt it, and carry your eye along that line until you find the neareſt logarithm next leſs than the given one, and you will have the fourth figure at the top of the table, which affix to the three given ones in the firſt ſide column.

What is the number to the logarithm 3.77342?—I look in column o, and find under it, againſt the number 593, the logarithm 77305; and guiding my eye along that line I find the given logarithm 77342 under the column, with five at the top; ſo that the number is 5935.

The Number, if taken out by this precept, will be either the number required or the next leſs.

To find the number anſwering any logarithm to 5 places of Figures nearly.

Find the next leſs logarithm to the given one; and take its difference betwixt it and the given one; alſo take the difference betwixt the next greater logarithm, and next leſs to the given one; then ſay, as the difference of the next greater and next leſs is to 10, ſo is the former difference to the correction ſought;—as ſuppoſe you would find the number to the logarithm 4.59632?

4.59632
4.59627 The neareſt next log. I can find is 59627=its num. 39470
The next greater ditto is - 59638= 39480

5	- -	Difference	11	10

Then ſay, 11 : 10 : : 5 : 5 nearly, the correction; which I add to the number 3947, and it makes the number ſought to be 39475, anſwering to the logarithm 4.59632.

Note.—Aliquot or even parts may be taken of the difference between the leſs and greater logarithms, where it can be done, thus: In this laſt, 5 is nearly the half of 11, as 5 the number ſought is of 10, the difference of the two numbers belonging to the greater and leſs logarithms, which will often ſave time and trouble.

MULTIPLICATION

MULTIPLICATION BY LOGARITHMS.

CASE I.

To find the product of two whole or mixed Numbers.

Multiply	76	Log. = 1.88081	Multiply	76.4	Log. = 1.88309
by	54	1.73239	by	5.4	0.73239
Product	4104	= 3.61320	Product	412.5	= 2.61548

CASE II.

When both, or either, of the fractions are less than unity, as

0.265	Log. 9.42325	
0.031	8.49136	
.008215	= 7.91461	

Here the index of a fraction is 9, when the first decimal figure, as 2, stands in the first decimal place; but if it should stand in the second decimal place, as the 3 in .031, the index will be 8; if it stood in the third decimal place, as .0031, the index would be 7. Thus the number of cyphers, prefixed to any decimal, and the index of that decimal always together, make 9; so that if you take the number of cyphers prefixed to the decimal from 9, its proper index remains. In the addition reject 10 in the sum of the indices; and the proper product, or value of the product, will be obtained: By reason, if 9 represent the index of a fraction, 10 will represent, in this case, the index of unity. Indeed the index of unity may be assumed either 0, 10, 100, &c. as you please; but generally for most uses, it is not wanted to be more than 10, as in the sines, tangents, secants, &c. As 7 or 8 places of decimals are generally sufficient for all purposes, take these two more examples:

Multiply	3.72	Log. = 0.57054	Multiply	59.4	Log. = 1.77415
by	0.00064	6.80618	by	.000031	5.49206
Product	.0023808	7.37672	Product	.0018414	7.26621

Here the remainder to 9 is 2 in the index; therefore prefix two cyphers to the number of the logarithm 37672 for the product required.

DIVISION BY LOGARITHMS.

CASE I.

To divide a whole or mixed Number by a less whole or mixed Number.

Rule.—From the logarithm of the dividend subtract the logarithm of the divisor, and the remainder is the logarithm of the quotient.

Divide 4104 by 54			Divide 410.4 by 5.4.		
4104	Its logarithm is	3.61321	410.4	Its logarithm is	2.61321
54	Its logarithm is	1.73239	5.4	Its logarithm is	0.73239
76	Quotient	= 1.88082	76.0	Quotient	= 1.88082

CASE

CASE II.

When both, or either, fractions are less than unity?

As divide .008215 by .031.

.008215	Its log. is	7.91461
.031	Its log. is	8.49136
.265	Product	9.42325

NOTE.—In the indices here I borrow 10 in the same manner as I flung it away in addition.

Divide .0023808 by 3.72.

.0023808	Its log. is	7.37672
3.72	Its log. is	0.57054
.00064	Quotient	6.80618

NOTE.—If I had assumed the index of unity 100, then the index of the first number would have been 97 or 97.91461,

and .031 98.49136

99.42325

So that 99 is the index of the first decimal place under 100 in this case.

Divide 59.4 by 000031.

59.4	Its log. is	1.77415
.000031	Its log. is	5.49209
.0001915	Its Quotient	6.28209

NOTE.—Whatever index you make represent unity, omit it in the sum of the indices, and borrow it in the subtraction of indices, the sum or remainder will be the true index required.

To EXTRACT the ROOTS in LOGARITHMS.

As the multiplying the logarithm of any number by the index of its power, produces the logarithm of that power; so the division of any logarithm by its proposed index, the quotient will be the logarithm of the root required.

What is the square root of 324?

324	Its logarithm is	2)2.51054
18	Log. of the root is	1.25527

What is the cube root of 10648?

10648	Its log. is	3)4.02726
22	Log. of the root is	1.34242

To find any proposed root of any decimal fraction, you must first prepare the index for the division by the proposed power, thus: For the square you must add 10 to the index before you divide it; for the cube you must add 20 to its index before you divide it; and so on for the root of any power proposed.

EXAMPLE.—What is the square root of .001849?

.001849	Its log. is	7.26694
	Add	10.
		2) 17.26694
.043	The log. of the root is	= 8.63347

What is the cube root of .125?

.125	The log. is	9.09691
	Add	20.
	Sum	3)29.09691
.5	Its root =	9.69897

The

The APPLICATION of LOGARITHMS in measuring Boards, Timber, Glass, Stone, and all kinds of Packages, usually taken on board Ships.

Required the content of a board or plank $9\frac{1}{2}$ feet long and $1\frac{1}{4}$ foot broad?

Log. of $9\frac{1}{2}$ or 9.5 is	0.97772
$1\frac{1}{4}$ or 1.25 is	0.09691
11.88 nearly log. of cont.	1.07463

or 11 feet $10\frac{1}{2}$ inches nearly.

Required the content of a piece of glass 2.9 feet long, and 1.75 broad?

Log. of 2.9	= 0.46240
1.75	= 0.24304
5.075	= 0.70544

The content is 5.075 feet.

In like manner may any dimensions be squared, and the content be found.

If the solid content be required of any box, bale, &c. add the logarithms of the length, breadth, and depth together, the sum will be the log. of the solid content.

Example.—What is the solid content of a box whose depth is 2.7, breadth 2.3, and length 4.5 feet?

2.7	Its log. is	0.43136
2.3	Its log. is	0.36173
4.5	Its log. is	0.65321

Sum equal the log. of the content 1.44630 = number 27.95 or 28 feet nearly.

The diameter of a cask at the head and bung, and also its length being given, to find its content in beer and wine measure?

1st. Multiply the difference of the head and bung diameter by 0.7, and add the product to the head diameter for a mean diameter.

RULE FOR WINE MEASURE.

Place down the log. of the mean diameter, twice the log. of the length, and under these two the constant log. 7.53148, the sum of these four logarithms will be the log. of the content, abating 10 in the sum of the indices.

RULE FOR BEER MEASURE.

Put this constant log. under the two former logs. always 7.44484 the sum of the four logs. will be the content for beer gallons, abating 10 in the index,

Example.

EXAMPLE.—What is the content of a cask whose head diameter is 20, the bung diameter 28, and length 40 inches?

	28	
	20	
	8	Difference.
	·7	
	5.6	Number to be added to
The head diameter	20.0	
	25.6	

FOR WINE.		FOR BEER.
Log. of mean diam. =	1.40824	1.40824
	1.40824	1.40824
Length 40 =	1.60206	1.60206
Constant Log.	7.53148	7.44484
Log. of 89.13 gallons the content for wine.	1,95002	Ans. 73.1 gallons = 1.86338 of beer.

The way these two constant multiplying logarithms were found is thus:

1st. The area of a circle, whose diameter is unity, is .7854 decimal parts of the square thereof; so that if the square of the diameter of any circle be multiplied by ,7854, the product will be the area of the given circle: hence ,7854 is always a constant quantity whose logarithm is 9.89509.

2d. If the area of a circle be divided by 231, the number of cubic inches there are in a wine gallon, the quotient will be the number of gallons that circular area contains, at 1 inch deep: hence 231 is a constant divisor. Its logarithm is 2.36361, the arithmetical complement of which is 7.63639, which I add to the former constant logarithm 9.89509
7.63639

The sum 7.53148, abating 10 in the indices, is the constant logarithm to be added, as per rule, for wine measure.

For beer measure the divisor is always 282, its logarithm is 2.45025, whose arithmetical complement is 7.54975
Add 9.89509

Sum 7.44484, the constant logarithm for beer measure, as per rule, omitting 10 in the index, or subtract 2.45025 from 9.89509
Take 2.45025

Remains 7.44484, the same as above.

The

The common way of finding a Ship's Tonnage at London.

RULE.—Multiply the length of the keel by the breadth of the beam, and that product by half the breadth of the beam, and divide the last product by 94, and the quotient arising is the tonnage.

EXAMPLE.—Suppose a ship 72 feet by the keel, and 24 feet by the beam, what is the tonnage ?

Length	72	- -	log. is	1.85733
Breadth	24,	- -	do.	1.38021
Half-Breadth	12,	- -	do.	1.07918
Arith. complement of log. of 94,			do.	8.02687
Tonnage 220.6		- - -		2.34359 Answer.

Rule for ascertaining a Ship's Tonnage in the United States.

If the vessel be double-decked, take the length thereof from the fore part of the main Stem to the after part of the Stern post above the upper deck; the breadth thereof at the broadest part above the main wales, half of which breadth shall be accounted the depth of such vessel; then deduct from the length three fifths of the breadth, multiply the remainder by the breadth, and the product by the depth; divide this last product by ninety-five, and the quotient is the true content or tonnage of such vessel.

If the vessel be single decked, take the length and breadth as above directed, in respect to a double decked vessel, and deduct from the length three fifths of the breadth, and taking the depth from the under side of the deck plank to the cieling in the hold; multiply and divide as aforesaid, the quotient is the true content or tonnage of such vessel.

To find the Logarithm of the Sines, Tangents, and Secants, &c. belonging to any number of Degrees and Minutes.

If the required degrees be less than 45 or more than 135 the degrees are marked on the top, but between 45 and 135 are marked on the bottom, the minutes being found in the column marked M, which stands on the same side of the page on which the degrees are marked; thus if the degrees are less than 45 the minutes are found in the left hand column, &c. and it must be noted that if the degrees are found at the top the names of Hour, sine, co-sine, tangent, &c. must also be found at the top: And if the degrees are found at the bottom, the names sine, cosine, &c. must also be found at the bottom.

EXAMPLE I.—Required the log. sine of 28° 37′ ?

Find 28 at the top of the page, directly below which in the left hand column find 37; against which in the column marked sine is 9.68029, the sine of the given number of degrees; and in the same manner the tangents, &c. are found.

EXAMPLE II.—Required the log. secant of 126° 20′ ?

Find 126 at the bottom of the page, directly above which in the left hand column find 20; against which in the column marked secants, is 10.22732 required.

To

To find the Degrees, Minutes and Seconds corresponding to any given Logarithm.

Find the two nearest numbers to the given logarithm, one greater and the other less, and take their difference; take also the difference between the given logarithm and the logarithm corresponding to the least number of degrees and minutes: then say, as the first found difference is to the second found difference, so is 60″ to a number of seconds to be annexed to the smallest number of degrees and minutes before found.

EXAMPLE I.—Find the degrees, minutes, and seconds (less than 90°) corresponding to the log. sine 9.61405?

Next less log.	24.16	9.61382	Log. of least numb.	24.16 is	9.61382
Greater	24.17	9.61411	Given log.		9.61405
		29			23

Then say, as 29 : 23 :: 60″ : 48″ which annexed to 24.16 gives 24° 16′ 48″, answering to log. sine 9.61405. Subtracting 24° 16′ 48″ from 180°, and there remains 155° 43′ 12″, which also answers the question.

EXAMPLE II.—Find the degrees, minutes, and seconds (above 90°) corresponding to the log. secant 10.56703?

Secant 105.43 log.	10.56722	Log. of least number	105.43	10.56722
Secant 105.44	10.56677	Given log.	- -	10.56703
	45			19

Then as 45 is to 19, so is 60 to 26″, which annexed to 105.43 gives 105° 43′ 26″, the degrees, minutes, and seconds required.

To find the Logarithm Sine, Co-sine, &c. for Degrees, Minutes, and Seconds.

Find the logarithms corresponding to the even minutes next above and below the given degrees and minutes, and take their difference; then say, as 60″ is to the odd number of seconds, so is the difference to a correction to be applied to the logarithm of the least number of degrees and minutes additive, if it is the least of the two logarithms taken from the table, otherwise subtractive.

EXAMPLE I.—Required the log. sine of 24° 16′ 48″?

Sine of 24° 16′	9.61382
Sine of 24.17	9.61411
Diff.	29

Then, as 60 : 48 :: 29 : 23, which added to the log. of 24.16, gives 9.61405 the log. of 24° 16′ 48″

EXAMPLE II.—Required the log. secant of 105° 20′ 16″?

Secant of 105.20 log.	10.57768
105.21	10.57722
Diff.	46

Then 60 : 16 :: 46 : 12, which subtracted from the log. of 105.20, gives 10.57756, the log. secant of 105.20.16.

If

If the given seconds be $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$ or $\frac{1}{6}$, or any other even parts of a minute, the like parts may be taken of the difference of the logarithms, and added or subtracted as above, which may be frequently done by inspection.

To find the Arithmetical Complement of any Logarithm.

The complement Arithmetic of any logarithm, is what it wants of 10.00000 or 20.00000, and is used to avoid subtraction. For finding it this is the rule: Take the residue or remainder of the first figure to 9, and so of the rest, till you come to the last figure; of which take its remainder under 10, and it is done.

EXAMPLE I.—I would have the complement arithmetic of 9.62595?

For the first figure 9, write 0; for 6, 3; for 2, 7; for 5, 4; for 9, 0; and for the last figure 5 write 5; and so you have 0.37405 for the complement arithmetic sought.

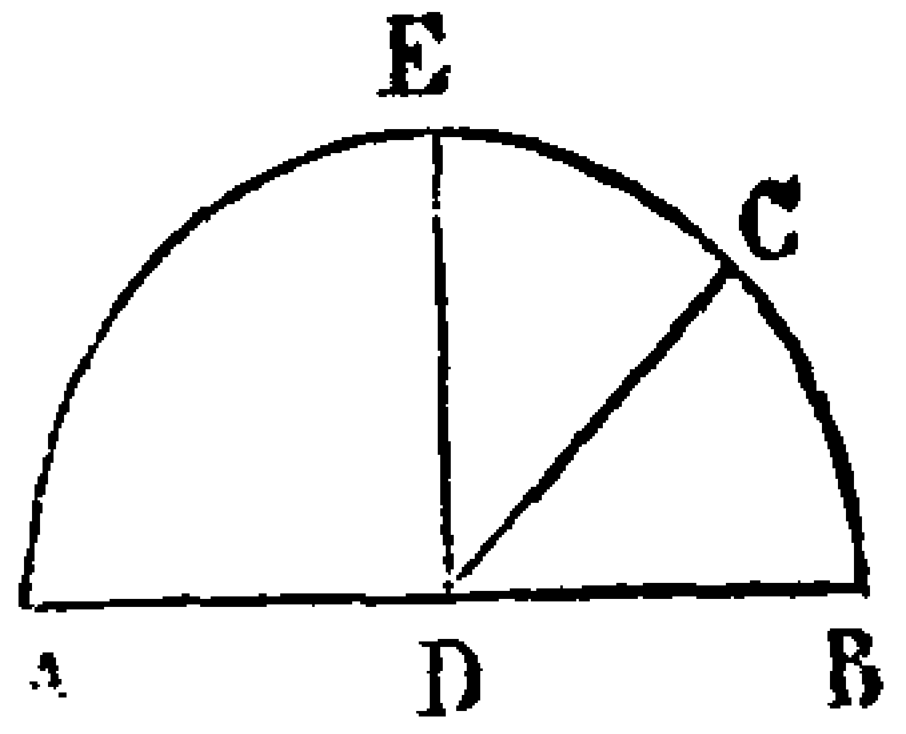
EXAMPLE II.—The complement arithmetic of 20.33133?

For 0 write 9, and so on as before directed, and then you will have 9.66867, which is the complement arithmetic of 20.33133. Or thus:

From	10.00000	From	20.00000
take	9.62595	take	10.33133
	0.37405		9.66867

It will be necessary for the reader to make himself well acquainted with the following propositions, as he will find them useful when he goes into Trigonometry, which are here rendered plain and easy to be understood;

PROPOSITION I.—If a right line stands upon, or meets with, another right line, and makes angles with it, the two angles taken together will be two right angles, or two angles equal to two right angles.

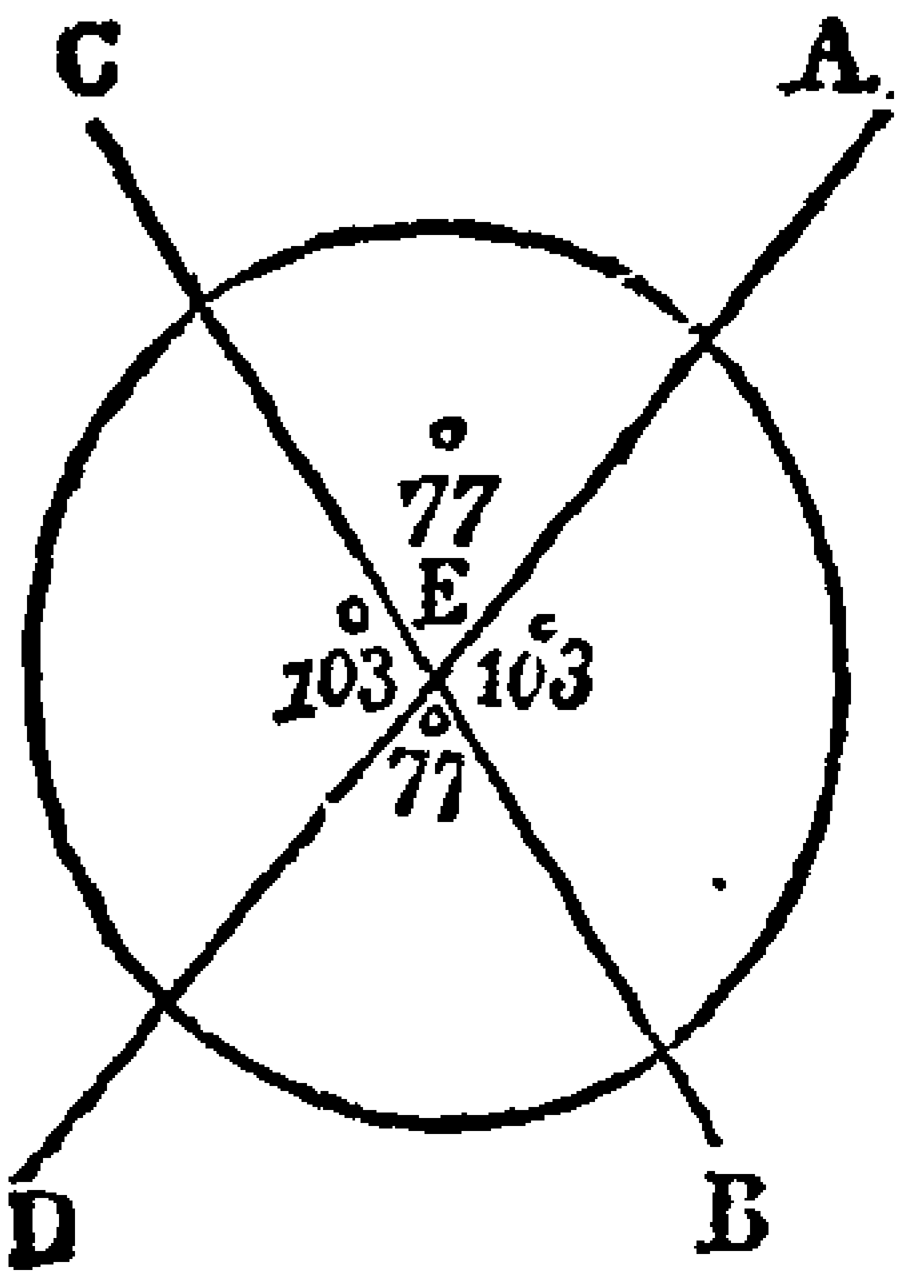


Let the line C D meet A B in D; on D erect the perpendicular D E, with the chord of 60° in your compasses, and one in D describe the arch A E B, which will be a semicircle or 180°; of which A B is the diameter, and the angles A D E and B D E are quadrants, each 90°, because E D is perpendicular to AB: now the angle BDC is less than 90°, since the two angles together make neither more nor less than 180° or a semicircle; consequently any number of right lines standing upon the same side of the line A B, and coming from the same point D, the sum of all the angles formed by such right lines cannot exceed 180°. If the angle B D C be subtracted from 180°, the remainder will be the angle C D A; or if the angle A D E is given, the angle B D C is found in the same manner.

PROPOSITION II.—If two right lines cross each other, the angles which are opposite are equal one to the other.

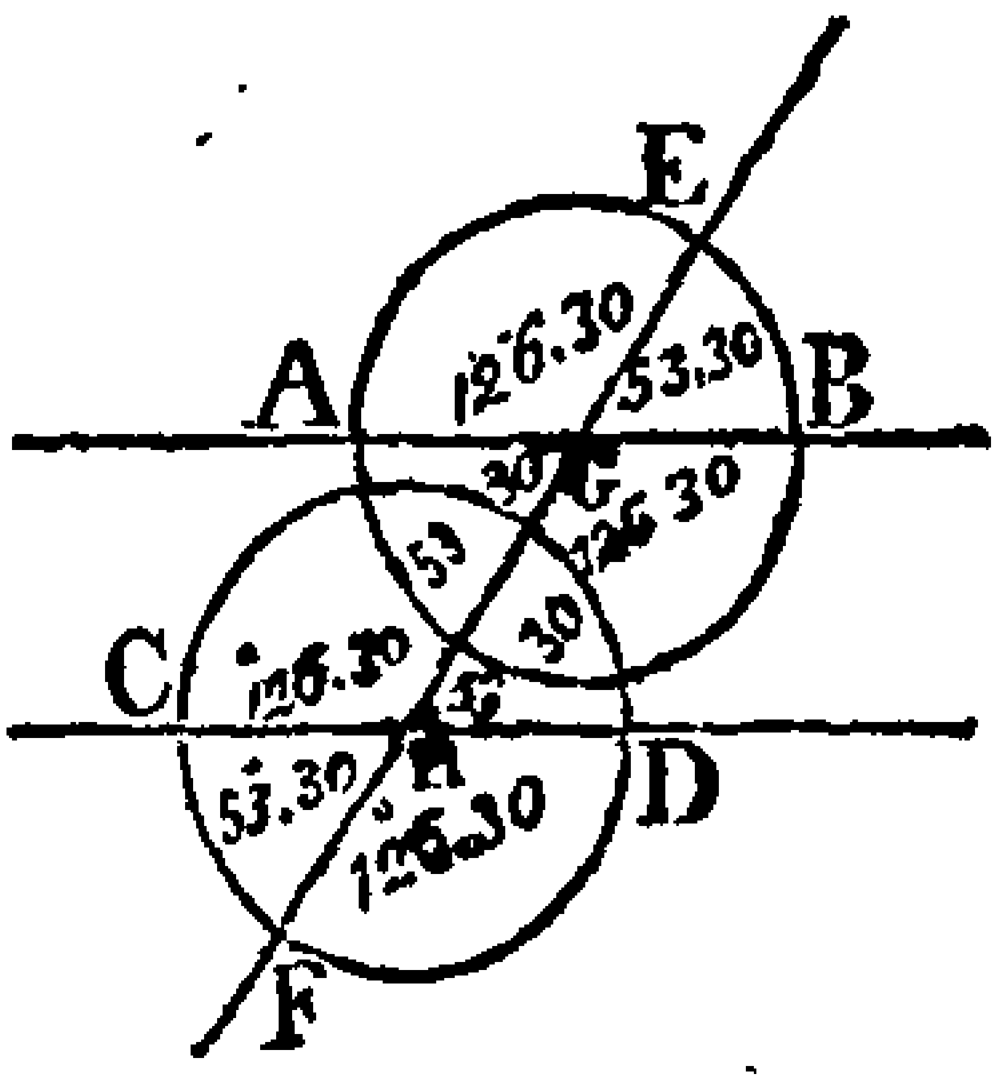
Let

Let the two lines A D and C B crofs each other in the point E. With the chord of 60°, or any convenient radius, in your compaffes, and one foot in E, defcribe a circle; then, by meafuring the angles, it will be found that the angle A E B is equal to the angle C E D, and that the angle A E C is equal to the angle B E D; for the angle A E B added to the angle A E C makes a femicircle; and fo do the angles B E D and D E C; and all the angles taken together make 360°.

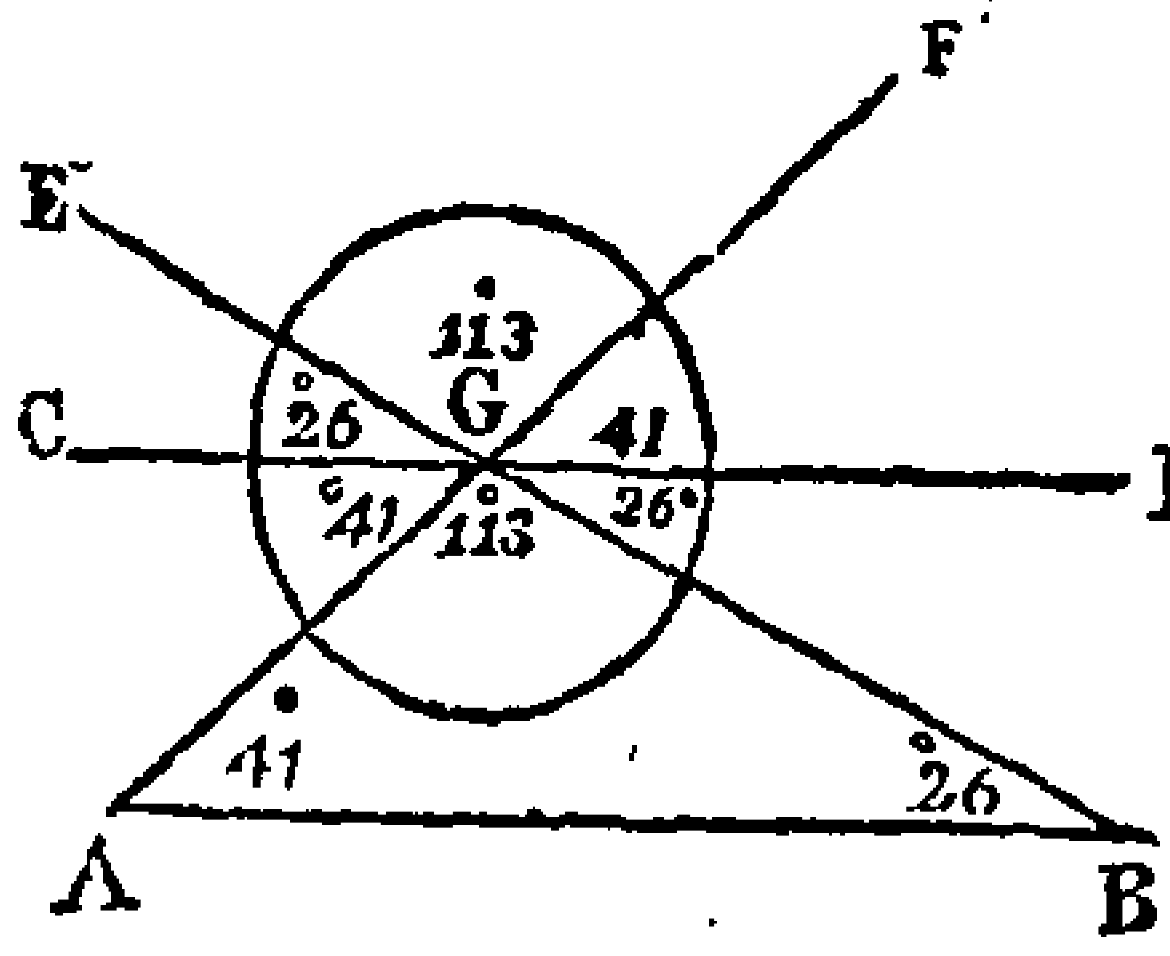


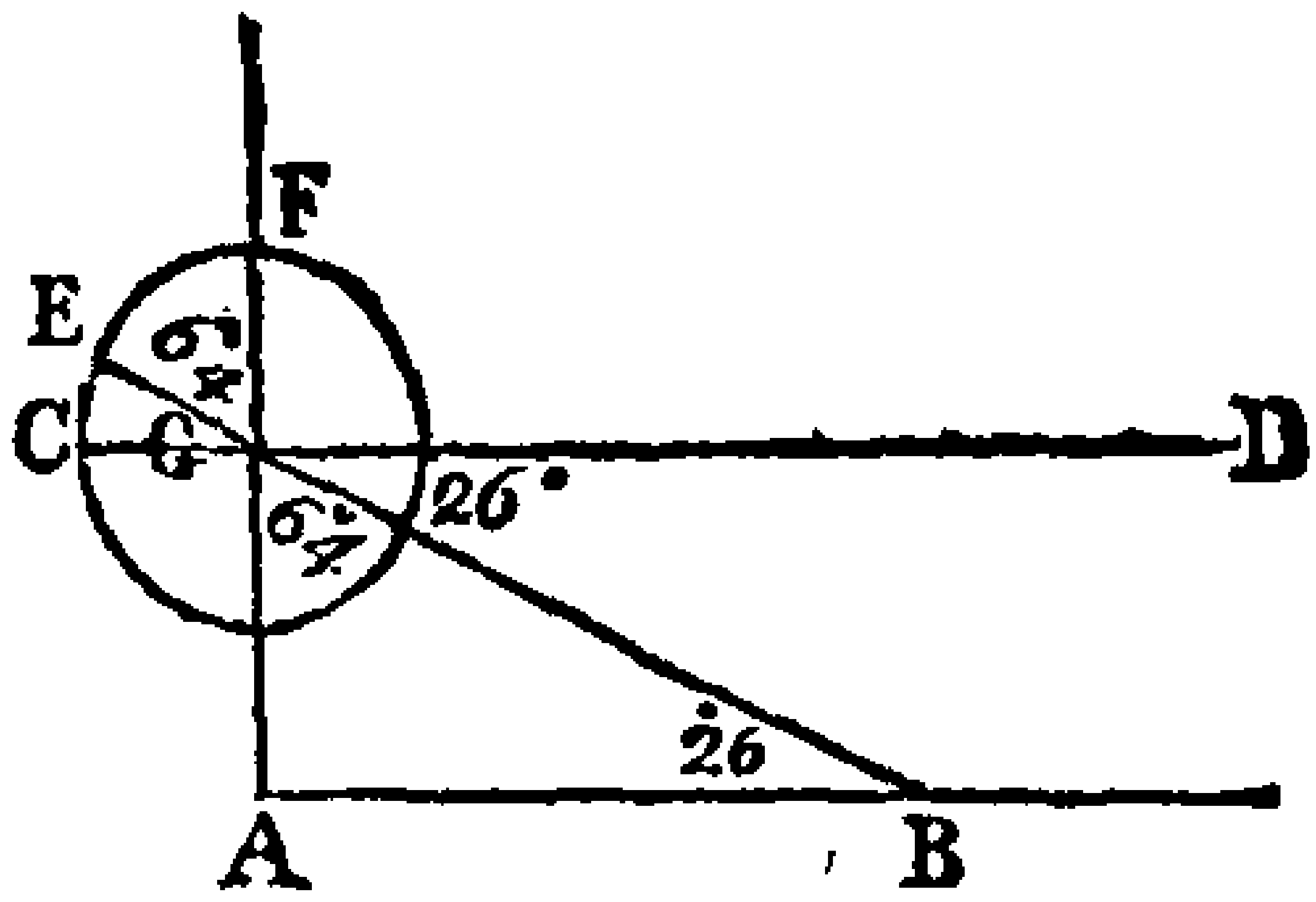
Proposition III.—If a right line crofs two parallel lines, the outward angles will be each equal to the inward and oppofite ones.

Let the lines A B and C D be parallel lines, and E F the line that cuts them in the points G and H. With the chord of 60° in your compaffes, and one foot on G and H, defcribe the arches B E A and D F C which will be each a femicircle: now, by meafuring the angles B G E and A G E, they will be found equal to the angles D H F and F H C, and each equal to 180°, by the firft propofition. In like manner it may be proved, that the two outward angles are equal to the two inward and oppofite ones.



Proposition IV.—In every plane triangle, whether right or oblique, the three angles are equal to two right angles or 180°.

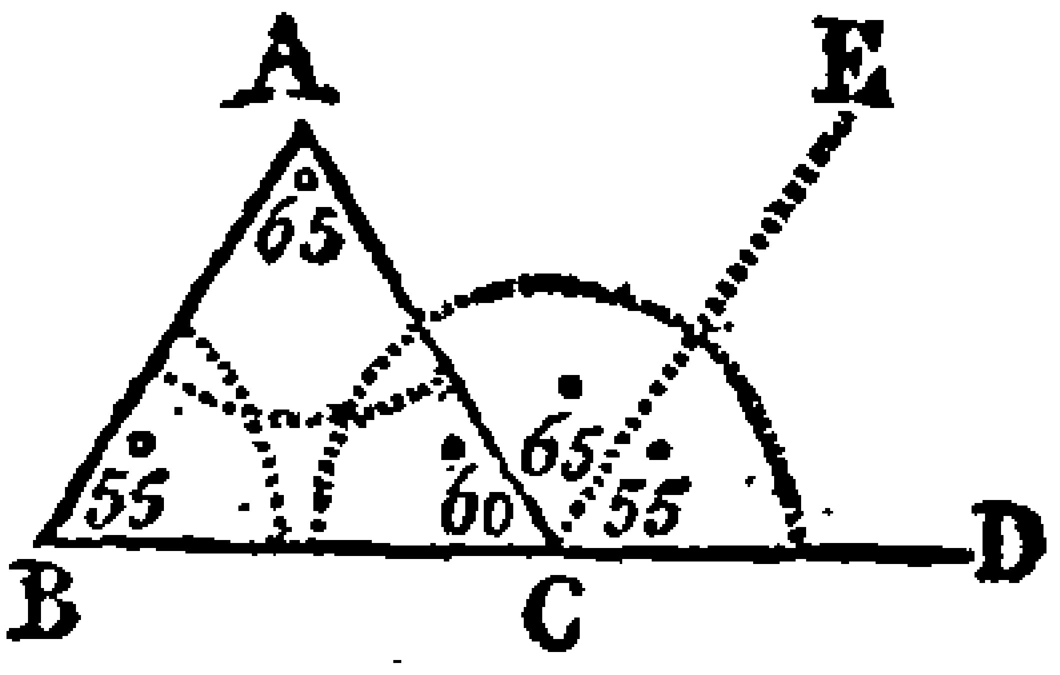




In the triangle AGB draw CD parallel to AB through the point G; on which point, with the chord of 60°, or any convenient radius, defcribe a circle on the point G; and with the fame radius, on A and B, defcribe arches; now, by the laft propofition, the angle A G B will be equal to the angle F G E, and the angle A B G will be equal to the angle CGE, and

and the angle BAG is equal to the angle DGF : now, since the opposite angles are equal, the angles DGF, FGE, and EGC, together, make a semicircle or 180° ; therefore it is plain that the three angles of a plane triangle, whether right, acute, or obtuse, together, are equal to two right angles or 180° ; hence it follows that, as the right angle B A G is 90°, the other two acute angles A B G and A G B taken together, can be no more than 90° ; therefore, if one of the acute angles, in a right-angled triangle, be given, the other is found by subtracting the given angle from 90°. And in any oblique-angled triangle, if one of the angles be given, the sum of the other two is found by subtracting the given angle from 180° ; and if two angles are given, the third is found by subtracting the sum of the two angles from 180°.

PROPOSITION V.—In every plane triangle, if one of its sides be produced, the outward angle will be equal to the two inward opposite angles.



Let A B C be the triangle, and C D the side produced, with the chord of 60°, or any other radius, describe arches on A B and C, draw C E parallel to A B ; then, by the third proposition, the angle A C E must be equal to the angle B A C and the angle D C E equal to the angle C B A ; therefore the outward angle D C A is equal to the two inward opposite angles ACB and B A C ; which may be easily proved by measuring the angles by the line of chords on the plane scale.

TRIGONOMETRY.

PLAIN Trigonometry is the art of measuring plane triangles, by comparing the sides and angles together by known analogies ; whereby three things being given, a fourth may be found, on condition that one of them be a side : but as angles are measured by the arch of a circle, described upon their angular points, and the proportions that these arches bear to right lines cannot be exactly found ; therefore the writers of Trigonometry have applied right lines to these arches, that the proportion they bear to the sides of a plane triangle may be found.

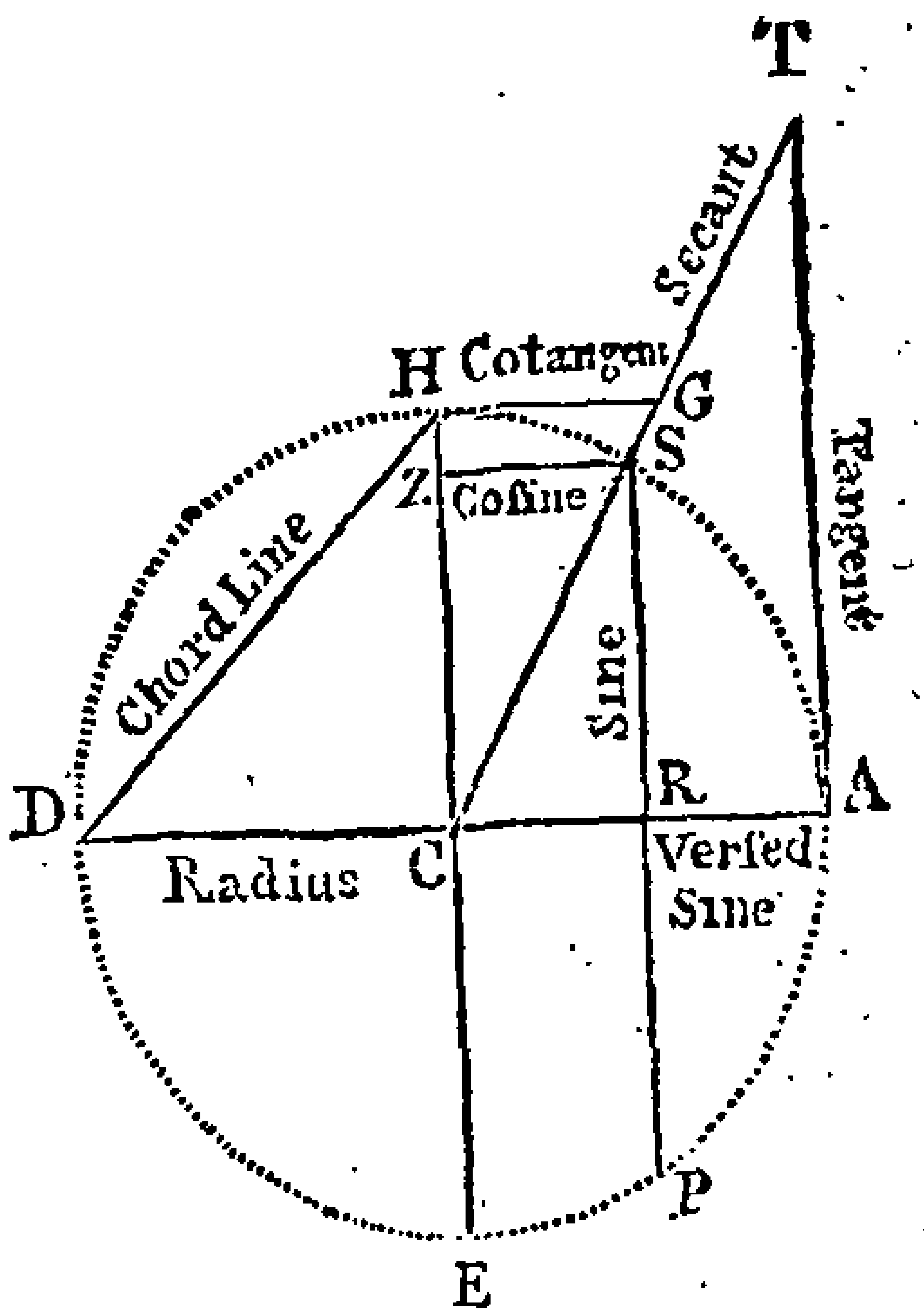
The

The right lines applied to a circle are :

1st. A CHORD, or the subtense of an arch, is a right line that divides the circle into two unequal parts, and is a chord to them both, as D H is the chord of the arches D H and D A H.

2d. A RIGHT SINE of an arch is, a right line drawn from one end or termination of an arch perpendicular to the radius, or it is half the chord of twice the arch ; so that R S is the sine of the arch AS, and SZ the cosine.

3d. A Versed SINE is that part of the diameter contained between the right sine, and the arch, as R A is the versed sine of A S, and R C D of D H S.



4th. A TANGENT of an arch, is a right line drawn perpendicular to one end of the diameter, just touching the arch, as A T is the tangent of the arch A S, and H G the co-tangent.

5th. A SECANT of an arch is a right line drawn from the center through the circumference, and produced until it cuts the tangent, as C T.

NOTE. The sine, tangent, and secant of the complement of an arch, is called the co-sine, co-tangent, and co-secant of that arch.

The sines, tangents, and secants of an arch, are said to be the measure of so many degrees, as that arch contains parts of 360 degrees ; so that the radius being the sine of a quadrant, or a fourth part of a circle contains 90°, thus : The radius is always equal to the sine of 90°, as is the chord of 60° and the tangent of 45°, all the three being each equal to the radius : and that the sine, tangent, and secant of an arch is equal to the sine, tangent, and secant of an arch, as much above 90 degrees as the former was deficient of 90 ; thus the sine, tangent, or secant of 80° is = 100°, of 70° is 110°, of 60° is = 120° ; of 40° is = 140°, &c. so that in taking out the logarithms of sines, tangents, or secants, for any number of degrees above 90°, the given angle must be subtracted from 180°, and the logarithm of the remainder be taken ; or subtract 90° from the given angle, and take the log. co-sine, co-tangent, or co-secant of the remainder.

Notwithstanding what has been said in Geometry, it may not be improper here to observe that,

1st. The fewest number of right lines that can include a space, are three ; which is called a triangle, or three-cornered figure, and consists of six parts, viz. three sides and three angles.

2d. In

2d. In every triangle the greateſt ſide is oppoſite the greateſt angle; conſequently, the greateſt angle is oppoſite the greateſt ſide.

3d. In every triangle equal ſides ſubtend or ſtand againſt equal angles.

4th. In every plane triangle the three angles together are equal 180° ——See Prob. 3d, in Geometry.

5th. If in a triangle, one angle be right or obtuſe, the reſt are acute; and if one angle in a triangle be right, the other two taken together make one right angle, or 90°; wherefore if one of the acute angles, in a right-angled-triangle, be known, the other is found by ſubtracting the known angle from 90°.

6th. In every plane triangle, if one of the angles be given or known, the ſum of the other two is found by ſubtracting the given angle from 180°, and if two of the angles be known or given, the third is found by ſubtracting their ſum from 180°.

7th. The complement of an angle is what it wants of 90°.

8th. The ſupplement of an angle is what it wants of 180°.

9th. All angles are meaſured by the arch of a circle, deſcribed about their angular points with the chord of 60°, and are ſaid to be greater or leſs, according to the number of degrees or parts to be contained between their legs; which legs may be ſuppoſed to be yards, miles, leagues, &c.; and are meaſured on a ſcale of equal parts.

10th. A circle deſcribed with the chord of 60°, the circumference will contain four right angles, or 360°, the quadrant 90°, and ſemicircle 180°.

11th. The angles of two triangles may be reſpectively equal, although their ſides may be unequal. Therefore, among the things given, in order to find the reſt, one of them muſt be a ſide.

In Trigonometry, the three parts given, in all triangles, muſt be either,

1ſt. Two ſides and angle oppoſite one of them.

2d. Two angles and a ſide oppoſite one of them.

3d. Two ſides and the included angle.

4th. Three ſides.

In every caſe, the other three things may be found by help of the table of logarithms, artificial ſines, tangents, and ſecants, by the following axioms; as well as by the foregoing conſtructions:

☞ It may not be improper here to obſerve, that the properties of a right-angled triangle depend on the 47th propoſition of the firſt book of Euclid, where it is demonſtrated, that

In every right-angled triangle, the ſquare of the hypothenuſe or longeſt ſide, is equal to the ſum of the ſquares of the other two ſides or legs; conſequently having the ſquares of the baſe and perpendicular, the ſquare root of their ſum will be the length of the hypothenuſe.

And, if the ſquare of the baſe be ſubtracted from the ſquare of the hypothenuſe, the ſquare root of the remainder will be the length of the perpendicular;

And, if the ſquare of the perpendicular be ſubtracted from the ſquare of the hypothenuſe, the ſquare root of the remainder will be the length of the baſe; conſequently by having any two ſides of a right-angled triangle, the third ſide may be found.

Thus, lines of the lengths 5, 4, 3, (or their doubles, triples, &c.) will form a right-angled triangle.

Now the ſquare of 5 is 25, the ſquare of 4 is 16, and the ſquare of 3 is 9; then 16 and 9 is 25, its root is 5, the length of the hypothenuſe; and if 16 be ſubtracted from 25 the remainder is 9, its root is 3, the length of the perpendicular; again, if 9 be ſubtracted from 25, the remainder is 16, its root is 4, the length of the baſe; the ſame of any other numbers, which may be readily done by the logarithms, or by the extraction of the ſquare root.

The

The Solution of the ſeveral Caſes in Plain Trigonometry depend upon four Propoſitions called Axioms, which the Learner ſhould get perfectly by heart.——We ſhall here give the firſt Axiom only, and the reſt before we begin Oblique Sailing.

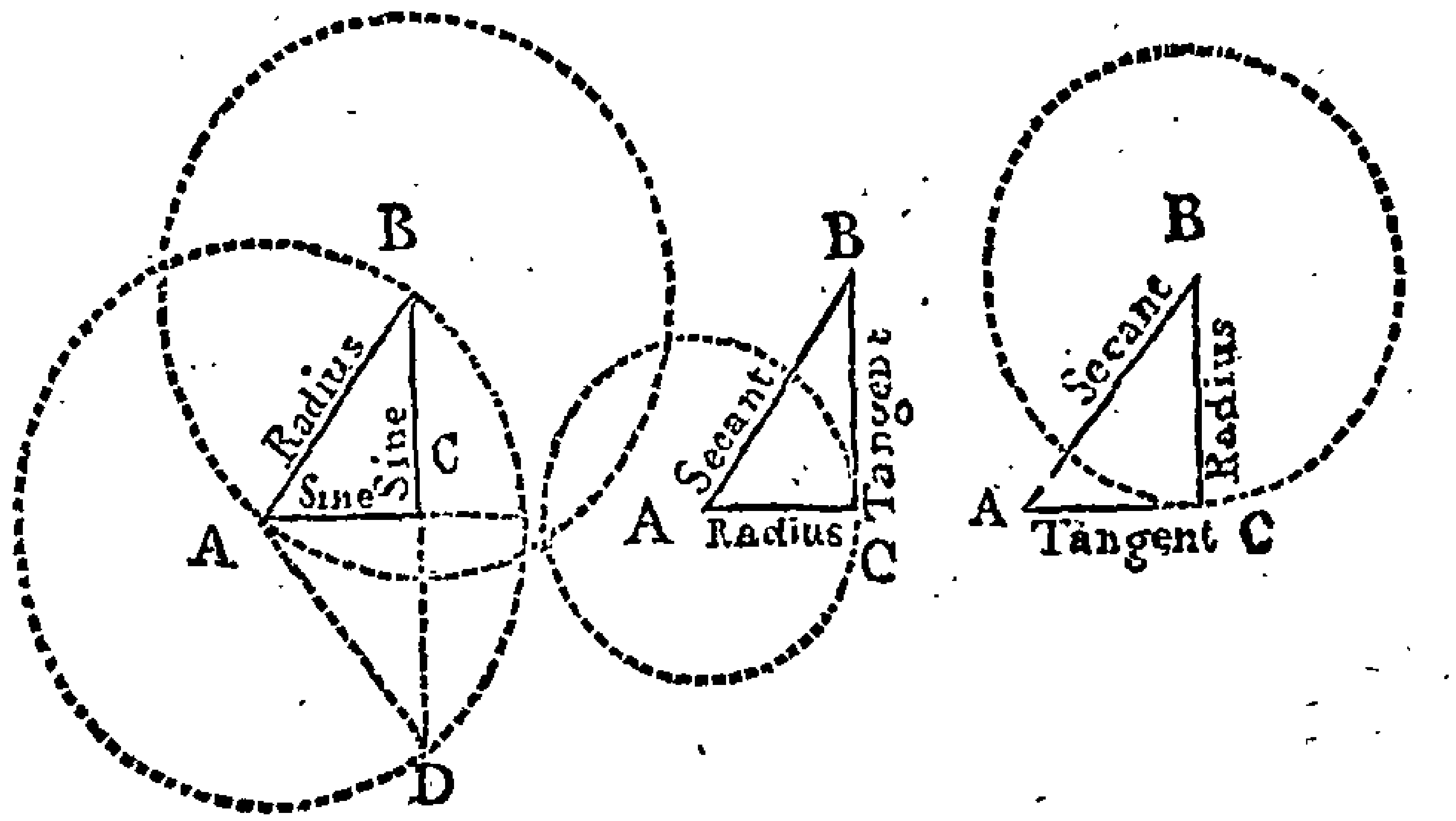
AXIOM I.

In any right-angled plane triangle,

If the hypothenuſe be made the radius of a circle, the other two ſides, or legs, will be the ſines of their oppoſite angles ; but

If either of the legs, including the right-angle, be made the radius of a circle, the other leg will be the tangent of its oppoſite angle, and the hypothenuſe, the ſecant of the ſame angle ;

For let the three following triangles have their ſides and angles equal :



It is plain, by comparing theſe with the firſt figure in Trigonometry, that taking the hypothenuſe A B as radius in your compaſſes, and on A and B deſcribe circles, C B will be the ſine of the angle B A C and C A will be the ſine of the angle A B C, and B C will be the ſine of half the arch B D, or the ſine of half the angle B A D, being half the chord of twice the arch ; but taking the baſe A C as a radius in your compaſſes, and with one foot in A deſcribe a circle, it is plain that C B will be the tangent, and A B the ſecant of the ſame angle ; but if C B, the perpendicular, be taken as the radius, and a circle be deſcribed on B, then will A C be the tangent of its oppoſite angle A B C, and the hypothenuſe the ſecant of the ſame angle : for it ſhould be remembered, that when any one of the legs becomes a tangent of its oppoſite angle, the hypothenuſe always accompanying it, becomes the ſecant of the ſame angle.

Now, ſince, by making any of the ſides of a right-angled triangle the radius of a circle, we can readily find the names or denominations of the other ſide, it comes next to be conſidered what parts or things are given, and what required, in order to ſtate the queſtion. In this caſe we ſhall compare Trigonometry with the Rule of Three in common Arithmetic ;

where we are taught to consider what name or denomination the answer is to be of, which names must always be made the second term in stating the question; if pounds are to be the fourth number, or answer, then pounds must be the second term; if yards are to be the answer, then yards must be the second term. As for example, if 60 yards cost £120, what will 90 yards cost? Then pounds being wanted, pounds must be the second term.

If 60 yards cost £120, what will 90 yards cost?

$$\begin{array}{r} 90 \\ \hline 60)1080(0 \\ \hline 180 \end{array} \text{ Answer.}$$

It is the same in Trigonometry; for if the fourth number, or answer, is to be an angle, an angle implied must be the second term, and sides the first and third terms: but when a side is required, it must be placed the second term, and angles the first and third terms, in stating the question; consequently, in all questions in Trigonometry, if a side is required, you must begin with an angle or radius, which is always considered as a given angle, equal to 90°; but when an angle is required, then you must begin with a known side.

In the Rule of Three we multiply the second and third terms together, and divide that product by the first term, and the quotient will be the fourth number sought, and of the same denomination the second term is of. Now; since the addition of logarithms answers the purpose of multiplication of whole numbers, and subtraction, that of division, add the logarithms of the second and third terms together, and from their sum subtract the logarithm of the first term, the remainder will be the logarithm of the fourth term.

As log. — 60 ——		1.77815
Is to log. of 120 ——		2.07918
So is log. — 90 ——		1.95424
	Add	4.03342
First term sub. 60	is	1.77815
To answer 180	=	2.25527

Here it is plain the logarithms give the same answer as that given by the Rule of Three.

In a right-angled triangle there are always two sides, or the angles and one side given, to find the rest.

To find a side, any side may be made radius; then say, as the name of the given side is to the given side, so is the name of the side required to the side required, which must be found among the logarithms.

To find an angle, one of the given sides must be made radius; then say, as the side made radius, is to radius, so is the other given side, to the

sine,

sine, tangent, or secant, by it represented ; which being looked for in the table of sines, tangents, and secants, will be found the degrees and minutes corresponding to the angle required.

Solution of the Six Cases in Right-angled Trigonometry.

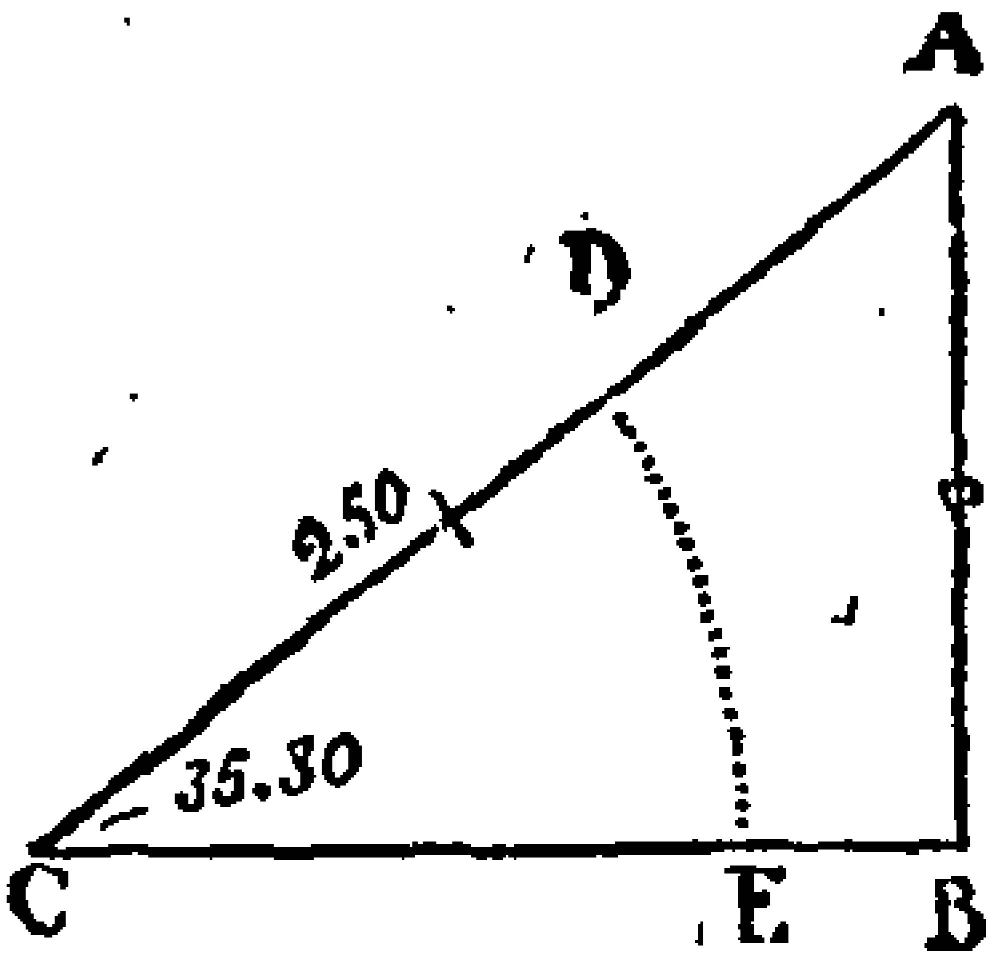
CASE I.

The Angle and Hypothenuse given, to find the Legs.

Given the Hypothenuse AC 250 Leag. and the Angle opposite to the Base CB = 54° 30′, to find the Base CB and Perpendicular AB.

By CONSTRUCTION.

Draw the base C B of any length, on C describe the arch D E, from E to D lay off 35° 30′, through C and D draw a line, which must be equal to 250 ; from A let fall the perpendicular A B, to cut C B in B, and it is done ; for C B will be 203.5, and A B = 145.2.



By CALCULATION.

By making the Hypothenuse C A Radius, it will be,

To find the Base BC.		To find the Perpendicular AB.	
As radius	10.00000	As radius	10.00000
Is to the hypoth. CA 250	2.39794	Is to the hypoth. CA 250	2.39794
So is sine ang. A 54° 30′	9.91069	So is sine ang. C 35° 30′	9.76395
	12.30863		12.16189
	10.00000		10.00000
To the base BC 203.5	2.30863	To the per. AB 145,2	2.16189

By making the Base Radius, the Proportion by Axiom the first, will be,

To find the Base BC.		To find the Perpendicular AB.	
As sec. ang. C 35° 30′	10.08931	As sec. ang. C 35° 30′	10.08931
Is to hypo. AC = 250	2.39794	Is to hypoth. AC = 250	2.39794
So is radius	10.00000	So is tang. ang. C 35° 30′	9.85327
	12.39794		12.25121
	10.08931		10.08931
To the base BC = 203,5	2.30863	To the per. AB 145,2 =	2.16190

By

By making the Perpendicular Radius, by Axiom the first, it will be,

To find the Base BC.		To find the Perpendicular AB.	
As sec. ang. A 54° 30′	10.23605	As sec. ang. 54° 30′	10.23605
Is to hypoth. AC 250	2.39794	Is to hypoth. AC 250	2.39794
So is tang. ang. A 54° 30′	10.14673	So is radius	10.00000
	12.54467		12.39794
	10.23605		10.23605
To the base BC = 203.5	2.30862	To the per. = AB 145,2	2.16189

NOTE. In the first stating, where the hypothenuse is made radius, the sum of the logarithms of the second and third terms are, 12.30863; from which it is easy to subtract the logarithm of the first term; for you may either cancel it, or leave it out; and then cast off the first figure towards the left hand, and it will leave the logarithm 2.30863, the same as if 10.00000 had been set down and subtracted from it: and indeed, the five cyphers may be always omitted in the radius, and only the index 10. set down.

It will greatly expedite the working the proportion by logarithms, if the two or all the statings be first made, and then the sines, tangents, or secants, may be taken out at one opening of the book; for if one angle of a right-angled triangle be given, the logarithm of its complement, or the other angle, whether sine, tangent, or secant, is found in the adjoining column, without being at the trouble of subtracting the given angle from 90°. If the given angle be less than 45 degrees, it is found at the top of the table, and the minutes in the left-hand column reckoned downwards, and its complement is found at the bottom, and the minutes on the right-hand column. On the contrary, if the given angle is found at the bottom, its complement, or the other angle, will be at the top of the table, and the minutes in the left-hand column; against which is the log. sine, tangent, or secant, corresponding to it.

By GUNTER's SCALE.

In all proportions wrought by Gunter's Scale, when the first and second terms are of the same kind, then the extent from the first term to the second, will reach from the third to the fourth;

Or when the first and third terms are of the same kind,

The extent from the first term to the third, will reach from the second to the fourth; that is, set one point of the compasses on the division expressing the first term, and extend the other point to the division expressing the second term, then, without altering the opening of the compasses, set one point on the division representing the third term, or second term, and the other point will fall on the division shewing the fourth term or answer.

Now in this last case, it will run thus:

Extend

Extend from radius, or 90° to 54° 30′ on the line of sines, that extent will reach from 250, the hypothenuse, to 203,5, the base, on the line of numbers; and the extent from radius, or sine of 90° to 35° 30′ on the line of sines, will reach from 250 to 145 on the line of numbers.

Observe the like in all that follows, except in those proportions where the word secant is mentioned, which may be readily wrought by considering the hypothenuse radius, as in the last case; there being no line of secants on Gunter's Scale.

NOTE. The radius, according to the nature of the proportion, may be any of these:

8 Points on the line of Rhumbs	90° On the Line of Sines.
4 Points on the line of Tan. Rhbs.	45° On the Line of Tangents.

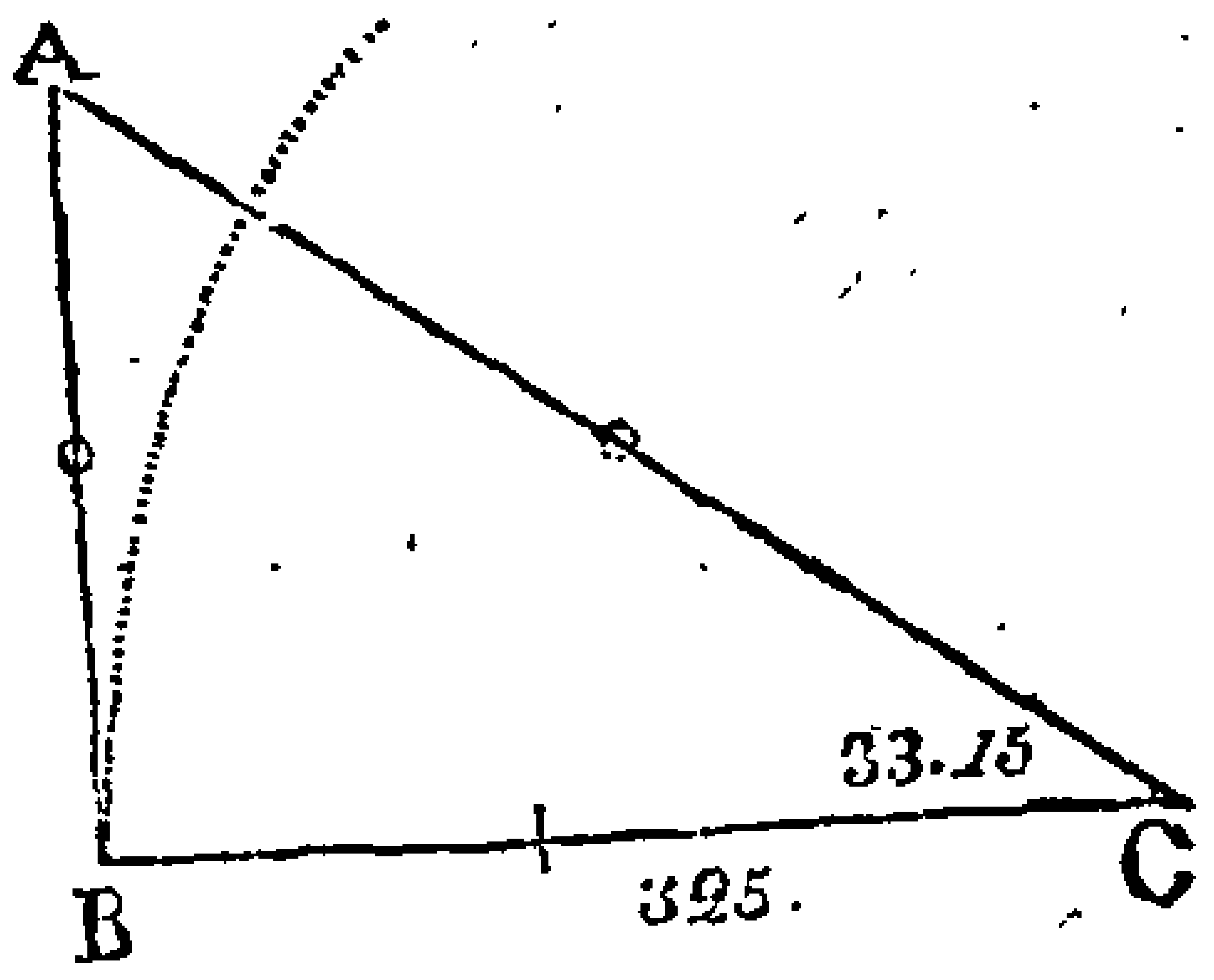
CASES II. and III.

The angles and one Leg given, to find the Hypothenuse and other Leg.

The angle A C B 33° 15′, the Leg B C 325 Miles given, to find the Hypothenuse and the other Leg.

By CONSTRUCTION.

Draw the line B C, which make equal to 325 miles; on B erect the perpendicular B A; on C describe an arch with the chord of 60°, and make the angle C = 33° 15′, through where that cuts the arch, draw A C to cut A B in A, and it is done; for B A being measured on the same scale that B C was, will be 213,1 and A C 388,6 miles.



By making the Hypothenuse AC Radius, it will be,

To find the Perpendicular AB.		To find the Hypothenuse AC.	
As sine ang. A 56° 45′	9.92235	As sine ang. A. 56° 45′	9.92235
Is to the base BC 325	2.51188	Is to the base BC 325	2.51188
So is sine ang. C 33° 15′	9.73901	So is radius 90°	10.00000
	12.25089		12.51188
	9.92235		9.92235
To the perpen. AB 213,1	2.32854	To the hypoth. AC 388,6	2.58953

By

By making the base B C Radius, it will be,

To find the Perpendicular AB.		To find the Hypothenuse AC.	
As radius 90°	10.00000	As radius 90°	10.00000
Is to the base BC 325	2.51188	Is to the base BC 325	2.51188
So is tang. ang. C 33° 15′	9.81666	So is sec. ang. C 33° 15′	10.07765
	12.32854		12.58953
	10.00000		10.00000
To the perpen. AB 213,1	2.32854	To the hypoth. AC 338,6	2.58953

By making the perpendicular A B Radius, it will be,

To find the Perpendicular A B.		To find the Hypothenuse AC.	
As tang. ang. A 56° 45′	10.18334	As tang. ang. A 56° 45′	10.18334
Is to the base BC 325	2.51188	Is to the base B C 274	2.51188
So is radius 90°	10.00000	So is sec. ang. A 56° 45′	10.26099
	12.51188		12.77287
	10.18334		10.18334
To the perpen. AB 213,1	2.32854	To the Hypoth. AC 388.6	2.58953

By GUNTER.

'Extend from 56 degrees 45 minutes to 33 degrees 15 minutes on the line of sines, that extent will reach from the base 325 to the perpendicular 213,1 on the line of numbers.'

2dly. 'Extend from 56 degrees 45 minutes to radius on the line of sines, that extent will reach from the base 325 to the hypothenuse 388,6 on the line of numbers.'

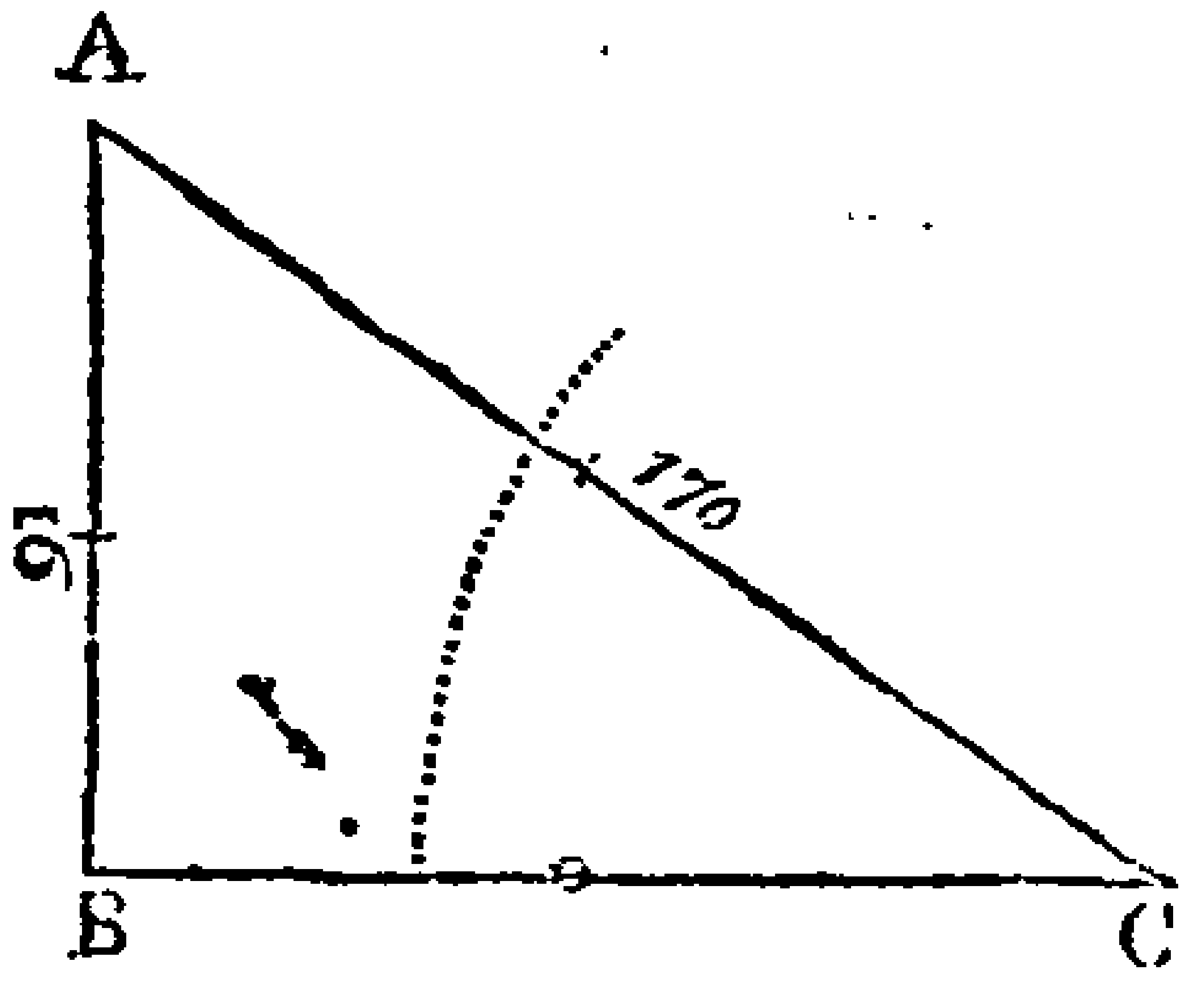
CASE IV. and V.

The Hypothenuse and one Leg given, to find the Angles and other Leg.

The leg AB 91, the Hypothenuse 170 given, to find the angle A C B, or BAC, and the leg BC.

By CONSTRUCTION.

Draw BC at pleasure, on B erect the perpendicular B A, which make equal to 91, take 170 in your compasses, and with one foot on A, lay the other on the line B C, and join A and C, and it is done: for the angle C will be 32° 22, the angle A 57° 38 and B C 143,6.



By

By making the Hypothenuse Radius, it will be,

To find the angle C.		To find the base C B.	
As the hypothenuse 170	2.23045	As Radius	10.00000
Is to the radius	10.00000	Is to the hypoth. 170	2.23045
So is the perpendicular 91	1.95904	So is sine ang. A. 57° 38′	9.92667
	11.95904		12.15712
	2.23045		10.00000
To sine angle C 32° 22′	9.72859	To the base 143,6	2.15712

By making the Perpendicular Radius, it will be,

To find the angle A.		To find the base BC.	
As the perpendicular 91	1.95904	As the radius	10.00000
Is to the radius	10.00000	Is to the perpend. 91.	1.95904
So is the hypoth. 170	2.23045	So is tang. ang. 57° 38′	10.19805
	12.23045		12.15709
	1.95904		10.00000
To sec. ang. A 57° 38′	10.27141	To the base 143,6	2.15709

By GUNTER.

'Extend from hypothenuse 170 to the perpendicular 91 on the line of numbers; that extent will reach from radius to sine angle C, the complement of angle A = 32 degrees 22 minutes on the line of sines.'

2dly. 'Extend from radius to sine angle A 57 degrees 38 minutes; that extent will reach from the hypothenuse 170 to the base 143.6 on the line of numbers.'

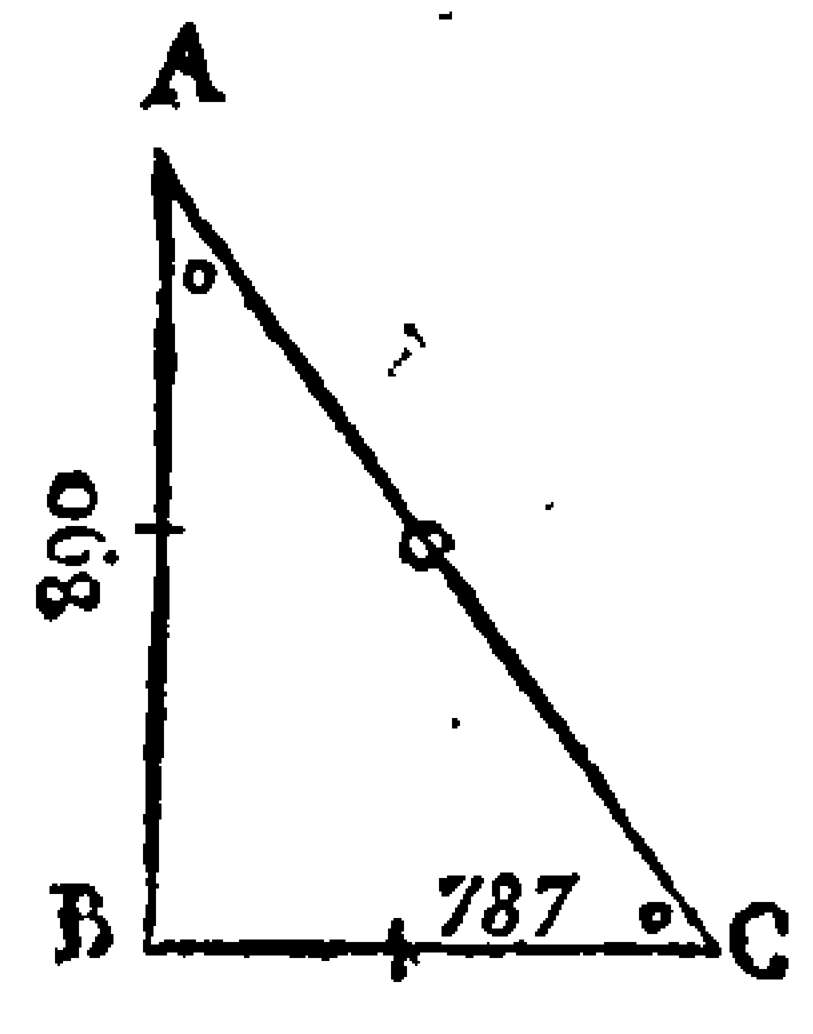
CASE VI.

The Legs given, to find the Angles and Hypothenuse.

The legs AB 890, B C 787 given, to find the angle B A C, or A C B' and the hypothenuse A C.

By CONSTRUCTION.

Make BC=787, and on B erect the perpendicular B A, which make equal to 890; join AC, and it is done; for the angle C will be 48° 31′; consequently, the angle A 41° 29′ and hypothenuse 1188.



By

By making the Base Radius, it will be,

To find the Angle C.		To find the Hypoth. AC.	
As the base 787	2.89597	As radius	10.00000
Is to radius	10.00000	Is to the base 787	2.89597
So is the perpend. 890	2.94939	So is sec. ang. C 48° 31′	10.17888
	12.94939		13.07485
	2.89597		10.00000
To tan. ang. C = 48° 31′	10.05342	To the hyp. AC. = 1188	3.07485

By making the Perpendicular Radius, it will be,

To find the Angle A.		To find the Hypoth. A C.	
As the perpend. 890	2.94939	As radius	10.00000
Is to radius	10.00000	Is to the perpend. 890	2.94939
So is the base BC = 787	2.89597	So is sec. ang. A. 41° 29′	10.12543
	12.89597		13.07482
	2.94939		10.00000
To tan. ang. A 41° 29′	9.94658	To the hyp. AC = 1188	3.07482

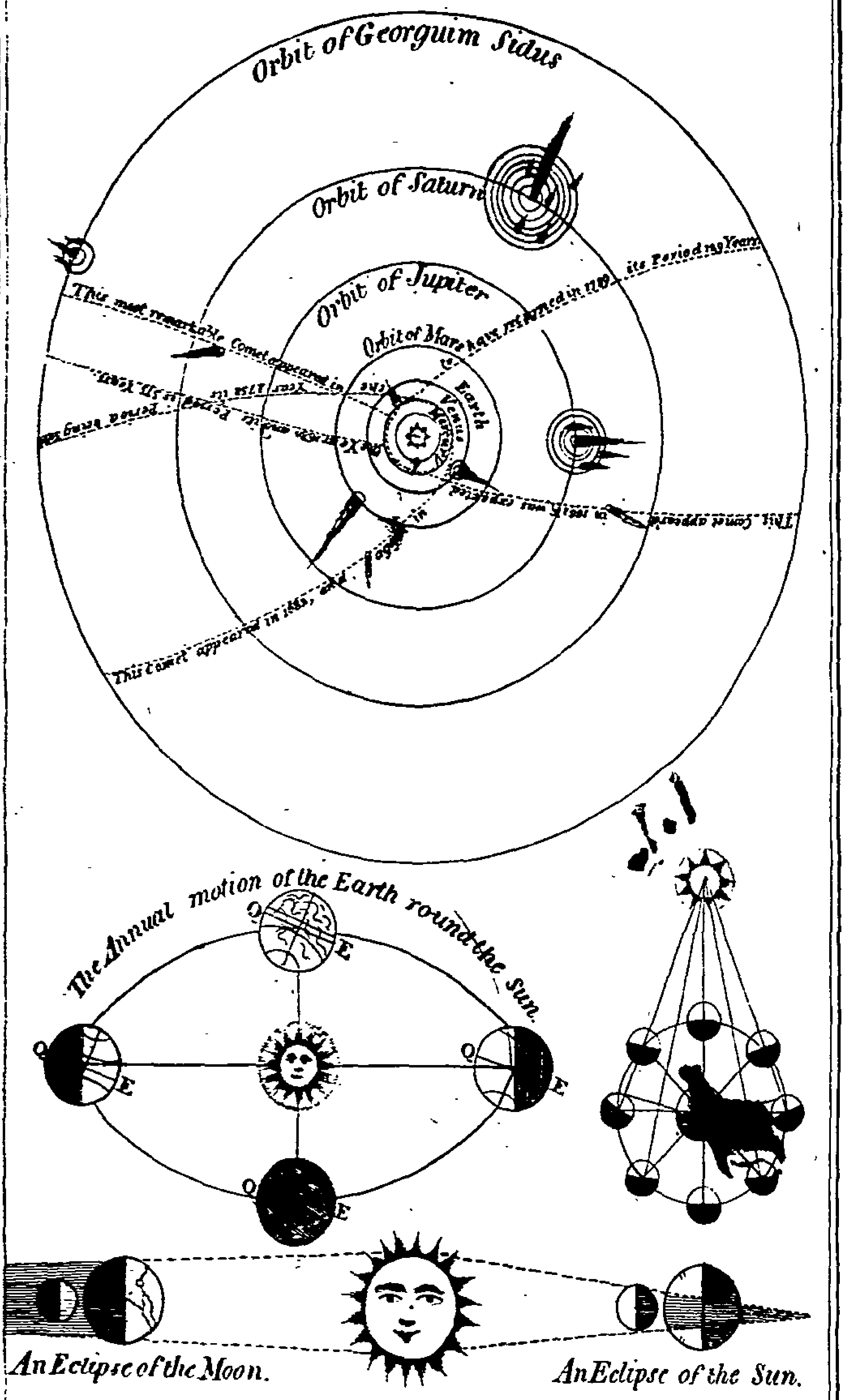
By GUNTER.

'The extent from 787 to 890 on the line of numbers will reach from radius (or 45 degrees) to 41° 29′ on the line of tangents.

2dly. 'The extent from sine angle C 48 degrees 31 minutes to radius, or 90 degrees, will reach from the base 890 to the hypothenuse 1188, on the line of numbers.

AN

THE SOLAR SYSTEM.



Newburyport Published by Edmund M. Blunt.

AN

INTRODUCTION

TO THE

ART OF NAVIGATION.

BEFORE we begin Navigation, it may not be improper to give the learner ſome idea of the Syſtem of the Univerſe, commonly called the Solar, or Copernican Syſtem, which is as follows :

The Sun, that immenſe and amazing globe of fire, the fountain of the heat and light of the whole ſyſtem, is placed near the common center of the orbits of ſeven opaque ſpherical bodies, which make their revolutions round it in leſs or more time, according to their ſeveral diſtances from it.

Mercury is neareſt to the Sun, and receives its light and heat from it, and revolves round it in an ellipſis in two months and twenty-eight days.

Venus is ſomewhat higher in the ſyſtem, and deſcribes its ellipſis round the Sun in ſeven months and fifteen days, and becomes our evening and morning ſtar by turns.

The Earth is next to Venus, and deſcribes an ellipſis round the Sun in 365¼ days, or one year, which being at a greater diſtance from the Sun than the former planets, and therefore receiving leſs of its light and heat, to make up the deficiency, the wiſe Author of nature has cauſed a ſecondary planet, called the Moon, to move round it in 27 days, 12 hours, and 44 minutes ; it receives its light and heat from the Sun, and reflects it upon the Earth, which in ſome meaſure compenſates for the abſence of the Sun, during the winter ſeaſons, in the North and South.

Mars is ſtill higher in the ſyſtem, and takes a larger circuit, revolving round the Sun in 1 year, 10 months, and 22 days.

Jupiter is the largeſt of all the planets, and deſcribes a large ellipſis round the Sun in 11 years, 10 months, 27 days ; there are four Satellites or Moons moving round it ; they receive their light from the Sun and reflect it upon their primary planet, as the Moon does upon the Earth.

Saturn revolves round the Sun in 29½ years, has 5 Moons which move round him, and is alſo ſurrounded with a prodigious ring or atmoſphere.

The Georgium Sidus is the moſt remote of all the planets, and is attended by two ſatellites :—the firſt or neareſt of which performs a ſynodical revolution in about eight days and three quarters.

The ſecond (which is about half as far again diſtant from its primary planet) is about thirteen days and a half in performing its ſynodical revolution.

The

The fixed ſtars, are ſuppoſed to be of the ſame matter with the Sun, and made for the ſame ends; each of them the center of its own proper ſyſtem, having planets moving round it as our Sun has.

Comets are a ſort of planets moving round the Sun, in ellipſes ſo very oblong, that their viſible parts ſeem to be in a manner parabolical, but have ſuch vaſt atmoſpheres about them, and tails derived from the ſame, eſpecially when they come near the Sun, as imply them deſigned for very different purpoſes from the other planets.

Having given a curſory view of the Syſtem of the Univerſe, we ſhall now conſider the Earth a little more particularly; a perfect knowledge of the figure and motion of which, with various real and imaginary lines upon it, is abſolutely neceſſary in the Art of Navigation.

The land and water of this Earth, or Planet, upon which we live, make a compoſition of a ſpherical form, or rather an oblate figure, called the Terraqueous Globe, which by turning round its axis every 24 hours, from Weſt to Eaſt, cauſe all the heavenly bodies to revolve apparently from Eaſt to Weſt in the ſame time, making the viciſſitudes of the day and night; and this Earth, together with its Moon by moving round the Sun in 1 year, or in 365 days 6 hours nearly, produce the ſeaſons of the year, viz. Winter, Summer, Autumn, and Spring.

That the Earth is round or nearly ſo, will appear, not only from the circular ſhadow it has upon the Moon, when that body happens to be eclipſed by it, but alſo from the very appearance of the Sea, and the many obſervations made by perſons ſtanding upon the ſhore, and viewing a ſhip departing from the port: they firſt loſe ſight of the body of the veſſel, whilſt they can ſtill ſee the rigging and uppermoſt ſails; but as the ſhip recedes farther, they loſe ſight of theſe alſo, as if the whole were ſunk in the deep. Again, in a ſhip making towards land, the mariners firſt deſcry the tops of ſteeples, trees, &c. pointing above the water; next, they ſee the buildings themſelves; and laſtly the ſhore, which can only be the effects of the Earth's rotundity.

The little unevenneſſes of the Earth's ſurface, ariſing from the hills and vales, is no material objection to its being conſidered as round; ſince the higheſt hill or mountain bears not ſo great a proportion to the bulk of the Earth itſelf, as the little riſings upon the coat of an orange, bear to the bigneſs of that fruit.

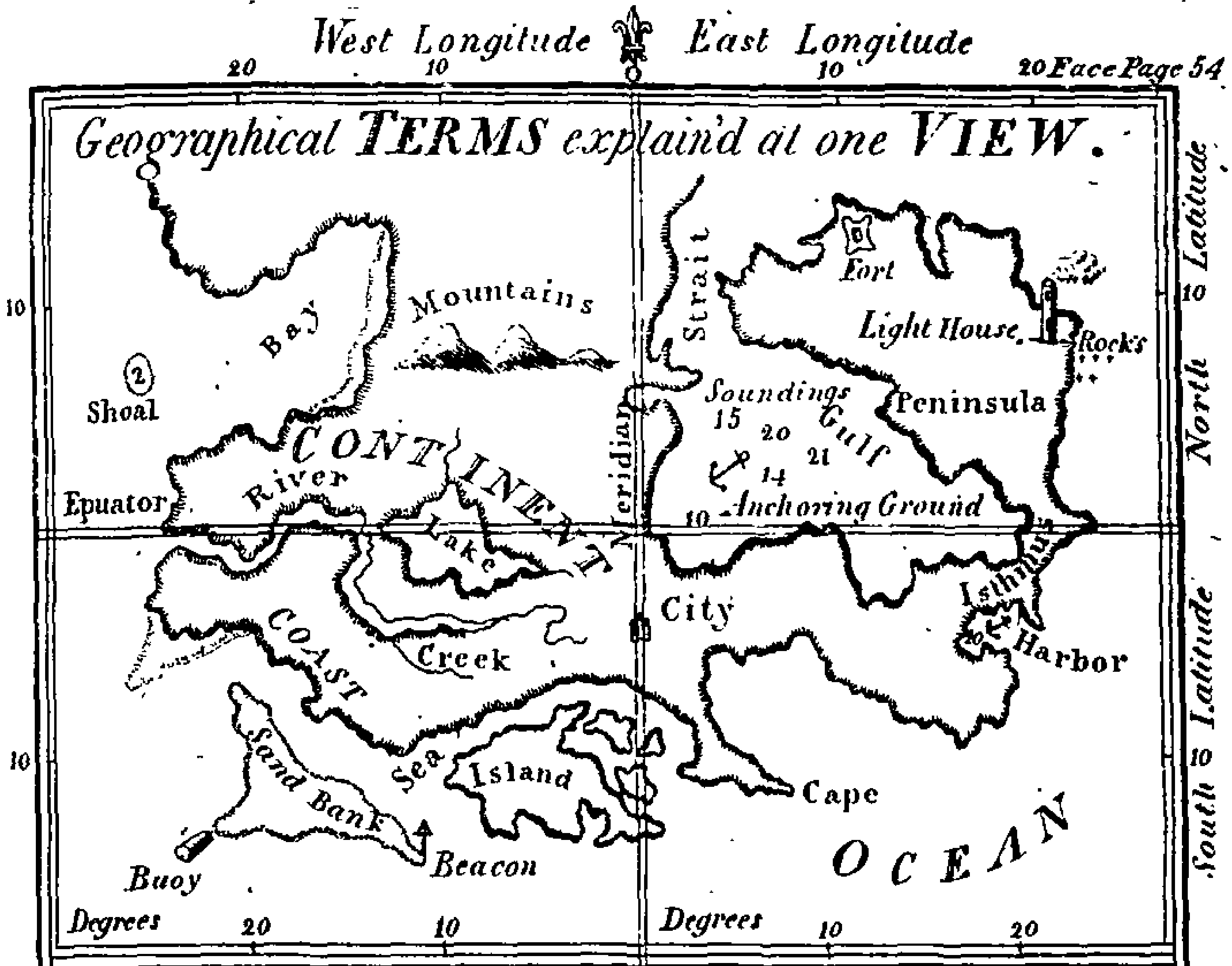
In order to deſcribe the poſition of places, geographers have found it neceſſary to imagine certain circles drawn upon the ſurface of the Earth; to which they have given the names of Equator, Meridian, Horizon, Parallels of Latitude, &c.

I. The Axis is a ſtrait line, imagined to paſs through the center of the Earth; the extreme points are the poles, on which the Earth is ſuppoſed to move, one called the Arctic or North Pole, and the other, the Antarctic, or South Pole.

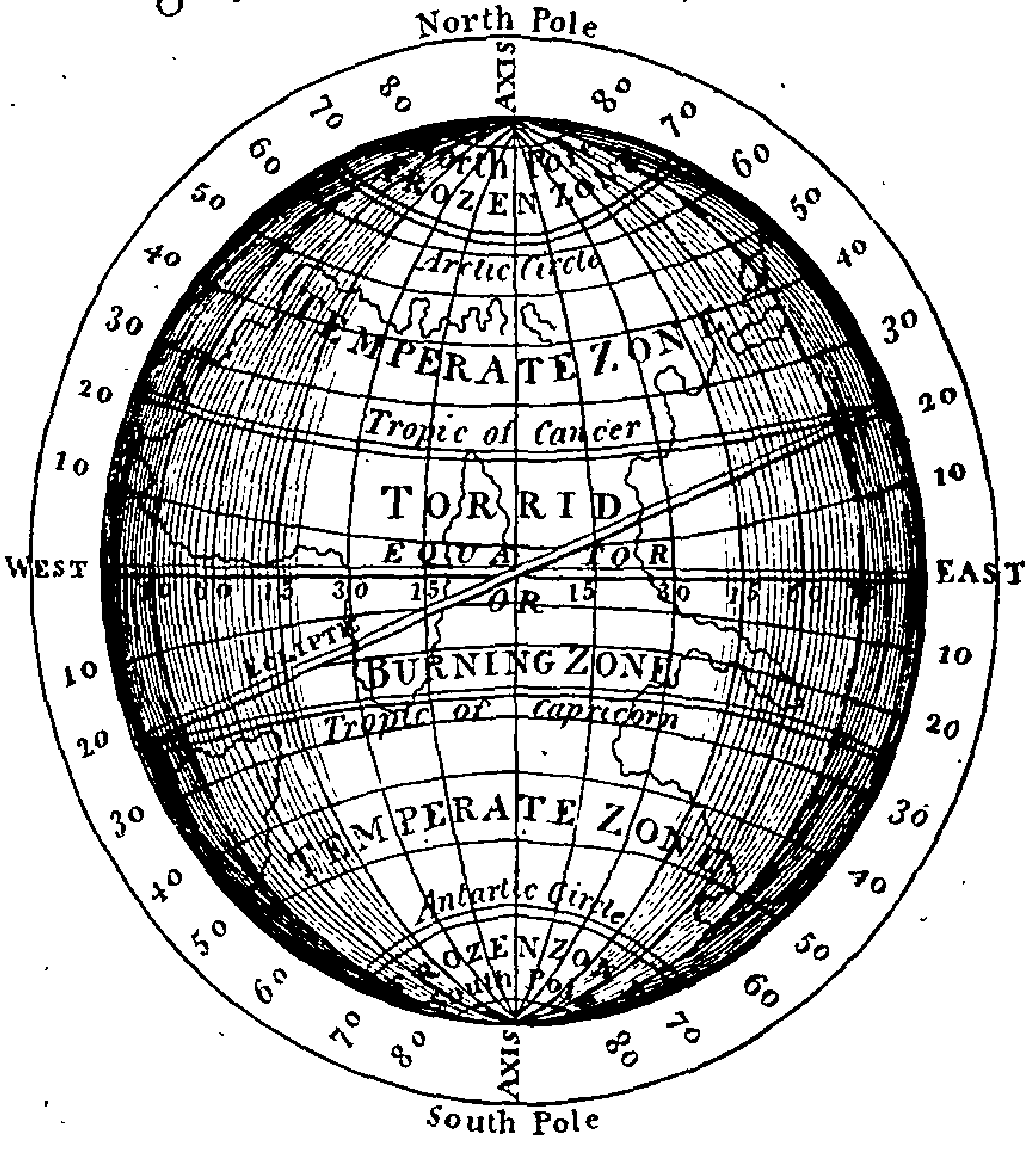
II. The Equator is a great circle under the Equinoctial Line in the Heavens, compaſſing the Earth in the middle, between the two Poles, and divides it into two equal parts, called the Northern and Southern Hemiſpheres: from it the latitude of places is reckoned either North or South; and on it are counted the degrees of longitude from Eaſt to Weſt. This circle is called the Equator, becauſe when the Sun comes to it, which is

twice

Face Page 54



Geographical CIRCLES and ZONES.



The ARTIFICIAL SPHERE or GLOBE.

Newburyport Published by Edmund M. Blunt.

twice a year, viz. about the 21st of March, at his entrance into Aries, and again into Libra about about the 21st of September, then, making equal day and night throughout the world.

III. The Meridians are circles which pass through the poles of the Earth, the Zenith, and Nadir, crossing the Equator at right angles, and dividing the Earth into two equal parts, one East and the other West; and is so called, because when the Sun comes to the meridian of any place, it is then noon or mid-day. They are infinite in number, for all places from East to West have their several meridians; of these one is called the first or chief Meridian, from which the longitude of places is reckoned; it is of special note and use, but variously placed by geographers; some placing it at London, others at Paris, Teneriffe, &c. and is divided into twice 90 degrees, numbered from the Equator towards each Pole, ending in 90 degrees, and since the Earth turns once round its axis in 24 hours, every point upon its surface describing a circle of 360 degrees in that time; therefore, any place lying 15 degrees to the East of us, has the Sun upon its meridian one hour sooner; or it is twelve o'clock with the easternmost, when it is eleven with us; and any place 15 degrees to the westward of us, has the sun one hour after us.

IV. Latitude is the nearest distance of any place from the Equator; it is measured on an arch of the Meridian, intercepted between the place and the Equator, and therefore can never exceed 90 degrees. It takes its name according as the place is situated, either North or South of the Equator; therefore, all places that lie at the same distance from, and on the same side of the Equator, are said to be under the same parallel of Latitude. Whence it follows, that if a ship sails from a North Latitude directly North, or in a South Latitude directly South, she encreases her Latitude equal to the distance sailed; and if a ship sails in North Latitude southerly, or in South Latitude northerly, she decreases her Latitude, because she sails nearer the Equator, from whence the Latitude is counted upon the Meridian: but if a ship sails from a South Latitude into a northerly one, or from a North Latitude into a southerly one, from the difference of Latitude subtract the Latitude left, and the remainder will be the Latitude come to, and of a different name with the Latitude left.

Parallels of Latitude are circles parallel to the Equator.

The difference of Latitude is an arch of the meridian contained between the two Parallels of Latitude; or it is the least distance of the Parallels of Latitude of two places, shewing how far one of them is to the northward or southward of the other, and can never exceed 180 degrees.

V. The Longitude of any place on the earth is expressed by an arch of the equator, shewing the east or west distance of the meridian of that place from some fixed meridian, where Longitude is reckoned to begin.

Difference of Longitude is an arch of the Equator, intercepted between the meridians of two places, shewing how far one of them is to the eastward or westward of the other.

NOTE. Here the Teacher will perhaps find it convenient to have a Globe, or Map of the World before him, whereon he can point out the several Positions, Latitudes, Longitudes, &c. to the Pupil, as that will strengthen his memory, and give him a better idea than he can possibly have by only reading them over. The same may be observed in reading the use of Gunter's Scale and the Quadrant.

As Longitude begins at the meridian of ſome place, and is counted from thence both eaſtward and weſtward, till it meets at the ſame meridian on the oppoſite point, therefore the difference of Longitude can never exceed 180 degrees.

VI. The Horizon is that apparent circle which limits or bounds the view of a ſpectator on the ſea, or an extended plain; the eye of the ſpectator being always ſuppoſed the centre of his horizon. Every part of this circle is 90 degrees from the centre of it over our heads, which point is called the Zenith; and the point of the Heaven's oppoſite to it, or under our feet, is called the Nadir.

When the ſun or ſtars come above the eaſternmoſt part of the Horizon, they are ſaid to riſe; and when they deſcend the weſtern part they are ſaid to ſet.

When a ſhip is under the Equator, both the poles appear in the Horizon; and, in proportion as ſhe ſails towards either, or increaſes her latitude, that pole is ſeen proportionably above the Horizon, and the other diſappears as much: but when a ſhip is ſailing towards the Equator, or decreaſes her latitude, ſhe depreſſes the elevated pole; that is, its diſtance from the Horizon decreaſes: conſequently, the latitude of a place is always equal to the elevation of the pole above the Horizon.

This circle is repreſented by the Mariner's Compaſs, divided into 32 points or rhumbs, each 11° 15′.

The Tropics are two circles parallel to the Equator, and diſtant from it 23 degrees 29 minutes; that on the north-ſide of it is called the Tropic of Cancer, at which the Sun has its greateſt north declination; then, making to us, and all places in north latitude, the longeſt day and ſhorteſt night, which is about the 21ſt of June. The other on the ſouth ſide is called the Tropic of Capricorn, at which the Sun has its greateſt ſouth declination, making then our ſhorteſt day and longeſt night, which is about the 22d of December.

The Polar Circles are alſo parallel to the Equator, compaſſing the poles of the world at 23 degrees 29 minutes diſtance; that about the North Pole is called the Arctic Circle, and the other is called the Antarctic Circle.

Theſe Tropics and Polar Circles divide the globe of the earth into 5 parts, called Zones, of which 3 were accounted by the Ancients to be ſo intemperate as to be uninhabitable; the Zones are called Torrid, Frigid, and Temperate; that is, 1 Torrid or Burning Zone, 2 Temperate, and 2 Frigid or Frozen Zones.

The Torrid Zone is all that ſpace of the earth and ſea which lies between the Tropics of Cancer and Capricorn, and is 47 degrees broad: its inhabitants ſee the ſhadow of the ſun turn ſometimes towards one pole, and ſometimes towards the other.

The two Temperate Zones are thoſe ſpaces of the earth and ſea contained between each Tropic and the Polar Circles; the inhabitants of the North Temperate Zone have their ſhadows at noon fall north, and thoſe of the South Temperate Zone have their ſhadows at noon fall ſouth.

The two Frigid Zones are contained between each Polar Circle and its pole; thoſe who inhabit them have their ſhadow always running round them; according to the different motions of the ſun.

Climates

Climates are thofe tracks of the earth bounded by imaginary lines running parallel to the Equator, and of fuch a breadth from fouth to north, that the length of the artificial day in one furpaffes that in the other by half an hour.

The inhabitants of the earth are diftinguifhed by the feveral meridians and parallels under which they live, and are denominated either Periæci, or Antipodes.

The Periæci are thofe people of the earth who live under the fame parallels, but oppofite meridians.

The Antiæci are thofe people of the earth who live under the fame meridians, but oppofite parallels.

The Antipodes are fituated directly oppofite to each other, the feet of the one directly againft the feet of the other, lying under oppofite parallels and oppofite meridians. It is midnight with one when it is noon day with the other; the longeft day with the one is the fhorteft with the other; the length of the day with the one is equal to the other's night; and the feafons are oppofite; being fummer with the one when it is winter with the other.

The Real Parts are earth and water, generally divided into four parts or quarters, called Europe, Afia, Africa, and America; each of thefe, and confequently the whole globe, is divided into continents, iflands, feas, &c.

A continent is a great quantity of land not divided by the fea, wherein are feveral empires, kingdoms, and countries conjoined, as Europe, Afia, and Africa, is one Continent, and America another.

An Ifland is a part of the earth that is environed or encompaffed round by the fea, as Great Britain and Ireland.

A Peninfula is a part of land almoft furrounded with water, fave one narrow neck of land which joins the fame to the Continent.

An Ifthmus is a narrow neck of land joining the Peninfula to the Continent, by which the people may pafs from one to the other.

A Promontory is a high part of land, ftretching itfelf into the fea, the extremity of which is called a Cape or Headland.

A Mountain is a rifing part of dry land over-topping the adjacent country, and appearing firft at a diftance.

The Earth being encompaffed with water, whofe wafhings, in furrounding the dry land, cut and fhape many winding bays, creeks, and meandering inlets, and extending itfelf round them all, is but one continued ocean.

An Ocean is a vaft collection of falt water, feparating Continents from one another, and wafhing their borders or fhores.

A Sea is part of the Ocean, to which we muft fail through fome Strait, as the Mediterranean and Baltic Seas.

A Strait is a narrow part of the Ocean lying between two fhores, and opening a way into fome fea, as the Straits of Gibraltar that lead into the Mediterranean Sea, and the Sound which leads into the Baltic Sea.

A Creek is a fmall narrow part of the fea or river, that goes up but a little way into the land.

A Bay is a great inlet of the land, as the Bay of Bifcay, and the Bay of Mexico; otherwife a Bay is a ftation or road for fhips to anchor in.

A River

A River is a conſiderable ſtream of water iſſuing out of one or various ſprings, and continually gliding along in one or more channels, till it diſcharges itſelf into the Ocean: The leſſer ſtreams are called rivulets.

A Lake is that which continually retains and keeps water in it, as the lake Zair, in Africa, and Nicaragua, in America.

A Gulph is a part of the Ocean or Sea, contained between two ſhores, and is every where environed by land, except its entrance, where it communicates with other bays, ſeas, or oceans.

There are five oceans, namely, the Northern, the Atlantic, the Pacific, the Indian, and the Southern.

The Atlantic Ocean, is uſually divided into two parts, one called the North Atlantic Ocean, and the other South Atlantic or Ethiopic Ocean.

The Northern Ocean ſtretches to the northward of Europe, Aſia, and America, towards the north pole.

The Atlantic Ocean lies between the Continents of Europe and Africa, on the eaſt, and America on the weſt.

That part of the North Atlantic Ocean lying between Europe and America, is frequently called the Weſtern Ocean.

The Pacific Ocean, or, as it is ſometimes called, the South Sea, is bounded by the weſtern and north-weſt ſhores of America, and by the eaſtern, and north-eaſt ſhores of Aſia.

The Indian Ocean waſhes the ſhores of the Eaſtern Coaſts of Africa, and the ſouth of Aſia, and is bounded on the eaſt by the Indian Iſlands and the Southern Continent.

The Southern Ocean extends to the ſouthward of Africa and America towards the South Pole.

NAVIGATION.

THE great end and bufinefs of Navigation is to inftruct the Mariner how to conduct a fhip through the wide and pathlefs ocean, to the remoteft parts of the world, the fafeft and fhorteft way, in paffages navigable.

For the due and regular performance of which are requifite—A perfect knowledge of the figure and motion of the earth, the various real and imaginary lines upon it, fo as to be able to afcertain the real diftance and fituation of places with refpect to one another, with the ufe of the feveral inftruments made ufe of in meafuring the fhip's way ; fuch as the log, half-minute glafs, quadrant, to take the altitude of the fun and ftars ; compafs, to reprefent the fenfible horizon ; and azimuth compafs, to take the azimuth or amplitude of the fun, in order to know the variation of the magnetic needle ; maps or charts of the feas and lands, together with the depth of water, the times and fettings of the tides upon the coafts he may have occafion to approach near ; a competent knowledge of currents ; of the mould and trim of the fhip, and the fail fhe bears, that fo due allowance may be made for leeway : By help of thefe, and fkill in the Navigator, he may know at all times the place the fhip is in, which way he muft fteer, and how far, to gain his intended port.

Notwithftanding what has been faid, it may not be improper here to obferve, that,

As latitude is counted from the Equator upon an arch of the meridian, north and fouth, the difference of latitude between two places, both north, or both fouth, is found by fubtracting the lefs latitude from the greater ; but if one latitude be north, and the other fouth, the difference is found by adding both latitudes together.

Confequently, if a fhip in north latitude fails northerly, or in fouth latitude foutherly, fhe increafes her latitude ; but in north latitude failing foutherly, or in fouth latitude failing northerly fhe decreafes her latitude ; becaufe fhe fails nearer to the Equator, from whence the latitude is reckoned.

Wherefore in north latitude failing northerly, or in fouth latitude failing foutherly, the difference of latitude added to the latitude left, gives the latitude in.

In north latitude failing foutherly, or in fouth latitude failing northerly, the difference of latitude fubtracted from the latitude left, gives the latitude in.

When the latitude decreafes, and the difference of latitude is greater than the latitude failed from, fubtract the latitude left from the difference, and

and the remainder will be the latitude in, and of a different name: for it is plain, in this caſe, that the ſhip has croſſed the Equator.

As the longitude is counted from the firſt meridian eaſt and weſt, until it comes to the oppoſite meridian, therefore it cannot exceed 180 degrees.

The difference of longitude between two places, being both eaſt or weſt, is found by ſubtracting the leſs longitude from the greater; but if one be in eaſt longitude and the other in weſt, their ſum is the difference of longitude.

Therefore in eaſt longitude ſailing eaſterly, or in weſt longitude ſailing weſterly, the difference of longitude added to the longitude left, gives the longitude in.

In eaſt longitude ſailing weſterly, or in weſt longitude ſailing eaſterly, the difference of longitude ſubtracted from the longitude left, gives the longitude in.

When a ſhip ſails eaſt or weſt, until ſhe paſſes the oppoſite meridian, or 180 degrees, ſhe changes her longitude, or comes into a longitude of a different name.

What has been ſaid, will be rendered familiar to the learner by the following examples:

EXAM. I. What is the difference of latitude between London in latitude 51° 32′ N. and Rome in latitude 41° 54′ N?

From London's lat.	51° 32′ N.
Subtract Rome's lat.	41° 54′ N.
Rem. the diff. of lat.	9° 38′ N.
	60
Diff. in miles - -	578

EXAM. II. A ſhip from latitude 29° 17′ S. ſails ſouthward until her difference of latitude be 374 miles, what latitude is ſhe come to?

Latitude ſailed from	29° 17′ S.
Diff. of Lat. 374 ÷ 60 =	6° 14′ S.
Lat. in - - -	35° 31′ S.

EXAM. III. Required the difference of latitude between Cape Finiſterre and Cape Rogue in South America.

Cape Finiſterre's lat.	42 52 N.
Cape Rogue's lat.	5 00 S.
Diff. of lat.	47 52
	60
Diff. in miles	2872

EXAM. IV. A ſhip from latitude 8° 25′ N. ſails ſouth 600 miles, what latitude is ſhe in?

From diff. of lat. 600 miles, or - -	10 00 S.
Sub. lat. left - -	8 25 N.
Diff. lat. in	1 35 S.

In the laſt example it is plain, that as the difference of latitude is more than the latitude left, the ſhip muſt have croſſed the Equator, and conſequently come into ſouth latitude.

NOTE.

NOTE. When one of the places has no latitude, or is on the Equator, then the latitude of the other place is their difference of latitude.

EXAM. V. What is the difference of longitude between Cape Finisterre and east point of Barbadoes?

Cape Finisterre's long.	9° 14′ W.
Barbadoes' long.	59 37 W.
Diff. of long. —	50 23 W.
	60
Diff. in miles —	3023.

EXAM. VII. What is the difference of longitude between Barcelona and Lisbon?

Barcelona's long.	2° 18′ E.
Lisbon's long.	9 7 W.
Diff. of Long. —	11 25 W.

EXAM. IX. What is the difference of longitude between the N. E. point of Japan and St. Christopher's?

N. E. of Japan's long.	140° 25′ E.
St. Christopher's long.	62 42 W.
Exceeds 180° 00′	203 07
	360 00
Diff. of long. —	156 53 W.

EXAM. VI. A ship from Cape Charles in Virginia sails westward, till her difference of longitude be 400 miles, what longitude is she in?

Cape Charles' long.	75° 9′ W.
Diff. of long. 400 miles =	6 40 W.
Long. in —	81 49 W.

EXAM. VIII. A ship from 15° 40′ E. long. sails westward till her diff. of long. be 27° 15′, what long. is she in?

Long. left	15 40 E.
Diff. of Long.	27 15 W.
Long. in —	11 35 W.

EXAM. X. A ship from longitude 160° 20′ W. sails westward until she differs her long. 41° 20′, what long. is she in?

Long. left —	160 20 W.
Diff. of long. —	41 20 W.
	201 40
	360 00
Long. in —	158 20 E.

Here it is plain, that the ship has crossed the opposite meridian, and therefore has come into a longitude of a different name.

In sailing due north or south, the ship changes her latitude only; and sailing east or west, her longitude; but sailing upon any other course, she must change both latitude and longitude.

Easting or westing in Plane Sailing is called departure or Meridian Distance.

The instrument used in measuring a ship's way at sea, is the Log.

Ships at sea are directed from one place to another by means of an instrument called the Mariner's Compass.

The Mariner's Compass is an artificial representation of the horizon of every place, by the means of a circular piece of paper, called a card, divided like the horizon into degrees and points, which are called Rhumbs.

Now the card being properly fixed to a piece of ſteel, called the Needle, that has been touched with a loadſtone (whoſe property is ſuch as to cauſe one end of the needle ſo touched to point towards the north, when turning freely on ſomething ſupporting it) all the points of the card will be directed towards the correſponding points of the horizon :

Hence it follows, that in every place the north point of the card ſhews the poſition of the meridian of that place, and ſome one rhumb or point of the card will coincide with, or be directed along the track that makes any given angle with the meridian ; conſequently, by the help of the card or compaſs, a ſhip may be kept in any propoſed track or courſe.

A Rhumb Line, or point, is a right line drawn from the centre of the compaſs to the horizon, and is named from that point of the horizon it falls in with.

The Courſe, is the angle which any rhumb line makes with the meridian, and is ſometimes reckoned in degrees, and ſometimes in points of the compaſs ; ſo that if a ſhip ſails upon the ſecond rhumb, or N. N. E. the courſe is 22 degrees 30 minutes : and ſo for any other, as in the table of the angles which every point of the compaſs makes with the Meridian, (page 64) which the learner ſhould be ſo well acquainted with, or the compaſs, as to be able readily to tell how many points any courſe or rhumb is diſtant from the meridian, or from the parallel.

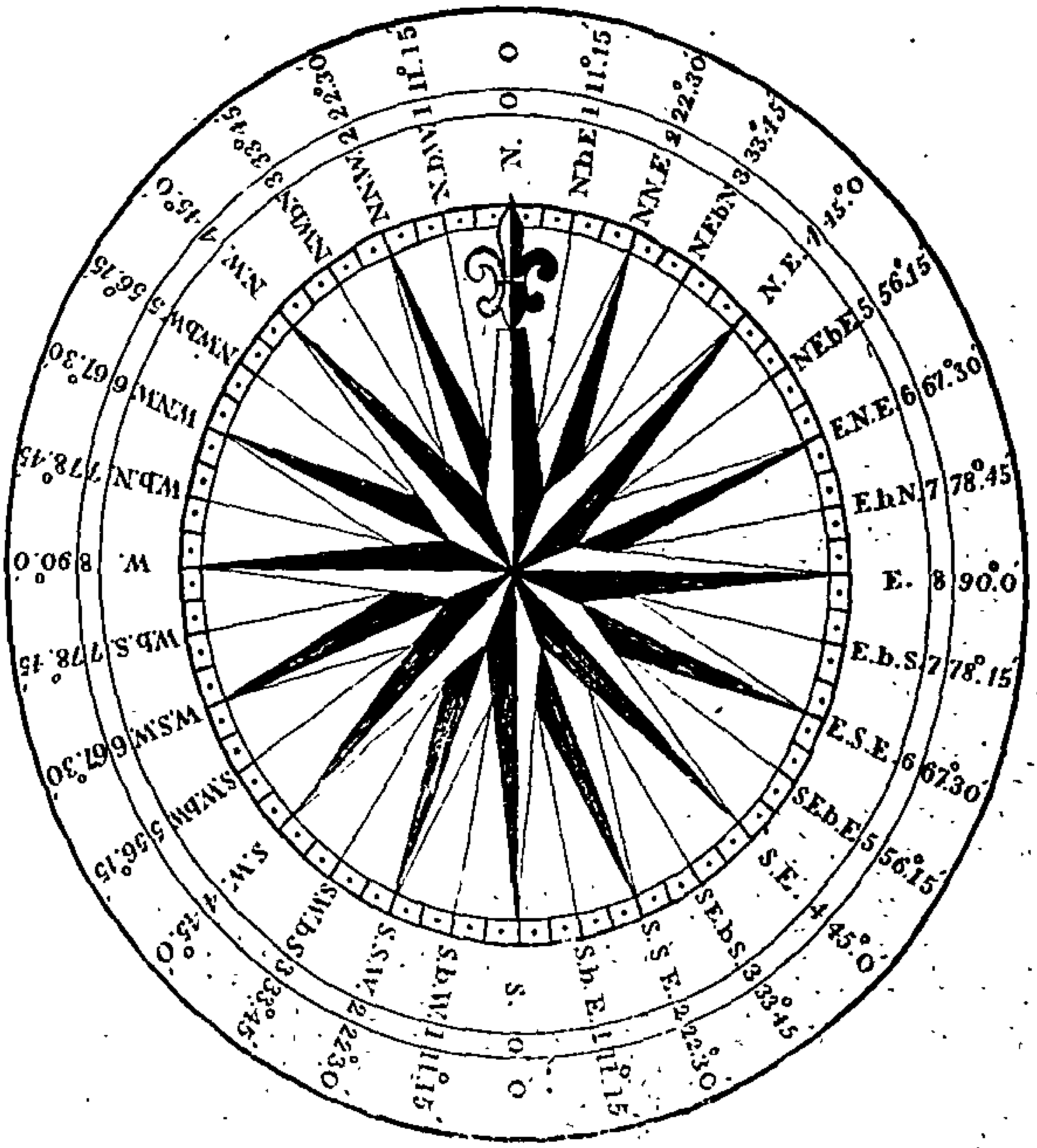
Table of Numbers for finding the Course in the Tables of Difference of Latitude and Departure.

Dist. and Diff. of Lat.				Distance and Depart.				Diff. of Lat. and Dep.			
Num.	Deg.	Num.	Deg.	Num.	Deg.	Num.	Deg.	Num.	Deg.	Num.	Deg.
1000	1	17	89	17	1	1000	89	2	1	5882	89
999	2	35	88	35	2	999	88	3	2	2855	88
998	3	52	87	52	3	998	87	5	3	1908	87
997	4	70	86	70	4	997	86	7	4	1432	86
996	5	87	85	87	5	996	85	9	5	1145	85
995	6	105	84	105	6	995	84	10	6	950	84
993	7	122	83	122	7	993	83	12	7	816	83
990	8	139	82	139	8	990	82	14	8	711	82
988	9	156	81	156	9	988	81	16	9	632	81
985	10	173	80	173	10	985	80	18	10	568	80
982	11	191	79	191	11	982	79	19	11	515	79
978	12	208	78	208	12	978	78	21	12	470	78
974	13	225	77	225	13	974	77	23	13	433	77
970	14	242	76	242	14	970	76	25	14	401	76
966	15	259	75	259	15	966	75	27	15	373	75
961	16	276	74	276	16	961	74	29	16	349	74
956	17	292	73	292	17	956	73	30	17	328	73
951	18	309	72	309	18	951	72	32	18	308	72
945	19	326	71	326	19	945	71	34	19	290	71
940	20	342	70	342	20	940	70	36	20	275	70
934	21	358	69	358	21	934	69	38	21	260	69
927	22	375	68	375	22	927	68	40	22	248	68
921	23	391	67	391	23	921	67	42	23	236	67
914	24	407	66	407	24	914	66	45	24	225	66
906	25	423	65	423	25	906	65	47	25	214	65
899	26	438	64	438	26	899	64	49	26	205	64
891	27	454	63	454	27	891	63	51	27	196	63
883	28	470	62	470	28	883	62	53	28	188	62
875	29	485	61	485	29	875	61	55	29	180	61
866	30	500	60	500	30	866	60	58	30	173	60
857	31	515	59	515	31	857	59	60	31	166	59
848	32	530	58	530	32	848	58	62	32	160	58
839	33	545	57	545	33	839	57	65	33	154	57
829	34	559	56	559	34	829	56	67	34	148	56
819	35	574	55	574	35	819	55	70	35	143	55
809	36	588	54	588	36	809	54	73	36	138	54
799	37	602	53	602	37	799	53	75	37	133	53
788	38	616	52	616	38	788	52	78	38	128	52
777	39	629	51	629	39	777	51	81	39	123	51
766	40	643	50	643	40	766	50	84	40	119	50
755	41	656	49	656	41	755	49	87	41	115	49
743	42	669	48	669	42	743	48	90	42	111	48
731	43	682	47	682	43	731	47	93	43	107	47
719	44	695	46	695	44	719	46	96	44	103	46
707	45	707	45	707	45	707	45	100	45	100	45

A Table of the Angles which every Point of the Compass makes with the Meridian.

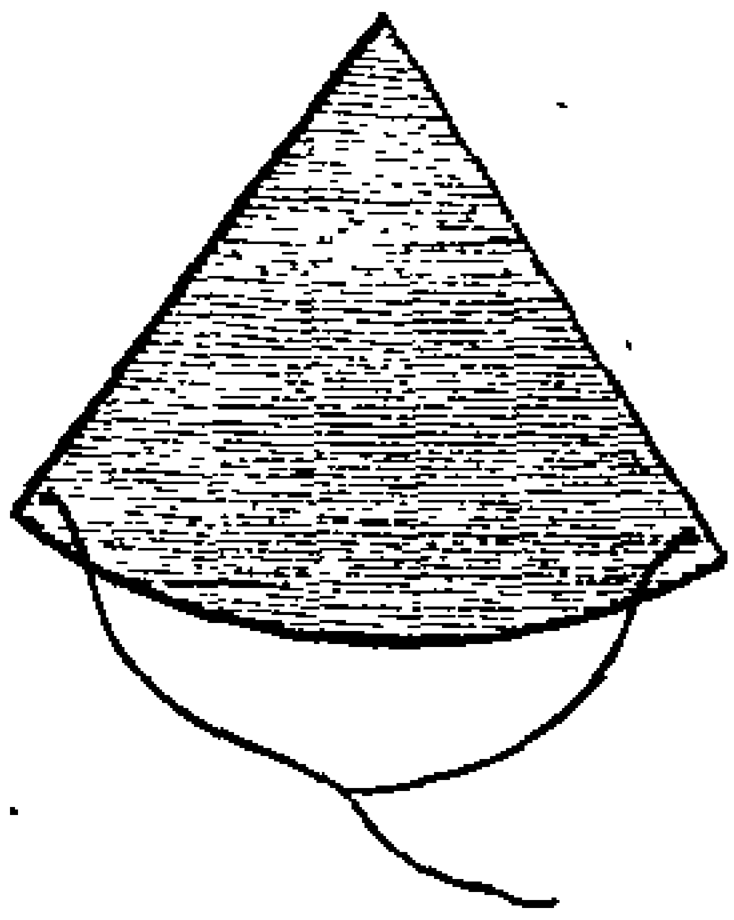
North.	South.	Points.	D. M.	North.	South.
		¼	2.49		
		½	5.37		
		¾	8.26		
N. by E.	S. by E.	1	11.15	N. by W.	S. by W.
		1 ¼	14. 4		
		1 ½	16.52		
		1 ¾	19.41		
N. N. E.	S. S. E.	2	22.30	N. N. W.	S. S. W.
		2 ¼	25.19		
		2 ½	28. 7		
		2 ¾	30.56		
N E.b.N.	S.E.b.S.	3	33.45	N. W. by N.	S. W. by S.
		3 ¼	36.34		
		3 ½	39.22		
		3 ¾	42.11		
N. E.	S. E.	4	45. 0	N. W.	S. W.
		4 ¼	47.49		
		4 ½	50.37		
		4 ¾	53.26		
N E.b.E.	S.E.b.E.	5	56.15	N. W. by W.	S. W.b.W.
		5 ¼	59. 4		
		5 ½	61.52		
		5 ¾	64.42		
E. N. E.	E. S. E.	6	67.30	W. N. W.	W. S. W.
		6 ¼	70.19		
		6 ½	73. 7		
		6 ¾	75.56		
E. by N.	E. by S.	7	78.45	W. by N.	W. by S.
		7 ¼	81.34		
		7 ½	84.22		
		7 ¾	87.11		
	East.	8	90. 0	West.	

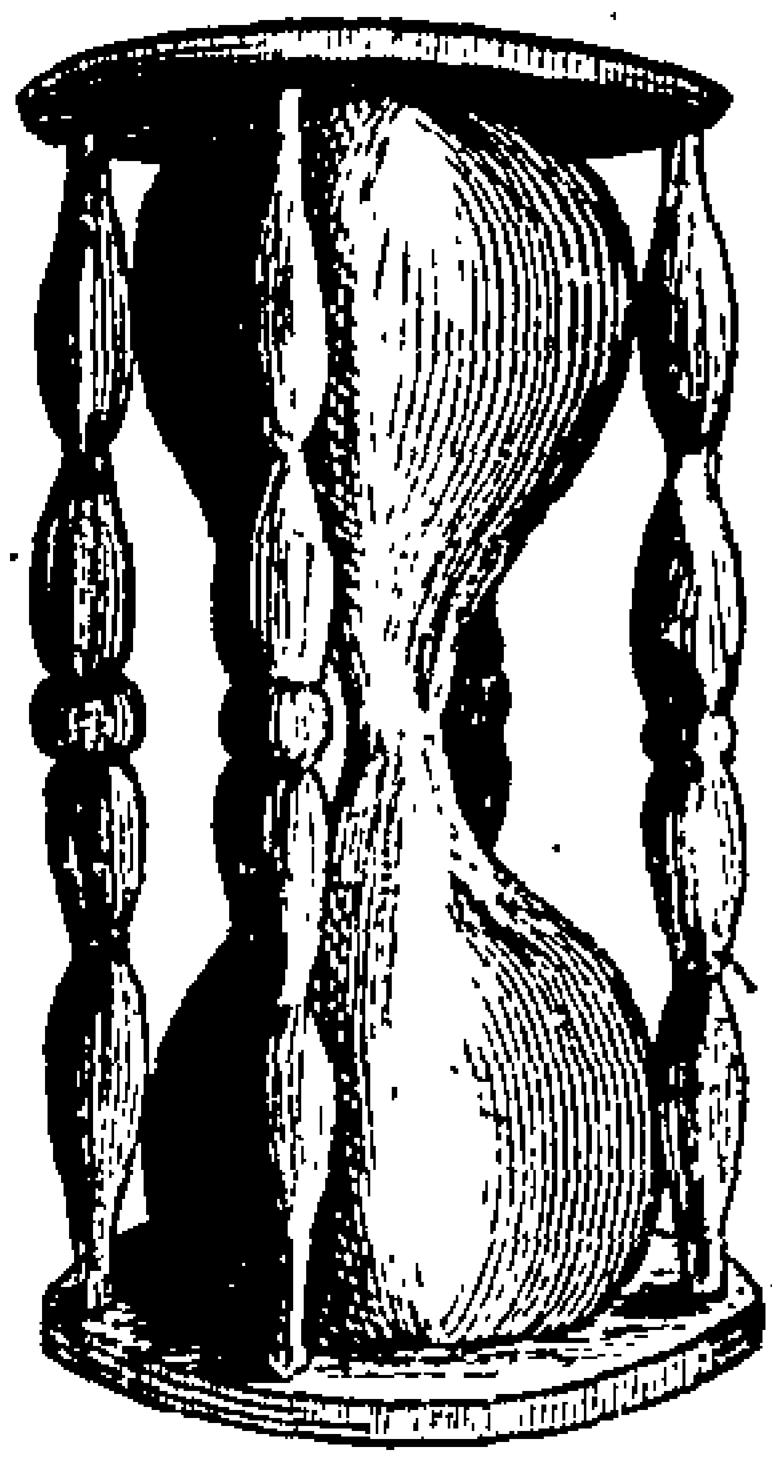
THE MARINERS COMPASS.



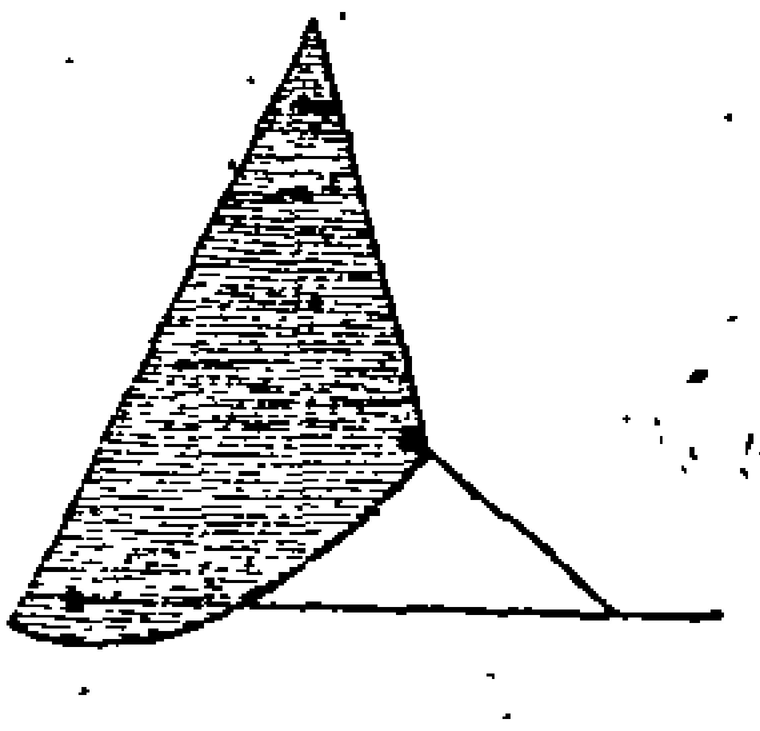
THE MINUTE GLASS.

The Log





The Log
in the Act of heaving



N.B. There are many kinds of Logs, but the above is the most Common.

Newburyport Published by Edmund M. Blunt

PLANE SAILING.

PLANE SAILING is the art of navigating a ſhip upon principles deduced from the notion of the earth's being an extended Plane, and is no more than the application of Plane Trigonometry to the ſolution of the ſeveral variations, or caſes; where the hypothenuſe, or longeſt ſide, is always the rhumb that the ſhip ſails upon.

The Perpendicular is the difference of latitude counted on the meridian, and the baſe the departure: which is eaſting or weſting, counted from the meridian.

The Angle oppoſite the baſe is the courſe, or angle, that the ſhip makes with the meridian; and the angle oppoſite the perpendicular is the complement of the courſe, which being taken together, make always eight points or rhumbs, which is 90 degrees.

In conſtructing figures relating to a ſhip's courſe, let the upper part of the paper, or what the figure is drawn upon, always repreſent the north; the lower part will be the ſouth; the right hand eaſt: and the left weſt.

Draw the north and ſouth line to repreſent the meridian of the place the ſhip ſails from; then, if the ſhip's courſe is to the ſouthward, mark the upper end of the line for the place ſailed from; but if the courſe is northward, mark the lower end for that place.

When the courſe is eaſterly, deſcribe the arch, and lay off the courſe and departure on the right-hand ſide of the meridian; but when weſterly, on the left-hand ſide.

When the courſe is given in degrees, the degrees expreſſing it muſt be taken from the line of chords; but when in points, from the line of rhumbs; and is always to be laid off upon the arch, beginning at the meridian.

When the courſe is given in points, it may be ſet down with its corresponding logarithm in points in the calculation, as found in the firſt page of the logarithms, without reducing it into degrees, as it ſeems altogether unneceſſary.

In all caſes, wherever the complement of courſe, or co-ſine, &c. is uſed, the degrees or points put down is the courſe itſelf; yet the logarithm belonging to the complement, or co-ſine, &c. of that courſe is taken.

CASE I.

Courſe and Diſtance ſailed given, to find the Difference of Latitude and Departure from the Meridian.

A Ship from the Lizard, in latitude 49° 57′ N. ſails S. W. by W. 488 miles.

Required

Required the Latitude she is in, aud her departure from the Meridian she failed from ?

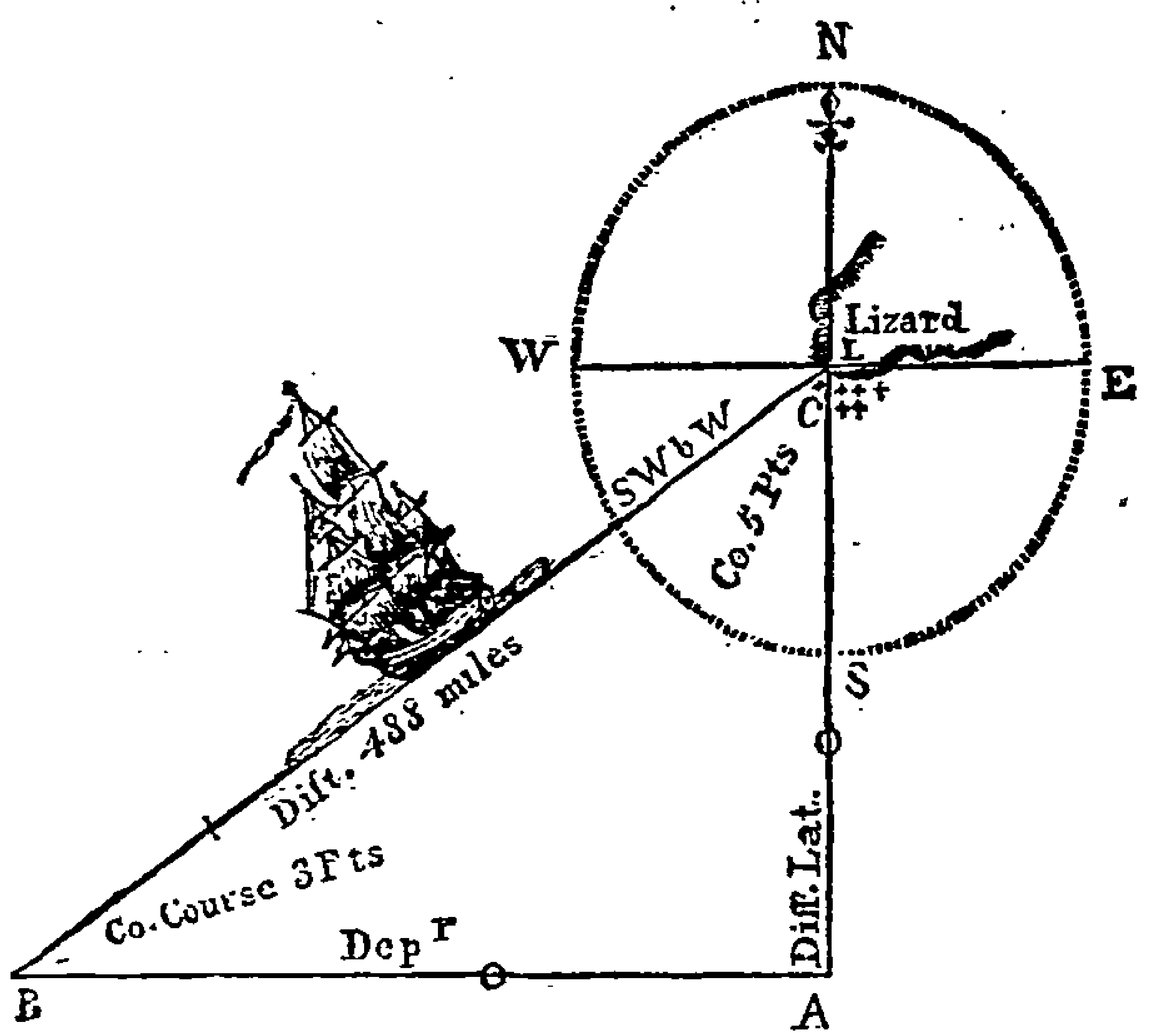
By CONSTRUCTION.

Draw the line C A to represent the meridian of the Lizard, and C the Lizard Point.

With the chord of 60° in your compasses, and one foot in C, describe the compass N. W. S. E.

Take 5 points in your compasses from the line of rhumbs on the plane scale. and set it off on the arch from S. towards W. for the course ; draw the line C B, which make equal to the distance 488 ; draw B A parallel to the E. and W. points W. E. to cut the Meridian in A.

Then will A C be the difference of latitude 271,1, and A B the departure 405.8.



By making the Distance Radius, it will be by AXIOM I.

The course 5 points = 56° 15′			The co-course 3 points 33° 45′		
To find the Departure.			To find the Diff. of latitude.		
As radius	90′	10.00000	As radius	90′	10.00000
Is to the distance 488		2.68842	Is to the distance 488		2.68842
So is the sine course 5 pts.		9.91985	So is co-sine course 5 pts.		9.74474
		12.60827			12.43316
		10.00000			10.00000
To the departure 405.8		2.60827	To the diff. of lat. 271.		2.43316

Now

Now as the ſhip is in north latitude ſailing ſoutherly; from the latitude left — — 49° 57′ N.
Take the difference of latitude 271.1 = 4 31 S.

Gives the latitude in 45 26 N.

And the departure from the Meridian is 405,8 miles.

By making the Departure Radius, it will be,

To find the Departure.		To find the Diff. of Latitude.	
As co-ſec. courſe 5 pts.	10.08015	As co-ſec. courſe 5 pts.	10.08015
Is to the diſt. 488	2.68842	Is to the diſt. 488	2.68842
So is radius 8 pts. 90	10.00000	So is co-tan. courſe 5 pts.	9.82489
	12.68842		12.51331
	10.08015		10.08015
To the departure 405,8	2.60827	To the diff. of lat. 271,1	2.43316

By making the difference of Latitude radius, it will be,

To find the Departure.		To find the Difference of Latitude.	
As ſec. courſe 5 pts.	10.25526	As ſec. courſe 5 pts.	10.25526
Is to the diſt. 488	2.68842	Is to the diſt. 488	2.68842
So is tang. courſe 5 pts.	10.17511	So is the radius 8 pts. 90°	10.00000
	12.86353		12.68842
	10.25526		10.25526
To the dep. 405,8	2.60827	To the diff. of lat. 271,1	2.43316

Here all the three ſides are made radius, to find the difference of latitude and departure; therefore, the Learner may make which ſide radius he pleaſes; but as for my part, I ſhall make the firſt, where the diſtance is made radius, whenever the courſe is given.

Though this method of working by logarithms is certain, yet the ſame may be wrought by Gunter's Scale and Compaſſes, much more expeditiouſly, and exact enough in the practice of navigation.

NOTE. When the courſe is given in points, make uſe of the lines marked ſine rhumbs, and tangent rhumbs, on the upper ſide of the Scale; when in degrees, make uſe of the lines marked ſine and tangent.

By GUNTER.

Now to perform the laſt caſe, extend from radius or 8 points to 5 points on the line marked S R; that extent will reach from the diſtance 488 to the departure 405,8 on the line of numbers.

2dly. Extend from radius or 8 points to 3 points, the complement of the courſe on the line S R; that extent will reach from the diſtance 488 to the difference of latitude 271 on the line of numbers.

Thus

Thus may all the operations be performed in the several cases of Navigation.

By this case is calculated the tables of latitude and departure for every degree, point and quarter-point of the Mariner's Compass, to the distance of 300 miles, which is of excellent use in working day's works at sea, and may be applied both to middle latitude and Mercator's Sailing, as shall be shewn hereafter; we shall only proceed now to the working of the last case by the Table of Diff. of Latitude and Departure.

By INSPECTION.

Find the given course at the top or bottom of the tables, either among the points or degrees, and in that page, and right against the distance taken in its column, stand the difference of latitude and departure in their columns.

Thus, the course is S. W. by W. or 5 points, which is found at the bottom of the table of difference of latitude and departure for points: and as the distance 488 is too great to be found in the tables, divide it by 2, (or any other convenient number) and that gives 244, which look for in the distance column, and right against it stands 135,5 for the difference of latitude, and 202,8 for the departure, which being doubled (because divided by 2) gives 271, for the difference of latitude, and 405,6 for the departure, the same as before. Any of these methods will do, but the last is chiefly practised at sea.

NOTE.—All points above 4, are to be looked for at bottom of Table I; and all less at top, with minutes to right hand in those above 4, and minutes on left hand, in those less than 45° or 4 points.

CASE II.

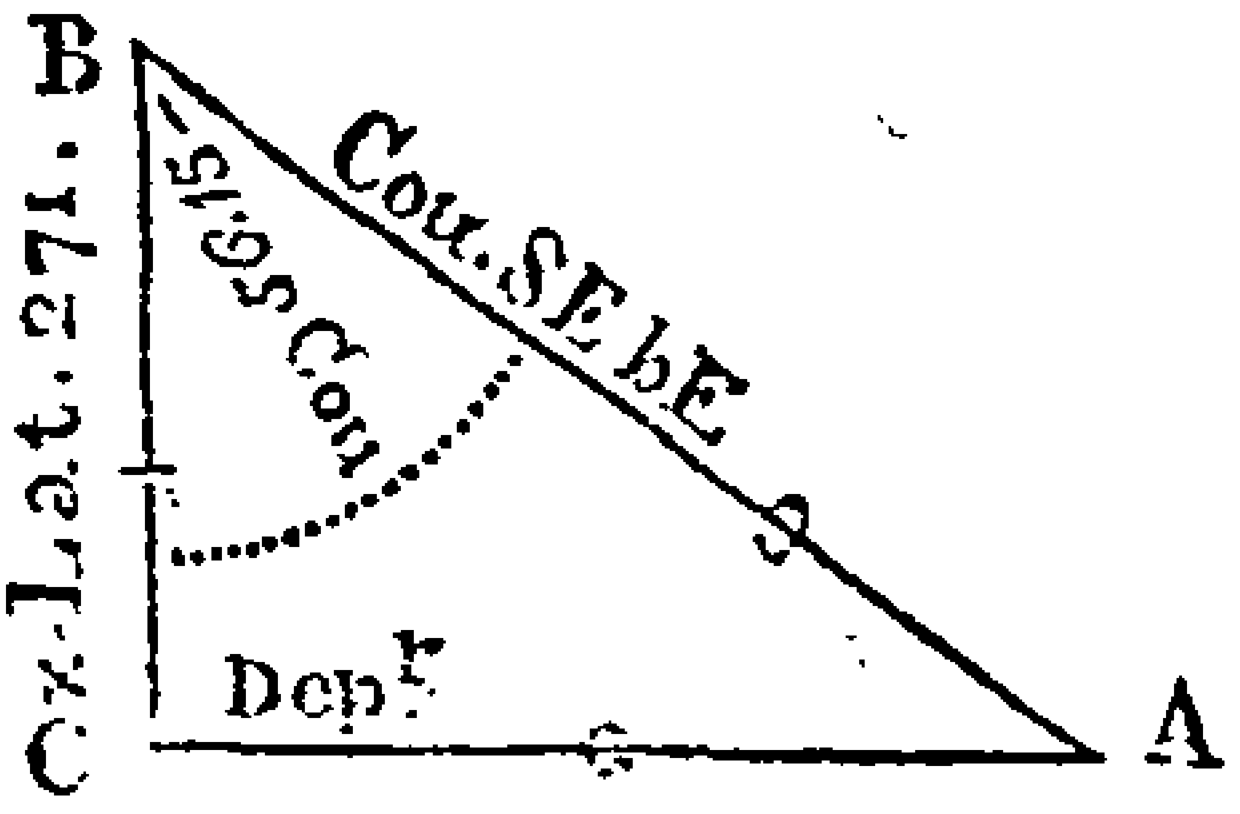
Course and Difference of Latitude given, to find the distance run, and Departure from the Meridian.

If a ship runs S. E. by E. from 1° 45′ north latitude, and then by observation is in 2° 46 south latitude, what is her distance and departure?

Now, in this case, as the ship has crossed the Equator, therefore the latitude 1° 45 N. added to 2° 46′ S. is 4° 31′, which multiplied by 60 gives 271 miles for the difference of latitude.

Constructed the same as Problem X. in Geometry.

Draw BC = 271. and BA making an angle with BC = 5 points, or 56° 15′: upon C erect the perpendicular CA to join BA in A and it is done; then will CA = 406, and AB = 488.



By

By making the Distance A B Radius, it will be,

Course S. E. by E. 5 Pts. $=56^\circ\ 15'$		Complement 3 Points $=33^\circ\ 45'$	
To find the Departure.		To find the Distance.	
As co-sine course 5 pts.	9.74474	As co-sine course 5 pts.	9.74474
Is to the diff. of lat. 271	2.43297	Is to the diff. of lat. 271	2.43297
So is sine course 5 points	9.91985	So is radius	10.00000
	12.35282		12.43297
	9.74474		9.74474
To the departure 405,6	2.60808	To the distance 487,8	2.68823

Hence the ship's distance run is 487,8 miles, and her departure from the meridian is 405,6 easterly.

By GUNTER.

Extend from 3 to 5 points on the line marked S R, that extent will reach from the difference of latitude 271 to the departure 405,6 on the line of numbers.

2dly. Extend from radius or 8 points to 3 points, that extent will reach from the difference of latitude 271 to the distance 488 on the line of numbers.

By INSPECTION.

Find the course among the points or degrees, and the difference of latitude in its column, right against which stand the distance and departure in their columns.

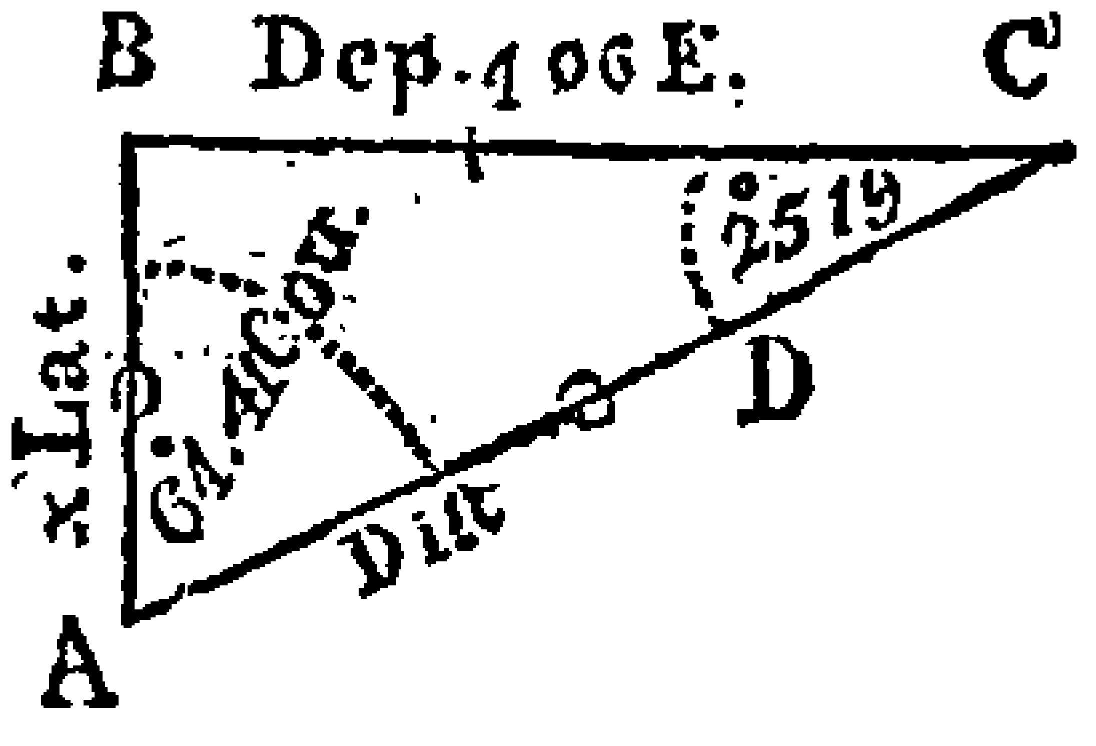
Now, as the difference of latitude 271 is too great to be found in the tables, I divide it by 2, and that gives 135,5 which I find over 5 points in the latitude column; against that stands 244, for the distance, and 202,5 for the departure, which multiplied by 2 gives the distance 488, and the departure 405.

CASE III.

Course and Departure from the Meridian given, to find the Distance and Difference of Latitude.

If a ship sails N. E. by E. $\frac{3}{4}$ E. from a port in $3^\circ\ 15'$ South latitude, until she depart from her first meridian 406 miles, I demand her distance, and what latitude she is in?

By CONSTRUCTION.



Draw the meridian A B, upon which erect the perpendicular B C, and set off thereon from B her departure 406 easterly from B to C, with the chord of 60°; on C describe an arch, and set off thereon the complement of the course, as D E, and through D and C draw the line C D A, cutting the meridian in the point

point A; then the distance A C, measured on the same scale before used, gives 449, and A B 192 the difference of latitude.

By making the Distance AC Radius, it will be,

The course $5\frac{3}{4}$ points $= 64° 41'$		The compl. $2\frac{1}{4}$ points $= 25° 19'$	
To find the Diff. of Lat.		To find the Distance.	
As sine course $5\frac{3}{4}$ pts.	9.95616	As sine course $5\frac{3}{4}$ points	9.95616
Is to the departure 406	2.60853	Is to the departure 406	2.60853
So is co-sine course $5\frac{3}{4}$ pts.	9.63099	So is radius	10.00000
	12.23952		12.60853
	9.95616		9.95616
To the diff. of lat. 192	2.28336	To the distance 449,1	2.65237

From the latitude left	3° 15′ S.
Subtract the difference of latitude 192 miles, or	3 12 N.
The remainder being 3, shews the ship is in	0 03′ S.

By GUNTER.

Extend from $5\frac{3}{4}$ points to $2\frac{1}{4}$ on the line marked S R, that extent will reach from the departure 406 to the difference of latitude 192 on the line of numbers.

2dly. Extend from radius to $5\frac{3}{4}$ points, that extent will reach from the departure 406 to the distance 449 miles.

By INSPECTION.

Find the course either among the points or degrees, and the departure in its column, right against which stands the distance and difference of latitude in their respective columns.

Thus, with the course $5\frac{3}{4}$ points, and half the departure, I find 202,5 for the distance, and 95,8 for the difference of latitude, which being doubled, gives the distance 405, and the difference of latitude 191,6, as before.

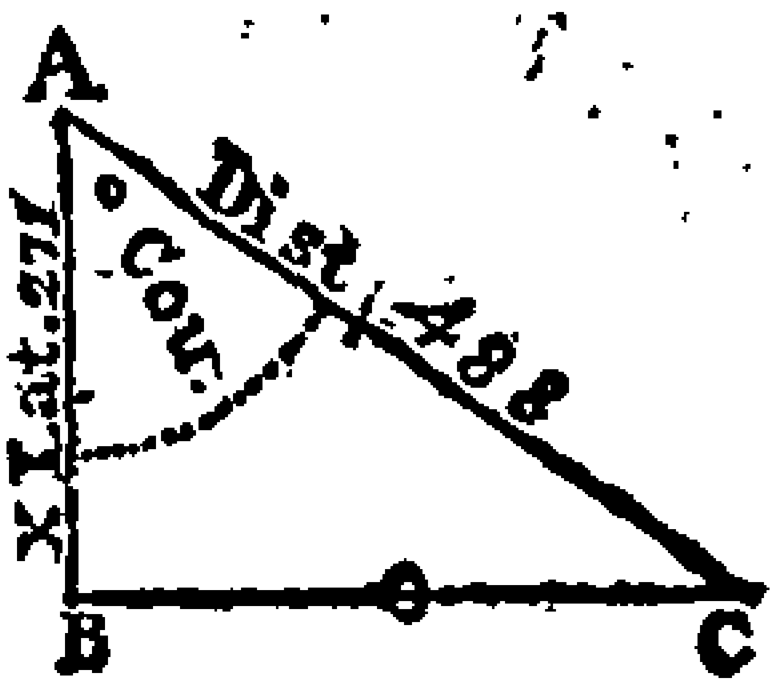
CASE IV.

Distance and Difference of Latitude given, to find the Course and Departure.

Suppose a ship sails 488 miles, between the south and the east, from a port in 2° 52′ south latitude, and then by observation is in 7° 23′ south latitude; what course has she steered, and what departure has she made?

From the latitude by observation 7° 23′ take 2° 52′ the latitude left, the remainder 4° 31′ multiply by 60 = 271 miles or minutes of difference of latitude.

Constructed



Constructed as Problem XI. in Geometry.

Draw the meridian A B = 271; upon B erect the perpendicular B C; take 488 in your compasses, and with one foot on A, lay the other on the line B C; join A and C; then will B C be the departure 406, and the angle B A C the course = 56° 10', or five points nearly.

To find the Course.		To find the Departure.	
As the distance 488	2.68842	As radius - -	10.00000
Is to radius - -	10.00000	Is to the distance 488	2.68842
So is the diff. lat. 271	2.43297	So is sine course 56° 16'	9.91993
	12.43297		12.60835
	2.68842		10.00000
To cosine cou. 56° 16'	9.74455	To the departure 405,8	2.60835

Hence the course is S. E. by E. and the departure 405,8.

By GUNTER.

The extent, from the distance 488, to the difference of latitude 271, on the line of numbers, will reach from radius or 90° to 33° 44' the co-course on the line of sines.

And the extent, from radius to 56° 16' on the line of sines, will reach from the distance 488 to the departure 405,8 on the line of numbers.

By INSPECTION.

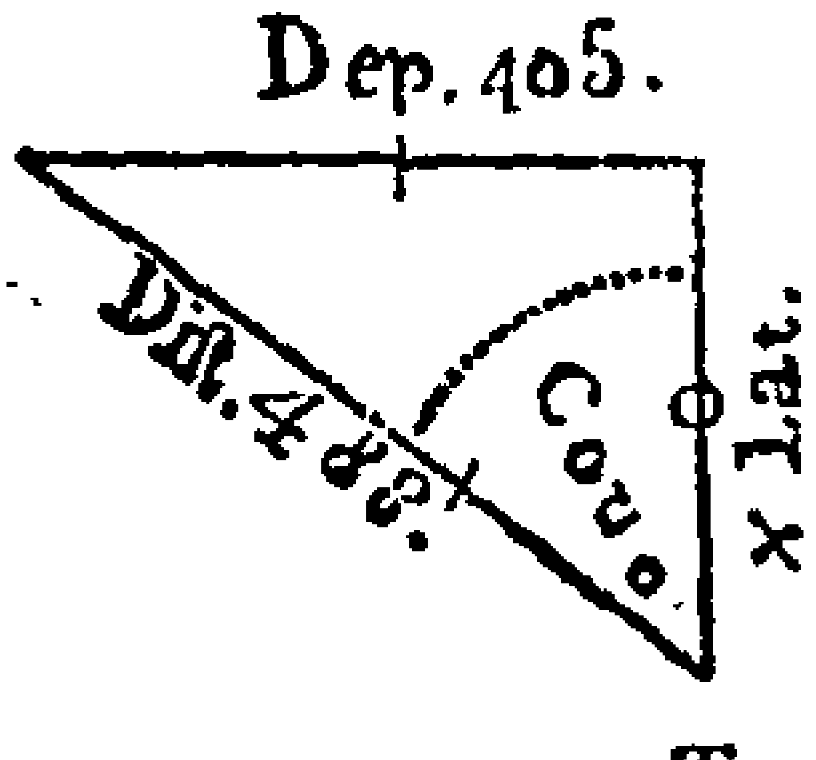
When the Distance and Difference of Lat. are given, to find the Course, put two Cyphers to the Diff. Lat. beside the tenths, and divide it by the Dist. (without taking any notice of the Comma between the miles and tenths.) Then look for the Quotient or the nearest number to it in the Table of Numbers in the Columns belonging to Distance and Difference Latitude, and the degrees answering to that number will be the Course. Thus, 488)271,000(555, the nearest to which in the Table is 559, and gives 56 degrees for the Course.—Then to find the Depart. proceed as in Case first.

CASE V.

Distance and Departure given, to find the Course and Difference of Latitude.

Admit a ship sails 488 miles between the north and west from the Island of Bermudas in lat. 32° 25' north, until her dep. is 405 miles; what course has she steered, and what lat. is she in?

NOTE. This case is constructed much the same as the last.



To

To find the Course.		To find the diff. of Lat.	
As the distance 488	2.68842	As radius -	10.00000
Is to radius - -	10.00000	Is to the distance 488	2.68842
So is departure 405	2.60746	So is co-sine co. 56° 06′	9.74644
	12.60746		12.43486
	2.68842		10.00000
To the sine of cou. 56° 6′	9.91904	To the diff. of lat. 272,2	2.43486

Hence the Course is N. 56° 6′ W. or N. W. by W. nearly.

To the latitude sailed from 32° 25′ add the difference of latitude 272, or 4° 32′, gives 36° 57′, the latitude the ship is in.

By GUNTER.

Extend from the distance 488 to the departure 405 on the line of numbers, that extent will reach from radius to the course 56° 6′ on the line of sines.

2dly. Extend from radius to the complement of the course 33° 54′ on the line of sines, that extent will reach from the distance 488 to the diff. of lat. 271 on the line of numbers.

By INSPECTION.

When the Distance and Departure are given as in Case 5th, put two Cyphers to the Departure, then divide it by the Distance, and find the Quotient, or nearest to it, in the Columns belonging to Distance and Departure: The degrees answering to that number will be the Course.

Thus, 488)405.000(829, which gives 56 degrees, Course. Now, find the Difference Latitude by Case first.

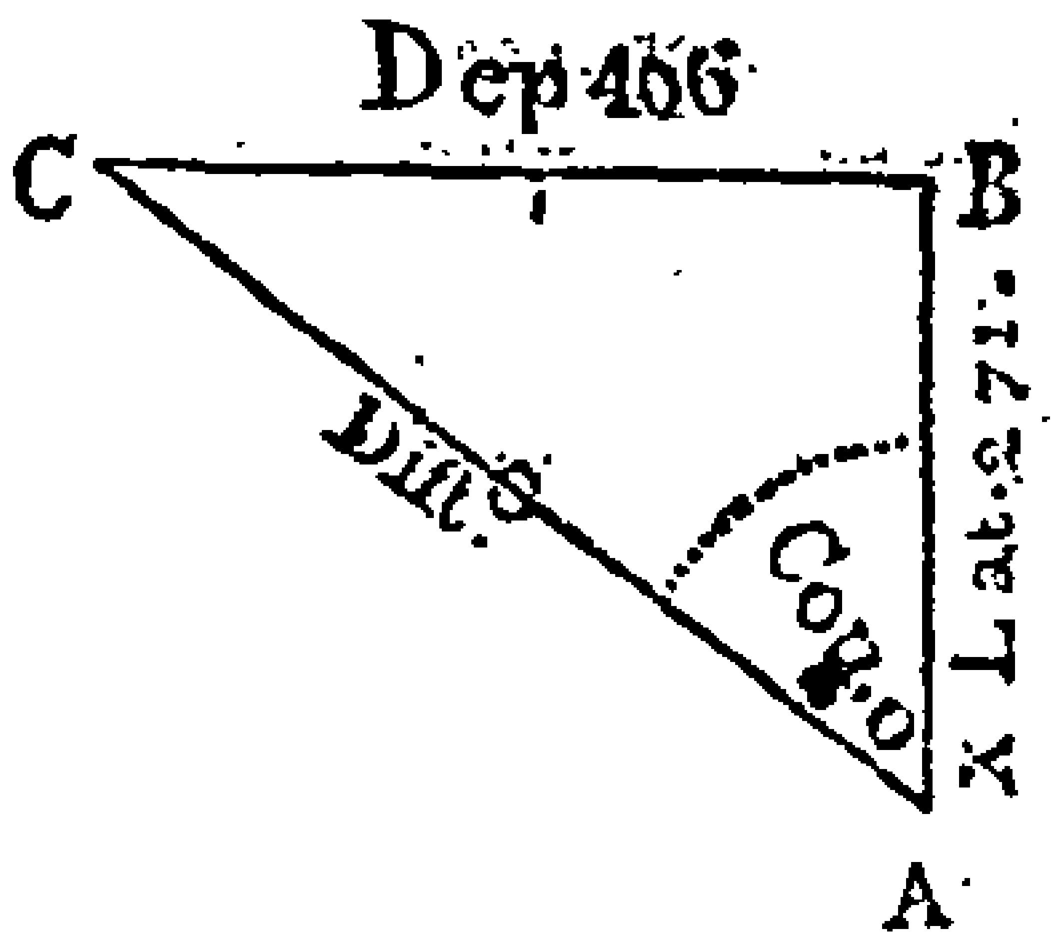
CASE VI.

Difference of Latitude and Departure given, to find the Course and Distance.

A ship sails between the north and west till her difference of latitude is 271 miles, and her departure is 406 miles; I demand her course and distance?

Constructed as Problem XII. in Geometry.

Draw A B = 271, and perpendicular to it B C = 406; join C and A; then will the angle C A B be the course = 56° 17′, and A C the distance = 488 miles.



To

To find the Course.		To find the Distance.	
As the diff. of lat. 271	2.43297	As radius -	10.00000
Is to radius	10.00000	Is to the diff. of lat. 271	2.43297
So is the departure 406	2.60853	So is sec. of the course	
		56° 17′ -	10.25564
	12.60853		
	2.43297		12.68861
			10.00000
To the tang. of the course			
56° 17′ -	10.17556	To the distance 488,2	2.68861

Hence her course is N. 56° 17′ W. or N. W. by W. and the distance sailed is 488,2 miles.

By GUNTER.

Extend from the difference of latitude 271 to the departure 406 on the line of numbers, that extent will reach from radius to 56° 17′ the course on the line of tangents.

2dly. For the distance we must consider it as radius (there being no line of secants on the scale), and extend from radius or 90° to the course 5 points on the line of sines, that extent will reach from the departure 406, to the distance 488 on the line of numbers.

By INSPECTION.

When the Difference of Latitude and Departure are given, as in Case 6th, put two Cyphers to the Departure, divide it by the Difference Latitude and look for the Quotient, or nearest to it in the Columns under Difference Lat. and Departure, and the degrees answering to that number will be the Course.

Thus, 271,0)406,000(149, which gives 56 degrees Course. Then, to find the Distance, proceed as in Case 2d or 3d.

The six foregoing Problems are common cases of Plane Sailing, which the learner ought to be well acquainted with, by the foregoing rules,

TRAVERSE SAILING.

HAVING learned those necessary Problems, concerning a Single Course, the next is a Compound Course, commonly called a Traverse; in order to the right understanding of which, observe the following definitions:

A Traverse

A Traverſe is when a ſhip, meeting with contrary winds, ſails on ſeveral courſes.

When the wind is directly or partly againſt a ſhip's direct courſe to the place ſhe is bound to, ſhe reaches her port by a kind of Z like courſe; which is made by ſailing with the wind, firſt on one ſide of the ſhip, and then on the other ſide.

In a ſhip, when looking towards the ſtem or head;

Starboard ſignifies the right-hand ſide;

Larboard, the left-hand ſide;

Forwards or Afore, is towards the head or ſtem of the ſhip;

Aft or Abaft, is towards the hinder part or ſtern;

The Beam, ſignifies athwart or acroſs the middle of the ſhip.

When the ſhip ſails the ſame way the wind blows, ſhe is ſaid to ſail or run before the wind; and the wind is right aft, or right aſtern; and her courſe is then 16 points from the wind.

When a ſhip ſails with the wind blowing directly acroſs her, ſhe is ſaid to have the wind on the beam; and her courſe is 8 points from the wind.

When the wind blows obliquely acroſs the ſhip, the wind is ſaid to be abaſt the beam, or afore the beam, according as her courſe is more or leſs than 8 points from the wind.

When a ſhip endeavours to ſail towards that part of the compaſs from whence the wind blows, ſhe is ſaid to ſail on a wind, or to ply to windward.

A veſſel ſailing as near as ſhe can to the point from whence the wind blows, is ſaid to be cloſe hauled. The generality of ſhips will lie within about 6 points of the wind, but ſloops and other veſſels will lie much nearer.

The Windward, or Weather-ſide, is that ſide of the ſhip on which the wind blows; and the other ſide is called the Leward or Lee-ſide.

Tacks and ſheets are large ropes made faſt to the lower corners of the fore and main-ſails by which either of theſe corners are hauled fore and aft.

When a ſhip ſails on the wind, the windward tacks are always hauled forwards, and leeward, or lee-ſheets, aft.

The ſtarboard tacks are aboard when the ſtarboard ſide is to windward, and the larboard to leeward; and the larboard tacks are aboard when the larboard ſide is to windward, and the ſtarboard to leeward.

To know how near the wind a ſhip will lie, obſerve the courſe ſhe goes on each tack when ſhe is cloſe hauled, then half the number of points between the two courſes will ſhew how near the wind that ſhip will lie.

The moſt common caſes, in turning to the windward, may be conſtructed by the following precepts:

Having drawn the meridian, or north and ſouth, and parallel of latitude (or eaſt and weſt line) in a circle, repreſenting the horizon of the place, mark, in the circumference, the place of the wind; draw the rhumb, paſſing through the place bound to, and lay thereon the diſtance of that place from the centre.

On each ſide of the wind lay off in the circumference the points or degrees ſhewing how near the wind the ſhip can lie, and draw the rhumbs.

Now,

Now, the firſt courſe will be on one of thoſe rhumbs, according to the tack the ſhip leads with ; draw a line through the place bound to, parallel to the other point, to meet with the firſt, and this will ſhew the courſe and diſtance on the other tack.

To reſolve a Traverſe, is to reduce and bring ſeveral courſes into one ; the courſes are known by the compaſs, and the diſtance by the log, which in common voyages is hove once in two hours, but in ſhips of war, or in Eaſt-Indiamen, every hour.

In the ſteerage, or ſome convenient place in the ſhip, there is generally kept a table, called the log-board, divided into ſeven columns ; in the firſt is written the hours of the day, in the ſecond the knots the ſhip runs during half a minute ; each of theſe knots bear the ſame proportion to a ſea mile that half a minute does to an hour ; conſequently, ſo many knots as the ſhip runs in half a minute, (the time allowed for trying the experiment) ſo many miles ſhe runs in an hour. In the third, the fathoms, 10 of which ought to make a knot ; in the fourth, the courſes ſteered by the compaſs ; in the fifth, the winds ; in the ſixth, the leeway, or how far the ſhip is drove to the leeward of the courſe ſteered by the compaſs ; in the ſeventh, the tranſactions of the day, as in the following table. Every day at noon the contents are tranſcribed into the log-book, which is divided into columns, exactly like the log-board, and the ſeveral courſes being corrected by allowing for the leeway and variations, and the diſtance run upon each being ſet down in a traverſe table, ſhews what difference of latitude and departure the ſhip has made during the laſt 24 hours ; and from thence is found the latitude and longitude the ſhip is in, &c. This operation is called doing a day's work.

The LOG-BOARD.

H.	K.	F.	Courſes.	Winds.	Leeway.	Tranſactions.
2	6		S. W. by S.	N.		
4	5	5				
6	5			N. W.		
8	5					Moderate gales & fair weather ; at 8 A. M. ſaw a ſhip to the northward.
10	4	5	N. E.	N. N. W.		
12	4	5				
2	4	5				
4	4	5				
6	4	5				
8	5		S. W. by S.	W. N. W.		
10	4	5				No obſervation.
12	4					

Having

Having placed the ſeveral courſes, and diſtances run upon each, begin with the firſt courſe S. W. by S. which is 3 points, and the diſtance run upon it being ſummed up, is 21,5 or an half, which being doubled (becauſe the log is hove every two hours) is 43. In like manner proceed with the other courſes, and then find the difference of latitude and departure for each courſe and diſtance.

When the courſe is to be ſouthward, the difference of latitude muſt be ſet in the column marked S. but if to the northward, in that marked N.; likewiſe when the courſe is to the eaſtward, the departure muſt be ſet in the column marked E.; but if to the weſtward, in that marked W. Thus the firſt courſe being S. W by S. 3 points, the difference of latitude belonging to it is ſet under S. and the departure under W. as in the following table:

The TRAVERSE TABLE.

COURSES.	DIST.	N.	S.	E.	W.
S. W. by S.	43		35,8		23,9
N. E.	45	31,8		31,8	
S. W. by W.	27		22,4		15,0
		31,8	58,2		38,9
			31,8	31,8	31,8
		D. Lat. S.	26,4	Dep. W.	7,1

Here the weſtings being greater than the eaſtings, the difference ſhews how far the ſhip has got to the weſtward; and the ſouthings being greater than the northing ſhew how far ſhe has got to the ſouthward of the place ſhe ſet out from.

By INSPECTION.

Find the Courſe by Caſe 6th; and Diſtance by Caſe 2d or 3d of Plane Sailing.

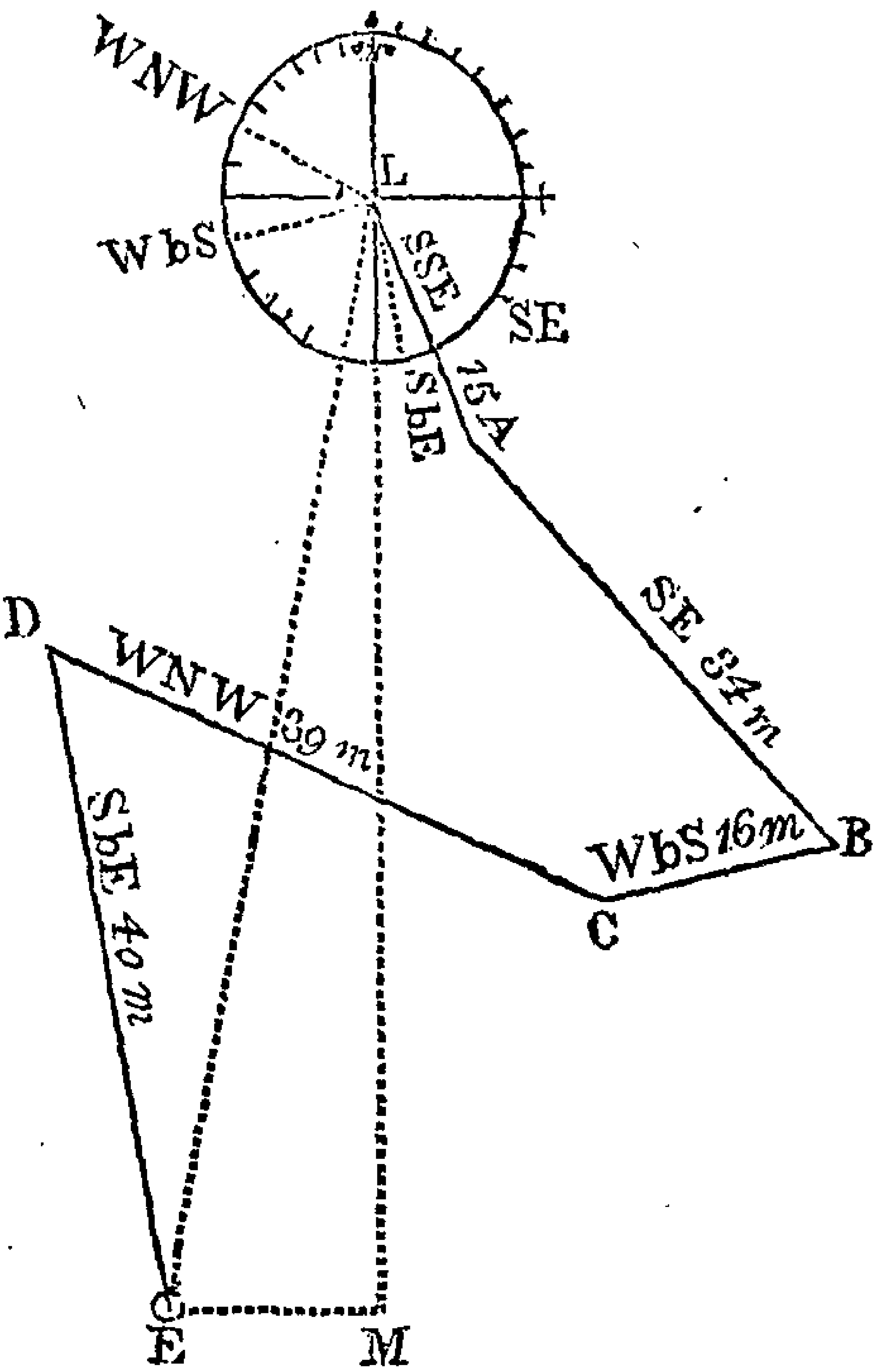
In heaving the log, one man holds the reel upon which the log-line is wound, and another holds the half-minute glaſs; an officer of the watch heaves the log over on the lee-quarter, and when he obſerves the ſtray-line is run off the reel (to denote which there is fixed a red rag) he cries *turn!* the glaſs-holder anſwers *done!* who, watching the glaſs, the moment it is run out, cries *ſtop!* the reel being immediately ſtopped, the knots, or knots and fathoms run off, ſhew the ſhip's rate of ſailing per hour, if the wind happens to have been conſtant.

EXAMPLE I.

EXAMPLE I.

Suppoſe a ſhip takes her departure from the Lizard in latitude 49° 57′ N. it bearing N. N. W. diſtance by eſtimation 5 leagues, ſails S. E. 34; W. by S. 16, W. N. W. 39, and S. by E. 40 miles; required the latitude ſhe is in, and her bearing and diſtance from the Lizard?

By CONSTRUCTION.



Draw the line L M to repreſent the meridian of the Lizard, and L the Lizard point; on L deſcribe the compaſs; then ſet off the oppoſite point to the bearing of the Lizard, the S. S. E. line L A, which make equal to 15 miles; parallel to the S. E. line draw the line A B equal to 34 miles: again, from B parallel to W. by S. draw B C equal to 16 miles; next through C draw a line parallel to W. N. W. which make equal to 39 miles; from D draw D E, parallel to the S. by E. line, equal to 40 miles; then is E the place of the ſhip at the end of her ſeveral courſes, E L the diſtance, L M the difference of latitude, E M her departure, and the angle E L M the courſe ſhe has made good.

To find the same by CALCULATION.

For the first Course, S. S. E. 15 miles.]

To find the Diff. of Latitude.		For Departure.	
As radius 90°	10.00000	As radius 90°	10.00000
Is to distance 15	1.17609	Is to distance 15	1.17609
So is co-sine course 2 pts.	9.96562	So is sine course 2 pts.	9.58284
	11.14171		10.75893
	10.00000		10.00000
To diff. lat. 13,9	1.14171	To departure 5,7	[illegible].75893

Second Course S. E. 34 Miles.

For Difference of Latitude.		For Departure.	
As radius 90°	10.00000	As radius 90°	10.00000
Is to co-sine course 45°	9.84948	Is to sine course 45°	9.84948
So is Distance 34	1.53148	So is distance 34	1.53148
	11.38096		11.38096
	10.00000		10.00000
To diff. latitude 24	1.38096	To departure 24	1.38096

Third Course W. by S. 16 Miles.

For Difference of Latitude.		For Departure.	
As radius 90°	10.00000	As radius 90°	10.00000
Is to co-sine course 78° 45′	9.29024	Is to sine course 78° 45′	9.99157
So is distance 16	1.20412	So is distance 16	1.20412
	10.49436		11.19569
	10.00000		10.00000
To diff. latitude 3,1	0.49436	To departure 15,6	1.19569

Fourth Course W. N. W. 39 Miles.

For Difference of Latitude.		For Departure.	
As radius 90°	10.00000	As radius 90°	10.00000
Is to co-sine course 67° 30′	9.58284	Is to sine course 67° 30′	9.96562
So is distance 39	1.59106	So is distance 39	1.59106
	11.17390		11.55668
	10.00000		10.00000
To diff. latitude 14,9	1.17390	To departure 36	1.55668

G 2 Fifth

Fifth Courſe S. by E. 40 Miles.

For Difference of Latitude.		For departure.	
As radius 90°	10.00000	As radius 90°	10.00000
Is to co-ſine cou. 11° 15′	9.99157	Is to ſine cou. 11° 15′	9.29024
So is diſtance 40	1.60206	So is diſtance 40	1.60206
	11.59363		10.89230
	10.00000		10.00000
To diff. lat. 39,2	1.59363	To departure 7,8	0.89230

Though this method of finding the difference of latitude and departure by logarithms is certain, yet the ſame may be more readily found by the tables of difference of latitude and departure ; that is, to find the difference of latitude and departure for each courſe and diſtance by inſpection, and placing them down as in the following

TRAVERSE TABLE.

COURSES.	DIST.	DIFF. LAT.		DEPARTURE.	
		N.	S.	E.	W.
S. S. E.	15		13,9	5,7	
S. E.	34		24,0	24,0	
W. by S.	16		3,1		15,7
W. N. W.	39	14,9			36,0
S. by E.	40		39,2	7,8	
From ſum	—	14,9	80,2	37,5	51,7
Take	—	—	14,9		37,5
Reſts	—	—	65,3		14,2

Having placed them as above, add up all the weſtings, eaſtings, northings and ſouthings, ſeparately, and ſet down their reſpective ſums at the bottom of each column ; and as the weſting is greater than the eaſting, ſubtract the eaſting therefrom, and the difference 14,2 ſhews that the ſhip's departure is ſo much weſt of her firſt meridian.

Again, the ſouthing being greater than the northing, ſubtract the northing from it, and the remainder ſhews how far the ſhip is to the ſouthward of her firſt place.

To

To find the direct Course or Bearing of the Lizard from the ship.		To find the direct distance.	
As the diff. lat. 65,3	1.81491	As sine of cou. 12° 16′	9.32728
Is to radius 90°	10.00000	Is to the depart. 14,2	1.15229
So is the departure 14,2	1.15229	So is radius 90°	10.00000
	11.15229		11.15229
	1.81491		9.32728
To tang. cou. 12° 16′	9.33738	To the distance 66,84	1.82501

Which, because the difference of latitude is southerly, and the departure westerly, is S. 12° 16′ West. Whence the Lizard bears from the ship N. 12° 16′ E. or N. b. E. 1° 1′ E.

By Inspection. Find the Course by Case 6th of Plane Sailing;—and the Distance by Case 2d or 3d.

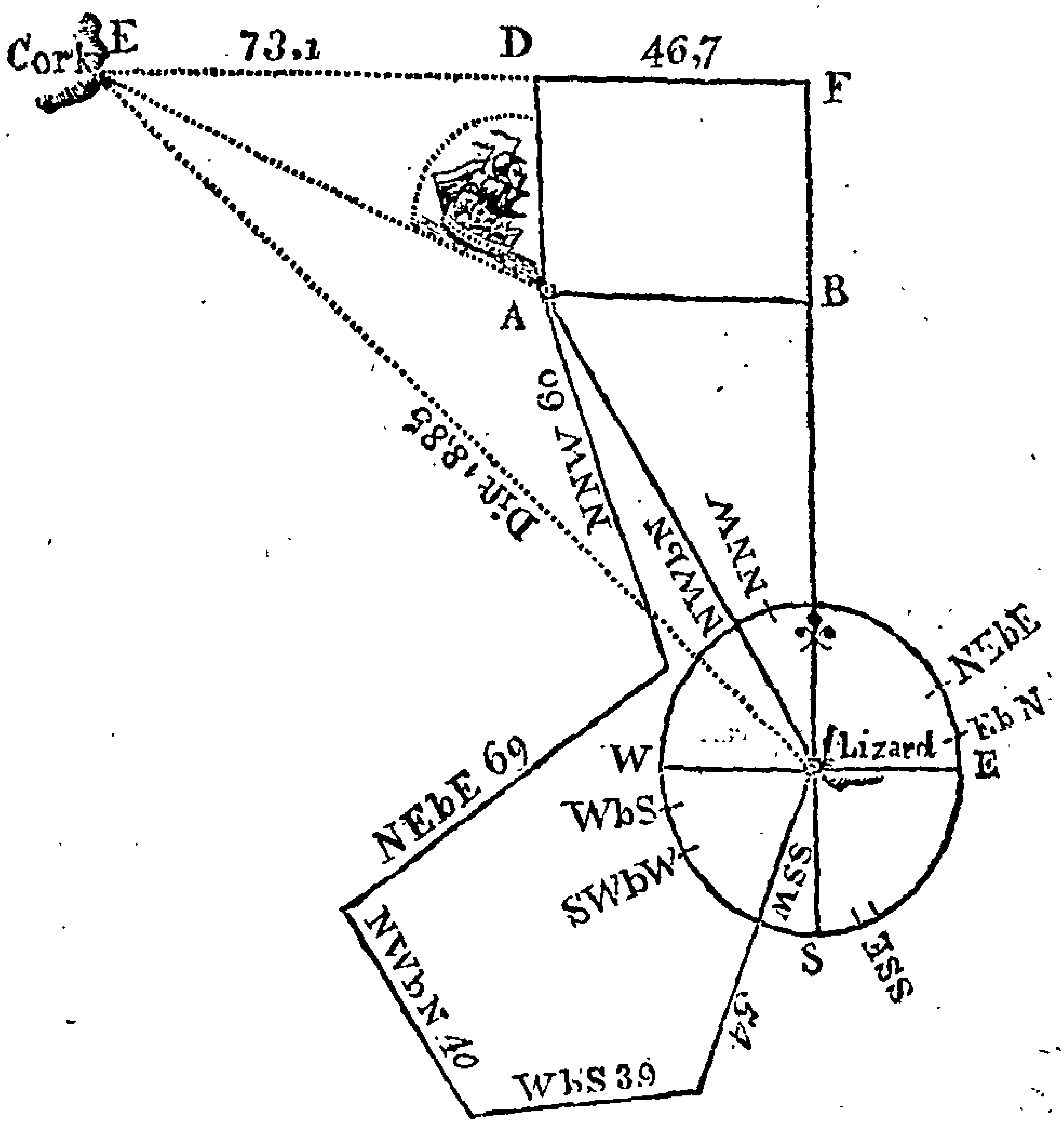
EXAMPLE II.

Suppose a ship from the Lizard 49° 57′ is bound to Cork in latitude 51° 41′ N. whose departure from the meridian of the Lizard is 120 miles west, but by reason of contrary winds is obliged to sail on the following courses, viz. S. S. W. 54 miles, W. by S. 39, N. W. by N. 40, N. E. by E. 69, and N. N. W. 60 miles; I demand the direct course, distance, difference of latitude and departure made good upon the several courses, with the latitude she is in, and what course she must afterwards steer, and how far to gain her intended port?

By

By PROJECTION.

Latitude of Cork	—	51° 41′
Latitude of Lizard	—	49 57
		1 44
Difference of latitude		104. Departure 120.



With the chord of 60° describe a circle, through which draw the meridian north and south, and crossing that at right angles, draw the east and west points; the centre represents the Lizard; then set off two points, from the south, westerly: through which draw a line to the centre for the first course S. S. W.; upon that set off the first distance run 54 miles, which is the ship's place at the end of her first course.

Draw the W. by S. rhumb; and parallel to it a line, passing through the ship's last place; and upon it set off 39 for the second distance; draw the N. W. by N. rhumb; and parallel to it, as before, draw a line, passing

ing through the ſhip's laſt place ; upon it ſet off 40, and that will be the place of the ſhip at the end of her third courſe ; then draw the N. E. by E. rhumb ; and parallel to it a line, paſſing through the ſhip's laſt place ; and upon it ſet off 69 for the fourth diſtance ; then draw a N. N. W. rhumb ; and parallel to it a line, as before, through the ſhip's laſt place ; and upon it ſet off the laſt diſtance 60, which is the ſhip's place at the end of her ſeveral courſes ; from which draw a line parallel to the eaſt and weſt line, until it cuts the meridian, for the whole departure ; from this to the centre, being meaſured on the ſame ſcale, will give her difference of latitude made good upon the ſeveral courſes ; and a line drawn from the ſhip's laſt place to her firſt, will give the whole diſtance ; and the angle which this line makes with the meridian, will be the ſhip's courſe made good.

Now, to find what courſe ſhe muſt ſteer, and how far ſhe muſt run, from the centre of the compaſs, or the Lizard point, ſet off the whole difference of latitude of the two ports, viz. 104, to F ; through F draw an E. and W. line weſterly, and ſet off thereon the whole departure 120 from F to E ; then will E repreſent the ſituation of Cork ; join A E, and draw A D parallel to the meridian ; then will A E be the diſtance ſhe has to run to her intended port, the angle E A D is the courſe ſhe muſt ſteer, E D is how far ſhe is to the eaſtward of it, and A D is how far to the ſouthward of it.

By CALCULATION.

With the difference of latitude and departure between the two ports, to find their bearing and diſtance.

To find the Bearing.			To find their Diſtance.		
As diff. of lat.	104	2.01703	As radius		10.00000
Is to radius	90°	10.00000	Is to diff. lat.	104	2.01703
So is whole dep.	120	2.07918	So is ſec. courſe	49° 5′	10.18378
		12.07918			12.20081
		2.01703			10.00000
To tang. courſe 49° 5′		10.06215	To diſt. aſunder 158,8		2.20081

By INSPECTION.

Find the Courſe by Caſe 6th of Plane Sailing ; and Diſtance by Caſe 2d or 3d.

Whence the courſe between the Lizard and Cork is N. 49° 5′ W. or N. W. ¼ W. 1° 16′ weſterly ; diſtance 159 miles. Or with the difference of latitude and departure, the courſe will be found by inſpection to be 49°, and diſtance 159 miles : and the ſeveral courſes and diſtances being found, will ſtand as in the following

TRAVERSE

TRAVERSE TABLE.

COURSES.	DIST.	DIFF. LATT. N.	DIFF. LATT. S.	DEPARTURE. E.	DEPARTURE. W.
S. S. W.	54	——	49,9	——	20,7
W. by S.	39	——	7,6	——	38,2
N. W. by N.	40	33,3	——	——	22,2
N. E. by E.	69	38,3	——	57,4	——
N. N. W.	60	55,4	——	——	23
From — — —		127,0	57,5	57,4	104,1
Take — — —		57,5	——	——	57,4
Remains — —		69,5	——	——	46,7

To find her direct Course and Distance made good.

To find the Course.			To find the Distance.		
As diff. of lat.	69,5	1.84198	As radius		10.00000
Is to radius	90°	10.00000	To diff. lat.	69,5	1.84198
So is departure	46,7	1.66932	So is sec. course	33° 54′	10.08092
		11.66932			11.92290
		1.84198			10.00000
To tang. course	33° 54′	9.82734	To distance	83,73	1.92290

By INSPECTION.

Find the Course by Case 6th of Plane Sailing; and Distance by Case 2d or 3d.

To find the Bearing and Distance to the intended Port.

			In Angle A E D.	
Lizard's latitude,		49° 57′ N.	From whose diff. lat. of ports	104
Add diff. lat.	-	1 9 N.	Subtract ship's northing.	69. 5
Ship's latitude in		51 6 N.	Remains ship southw. of port	34. 5

From whole departure subtract ship's depart. 120—47=73 ED.

As diff. of lat.	34,5	1.53782	As radius 90	-	10.00000
Is to radius	90°	10.00000	Is to diff. of lat.	34,5	1.53782
So is dep.	73	1.86332	So is sec. course	64° 42′	10.36921
		11.86332			11.90703
		1.53782			10.00000
To tang. course	64° 42′	10.32550	To dist.	80,73	1.90703

Whence the course she must steer is N. 64° 42′ W. or N. W. by W. ¼ W. distance 81 miles.

By

By INSPECTION.

Find the Courſe by Caſe 6th of Plane Sailing ; and Diſtance by Caſe 2d or 3d.

All the preceding may be found by Gunter's Scale but ſhall leave the working of them to exerciſe the learner, who ought to be well acquainted with Traverſe Sailing ; and for that purpoſe it has been thought proper to ſubjoin the following, which is the moſt general and uſeful that well can be, and may be worked by any of the foregoing methods.

A ſhip being at ſea in lat. 37° 10′ N. is bound to a port, which lies to the weſtward in latitude 33° 0′ N. the departure between the ſhip and the place is 180 miles ; conſequently, by Caſe VI. the courſe will be S. W. by S. 2 degrees weſterly, and diſtance 308 miles, but the wind being variable, is obliged to ply upon theſe ſeveral courſes, the diſtance run upon each, being obtained by the log ; and the firſt ſhe ſails (with her larboard tacks on board) S. W. by W. 27 miles, W. S. W. half W. 30 miles, W. by S. 25 miles, W. by N. 18 miles.

(Starboard tacks on board wind ſhifting) S. S. E. 32 miles, S. S. E. three-quarters E. 27 miles, S. by E. 25 miles, S. 31 miles, S. S. E. 39 miles.

Required the latitude the ſhip is in, and her departure from the meridian, upon what courſe ſhe muſt ſteer if poſſible, and how far ſhe muſt ſail to gain her intended port ?

The difference of latitude and departure being found by the preceding directions, will ſtand as in the following Table :

The TRAVERSE TABLE.

COURSES.	DIST.	DIFF. OF LAT.		DEPARTURE.	
		N.	S.	E.	W.
S. W. by W.	27		15,0		22,4
W. S. W. ½ W	30		8,7		28,7
W. by S.	25		4,9		24,5
W. by N.	18	3,5			17,7
S. S. E.	32		29,6	12,2	
S. S. E. ¾ E.	27		23,2	13,9	
S. by E.	25		24,5	4,9	
South.	31		31,0		
S. S. E.	39		36,0	14,9	
		5,3	172,9	45,9	93,3
			3,5		45,9
		Diff. Lat.	169,4 S	Depar.	47,4 W.

By INSPECTION.

Find the Courſe by Caſe 6th of Plane Sailing ; and Diſtance by Caſe 2d or 3d.

The

The ſhip is in latitude 34° 21′ N. the departure is 47,4 W.
The courſe made good is S. 15° 38′ W. and diſtance 175,9.
The courſe to the intended port is S. 58° 35′ W. or S. W. by W. one-quarter weſt nearly, diſtance 155,4.

MIDDLE LATITUDE SAILING.

IN Plane Sailing the earth was conſidered as a plane, repreſenting a bowling green, having the meridians parallel to each other, and conſequently the degrees of longitude equal in all places; but this cannot be true, as the earth is a globe or ſphere; for,

As the meridians are circles on the terraqueous globe, meeting in the poles, (as may be ſeen in the artificial ſphere) it is obvious, that any two of thoſe circles muſt recede more at greater diſtances from the poles; and at equal diſtances from each pole, or at the equator, where the diſtance between the meridians is greateſt.

The true place of a ſhip at ſea depends upon its diſtance from the equator, and ſome noted meridian; and ſince the meridional diſtance, that is, the diſtance between any two meridians, varies in every latitude, it is therefore convenient this diſtance ſhould be reckoned in a fixed latitude; and where the degrees are of the ſame magnitude with thoſe of the meridian, which can be no where but on the equator, where 60 geographical miles make a degree.

The circumference of all circles are in direct proportion to each other, as their radii: and ſince the earth turns once round its axis in 24 hours, every point upon its ſurface muſt deſcribe circles parallel to the equator: hence it follows, that the circumference of any parallel of latitude in miles, is to the circumference of the Equator, in miles, as the co-ſine of that latitude is to radius; and, that the breadth of a degree, in any parallel or latitude, is to the breadth of a degree upon the equator, as the ſine complement of that latitude is to radius.

By the laſt proportion was the following table calculated, which ſhews the breadth of a degree of longitude in every latitude: and may be made to anſwer for any degrees or minutes by taking proportional parts.

The

The following Table shews how many Miles answer to a Degree of Longitude at every Degree of Latitude.

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

Hence it follows, that

As radius, or sine 90°
Is to the diff. of long. in miles,
So is co-sine of any paral. of lat.
To the dist. in miles between any
Two merid. in that paral. of lat.

And,

As co-sine of any paral. of lat.
Is to the dist. run in miles in that lat.
So is the radius, or sine of 90°
To the diff. of long. in miles.

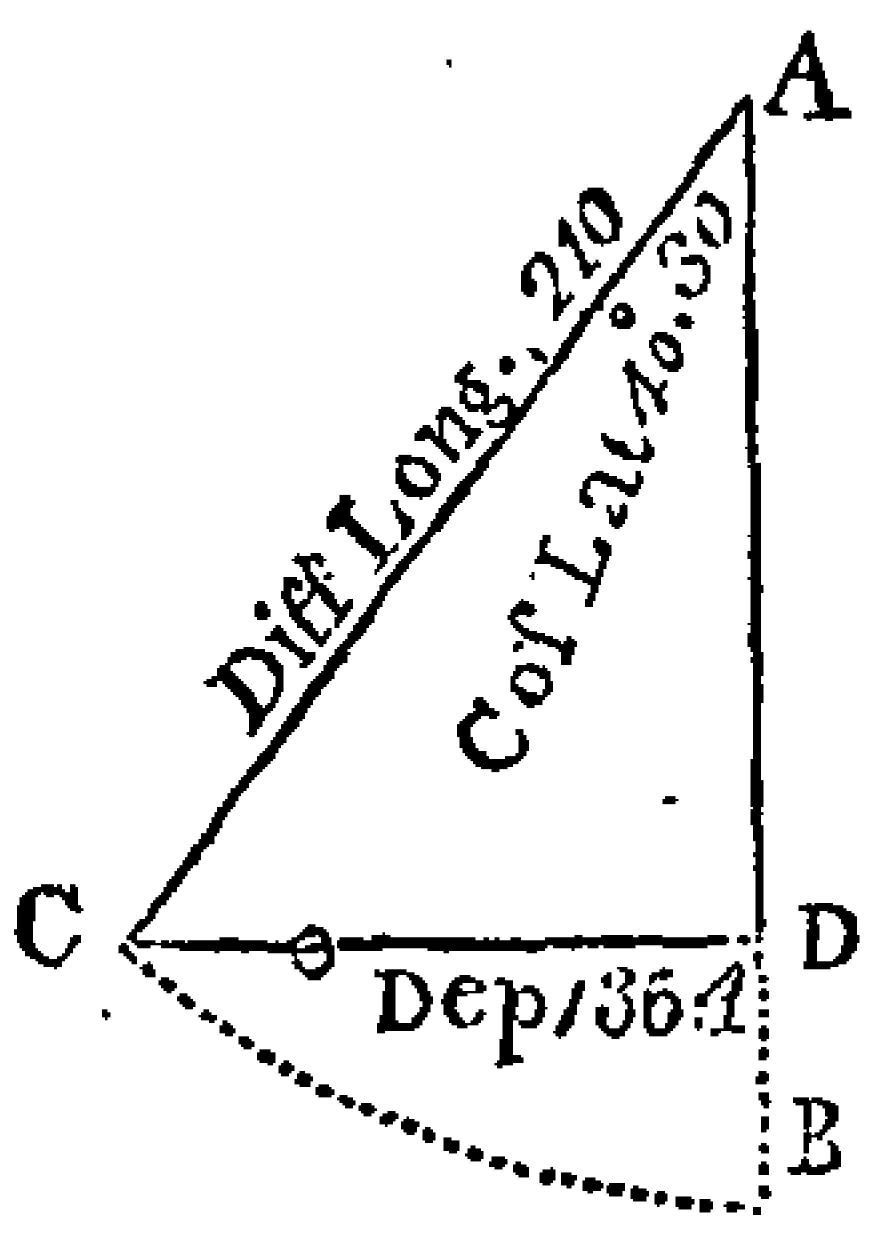
From what has been said, arises the solution of the following Problems :

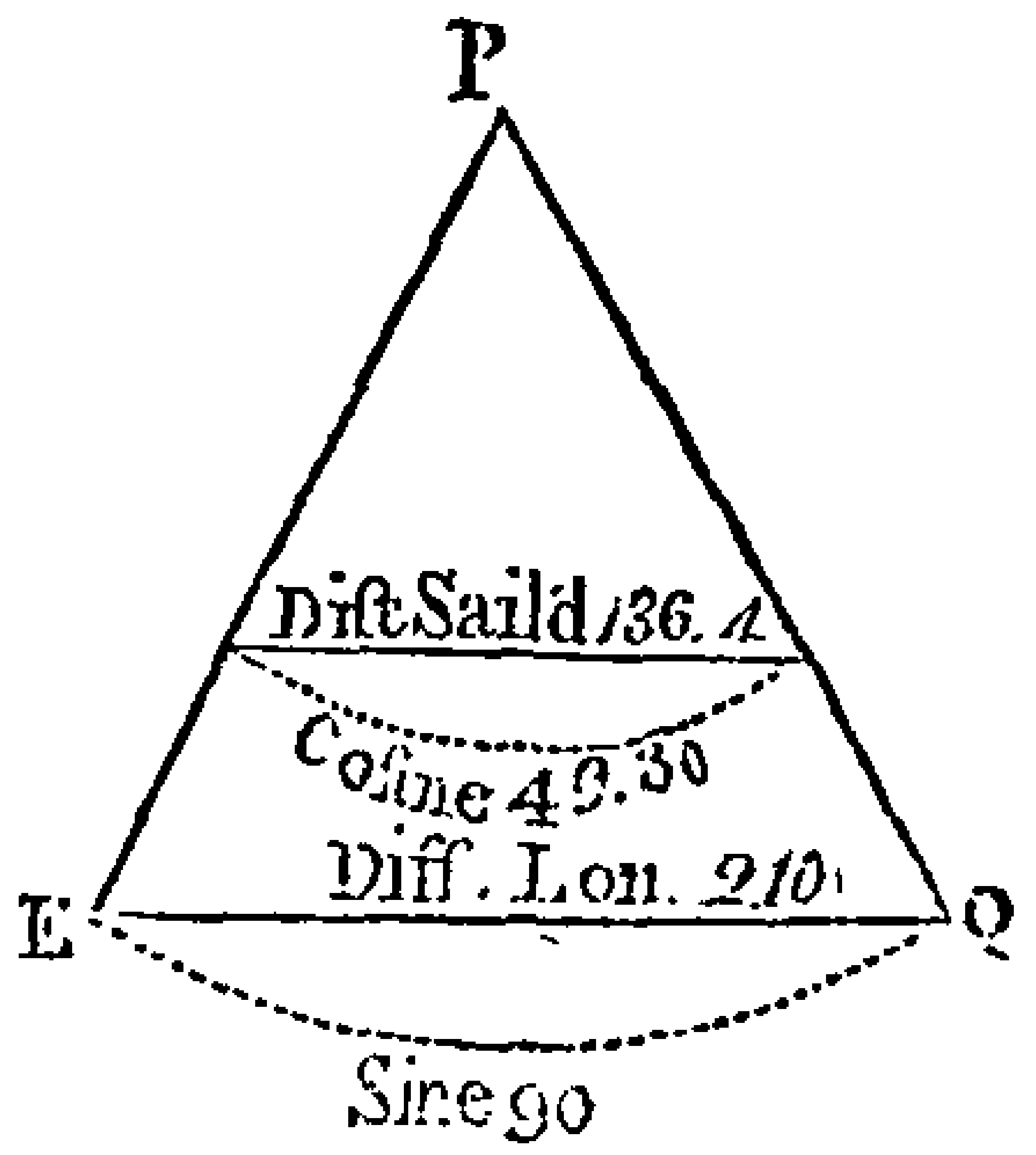
PROBLEM I.

The Difference of Longitude between two Places both in one Parallel of Latitude being given, to find the Distance between them.

Suppose a ship in the latitude of 49° 30′ North or South, sails directly East or West until her difference of longitude be 3° 30′, and the distance sailed be required ?

By





By PROJECTION.

With the ſine of 90° in your compaſſes taken from the Plane Scale, and with one foot in P deſcribe the arch E Q and upon it ſet off the difference of longitude 210 miles, and draw the lines P E and P Q to repreſent the two meridians ; and then E Q repreſent the Equator, and P the Pole. Again, with the ſine comp. of the latitude 49° 30′ *viz.* 40° 30′ in your compaſſes, taken from the line of ſines on the Plane Scale, and with one foot in P deſcribe an arch, and the diſtance between the points, where it cuts the two meridians, being meaſured upon the ſame ſcale of equal parts that the difference of longitude was, will be the departure 136,4 miles.

Or, thus :

Draw the meridian A B, and with the chord of 60 in your compaſſes deſcribe an arch, and upon it ſet off the complement of the latitude 40° 30′ (taken from the line of chords) and ſet it off upon the arch as a courſe in Plane Sailing, and draw the line A C as a diſtance, which make equal to the difference of longitude 210 miles ; then will the departure C D be the diſtance 136,4 miles, as before : this laſt method is preferable to the former, as we are not confined to any particular ſcale.

Reverſe this Problem, and ſuppoſe the diſtance ſailed in any parallel of latitude given, to find the difference of longitude.

With the ſine comp. of latitude in your compaſſes deſcribe an arch, upon which ſet off the departure 136,4 miles, and through the points where it cuts the arch draw the lines P E and P Q ; then with the ſine of 90° in the compaſſes, and one foot in the former centre P, deſcribe an arch to cut P E and P Q ; then E Q being meaſured upon the ſmall ſcale of equal parts that the departure was, will be the difference of longitude 210 miles.

By

By CALCULATION.

To find the Departure.

As radius — — —	90°	10,00000
Is to the difference of longitude	210	2,32222
So is co-fine latitude —	49° 30′	9,81254
		12,13476
		10,00000
To the diftance or departure	136,4	2,13476

By GUNTER.

The extent from radius to fine comp. latitude 40° 30′ on the line of fines, will reach from the difference of longitude 210 to the diftance 136,4 on the line of numbers.

By INSPECTION.

Find the fine comp. of the latitude among the degrees in table I. or II. and in the diftance column, the difference of longitude, oppofite to which, in the column of departure, is the diftance required ; but as the co-latitude is 40° 30′, therefore,

For 40 degrees you will find — —	135
For 41 degrees you will find — —	137,7
The fum is — — —	272,7
Half is the diftance required —	136,3

This is done becaufe the table of difference of latitude and departure is calculated only for fingle degrees.

By the reverfe of the laft problem, having the diftance run in any parallel to find the difference of longitude.

Suppofe a fhip in latitude 49° 30′ N. or S. and long. 26° 45′ W. fails directly W. 136,4 miles, and her diff. of long. and long. in be required ?

As co-fine of latitude	49° 30′	9.81254	Long. left	26° 45′ W.
Is to the diftance	136,4	2.13481	Diff. long.	3 30 W.
So is radius —		10.00000		30 15 W.
		12.13481		
		9.81254		
To the difference of longitude 210		2.32227		

By INSPECTION.

Look for the complement of the latitude among the degrees as if it was a courfe, and the departure in its column ; right againft which ftands the difference

difference of longitude in the distance column.—In the last Problem the ship is supposed to have sailed due east or west, in the same parallel of latitude; but in her course she generally crosses several meridians and parallels, and then arrives at a different latitude from that she left; and, as it is plain by the foregoing table, that the miles which make a degree in one parallel, will not be the same as those that make a degree in any other parallel, lying on the same side of the equator; therefore, add both latitudes together, and take half their sum for a mean or middle latitude; which may be conceived as if the ship had sailed in one latitude; with which the difference of longitude may be turned into departure, and departure into difference of longitude, in the same manner as has been already shewn, for it will be

As radius		As the co-sine of the middle lat.
Is to the difference of longitude,	AND	Is to the departure,
So is the co-sine of the middle lat.		So is radius
To the departure.		To the difference of longitude.

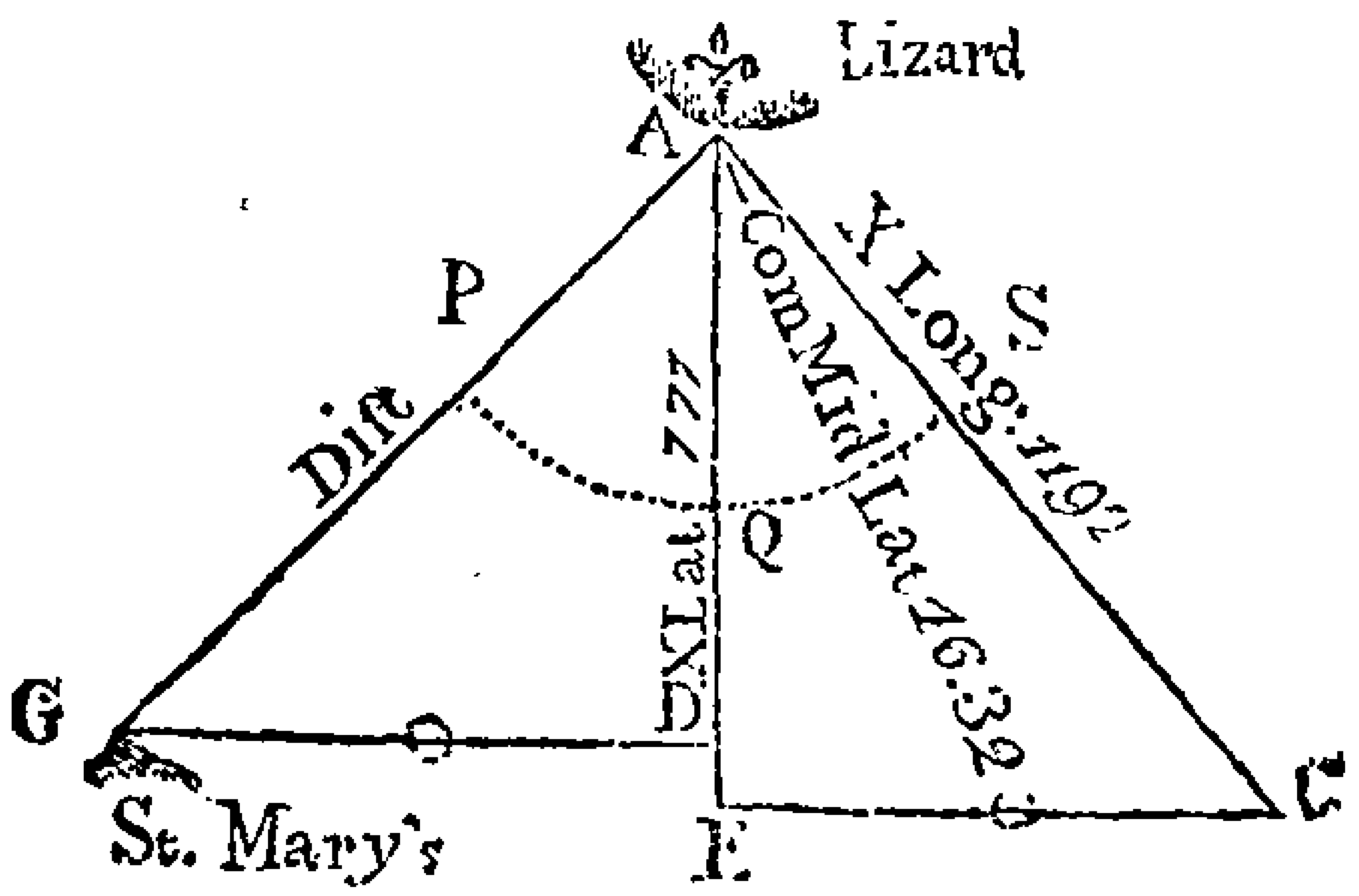
Having the difference of latitude and departure, the course and distance are found by Case VI. in Plain Sailing.

CASE I.

Required the bearing and distance between the Lizard, in latitude 49° 57′ N. longitude 5° 14′ W. and the island of St. Mary, one of the Western islands in latitude 37° N. and longitude 25° 6′ W.?

Lizard's lat.	49° 57′ N.		49° 57′	Long. 5° 14′ W.
St. Mary's lat.	37 00 N.		37 00	Long. 25 6 W.
	12 57	Sum 2)	86 57	19 52
	60			60
		Mid. lat.	43 28	
Diff. in miles	777		90 00	1192 diff. long.
		Co-mid. lat.	46 32	

The PROJECTION.



Draw

Draw the meridian A E, with the chord of 60 describe the arch P S; upon which set off 46° 32′, the complement of middle latitude, from Q to S; through S draw the line AC=1192, the difference of longitude; let fall the perpendicular C E, which will be the departure 865; upon A E set off A D 777, the difference of latitude; and upon D erect the perpendicular D G, and upon it set off the departure 865; join G and A, and it is done; for G A will be the distance 1163 miles, and the angle GAD the course S. 48° 4′ W.

The CALCULATION.

To find the Departure.	
As radius 90°	10.00000
Is to diff. of long. 1192	3.07628
So is co-sine mid. lat. 43° 28′	9.86080
	12.93708
	10.00000
To the departure 865,1	2.93708

To find the Course.	
As diff. of lat. 777	2.89042
Is to radius 90	10.00000
So is departure 865,1	2.93708
	12.93708
	2.89042
To tang. of course 18° 4′	10.04666

To find the Distance.	
As radius	10.00000
Is to diff. latitude 777	2.89042
So is sec. of course 48° 4′	10.17505
	13.06547
	10.00000
To the distance 1163	3.06547

NOTE. The course may be found without the departure, by Middle Latitude Sailing, thus:

As the diff. lat. 777	2.89042
Is to diff. long. 1192	3.07628
So is co-sine mid. lat. 43° 28′	9.86080
	12.93708
	2.89042
To tang. of course 48° 4′	10.04666

By GUNTER.

1st. The extent from 46° 32′, the complement of the middle latitude, to radius, on the line of sines, will reach from 1192 to 865 on the line of numbers.

2dly. The extent from radius or 90° to 41° 56′ the complement of the course on the line of sines, will reach from 777 to 1163 on the line of numbers.

3dly. The extent from 777 to 865,1 on the line of numbers, will reach from 45° to 48,4 on the line of tangents.

By INSPECTION.

Look for the complement of middle latitude, as if it was a course in Plane Sailing, and difference of longitude in the distance column; opposite to which stands the departure in its column. Having the difference of of latitude and departure, the courſe and diſtance are found as in Caſes VI. and II. in Plane Sailing.

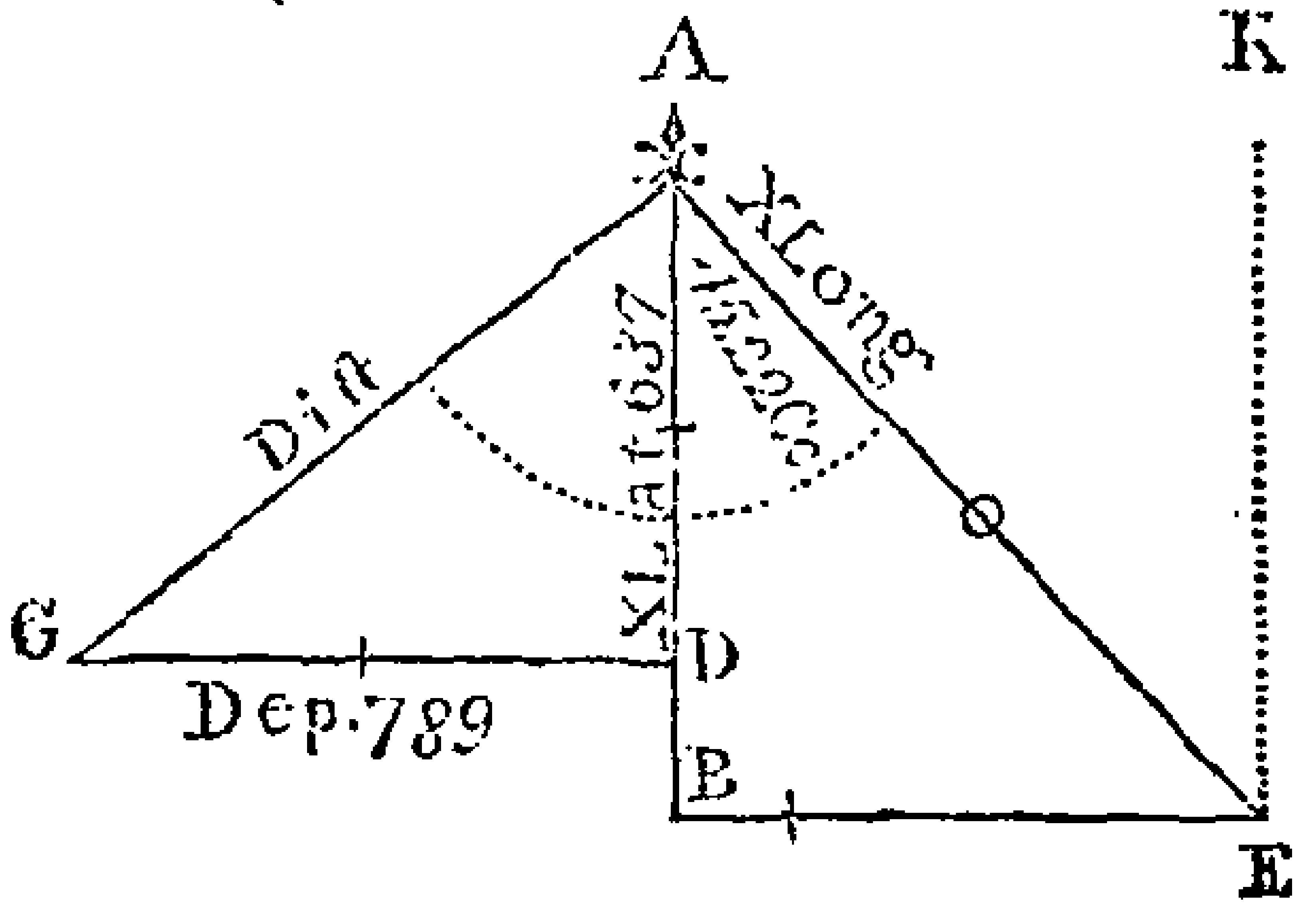
Thus, taking $\frac{1}{4}$ of the difference of longitude 1192 = 298, and as the complement of the middle latitude is 46° 32′, or nearly 46½, I look over 46 and 47, and againſt the diſtance ſtands 214,4 and 218 in the departure columns; which added together gives 432,4; half is 216,2; this multiplied by 4 gives 864,8, the departure.

CASE II.

Both Latitudes and Departure from the Meridian given, to find the Courſe and Diſtance, and Difference of Longitude.

A ſhip in latitude 49° 57′ N. and longitude 5° 24′ W. ſails ſouth weſterly, till her departure is 789 miles, and ſhe be in latitude 39° 20′ N.; I demand the courſe, diſtance, and longitude ſhe is in?

Latitude left	49° 37′ N.	Latitude left	49° 57′ N.
Latitude in	39 20 N.	Latitude in	39 20 N.
Diff. of lat.	10 37	Sum of latitude	89 17
	60		
		Middle latitude	44 38
In miles	637		90 00
		Comp. of mid. lat.	45 22



By CONSTRUCTION.

Draw the meridian A D, from A to D ſet off the difference of latitude 637 miles, and on D erect the perpendicular D G, which make equal to the departure 789 miles. Draw the line A G, and that will be the diſtance 1014 miles, and the angle D A G the courſe 51° 5′.

Again, draw E K parallel to A D, making the diſtance from AD equal to the departure D G 789, on A deſcribe an arch; take the complement of the middle latitude 45° 22′ in your compaſſes, from the line of chords, and ſet that off on the arch on the oppoſite ſide of the meridian A D, through

through where that cuts the arch draw the line A E to cut the line K E in E, from E let fall the perpendicular E B, and it is done; for A E will be the difference of longitude 1109 miles.

By CALCULATION.

To find the course it will be,		To find the Distance it will be,	
As the diff. of lat. 637	2.80414	As the sine course 51° 5′	9.89101
Is to radius 90°	10.00000	Is to the departure 789	2.89708
So is departure 789	2.89708	So is radius 90°	10.00000
	12.89708		12.89708
	2.80414		9.89101
To tang. course 51° 5′	10.09294	To the distance 1014	3.00607

To find the Difference of Longitude it will be,

As co-sine middle latitude	—	44° 38′	9.85225
Is to departure	— —	789	2.89708
So is radius	— —	90	10.00000
			12.89708
			9.85225
To difference of longitude	—	1109	3.04483

Longitude the ship sailed from	—	5° 24′ W.
Diff. long. 1109 miles, or	—	18 29 W.
Longitude in	— —	23 53 W.

By GUNTER.

1st. The extent from the difference of latitude 637 to the departure 789 on the line of numbers, will reach from radius, or 45° backward to 51° 5′ the course on the line of tangents.

2dly. The extent from 51° 5′ to radius or 90° on the line of sines, will reach from the departure 789, to the distance 1014 on the line of numbers.

3dly. The extent from the complement of middle latitude, 45° 22 to radius or 90° on the line of sines, will reach from the departure 789, to the difference of longitude 1109 on the line of numbers.

By INSPECTION.

Rule. With the difference of latitude and departure, find the course and distance, as Cases VI. and II. in Plane Sailing.

2dly. Taking the complement of middle latitude as a course and the departure in its column, and the distance corresponding to these, will be the difference of longitude.

3dly. Taking

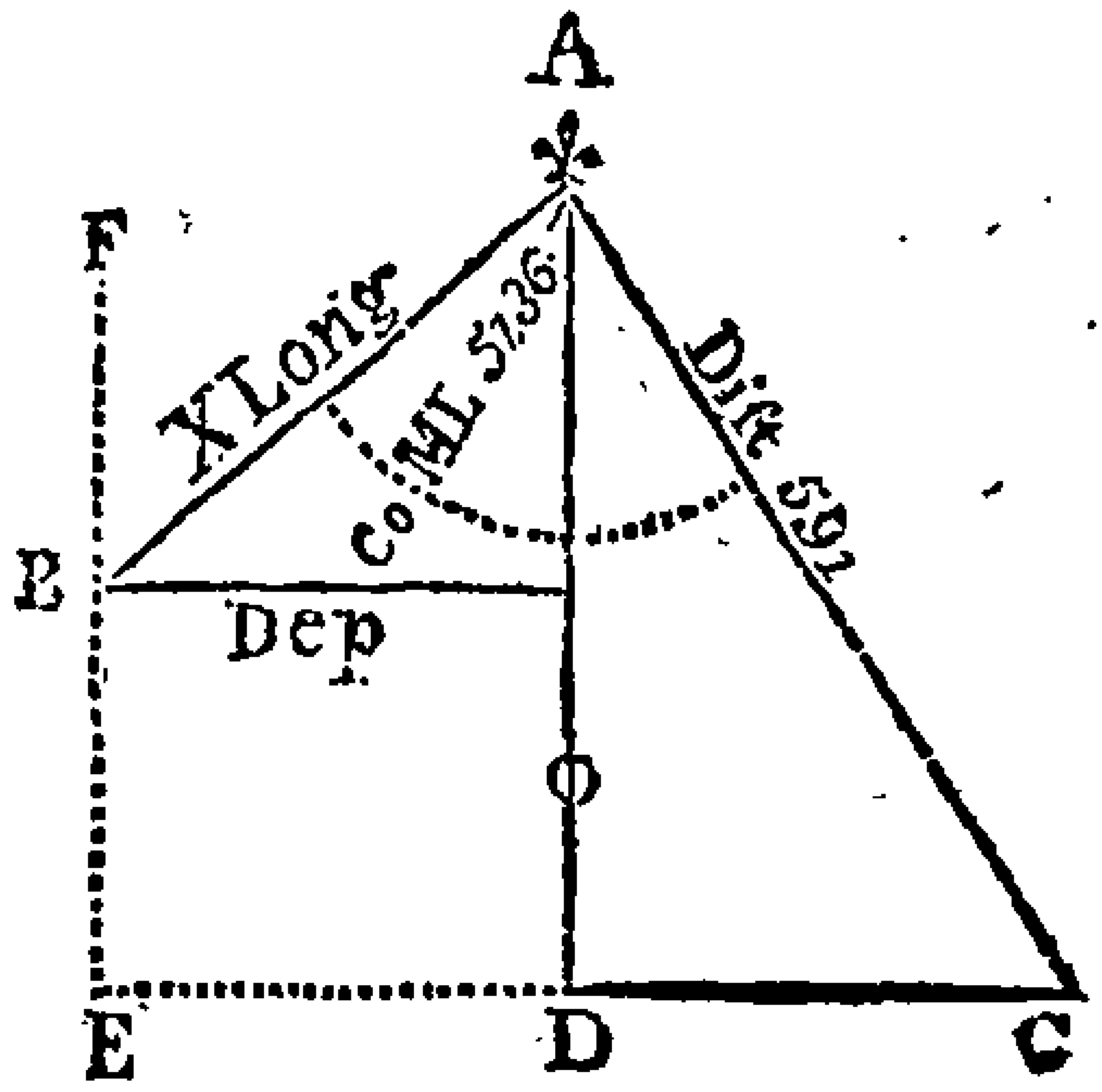
Taking a tenth of the departure 789, that is, 78,9, the neareſt number to this is 78,5, againſt the diſtance 101, which multiplied by 10 gives 1010; whence the courſe by inſpection is S. 51° W. and the diſtance 1010.

Taking 45° 22′ or 45° as a courſe, and a tenth of the departure 78,9 in its column, the neareſt is 78,5, in the diſtance column ſtands 111, which multiplied by 10 gives 1110 for the difference of longitude nearly, as before.

CASE III.

One Latitude, Courſe and Diſtance given, to find the Difference of Latitude and Difference of Longitude.

A ſhip in Latitude 42° 30′ N. and longitude 18° 31′ W. ſails S. E. by S. 591 miles, or 197 leagues; I demand the latitude and longitude the ſhip is in?



By PROJECTION.

With the courſe and diſtance, find the difference of latitude and departure, as in Caſe I. in Plane Sailing, viz. Draw the meridian A D, and on A deſcribe an arch with the chord of 60°, and upon it ſet off the courſe S. E. by S. or 3 points, through where that cuts the arch draw the line A C, making it equal to the diſtance 591, from C let fall the perpendicular C D; then will C D be the departure, and A D the difference of latitude 491 miles.

Draw the line E F parallel to A D, making the diſtance from it equal to the departure.

Take the complement of middle latitude 51° 36′ from the line of chords in your compaſſes, and ſet it off on the arch on the other ſide of the meridian A D, and, through where that cuts the arch, draw the line A B to cut the line E F in B, from B let fall the perpendicular on the line A D, and it is done; for A B will be the difference of longitude, 419 miles.

H Latitude

Latitude left	42° 30′ N.	Middle latitude	38 24
Difference of latitude	8 11 S.	Comp. middle latitude	51 36
Latitude in	34 19 N.	Longitude left	18° 31′ W.
Latitude left	42 30	Difference of longitude	6 59 E.
Sum	76 49	Longitude in	11 32 W.

From what has been ſaid, it will be eaſy to conſtruct any of the following caſes, as they are conſtructed the ſame as in Plane Sailing: only obſerving, that to find the difference of longitude you muſt take the complement of middle latitude as a courſe in Plane Sailing, with this courſe and the departure find the diſtance, and that will be the difference of longitude.

To find the ſame by CALCULATION.

To find the Difference of Lat.		To find the Departure.	
As radius 90°	10.00000	As radius 90°	10.00000
Is to the diſtance 591	2.77159	Is to the diſtance 591	2.77159
So is co-ſine cou. 3 pts.	9.91985	So is ſine courſe 3 pts.	9.74474
	12.69144		12.51633
	10.00000		10.00000
To the diff. of lat. 491,4	2.69144	To the departure 328,3	2.51633

To find the Difference of Longitude.

Without the Departure it will be,		With the Departure it will be,	
As co-ſi. mid. lat. 38° 24′	9.89415	As co-ſine mid. lat. 38° 24′	9.89415
Is to ſine courſe 3 pts.	9.74474	Is to departure 328.3	2.51627
So is diſtance 591	2.77159	So is radius 90°	10.00000
	12.51633		12.51627
	9.89415		9.89415
To Diff. of long. 419	2.62218	To diff. of long. 419=6° 59′	2.62212
		Long. left	18° 31′ W.

Whence the ſhip is in lat. 34° 19′ N. and long. 11 32 W.

By GUNTER.

1ſt. The extent from radius or 8 points to the complement of the courſe, 5 points on the line marked S R, will reach from the diſtance 591 to 491 the difference of latitude on the line of numbers.

2dly. The extent from radius or 8 points to the courſe, 3 points on the line S R, will reach from the diſtance 591 to the departure 328 on the line of numbers.

3dly. The extent from the ſine complement of middle latitude 51° 36′ to radius or 90° on the line of ſines, will reach from the departure 328 to the difference of longitude 419 on the line of numbers.

By INSPECTION.

Rule.—With the courſe and diſtance find the difference of latitude and departure, as in Caſe I. in Plane Sailing.

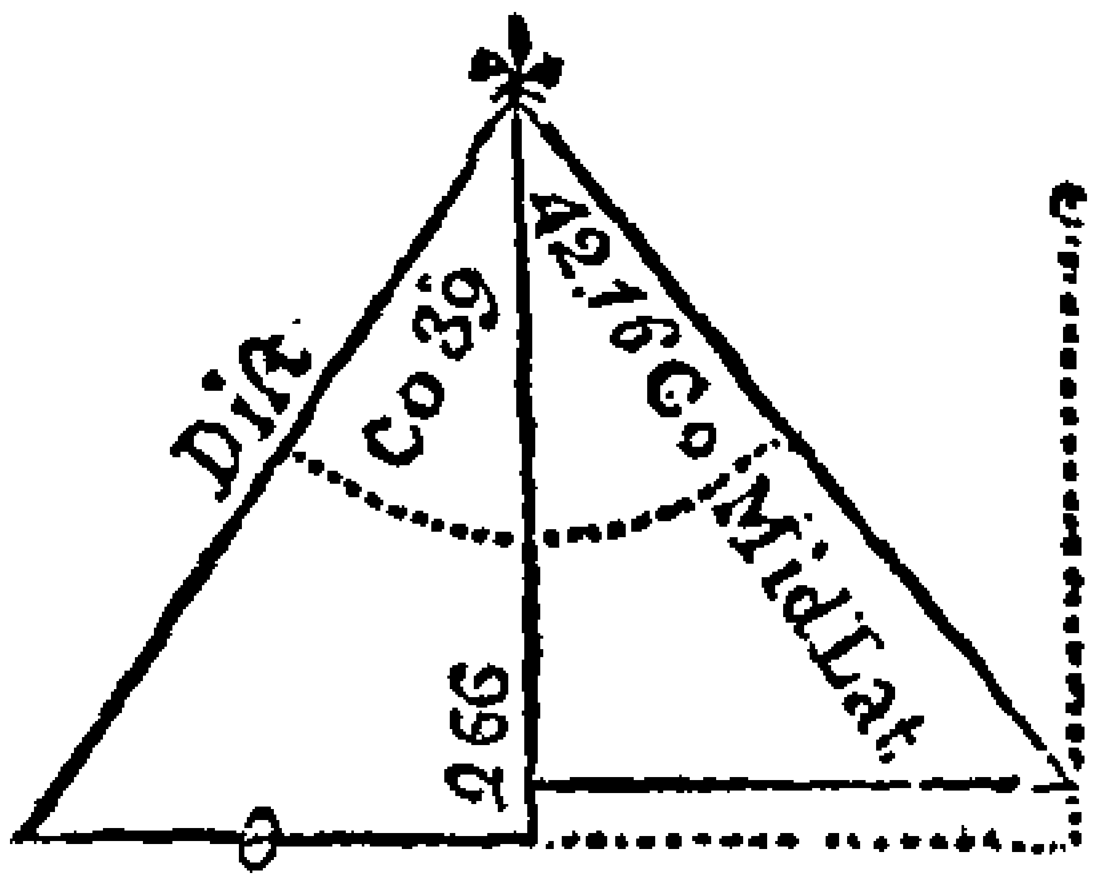
2dly. Take the complement of middle latitude as a courſe and the departure in its column, and againſt it in the diſtance column ſtands the difference of longitude.

Thus, under the courſe 3 points, and againſt the tenth of the diſtance 591=59,1 ſtand 49,1 and 32,8; theſe multiplied by 10 give 491 for the difference of latitude, and 328 for the departure.

Now, taking the complement middle latitude 51° 36′ or 51° as a courſe, and a tenth of the departure 328=32,8 in its column, (the neareſt is 32,6), againſt which ſtands 42 in the diſtance column; this multiplied by 10 gives 420 the difference of longitude nearly as before.

CASE IV.

Courſe and Difference of Latitude given, to find the Departure, Diſtance, and Difference of Longitude.



Suppoſe a ſhip ſailing from the Lizard, makes, when the variation, leeway, &c. are allowed for, her courſe S. 39° W. or S. W. by S. half weſterly, and then by obſervation is in latitude 45° 31′ N.; what is her diſtance run, and longitude in?

Latitude of the Lizard	49° 57′ N.	——	49° 57′ N.
Latitude by obſervation	45 31 N.	——	45 31 N.
Difference of latitude	4 26	Sum of latitudes	95 28
	60	Middle lat.	47 44
In miles ——	266	Co-middle latitude	42 16

By

By CALCULATION.

To find the Departure it will be,

As the co-sine course 39°	9.89050
Is to the diff. of lat. 266	2.42488
So is sine course 39°	9.79887
	12.22375
	9.89050
To the departure 215,4	2.33325

To find the distance it will be,

As the co-si. course 39°	9.89050
Is to the diff. of lat. 266	2.42488
So is radius 90°	10.00000
	12.42488
	9.89050
To the Distance 342,3	2.53438

To find the Diff. of Longitude.

As co-si. of mid. lat. 47° 44′	9.82775
Is to the departure 215,4	2.33325
So is radius 90°	10.00000
	12.33325
	9.82775
To the diff. of long. 320,3	2.50550

To find the longitude in.

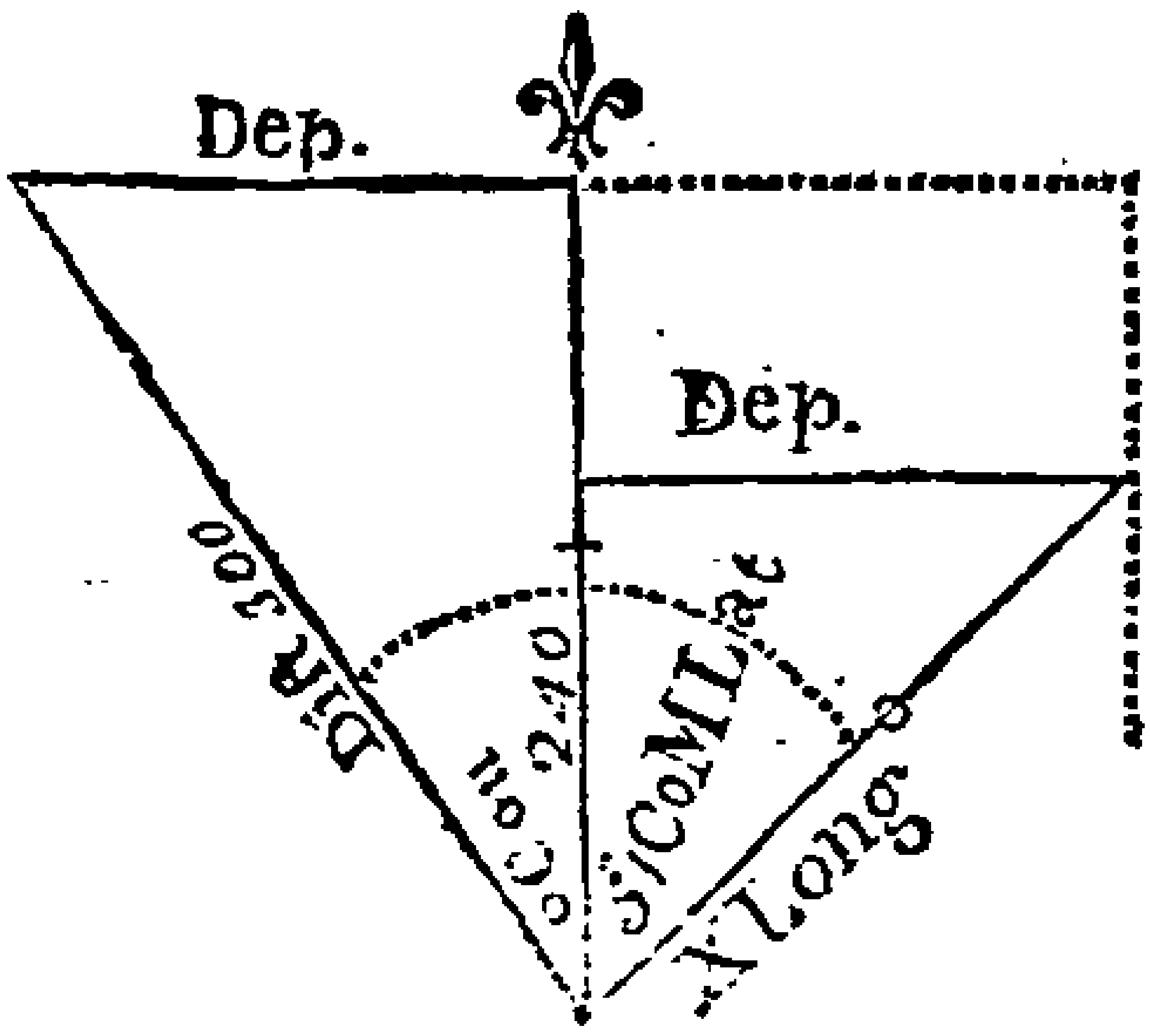
Lizard's longitude	5° 14′ W.
Diff. of lon. 320 miles or	5 20 W.
Longitude in	10 34 W.

By INSPECTION.

By Plane Sailing, Case 2d. Find Dist. and Depart. Then by Case 3d. with the complement of Mid. Lat. (as course) and the departure, find the Diff. Long. in the Distance Column.

CASE V.

Both Latitudes and Distance given, to find the Course and Difference of Longitude.



Suppose

Suppose a ship runs 300 miles N. westerly, from a port in 37° N. latitude, and longitude 10° 25′ W. until she be in latitude 41° N.; what is her course and longitude in?

Latitude left	—	37° 00′ N.	—	37° 00′ N.
Latitude in	—	41 00 N.	—	41 00 N.
Diff. of lat.	—	4 00	Sum of latitude	78 00
		60	Middle latitude	39 00
In miles	—	240	Co-middle lat.	51 00

By CALCULATION.

To find the Course it will be,		To find the Diff. of Long. it will be,	
As the distance 300	2.47712	As co-sine mid. lat. 39°	9.89050
Is to radius 90°	10.00000	Is to tang. course 36 52	9.87501
So is diff. lat. 240	2.38021	So is diff. of lat. 240	2.38021
	12.38021		12.25522
	2.47712		9.89050
To the co-sine cou. 36° 52′	9.90309	To diff. of long. 231,6	2.36472

Longitude left	—	10° 25′ W.
Difference of Longitude		3 52 W.
Longitude in	—	14 17 W.

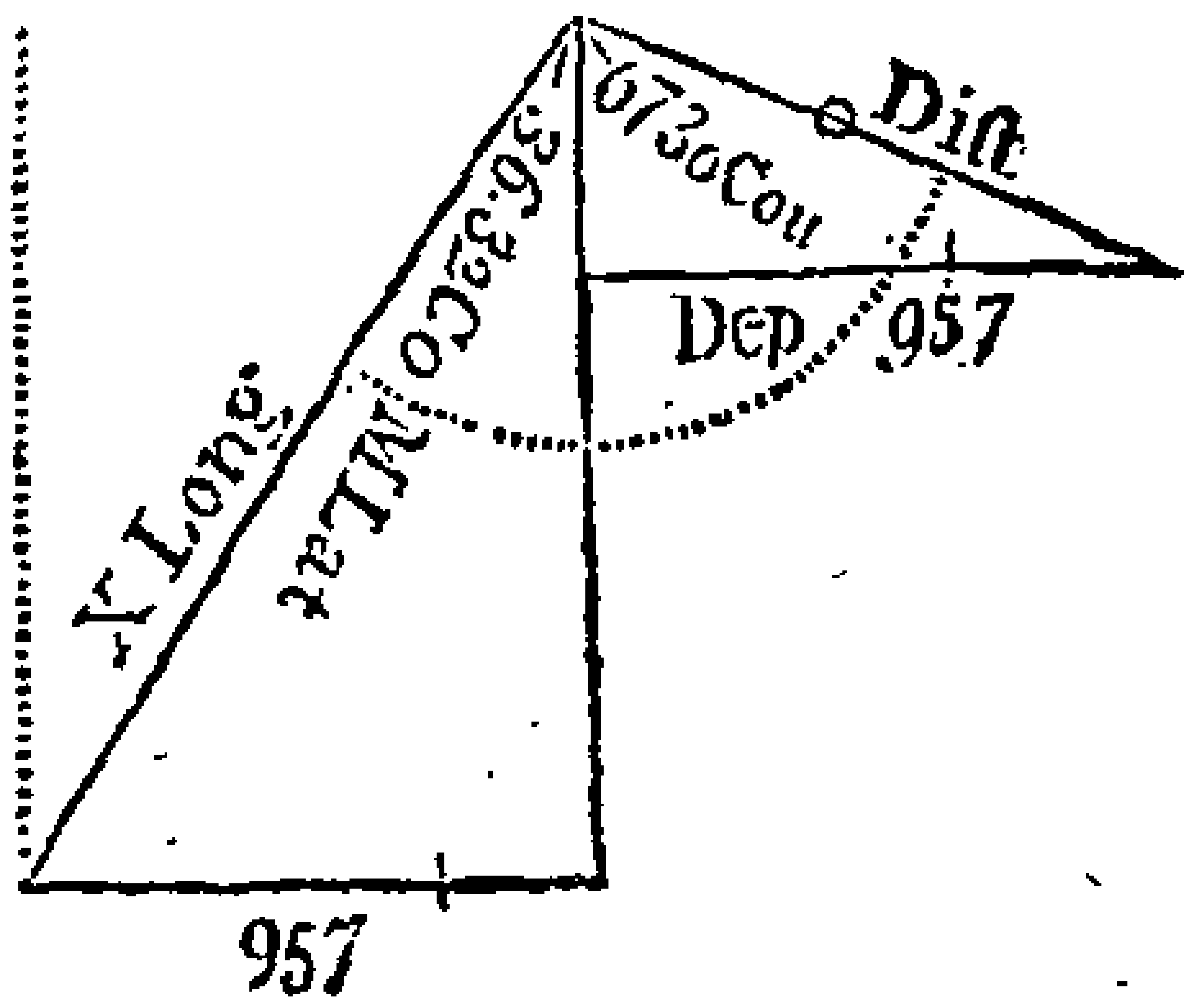
By INSPECTION.

By Plane Sailing, Case 4th find the Course. By Case 2d. the Departure; then by Case 3d. with the Comp. of Mid. Latitude as Course, and the Departure find the Diff. Long. in the Distance Column.

CASE VI.

One Latitude, Course and Departure given, to find the Distance, Difference of Latitude, and Difference of Longitude.

A ship sails E. S. E. from a certain port in latitude 50° 10′ S. and longitude 10° 16′ E. until her departure from the meridian be 957 miles; I demand her distance sailed, and the latitude and longitude she is in?



To

To find the Diff. of Lat. it will be,			
As fine courfe 6 pts.	9.96562		
Is to the departure 957	2.98091	Latitude left	50° 10′ S,
So is co-fine courfe 6 pts.	9.58284	Diff. of lat. 396, or	6 36 S.
	12.56375	Latiude in	56 46 S.
	9.96562		
To the diff. of lat. 396,4	2.59813		

To find the diftance it will be,			
As fine courfe 6 pts.	9.96562	Latitude left	50° 10′ S.
Is to the departure 957	2.98091	Latitude in	56 46 S.
So is radius	10.00000		
		Sum is	2)106 56
	12.98091		
	9.96562	Mid. lat.	53 28
To the diftance 1036	3.01529	Co-mid. lat.	36 32

To find the Diff. of Long. it will be,		Long. left is	10° 16′ E.
As co-fi. mid. lat. 53° 28′	9.77473	Diff. of long. 1608, or	26 48 E.
Is to the departure 957	2.98091		
So is radius	10.00000	Long. in	37 04 E.
	12.98091		
	9.77472		
To the m. diff. of long. 1608	3.20618		

By INSPECTION.

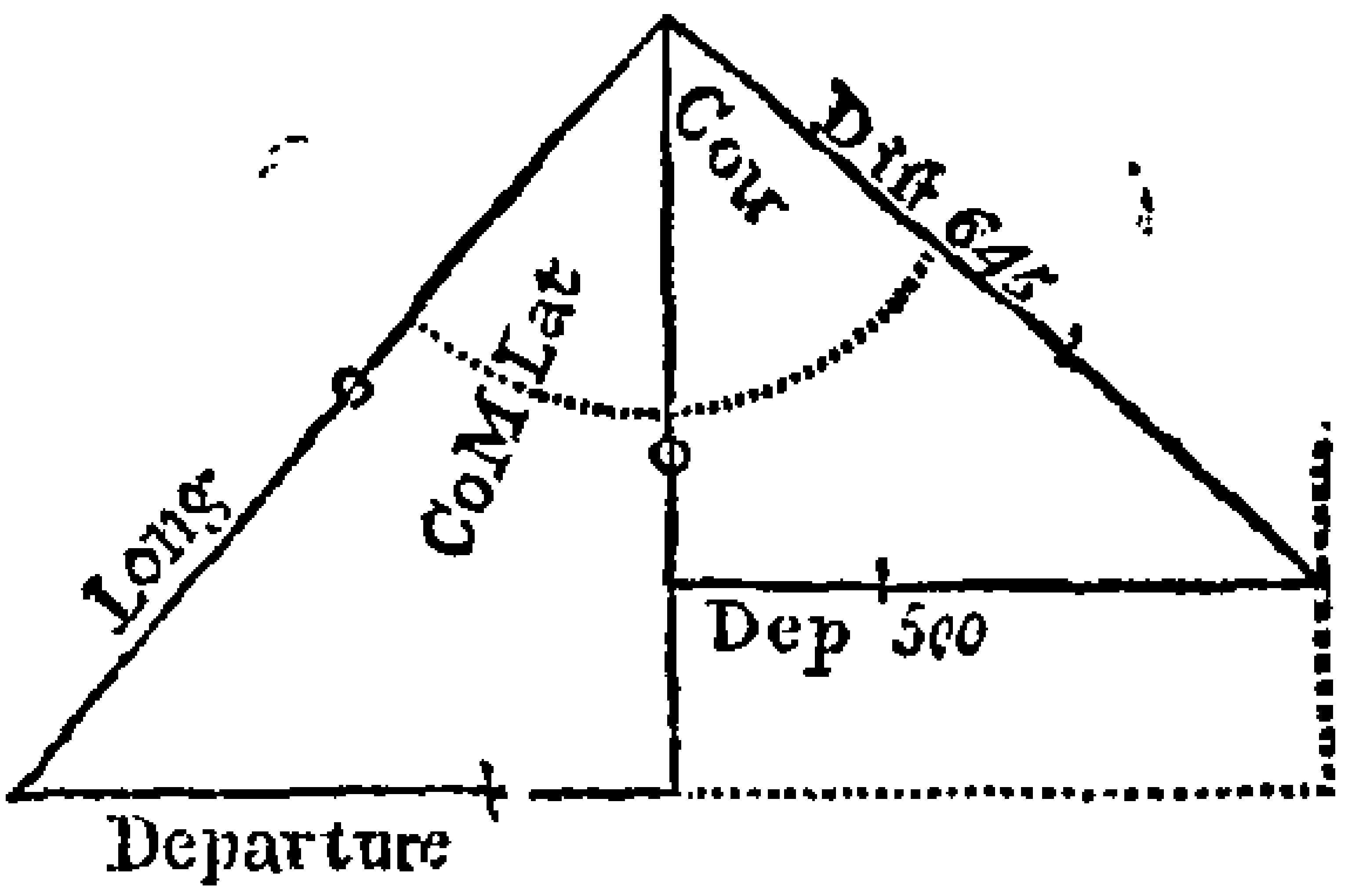
By Plane Sailing, Cafe 3d. find Dift. and Diff. Lat. Then by the fame Cafe, with the Comp. of Mid. Lat. (as courfe) and the Departure find the Diff. Long. in the diftance Column.

CASE VII.

One Latitude, Diftance failed, and Departure from Meridian given, to find the Courfe, Difference of Latitude, and Difference of Longitude.

A fhip in latitude 49° 30′ N. and longitude 14° 40′ W. fails fouth eaftward 645 miles, until her departure from the meridian be 500 miles; I demand the courfe fteered, and the latitude and longitude the fhip is in?

To



To find the Courſe it will be,		To find the Diff. of Lat. it will be,	
As the diſtance 645	2.80956	As radius	10.00000
Is to radius	10.00000	Is to the diſtance 945	2.80956
So is the departure 500	2.69897	So is co-ſine cou. 50° 50′	9.80043
	12.69897		12.60999
	2.80956		10.00000
To ſine courſe 50° 50′	9.88941	To the diff. of lat. 407,3	2.60999
Lat. left is	49° 39′ N.	Latitude left	49° 30
Diff. lat. 407, or	6 47 S.	Latitude in	42 43
Latitude in	42 43 N.	Sum is	92 13
		Middle latitude	46 06
		Co-middle latitude	43 54

To find the Diff. of Long. it will be,			
As co-ſine mid. lat. 46° 6′	9.84098	Longitude left is	14° 40′ W.
Is to the departure 500	2.69897	Diff. of long. 721, 01	12 01 E.
So is radius	10.00000		
		Longitude in	2 39 W.
	12.69897		
	9.84098		
To the diff. of lon. 721,1	2.85799		

By INSPECTION.

By Plane Sailing, Caſe 5th, find the courſe. By Caſe 3d. find Diff. Lat. and by the ſame caſe, with Comp. of Mid. Lat. (as courſe) and the Departure; find the Diff. Long. in the Diſtance Column.

MERCATOR's

MERCATOR's SAILING.

PLANE SAILING, as has been before obſerved, ſuppoſes the earth and ſea to be in the form of a bowling green, on which the meridians are parallel, and the degrees of latitude and longitude equal in all places ; but the earth and ſea compoſe a round body, or globe, on which the degrees of latitude are equal in all places, and the degrees of longitude decreaſe from the equator in proportion to the ſine complements of the latitudes.

Though the meridians all meet at the poles, and the parallels to the equator continually decreaſe, and that in proportion to the co-ſines of their latitudes ; yet in old ſea-charts the meridians were drawn parallel to each other, and, conſequently, the parallels of latitude made equal to the equator, and ſo a degree of longitude on any parallel, as large as a degreee on the equator : alſo, in theſe charts, the degrees of latitude were ſtill repreſented (as they are in themſelves) equal to each other, and to thoſe of the equator ; by theſe means the degrees of longitude being increaſed beyond their juſt proportion, and the more ſo the nearer they approached the poles, the degrees of latitude at the ſame time remaining the ſame ; it is evident places muſt be very erroneouſly marked down upon thoſe charts, with reſpect to their latitude and longitude, and, conſequently, their bearings from one another muſt be very falſe.

To remedy this inconvenience, ſo as ſtill to keep the meridians parallel, it is plain we muſt protract or lengthen the degrees of latitude in the ſame proportion as thoſe of longitude are, that ſo the proportion in eaſting or weſting may be the ſame with that of northing or ſouthing ; and, conſequently, the bearing of places from each other to be the ſame upon the chart as upon the globe itſelf.

The difficulty in conſtructing a true ſea-chart conſiſts in finding a proper manner of applying the ſurface of a globe to a plane ; which, Mr. WRIGHT, an Engliſhman, by an ingenious conception, happily accompliſhed.

He conceived the ſurface of this globe to ſwell like a bladder while it is blowing up from the equator towards the poles, proportionally in latitude as it does in longitude, until every part of its ſurface meet that of a concave

concave cylinder impressed on it, whose diameter was equal to the globe's diameter. The equator being thus confined, the parts towards the poles must be extended, both in latitude and longitude, to fill up the cylinder, or figure, in the form of a rolling stone, and impress on its concave surface the lines drawn on the surface of the globe. This cylinder being cut on one of the meridians, from north to south, and laid open, would represent a true sea-chart, the parts of which bear the same proportion to one another as the corresponding parts of the globe do, and on which all the lines will be right lines; having every parallel of latitude on the globe increased till it is equal to the equator; and so the distance of the meridians in these parallels will become equal to their distance at the equator; consequently, the meridians on the chart are expressed by parallel right lines.

Also the meridians being lengthened as the parallels are increased, every degree of latitude is lengthened in the same proportion as the degrees of longitude are increased; therefore the distance of the parallels of latitude grow wider and wider as they approach the poles.

Mr. GERRARD MERCATOR, a Fleming, in 1556, published a similar chart; but in what manner it was constructed he did not show; neither were those degrees in their true proportion; whence called Mercator's Chart.

Mr. WRIGHT, in 1599, published the principles of the True Sea-Chart, and how to construct it on the following principles, viz.

That the distance between any two meridians at the equator is in proportion to their distance in any parallel of latitude, as the radius is to the co-sine of that latitude:

That any part of a parallel of latitude is to a like part of the meridian, as the radius is to the secant of that parallel:

And, that the distance of any parallel of latitude from the equator is equal to the sum of the secants of all the arches between the equator and that parallel.

From these principles, Mr. WRIGHT set about forming a table, by the continual additions of secants of all the parallels of latitude, beginning with one minute, which he made radius, and thereto adding the second parallel of 2 minutes, and to the sum of these two, the secant of 3 minutes, &c. The table thus formed, is that which is commonly called the Table of Meridional parts, (see Table III.) by means of which a true nautical chart may be constructed, called Mercator's Chart, and all the Cases in WRIGHT's, commonly called Mercator's Sailing, constructed and calculated.

As this table contains the meridional parts for every degree and minute of the quadrant, from the equator to the poles, it will be easy to find the meridional parts corresponding to any parallel of latitude, as for example:

Required the meridional parts corresponding to the latitude 33° 45′?

Look in the top of the table for 33°, marked 33d, and in the right or left hand columns, marked (M), under the degrees 33, and opposite the minutes 45 stands 2153, the meridional parts belonging 33° 45′.

When the given latitudes are both north or both south, the meridional difference of latitude is found by subtracting the meridional parts of the lesser latitude from those of the greater.

Required

Required the meridional difference of latitude between the Lizard, in latitude 49° 57′ N. and the Island of St. Mary's in latitude 37° N?

The Lizard's latitude	49° 57′ N.	meridional parts	3470
St. Mary's Latitude	37 00 N.	meridional parts	2393
		Meridional difference of latitude	1077

When the latitudes are one north, and the other south, the meridional difference of latitude is found by adding the meridional parts corresponding to both the latitudes together.

Required the meridional difference of latitude between Cape Verd, in latitude 14° 46′ N. and the Cape of Good Hope, in latitude 34° 29′ S.?

Cape Verd's latitude	14° 46′ N.	meridional parts	896
Cape of Good Hope's	34 29 S.	meridional parts	2207
		Meridional difference of latitude	3103

The several cases in Mercator's Sailing are worked by geometry, trigonometry, Gunter's Scale, and the tables of difference of latitude and departure, exactly in the same manner as those in Plane Sailing, by only considering the meridional difference of latitude, as if it was the proper difference of latitude, and the difference of longitude as the departure: for it is no more than enlarging the proper difference of latitude, so as to be equal to the meridional difference of latitude; then will the difference of longitude bear the same proportion to the departure, that the meridional difference of latitude does to the proper difference; for, in the following figure, (which is the first Case in Mercator's Sailing):

Let M T represent the meridional and M I the proper difference of latitude, TH the difference of longitude, IO the departure, MO the distance, and the angle TMH, or IMO, the course; then will MI be in proportion to IO, as MT is to TH; and the contrary.

Wherefore, as the proper difference of latitude is to the departure, so is the meridional difference of latitude to the difference of longitude: and,

As the meridional difference of latitude is to the difference of longitude so is the proper difference of latitude to the departure.

Since by lengthening or shortening the sides of a triangle does not alter the angles, the departure may be reduced into difference of longitude, and difference of longitude into departure.

In all the Cases (save the first) in Mercator's Sailing, the course, distance, difference of latitude and departure, are found in the same manner as those in Plane Sailing; and then the difference of longitude may be found by either of the following proportions, viz. (see the opposite figure.)

By making the enlarged Distance M H radius, it will be,		By making meridional Difference of Latitude M T radius, it will be,
As the co-sine of the course Is to the merid. diff. of latitude So is the sine of the course To the diff. of longitude;	or	As radius Is to merid. difference of latitude So is the tangent of the course To the difference of longitude.

But

But in the first Case, it will be,

As the merid. diff. of lat. MT Is to radius So is the diff. of longitude TH To the tangent of the course;	And,	As radius Is to the proper diff. of lat. MI So is the secant of the course To the distance M O.

Or, when the course is found, you may say, As the co-sine of the course is to the proper difference of latitude, so is radius to the distance.

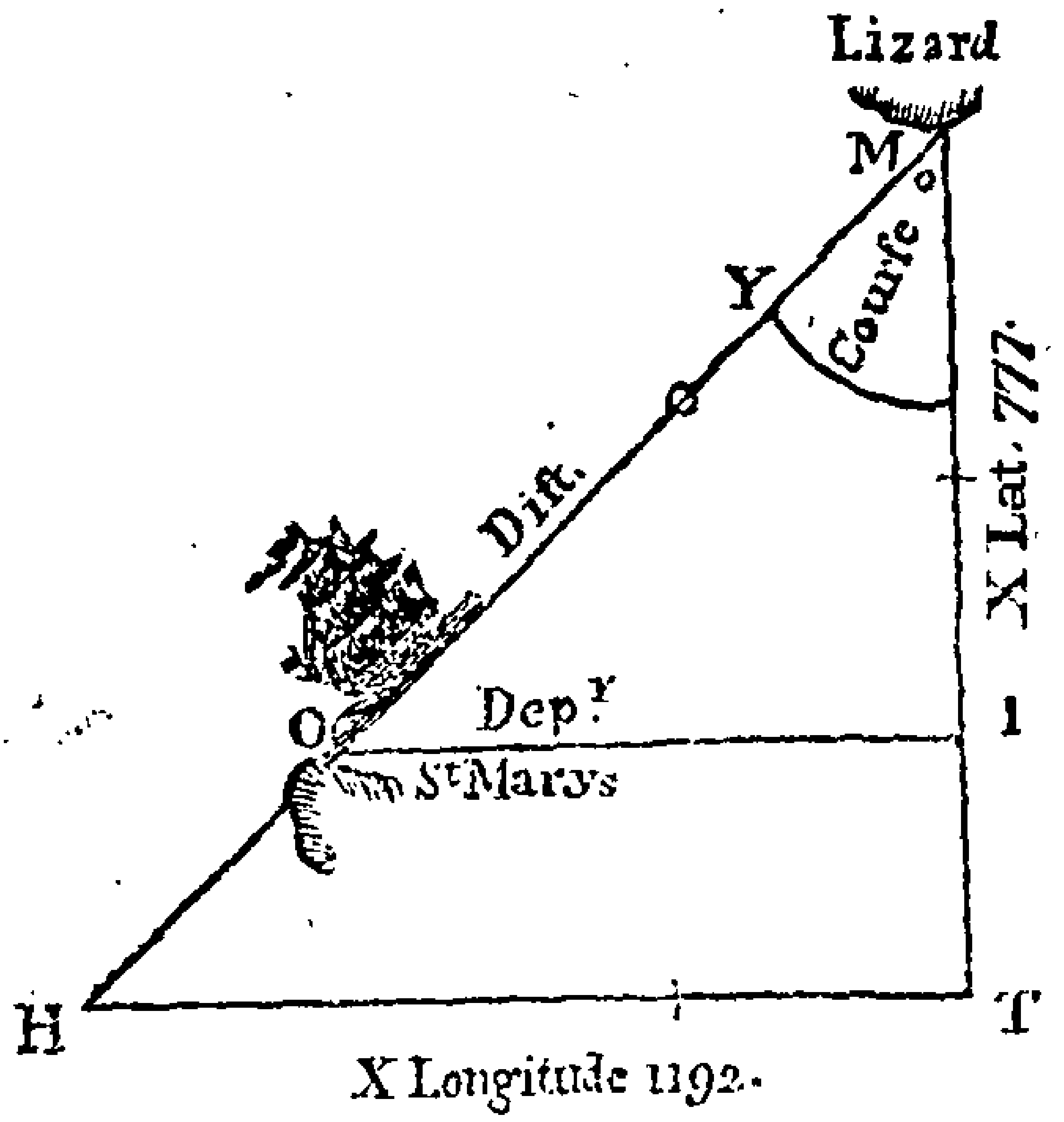
CASE I.

The Latitudes and Longitudes of two places given, to find the direct Course and Distance between them.

Required the bearing and distance between the Lizard, in latitude 49° 57′ N. longitude 5° 14′ W. and the Island of St. Mary's, one of the Western Islands, in latitude 37° N. and longitude 25° 06′ W.?

Lizard's lat.	49° 57′ N.	meridional parts	3470	long.	5° 14′ W.
St. Mary's	37 00 N.	meridional parts	2393	long.	25 06 W.
Diff. of lat.	12 57=777		Diff. 1077	Diff.	19 52=1192.

By PROJECTION.



Draw the meridian MT=1077, the meridional difference of latitude, and M I=777, the proper difference of latitude, perpendicular to MT; draw T H and I O, and make T H 1192 miles, the difference of longitude; join

join H and M; then will the angle T M H be the course S. 47° 54′ W. and O M the distance 1159 miles.

By CALCULATION.

To find the Course, it will be,		To find the Distance, it will be,	
As mer. diff. of lat. 1077	3.03222	As radius 90°	10.00000
Is to radius 90°	10.00000	Is to prop. diff. lat. 777	2.89042
So is diff. of long. 1192	3.07628	So is sec. of course 47° 54′	10.17365
	13.07628		13.06407
	3.03222		10.00000
To tang. of cou. 47° 54′	10.04406	To the dist. 1159	3.06407

By GUNTER.

1st. Extend from the meridional difference of latitude 1077, to difference of longitude 1192, that extent will reach from radius, or 45°, to the course 47° 54′ on the line of tangents.

2d. Extend from radius, or 90°, to the complement of the course 42° 06′ on the line of sines, that extent will reach from 777 to 1159 on the line of numbers.

By INSPECTION.

By Plane Sailing, Case 6th with the Meridional Diff. Lat. and Diff. Long. (used as the true Diff. Lat. and Depart.) find the Course; then by Case 2d. with the Course and true Diff. Lat. find the Distance and Departure.

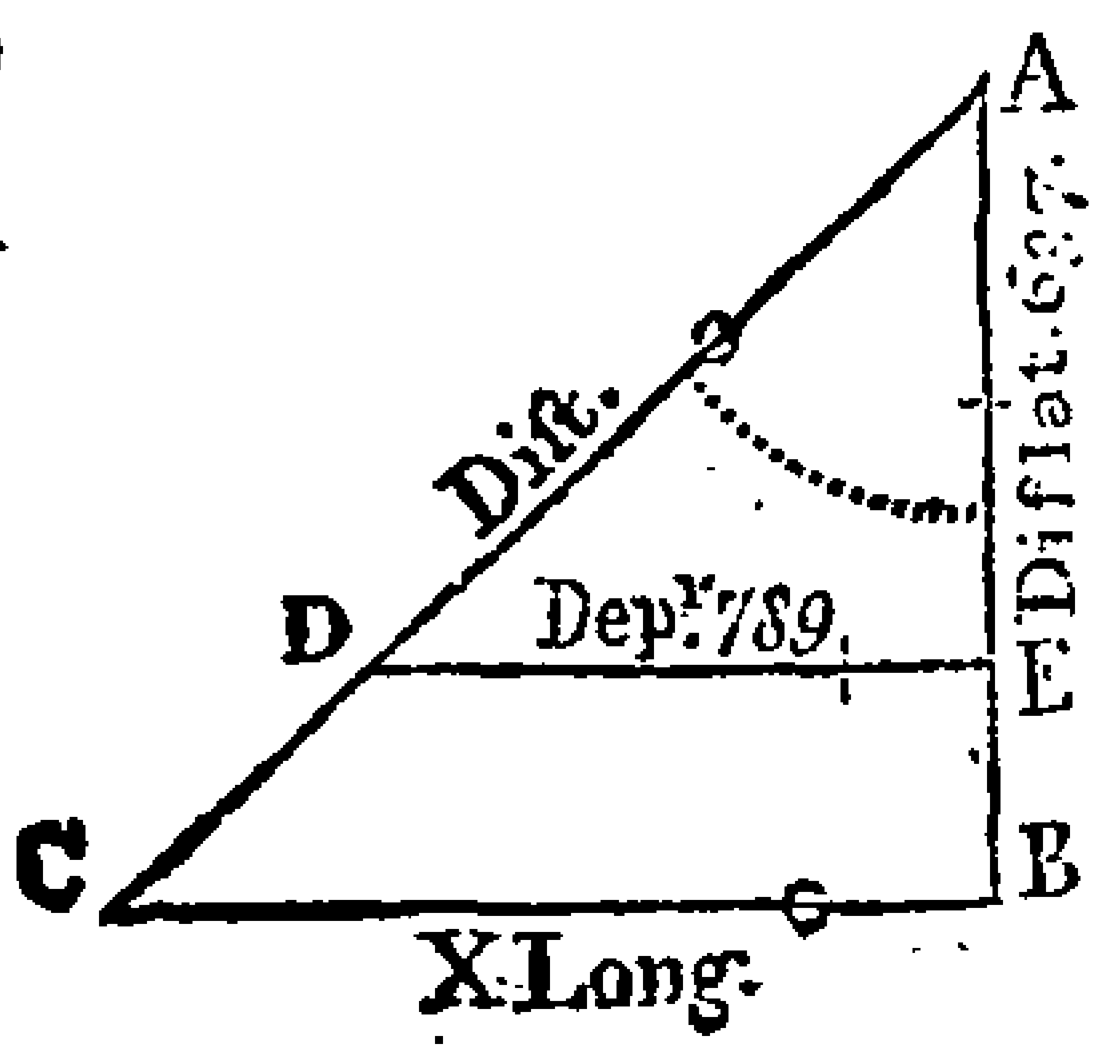
In the latitude column I look for $\frac{1}{10}$ of the proper difference of latitude, which is 77,7, the nearest is 77,6, against this stands 116 in the distance column, and 86,2 in the departure column, which multiplied by 10 gives 1160 and 862 nearly, the same as that found by calculation.

CASE II.

Both Latitudes and the Departure from the Meridian given, to find the Course, Distance, and Difference of Longitude.

A ship in lat. 49° 57′ N. and long. 5° 14′ W. sails S. westward, until her departure from the meridian be 789 miles, and then by observation is in the lat. 39° 20′ N. required her course steered, distance run, and longitude in?

Lat. left	49° 57′	Merid. parts	3470
Lat. in	39 20	Merid. parts	2571
Diff. of lat.	10 37=637 miles	Diff.	899



By

By PROJECTION.

With the proper difference of lat. and departure, project the same as in Case VI. in Plane Sailing: extend the meridian A E to B, and make A B equal to the meridional diff. of lat. and draw a line parallel to the departure D E; produce the distance A D to cut this parallel; and C B will be the difference of longitude. Hence the angle B A C will be the course, S. 50° 05′ W. D A the distance 1014, and B C the difference of longitude 1114 miles.

To find the same by CALCULATION.

As the pr. diff. of lat. 637	2.80414
Is to radius 90°	10.00000
So is the departure 789	2.89708
	12.89708
	2.80414
To tang. course 51° 05′ =	10.09294
As tangents radius 45°	10.00000
Is to mer. diff. lat. 899	2.95376
So is tang. course 51,5	10.09292
	13.04668
	10.00000
To diff. of long. 1114	3.04668

As radius 45°	10.00000
Is to diff. of lat. 637	2.80414
So is sec. course 51° 05′	10.20191
	13.00605
	10.00000
To the distance 1014	3.00605
Longitude left	5° 14′ W.
Diff. of long. 1114 =	18 34 W.
Longitude in	23 48 W.

Her course is S. 51° 05′ W. and distance 1014 miles.

NOTE. The diff. of long. may be found by saying, As prop. diff. of lat. : dep. : : merid. diff. of lat. : diff. of long.

By GUNTER.

1st. The extent from diff. lat. 637, to dep. 789, on the line of numbers, will reach from radius, or 45°, to 51° 05′, the course on the line of tangents.

2dly. The extent from radius to comp. course 38° 55′, on the line of sines, will reach from diff. lat. 637, to 1014, the distance of the line of numbers.

3dly. The extent from co-course 38° 55′ to sine course 51° 05′ on the line of sines, will reach from merid. diff. lat. 899, to 1114 the difference of longitude on the line of numbers.

By INSPECTION.

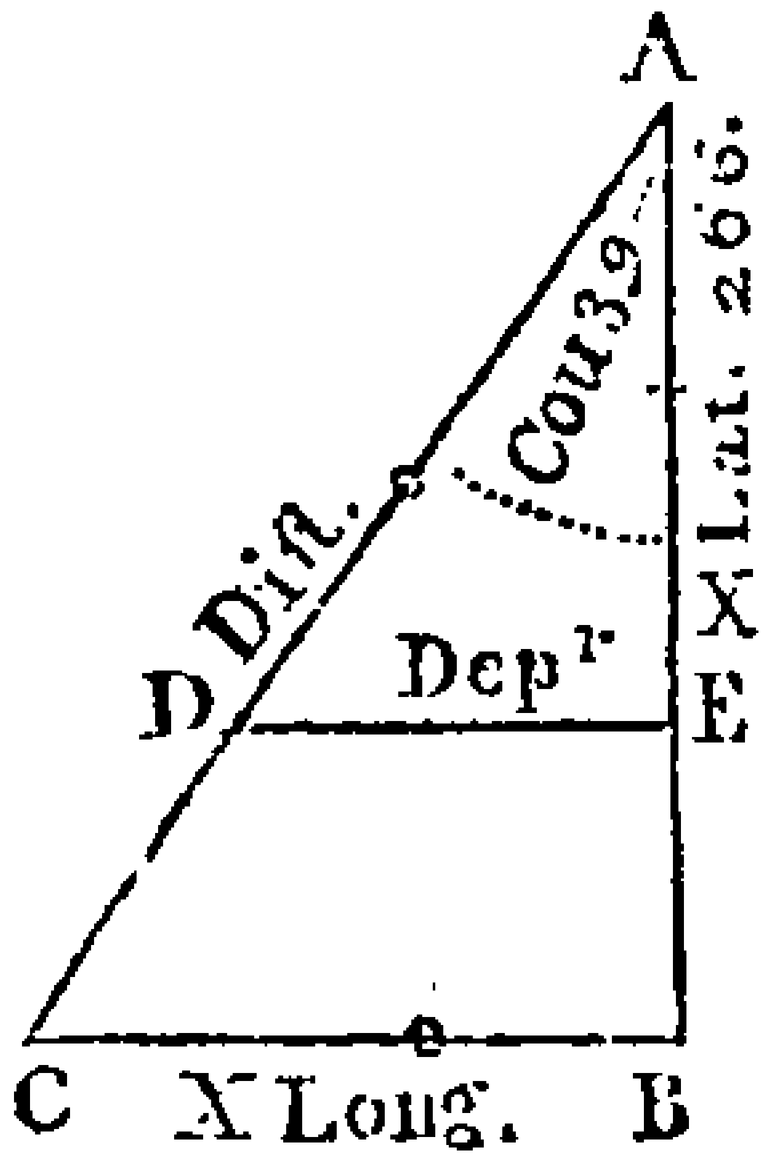
By Plane Sailing, Case VI. find the course. By Case II. with course and true diff. lat. find the departure; and with course and merid. diff. lat. in the same manner find the diff. long. in the departure column.

CASE III.

Both Latitudes and Course given, to find the Distance, Departure, and Difference of Longitude.

A ship from the Lizard makes her course S. 39° W. and then by observation is in latitude 45° 31′ N.; required her distance run, and longitude in?

Lat. of the Lizard	49° 57′ N.	Mer. parts	3470
Lat. by obsarv.	45 41 N.	Mer. parts	3074
Diff.	4 26 = 266 m. diff.		396



By CONSTRUCTION.

Draw a meridian A B, the upper end A will represent the ship's place in her first latitude.

Take the proper difference of latitude 266 in your compasses, and with one foot in A, the ship's place, lay the other upon the meridian from A to E; take the merid. diff. of latitude 396 in your compasses, and with one foot in A, the ship's place, as before, lay the other upon the meridian at B; and upon these two points raise the perpendiculars D E and C B; a line drawn from the ship's place making an angle with the meridian equal to 39° the ship's course, will cut the two perpendiculars at D and C; the first will be the departure, which terminates the distance A D 342, and the other will be the difference of longitude C B = 321 miles.

From what has been said, it is plain, that any case in Mercator's Sailing may be projected as a right-angled triangle, by only considering the difference of longitude, or departure, as the base; the meridional, or proper difference of latitude, as the perpendicular, the hypothenuse cut by the departure, as distance; and the angle which that makes with the perpendicular, the course; for in all cases in Mercator's Sailing, the meridional difference of latitude bears the same proportion to the difference of longitude, that the proper difference of latitude does to the departure.

These instructions being well understood, will be sufficient to inform the learner how to construct any of the following cases:

By

By CALCULATION.

To find the Diſtance.		To find the Diff. of Longitude.	
As the co-ſine courſe 39°	9.89050	As the co-ſine courſe 39°	9.89050
Is to the diff. of lat. 266	2.42488	Is to mer. diff. of lat. 396	2.59770
So is radius	10.00000	So is ſine courſe 39°	9.79887
	12.42488		12.39657
	9.89050		9.89050
To the diſtance 342,3	2.53438	To the diff. of long. 320,7	2.50607

Lizard's Longitude left	5° 14′ W.
Difference of long. 321 ; or	5 21 W.
Longitude in	10 35 W.

By GUNTER.

1ſt. The extent from co-ſine courſe 51°, to radius on the line of ſines, will reach from the proper difference of latitude 266, to the diſtance 342.3 on the line of numbers.

2dly. The extent from co-ſine courſe 51°, to ſine courſe 39° on the line of ſines, will reach from the meridian difference of latitude 396, to the difference of longitude 321, on the line of numbers.

By INSPECTION.

Under the courſe 39°, and againſt half the diff. of lat. 133, ſtands 171 in the diſtance column, and 107,6 in the dep. column, which being doubled is 342, the diſtance, and 215,2 the departure ; under the ſame degrees, and in the latitude column, look for half the meridian difference of latitude 198, againſt that, in the departure column, ſtands 160,5 doubled is 321, the difference of longitude nearly, as before.

CASE IV.

One Latitude, Courſe, and Diſtance given, to find the Difference of Latitude, and Difference of Longitude.

A ſhip in latitude 42° 30′ N. and longitude 18° 31′ W. ſails S. W. by S. 591 miles ; I demand the latitude and longitude the ſhip is in ?

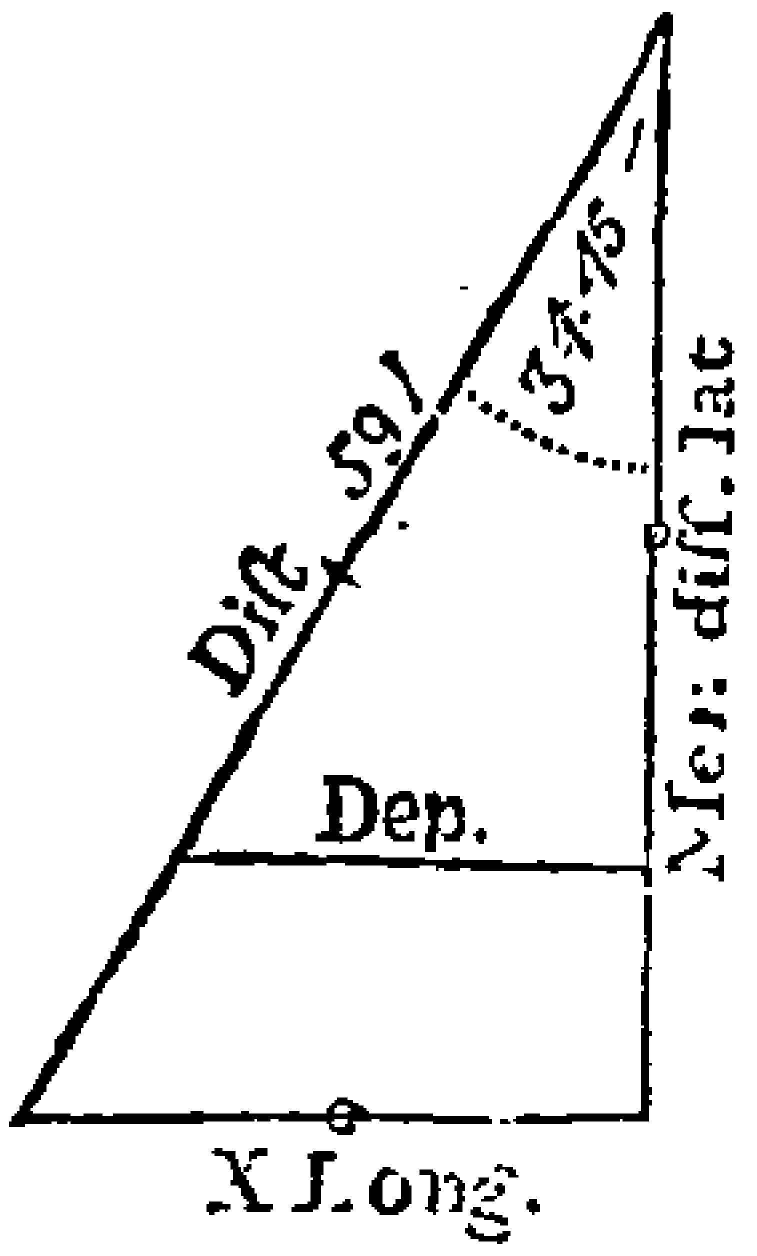
To find the Difference of Latitude it will be,

As radius	10.00000	Lat. left	42°30	M. parts.	2822
Is to the diſtance 591	2.77159	Diff. lat. 491	8 11		2194
So is co-ſine courſe 3 pts.	9.91985				
		Lat. in	34 19	M. diff. lat.	628
	12.69144				
	10.00000				
To the diff. of lat. 491,4	2.69144				

To

To find the Diff. of Long. it will be,

As co-fi. cou. 3 pts.	9.91985	Lon. left	18° 31' W
Is to M. diff. of lat. 628	2.79796	D. lo. 420 =	7 00 W
So is S. course 3 pts.	9.74474		
	12.54270	Long. in	25 31 W
	9.91985		
To diff. of lon. 419,6	2.62285		



By GUNTER.

1st. The extent from radius to 5 points, the comp. of the course on the line marked S R, will reach from the distance 591, to the difference of latitude, 491,4 on the line of numbers.

2dly. The extent from co-course 5 points, to the course 3 points on the line marked S R, will reach from the meridian difference of latitude 628 to the difference of longitude 419,6, on the line of numbers.

By INSPECTION.

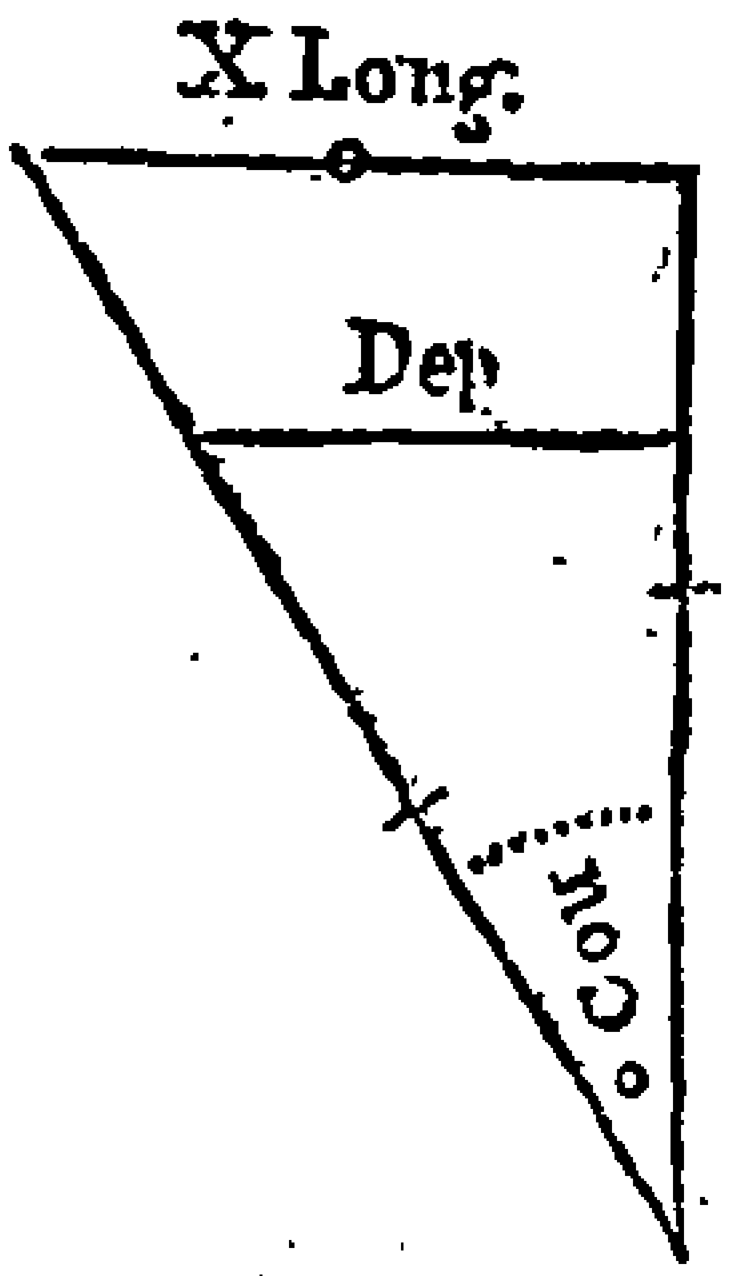
Under the course 3 points, and opposite a tenth of the distance 59, in the latitude column, stands 49,1, which multiplied by 10 is 491, the difference of latitude; then find $\frac{1}{4}$ of the meridian difference of latitude 157, in the latitude column, against which stands 105 in the departure column, which multiplied by 4, gives 420, the difference of longitude.

CASE V.

Both Latitudes and Distance given, to find the Course and Difference of Longitude.

If a ship runs 300 miles N. Westerly from a port in latitude 37° N. and longitude 10° 25' W. until she be in latitude 41° N.; required the course steered and longitude in?

Latitude left	37 N.	Merid. parts 2393
Latitude in	41 N.	Merid. parts 2702
Diff.	4 = 240	M. diff. long. 309 m.



By CALCULATION.

To find the Course.		To find the Diff. of Longitude.	
As the distance 300	2.47712	As co-si. course 36° 52′	9.90311
Is to radius	10.00000	Is to mer. diff. of lat. 309	2.48996
So is pro. diff. of lat. 240	2.38021	So is sine course 36° 52′	9.77812
	12.38021		12.26808
	2.47712		9.90311
To the co-si. course 36° 52′	9.90309	To the diff. of long. 231,7	2.36497

Longitude left	10° 25′ W.
Diff. of long. 232, or	3 52 W.
Longitude in	14 17 W.

By GUNTER.

1st. The extent from the distance 300, to the proper difference of latitude 240, on the line of numbers, will reach from radius or 90°, to 53° 8′ the complement of the course, on the line of sines.

2dly. The extent from co-course 53° 8′, to course 36° 52′, on the line of sines, will reach from the meridian difference of latitude 309, to the difference of longitude 231,7, on the line of numbers.

By INSPECTION.

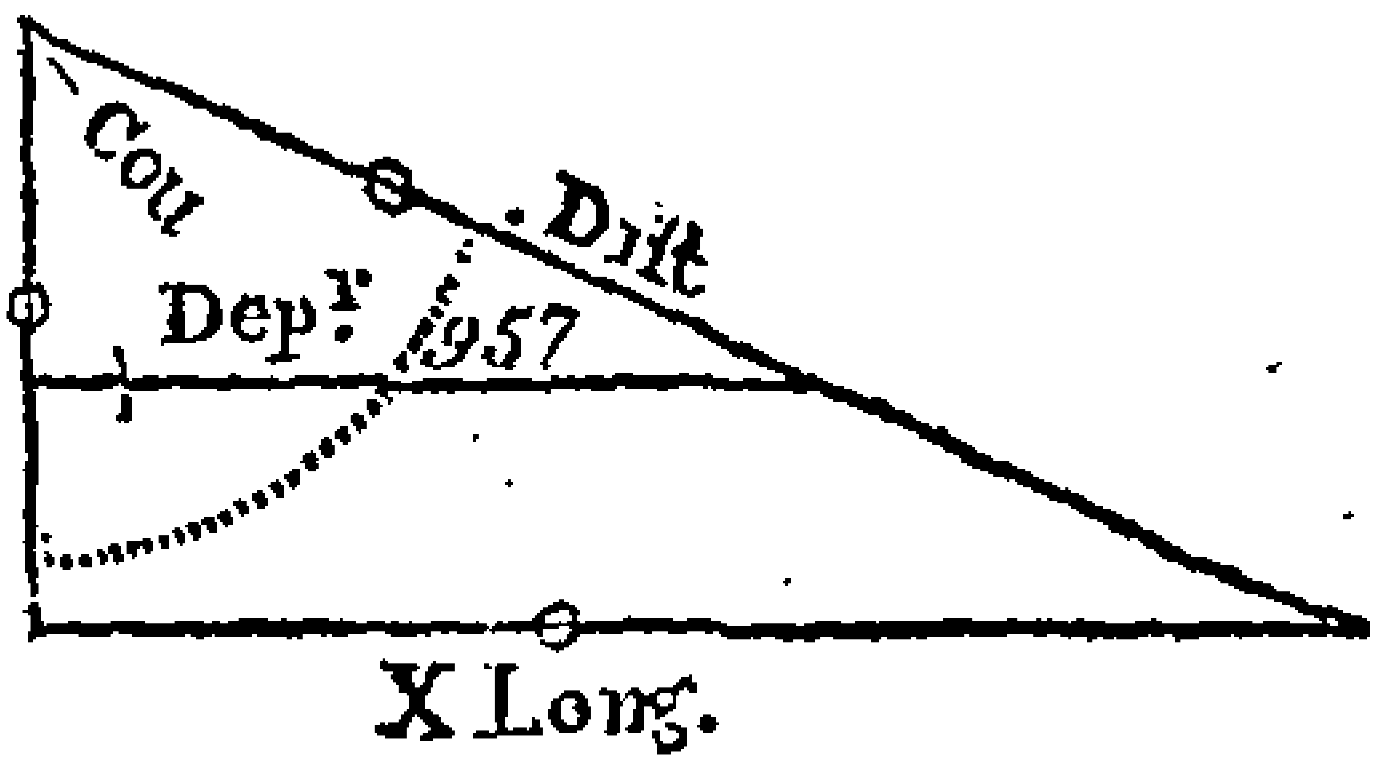
With the distance and difference of latitude find the course by Case IV. of Plane Sailing; then in the latitude column belonging to this course, find the meridian difference of latitude: against which, in the departure column, will stand the difference of longitude, and against the true diff. lat. the departure.

In the latitude column, find half the meridian difference of latitude 154,5 the nearest to it is 154,1; against which, in the departure column, stands 116,1, which doubled is 232,2, the difference of longitude nearly, as before.

CASE VI.

One Latitude, Course, and Departure given, to find the Distance, Difference of Latitude, and Difference of Longitude.

A ship sails E. S. E. from a certain port in latitude 50° 10′ S. and longitude 10° 16′ E. until her departure from the meridian be 957 miles; I demand the distance sailed, and the latitude and longitude she is in?



To find the Distance it will be,		To find the Diff. of Lat. it will be,	
As the sine course 6 pts.	9.96562	As sine course 6 pts.	9.96562
Is to the departure 957	2.98091	Is to the departure 957	2.98091
So is radius	10.00000	So is co-si. course 6 pts.	9.58284
	12.98091		12.56375
	9.96562		9.96562
To the distance 1036	3.01529	To diff. of lat. 396=6° 36′	2.59813

To find the Diff. of Longitude,			
As co-sine course 6 pts.	9.58284	Lat. left 50° 10′ S. mer. pts.	3490
Is to mer. diff. of lat. 667	2.82413	Lat. in 56 46 S. mer. pts.	4157
So is sine course 6 pts.	9.96562	Merid. difference of lat.	667
	12.78975	Long. left	10° 15′ E.
	9.58284	Diff. of long. 1610 =	26 50 E.
To diff. of long. 1610	3.20691	Longitude in	37 6 E.

By GUNTER.

1st. The extent from 6 points to radius, on the line marked S R, will reach from the departure 957, to the distance 1036 on the line of numbers.

2dly. The extent from 6 points to 2 points, on the line marked S R, will reach from the departure 957, to the difference of latitude 396, on the line of numbers.

3dly. The extent from 2 points to 6 points, on the line marked S R, will reach from the meridian difference of latitude 667, to the difference of longitude 1610, on the line of numbers.

By INSPECTION.

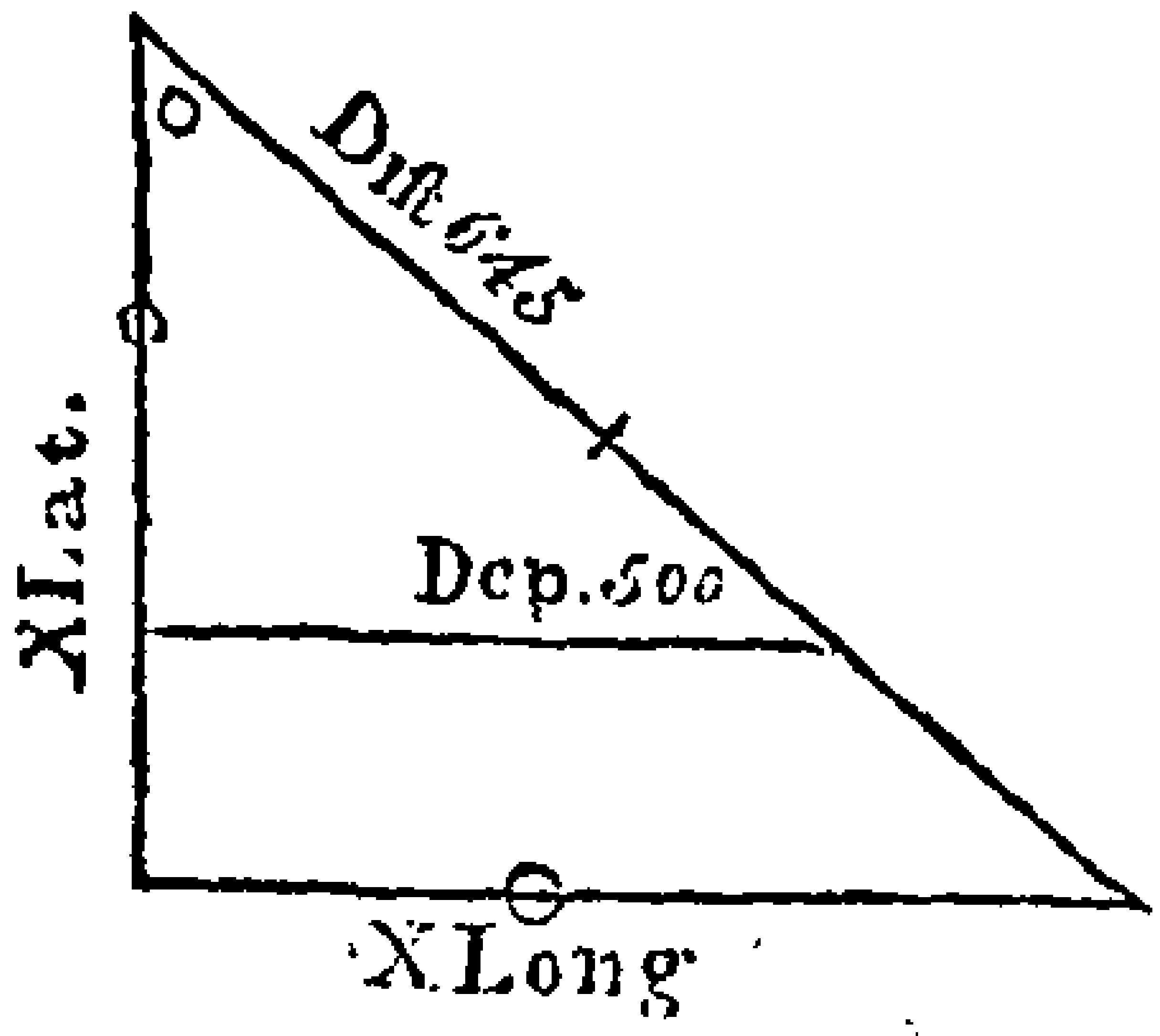
By Plane Sailing Case III. over the course of 6 points, and against a fifth of the departure 191,4 stands 79,2 and 207, which multiplied by 5 gives 396, the difference of latitude, and 1035 for the distance. Then, by Case II. in the latitude column, find a tenth of the meridian difference of latitude 66,7, the nearest to that is 66,6 ; against which, in the departure column, stands 160,8, which multiplied by 10 is 1608, the difference of longitude.

 CASE VII.

CASE VII.

One Latitude, Diſtance ſailed, and Departure from the Meridian given, to find the Courſe, Difference of Latitude, and Difference of Longitude.

A ſhip in latitude 49° 30′ N. and longitude 14° 40′ W. ſails S. eaſtward 645 miles, until her departure from the meridian be 500 miles. Required the courſe ſteered, and the latitude and longitude ſhe is in?



To find the courſe it will be,

As the diſtance 645	2.80956
Is to radius 90°	10.00000
So is departure 500	2.69897
	12.69897
	2.80956
To ſine courſe 50° 50′	9.88941

To find the Diff. of Long. it will be.

As co ſine courſe 50° 50′	9.80043
Is to m. diff. of lat. 588	2.76938
So is ſine courſe 50° 50′	9.88948
	12.65886
	8.80043
To diff. of lon. 721,8=12° 2′	2.85843
Long. left. 14 40	
Long. in 2 38 W.	

To find the Diff. of lat. it will be,

As ſine courſe 50° 50′	9.88948
Is to the departure 500	2.69897
So is co-ſi. courſe 50° 50′	9.80043
	12.49940
	9.88948
To diff. lat. 407,3=6° 47′	2.60992
Lat. left 49° 30′ N. M. pts.	3428
Lat. in 42 43 N. M. pts.	2840
Mer. diff. lat.	588
As pro. diff. of lat. 407,3	2.60992
Is to departure 500	2.69897
So is m. diff. of lat. 588	2.76938
	5.46835
	2.60992
To diff. of long. 721,8	2.85843

Hence the ſhip's courſe is S. 50° 50′ E. or S. E. ½ eaſt nearly, and ſhe is in the latitude of 42° 43′ N. and long. 2° 38′ W.

By GUNTER.

1ſt. The extent from the diſtance 645, to the departure 500 on the line of numbers, will reach from radius to 50° 50′, on the line of ſines.

2dly. That extent from 50° 50′ to 39° 10′, on the line of ſines, will reach from the departure 500, to the difference of latitude 407, on the line of numbers.

3dly. The

3dly. The extent from 39° 10′ to 50° 50′, on the line of fines, will reach from the meridian difference of latitude 588, to the difference of longitude 722, on the line of numbers.

By INSPECTION.

By Plane Sailing, Cafe V. find the Courfe: By Cafe I. find the true diff. latitude; and by Cafe II. with the courfe and mer. difference latitude find the difference longitude in the departure column.

In the latitude column, feek $\frac{1}{4}$ of the meridional difference of latitude 146, the neareft is 146,6; againft which, in the departure column, ftands 181.1 which multiplied by 4 is 724,4 the difference of longitude.

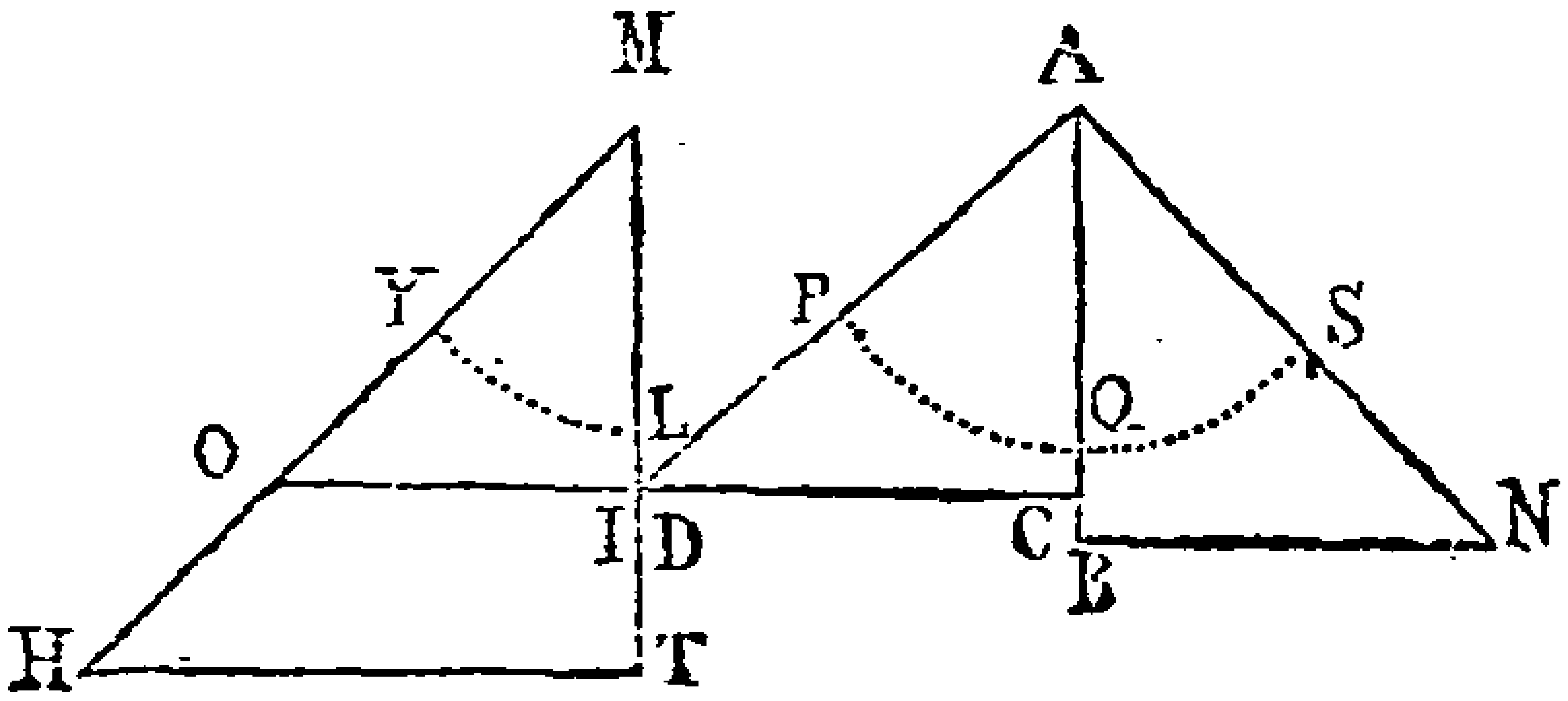
Having in the preceding parts fhewn how to work the moft ufeful problems in Middle Latitude and Mercator's Sailing; I fhall now work the four following cafes both by Middle Latitude and Mercator's Sailing, in the manner I generally teach perfons who are of age, and youth of good abilities; efpecially if they are limited to a fhort time; and I believe they are all that can well happen at fea.

The following four Cafes are worked by Middle Latitude and Mercator's Sailing.

The Latitudes and Longitudes of two places given, to find the Courfe and Diftance between them.

Required the bearing and diftance between the Lizard in latitude 49° 57′ N. longitude 5° 14′ W. and the Ifland of St. Mary's one of the weftern Iflands, in latitude 37° N. and longitude 25° 6′ weft?

Lizard's lat.	49° 57′ N.	Merid. pts. 3470	Lon. 5° 14′ W.
St. Mary's lat.	37 N.	Merid. pts. 2393	Lon. 25 06 W.
Diff. of lat.	12 57=777 miles.	Diff. 1077	Diff. 19 52=1192 miles.
Sum of lats.	2)86 57		
Mid. lat.	43 28		
From	90 00		
Comp. mid. lat.	46 32		



By

By PROJECTION.

By Mercator's Sailing.

Draw the meridian M T=1077 the meridian diff. of lat. and M I =777 the proper diff. of lat. perpendicular to M T draw T H and I O. Make T H=1192 miles, the difference of longitude. Join H and M, then will the angle TMH be the course S. 47° 54′ W. and O M the distance 1159 miles.

By Middle Latitude Sailing.

Draw the meridian AE, with the chord of 60° describe the arch PS, upon which set off 46 32 the comp. of middle latitude from Q to S; through S draw the line AN=1192 miles the difference of longitude. Let fall the perpendicular NB, which will be the departure 865. Upon AB set off AC 777 miles, the difference of latitude; and upon C erect the perpendicular CD, and upon it set off the departure 865.

Join D and A, and it is done; for DA will be the distance 1163 miles, and the angel CAD S. 48° 4′ W.

By CALCULATION.

By Middle Lat. Sailing.

As radius 90°	10.00000
Is to diff. of long. 1192	3.07628
So is co-si. m. lat. 43° 28′	9.86080
	12.93708
	10.00000
To the departure 865,1 =	2.93708
As diff. of lat. 777	2.89042
Is to radius 90°	10.00000
So is the departure 865,1	2.93708
	12.93708
	2.89042
To tang. of course 48° 4′	10.04666
As radius	10.00000
Is to the diff. of lat. 777	2.89042
So is sec. of course 48° 4′	10.06000
	13.06547
	10.17505
To the distance 1163	3.06547

By Mercator's Sailing.

As the m. diff. of lat. 1077	3.03222
Is to radius 90°	10.00000
So is the diff. of long. 1192	3.07628
	13.07628
	3.03222
Tang. of cou. 47° 54′	10.04406
As radius	10.00000
Is to the p. diff. of lat. 777	2.89042
So is sec. of cou. 47° 54	10.17365
	13.06547
	10.00000
To the dist. in miles 1159	3.06407

Note. The course may be found by Middle Lat. Sailing without the Departure; thus,

As diff. of lat. 777	2.89042
Is to diff. of long. 1192	3.07628
So is co-si. mid. lat. 43° 28′	9.86080
	12.93708
	2.89042
To tang. course 48° 4′	10.04666

By

By GUNTER.

BY MIDDLE LATITUDE SAILING.

1ſt. Extend from radius or 90°, to 46° 32′ the comp. mid. lat. on the line of ſines, that extent will reach from the difference of long. 1192, to the dep. 865, on the line of numbers.

2dly. Extend from the diff. of lat. 777 to the dep. 865, on the line of numbers, that extent will reach from radius or 45°, to the courſe 48° 4′ on the line of tangents.

3dly. Extend from the courſe 48° 4′, to radius or 90°, on the line of ſines, that extent will reach from the departure 865, to the diſtance 1163 miles, on the line of numbers.

By MERCATOR.

1ſt. Extend from merid. diff. of lat. 1077, to diff. of longitude 1192 on the line of numbers, that extent will reach from radius or 45°, to the courſe 47° 54′ on the line of tangents.

2dly. Extend from radius or 90°, to the comp. of 42° 6′ on the line of ſines, that extent will reach from the prop. diff. of lat. 777, to the diſtance 1159, on the line of numbers.

By INSPECTION.

BY MIDDLE LATITUDE SAILING.

Look for the comp. of mid. latitude, as if it was a courſe in Plane Sailing, and difference of longitude in the diſtance column, oppoſite to which will ſtand the departure in its column. Having the difference of latitude and departure, the courſe and diſtance is found as in Caſe VI. in Plane Sailing.

Thus, taking $\frac{1}{4}$ of the difference of longitude 1192 = 298, and as the comp. of middle latitude is 46° 32′ or nearly $46\frac{1}{2}$; I look over 46° and 47°, and againſt diſtance 298 ſtands 214,4 and 218 in the departure columns; which added together gives 432,4, half is 216,2, this multiplied by 4, becauſe the difference of longitude was divided by 4, gives 864,8, the departure: Then by Caſe II. with the courſe and $\frac{1}{4}$ the diff. lat. find the diſtance and departure. Hence the courſe is S. 48° W. and diſtance 1164 miles.

By MERCATOR.

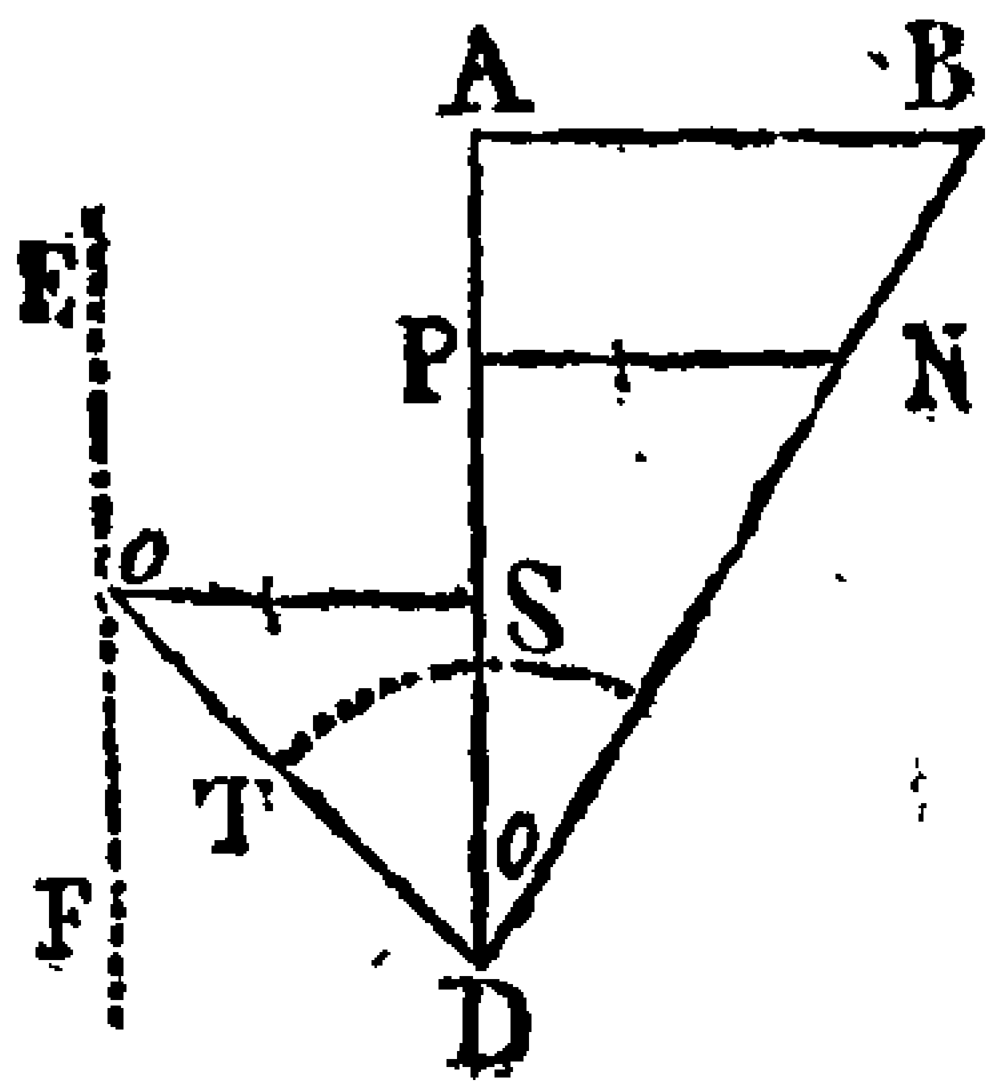
By Plane Sailing, Caſe VI. with the merid. diff. lat. and diff. long. find the courſe. By Caſe II. find the diſtance. Over 48° in the latitude column, I look for the $\frac{1}{10}$ of the proper difference of latitude, which is 77,7 the neareſt is 77,6, againſt this ſtands 116 in the diſtance column, which multiplied by 10 gives 1160 the diſtance nearly, as before.

The

The Difference of Latitude and Departure given, to find the Courſe, Diſtance and Difference of Longitude, by Middle Latitude and Mercator's Sailing.

A ſhip from the latitude of 37° N. and longitude 48° 20′ W. ſails between the north and eaſt, until ſhe be in latitude 51° 15′ N. and finds that ſhe has made 564 miles of departure; what was her direct courſe, diſtance run, and longitude in?

Lat. left	37° 00′ N.	mer. parts	2393
Lat. in	51 15 N.	mer. parts	3593
	14 15=855 m.	M. diff.	1200
Sum lats. ½)88	15		
Mid. lat.	44 7		90° ′
			-44 7
Comp. mid. lat.			45 53



By PROJECTION.

Draw the meridian D P, make it equal to 855 the difference of latitude; on P erect the perpendicular P N, and make it = 564 the departure; join D and N, then will the angle P D N be the courſe N. 33° 25′ W. and D N the diſtance 1025 miles.

At the diſtance of the departure 564, draw E F parallel to D P; with the chord of 60° deſcribe the arch TS, and upon it ſet off the comp. of the middle latitude 45° 53′ from S to T, through T draw D O, to cut E F in O, then will O D be the difference of longitude 785,6 miles, by Middle Latitude Sailing.

Again, produce D P to A, and make D A = 1200 the merid. difference of latitude; draw A B parallel to P N, and produce D N until it cuts A B in B; then will A B be 791,7 miles; the difference of longitude by Mercator's Sailing.

By CALCULATION.

As the diff. of lat. 855	2.93197	As radius 90°	10.00000
Is to radius 90°	10.00000	Is to the diff. of lat. 855	2.93197
So is the departure 564	2.75128	So is ſec. courſe 33° 25′	10.07848
	12.75128		13.01045
	2.93197		10.00000
To tang. of cou. 33° 25′	9.81931	To the diſtance 1024	3.01045

To

To find the Difference of Latitude,

By Middle Latitude Sailing.		By Mercator's Sailing.	
As co-si. mid. lat. 44° 7′	9.85608	As co-si. course 33° 25′	9.92152
Is to departure 564	2.75128	Is to mer. diff. lat. 1200	3.07918
So is radius 90°	10.00000	So is the sine cou. 33° 25′	9.74093
	12.75128		12.82011
	9.85608		9.92152
To diff. of long. 785,6 miles	2.89520	To diff. of long. 791,7 ms.	2.89859
6,0)78,6		6,0)79,2	
Diff. 13. 6 E.		Diff. lon. 13. 12 E.	
Lon. left 48. 20 W.		Lon. left 48. 20 W.	
Long. in 35. 14 W. by M. Lat. Sail.		Long. in 35. 8 W. by Merc. Sail.	

Her direct course is N. 33° 25′ E. or N. E. by N. nearly, and distance 1024 miles.

By GUNTER.

1st. Extend from 855 to 564 on the line of numbers, that extent will reach from radius or 45°, to 33° 25′ the course, on the line of tangents.

2dly. Extend from radius or 90°, to the course 33° 25′ on the line of sines, that extent will reach from the departure 564, to the distance 1024, on the line of numbers.

3dly. Extend from radius or 90°, to the complement of middle latitude 45° 53′ on the line of sines, that extent will reach from the departure 564, to 786 miles, the difference of Longitude by Middle Latitude Sailing.

4thly. Extend from the sine of the course 33° 25′ to the co-sine of the course 56° 35′ on the line of sines, that extent will reach from the meridional difference of latitude 1200 to 792 miles, the difference of Longitude by Mercator.

Or, the extent from the difference of latitude 855, to the departure 564, will reach from the meridional difference of latitude 1200, to 792, on the line of numbers.

By INSPECTION.

With the difference of latitude and departure, find the course and distance as in Case VI. in Plane Sailing. Take the complement of middle latitude as a course, and the departure in its column by Case III. and the corresponding distance will be the difference of longitude, by Middle Latitude Sailing.

Having found the course; Instead of the proper difference of latitude, find the meridional difference of latitude in the latitude column belonging

to

to the courſe ; the correſponding departure will be the difference of longitude, by Mercator's Sailing.

By Caſe II. with courſe and difference latitude find the diſtance.

To find the Difference of Longitude.

Over the complement of middle latitude 46°, find $\frac{1}{4}$ of the departure, viz. 141 in its column, and againſt it ſtands 196 in the diſtance column, this multiplied by 4, gives 784 miles, the difference of longitude, by Middle Latitude Sailing.

Again, the courſe being 33° 25′ or nearly, 33° $\frac{1}{2}$, look for $\frac{1}{10}$ of meridional difference of latitude=120 in the latitude columns, under 33° and 34°, the neareſt numbers to theſe are 110,9 and 120,2, the departures correſponding are 77,9 and 81,1 their ſum is 159, half is 79,5, which multiplied by 10, gives 795 the difference of longitude, by Mercator's Sailing, nearly, as before.

From what has been ſaid, it is eaſy to perceive that all the Caſes (ſave the firſt) in Middle Latitude and Mercator's Sailing, are projected and worked in the ſame manner as in Plane Sailing, and to obtain the difference of longitude by Middle Latitude Sailing, the complement of the middle latitude is taken as a courſe in Plane Sailing, and with this courſe and the departure, the diſtance is found, which will be the difference of longitude by Middle Latitude Sailing. And having the courſe, take the meridional difference of latitude, as if it were the proper difference of latitude, the correſponding departure will be the difference of longitude by Mercator's Sailing.

The Courſe and Diſtance given, to find the Difference of Latitude, Departure, and Difference of Longitude.

A ſhip from Cape Clear, in latitude 51° 15′ N. and longitude 9° 50′. W. ſails S. W. by S. until ſhe has run 1022 miles, what latitude and longitude is ſhe in ?

As radius 90°	10.00000	As radius 90°	10.00000
Is to the diſtance 1022	3.00945	Is to the diſtance 1022	3.00945
So is ſine courſe 3 pts.	9.74474	So is co-ſine courſe 3 pts.	9.91985
	12.75419		12.92930
	10.00000		10.00000
To the departure 567,8	2.75419	To the diff. of lat. 849,8	2.92930

Now 849,8 or 850 divided by 60, gives 14° 10′ S. and being ſubtracted from the latitude of Cape Clear, leaves 37° 5′ the latitude in : Hence the middle latitude is found to be 44° 10′, and meridional difference of latitude 1194. Whence,

To

To find the Difference of Longitude by Mid. Lat. Sailing.		To find the Difference of Longitude by Mercator's Sailing.	
As co-sine mid. lat. 44° 10′	9.85571	As the co-si. course 3 pts.	9.91985
Is to the departure 567,8	2.75420	Is to mid. diff. of lat. 1194	3.07700
So is radius 90°	10.00000	So is sine course 3 pts.	9.74474
	12.75420		12.82174
	9.85571		9.91985
To the diff. of lon. 791,6	2.89849	To the diff. of lon. 797,8	2.90189
Cape Clear's long.	9° 50′ W.	Cape Clear's long.	9° 50 W.
Diff. of long. 792 =	13 12 W.	Diff. of long. 798 =	13 18 W.
Long. in by mid. lat. =	23 2 W.	Long. in, by Mercator	23 8 W.

By INSPECTION.

By Plane Sailing, Case I. find the diff. of lat. and dep. By Case II. with the course and meridional difference lat. find the difference longitude in the departure column.

The Course and Difference of Latitude given, to find the Distance, Departure and Difference of Longitude.

A ship in 37° N. and longitude 22° 56′ W. sails N. 22° 20′ E. for several days, and then by observation is found to be in the latitude 51° 15′ N.; required the distance run and longitude in?

Lat.	51° 15′	Merid. parts	3593
Lat.	37	Merid. parts	2393
Diff.	14 15 = 855 miles		1200 = merid. diff. of lat.
Sum ½)88	15 = 44 07 mid. lat.		

As co-sine course 22° 20′	9.96614	As co-sine course 22° 20′	9.96614
Is to diff. of lat. 855	2.93197	Is to diff. of lat. 855	2.93197
So is sine course 22° 20′	9.57978	So is radius 90°	10.00000
	12.51175		12.93197
	9.96614		9.96614
To the departure 351,3	2.54561	To the distance 924,3	2.96583

To

To find the Difference of Longitude,

By Mid. Lat. Sailing.		By Mercator's Sailing.	
As co-sine mid. lat. 44° 7′	9.85608	As co-sine course 22° 20′	9.96614
Is to the departure 351	2.54531	Is to mer. diff. of lat. 1200	3.07918
So is radius 90°	10.00000	So is sine course 22° 20′	9.57978
	12.54531		12.65896
	9.85608		9.92614
To diff. lon. 489 = 8° 9′ E.	2.68923	To diff. lon. 493 = 8° 13′	2.69282
Long. left 22 56 W.		Long. left. 22 56	
Long. in 14 47 W. by m. lat.		Long. in 14 43 W. by Mer	

By INSPECTION.

By Plane Sailing, Case II. find distance and departure :—By the same Case, with the course and merid. difference latitude find the difference longitude in the departure column.

These four cases are all that can well happen at sea ; but as some young men are inattentive, and frequently looking in the book to see if their calculation is the same as that set down ;

The Teacher perhaps may find it necessary to let such work the two following questions by way of exercise.

Quest. I. A ship from the latitude 45° 30′ S. sails N. N. W. until her difference of longitude be 7° 40f ; required the latitude she is in, and her distance sailed ?

NOTE. This must be worked by Mercator's Sailing, thus :

As tang. course 22° 30f : radius or 90° : : the difference of longitude to the mer. diff. of latitude 1110 miles. Now, from the meridian parts of latitude left 3073, take the meridian diff. of latitude 1110, the remainder 1963, is the meridian parts of the latitude come to 31° 4′ S. Having the course and proper difference of latitude, the rest is found by Case II. in Plane Sailing.

Answ. The ship is in latitude 31° 4′ S. distance 937,4 miles.

Quest. II. A ship in the latitude 51° 15′ N. and longitude 22° W. sails between S. and W. until she has made 564 miles of departure, and 786 miles of difference of longitude, required her course, distance, and latitude, and longitude in ?

NOTE. This must be worked by Middle Latitude Sailing, thus :

As diff. of long. 786 : radius : : the departure 564 : co-sine of middle latitude 44° 9′ + 44° 9′=88° 18′ the sum lats. and 88° 18′—51° 15′= lat. in 37° 3′ N. Having the difference of latitude and departure, the course is found to be S. 33° 30′ W. and the distance 1021,7 miles.

It may now be supposed that the Learner is capable of working any single course, either by Middle Latitude or Mercator's Sailing ; we shall now

now proceed to Compound Courses, commonly called Traverse Sailing, which may be worked by Middle Latitude and Mercator's Sailing; either by projection, calculation, Gunter's scale, or inspection.

How to solve compound courses or a traverse, has already been shewn in Plane Sailing; but it is necessary also to shew, how proper allowance for the longitude should be introduced into such accounts, which is easily done by any of the following methods:

1st. Complete the traverse table to each course and distance as in Plane Sailing, and find the whole difference of latitude, departure and latitude in.

2dly. With the whole difference of latitude and departure, find the direct course and distance by Case VI. of Plane Sailing.

3dly. With the latitude left and latitude in, find the complement of the middle latitude; with which, and the departure, find the difference of longitude by Middle Latitude Sailing, in the distance column.

Or, with the course and meridional difference of latitude, find the difference of longitude by Mercator's Sailing, in the departure column.

These methods are generally used in working a day's work at sea; but those that want a greater degree of accuracy, may work by the following methods, especially in high latitudes:

By the several differences of latitudes and departures, found in the tables of difference of latitude and departure, find the latitudes come to, middle latitudes, and complements of middle latitudes: with each complement of middle latitude and corresponding departure, find the difference of longitude to each course and distance, and set them down in the two additional columns marked difference of longitude, east and west, according to the departure used; add up the east and west columns, and their difference will be the whole difference of longitude, by Middle Latitude Sailing.

But if you work by Mercator's Sailing, find the meridional difference of latitude for each course and distance; with each course and meridional difference of latitude, find the difference of longitude; which set down as above directed, and the difference between the east and west columns will be the difference of longitude by Mercator's Sailing. By this method the ship's place may be found at the end of each course and distance run, and pricked off on a Mercator's chart.

EXAMPLE I.

Suppose a ship from the Land's End in latitude 50° 6' N. and longitude 5° 55' W. is bound to the island of St. Mary's in lat. 37° N. and longitude 25° 6' W. but by reason of contrary winds is obliged to steer the following courses, viz. S. by W. 24 miles, W. S. W. 32, N. W. $\frac{1}{2}$ W. 41, S. S. E. $\frac{1}{2}$ E. 49, E. N. E. $\frac{1}{4}$ E. 19, W. 21, N. E. $\frac{1}{2}$ E. 36, S. 21, S. S. W. 92, and N. 36 miles; and it be required the latitude and longitude she is in, with the direct course and distance to her intended port?

With the several courses and distances, find their differences of latitude and departure, and set them down as in the following Traverse Table.

TRAVERSE

TRAVERSE TABLE.

COURSES.	DIST.	DIFF. OF LAT.		DEPARTURE.	
		N.	S.	E.	W.
S. by W.	24		23,5		4,7
W. S. W.	32		12,2		29,6
N. W. ½ W.	41	26,0			31,7
S. S. E. ¼ E.	49		44,3	21,0	
E. N. E. ¾ E.	19	4,6		18,4	
West.	21				21,0
N. E. ½ E.	36	22,8		27,8	
South.	41		41,0		
S. S. W.	92		85,0		35,2
North.	36	36,0			
		89,4	206,0 89,4	67,2	122,2 67,2
		Dif. lat. S.	116,6	Depar.	55,0

It is plain by the Traverse Table, that the ship has made 116,6 miles of southing, and 55 miles of westing.

Now from latitude left		50°. 6′	Meridian parts	3484
Take diff. of lat. 117	=	1. 57		
Latitude in		48. 9 N.	Meridian parts	3305
Sum of latitudes		2)98. 15		
Middle latitude		49. 7	Meridian Difference	179

Whence to find the Difference of Longitude, it will be,

By Middle Latitude Sailing.		By Mercator's Sailing.	
As co-sine mid. lat. 49° 7′	9.81592	As prop. diff. of lat. 116,6	2.06670
Is to the departure 55	1.74036	Is to the departure 55	1.74036
So is radius 90°	10.00000	So is mer. diff. lat. 179	2.25285
	11.74036		3.99321
	9.81592		2.06670
To diff. lon. 84=1° 24′ W.	1.92444	To diff. long. 84,4=1° 24′	1.92651
Long. left 5 55 W.		Long. left. 5 55	
Long. in 7 19 by mid. lat.		Long. in 7 19 by Mer.	

By

By INSPECTION.

Taking the complement of middle latitude 41° as a course, and the departure 55 in its column, the nearest is 55,1 against which stands 84 in the distance column, the difference of longitude by Middle Latitude Sailing. And,

With the proper difference of latitude and departure; the course, by Case VI. of Plane Sailing is found nearly 25 degrees and distance 129 under the course; in the latitude column look for the meridian difference of latitude 179, the nearest is 180,4, against which stands 84,1 in the departure column, which is the difference of longitude by Mercator's Sailing.

To find the direct Course and Distance to St. Mary's.

Lat. of ship.	48° 9' N.	Merid. pts. 3305.	Long. of ship	7°	19'	W.
Lat. St. Mary's	37 N.	Merid. pts. 2393.	L. St. Mary's	25	6	W.
Diff.	11 9 = 669 ms.	Diff. 912.	Diff. of long.	17	47 = 1067	
				90	00	
Sum of lats.	2)85 9			42	34	
Mid. lat.	42 34		Comp. mid. lat.	47	26	

By Middle Latitude Sailing.

As the diff. of lat. 669	2.82543	As co-si. course 49° 35'	9.81180
Is to diff. of long. 1067	3.02816	Is to prop. diff. of lat. 669	2.82543
So is co-si. mid. lat. 42° 34'	9.86717	So is radius 90°	10.00000
	12.89533		12.82543
	2.82543		9.81180
To tang. course 49° 35'	10.06990	To the distance 1032	3.01363

By Mercator's Sailing.

As merid. diff. of lat. 912	2.95999	As radius	10.00000
Is to radius 90°	10.00000	Is to prop. diff. of lat. 669	2.82543
So is diff. of long. 1067	3.02816	So is secant course 49° 29'	10.18731
	13.02816		13.01274
	2.95999		10.00000
To tang. course 49° 29'	10.06817	To the distance 1030	3.01274

Hence the direct course from the ship to St. Mary's is S. 49° 35' W. and distance 1032 miles, by Middle Latitude Sailing; and S. 49° 29' W. and distance 1030 miles, by Mercator's Sailing. The same may be found

By INSPECTION.

BY MIDDLE LATITUDE SAILING.

Take ¼ of the diff. of long. 1067, viz. 267 nearly, and look for that in the distance column over the complement middle lat. 47° nearly, and in the departure column stands 195,3 = ¼ of the departure.

Then

Then by Plane Sailing Case VI. find the course, and by Case II. find the Distance ; or they are found standing together in their respective columns, the nearest are found over 49° and 50°, viz. 195,5, 169,9, and 195.3 163.9 ; the sum is 514, half is 257, this multiplied by 4, gives 1028 miles. Hence the course is S. 49° 40′ W. dist. 1028 miles, by Mid. Lat. Sailing.

BY MERCATOR.

Again, taking the meridional difference, and difference of longitude, find the course by Case VI. Plane Sailing. With course and proper difference latitude find the distance by Case II. of Plane Sailing ; which is 1030 miles.

Hence the course is S. 49° 30′ W. and distance 1030 miles, by Mercator's Sailing, the same as by calculation.

Here, to have gone to geometrical strictness, the difference of longitude should have been found to every course and distance run, by Middle Latitude or Mercator's Sailing, which would have given the ship's true place at the end of each course and distance, but shall leave the doing of that to the Reader ; and as all traverses are worked in the manner shown above, which is sufficiently exact for a ship's run in 24 hours, I shall therefore only add a few questions for the Learner's exercise.

Suppose a ship from the latitude 68° 38′ N. and longitude 8° 40′ E. is bound to the North Cape, in 71° 10′ N. and longitude 26° 3′ E. sails as in the following table ; required the latitude and longitude she is in, and her direct course and distance to the Cape ?

Course.	Dis.	N.	S.	E.	W.	Lat. in	Diff. of Lon. E.	Diff. of Lon. W.
						68 38		
N. E. by N.	63	52,4		35,0		69 30	97,2	
N. E.	38	26,9		26,9		69 57	78,0	
N. N. E.	56	51,7		21,4		70 49	64,2	
North.	30	30,0				71 19		
N. W. by N.	25	20,8			13,9	71 40		44,1
N. N. W. ½ W.	36	31,8			17,0	72 12		55,0
N. by E.	40	39,2		7,8		72 51	26,0	
N.E. by E. ½ E.	72	33,9		63,5		73 25	219,4	
S. E.	50		35,3	35,3		72 50	120,6	
E. N. E.	65	24,9		60,0		73 15	207,9	
		311,5	35,3	249,9	30,9		813,3	99,1
		35,3		30,9			99,1	
Diff. of lat.		276,2	Dep.	219,0		Diff. long.	714,2	E.

In working the above, the difference of longitude is found by the courſe and meridional difference between each parallel of latitude; or it may be done by taking the complements of each middle latitude, and the departure for each courſe.

Now the lat. left was	68° 38′ N.	Long.		8° 40′ E.
The diff. of lat. 276 ms. =	4 36. N.	Diff. of long. 714 m. =		11 54 E.
Lat. in	73 14.	Long. in	—	20 34 E.
Lat. of N. Cape	71 10.	Long. of Cape		26 3 E.
The diff. lat. is	2° 4′ = 124 ms.	Diff. of long.		5° 29′ = 329 miles.

Mer. diff. latitude is 405 miles.

With the meridional difference of latitude 406, and difference of longitude 329, the courſe between the ſhip and the Cape is S. 39° 1′ E. diſtance 160 miles, by Mercator; and S. 39° 3′ E. diſtance 159,7, by Mid. Lat. Sailing.

By INSPECTION.

By Plane Sailing Caſe 6th. either with the true Diff. Lat. and Dep. or with the Merid. Diff. Lat. and Diff. Long. find the Courſe. By Caſe 2d. find the diſtance by Mercator's Sailing.

And with the complement of middle latitude 19,2 and the departure 219, the difference of longitude is 675 nearly, by Middle Latitude Sailing; differing from that above 38 miles, by Mercator, and 39 miles by Middle Latitude Sailing.

But as ſhips never run ſuch diſtances in 24 hours, the firſt method of finding the difference of longitude will be ſufficiently exact for any day's run.

The bearing and diſtance to the North Cape may be either found by Middle Latitude or Mercator, by inſpection, which will be nearly as above.

Having gone through the neceſſary problems in Mercator's Sailing, we ſhall now proceed to ſhew how the true chart, commonly called Mercator's Chart, may be conſtructed either for the whole, or any part of the Terraqueous Globe.

When a Chart is to commence from the Equator, or if the Equator is to run through it.

Having provided a ſcale of convenient length, draw a line to repreſent the equator, and croſſing that at right angles, another to repreſent the meridian of ſome known place, ſuch as London, Paris, the Lizard, or any other place whoſe longitude is known: the upper end of which will repreſent the north, and the lower the ſouth.

From

From the ſcale take 60 in your compaſſes, and with one foot upon the meridian, ſet off that diſtance on both ſides of it upon the equator, if the chart is to contain eaſt and weſt longitude; but, if it is only to contain eaſt or weſt longitude, lay it off upon that ſide of the meridian the caſe requires: that is, if the longitude is to be weſtward, lay it off on the left-hand ſide of the meridian; but if eaſterly, the right-hand ſide.

Again, take 2 degrees or 120 miles in your compaſſes, and ſet it off from the meridian, in the ſame manner as before; or with 60 miles in the compaſſes, turn over from the meridian, and that will point out the degrees of longitude, which may be divided into halves, quarters, or minutes, if required.

Having ſet off as many degrees of longitude as you intend the chart ſhould contain, through the laſt draw a line (or lines) parallel to the meridian, which will be the bounds of the chart eaſt and weſt.

Having divided the equator as above, proceed to ſet off, upon the two extreme meridians from the equator, the meridional parts (as found in the table) belonging to each degree of latitude; that is, take from the ſcale in your compaſſes the miles anſwering to one degree in the table, and with one foot in the equator, ſet off that diſtance on each ſide of it upon the extreme meridians, if the chart is to contain north and ſouth latitude; but if only north or ſouth, upon one ſide of the equator.

Again, take the meridional parts anſwering to 2 degrees and 3 degrees, &c. in your compaſſes and ſet them off upon the meridian from the equator, as before.

In like manner proceed to ſet off as many degrees as you intend the chart ſhould contain; or, which will be the ſame thing, take the meridional difference of latitude between any two parallels, and ſet them off ſeverally from the leaſt latitude.

Lay a ruler on each of theſe diviſions, and draw lines parallel to the equator, and they will be the parallels of latitude; each of which will be enlarged towards the poles, in proportion as the degrees of longitude are.

Parallel to the meridian, draw lines through the points, expreſſing the degrees of longitude, to cut the parallels of latitude, which bound the chart north and ſouth.

The parallels of latitude may alſo be divided into halves, quarters, or minutes, by taking the meridional parts for degrees and minutes and ſetting them off as before.

Draw double lines on the borders of the chart, and mark out the degrees of latitude and longitude; and, in ſome convenient place, draw the compaſs. In like manner may a chart be made that ſhall contain any number of degrees and minutes required. When the chart is not to commence from the equator, but is only to ſerve from a certain diſtance on the meridian, between two parallels on the ſame ſide of the equator, then the meridians are to be drawn as before, and for the parallels of latitude you are to proceed thus:

From the meridional parts anſwering to each point of latitude in your chart, ſubtract the meridional parts anſwering to the leaſt latitude, and ſet off the difference ſeverally from the parallels of the leaſt latitude upon the two extreme meridians, and the lines joining these points of the meridian will represent the several parallels upon the chart.

Let it be required to draw a chart that shall serve from the latitude of 14 degrees north, to 52 degrees north, and that shall contain 1 degree east, and 26 degrees of longitude west of the meridian of London.——See the chart.

Draw a line to represent the meridian of London, from which set off 60 miles towards the right hand, for one degree of longitude, and on the other side, towards the left hand, set off 26 degrees of west longitude, as before directed: through the two last points draw lines parallel to the meridian of London, and these will be the extreme meridians, or east and west bounds of your chart.

Having drawn the two meridians on the lower edge of the paper, draw a line perpendicular to the meridians, to represent the parallel of 14 degrees north; then from the meridional parts answering to 15 degrees 910, subtract the meridional parts answering to 14 degrees 848, and take the difference 62 in your compasses, and set it off from the parallel on both the meridians from you, and that will represent the parallel of 15 degrees.

Again, take the meridional parts of 15 degrees 910, from the meridional parts of 16 degrees 973, and set off the difference 63, upon the meridians from the point representing the parallel of 15 degrees, and that will represent the parallel of 16 degrees. In like manner proceed to set off the parallels upon the meridians.

Or, if the meridional parts of 14 degrees be subtracted from the meridional parts of every succeeding parallel, and the difference be set off from the parallel of 14 degrees upon the meridians, these points will represent the several enlarged parallels of latitude, the same as before; and, if it be required that the meridians should be divided into degrees and meridians, the meridional parts for such must be taken from the table, and set off as above.

Having set off as many parallels as you intend the chart should contain, through each point draw parallels, or if you think drawing lines through every degree will croud your chart too much, you may divide the borders only into single degrees, &c. and draw lines through every 5 degrees of latitude and longitude, as in the chart.

Take from the table of latitude and longitude of places, the latitude and longitude of each particular place contained within the bounds of the chart, and lay a ruler over its latitude, and another crossing that over its longitude; the points where these cross will represent the proposed place upon the chart. In like manner may any place be readily marked. Hence, the particular points of a sea-coast may be laid down as above, and lines properly drawn from point to point will form the out-lines of the sea-coast, islands, &c. to which may be annexed, the depths of water, setting of currents, and whatever else may be thought convenient for the chart to contain.

This map or chart is not to be considered as a just or similar representation of the earth's surface, for in it the figures of islands and countries are distorted near the poles. For,

 Suppose

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Suppoſe an iſland in the latitude 60° N. or S. where the breadth of a degree of longitude is juſt half as large as a degree upon the equator. Now, as the degrees of latitude are enlarged in proportion as the degrees of longitude are expanded towards the poles, it is plain, that every point of that iſland or country, being laid down in its proper latitude and longitude, will be repreſented twice as large as it really is.

Hence it follows, that as the degrees of latitude are every where increaſed like thoſe of longitude, it is plain the bearings between places will be the ſame on this chart as on the globe; and the proportions between the latitude and longitude and nautical diſtances, will be the ſame upon this chart as upon the globe.

And ſince the meridians in this projection are right-lines, it follows that the rhumbs, which form equal angles with the meridians, will be ſtraight lines, which render this projection of the earth's ſurface much more eaſy and proper for the Mariner's uſe than any other.

Gunter's Scales have drawn upon them two lines, one marked N M, ſignifying the Nautical Meridian; and the other directly under it marked E P ſignifying Equal Parts, or degrees of longitude, upon a Mercator's Chart.

Thoſe are equal parts, or degrees of longitude, to which the degrees of the nautical meridian are fitted, by increaſing them in their true proportion; hence the limits or bounds of a Mercator's Chart by theſe lines are eaſily made by transferring the diviſions correſponding to the degrees to be uſed, from the ſcale to the paper the chart is to be drawn upon: but as the degrees drawn by theſe lines are too ſmall for the ſeaman's uſe, it is much better to uſe a ſcale of equal parts as before, and conſequently the degrees may be made of any propoſed length.

By the Latitude and Longitude in, to prick off the Ship on the Chart.

RULE. Lay the ruler acroſs the chart in the latitude your ſhip is in, then look upon the equator, or line marked with the degrees of longitude, for the longitude your ſhip is in by your reckoning, and ſetting one foot of your compaſſes in that longitude, take the neareſt diſtance to ſome north and ſouth line, and from where that line croſſes the edge of the ruler that lies in the given latitude; lay off that ſame diſtance along the edge of the ruler to the right-hand, if the longitude you are in was to the right-hand of the north and ſouth line, or to the left-hand, if it was to the left hand; where this falls will be the place of the ſhip: but this will only do when the longitude marked on the chart, and your reckoning of longitude in, are both counted from the ſame meridian. Therefore, for a general rule, take the following, viz.

By the Latitude in and Longitude made, to prick off the Ship's Place.

RULE. Set one foot of your compaſſes in the place you take your departure from, and take the neareſt diſtance to ſome north or ſouth line, and from where that line falls upon the equator, or the line marked with the degrees of longitude, ſet off that diſtance the ſame way the place lies from

it

it; that is, to the right hand, if the place lies to the right-hand of the north and south line, or to the left hand if it lies to the west; and make a mark with a black lead pencil; this mark will serve to prick off by, till you come to take a new departure; and then rub it out, and make a new one as before.

Then lay a ruler across the chart in the latitude you are in, and taking so many degrees in your compasses from the line of longitude, as your longitude made comes to, set them off from your black-lead mark along the edge of the ruler to the eastward; if the longitude made be east, or to the westward if it be west; where this falls will be the longitude the ship is in by the chart; from which take the nearest distance to some north and south line, and from where that line &c. as in the first case.

The ship's place on the chart being found, as before taught, it remains in the next to shew how to find the bearing and distance of any place from the ship; and first,

To find how any Place bears from the Ship.

RULE. Lay a ruler from the place of the ship to the place you would know the bearing of; then set one foot of your compasses in the centre of some compass near the ruler, and take the nearest distance to the edge of the ruler; then run one foot of your compasses along by the edge of the ruler, and observing what point of the compass the other comes nearest to, which will be the bearing required.

To find the Distance of any Place from the Ship.

CASE I.

If the place be in the same longitude that the ship is in; that is, if it bears due north or south, then the difference of latitude between them turned into miles or leagues, will be the distance.

CASE II.

If the place be in the same latitude the ship is in; that is, if it bears due east or due west, then take half the distance between the ship and the place in your compasses; and setting one foot on the line marked with the degrees of latitude, in the latitude the ship is in, see what latitudes the other foot will reach to, both above and below it; the difference between these two latitudes will be the distance required.

CASE III.

When they are neither in the same Latitude nor in the same Longitude with the Ship.

RULE. Take the difference of latitude between both places in your compasses from the equator, or graduated parallel; and laying a ruler over both places, put one foot on the ship's place, and slide your compasses along the

the edge of the ruler (holding both points parallel to the meridian) until the other cuts the parallel of latitude paſſing through the place, (or E. and W. line cut by the ruler) and then ſtay the compaſſes. Take the diſtance between where the point reſted by the edge of the ruler and the place (or where the ruler croſſed the aforeſaid eaſt and weſt line) in your compaſſes, and apply it to the equator, or graduated parallel, and that will give their diſtance in degrees, which may be turned into miles or leagues ; and in the ſame manner as you find the bearing and diſtance between the ſhip and any place, you may alſo find the bearing and diſtance of one place from another ; or if the diſtance between the ſhip and place be taken in your compaſſes, and applied to the ſide of the chart, or graduated meridian, nearly in the parallels of the ſhi pand place, it will give the diſtance in degrees as before ; and for this purpoſe there are generally marked on the ſides of charts ſcales of leagues, by which the diſtance between the places may be readily found.

Or the diſtance between two places upon a Mercator's Chart may be eaſily found, thus :

Take half the diſtance between any two places, and with one foot of the compaſſes in the middle parallel, extend both ways upon the graduated meridian ; count the number of degrees between both points, which will be your diſtance, either in leagues or miles, according as the ſcale is divided ; or take the diſtance in your compaſſes, and ſet one foot as much above the one place as the other point is below the other place, on the meridian, the number of degrees between the points of the compaſſes will be the diſtance.

EXAMPLE.

Required the Bearing and Diſtance between Cape St. Vincent *and* Teneriff ? See the Chart.

Lay a ruler over both places, and take their difference of latitude 8° 30', from the equator or graduated parallel, in your compaſſes ; and ſlide one foot along the edge of the ruler from Teneriff, holding the other point in the direction of the line C B, until the other point juſt touches the eaſt and weſt line, (AB) paſſing through St. Vincent, as at B ; then the diſtance between C (where the lower foot of the compaſſes reſted, by the edge of the ruler) and St. Vincent being meaſured, and applied to the graduated parallel, gives 10 2-third degrees, or 640 miles the diſtance.

Again, take the neareſt diſtance between the centre of the compaſs in your compaſſes, and ſliding them along the edge of the ruler, as before directed, you will find the courſe to be S. W. by S. $\frac{1}{4}$ W. nearly.

Hence, the direct courſe between Cape St. Vincent and Teneriff is S. W. by S. $\frac{1}{4}$ W. diſtance 640 miles, or 213 and one third leagues ; and the ſame with other places.

OF

OF WINDS.

THE earth is endued with a wonderful principle of gravitation, whereby all its parts are ſtrictly united together; and all bodies that are looſe upon it cloſely adhere to its ſervice, tending directly towards its centre. Hence it is, that ſhips are able to ſail with the ſame facility every where (void of impediments) upon the ſurface of the ſea, quite round the terraqueous globe; and that (as to ſenſe) there is no ſuch thing as an upper or lower part of the earth; for let the inhabitant be in what part ſoever, he will there gravitate towards the earth's centre, and imagine himſelf to be on the higheſt point of its ſurface; from whence he will obſerve the heavens like a large vault over his head, and his antipodes he will imagine to be directly under him, as they will alſo theirs, for the like reaſon. According to this law of gravity, if the earth was at reſt, (and not acted upon by any other power) and its parts looſe, or its ſurface all over covered with a deep fluid, it would naturally form itſelf into a true ſphere or globe.

Notwithſtanding this power of attraction, yet the ſun, whoſe rays upon the earth cauſe vapours or fumes to be continually riſing from it, which muſt partake of the quality of thoſe parts from whence they are evaporated; a collection of which form what we call our air or atmoſphere, ſurrounding the earth, and extending ſome miles above its ſurface, and is liable to be put in motion by various cauſes. Hence, air is a fine elaſtic fluid, and is found capable of being compreſſed, or condenſed by cold, and expanded or rarefied by heat.

Conſequently, an alteration of heat or cold happening in any part of the atmoſphere, the air in that part will be either condenſed or rarefied, and the neighbouring parts will thereby be put into motion, through the endeavour which the air by its elaſticity or ſpringineſs always makes to reſtore itſelf to its former ſtate, or come to an equilibrium.

Wind, is a ſtream or current of air, which generally blows from one part of the horizon to its oppoſite.

The following obſervations have been made on it, particularly by Dr. Halley, which are not unworthy the ſeaman's notice.

Between 30 degrees north latitude, and 30 ſouth latitude, there is a conſtant eaſt wind throughout the year, blowing on the Atlantic and Pacific Oceans, and this is called the Trade Winds.

For as the ſun, in moving from eaſt to weſt, heats the air more immediately under him, and thereby expands it; the air to the eaſtward is conſtantly ruſhing towards the weſt to reſtore the equilibrium or natural ſtate of the atmoſphere, which occaſions a perpetual eaſt wind in thoſe limits.

The trade winds, near theſe northern limits, blow between the north and eaſt; and near the ſouthern limits, they blow between the ſouth and eaſt.

For as the air is expanded by the heat of the ſun near the equator, therefore the air from the northward and ſouthward will both tend toward the equator to reſtore the equilibrium: now theſe motions from the north and ſouth, joined with the foregoing eaſterly motion, will produce the motions obſerved near thoſe limits, between the north and eaſt, and between the ſouth and weſt.

Theſe winds, if the whole ſurface of the globe were ſea, would undoubtedly blow quite round it, as they are found to do in the Atlantic and Ethiopic oceans; but ſeeing ſuch great continents interpoſe and break the continuity of the ocean; regard muſt be had to the nature of ſoils, and the poſition of high mountains, which are the principal cauſes of the variety of winds differing from the former general one.

In

In ſome parts of the Indian ocean there are periodical winds, which are called Monſoons; that is, ſuch as blow half the year one way, and the other half the contrary way.

For air that is cool and denſe will force the warm and rarefied air into a continual ſtream upwards, where it muſt ſpread itſelf to preſerve the equilibrium; ſo that the upper courſe or current of the air ſhall be contrary to the under current; for the upper air muſt move from thoſe parts where the greateſt heat is, and ſo by a kind of circulation the N. E. trade wind below will be attended with a S. W. above, and a S. E. below, with a N. W. above: And this is confirmed by the experience of ſeamen, who, as ſoon as they get ou of the trade winds, immediately find a wind blowing from the oppoſite quarter.

In the Atlantic ocean, near the coaſts of Africa, at about 100 leagues from ſhore between the latitudes of 28° and 10° north, ſeamen conſtantly meet with a freſh gale of wind blowing from the N. E.

Thoſe bound to the Caribbee Iſlands acroſs the Atlantic find, as they approach the American ſide, that the ſaid N. E. wind becomes eaſterly, or ſeldom blows more than a point from the eaſt either to the northward or ſouthward.

Theſe trade winds on the American ſide are extended to 30°, 31°, or even to 32° of north latitude; which is about 4° farther than what they extend to on the African ſide; alſo to the ſouthward of the equator, the trade winds extend 3 or 4 degrees farther towards the coaſt of Brazil on the American ſide, than they do near the Cape of Good Hope on the African ſide.

Between the latitudes of 4 degrees north and 4 ſouth, the wind always blows between the ſouth and eaſt: On the African ſide the winds are neareſt the ſouth, and on the American ſide neareſt the eaſt. In theſe ſeas Dr. Halley obſerved, that when the wind was eaſtward, the weather was gloomy, dark, and rainy, with hard gales of wind; but when the wind veered to the ſouthward, the weather generally became ſerene, with gentle breezes next to a calm.

Theſe winds are ſomewhat changed by the ſeaſons of the year; when the ſun is far northward, the Brazil S. E. wind gets to the ſouth, and the N. E. wind to the eaſt; and when the ſun is far ſouth, the S. E. wind gets to the eaſt, and the N. E. wind on this ſide of the equator veers more to the north.

Along the coaſt of Guinea, from Sierra Leon to the Iſland of St. Thomas, under the equator, which is above 500 leagues, the ſoutherly and S. W. winds blow perpetually; for the S. E. trade wind having paſſed the equator, and approaching the Guinea coaſt, within 80 or 100 leagues, inclines toward the ſhore, and becomes S. S. E. then ſouth, and by degrees, as it comes near the land, it veers about to S. S. W. and within the land it is S. W. and ſometimes W. S. W. This track is troubled with frequent calms, and violent ſudden guſts of wind, called Tornadoes, blowing from all points of the horizon.

The reaſon of the wind ſetting in weſt on the coaſt of Guinea is, in all probability, owing to the nature of the coaſt, which being greatly heated by the ſun, rarefies the air exceedingly, and conſequently the cool air, from off the ſea, will keep ruſhing in to reſtore the equilibrium.

Between the 4th and 10th degrees of north latitude, and between the longitude of Cape Verd and the eaſtermoſt of the Cape Verd Iſlands, there is a track of ſea which ſeems to be condemned to perpetual calms, attended with terrible thunder and lightnings, and ſuch frequent rains, that this part of the ſea is called The Rains. Ships in ſailing theſe 6 degrees have been ſometimes detained whole months, as is reported.

The cauſe of this ſeems to be, that the weſterly winds ſetting in on this coaſt, and meeting the general eaſterly winds in this track, balance each other, and ſo cauſe the calms and the vapours, carried thither by each wind meeting and condenſing, occaſion the almoſt conſtant rains.

The laſt three obſervations ſhew the reaſon of the two following, which mariners experience in ſailing from Europe to India, and in the Guinea trade. The difficulty which ſhips in going to the ſouthward, eſpecially in the months of July and Auguſt, find in paſſing between the coaſts of Guinea and Brazil, notwithſtanding the width of this ſea is more than 500 leagues: This happens becauſe the S. E. winds at that time of the year commonly extend ſome degrees beyond the ordinary limits of 4° N. latitude; and beſides, coming ſo much ſoutherly, as to be ſometimes ſouth, ſometimes a point or two to the weſt; it then only remains to ply to windward. And if on the one ſide they ſteer W. S. W. they get a wind more and more eaſterly; but then there is danger of falling in with the Brazilian coaſt, or ſhoals; and if they ſteer E. S. E. they fall into the neighbourhood of the coaſt of Guinea,

Guinea, from whence they cannot depart without running easterly as far as the island of St. Thomas; and this is the constant practice of all the Guinea ships.

All ships departing from Guinea for Europe, their direct course is northward; but on this course they cannot go, because the coast bending nearly east and west, the land is to the northward; therefore as the winds on this coast are generally between the S. and W. S. W. they are obliged to steer S. S. E. or S. and with these courses they run off the shore, but in so doing they always find the wind more and more contrary, so that when near the shore they can lie south; at a great distance they can make no better than S. E. and afterwards E. S. E. with which courses they generally fetch the island of St. Thomas, and Cape Lopez, where finding the winds to the eastward of the south, they sail westerly with it, till coming to the latitude of four degrees south, where they find the S. E. wind blowing perpetually.

On account of these general winds, all those that use the West-India trade, even those bound to Virginia, reckon it their best course to get as soon as they can to the southward, that so they may be certain of a fair and fresh gale to run before it to the westward; and for the same reason those homeward bound from America endeavour to gain the latitude of 30°, where they first find the wind begin to be variable, though the most ordinary winds in the North Atlantic ocean come between the south and west.

Between the southern lats. of 10° and 30° in the Indian Ocean, the general trade-wind about S. E. by S. is found to blow all the year round in the same manner as in the like lats. in the Ethiopic Ocean, and during the six months, from May to December, these winds reach to within 2° of the equator; but during the other 6 months, from November to June, a N. W. wind blows in the track lying between the 3d and 10th degrees of southern latitude in the meridian of the north end of Madagascar; and between the 2d and 12th degrees of south latitude, near the longitude of Sumatra and Java.

In the track between Sumatra and the African coast, and from 3° of S. Lat. quite northward to the Asiatic coast, including the Arabian sea and the gulph of Bengal, the monsoons blow from September to April on the N. E. and from March to October on the S. W. In the former half year, the wind is more steady and gentle, and the weather clearer than in the latter six months: and the wind is more strong and steady in the Arabian sea than in the gulph of Bengal.

Between the island of Madagascar and the coast of Africa, and thence northward as far as the equator, there is a track wherein, from April to October, there is a constant fresh S. S. W. wind, which, to the northward, changes into the W. S. W. wind blowing at that time in the Arabian Sea.

To the eastward of Sumatra and Malacca, on the north of the equator, and along the coasts of Cambodia and China, quite through the Philippines as far as Japan, the monsoons blow northerly and southerly; the northern setting in about October or November, and the southern about May. These winds are not quite so certain as those in the Arabian sea

Between Sumatra and Java to the west, and New Guinea to the east, the same northerly and southerly winds are observed; but the first half year the monsoons incline to the N. W. and the later to the S. E. These winds begin a month or six weeks after those in the Chinese seas set in, and are quite as variable.

These contrary winds do not shift from one point to its opposite all at once: in some places, the time of the change is attended with calms, in others by variable winds; and it often happens on the shores of Coromandel and China, towards the end of the monsoon, that there are most violent storms, greatly resembling the hurricanes in the West-Indies, wherein the wind is so vastly strong, that hardly any thing can resist its force.

All navigation in the Indian ocean must necessarily be regulated by these winds; for if mariners should delay their voyages till the contrary monsoon begins, they must either sail back, or go into harbour, and wait for the changing of the trade wind.

NOTE. The swiftness of wind in a great storm is not more than 50 or 60 miles in an hour, and a common brisk gale is about 15 miles an hour.

TIDES.

T I D E S.

A TIDE is that motion of the water in the seas and rivers, by which they regularly rise and fall, the general cause of which was discovered by Sir ISAAC NEWTON, and is deduced from the following considerations.—Daily experience shews, that all bodies, when thrown upwards from the earth, fall down to its surface in perpendicular lines; and as lines perpendicular to the surface of any sphere tend towards its centre, the lines, along which all heavy bodies fall, must be directed towards the earth's centre.

As bodies appear to fall by their weight, or gravity; the law, by which they descend, is called the law of gravitation: and as a magnet or loadstone will draw small portions of iron or steel, and as a piece of glass, amber, or sealing-wax, when warmed by rubbing, will draw small bits of paper and other light substances, the law, by which such bodies fly to those which draw them, is called the law of attraction. Hence it is not improper to say, that bodies, when falling by their gravity towards the earth, are *attracted* by the earth; and therefore the words gravitation and attraction may, respecting the earth, be used indifferently, as by them is only meant that power, or law, by which all bodies tend towards its centre.

Sir ISAAC discovered, by a great number of observations, that this law of gravitation or attraction was universally diffused throughout the solar system, and that the regular motions, observed among the heavenly bodies, were governed by it; so that the earth and moon attract each other, and both of them are attracted by the sun. He also discovered, that the force of attraction, mutually exerted by these bodies, was lessened as the distance increased, in proportion to the squares of those distances; that is, the power of attraction, at double the distance, was four times less; at triple the distance, nine times less; at quadruple the distance, sixteen times less, and so on.

As the earth is attracted by the sun and moon, it follows, that all the parts of the earth will not gravitate towards its centre in the same manner as they would do, if those parts were not affected by such attractions. And it is evident, that were the earth entirely free from such actions of the sun and moon, the ocean, being on all sides equally inclined towards its centre by the force of gravity, would continue in a perfect stagnant state, without ever ebbing or flowing. But, as the case is otherwise, the water in the ocean must needs rise higher in those places where the sun and moon diminish its gravity, or where they have the greatest attraction.

As the force of gravity must be diminished most, in those parts of the earth to which the moon is nearest, or in the zenith, because her attraction will there be most powerful; therefore the waters, in such places, will rise higher, and it will in them be full sea or high water. The parts of the earth directly under the moon, and also those in her nadir, viz. such places as are diamatrically opposite to those where the moon is in the zenith, will have high water at the same time. For either half of the earth would gravitate equally towards the other half, were they free from all external attraction. But, by the action of the moon, the gravitation of one half of the earth towards its centre is diminished, and that of the other increased. In the half-earth next the moon, the parts directly under her being most attracted, and consequently, their gravitation towards the earth's centre most diminished, the waters in these parts must be higher

higher than any other part of this half-earth. And in the half-earth, the farthest from the moon, the parts in the nadir being less attracted by her than those which are nearer, gravitate less towards the earth's centre, and consequently, the waters in those parts must be higher than they are in any other part of this half-earth.

Those parts of the earth where the moon appears in the horizon, or is 90 degrees distant from the zenith and nadir, will have their lowest waters. For as the waters in the zenith and nadir rise at the same time, the adjacent waters will press towards those places to restore the equilibrium; and, to supply the places of these, others will move the same way, and so on to 90° distant from the said zenith and nadir; consequently the waters, in those places where the moon appears in the horizon, will have most liberty to descend towards the centre; and therefore, they will, in such places, be the lowest. Hence it plainly follows, that the ocean, if it covered the surface of the earth, would put on a spheroidal, or egg-like figure; in which the longest diameter would pass through the place where the moon is vertical; and the shortest where she is in the horizon. And as the moon apparently shifts her position from east to west in going round the earth every day, the long diameter of the spheroid, following that motion, would occasion the two floods and ebbs in about every 25 hours, which is about the length of a lunar day, or the time spent between the moon's leaving the meridian of any place, and her coming to it again. Hence, the greater the moon's meridian altitude is at any place, the greater will those tides be which happen when she is above the horizon; and the greater her meridian depression is, the greater will those tides be which happen when she is below the horizon. The summer day, and the winter night tides, have a tendency to be highest; because the sun's summer elevation, and his winter depression are greatest: this is more especially to be observed when the moon has north declination in summer, and south declination in winter.

The time of high water is not precisely at the time of the moon's coming to the meridian, but about an hour after. For the moon continues to act with some force after she has past the meridian, and by that means adds to the libratory, or waving motion, which she put the water into whilst she was on the meridian; in the same manner as a small force applied upwards to a ball, already raised to some height, will raise it still higher. The tides are greater than ordinary twice every month: that is, about the times of new and full moon: they are called spring-tides. At these times the sun and moon concur to draw in the same right line; and therefore the sea must, under such joint influence, be more elevated than at other times. During the time of their conjunction, or whilst they are on the same side of the earth, they both conspire to raise the water in the zenith, and consequently in the nadir: and when the sun and moon are in opposition, that is, when the earth is between them, whilst one makes high-water in the zenith and nadir, the other does the same in the nadir and zenith. The tides are less than ordinary twice every month; that is, about the times of the first and last quarters of the moon; these are called neap-tides: because in the quarters of the moon, the sun raises the water where the moon depresses it, and depresses where the moon raises the water; so that the tides are then caused only by the difference of their actions. Hence it is necessary to observe, that the spring tides happen not exactly at the new and full moons, but generally three days after, when the attracting powers of the sun and moon have conspired for a considerable time. In like manner the neap-tides happen about three days after the quarters, when the moon's attraction has been lessened by that of the sun for several days together.

When the moon is in her *perigeum*, or nearest approach to the earth, the tides rise higher than they do, under the same circumstances, at other times; for, according to the laws of gravitation, the moon must attract most when she is nearest the earth. The spring-tides are greater about the time of the equinoxes, that is about the latter end of March and September, than at other times of the year; and the neap-tides are then less; because the longer diameter of the spheroid, or the two opposite floods, being then in the earth's equator, will describe a great circle of the earth; by the diurnal rotation of which those floods will move swifter, describing a great circle in the same time they used to describe a less one, parallel to the equator; and consequently the waters being thrown more forcibly against the shores, must cause them to rise higher.

The following observations have been made on the rise of the tides: namely, the morning tides generally differ in their rise from the evening-tides. The new and full moon spring-tides rise to different heights. In winter the morning-tides are highest. In summer the evening-tides are highest. Thus it appears, that, after a period of about six months, the order of the highest tides are inverted; that is, the rise of the morning and evening-tides will change places, the winter morning high tides becoming the same as the summer evening high tides.

tides. Some of these effects rise from the different distances of the moon from the earth after a period of six months, when she is in the same situation with respect to the sun; for, if she be in perigee at the time of the new moon, she will, in about six months after, be in perigee about the time of full moon. These particulars being well known, a pilot may chuse that time which will prove most convenient for conducting a ship out of any port, where there is not a sufficient depth of water on common spring-tides.

A small inland sea, such as the Mediterranean and Baltic, are little subject to tides; because the action of the sun and moon is always nearly equal to the extremities of such seas. The tides, in very high latitudes, also, are very inconsiderable: for the sun and moon acting towards the equator, and always raising the water towards the middle of the torrid zone, the neighbourhood of the poles must consequently be deprived of the waters, and the sea, within the frigid zones, must be low in comparison to the other parts.

All the things hitherto explained would be exactly obtained, were the whole surface of the earth covered with sea. But since there is a multitude of islands, besides continents, lying in the way of the tide, which interrupt its course; therefore there arise, in many places near the shores, a great variety of other appearances, besides the foregoing ones, which require particular solutions, in which the situations of the shores, straits, shoals, winds, and other things, must necessarily be considered. For instance; as the sea has no visible passage between Europe and Africa, let them be supposed one continent, extending from 79° north, to 3[illegible]° south: the middle of those two would be in latitude 19 degrees north, near Cape Blanco on the west coast of Africa. But it is impossible the flood-tide should set to the westward, upon the western coast of Africa, (for the general tide following the course of the moon, must set from east to west) because the continent for above 60°, both northward and southward, bounds that sea on the east; and therefore if any regular tide proceed from the motion of the sea, from east to west, should reach this place, it must be either from the North of Europe southward, or from the South of Africa northward.

This opinion is further corroborated, or rather fully confirmed, by common experience, which shews that the flood-tide sets to the southward along the west coast of Norway from the North Cape to the Naze, or entrance of the Baltic Sea, and so proceeds to the southward along the east coast of Great Britain, and in its passage supplies all those ports which lie in its way one after another. The coast of Scotland has the tide first, because it comes from the northward to the southward. On the full and change days, it is high-water at Aberdeen at 12 h. 45 m. but at Tinmouth Bar not till 3 h. Rolling thence to the southward, it makes high-water at the Spurn a little after 5 h. at Yarmouth Roads a little after 8 h. at Harwich at 10 h. 30 m. at the Nore 12 h. and at London 2 h. 30. all in the same day.

While the flood-tide is thus gliding to the southward along the east coast of England, it also sets to the southward along the west coasts of Scotland and Ireland; one branch of it falls back, north east into St. George's Channel; and another runs between Ushant and the Lizard, into the British Channel.

Among Pilots it is customary to reckon the time of high-water by the point of the compass the moon bears on at that time, allowing three quarters of an hour for each point. Thus, in places where it is high-water at noon, on the full and change days the tide is said to flow north and south, at 12 o'clock. In places where the moon bears 1, 2, 3, 4, or more points to the eastward or westward of the meridian, when it is high water on such days, the tide is said to flow on such a point; so, if the moon bears south-east at high-water, it is said to flow south-east and north-west, or 9 o'clock; if she bears south-west, it flows south-west and north-east, or three o'clock: and in like manner for every other point of the moon's bearing.

From the observations of many persons, the times of high-water on the days of the new and full-moon on most of the coasts of Europe, and several other places have been collected; and those are generally put in a table, against the names of their respective places, in an alphabetical order; hence it is called the tide-table.

The best method generally prescribed for finding the time of high-water at any place, is contained in the following particulars:

To

To find the Leap-Year.

Divide the given year by 4, if nothing remains it is leap-year, but if 1, 2, or 3 remains, they ſhew that it is ſo many years after biſſextile, or leap-year, as the remainder is: thus, in the year 1799 divided by 4, gives 446, and the remainder is (3) ſhews that it is the 3d. after leap-year.

To find the Golden Number for any Year.

RULE. Add one to the given year, and divide the ſum by 19, the remainder will be the golden number.

EXAMPLE.

Required the Golden Number of 1799?

By adding one to that year, it gives 1800, this divided by 19, gives 94 for the quotient, and the remainder is 14, the golden number for 1799.

To find the Moon's Southing on any Day of her Age.

Since the ſun returns to the meridian he has left in the ſpace of 24 hours, and the moon in about 24 hours 49 minutes; therefore, if the moon leaves the meridian at the ſame time that the ſun does, on any day, the next day ſhe will come to the meridian 49 minutes after him, falling back, about 49 minutes every day; whence to find the time of the moon's ſouthing, or coming to the meridian on any day, we have this eaſy RULE:

Firſt find her age by the Table, Page 138, then multiply the day of her age by 49, and divide the product by 60, the quotient is the hours, and the remainder the minutes, afternoon when ſhe ſouths. Or, which is rather eaſier, and in many reſpects ſufficiently exact for the mariner's purpoſe: multiply the moon's age by 4, and divide the product by 5, the quotient is the hours, and the remainder multiplied by 12, gives the minutes afternoon when ſhe is upon the meridian; but if this time exceeds 12, ſubtract 12 hours from it, and the remainder is the time of her ſouthing in the morning.

N. B. From the full moon to the change ſhe comes to the meridian, or ſouths in the morning; but from the change to the full, in the afternoon.

EXAMPLE.

EXAMPLE.

Required the Moon's Southing, Auguſt 25, 1796?

Moon's age by the table	22	Or thus,	22 days
	49		4
	198	17,36	5)88(17 h.
	88	12,00	5
	6,0)107,8	5,36	38
Moon's ſouthing	17,58 afternoon		35
Subtract	12		
			3
Moon's ſouthing	5 58 in the morning.		60
			5)180(36 m.
			15
			30
			30

Hence it appears that the moon comes to the ſouth at 58 minutes after 5 in the morning.

The method of finding the time of high water inſerted in common books of navigation, at times will give the moon's age, whole days, and the time of ſouthing, and of high water, hours wide of the truth; and even if the moon's ſouthing be exactly found, yet the tides may differ leſs or more from the computed time; for the floods do not always happen at the ſame diſtance of time from each other, but at different diſtances, according to the times of the moon's age, and her aſpect with reſpect to the ſun; or as the waters are acted upon by the ſum or difference of the attractive forces of the ſun and moon, and alſo on account of winds and ſtorms, which greatly affected the tides, the real time of high water at any place will often differ from the computed times; therefore pilots, and all concerned, would do well to uſe the following method, which will in general give the time of high water within half an hour of the truth, when the tides are not greatly influenced by the wind.

A TABLE

A TABLE for the readily finding the Day of the Month the *New Moon* will fall on till the Year 1900, and consequently the *Moon's* Age for any Day, by knowing the Golden Number, according to the Method commonly used for finding the Moon's Age.—Add 1 to the given Year, and divide the Sum by 19, the Remainder will be the Golden Number, which being marked with a Pencil at the top of the Table, will shew the Golden Number during that Year.

Golden Num.	*Ja.*	*Feb*	*M.*	*A.*	*May*	*Ju*	*Jul.*	*Au.*	*Sep.*	*Oct.*	*No.*	*Dec.*
	N M	N M	N M	N M	N M	N M	N M	N M	M N	N M	N M	N M
1	29	28	29	28	27	26	25	24	22	22	20	20
2	18	17	19	17	17	16	15	13	12	11	10	9
3	8	6	7	5	5	3	3	2	1.30	29	28	27
4	26	25	27	25	25	23	22	20	19	8	17	17
5	15	14	16	15	14	13	12	10	8	8	6	6
6	4	3	5	3	3	1	1.30	29	27	27	25	25
7	23	22	22	21	20	19	18	17	16	15	14	13
8	12	10	12	10	10	8	8	6	5	4	3	3
9	1	—	1	29	29	27	27	25	24	23	22	21
10	20	18	20	19	18	17	16	15	13	13	11	11
11	9	8	8	7	6	5	4	4	2	1	29	29
12	27	26	27	26	25	24	23	22	20	20	18	18
13	17	15	17	15	15	13	13	11	10	9	8	7
14	6	4	6	5	4	3	2	1.30	29	28	27	26
15	25	23	24	22	22	20	20	19	17	17	15	15
16	13	12	13	12	11	10	9	8	6	6	4	4
17	3	1	3	1	1.30	29	28	27	25	25	23	23
18	22	20	22	20	20	18	18	16	15	14	13	12
19	11	9	10	8	8	6	6	5	3	2	1	1.30

Moon's Age.	Times Answ.		
	High Water *later* each Day after the New and Full Moon.		
Days	H	M	
1	0	44	Afternoon.
2	1	22	
3	1	56	
4	2	28	
5	3	2	
6	3	40	
7	4	24	
8	5	12	
9	6	4	
10	7	4	
11	8	8	
12	9	12	
13	10	15	
14	11	10	
15	12	12	
16	0	56	After Midnight.
17	1	24	
18	2	8	
19	2	40	
20	3	14	
21	3	52	
22	4	36	
23	5	22	
24	6	16	
25	7	18	
26	8	22	
27	9	26	
28	10	30	
29	11	32	
$29\frac{1}{2}$	12	12	

From the Change to the Full, the Moon comes to the Meridian in the Afternoon; and from the Full to the change, she comes to the meridian after Midnight.

The

The Uſe of the foregoing Table.

To find the moon's age on any given day, look in the firſt column (marked Golden Num.) for the golden number, and under the month, on the ſame line, ſtands the day of the new moon; then count the days which have completely paſſed ſince the laſt change, and they will be her age on the given day.

To find the Time of High Water.

Look for the moon's age in the table of times, and the hours and minutes oppoſite to which being added to the time of high water, on the change and full days, at any place, will, if it does not exceed 12 hours, give the time of high water there in the afternoon of the given day; but if it does exceed that number, take 12 from it, and the remainder will ſhew the time of high-water in the morning.

EXAMPLE I.

At what Time will it be High Water at London, April 29, 1796?

Oppoſite 11 the golden number, and under April, I find it was new moon the 7th day; and reckoning forward to April 29, gives 22 days for the moon's age.

Againſt 22, in the table of times, ſtand 4 hours 36 minutes, to which add 3 hours, the time of high water at London on the full and change days, and that gives 7 hours 36 minutes, the time of high water at London in the morning.

EXAMPLE II.

Required the Time of High Water at Dover, October 12, 1796?

Oppoſite to 11 the golden number, and under October, I find it was new moon the 1ſt day; reckoning forward to October 12, I find the moon's age is 11 days; againſt 11 in the table of times ſtand 8 hours and 8 minutes. This added to 10 hours 30 minutes, the time of high water on full and change days at Dover, gives 18 hours 38 minutes; from which I take 12, and the remainder 6 hours 38 minutes is the time of high water in the morning at Dover on the given day.

EXAMPLE. III.

What Time will it be High Water at Torbay, July 10, 1796?

By the table it was new moon on the 4th day, and reckoning forward to the 10th, I find there are 5 days completely paſt. Againſt 5 in the table

table of times, ſtand 3 hours 2 minutes, which added to 6 hours, the time of high water at Torbay, on full and change days, gives 9 hours 2 minutes, the time of high water in the afternoon, on the above day.

To find the time of the Moon's riſing.

If the moon is not yet come to the full, add the time of her ſouthing to the time of the ſun's riſing, and the ſum will be the time of the moon's riſing in the forenoon; but if the ſum exceeds 12, ſubtract 12, and take the remainder for the time of her riſing in the afternoon. But if the moon is paſt her full, then add the time of her ſouthing to the time of the ſun's ſetting, and the ſum will be the time of the moon's riſing in the afternoon. But if the ſum exceed 12, ſubtract 12, and take the remainder for the time of the moon's riſing in the morning.

Note. If the time of the ſun's riſing and ſetting is not known, it may be eaſily found, having the latitude of the place and the ſun's declination in the table, ſhewing the riſing and ſetting of the ſun, moon, or ſtars. See Table VIII.

At London, Dec. 1, 1792, required the time of the Moon's Riſing?

	H.	M.	
Riſing — — —	12	00	
Sun riſes that day by the table at —	8	02	
Sun ſetts — — —	3	58	
Moon ſouths that day at — —	2	24	
Moon riſes at	6	22	afternoon.

To find the Time of the Moon's Setting.

Find the time of the ſun's riſing and ſetting by the tables as before, and if the moon is not yet to the full, add the time of her ſouthing to the time of the ſun's ſetting, and the ſum will be the time of the moon's ſetting in the afternoon; but if the ſum exceeds 12, ſubtract 12, and take the remainder for the time of her ſetting in the morning.

And if the moon is paſt the full, add her ſouthing to the time of the ſun's riſing, and the ſum will be the time of the moon's ſetting in the morning; but if the ſum exceeds 12, ſubtract the 12, and take the remainder for the time of the moon's ſetting in the afternoon.

EXAMPLE.

EXAMPLE.

At London, November 16, 1792, required the Time of the moon's Setting?

	H.	M.	
Setting — — —	12	00	
Sun riſes Nov. 16th, by the tables, at —	7	43	
Sun ſets — — —	4	17	
Moon ſouths Nov. 16th — —	1	36	
Moon ſets Nov. 16th at — —	5	53	afternoon.

NOTE. The above method may differ half an hour from the time given by the almanacs.

In like manner may the time of high water be found at any other place. On account of the irregularities of the moon's motion, the times of her change may differ half a day from the truth; and the time of high water 30 minutes, but ſeldom more, if the ſea is not greatly influenced by the wind.

The tides do not always anſwer to the ſame diſtance of the moon from the meridian at the ſame places, but are variouſly affected by the action of the ſun, which bring them on ſooner when the moon is in her firſt and third quarters; and keeps them back later when ſhe is in her ſecond and fourth quarters; becauſe in the former caſe, the tides raiſed by the ſun, alone, would be earlier than the tide raiſed by the moon; and in the latter caſe, later, as may be ſeen in the table of the ſhifting of the tides.

As the Nautical Almanac is become now of general uſe in long voyages, the time of high water at any part of the world may be readily found, if the time making high water full and change be known; for in the ſixth page of each month is given the time of the moon's paſſage over the meridian of Greenwich every day; this time may be reduced to the meridian of any other place, by allowing 1 hour for every 15 degrees of longitude. To this time add the time making high water there, on full and change days, which gives the time of high water nearly on that day, if the ſum be leſs than 12 hours; but if above, ſubtract 12 hours, or 24 hours from it; obſerving, that the days in this Almanac begin 12 hours later than the common day.

A TABLE.

A TABLE *of the Bearings of the* MOON *at the Time of High Water, for every Point of the Compass, nearly with the Times of those Bearings at the following Places on the Coasts of England, Ireland, France, &c.*

When the Moon bears as follows.		H.	
N. and	S.	12	Isle of Alderney, Gibraltar, Southampton, Beachy, Sheerness, a Sand called Kentish Knock, a Sand called the Swin, at the Mouth of the Thames.
N. by E.	S. by W.	$0\frac{3}{4}$	or 45 minutes past 12, Rochester, Flushing, Malden, Nore.
N. N. E.	S. S. W.	$1\frac{1}{2}$	or 30 minutes past 1, Bell Isle, Tinmouth, Gravesend, Holyhead.
N. E. by N.	S. W. by W.	$2\frac{1}{4}$	or 15 minutes past 2, Berwick, Lisbon, St. Andrew's Coquet.
N. E.	S. W.	3	Whitby, London, Amsterdam, Bourdeaux, Bay of Biscay.
N. E. by E.	S. W. by W.	$3\frac{3}{4}$	Brest, Huntcliff, Isle of Bas, at the Maes, Scarborough.
E. N. E.	W. S. W.	$4\frac{1}{2}$	In Bresound, Ushant, Scilly, Cork, Cape Clear.
E. by N.	W. by S.	$5\frac{1}{4}$	Humber Mouth, at the Spurn, Torbay, Start Point.
E.	W.	6	Hull, Wells, Weymouth, Plymouth, Ramhead, Torbay, Dartmouth.
E. by S.	W. by N.	$6\frac{3}{4}$	Bristol, Portland Road, Lynd, Foulness, Foy.
E. S. E.	W. N. W.	$7\frac{1}{2}$	Lizard, Land's End, Falmouth, Penryn, C. Barfleur.
S. E. by E.	N. W. by W.	$8\frac{1}{4}$	Eddiston, Yarmouth, Needles, Fly, Dublin, Isle of Ely.
S. E.	N. W.	9	Isle of Man, Isle of Wight, E. End, Caskets, Caen, St. Helen's.
S. E. by S.	N. W. by N.	$9\frac{3}{4}$	North Foreland, Dungeness, Dunnose, Shoreham.
S. S. E.	N. N. W.	$10\frac{1}{2}$	Downs, Deal, Dover, S. Foreland.
S. by E.	N. by W.	$11\frac{1}{4}$	Margate, Harwich, Rose, Pool, Portsmouth, Spithead, Calais.
S.	N.	12	Dunkirk, Embden, R. Elbe, Coast of Flanders, Ostend.

NOTE. The current in the Downs generally runs $7\frac{1}{4}$ hours to the north; and $5\frac{1}{4}$ hours to the southward; at Dover the tide from the channel runs northward $7\frac{1}{4}$ hours; and from the north 5 h. 10 m. at the full and change of the moon. The tides set in the Downs N. N. E. and S. S. W. hourly. It is high water at London 46 minutes after two at full and change by the shore.

Pilots

Pilots reckon ſix hours for a tide, then as $\frac{1}{2}$ a tide, is 3 hours, $\frac{1}{4}$ tide is $1\frac{1}{2}$ hour, and half-quarter tide is $\frac{3}{4}$ of an hour. So that if it flows tide, half tide, and quarter tide, it is high water at half an hour after 10 o'clock, which is the caſe in the Downs by the ſhore.

A TABLE *ſhewing the Time of High Water at Full and Change of the* Moon *at the following Places on the Coaſt of the United States of America.*

[NOTE. *H.* ſtands for hours, *M.* for minutes, and *F.* for feet.]

	H.	*M.*	*F.*
Boſton Light-Houſe,	11	30	12
Marblehead, Salem, and Cape-Ann,	11	30	12
Newburyport and Portſmouth,	11	15	10
Portland and Caſco-Bay,	10	45	9
Kennebeck and Sheepſcut,	10	45	9
Townſend, Broad-Bay, and George's-River,	10	45	9
Penobſcot-River and Fox-Iſland,	10	45	10
Mount-Deſert, and Goulſborough,	11	—	12
Machias,	11	—	12
Paſſamaquoddy-River and Mooſe-Iſland,	11	30	25
Plymouth, Cape-Cod, and Manomoy-Point,	11	30	$6\frac{1}{2}$
Race-Point,	10	45	
Nantucket,	12	3	6
Tarpaulin-Cove,	9	52	5
Gay-Head, New-Bedford, Block-Iſland, and Rhode-Iſland Harbours,	7	37	5
New-Haven,	11		8
New-London, New-York, Elizabeth-Town-Point, and Cape-Henlopen,	8	54	5
Sandy-Hook (New-York,)	6	37	5
Cape-Henry and Cape-Charles,*	7		4
Charleſton, (S. C.)	7		6
Port-Royal,	8	15	
St. Simon's Sound,	9		
St. Simon's-Bar,	7	30	
St. Simon's Offing,	6	45	
St. Anaſtatia's-Iſland,	7	30	
Florida-Keys,	8	50	

* *The Tides in theſe Rivers are governed by the winds. When it blows for two or three days at N. or N. W. the flood tide does not riſe two feet, but when the wind blows a gale to the S. E. or E. S. E. the Tide riſes 4 or 5 feet.*

OF

OF THE

LOG-LINE AND HALF-MINUTE GLASS,

AND HOW TO

CORRECT THE DISTANCE GIVEN BY THEM.

THE Log is a flat piece of wood like a flounder, or of the figure of a quarter of a circle, having its circular side loaded with lead sufficient to make it swim upright in the water. To this log is fastened a long line of about 150 fathoms, called the Log-line, which is divided into certain equal spaces, called Knots, each of which ought to bear the same proportion to a nautical mile (60 of which make a degree) that half a minute does to an hour, that being the time allowed for the experiment.

They are called Knots, because at the end of each of them there is a piece of twine with knots in it, reeved between the strands of the line; these pieces of twine shew how many knots run out in half a minute, and consequently the ship's rate of sailing per hour.

Mr. Norwood, and several other able mathematicians, have found that a degree of a great circle upon the earth contains about 367200 English feet, therefore a nautical mile being the $\frac{1}{60}$ part of 367200 feet, that is, 6120 feet, and since half a minute is $\frac{1}{120}$ part of an hour, the length of a knot on the log-line ought to be the $\frac{1}{120}$ part of 6120 feet, or 51 feet. But as for the most part, the ship's way is found, by experience, to be really more than that given by the log, and as it is safer to have the reckoning before the ship than after it, therefore 50 feet may be taken as the proper length of each knot, and these knots subdivided into ten fathoms, each of 5 feet, which is certainly the best adapted for practice, and will correspond with all the tables and instruments used in navigation, as they are decimally divided, and consequently, the ship's run determined with greater ease and certainty. But some experienced commanders find, that the allowing 50 feet to a knot generally makes a ship a-head of the reckoning; and, to avoid danger, mostly divide the log-line into knots of 7 or $7\frac{1}{2}$ fathoms of 6 feet each, to correspond with a glass that runs 28 seconds. Others again divide the seconds, the glass runs, by 4, and take the quotient for the distance in fathoms between the knots; which of these methods are best, I leave to every captain's own experience to determine; but certain

tain it is, that whatever length the knots are, the moſt convenient way is ſo divide them into tenths.

In hot or dry weather, the glaſs runs out faſter than in moiſt or rainy weather: therefore care ſhould be taken to try what number of ſeconds the glaſs runs.

The knots commonly begin to be counted at the diſtance of 10, 12, or 15 fathoms from the log, according to the largeneſs of the ſhip, that ſo the log may be out of the ſhip's wake when it is thrown overboard before they begin to count, leſt the eddies ſhould ſuck the log after the ſhip; and for the more ready diſcovery of this point of commencement, there is commonly faſtened at it a piece of red rag; that part of the line between the red rag and the log is called the ſtray-line.

The log and log-line being duly prepared and hove overboard from the poop, or lee-quarter, and the line veered out (by the help of a reel which turns eaſy, and about which it is wound) as faſt as the log will carry it away, or rather as faſt as the ſhip ſails from it, will ſhew how faſt the ſhip has ſailed in the given time, or rate of ſailing per hour.

The experiment for finding the velocity of the ſhip is called heaving the log.

Care ſhould be taken to veer out the line as faſt as the log takes it, for if the log is left to turn the reel of itſelf, the log will come home and deceive you in the reckoning.

In king's ſhips, India ſhips, and ſome others, the log is hove every hour, but in coaſters, and thoſe uſing ſhort voyages, every two hours.

Here the ſhip is ſuppoſed to move with equal velocity between the times of trying the experiment. But if the gale has not been the ſame during the whole hour, or time between heaving the log, or if there have been more ſail ſet, or any handed, that ſo the ſhip has run more or leſs in any part of the hour than ſhe did at the time of the experiment; or if it ſhould fall little or more wind at that time, there muſt be allowance made for it according to the diſcretion of the artiſt: Sometimes too, when the ſhip is before the wind, and a great ſea ſetting after her, it will bring home the log; in ſuch caſes it is cuſtomary to allow one mile in ten, and leſs in proportion, if the ſea be not ſo great.

Care ſhould alſo be taken to meaſure the log-line pretty often, leſt it ſtretch and deceive you in the diſtance.

The like regard muſt be had that the half minute glaſs be juſt 30 ſeconds, otherwiſe no account of the ſhip's way can be kept; to prove which, if there be no ſtop-watch at hand, let a plummet, of any form or weight, be faſtened to a ſilk ſtring or thread, with a loop to hang on a ſmall pin or nail faſtened in any place, ſo that the plummet may ſwing freely; let it be $39\frac{1}{5}$ inches from the end of the loop to the middle of the plummet, and the plummet cauſed to ſwing; each of thoſe ſwings will be a true ſecond of time, always counting every time it paſſes the perpendicular, let fall from the pin, and every time it paſſes from the perpendicular to the utmoſt ſwing will be half-a-ſecond.

How

How to correct the Distance given by the Log-Line and Half-Minute Glass.

The distance given by the log may be wrong on three accounts, *viz.* by an error in the glass, an error in the log-line, or an error in both; for correcting of which take the following cases:

CASE I.

When the log-line is truly divided, and the glass is faulty.

RULE. Say, as the seconds run by the glass are to 30 seconds, so is the distance, given by the log, to the true distance.

EXAMPLE I.

Suppose a ship runs at the rate of $7\frac{1}{2}$ knots in the time the glass runs out; but measuring the glass I find it runs 34 seconds; what is the true rate of sailing?

As 34 : 30 : : 7,5 : 6,6 miles, the true distance sailed in an hour.

EXAMPLE II.

Suppose a ship runs at the rate of $6\frac{1}{4}$ knots, but measuring the glass, I find it runs only 25 seconds; required the true rate of sailing?

As 25 : 30 : : 6,5 : 7,8 miles, the true distance sailed in an hour.

CASE II.

When the glass is true and log-line faulty.

RULE. Say, as 50 feet is to the distance measured between knot and knot, so is the distance run by the log to the true distance.

EXAMPLE I.

Suppose a ship runs at the rate of $6\frac{1}{4}$ knots in half a minute, but measuring the space between knot and knot, I find it to be 56 feet; required the true rate of sailing?

As 50 : 56 : : 6,25 : 7 miles, the true distance sailed in an hour.

EXAMPLE II.

Suppose a ship runs at the rate of $6\frac{1}{2}$ knots in half a minute, but measuring the space between knot and knot, I find it to be only 44 feet; required the true rate of sailing?

As 50 : 44 : : 6,5 : 5,72 miles, the true distance sailed in an hour.

CASE III.

When both the log-line and glass are faulty.

RULE. Multiply thrice the measured length of a knot by the distance run by the log, the product, divided by 5 times the measured time of the glass, will give the true distance run.

EXAMPLE.

EXAMPLE.

Suppoſe a ſhip runs 5 knots of a log-line of 45 feet to a knot, while a glaſs of 25 ſeconds is running out; what is the true rate of ſailing?

The meaſured length of a knot — —	45
Multiplied by — — —	3
Gives thrice the meaſured length of a knot	135
Which multiplied by the diſtance run per log	5
	675

And dividing the product by 5 times the time the glaſs runs, that is $5 \times 25 = 125$, the quotient is 5,4, the number of miles the ſhip runs per hour.

This rule is only a compound of the two former ſimple ones, which is contracted a little.

When the glaſs is faulty, the log-line may be divided as in the annexed table, ſhewing the length of the knots of the log-line of different glaſſes.

Seconds of Glaſs.	Length of Knots in Feet.
24	40,0
25	41,8
26	43,4
27	45,0
28	46,8
29	48,4
30	50,0
31	51,8
32	53,4
33	55,0
34	56,8
35	58,4
36	60,0

THE

THE DESCRIPTION AND USE OF HADLEY's OCTANT,

COMMONLY CALLED

HADLEY's QUADRANT.

THE inventor of this noble inftrument is difputed; fome fay it was firft invented by one GODFREY, in Philadelphia, and that Mr. HADLEY, then an officer in the royal navy, pirated it from him, and brought it to England, who being the firft that made it public, it ftill bears his name. How far this is true, I cannot fay, but certain it is, that two men in different parts of the world may hit upon one invention at the fame time.

This inftrument is now fo much improved, that angles, whether vertical, horizontal, or any other pofition, the objects happen to be in, may be taken to fuch a degree of exactnefs, that people unacquainted with the ufe of it would fcarcely think it poffible.

The principles of this admirable inftrument have been fo well demonftrated by other hands, that a repetition thereof here feems to me unneceffary; I fhall therefore content myfelf with giving a fhort defcription of it, and its ufe in navigation.

The principal Parts of the Inftrument are,

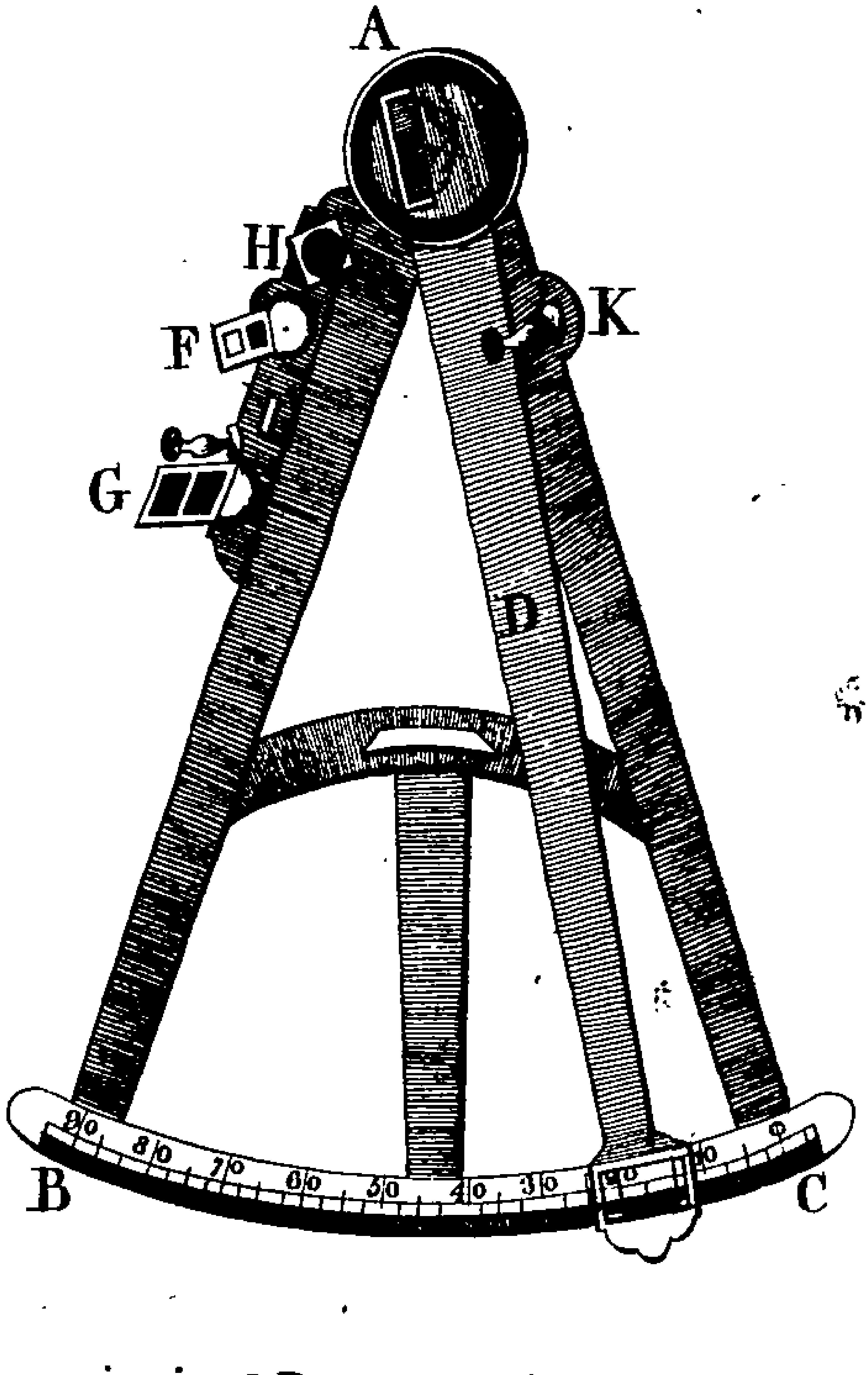
The Index D
The Index Glafs E
The Horizon Glaffes G and F
The Dark Glaffes, or Screens H
The Sight Vanes K and G.

The graduated arch B C contains only 45 degrees, or is the 8th part of a circle, but it is to be efteemed as 90°, and fo divided, becaufe by the double reflection the angle is doubled.

The divifions run 0, 10, 20, &c. to 90 as in the figure, each degree is divided into 3 parts of 20 minutes each, which by the help of the vernier, or divifions on the index, is again fubdivided into minutes of a degree, thus:

The index D is a flat bar moveable on the centre of the inftrument; that part of the index that flides over the graduated arch, having the firft and laft divifions thereon correfponding to thofe on the arch, is called the Vernier or Nonius, and which divides every fub-divifion on the arch in minutes,

HADLEY'S QUADRANT.



The principal Parts of this Instrument are

The Index .... D.
The Index Glass .... E.
The Horizon Glasses ... G *and* F.
The dark Glasses or Screens ... H.
The Sight Vanes K *and* G.

Newburyport Published by Edmund M. Blunt.

minutes, thus, 7 divisions on the nonius being divided into 20 parts, it is evident the difference between the first division on the arch and on the nonius is $\frac{1}{20}$ of one of the sub-divisions on the arch, or 1 minute, because 7° there is divided into 21 parts, being one in 20 greater than on the arch. The difference of the two first divisions will be 2', and the difference of the three first 3, and so on; hence it will arise, that in whatever divisions on the vernier and arch cut one another the nearest, the vernier will indicate how many minutes above the next sub-division according as it is numbered to right or left thereof. On the bottom of the index against the back of the arch is a screw made to fix fast the index when required.

The arch, as before observed, is divided into 90 degrees, numbered 0, 10, 20, 30, &c. and each degree into 3 parts, each 20 minutes, and is to be read thus: 1d.—1d. 20m.—1d. 40m.—2d.—2d. 20m.—2d. 40m.—3d. &c. observing to read to the division that the o, or diamond-like point, of the nonius last passed over; then the nonius will give the number of minutes more, to be added to the division last passed by the nonius. Thus, suppose the o, or △ of the nonius has passed over 15 degrees and two parts or 15d. 40m. and stands somewhere between 15d. 40m. and 6d. then observe what division or line on the nonius coincides with any division or line on the arch, that number on the nonius will be the minutes to be added to 15d. 40m. Suppose 15 on the nonius touches some division on the arch, then 15m. must be added to 15d. 40m. and the angle or altitude measured will be 15d. 55m.

The index glass E is a piece of glass truly ground, silvered on the back, and fixed in a brass frame, perpendicularly to the index; its use is to receive the rays proceeding from any object, and reflect them to the horizon glasses F and G; at the back of the brass frame of this glass are two screws, serving to adjust the frame perpendicularly to the index.

The horison glasses F and G are smaller pieces of ground glass, one part of which is silvered and the other part open or unsilvered, in order to look at an object through it; these are set in frames and placed perpendicularly on the limb at G and F; their use is to receive the rays of any object reflected from the index glass, and again to reflect those rays to the eye through the holes of the sight vanes K and G.

To adjust the Quadrant.

First, The index glass must be perpendicular to the plane of the quadrant, which if not, you may thus discover; hold the plane of the quadrant in an horizontal position, with the index glass near the eye, look right down the quadrant in such a manner as to see the arch of the quadrant direct, and at the same time reflected by the index glass; then, if the arch seen direct, together with its reflected image, appear to be in one line, the index glass is truly adjusted, if not it must be rectified by means of the screws placed at the back of the index glass; it is easy to discover which way the inclination is by pressing the index glass with your thumb while you observe the arch.

Secondly, The axis of the horizon glass must be parallel to the axis of the index glass, if not the error is easily discovered and rectified in the

fore

fore horizon glaſs when the index is adjuſted, thus: bring O on the nonious nearly to O on the graduated arch, and look directly through the ſight vane at the moon or any bright ſtar, ſo as to ſee the reflected image in the horizontal glaſs, and the object at the ſame time through the unſilvered part; then move the index backwards and forwards ſlowly, and obſerve if both images coincide or paſs behind one another, which if they do, the axis of both are parallel, which, if not, you ſhould nicely adjuſt by the two ſcrews placed on the top block of the horizon glaſs.

If a ſmall piece of coloured glaſs ſet in braſs be made to turn round to the ſight vane occaſionally to guard the eye, and the ſcrews turned back, the ſame correction may be made by uſing the ſun inſtead of the moon or ſtar.

To take the Altitude of the Sun by the Fore Obſervation.

The ſun's image at any time when not much obſcured by clouds may be ſeen as reflected from the unſilvered part of the horizon glaſs, by looking through the hole in the ſight-vane; having put the ſcreens down to guard the eye, hold the inſtrument vertical, and turning towards the ſun, direct the ſight to that part of the horizon beneath the ſun, and moving the index you may bring down the red image of the ſun towards the horizon: if the ſun's image ſhould be faint, you may turn back the ſcreens, and you cannot miſs it.

Having brought down the ſun's image near the horizon, ſwing the quadrant backwards and forwards, making your eye the centre of motion, and keep moving the index at the ſame time till the ſun's lower edge juſt touches the horizon, and you will have the apparent altitude of the ſun's lower limb upon the arch of the quadrant at that inſtant. But this altitude is greateſt at 12 o'clock, when the ſun is on the meridian, from which the latitude is determined; much time will be ſaved if you have a good watch well regulated to tell you within a minute or two when to begin your obſervation, but this apparent altitude requires the four following corrections:

Firſt, The index error, if any, to be added or ſubtracted.

Secondly, The dip of the horizon.

Thirdly, The ſun's ſemi-diameter and refraction.

Note. Inſtead of adding the ſemi-diameter and ſubtracting the dip, it is common to add 12 minutes.

Theſe four corrections are neceſſary to find the true altitude of the ſun's centre nearly, the correction of the ſun's parallax being ſo ſmall, that it may always be neglected in determining the latitude.

The back obſervation is managed the ſame as the fore obſervation, only your back muſt be turned towards the ſun, and the ſcreens ſhifted to the back horizon glaſs, remembering to ſubtract the ſun's ſemi-diameter (if the apparent lower limb be taken) and add the dip, ſubtracting the effect of refraction, and you will have the altitude of the ſun's centre.

The correction for the index error is thus: Turn down the ſmall knob of braſs, placed on the limb, to hinder the index from going off the arch, as it may be in the way. This correction may be accurately eſtimated by

taking

taking the diameter of the ſun, moon, or any object before and behind O on the arch; that is, bring the upper limb of the object to coincide with the lower, and note the angle, then take it on the extra arch, as it is called; that is, bring the lower limb to coincide with the upper, and note the angle, half the difference of theſe two angles will be the true correction of the index error.

EXAMPLE.

Suppoſe the ſun's diameter meaſures 36 on the arch and 28 in the extra arch. The difference is 8′, half which is the error to be ſubtracted, becauſe the diameter meaſures more on the arch, or gives the ſun's diameter too much, but had the extra arch given the greater angle, the error would have been additive.

To take the Altitude of the Moon.

The moon's altitude may be taken either by the fore or back obſervation exactly in the ſame manner as the ſun's altitude, only here you muſt bring the edge of the moon into contact with the horizon, which is round and well defined, whether that be the upper or under edge: the corrections to be applied to the obſerved altitude are as follow:

Firſt, The index error as before directed.

Secondly, The dip to be ſubtracted in the fore obſervation, and to be added in the back obſervation.

Thirdly, Semi-diameter to be found in the nautical ephemeris for every noon and midnight at Greenwich; if very great accuracy is required, this ſemi-diameter muſt be corrected for the intermediate time: which being added to, or ſubtracted from, the obſerved altitude will give the apparent altitude of her centre.

Fourthly, Parallax and refraction. The moon's horizontal parallax for every noon and midnight at Greenwich is to be found in the nautical ephemeris. This muſt be corrected for the intermediate time; then take the proportional logarithm of the moon's horizontal parallax out of the nautical almanac, increaſe its index by 10, and ſubtract the log. co-ſine of the moon's apparent altitude from the ſun; the remainder will be the proportional logarithm of her parallax in altitude; from which take the moon's refraction, (table IX.) and the remainder will be the correction of the moon's altitude, which being added to her apparent altitude, will give the true altitude of her centre.

To take the Altitude of a Star by the Fore Obſervation.

Set the index at O, and holding the plane of the quadrant vertical, direct the ſight to the ſtar, and at the ſame time look for the reflected image of the ſtar in the ſilvered part of the horizon glaſs; move the index a little, which will ſeparate the reflected image from the direct image, the former will be eaſily diſtinguiſhed from the latter by its motion, when you ſtir the index; continue to advance the index, and at the ſame time follow

the

the reflected image of the ſtar with your eye, directing the ſight lower and lower, and changing the poſition of the quadrant or octant, as the image of the ſtar deſcends, till you have brought it down to the horizon, the index will then ſhew the obſerved altitude of the ſtar. The corrections to be applied to the obſerved altitude of the ſtar are, Firſt, the Index error; ſecondly, the Dip, theſe two give the apparent altitude; thirdly, the Refraction, which gives the true altitude; the fixed ſtars have neither ſemidiameter nor parallax worth notice.

In taking the altitude of a ſtar, or the moon, by night, always get as near the water as poſſible; in eaſy weather a grating may be flung over the ſhip's ſide, and an obſerver ſit upon it to take the altitudes; the ſame may be done to take the altitude of the ſun in an hazy horizon; for the nearer the eye is to the ſurface of the water, the nearer the true horizon will be to the eye.

Advice to Seamen in the Choice of their Quadrants or Sextants.

The joints of the frame muſt be cloſe, without the leaſt opening or looſneſs, and the ivory on the arch and nonius inlaid and fixed, ſo as not to riſe at the ends, nor above the plane of the inſtrument; all the diviſions on the arch and nonius muſt be exceeding fine and ſtraight, ſo that when the index or nonius is ſet to any diviſion on the arch, the diviſions on the line that coincides may appear diſtinct, for only the firſt and laſt line on the nonius will coincide with the other lines upon the arch, if the quadrant is well divided; likewiſe try in different parts of the arch, if the nonius, or index plate, cuts regularly in order with thoſe on the arch, if they do not, the diviſions are bad, and the quadrant ought to be rejected.

Again, look into the great ſpeculum or index-glaſs ſlant-ways, holding it about ten or twelve inches from the eye, and obſerve the image of ſome diſtant object; if the image appears clear and diſtinct in every part of the glaſs, the ſpeculum is good; but if it appears notched, or drawn with ſmall lines, the glaſs is veiny, and muſt be rejected; if more images than one of the ſame object are ſeen, it ſhews that the two ſurfaces are not ground parallel; the other ſpeculum may be examined in the ſame manner.

Obſerve the ſun, or a candle, through the dark glaſſes ſeverally, holding the glaſs about eight or ten inches from the eye; if they are veiny the object will appear notched at the edges, but if clear and well defined, the glaſſes are good.

Moſt people prefer black ebony, on account of its weight; but I have found by experience, that good mahogany takes the glue and ſtands the heat better.

Quadrants, like watches, may appear well to the eye, and yet be good for little; it is therefore much better to give two guineas and an half, or three guineas for a good one, that will laſt a man for life, than purchaſe thoſe wretched inſtruments made up at a low price, which cannot be depended on.

Of

Of the Dip and Refraction.

The rays of light in paſſing through the aſmoſphere are bent out of their ſtraight courſe into a curve line; and hence it happens that all the heavenly bodies, except when they are in the zenith, appear higher than they ought to do, and ſo much the more the nearer they are to the horizon. This apparent elevation of the heavenly bodies above their true height is called the refraction of objects; and the quantity or effect of it, according to the different altitudes of objects, has been carefully obſerved by eminent aſtronomers, and muſt always be ſubtracted from the apparent altitude, but added to the apparent zenith diſtance of an object with whatever inſtrument the obſervation is made, in order to obtain its true altitude or zenith diſtance.

That the corrections of obſerved altitudes of objects, both on account of the dip of the horizon and the refraction of their light, may appear at one view, they are both exhibited together in the tables.

To work an Obſervation, or to find the Latitude of a Place, by the Tables, of the Sun's or Star's Declination and the Zenith Diſtance.

The latitude of any place is its diſtance from the equator, either north or ſouth, counted in degrees, &c. upon an arch of the meridian, contained between the zenith, or that point directly over your head and the equator. It can never exceed 90 degrees, and is found by taking the altitude or height of the ſun or ſtar above the horizon of the ſea with a quadrant, when on the meridian or due north or ſouth of the place of obſervation.

This meridian altitude, corrected for the dip of the horizon, and refraction, and 16 minutes the ſun's ſemi-diameter added thereto, gives the altitude of his centre, which being ſubtracted from 90°, gives the zenith diſtance or the number of degrees, &c. the centre of the object is from the point over your head; with which, and knowing how far the object is to the north or ſouth of the equator, which is called declination, the latitude is found by the meridian altitude of any celeſtial object, as follows;

If the ſun or ſtar be ſouth, when obſerved, call the zenith diſtance north: but if north, call it ſouth; place it under the declination, and if they are of the ſame name add them together, but if of different names take their difference and you will obtain the latitude which will be of the ſame name as the greater number.

NOTE. Firſt, When the ſun or ſtar is on the equator, or hath no declination, the zenith diſtance is the latitude of the place, and of a contrary name to the zenith diſtance.

Secondly, When the ſun or ſtar is in the zenith, the declination is the latitude, and of the ſame name as the declination is of. For it is evident, that as they are equally diſtant from the equator, and on the ſame ſide of it; conſequently, if the declination be north, the latitude will be alſo north, and if ſouth, ſouth.

 EXAMPLE

EXAMPLE I. and II.

Being at sea May 27, 1800, the sun's meridian alt. was found to be 57° 35′, and it was south of me, what latitude was I in?

		90° 00′
Meridian altitude		57 35
Zenith distance	=	32 25 N.
Sun's decli. in table for May 27, is		21 19 N.
Latitude in	=	53 44 N.

Being at sea 24th July 1800, meridian altitude of the sun was 27° 13′ being north of me, required the latitude in?

		90° 00′
Meridian altitude	=	27 13
Zenith distance	=	62 47 S.
Sun's decli. in table for July 24		19 54 N.
Latitude in	=	42 53 S.

EXAMPLE III.

Being at sea January 14, 1800, the sun's mer. altitude was found 72° 17′ south, what was the latitude of the place of observation?

		90° 00′
Meridian altitude		72 17
Zenith distance	=	17 43 N.
Sun's decli. Jan. 14, is		21 18 S.
Latitude in	=	3 35 S.

In this case, it is plain the observer was between the sun and the equator.

EXAMPLE IV.

Being at sea the 4th of May 1800, I observed the bright star Fomalhaut 27° 21 above the horizon of the sea, and it was south of me, required the latitude in?

		90° 00′
Meridian altitude	=	27 21
Zenith distance		62 39 N.
Fomalhaut's declination		30 40 S.
Latitude in	=	31 59 N.

NOTE. The declination here is fitted to the year 1800.

The foregoing rules are for observing by the sun or stars when they are at the greatest altitudes, or upon the meridian above the pole, but as in some parts of the earth the sun does not set for several days, and some stars never set, in that case they may be observed upon the meridian twice in 24 hours; that is, once at their greatest height as before, and again when they are at the lowest or upon the meridian below the pole, to work which observations, take the following

RULE. Add the complement of the declination to the meridian altitude, the sum is the latitude of the same name with the declination.

EXAMPLE. V.

At sea I took the altitude of the north pole-star, when on the meridian below the pole, and found it 46° 21′; required the latitude?

Meridian altitude		46° 21′ N.
Compl. declination.		1 47 N.
The latitude in	=	48 8 N.

In the following examples the corrections for dip and refraction are introduced:

EXAMPLE VI.

By a fore observation, the alt. of the sun's lower limb was found by Hadley's Quadrant to be 40° 20′ S. when his declination was 9° 56′ N. the eye being 30 feet above the horizon; required the latitude of the place?

Obs. alt. sun's lower edge	40° 20′
Semi-diameter to be added	16
App. alt. sun's centre	40 36
Dip of ho. to be subtracted	05
App. alt. corrected by dip	40 31
Refraction to be subtracted	01
True alt. of sun's centre	40 30
Zenith distance	49 30 N.
Declination	9 56 N.
Latitude	59 26 N.

EXAMPLE VII.

Suppose the eye of an observer at 35 feet above the water should with Hadley's Quadrant, by a fore observation, find the altitude of Sirius 53° 35′ S. when it passed the meridian, having before-hand set his watch, and found the time of Sirius's passage; required the latitude of the place of observation?

Obs. alt. of Sirius	53° 35′ 0″
Dip of hor. to be subt.	05 39
App. alt. above hor.	53 29 21
Refraction to be subt.	42
True alt. of Sirius	53 28 39
True zenith distance	36 31 21 N.
Sirius's declination	16 26 47 S.
Latitude	20 04 34 N.

EXAMPLE VIII.

By a back observation with Hadley's Quadrant, the app. alt. of the sun's lower edge was 25° 12′ S. when his declination was 21° 14′ S. and the eye 40 feet above the horizon; in what latitude was the observation made?

Obs. alt. sun's lower edge	25° 12′ S.
Semi-diam. to be subtracted	16
App. alt. sun's centre	24 56
Dip of hor. to be added	06
App. alt. correct by the dip	25 02
Refraction to be subtracted	02
True alt. sun's centre	25 00
True zenith distance	65 00 N.
Declination	21 14 S.
Latitude	43 46 N.

EXAMPLE IX.

Suppose on the 12th June, 1800, an observer in an high northern lat. and 65° west of London, his eye being 28 feet high, observed the alt. of the sun's lower limb on the meridian below the pole to be 8° 15′ S. by a fore observation with Hadley's Quadrant; required the latitude?

The sun being observed below the pole, it must have been at 12 hours past noon at the place of observation, and that place being 65° W. of London=4 hours 20′ later than at London, therefore it must have been 16h. 20′ past noon at London.

* June 12, 1800, the sun's declination is 23° 10′ 21″ the daily variation 3′ 37″; and as 24h. : 3′ 37″ :: 16h. 20′ : 2 28, which, added to 23° 10′ 21″ because the declination is increasing gives 23° 13′ the sun's declination at the time & place of observation.

App.

* *See Nautical Almanack for 1800.*

App. alt. ſun's lower limb	——	8° 15′ S.
Semi-diameter added	——	16
App. alt. ſun's centre	——	8 31
Dip horizon ſubtracted	——	05
Sun's alt. corrected by dip	——	8 26
Refraction to be ſubtracted	——	06
True alt of ſun's centre	——	8 20 N.
Complement ſun's declination		66 47 N.
Latitude in	——	75 07 N.

OF THE VARIATION OF THE COMPASS.

THE variation of the compaſs is an arch of the horizon contained between the meridian of the place and the magnetic meridian, and is either eaſt or weſt; or it is the number of degrres, &c. the needle's point ſtands from the true north or ſouth points of the horizon, reckoned to the eaſtward or weſtward, and is readily found either from the ſun's amplitude or azimuth.

To find the true Amplitude.

The ſun's true amplitude is an arch of the horizon, comprehended between the true eaſt or weſt points thereof, and the centre of the ſun at its riſing or ſetting; or it is the number of degrees, &c. the ſun riſes or ſets to the northward or ſouthward of the eaſt or weſt points of the horizon.

The ſun's magnetic amplitude is the number of degrees, &c. the centre is northward or ſouthward of the eaſt or weſt points of the compaſs at his riſing or ſetting, and is found with an azimuth compaſs in the following manner:

Having placed the azimuth compaſs in a convenient part of the ſhip, look directly through the ſight-vanes at the ſun's centre; and when the ſun's lower edge juſt touches the horizon, ſtop the card, by a ſtop which is placed on the compaſs for that purpoſe; then the quantity of degrees and minutes contained between the eaſt or weſt, and the north and ſouth points of the compaſs will be the magnetic amplitude.

The true amplitude is found either by inſpection in the tables of the ſun's amplitude, or by calculation, as follows:

RULE.

RULE. As the ſine complement of the latitude
Is to radius,
So is the ſine of the ſun or ſtar's declination
To the ſine of the true amplitude :
Which is always of the ſame name with the declination, whether north or ſouth.

Or, to the ſecant of the latitude, (rejecting the index) add the log. ſine of the ſun's declination, the ſum will be the log. ſine of the true amplitude.

NOTE. The arithmetical complement of the co-ſine of any arch is always equal to the ſecant of that arch, throwing away radius, or neglecting one, which ſtands the firſt figure in the ſecant's index ; likewiſe the arithmetical complement of the ſine of any arch, is the co-ſecant of that arch leſs radius, or the firſt figure of its index : Wherefore, the arithmetical complement of the ſine or co-ſine of any arch is found in the table of ſecants by inſpection.

EXAMPLE I.

On the 21ſt of October, 1800, in latitude 51° 32′ N. ; I demand the true amplitude ?

As ſine comp. lat. 51° 32′	9.79383	Or thus :	
Is to radius	10.00000	Lat. 51° 32′ N. ſecant	0.20617
So is ſi. ſun's dec. 10° 43′ S.	9.26940	Decl. 10 40 S. log. ſine	9.26940
To ſi. of true amp. 17° 24′	9.47557	True amp. 17° 24′ S. =	9.47557

EXAMPLE II.

In latitude 38° 25′ N. what is the ſun's true amplitude when the declination is 18° 59′ N. ?

As ſine comp. lat. 38° 25′	9.89405	Or thus :	
Is to radius	10.00000	Lat. 38° 22′ N. ſecant	0.10595
So is ſine ſun's decl. 18° 59′	9.51227	Decl. 18 59 N. log. ſine	9.51227
To ſun's true amp. 24° 32′	9.61822	Log. ſi. 24° 32′ true am. N.	9.61822

To find the true Amplitude by the Table of Amplitudes.

Look for the given declination at the top of the table, and the latitude in the firſt column on the left hand, in the common angle of meeting, will be the degrees and minutes of the amplitude required.

EXAMPLE I.

In latitude 40° N. when the declination was 17° N. required the ſun's true amplitude at riſing ?

Under

Under declination 17°, and right against the latitude 4°, stand 22° 26′ the true amplitude, and is to be counted from the east towards the north, because it is at the sun's rising, and the declination is north ; that is, E. 22° 26′ N.

But when the latitude is given in degrees, and the declination in degrees and minutes, find the declin. at the top as before, and the nearest degrees to the given latitude in the left hand-column, against which, and under the given declin. stands the true amplitude ; or, if the minutes of the declination be near 30, or half a degree, find the amplitude for the given degrees of declination, and the amplitude for one degree above it, add these two amplitudes together, half their sum will be the true amplitude, sufficiently exact for practice at sea.

EXAMPLE II.

Suppose I would know the sun's true amplitude at his setting in latitude 57°, his declination being 11° 33′ S.

Find the ampl. as before for the Lat. 57°, and the declinations $\left.\begin{matrix}11°\\12\end{matrix}\right\}$ which will be $\left.\begin{matrix}20°\ 29′\\22\ \ 15\end{matrix}\right\}$

Their sum 42 44

Half the sum 21 22 is the true amplitude : that is, W. 21° 22′ S. because at sun-setting, and the declination south. In like manner, if the declination be in degrees, and the latitude in degrees and minutes, as in

EXAMPLE III.

Suppose it were required to find the sun's true amplitude at setting in latitude 49° 27′, when his declination was 21° N.

Now 27 minutes being nearly half a degree, therefore,

For lat. $\left\{\begin{matrix}49°\\50\end{matrix}\right.$ and declination 21° the amplitudes are $\left\{\begin{matrix}33°\ \ 6′\\33\ \ 52\end{matrix}\right.$

Sum 66 58

Half the sum is 33 29, the true amplitude required ; that is, W. 33° 29′ N. because the sun was setting, and the declination N.

When the latitude and declination are both given in degrees and minutes, take the nearest degrees to both, unless they are near 30 minutes, as observed before, and find the amplitude as in Example I.

EXAMPLE IV.

Suppose it were required to find the sun's true amplitude at setting, in latitude 49° 18′, his declination being 12° 41′ N.

Now

Now as the latitude is nearest to 49°, and the declination nearest 20°, therefore against latitude 49° and under declination 20°, stands 31° 25′ N. the true amplitude; that is, W. 31° 25′ N. the declination being north, and at the sun's setting.

To find the true Azimuth.

The true azimuth is an arch of the horizon, contained between the meridian of the place and the azimuth circle, passing through the centre of the sun or star at the time of observation; or it is the true distance of the sun or star from the true north or south points of the compass.

The magnetic azimuth is an arch of the horizon contained between the magnetic meridian and the azimuth circle, passing through the centre of the sun or star when observed; or it is the apparent distance of the sun or star from the north or south points of the compass, either in the forenoon or in the afternoon, when they are 5°, 10°, 15°, &c. above the horizon; and the less the latitude is, the more exact you may perform the observation.

The magnetic azimuth is found by the compass in the following manner.

Place the compass in a convenient part of the ship; then move it so that the sights may be directed to the sun's centre; and the shadow of the string will fall directly on the line marked on the plane which join the sights; then the degree, &c. in the arch intercepted between the end of the index, and north point of the card, will give the magnetic azimuth required. If the sun does not shine strong enough to give a strong shadow, look through one of the sights, and move the compass till one of the strings cuts the sun's centre, and then the intercepted arch, as before, shews the sun's azimuth, and the like of the star's.

When there is a rough sea, the observation is best made by two persons; and if the card vibrates much, take the middle degree between the limits which the vibration reaches.

When the azimuth is observed, the altitude of the object must be observed at the same time.

Having the latitude of the place of observation, and the sun or star's declination with the altitude at the time of observation, the true azimuth is found as follows:

To find the true azimuth, observe these general rules:

RULE.

Add the complement of the latitude,
the complement of the altitude,
and the sun or star's polar distance into one sum:
From half this sum, subtract the polar distance,
and note the half-sum and the remainder.

Then

Then add together

The log. co-secant of the comp. latitude, } rejecting the indexes.
The log. co-secant of the comp. altitude, }
The log. sine of the half-sum,
And the log. sine of the remainder, into one sum ;

Half the sum of these four logarithms, will be the log. co-sine of the half of the true azimuth ; which being doubled, gives the true azimuth reckoned from the north in north latitude, and from the south in south latitude.

N. B. The polar distance of the sun or star, is their distance from the nearest, or elevated pole, and if the latitude of the place, and the declination of the sun or star, be both north, or both south, then the complement of the declination is the polar distance ; but if the latitude and declination one be north, and the other south, the declination added to 90° gives the polar distance.

EXAMPLE I.

In latitude 51° 32′ N. the sun's altitude was observed to be 39° 28′, his declination being then 16° 37′ N. ; required the true azimuth ?

	90° 00′		90° 00′		90° 00′
Latitude	51 32	N. Altitude	32 28	Declination	16 37
		Co-alt.	50 32	Polar dist.	73 23

Co-lat.	38 28	Co-secant	0,20617
Co-alt	50 32	Co-secant	0,11239
Polar dist.	73 23		
Sum	162 23		
½ Sum	81 11	Log. sine	9,99484
Polar dist.	73 23		
Remainder	7 48	Log. sine	9,13263
			19,44603
		Log. co-si. 58° 06′	9,72301
			2
True azimuth			116 12 from the north.

EXAMPLE

EXAMPLE II.

In latitude 42° 16′ N. the sun's altitude was observed to be 18° 40′, his declination being then 7° 38′ S.; required the true azimuth?

	90° 00′		90° 00′		90° 00′
Latitude	42 16 N.	Altitude	18 40	Declination	7 38 S.
		Co-alt.	71 20		97 38

Co-lat.	47 44	Co-secant	0,13076
Co-alt.	71 20	Co-secant	0,02347
Polar dist.	97 38		
Sum	216 42		
½ Sum	108 21	Log. sine	9,97733
Polar dist.	97 38		
Remainder	10 43	Log. sine	9,26940
		Sum	19,40096
½ Sum log. co-si.	59° 53′ =		9,70048
	2		
True azimuth	119 46	from the north.	

The following questions are set down for the Learner's Exercise:

Question I. Being at sea in latitude 40° 38′ N. in the afternoon, the sun's altitude was observed to be 20° 46′, when his declination was 17° 10′ S.; what was the sun's azimuth at that time?

Answer. 137° 50′ from the north.

Quest. II. What is the sun's true azimuth in lat. 26° 30′ N. in the forenoon, when his altitude is 24° 28′, and his declination 22° 40′ north?

Answ. 75° 44′ from the north point of the compass.

Quest. III. At the island of St. Helena, the sun's altitude was observed to be 30° 22′ in the forenoon, his declination being then 22° 58′ S.; required the azimuth at that time?

Answ. 72° 22′ from the south, or 107° 38′ from the north.

Quest. IV. What point of the compass does the star Aldebaran bear on, at the Cape of Good Hope, when its altitude is 22° 25′?

Answ. 130° 20′ from the south, or 49° 40′ from the north.

Having found the sun's true amplitude or azimuth by the preceding methods, and magnetic amplitude or azimuth by observation, it is evident, that when they agree there is no variation; but when they disagree, then, if the true and observed amplitudes be both of the same name, that is, both north

north or both south, their difference is the variation; but if the true and observed amplitudes be of different names, that is, one north and the other south, their sum is the variation. Again, if the true and observed azimuths be both on the east, or both on the west side of the meridian, their difference is the variation; but if the true and observed azimuths be one on the east and one on the west side of the meridian, their sum gives the variation; and to know whether the variation is easterly or westerly, observe this general

RULE.

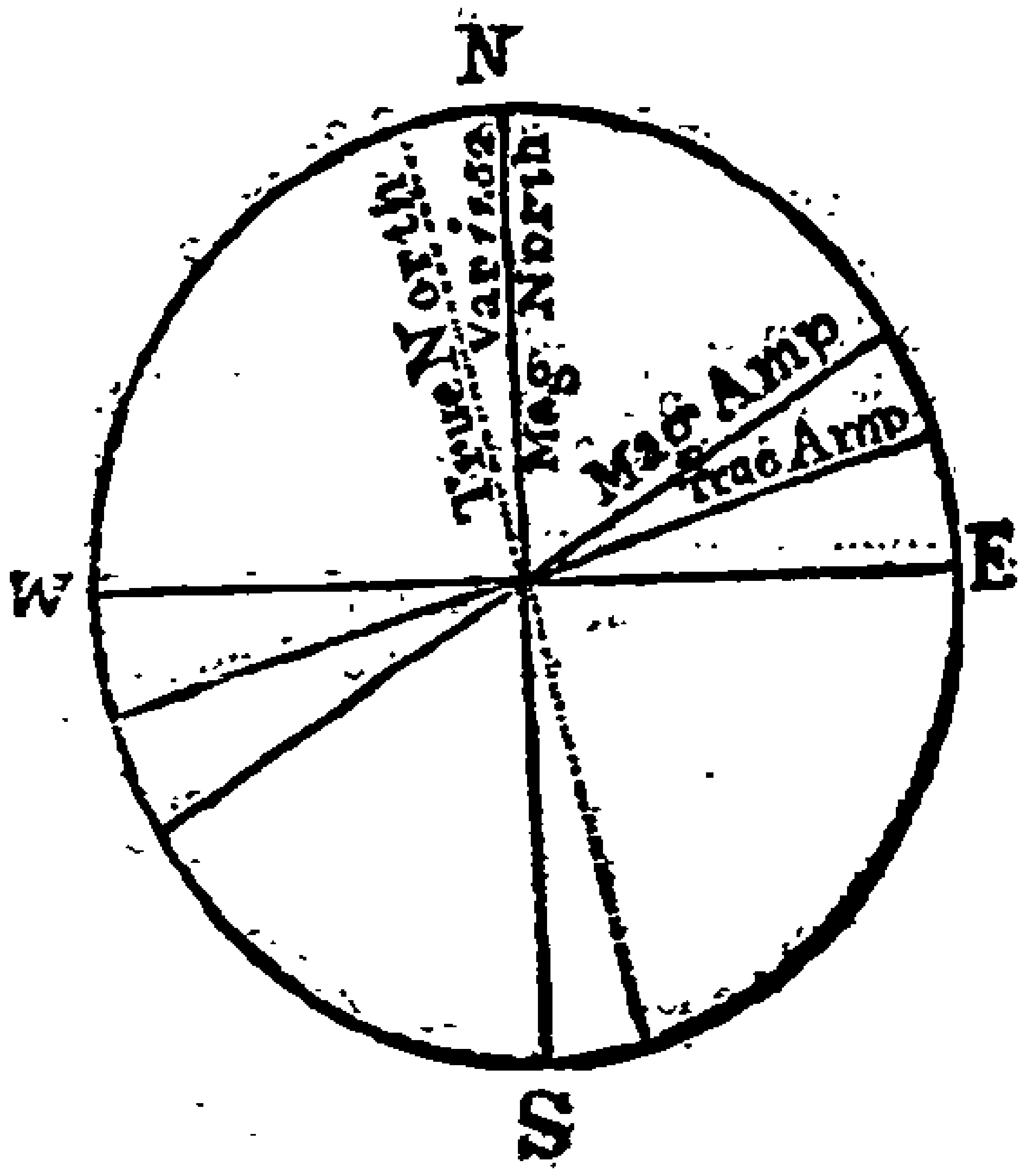
Let the observer's face be turned to the sun; then, if the true amplitude or azimuth be to the right hand of the magnetic, or observed, the variation is easterly; but if to the left hand, westerly.

EXAMPLE I.

Suppose the sun's magnetic amplitude at rising is found to be E. 26° 12′ N. but the true is found to be E. 14° 20′ N.; required the variation?

From the greater	E. 26° 12′ N.
Take the lesser	E. 14 20 N.
Remains the variation	11 52 E.

Which is easterly, because in this case the true amplitude is to the right of the observed.



With the chord of 60° describe a circle to represent the compass, through which draw the north, south, east and west lines; take the amplitude at rising, 26° 12′ from the line of chords, and setting it from E. towards N. and

and likewise the true amplitude 14° 20′ and set it from E. towards N. as before, the difference of these two angles, or between the true and magnetic amplitudes, viz. 11° 52′ is the variation. Now suppose yourself placed at the centre of the horizon, represented by the compass, and looking towards the magnetic amplitude at the sun's rising, it is plain that the true amplitude found by calculation is towards the right hand of the observed, which shews the variation is 11° 52′ E. and must be allowed to the right hand in all courses steered, before they can be put in the Traverse Table or bearings, taken by the compass.

EXAMPLE II.

Suppose the sun's true amplitude at setting be W. 34° 26′ S. and his magnetic amplitude W. 23° 13′ S. required the variation, since they are both of the same name?

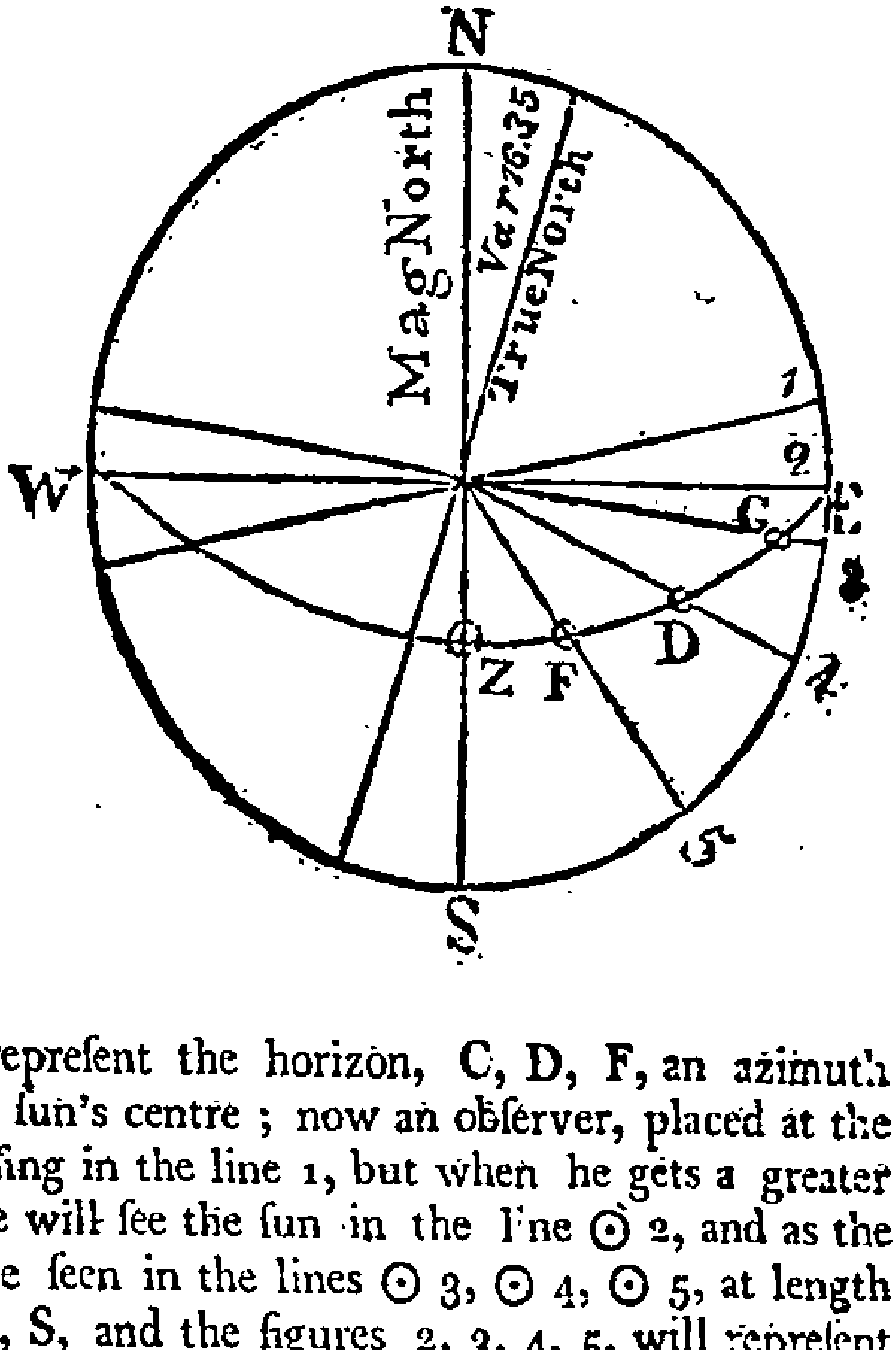
From the greater	—	W. 34° 26′ S.
Take the lesser	—	W. 23 13 S.
Remains the variation	—	11 13 W.

Which is westerly, because the true amplitude is to the left of the observed in this case.

EXAMPLE III.

Suppose the true azimuth 84° 40′ W.
The mag. az. 101 15 W.

Suppose the true azimuth	84° 40′	W.
The mag. az.	101 15	W.
* Variation	16 35	



* Let N. E. S. and W. represent the horizon, C, D, F, an azimuth circle, passing through the sun's centre; now an observer, placed at the centre, will see the sun at rising in the line 1, but when he gets a greater altitude, and arrives at E, he will see the sun in the line ☉ 2, and as the sun alters its altitude, will be seen in the lines ☉ 3, ☉ 4, ☉ 5, at length will arrive at its meridian Z, S, and the figures 2, 3, 4, 5, will represent the magnetic azimuth; the difference between these and the true azimuth found by calculation is the variation.

EXAMPLE

EXAMPLE IV.

Suppoſe the ſun's true amplitude at riſing is E. 13° 24′ N. and his magnetic amplitude E. 12° 32′ S. required the variation, and which way?

Since the true amplitude and obſerved have different names

To the true amplitude	E. 13° 24′	N.
Add the magnetic amp.	E. 12 32	S.
The ſum is the variation	25 56	W.

Which is weſterly, becauſe the true amplitude is to the left of the obſerved.

EXAMPLE V.

Suppoſe the ſun's true azimuth in the forenoon is N. 86° 40′ eaſterly, but by the compaſs it is N. 73° 24′ eaſterly; required the variation and which way?

Since the true and obſerved azimuths are both on the ſame ſide of the meridian,

From the greater	N. 86° 40′	E.
Take the leſſer	N. 73 24	E.
Remainder variation	13 16	E.

Which is eaſterly, becauſe the true azimuth is to the right of the obſerved.

EXAMPLE VI.

Suppoſe the ſun's true azimuth is N. 32° 28′ eaſterly, and his magnetic azimuth N. 8° 50′ weſt; required the variation and which way?

Since they are on the different ſides of the meridian,

To the true azimuth	N. 32° 28′	E.
Add the mag. azim.	N. 8 50	W.
Sum is the variation	41 18	E.

Which is eaſterly, becauſe the true azimuth is to the right of the obſerved.

EXAMPLE VII.

Suppoſe the ſun's true azimuth S. 17° 45′ E. and the magnetic azimuth S. 5° 48′ weſt, required the variation and which way?

Since they are on different ſides of the meridian,

To the true azimuth	S. 17° 45′	E.
Add the obſerved az.	S. 5 48	W.
Sum is the variation	23 33	W.

Which is weſt, becauſe the true azimuth is to the left of the obſerved.

The uſe of the variation is to correct the courſe ſteered by the compaſs; when the variation is eaſt, it muſt be allowed to the right hand upon every courſe ſteered quite round the compaſs; but when the variation is weſt, to the left hand.

NOTE. The variation may be eaſily found by taking the ſun's altitude in the morning, and obſerving what point of the compaſs he bears upon; and in the afternoon when the altitude is the ſame, the middle point will be the true meridian, the difference between which and the north or ſouth points of the compaſs is the variation. If the altitudes are taken at 5, 6, or 7 o'clock in the morning, you will have the ſame altitude at 5, 6, or 7 o'clock in the evening, being equally diſtant from noon.

The variation of the compaſs was firſt obſerved at London, in the year 1580, to be 11° 15′ eaſterly; and in the year 1622, it was 6° 0′ E. ſtill decreaſing,

decreasing, and the needle approaching the true meridian, until it coincided with it in the year 1662, since that time the variation still continues at London to increase westerly, at the rate of about 11 or 12 minutes every year; and is at this time about 23° 30′ westerly, and in the English channel about 25° 33′ westerly; but how far it will go that way, time and observations will probably be the only means to discover.

The variation at Paris in the year 1640, was 3° E. but in the year 1681 it was 2° 21′ W. and is now about 22° 20′ westerly, still continuing to go westerly.

In short, from observations made in different parts of the world, it appears, that in different places the variation differs both as to its quantity and denomination, it being east in one place, and west in another; the true cause and theory of which has not yet been discovered, and therefore in long voyages it is absolutely necessary that the mariner should find the variation of the compass by observation as often as possible.

One Magnus, a shepherd, first discovered the wonderful power of the loadstone, that gives polarity to the needle, by its sticking to the iron of his sandals; whence the name of Magnet was given to the stone, or magnetic needle. Gio, of Naples, about 300 years ago, first discovered that a piece of iron rubbed on it, and then suspended, had the property of pointing to the north and south, and thence applied to Navigation. An author of some degree of popularity, who has drawn a variation chart, says, he has found out the theory of the variation of the magnetic needle, without favouring the world with the principles; if his genius has been able to penetrate into the bowels of the earth, to discover this wonderful phenomenon, it is more than Sir Isaac Newton's or Dr. Halley's could do; however his veracity may be well doubted, as Mr. Wales, who accompanied Captain Cook round the world, told me, that his theory did not reach those islands which they discovered.

How to touch the Compass Needles.

Having two strong magnetical bars, lay the compass needle as nearly north and south as you can, with the intended north northwards, join the two magnets in a line, considerably above the needle, the north end of each being northward, and bring them down upon the needle, so that the place of junction may be over its centre; then draw them asunder along each half of the needle, and continue their motion till they are eight inches clear of the needle's end; by a circular motion bring them again to the centre and join them as before; repeat this operation six or seven times, taking care not to put the magnets out of their parallelism, and the needle will be sufficiently magnetical.

The METHOD of KEEPING a SHIP's RECKONING or JOURNAL at SEA.

BY keeping a Ship's Reckoning or Journal, is meant keeping such an account of the ship's way, that the mariner may be able at any time to ascertain the latitude and longitude the ship is in; it therefore should be the great concern of every person who takes upon them the navigating of ships to remote parts, to be expert therein, as the lives and fortunes of so many men are committed to their charge.

When a ship is bound from one place to another, which lies so far from her, that she is obliged to go out of sight of land for any considerable time, as from England to Jamaica; at the time of her leaving sight of land, she is said to take her departure, and that part of the land she then leaves, is said to be the place she takes her departure from; such as the Land's-end, Lizard, &c. and at the time of taking such departure, the captain or mate generally takes the bearing and distance of that land, (according to his judgment) and sets it down on the log-board, or in the log-book against the time it was taken, thus, Land's-end N. N. E. dist. 7 leagues, or Lizard N. by W. dist. 5 leagues, &c.

In the same manner may the departure from any place be taken, as may be seen in the first day's log of the following journal, where the log-book is marked in columns for hours, knots, fathoms, courses, winds, leeway, transactions; and under it the columns for courses, distances, northings, or southings, eastings, or westings, the latitude by dead reckoning, latitude by observation, meridianal distance, difference of longitude, longitude in, and in the last, bearing and distance of the land.

Notice must be taken, that in the column for course, you are always to set down the course you have made by your reckoning for that twenty-four hours; that is, from the noon of the day before to the noon of the day you work on, the sea account being always kept from noon to noon.

Dead reckoning, is that account deduced from occurrences which are written on the log-board.

In the columns for distance you are to set down the distance made by your reckoning for that twenty-four hours.

In the columns of northing and southing, you are to set down the difference of latitude made in that twenty-four hours, marking the column with north, if the difference of latitude be north; and south, if south.

In the column of easting or westing you are to set down the departure made that 24 hours, marking the column with east, if the departure be east, and with west, if westerly.

In the column marked lat. by D. R. you are to set down the lat. you reckon yourself in on that day; and in the column marked lat. by ob. you are to set down the latitude found by observation; also the difference of longitude

longitude made in the 24 hours in the column marked diff. long. ; the longitude in, in the column marked long. in ; and in the last, the bearing and distance from the land.

The variation, if any, must be allowed upon all courses steered, and upon all bearings that are taken by the compass ; that is, if it be easterly variation, it must be allowed to the right-hand ; if westerly, to the left of the course or bearing. Supposing yourself placed in the centre of the compass, and looking directly forward to the point you are to allow the variation upon.

EXAMPLE.

Suppose I steer S. W. and there is one point westerly variation, then my true course is S. W. by S. ; or suppose I set a point of land, and find it to bear by the compass E. S. E. and I know there is half a point easterly variation, then the true bearing is S. E. by E. ½ E.

Leeway must be allowed upon all courses steered, which is the difference between the point which the ship endeavours to sail upon, and the point she really sails upon, and is caused by the force of the wind or surge of the sea, when she is close hauled or plying to windward, which makes her fall off and glide side-ways from the point of the compass she capes at, and must be allowed to be on the right-hand of the course steered when the larboard tacks are on board, and on the left-hand when the starboard tacks are on board. The allowances that are generally made are as follow :

1st. When a ship is close hauled, if all her sails be set, the water smooth, and a moderate gale of wind, she is then supposed to make little or no leeway.

2dly. The ship being upon a wind, and the small sails in, allow one point for leeway.

3dly. The wind blowing hard, so as to cause one top-sail to be taken in, allow two points for leeway.

4thly. When it blows so hard that both topsails are taken in, and the sea runs high, allow then three points for leeway.

5thly. The fore-sail being furled, and the ship tries under a main-sail and mizen, allow four points for leeway ; for she then makes her way about four points before the beam, as the sea phrase is.

6thly. When the ship tries under the main-sail only, she then makes her way about three points before the beam, that is, allow near five points leeway.

7thly. If the ship tries under a mizen only, the way is about two points before the beam ; that is, allow six points for her leeway.

8thly. When she lies hull, that is, with all her sails furled, her way is one point before the beam, and then seven points is her leeway.

9thly. When a ship is lying-to under a main-sail, mizen, &c. then observe how she comes up and falls off, and take the middle between the two points, and from that allow the leeway and variation.

Note. In all cases, respect must be had to the smoothness of the water, or to the sea's running high, the mould and trim of the ship, and then the allowances

allowances may be aſcertained with the greater certainty, by ſetting the ſhip's wake by a compaſs placed on each rail of the ſhip's quarter, which is uſually ſet there for that purpoſe.

For it is well known, that ſome ſhips, with the ſame quantity of ſail, and with the ſame gale, will make more or leſs leeway than others; and alſo the ſame ſhip when ſhe is out of her trim, or differently loaded, will make different leeways: for it is obſervable, that the more water a ſhip draws, the leſs leeway ſhe makes; becauſe ſhe then meets with a greater reſiſtance in ſplitting the water with her ſide, than otherwiſe ſhe would.

The leeway may be eaſily found by the azimuth compaſs, by turning the inſtrument about until you ſee the wake of the ſhip either over the ſights or parallel to them; then the point of the card, which is cut by the vertical line in the box, which is neareſt to you, is the true courſe; the difference between that and the courſe given by the compaſs in the binnacle, is the leeway required, which ought to be accordingly entered upon the log-board.

There is another way of finding the leeway, by fixing a compaſs cut in lead, (or in other metal) on the poop, or ſome other convenient part of the ſhip's ſtern, with the meridian parallel to the ſhip's ſide, and in the centre a pin is fixed, to which is faſtened a ſmall line of a good length, with a piece of wood at the end of it, that it may be dragged after the ſhip. The point or degree cut by this line will ſhew the leeway; if it cuts the meridian, the ſhip makes no leeway; but if it does not, the difference between the meridian and where it cuts is the leeway.

By ſome of the above methods, the leeway (if there be any) ought to be carefully obſerved as often as may be judged neceſſary; and theſe obſervations ſhould be punctually ſet down by the officer of the reſpective watch; at leaſt, if no obſervation be made, he ought to ſet down the leeway according to his judgment once or twice in the watch, and by this means the courſe made good may be found to a much greater certainty and exactneſs than by the common method of allowing for leeway, when the day's account comes to be worked (which is generally once in 24 hours); for an obſervation muſt certainly be better than any gueſs. But if no obſervation be made, the perſon who is upon deck, and has the care of the watch, is better able to make proper allowances, while things are freſh in his memory, and while he is an eye-witneſs of the ſeveral accidents that happen; and certainly much more capable than another who was not upon the deck during the whole watch.

I have often admired to ſee how particularly every thing is ſtated upon the log-board, excepting the leeway: and yet that (which is one of the moſt material articles, ſince the courſe, according to the compaſs, muſt be corrected by it) only allowed for the next day according to every one's fancy, thereby, as it were, keeping as many different journals as there are artiſts (ſo called) on board the ſhip, and yet not one regular journal properly kept amongſt them all, ſince one of the moſt material articles is only gueſſed at.

EXAMPLE

EXAMPLE I.

Suppoſe I ſteer N. E. by E. with my larboard tacks on board, and make one point leeway, then my courſe made good is E. N. E.

Leeway and variation, when they are both to be allowed one way, that is, both to the right hand, or both to the left, add them together, and allow their ſum the ſame way they were to be allowed.

But if they are to be allowed, one to the right-hand, and the other to the left, ſubtract the leſs from the greater, and allow the remainder the ſame way the greater was to be allowed.

EXAMPLE II.

Suppoſe I ſteer N. N. W. with my ſtarboard tacks on board, and make one point leeway, there being at the time half a point weſterly variation; I would know my true courſe?

Leeway to the left-hand	——	1 point.
Variation to ditto	——	$\frac{1}{2}$ point.
Their ſum to be allowed to the left-hand		1 $\frac{1}{2}$

Whence the true courſe is N. W. by N. $\frac{1}{2}$ W.

EXAMPLE III.

Suppoſe I ſteer S. W. by W. with my larboard tacks on board, and make two points and a half leeway, and I have one point and a quarter weſterly variation; what is my true courſe?

Leeway to the right-hand	——	2 $\frac{1}{2}$ points.
Variation to the left-hand	——	1 $\frac{1}{4}$ point.
The rem. to be allowed to the right hand		1 $\frac{1}{4}$

Whence the true courſe W. S. W. $\frac{1}{4}$ weſterly.

EXAMPLE IV.

Suppoſe a ſhip lying-to under a main-ſail, with her ſtarboard tacks on board, comes up E. by S. and falls off to N. E. by E. there being one point weſterly variation, and ſhe makes 5 points leeway; what courſe does ſhe make good?

The middle between E. by S. and N. E. by E. is E. by N.; for which, allowing 6 points to the left-hand, the true courſe will be N. by E.

It is plain by the preceding examples, that if the leeway is made towards the meridian, it is taken from the courſe ſteered; but when it is made from the meridian, it muſt add to the courſe ſteered, to find the true courſe. The ſame may be obſerved of the ſum or difference of the leeway and variation, as may be ſeen by the following table, which is here ſet down to exerciſe the young Navigator in the foregoing rules.

THE TABLE.

Courses steered.	Winds.	Lee-way	Variation.	Courses corrected.
N. W. ½ W.	N. N. E.	½	¾ W.	N. 5 ¾ W.
W.	N. N. W.	¾		S. 6 ½ W.
W. S. W.	S.	1		S. 6 ¼ W.
W.	S. S. W.	¾		W.
W. by N.	N. by W.	1¼		S. 7 W.
S. W.	W. N. W.	1½		S. 1 ¾ W.
S.	W. S. W.	¾	1¼ W.	S. S. E.
S. S. W.	W.	1		S. ¼ E.
S. W.	N. W. by W.	½		S. S. W. ¼ W.
W.	S. S. W.	1¾		W. by N. ½ W.
W. by N.	N. by W.	1		W. S. W. ¾ W.
S.	E. S. E.	2		S. ¾ W.
E. by S.	S. ½ E.	¾		E. by N.
E. N. E.	N.	1¾		E. N. E. ½ E.
E.	N.	¾		E. by N. ½ E.
E.	S.	0		E. N. E. ¾ E.
S.	E. S. E.	½	1¾ W.	S. by E. ¼ E.
E. S. E.	N. E.	½		E. by S. ¼ E.
W. S. W.	S.	¾		S. W. by W.
W. by N.	S. W. by. S.	1		W. ¼ N.
N. W.	W. S. W.	1		N. W. ¼ W.
S.	W. S. W.	1	0¼ E.	S. ¼ E.
N. by E.	N. W. by W.	¾	1	N. N. E. ¾ E.
N. W. by N.	W. by S.	1¼	1	N. ¾ W.
N. W. by W.	N. by E.	1½	1¼	N. W. by W. ¼ W.
W. by S.	N. W. by N.	1¾	2½	W. ½ S.

NOTE. In sailing in the channel, or along a coast in a tide or current, particular care must be taken to take its setting for a course, and its drift for a distance, which must be entered among the courses and distances in the table of that day's reckoning. And where the setting of the tide and drift are not known, you must attain the point it must set upon, both of the flood and ebb, from the chart of the coast you are sailing along, by the times of high water at different places on the coast, and by the principles of fluids acting against such rocks, shoals, sand banks, &c. By a strict regard to these, both the drift and setting of the tides may be pretty nearly ascertained and allowed for.

Currents, the way they set you, and the distance you suppose you are driven by them, are to be set in the traverse table for the day, as any other course and distance.

EXAMPLE V.

Suppose I try the current, and find it to set W. by N. per compass one mile per hour, the variation being one point easterly; then if I sail in that current 24 hours, I set down in the table as a course, W. N. W. distance 24 miles.

Heave of the sea is to be accounted for in the same manner as currents: as, suppose there is a great sea heaving towards the S. W. by my compass, there being half a point westerly variation, I then set down in my traverse table S. W. by S. half westerly, with so much distance as I judge the sea has heaved the ship.

At leaving the land, the opposite point of the bearing, with the variation allowed upon it, and the distance you judge yourself from it, must be set down in the traverse table as a course and distance.

EXAMPLE VI.

Suppose, having one and a quarter point westerly variation, the Start bearing by my compass N. N. E. distant four leagues; the opposite point to N. N. E. is S. S. W. which, with the variation, makes S. $\frac{3}{4}$ westerly, for the course to be set in the traverse table, distant 12 miles.

When you make the land your bearing itself (with the variation allowed upon it, and the distance you judge yourself from it) is to be set down in the traverse table, as a course and distance. This needs no example.

The courses marked on the log-board are the courses steered by the compass. In order to obtain the true course, it is necessary to allow both for the variation of the compass, and for the leeway upon each course on the log-board, as has been shewn, before they are put into the traverse table.

Every day, at noon, the log-board is to be transcribed into the log-book, which is ruled exactly like the log-board.

Mariners reckon by the civil account of time used on shore, but they keep the reckoning for the ship's place, by beginning at noon, and counting from thence 24 hours to the next noon. From noon to midnight they mark with P. M. signifying after mid-day; and the second twelve hours with A. M. signifying after midnight; ending their day's work at the noon of the civil day. Hence, their ship's account is twelve hours earlier than their shore account of time. And as the sun's declination used for finally determining the ship's place at the end of the sea-day is calculated for the noon of the common day at London or Greenwich, therefore the declination for the noon of the civil day must be taken for determining the latitude, &c. at finishing their day's account. Thus, a day's work marked Tuesday, May 6th, began on Monday at noon, and ends on Tuesday noon, so that the sun's declination for the 6th of May is used for the noon of Tuesday, and fitted to the meridian of the ship, according as she is E. or W. of London.

There are various methods of keeping a sea-journal, according to the sentiments of various persons, with regard to what deserves being recorded: some approve of a journal including the log-book, each day's work at some length, and such occurrences as seem of most importance; while others

others prefer a ſhort abſtract of this long journal, containing little more than the courſe run, the latitude and longitude in, and ſometimes the bearing and diſtance of the intended port for each day.

In the following journal the long form is uſed as repreſenting more fully each day's work, and the neceſſary corrections: and an abſtract of this may be drawn out in the ſhorteſt form that ſeems conſiſtent with diſtinctneſs. The Learner ought to be thoroughly acquainted with the long form, and when he does that, he may either continue it, or take the ſhorteſt form; or retrenching from the firſt, and adding to the ſecond what particulars he thinks proper, and thereby make out a form adapted to his own particular taſte.

RULES for correcting the DEAD RECKONING by an Obſervation.

NOTWITHSTANDING the rules already laid down for keeping a ſhip's way at ſea, yet by reaſon of the ſeveral accidents that may attend a ſhip in one day's run, ſuch as ſwelling ſeas, different rates of ſailing between the times of heaving the log, want of care at the helm in letting the ſhip fall off, or come to, accidental currents, ſudden ſqualls, when no account can be kept, &c. the latitude by account and latitude by obſervation may very often differ, then it is neceſſary that proper corrections be made in the difference of longitude.

When you have made all proper allowances you can, ſuch as for leeway, variation, currents, &c. and ſtill find that your latitude by account will not agree with your latitude by obſervation, then you muſt correct as follows:

Firſt, Conſider whether you have made proper allowances for currents, heave of the ſea, if the courſe at the helm has been carefully attended to, if the log-line and half-minute glaſs be juſt, and the log properly hove, or any ſudden ſqualls, or proper allowances made for the leeway, &c. which of theſe you conjecture your error is in; make what allowances you think meet to your difference of latitude and departure by dead reckoning, and ſee if that will reform your latitude by account, ſo as to make it agree with your latitude by obſervation; if it does, you have gueſſed right (for you muſt always keep to the latitude by obſervation, it being the only thing to be depended on); but if it will not agree with the obſerved latitude, it is to be ſuppoſed that there are miſtakes in your conjecture, or ſome other cauſe which produces the error in the reckoning,

ing, and ſtands in need of being corrected. In this caſe, you are firſt to examine your log-line and half-minute glaſs, and if there be an error in them, allow for it, as in the following examples;

EXAMPLE I.

Yeſterday at noon, we were in latitude 48° 20′ N. and till this day at noon we have failed S. S. W. 48 miles, S. W. by S. 36 miles, N. E. 24 miles, and find by good obſervation that we are in latitude 47° 14′ N.

TRAVERSE TABLE.

COURSES.	DIST.	N.	S.	E.	W.
S. S. W.	48		44,4		18,4
S. W. by S.	36		29,9		
N. E.	24	17,0		17.0	20,0
		17,0	74,3		38,4
			17,0		17,0
			57,3		21,4

By the Traverſe Table it appears, that by account the diff. of lat. is 57,3 S. and the departure 21,4 W.

Now the lat. left was	——	48° 20′ N.
Diff. of lat. by account	——	0 57 S.
Latitude in by account	——	47 23 N.

Differing 9 miles from the true latitude by obſervation.

Wherefore I examine the log-line and half-minute glaſs, and find that the former meaſures 52 feet between knot and knot, and that the latter runs only 27 ſeconds. Now, as the log-line and half-minute glaſs are both faulty, I correct my difference of latitude and departure as in Caſe III. (page 146) and find my correct difference of latitude 66,2 S. and my departure 24,7 W.

Now from latitude left	——	48° 20′ N.
Take diff. corrected for error in diſt.		1 6 S.
Lat. in, corrected for error in diſt.		47 14 N.

Agreeing exactly with my latitude by obſervation; I therefore conclude my reckoning ſufficiently correct. Then, with the difference of latitude 66,2, and departure 24,7, together with yeſterday's latitude, I find the difference

difference of longitude either by Middle Latitude or Mercator's ſailing. (See Caſes 2d. of Mid. Lat. and Mercator.)

In the laſt example 57,3 and 21.4. multiplied ſeverally by 156, thrice the meaſured length of a knot, and divide the two products by 135, five times the meaſured time of the glaſs, will give the difference of latitude 66,2, and departure 24,7, which is the ſame thing as if every courſe had been corrected ſeparately. (See Caſe III. page 146.)

EXAMPLE II.

Yeſterday at noon we were in lat. 36° 15′ N. and have ſailed theſe 24 hours S. E. ½ E. 55 miles, N. E by N. 20 miles, W. S. W. 70 miles, S. by W. ½ W. 20 miles, and by obſ. this day at noon we are in lat. 34° 56′ N.

THE TRAVERSE TABLE.

COURSES.	DIST.	N.	S.	E.	W.
S. E. ½ E.	55		34.9	42.5	
N. E. by N.	20	16.6		11.1	
W. S. W.	70		26.8		64.7
S. b. W. ½ W.	20		19.1		5.8
		16.6	80.8	53.6	70.5
			16.6		53.6
			64.2		16.9

By the Traverſe Table it appears, that by account the diff. of lat. is 64.2 S. and the departure 16.9 W.

Latitude ſailed from ——	36° 15′	N.
Differerence of latitude by account	1 4	S.
Latitude in by account ——	35 11	N.

Differing 15 miles from the latitude by obſervation.

I now examine the log-line and half-minute glaſs, and find them both right. Next I conſider whether there be any current, and I think I have reaſon to ſuſpect one ; upon trial I find there is one ſetting S. S. W. ¾ W. at the rate of 7 fathoms an hour, and judge I have been in it theſe 24 hours. Then 7 fathoms (or tenths of a knot) per hour, in 24 hours, makes about 17 miles ; and to the diſt. 17 miles, and courſe S. S. W. ¾ W. the diff. of lat. is 14,6 S. and departure 8,7 W.

	Diff. Lat.	Dep.		
Now by tra. table	64.2 S.	16.9 W.	Latitude ſailed from	36° 15′ N.
And by current	14,6 S.	8,7 W.	Diff. of lat. cor. for cur.	1 19 S.
Correct for cur.	78,8 S.	25,6 W.	Lat. in, correct. for cur.	34 56 N.

Which

Which agreeing with my latitude by obſervation, I conclude that my reckoning is right; then having the latitude left, and latitude come to, the difference of longitude may be found either by Middle Latitude or Mercator's Sailing as before.

If, after all proper allowances are made for errors in diſtance, currents, &c. the latitude by account and obſerved latitude ſhould diſagree, then the reckoning muſt yet be further corrected; and to do which, the following are the common, and ſeem to be the moſt rational methods.

CASE I.

If the Courſe found by Dead Reckoning be leſs than three Points, or thirty-three Degrees.

RULE. To the difference of latitude and departure by account find a courſe; to this courſe and the difference of latitude by obſervation, find the difference of longitude, either by Middle Latitude or Mercator's Sailing.

EXAMPLE.

Yeſterday at noon, we were in lat. 39° 18′ N. by an obſervation, this noon we are in lat. 37° 48′ N. and our dead reckoning gives 107 miles of ſouthing, and 64 of weſting; required the true difference of longitude?

To the difference of latitude 107, and departure 64, I find the courſe $2\frac{1}{4}$ points; then with the meridional difference of latitude between the two obſervations 115, and the ſame courſe, I find the true difference of longitude 69 miles.

CASE II.

If the Courſe found by Dead Reckoning be more than three Points, or thirty-three Degrees, and leſs than five Points, or fifty-ſix Degrees.

RULE. With the diff. of lat. and dep. by account, find the diſtance; with this diſtance, and diff. of lat. by obſervation, find another departure. Take half the ſum of this dep. and dep. by account for the true dep. with which and the diff. of lat. by obſervation, find the diff. of longitude.

EXAMPLE.

Yeſterday at noon, we were in lat. 52° 40′ N. and are this noon in lat. 54° 22′ N. having by account made 84 miles of northing and 76 miles of weſting; required the true difference of longitude?

To the diff. of lat. 84, and dep. 76, the diſtance is 113 miles, and the courſe 42° by Caſe VI. of Plane Sailing.

To diſt. 113, and diff. of lat. between the two obſervations 102, the dep. is 47,7 by Caſe IV. of Plane Sailing; then 76 added to 47,7, is 123,7, half of which is 61,8, the true dep.

To

To dep. 61,8, and diff. of lat. by obſervation 102, the courſe is 31° by Caſe VI. and with the courſe 31°, and the meridional diff. of lat. between the two obſervations 171, I find the diff. of long. is 103 miles, by Caſe II. Plane Sailing.

CASE III.

If the Courſe by Dead Reckoning be more than five Points, or fifty-ſix Degrees.

RULE. With the diff. of lat. and departure by account find the diſtance; then with this diſt. and diff. of lat. by obſervation find the diff. of long. by Caſes VI. and IV. of Plane Sailing.

EXAMPLE.

Yeſterday at noon we were in lat. 38° 52′ N. to-day at noon we are in lat. 40° 18′ N. and by account have made 68 miles northing, and 112 miles of weſting; required the true diff. of longitude?

With the diff. of latitude 68, and departure 112, I find the diſtance 132 miles, and to diſtance 132, and difference of latitude by obſervation 86. the courſe is 49° 30 nearly; with this courſe, and the meridional difference of latitude between the two obſervations 111, the difference of longitude is 130 miles.

The reaſon of the above rule is plain, if we conſider, that when a ſhip ſails near the meridian, it will require a ſenſible error in the courſe, to make any conſiderable error in the difference of latitude; which can hardly happen if proper care is taken at the helm; and therefore it is moſt likely that the error is in the diſtance run; but when the courſe is near the middle of the quadrant, or between 3 and 5 points from the meridian, it is then probable the error may be in both courſe and diſtance; and when the courſe is more than five points from the meridian, it is then moſt likely the error is in the courſe, as it will require a great error in the diſtance to make any conſiderable one in the difference of latitude.

NOTE. As the true place of a ſhip depends upon her latitude and longitude being truly aſcertained, I have ſet theſe down only, the reſt being of leſs conſequence to the mariner.

To correct for ſeveral Days.

By help of the three preceding rules, the longitude may always be corrected for a ſingle day, but if an obſervation has been wanted for one or more days, then mark the latitude and longitude at laſt obſervation, or if this be your firſt obſervation ſince leaving the land, mark the latitude and longitude of the land you left; this is the only latitude and longitude you can call certain; all the following part of the reckoning muſt undergo a correction, which is made as follows;

Take the northings, ſouthings, eaſtings, and weſtings, that you have made ſince your laſt obſervation; or if this be your firſt obſervation, then

for

for every day from your leaving the land, minding not to leave out the difference of latitude and departure of the day you correct on, and bring them into the traverse table, by which you will have the whole difference of latitude and departure by account since the last observation; and with that same difference of latitude and departure find the course by Dead Reckoning by Case VI. of Plane Sailing; then observe which of the foregoing cases that course falls under, and correct by the rule for that case. But when an observation has been wanting for several days, then mark the latitude and longitude you were in at your last observation, of leaving the land as before, and then you may correct with a greater degree of certainty; especially in high latitudes, by the following rules:

CASE I.

Reckoning from the last certain latitude and longitude.

When the course given by the meridional difference of latitude and difference of longitude by account, taken as difference of latitude and departure, is less than three points, or 33 degrees.

RULE. To the meridian difference of latitude and difference of longitude by account (taken as difference of latitude and departure as shewn in Mercator's sailing,) find a course by Case VI. of Plane Sailing; with this course and the meridian difference of latitude by observation, find a corresponding departure, by Case III. of Plane Sailing, which will be the correct difference of longitude.

EXAMPLE I.

Having sailed three days ago from latitude 49° 57′ N. and got no observation till this day at noon, and find I am in latitude 45° 23′ N. and by dead reckoning I am in 45° 12′ N. having differed my longitude 173 miles; required my difference of longitude?

		M. Parts.			M. Parts.
Lat. sailed from	49° 57′ N.	3470	Lat. sailed from	49° 57′	3470
Lat. by account	45 12 N.	3047	Lat. by obser.	45 23	3063
Merid. diff. of lat. by acc.		423	Mer. diff. of lat. by obs.		407

To meridian difference of latitude by account 423, and difference of longitude by account 173, the course is 22° 15′. Then with the course 22° 15′, and meridional difference of latitude between the observations 407, I find the difference of longitude is 167 miles.

CASE II.

When the course given by the meridional difference of latitude and difference of longitude by account, (taken as before) is greater than 3 points, and less than 5 points.

RULE. To the meridian difference of latitude and difference of longitude by account, taken as difference of latitude and departure, find a dist-

ance

ance by Case VI.; with this distance, and meridian difference of latitude by observation, find a corresponding departure by Case IV. of Plane Sailing; half the sum of this departure, and the difference of longitude by account, is the correct difference of longitude.

EXAMPLE II.

Three days ago we were in latitude 45° 23′ N. and have since that time sailed between south and west, have by dead reckoning altered our latitude 94 miles, and our longitude 147 miles; but by an observation this day, we find we are in latitude 43° 34′; required the correct difference of longitude?

		M. Parts.			M. Parts.
Lat. sailed from	45° 23′ N.	3063	Lat. sailed from	45° 23′ N.	3063
Lat. by acc.	43 49 N.	2931	Lat. by obser.	43 34 N.	2910
Mer. diff. of lat. by account		132	Mer. diff. by observation		153

With the meridian difference of latitude by acc. 132, and difference of longitude by acc. 147, I find the distance 198, and course 48°. Then to distance 198, and meridian difference of latitude by observation 153, the dep. is 125; now 125 added to 147 is 272, and half this sum, viz. 136, is the correct diff. of longitude.

CASE III.

When the course given by the meridian difference of latitude and difference of longitude by account, (taken as before) is more than 5 points or 56 degrees.

Rule.—To the meridian difference of latitude and difference of longitude by account, taken as difference of latitude and departure, find a distance by Case VI. of Plane Sailing.

To this distance and meridian difference of latitude by observation, find a corresponding departure by Case IV. of Plane Sailing; this departure will be the correct difference of longitude.

EXAMPLE III.

Two days ago I was in latitude 43° 34′ N. and have since then made by account 50 miles southing, and 256 miles difference of longitude west, but find by observation that I am in 42° 30′ N.; what is my true difference of longitude?

		M. Parts.			M. Parts.
Lat. sailed from	43° 34′ N.	2910	Lat. sailed from	43° 34′	2910
Lat. by account	42 44 N.	2841	Lat. by obser.	42 30	2822
Mer. diff. of lat. by account		69	Mer. diff. of lat. by obser.		88

Then to meridian difference of latitude by account 69, and diff. of longitude by account 256 (taken as difference of latitude and departure), the distance is 265, and course 75 degrees. And

And to diſtance 265, and difference of latitude 88 (the meridian difference of latitude by obſervation), the departure is 250, which is the correct difference of longitude.

Here we have given at ſome length the different methods of correcting the dead reckoning by an obſervation, which are readily done by the table of difference of latitude and departure.

The ſhip's way is generally greater than the diſtance given by the log, and it is always ſafeſt to have the reckoning a-head of the ſhip, that the mariner may be looking out for land, and not make it before he is aware of it.

When a great ſea ſets after the ſhip, it is common to allow one mile over for every ten given by the log, for the heave of the ſea ; but if the ſea be againſt or athwart her, her diſtance muſt be leſs than that given by the log.

The error in the ſhip's reckoning is frequently attributed to unknown currents ; for by various cauſes yet undetermined, there are many counter motions of the water in the open ſeas, as well as thoſe obſerved near the ſhores, where the motions may be tolerably well accounted for. Some of the obſerved currents in the great ſeas may perhaps be owing to the tides following the moon, and to the libratory motion the waters may have thereby, and the unſettled ſetting and drift of theſe currents may poſſibly depend on the change in the moon's declination. However, it is well known from obſervations, that the trade-winds occaſion a conſiderable current within their limits, particularly within the Torrid Zone, where the motion is perpetually towards the weſt, at the rate of 8 or 10 miles a day, but at the extremities of the trade-winds, or near the latitudes of 30° N. or S. it is likely that the currents are compounded of the ſaid weſtern motion, and of one towards the equator ; therefore all ſhips ſailing within theſe limits ſhould allow a courſe each day for this current.

Note. When the difference of latitude by account is leſs than the difference of latitude by obſervation, the ſhip is a-head of the reckoning, but if leſs, the reckoning is a-head of the ſhip.

When the mariner is dubious of his account of longitude, he generally runs into the latitude of the intended port, and then ſails E. or W. if there be ſea room, according as it is ſituated, and keeps a good look-out for the land.

The method I have choſen to introduce the young mariner into the moſt capital part of navigation is, by ſhewing him firſt how to work a few ſeparate day's works independent of each other, and then proceed to a continued journal from London to Madeira and Teneriffe, in which will be inſerted moſt of the occurrences that commonly happen at ſea, or in harbour.

I have ſeen many young navigators who have been taught the principles of navigation on ſhore, very deficient in keeping a journal at ſea ; and therefore, muſt requeſt the Teacher not to omit putting the pupils over the following journal, which will render them ready at working a day's work at ſea, and confirm in their memory thoſe rules they have been over.

EXAMPLE

EXAMPLE I.

Yesterday at noon we were in the latitude of 46° 28' N. and longitude 22° 18' W. and have sailed till this day noon, as by the log-board, the tide having all the time set S. by E. 2½ miles per hour; required the ship's place and the direct course and distance made good?

LOG-BOARD.

H	K	F	Courses.	Winds.	L W
1	6	3	N. N. E.	W.	
2	6	2			
3	6	5			
4	6	4			
5	6	0			
6	6	1	E. N. E.	N. W.	
7	6	6			
8	5	8			
9	5	6			
10	5	4			
11	5	5			
12	5	3	E. by S.	N.	
1	5	9			
2	6	2			
3	6	0			
4	6	3			
5	6	4			
6	7	0	S. S. E.		
7	6	8			
8	7	3			
9	7	5			
10	7	1			
11	7	9			
12	7	3			

TRAVERSE TABLE.

Courses.	D	N.	S.	E.	W.
N. N. E.	31	28.6		11.9	
E. N. E.	35	13.4		32.3	
E. by S.	36		7.0	35.3	
S. S. E.	51		47.1	19.5	
S. by E.	60		58.8	11.7	
		42.0	112.9	110.7	Dep.
			42.0		
	Diff. Lat.		70.9		

Lat. left	46° 28'	N.	M. Par. = 3156
Diff. lat.	1 11	S.	
Lat. in	45 17	N.	M. Par. = 3052
Sum lat.	91 45		Mer. D. Lat. = 102
Mid. lat.	45 52		
Co. M. lat.	44 08		
Long. left	22 18	W.	
Diff. of lon.	2 39	E. or 2° 40'	
Long. in	19 39	W.	

Direct Course S. 57° 22' E.
Distance 131 miles.

The courses and winds on the log-board being examined, it appears that the ship goes large and has no lee-way; therefore the several courses from the log-board are entered in the Traverse Table without alteration.

Next the fathoms and knots belonging to each course are summed up, and the results are put in the column of distances in the Traverse Table: and to these courses and distances, the whole difference of latitude, departure, course and distance made good, are found as above.

Then having the lat. left, and the latitude come to; find the complement of the middle latitude, and with that, and the departure, find the course, &c. by middle latitude sailing.

Or with the course, and meridional difference of latitude, find the difference of longitude, by Mercator's Sailing.

Note. When the odd fathoms are above five, we allow one knot, but, if under five, nothing is allowed.

EXAMPLE

EXAMPLE II.

June 29, 1795; Being yesterday noon in latitude 25° 30' S. and longitude 10° 15' E. we have sailed till this day noon, as per log-board, in a current setting south 2½ miles an hour, the variation 1½ point west; required the ship's place?

LOG-BOARD.

H	K	F	Courses.	Winds.	L W
1	6	0	S. W.	W.N.W.	1
2	6	2			
3	6	4			
4	6	0			
5	5	3			
6	6	0	S. by W.	W. by S.	1
7	5	1			
8	5	4			
9	5	2			
10	5	3			
11	5	5			
12	5	2	S. S. W.	W.	1
1	5	2			
2	5	0			
3	4	6			
4	5	0			
5	5	1			
6	5	2	S. E. by S.	S.W. by S.	1
7	5	4			
8	5	4			
9	6	0			
10	6	0			
11	5	4			
12	5	5			

TRAVERSE TABLE.

Courses.	D	N	S.	E.	W.
S.bW½W	30		28,7		8,7
S.byE½E.	32		30,6	9,3	
S. ½ E.	30		29,9	2,9	
S.EbE½E	39		18,4	34,4	
S.bE.½E.	60		57,4	17,4	
	D.Lat.		165,0	64,0	8,7
				8,7	
				55,3	Dep.

Diff. lat. 2° 45′ S.
Lat. left 25 30 S. Mer.parts 1583

Lat. in 28 15 S. Mer.parts 1768

Sum lat. 53 45 M. diff. lat. 185

Mid. lat. 26 52

Co.m.lat. 63 08

Long. left 10 15 E.
Dif. Long 1 02 E. or 1° 01′½ E.

Long. in 11 17 E.

Cou. is S. 18 30 E.
Distance 174 miles.

The courses and winds on the log-board being examined, it appears that the ship is close hauled on each tack, and one point lee-way being allowed, reduces the courses, and taking a course for the current S. these several courses being corrected by the variation 1½ point west, give those in the Traverse Table, to which the whole difference of latitude and departure is to be found as above.

And hence the latitude and longitude in may be found, either by middle latitude or Mercator's sailing; for as the ship is near the Equator, the difference will be almost insensible.

NOTE. In the two following examples, the courses are corrected to the nearest degrees, as set down in the Traverse Table, and the odd minutes are rejected.

EXAMPLE

EXAMPLE III.

Yesterday at noon we were in latitude 33° 40′ N. longitude 16° 20′ west, the sun was observed to set 50° 13′ from the north point of the compass; we have sailed this day noon, as per log-board, in a current setting W. S. W. 1½ mile per hour; required the ship's place, and her course and distance to the west end of the Island of Madeira?

LOG-BOARD.

H	K	F	Courses.	Winds.	L.W
1	6	2	S. by W.	W.	0
2	6	0			
3	6	3			
4	7	0			
5	7	2			
6	7	3			
7	7	2	S.W.byS.	W.b.N	1
8	7	2			
9	7	4			
10	7	6			
11	7	4			
12	8	1			
1	8	0			
2	8	5			
3	8	2			
4	7	5	S.WbyW	N. W.	0
5	7	3			
6	6	6			
7	6	4			
8	6	0			
9	6	2			
10	6	1			
11	6	3			
12	6	1			

TRAVERSE TABLE.

Courses.	Dist.	N.	S.	E.	W.
S. 01° E.	40		40,0	0,7	
S. 10 W.	70		68,9		12,2
S. 44 W.	58		41,7		40,3
S. 55 W.	36		20,6		29,5
	Diff. Lat		171,2	0,7	82,0
					0,7
				Dep.	81,3

Before the courses can be corrected to be put into the Traverse Table, the variation of the compass must be found from the sun's true amplitude. The declination is 22° 30′ N.

As cos. lat. 33° 40′ : rad : : sin. 22° 30′ : sine 27° 22′.

So that the true amp. = N. 62° 38′ W.
Magnetic ampl. = N. 50 18 W.

Variation = 12 20 W.

The courses on the log-board, being corrected by this variation and the lee-way, will give the courses fitted for the Traverse Table.

Lat. left	-	33° 40′	N.
Diff. lat.	-	2 51	S.
Lat. in	-	30 49	N.
Sum. lats.	-	64 29	
Mid lat.	-	32 14	
Co. mid. lat.	-	57 46	N.
Long. left	-	16 20	W.
Diff. long.	-	1 36	W.
Long. in	-	17 56	W.

Madeira's lat.	32° 30′	N.	M. parts 2064
Lat. in -	30 49	N.	1945
Diff. lat. -	1 41	= 101 miles.	119
Sum lats.	63 19		
Mid. lat.	31 39		
Co. mid. lat.	58 21		
Madeira's lon.	17 26	W.	
Long. in -	17 56	W.	
Diff. long.	0 30	E.	

The course N. 14 30 E. dist. 104 miles.

In the work for the amplitude, the latitude at sun-set was taken the same as at noon; for although there were about 46 miles of southing in that time, and so the latitude at sun-set was about 32° 54′, yet the amplitude being only about 15′ less, the alteration in variation would scarcely affect the difference of latitude and departure found from the courses so corrected.

EXAMPLE IV.

Yesterday at Noon we were in Latitude 19° 30′ S. and Longitude 0° 10′ E. This Forenoon we observed the Sun's Altitude to be 10° 40′ when he was 80° 30′ from the North Point of the Compass, Declination being then 17° 27′ N. we have sailed till this Day Noon, as per Log Board, in a Current setting by the Compass W. N. W. half a Mile an Hour. Required the Ship's Place and her direct Course and Distance to the Island of St. Helena.

Log-Board.

H	K	F	Courses.	Winds.	Lee-way.
1	6	7	N. by E.	E. by N.	1
2	6	2			
3	6	4			
4	6	3			
5	6	1			
6	6	0			
7	5	8	North.	E. N. E.	1
8	5	4			
9	5	0			
10	5	3			
11	5	6			
12	5	9			
1	5	7			
2	6	4	N. N. W.	N. E.	1
3	6	8			
4	7	0			
5	7	3			
6	7	6			
7	7	5			
8	7	0			
9	7	2			
10	7	4			
11	6	3			
12	6	0			

Diff. Lat.	2° 06′ N.	M. Parts.
Lat. left.	19 30 S.	1193
Lat. in	17 24 S.	1060
Sum Lats. 2)36	54 Mer. diff. L.	133
Mid. lat.	18 27	
	90 00	
Co. Mid. Lat. 71 33		
Longitude left	00° 10′ E.	
Diff. Long.	1 38 W.	
Present long.	1 28 W.	

Traverse Table.

Courses.	Dist.	N.	S.	E.	W.
N. 13° W.	38	37.0			8.5
N. 25 W.	39	35.3			16.5
N. 47 W.	76	51.8			55.6
N. 81 W.	12	1.9			11.9
		126.0	Diff. Lat.	Dep.	92.5

Lat. 19° 30′ S.	Alt. 10° 40′	Dec. 17° 27′ N.	
90 00	90 00	90 00	
	Co. Alt. 79 20	P. Dist 107 27	
Co. Lat.	70 30	Co. Sec.	0,02565
Co. Alt.	79 20	Co. Sec.	0,00757
P. Dist.	107 27		
Sum	357 17		
$\frac{1}{2}$ Sum	128 38	Log. Sine	9,89274
Pol. Dist.	107 27		
Rem.	21 11	Log. Sine	9,55793
			2)19,48389
Co. S. True Azimut =	56° 30′		9,74914
	2		
True Azimuth	113 00 from the S.		
	180 00		
True ditto	67 00 from the N.		
Mag. Azimuth	80 30 from the N.		
Variation	13 30 W.		

Lat. in 17° 24′ S.	Long. in 1° 28′ W.	M.P. 1060	
St Hel. L. 15 55 S.	St. Hel. lo. 5 46 W.	M.P. 968	
Diff. lat. 1 29	Diff. long. 4 18	M. D. Lat. 92	
60	60		
In Miles 89	In Miles 258		

With the Meridional Difference of Latitude and Difference of Longitude, the direct Course to St. Helena is found S. 70° 22′ W. and with that Course and the proper Difference of Latitude the Distance is found 265 Miles.

In this Example the Azimuth is worked with Yesterday's Latitude and Declination, but had it been worked with this Day's, the Variation would have been 12° 26′ W.

A JOURNAL OF A VOYAGE FROM *LONDON* TO *MADEIRA*, AND TENERIFFE, IN THE FRANCES, OF LONDON; *WILLIAM JOHNSON*, COMMANDER: KEPT BY JOSEPH MILLS, MATE.

Departure taken from the Lizard in Latitude 49° 57′ N. Longitude 5° 14′ W. bound for Funchal, in Madeira, in Latitude 32° 38 N. Longitude 17° 5 W. and to Teneriffe in Latitude 28° 13′ N. Longitude 10° 26′ W. bearing from the Lizard-Point S. 26° 58′ W. distance 1166 Miles.

Begun April 1, 1795.

In the following JOURNAL are exemplified, the Manner of allowing for the Variation, Lee-way, Lying-to, Calms, Currents, Heave of the Sea, &c. and to correct the Dead Reckoning, by an Observation, in all Cases; with most of the Occurrences that commonly happen at Sea, and the Ship's Way pricked off on MERCATOR'S CHART.

Wednesday, April 1, 1795.	At 5 A. M. the pilot came on board; then weighed and failed from Tower Wharf; at 11 came to with the best bower at Blackwall. Wind S. S. W.
Thursday, 2.	Fresh gales and cloudy weather, with rain. At 5 A. M. weighed and failed, at 9 came to an anchor at Gravesend and cleared ship. Wind from S. S. W. to N. N. W.
Friday, 3.	At 4 P. M. weighed and failed, moderate weather; at 9 came to with the best bower at the Nore in 9½ fathoms. fresh gales; at 4 A. M. weighed and failed; at 11 came to anchor in the Downs in 7 fathoms, Deal Castle bearing W. ½ S. distant 3 miles. Wind W. by S.
Saturday, 4.	At 1 P. M. set the Pilot on shore. These 24 hours, the first and middle parts moderate and fair, the latter part strong gales and cloudy; hoisted the boats in.
Sunday, 5.	Strong gales and cloudy; at 2 P. M. veered out the long service of the best bower, got top-gallant yards down; at 4 P. M. struck yards and top-masts. These 24 hours had very hard gales of wind. Wind W. by S.
Monday, 6.	These 24 hours, for the most part, fresh gales; at 4 A. M. hove up the best bower, and let go the small bower; at 9 hove up the small bower and let go the best bower again; people employed in making points and gaskets.
Tuesday, 7.	At 6 P. M. strong gales with heavy rain; at 8 veered out the long service, and let go the sheet anchor under foot: at 9 A. M. hove up the sheet anchor. Wind variable from S. by W. to W.
Wednesday, 8.	These 24 hours, for the first and middle parts, moderate and fair; the latter part, strong gales. Wind W. by S.
Thursday, 9.	These 24 hours, fresh gales and fair; at 3 P. M. got top-gallant mast down; at 10 A. M. got yards and top-mast up. Wind E. S. E.

H	K	F.	Courses.	Winds.	Lee way	Remarks on board, Friday, April 10th, 1795.
2			S. by W. ½ W.	N. ¼ W.		At 2, P. M. hove short.
4						At 4 weighed and sailed in company with a 40 Gun Man of War, and 20 sail of Merchant-men.
6						
8						
10			W.	N. by W.		At 6 S. Foreland bore N. N. W. distant 4 Miles.
12			S. W. by W. ½ W.			At 2 A. M. Fairlee bore N. distant 6 Miles,
2						At 6 Beachy bore N. by W. 6 Miles.
4			W. N. W. ½ W.	N. ½ W.		At 8 Beachy bore N. E. by E. 9 Miles.
6			W. S. W.	N. by E.		Fresh Gales and clear, several Ships standing up Channel; close reefed both Topsails.
8						
10						
12						At 12 Bembridge P. bore W. N. W. 27 miles. Still in Company with the Fleet.

H	K	F.	Courses.	Winds.	Lee way.	Remarks on board, Saturday, April 11.
2	4	0	W. S. W.	N. by E.		
4	4	6	W. ¾ S.			
6	5	3				Fresh Gales and clear.
8	5	0				At 4 P. M. parted with the Fleet, they being bound to Spithead. Dunnose bearing W. N. W. distant 21 Miles.
10	5	1				
12	4	6				
2	5	0				At 5 let out one Reef of each Top-sail.
4	4	4				At 7 A. M. Portland Light bore W. N. W. 5 Miles.
6	4	5				
8	4	0				At 10 A. M. it bore N. E. 12 Miles, 14 Sail in Sight.
10	4	2	S. by W. ½ W.	N. N. E.		
12	3	0				

* Being upon the Coast this last Day, the Log is hove, and the Bearings and Distances of Lands, Rocks, Sands, &c. as you approach them, must always be set down, and are of the greatest consequence, especially in bad Weather, or when you are in danger of being drove out of your true Course, in the Night, or in a Fog; so that you may at any Time determine, by your Reckoning, or the Chart, the Ship's Place, and sail Courses and Distances as Circumstances require, in order to pass places of danger, and to have it always in your power to take your Departure from some known place, in case you should be drove out to Sea in the Night or in foggy Weather, when no Land can be seen. For it sometimes happens, that in working to Windward in the English Channel, E. of Dunnose, Ships, by making too long a Board, have got upon a Sand called the Ower, which lies from Dunnose E. ½ N. 25 Miles. It is therefore absolutely necessary to have good Draughts of the Coast you sail upon, unless you are well acquainted with them indeed.

H	K	F	Courses.	Winds.	Lee way.	Remarks on board, Sunday, April 12, 1795.
2						These 24 Hours moderate Gales and fair Weather.
4						
6						
8	4		S.W.by W.¼W	N. E.		At 6. P. M. the Lizard bore N. by E. ½ E. Distance 6 Leagues, from which I take my Depar. it being in the Lat. of 49° 57' N. and Long. 5° 14' West of London.
10	4	5				
12	5					
2	5		S. W. ¾ W.			Several Sail in sight, standing to Westward.
4	5	5				
6	5	5				
8	5	5				At Noon Ushant N. 80° 26' W. Distance 54 Miles.
10	5	5				
12	6					Variation 2½ Points Westerly.

Course.	Dist.	S.	W.	Lat. by D. R.	Lat. by Obs.	Mer. Dist.	Diff. Lon.	Long. in	Bearing & Dist.
S26 30 W.	107	96	48	48 21N		0° 48'	1° 14'	6° 28' W	Fun. S27W D. 1058M.

The Lizard bearing N. by E. ½ E. Dist 6 Leagues from the Ship, is the same as if the Ship had sailed from the Lizard 6 Leagues or 18 Miles upon the opposite, or S. by W. ½ W. Point of the Compass, and allowing for the Variation, as before taught, makes it S. half E. dist. 18 M. which is to be set down as the first Course and Distance in the following Traverse Table.

The first Course steered by Compass is S. W. by W. ¼ W. which, allowing for the Variation, makes S. W. by S. half W. and the sum of all the Distances sailed on that Course till two o'clock, when it alters, is 18 Miles and an half, which being doubled, because the Log is heaved every two Hours, gives 37 Miles; so the second Course and Dist. to be set down in the Traverse Table is S. W. by S half W. 37 Miles. In like manner the second Course steered is S. W. ¾ W. and the Variation allowed makes it S. S. W. half W. and the Dist. on that Course summed up and doubled, gives 56 Miles; therefore the third Course and Dist. to be set down in the Traverse Table is S. S. W. half W. 56 Miles. Having found the whole Difference of Latitude and Departure made upon the several Courses, I then mark down upon my Slate or Paper what every thing, that is to be found, comes to, and afterwards set them down in their proper Columns as above.

TRAVERSE TABLE.

Courses.	Dist	N.	S.	E.	W.
S. ½ E.	18		17.9	1.8	
S. W. by S. ½ W.	37		28.6		23.5
S. S. W. ¾ W.	56		49.4		26.4
			95.9		49.9
					1.8
					.1

Now to Diff. of lat. 95.9 S. & Dep. 48.1 W. the Course is S. 26° 30' W. Dist. 107 Miles; then lat. sailed from, or Liz. lat. 49° 57' N.

Diff. of Lat. — —	1 36 S.
Lat. in, or Ship's Lat.	48 21 N.
Sum of Lats. — —	98 18
Middle Lat. — —	49 09
Comp. of Middle Lat. —	40 51

Then with this Com. of Mid. Lat. 40° 51' or 41 found as a Course among the Degrees, and the Dep. 48. 1 in its Column, in the Dist. Col. stands 74, which is the Diff. of Long.

Or, with the Course 26 30 and Meridional Diff. of Lat. 147, the Diff. of Long. is found to be nearly 74 by Mercator's sailing.

Longitude sailed from, or Lizard's Longitude	5° 14' W.	This being the first Day since leaving the Land, the Departure is the Mer. Dist.
Difference of Longitude 74 miles	1 14 W.	
Longitude in, or Ship's Longitude	6 28 W.	

To find the Bearing and Distance of Ushant.

Latitude in	48° 21' N.	Mer. Parts	3323	Longitude in	6° 28' W.
Ushant's Lat.	48 30 N.	Mer. Parts	3337	Ushant's Long.	5 5 W.
Difference of Lat.	9	Mer. Diff. of Lat.	14	Diff. Long.	1 23

With the Mer. Diff. and Diff. Long. Ushant is found to bear N. 80° 26' E. and with that Bearing, taken as a Course, and the proper Difference of Latitude, the Distance is found 54 Miles.—The bearing and distance to Funchal is found in the same manner.

H	K	F.	Courses.	Winds.	Lee way.	REMARKS on board, Monday, April 13, 1795.
2	6		S. W. by W. $\frac{3}{4}$ W	N.		These 24 Hours moderate Gales and Cloudy Weather.
4	5	5				
6	5			N. W.		At 4 P. M. Spoke the Charming Nancy, from Carolina bound to London.
8	5					
10	3	6	S. W. $\frac{1}{2}$ W.			
12	3	4				
2	3	4				
4	4	5				
6	4	6				At 6 A. M. got the Bower Anchors on the gunnel, and unbent the cables and stowed them.
8	5		S. W. by S. $\frac{3}{4}$ W.	W. N. W.		
10	4	5				At Noon C. Ortegal bore S. 2° 26' E. Dist. 183 Miles.
12	4					Variation $2\frac{1}{2}$ Points Westerly.

Course.	Dist.	Diff. Lat.	Dep.	Lat. by D. R.	Lat by Obs.	Mer. Dist.	Diff. Long.	Long. in	Bearings and Dist.
S. 30° W.	108	93 S.	53 W.	46 48		1° 41' W.	1° 19' W.	7° 47' W.	Funchal S. 28° 30' W D 951 M

The Variation being allowed on each Course, and the Distances summed up, as before taught, the Traverse Table will stand thus :

With the Difference of Latitude and Departure the Course is found S. 30° 0' W. and the Distance 108 Miles.

Diff. of Latitude	1°	33' S.	Mer. Parts.	
Latitude left	48	21 N.		3323
Latitude in	46	48 N.		3185
Sum of Lats.	95	09	Mer. Diff. L.	138
Middle Lat.	47	34		
	90	00		
Comp. Mid. Lat.	42	26		

TRAVERSE TABLE.

COURSES.	DIST	N.	S.	E.	W.
S. W. by S. $\frac{1}{2}$ W.	43		33.2		27.3
S. S. W. $\frac{1}{2}$ W.	39		34.4		18.4
S. by W. $\frac{1}{2}$ W.	27		25.8		7.8
		Diff. Lat	93.4	Dep.	53.5

The Diff. of Long. is found by Mercator's or Middle Latitude Sailing, to be 1° 19' W.

Yesterday's Longitude	6	28 W.
Longitude in	7	47 W.

This Day's Departure being added to the Mer. Distance Yesterday, gives 1° 41' the Mer. Distance to-day.

To find the Bearing and Distance of Cape Ortegal.

Latitude in	46°	48' N.	Mer. Parts	3185	Longitude in	7°	47' W.
Cape's Latitude	43	46 N.	Mer. Parts	2926	Cape's long.	7	36 W.
Diff. Lat.	3	2	Mer. Diff. lat.	259	Diff. long.		11
	60						
In Miles	182						

With the Meridional Difference of Latitude and Difference of Longitude, the direct Course to Cape Ortegal is S. 2° 26' E. and with that Course and the proper Difference of Latitude the Distance is 183 Miles.

NOTE. As the Table of Difference of Latitude and Departure are only calculated to single Degrees, the nearest Degree to the Comp. of Middle Latitude is to be taken in working by Inspection to find the Difference of Longitude by, which is near enough for all common Purposes at Sea ; thus the Comp. of Mid. Latitude is 42° 26', for which I take 42° to find the Difference of Longitude. The same may be observed in finding the Course made good, the nearest Degree or $\frac{1}{4}$ Degree to the Course is always set down, and will be found sufficiently exact.

H	K	F	Courses.	Winds.	Lee-way.	Remarks on board, Tuesday, April 14th, 1795.
2	4		S. W.	W. N. W.	0	These 24 hours moderate gales and clear weather.
4	4					
6	4					At 6 P. M. saw a ship to the westward.
8	4	4	S. W. by S.	W. by N.	½	90
10	4	5				Observed the sun's mer. alt. at noon 61 40
12	4	6				
2	4	5				Zenith distance — 28 20 S.
4	4		S. S. W.	West.	1	Declination — 17 03 N.
6	4					
8	4					Latitude — 45 23 N.
10	4					At noon C Ortegal S. 10° 21' E. dist. 99 miles.
12	4					Variation 1½ point westerly.

Course.	Dist.	Dif. Lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Mer. Dist.	Diff. long.	Long. in	Bearing and Distance.
8° 30' W	97	96	14	45.12	45.23	1° 53'	00.21	8.01	Funchal S. 28° 47' W. Dist. 873 miles.

By allowing for Variation and Leeway the Work will be as follows:

With the diff. of lat. and dep. the course is found S. 8° 30' W. and the dist. 97 miles.

Dif. lat.	1° 36' S.	Mer. Parts.	
Latitude left	46 48 N.		3185
Lat. in by D. R.	45 12	=	3047
Sum lats.	92 00	Mer. diff. lat.	138
Middle lat.	46 00		
	90 00		
Comp. mid. lat.	44 00		

Traverse Table.

Courses.	Dist.	N.	S.	E.	W.
S. S. W. ½ W.	24		21.2		11.3
S. by W.	36		35.3		7.0
S. ½ E.	40		39.8	3.9	
	Dif. lat.		96.3	3.9	18.3
					3.9
				Dep.	14.4

Longitude left	7° 47' W.
Diff. Longitude	21 W.
Long. in by account	8 08

Here the latitude by observation differing from the latitude by account, I correct for the true longitude; and as this is the first observation got since leaving the land, I correct by Case I. as follows;

Lizard's lat.	49° 57' N.	Mer. parts	3470
Lat. by D. R.	45 12 N.	Mer. parts	3047
Mer. diff. of lat. by account			423
Lizard's longitude	5° 14' W.		
Long. in by account	8 8 W.		
Diff. of long. by account	2 54		
	60		
In miles —	174		
Lizard's lat.	49° 57' N.	Mer. parts	3470
Obs. lat.	45 23 N.	Mer. parts	3063
Mer. diff. of lat. by observation			407

With the mer. diff. of lat. and diff. long. by account, the ship's direct course from the Lizard is found to be S. 22° 22' W. or S. S. W.

With that course and mer. diff. of latitude by observation, the diff. of longitude since leaving the Lizard is found 167 miles equal to 2° 47' W.

Lizard's longitude	5 14 W.
Longitude in	8 01

With the course 22° 22' or 2 points, the proper diff. of latitude 274 miles, the true mer. dist. is found 113 miles.

To find the direct Course and Distance to Cape Ortegal.

Lat. in	45° 23' N.	Mer. parts	3063	Longitude in	8° 01' W.
Cape's Lat.	43 46 N.	Mer. parts	2926	Cape's longitude	7 36 W.
Diff. lat.	1 37	Mer. diff. Lat.	137	Diff. longitude	0 25

With the mer. diff. of lat. and dif. of long. the direct course to Cape Ortegal is found S. by E. and with that course and the proper diff. of lat. 67, the distance is found to be 99 miles.

H	K	F	Courses.	Winds.	Lee-way.	Remarks on board, Wednesday, April 15, 1795.
2	3	5	S. by W. ¼ W.	West.	1	These 24 hours moderate Gales and clear Weather.
4	3	5				
6	3	5				
8	3					At 8 P. M. set up the Mizen Top Mast Shrouds and Back-stays.
10	3	5				
12	3					At noon Cape Ortegal S. 14° 28′ E. Distance 23 Miles.
2	3					
4	3					
6	3		S. by W.	W. by S.	1	
8	3					
10	3					
12	3					Variation 1½ point Westerly, per Amplitude.

Course.	Dist.	Dif. Lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Mer. Dist.	Dif. of Long.	Long. in	Bearing and distance.
S. 9° E.	76	75 S.	12 E.	44.08		1.41	17 E.	7° 44′ W.	Funchal, S. 32° 24′ W. Dist. 817 Miles.

With the difference of lat. and departure the Course is found S. 9° E. and the distance 76 M.

			Mer. Parts.
Diff. latitude	1° 15′ S.		
Yesterday's lat.	45 23 N.		3063
Latitude in	44 08 N.		2957
Sum lats.	89 31		106
Middle latitude	44 45		
	90 00		
Comp. mid. lat.	45 15		

TRAVERSE TABLE.

Courses.	Dist.	N.	S.	E.	W.
S. ½ E.	46		45.8	4.5	
S. by E. ¼ E.	30		29.1	7.3	
	Diff. lat.		74.9	11.8	Dep.

Yesterday's longitude	8° 01′ W.
Diff. longitude	0 17 E.
Longitude in	7 44 W.

This day's departure being subtracted from the meridional distance of yesterday, gives 1° 41′ the meridional distance of to-day.

To find the Bearing and Distance of Cape Ortegal.

Latitude in	44° 08′ N.	Mer. parts	2957	Longitude in	7° 44′ W.
Cape's latitude	43 46 N.	Mer. parts	2926	Cape's longitude	7 36 W.
Diff. latitude	22	Mer. diff. lat.	31	Diff. longitude	8

With the mer. difference of latitude and difference of longitude, Cape Ortegal is found to bear S. 14° 28′ E. and with that bearing, taken as a Course, and the proper difference of latitude, the distance is found 23 miles.

NOTE. When the Tenths on any side are more than 5, or half a mile, you must call that side one more than you found it to be; but when they are less than 5, then you need take no notice of them; as in the above the difference of latitude and departure are 74.9 and 11.8, which I call 75 and 12, because the Tenths are above 5.

But when you take the difference of latitude and departure to find the Course, then take them in Miles and Tenths; the same may be observed in casting-up the Knots and Fathoms.

If, when doubled, the Tenths are more than 5, set one mile more in the Traverse Table; but if less, omit them, as there are no Tenths in the distance column.

H	K	F	Courses.	Winds.	Lee way.	Remarks on board, Thursday, April 16, 1795.
2	3	5	West.	S. S. W.	3	These 24 hours hard gales and squally, with small rain.—Handed the Fore and Main Courses.
4	3	5				
6	3	5				
8	Lay to, up N. W. by N. off N. by E.				5	At 8 P. M. saw a ship to windward with Jury Masts up.
10	Drift 1½ mile per hour W.					
12						
2	Up N. W. off North.			W. by S.	5	Set the courses close reefed—More moderate.
4	Drift 1½ mile per hour.			Wore ship.		
6						
8	5		S. W.	N. W. by W. ½ W.	½	Set the Top-sails close reefed. C. Finisterre S. 28° 37' W. dist. 82 M. Variation 1½ point westerly.
10	5					
12	5					

Course.	Dist.	Diff. Lat.	Dep.	Lat by D. R.	Lat. by Obs.	Mer. Dift.	Diff. of Long.	Long. in	Bearing and Dist.
S.81°21'W.	25	4	25	44° 04'		2.6	36	8.20 W.	Func. S.30°53'W Distance 799 miles

Taking the middle points (viz. N. by W. and N. N. W.) between the point to which the ship comes up to, add the point she fell off to for the second and third courses, as taught in the rules for lying to, and then allowing as before for variation and leeway, the Traverse Table will stand as follows:

With the diff. of lat and dep. the course is found S.81°21'W. and the distance 25 M.

Diff. of lat.	00° 04' S.		Mer. parts.
Yesterday's lat.	44 08 N.		2957
Lat. in	44 04 N.		2951
Sum lats.	88 12	Mer. dif. lat.	6
Middle latitude	44 06		
	90 00		
Comp. mid. lat.	45 54		

Traverse Table.

Courses.	Dist.	N.	S.	E.	W.
W. N. W. ¼ W.	21	7.1			19.8
N. N. E. ½ E.	9	7.7		4.6	
N. by E. ¾ E.	9	8.5		3.0	
S. S. W. ¼ W.	30		27.1		12.8
		23.3	27.1	7.6	32.6
			23.3		7.6
		Diff. lat.	3.8	Dep.	25.0

The departure to-day being added to the mer. dist. yesterday, gives 2° 6', the mer. dist. to-day.

With the course and mer. diff. of lat. the diff. of long. is found by Mercator to be 39 miles. Or, with the mid. lat. and dep. the diff. of long. is found by mid. lat. sailing 36 miles west.

Diff. longitude	—	0° 36'
Yesterday's longitude		7 44 W.
Longitude in	—	8 20 W.
		0 . 36

Here the dif. of long. found by mid. lat. differs considerably from that found by Mercator's sailing, but if the mer. parts were taken from a table of miles and tenths it would agree nearer with mid. lat. sailing; but in all cases where the course is so great, and the difference of latitude is in miles and tenths, middle latitude should be depended on.

To find the Bearing and Distance of Cape Finisterre.

Latitude in	44° 04' N.	Mer. parts	2951	Longitude in	8° 20' W.
Cape's latitude	42 52 N.	Mer. parts	2852	Cape's long.	9 14 W.
Diff. lat. 72 =	1 12	Mer. diff. of lat.	99	Diff. long.	54

With the mer. diff. of lat. and diff. of long. Cape Finisterre is found to bear S. 28° 37' W. and with that bearing and the proper diff. of lat. the distance is found 82 miles.

H	K	F	Courses.	Winds.	Lee way.	REMARKS on board, Friday, April 17, 1795.
2				Calm.		The first eight hours calm and foggy.
4						
6						
8						
10	3	5	W. S. W.	South.	1	Fresh gales and clear.
12	4	4				Cape Finisterre S. 39° 57' E. dist. 54 M.
2	4	6				Hoisted the boats out, and tried the current, found it to set N. W. by N. 1 mile per hour all day.
4	4	8				
6	4	6				
8	4	8				Variation 1¼ point westerly.
10	4	8				
12	4	5				

Course.	Dist.	Dif. lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Mer. Dist.	Dif. long.	Long. in	Bearing and Distance.
S. 79° 57' W. or 80°.	84	15	83	43.49	43.34	3.19	1.55	10.2	Funchal S. 26° 49' W. Distance 735 miles.

The variation and lee-way being allowed on the course steered, and the setting of the current and its drift in 24 hours being made a course and dist. the work will be as follows:

With the diff. of lat. and dep. the course is found S. 79° 57' W. and the dist. 84 miles.

Diff. of latitude	00° 15' S.	Mer. parts.
Lat. left	44 4 N.	2951
Lat. in	43 49 N.	2931
Sum of lats.	87 53	M. dif. lat. 20
Mid. lat.	43 56	
	00 00	
Comp. mid. lat.	46 04	

TRAVERSE TABLE.					
COURSES.	Dist.	N.	S.	E.	W.
N. W. ½ W.	24	16.1			17.8
S.W. by W. ¾ W.	72		30.8		65.1
		16.1	30.8	Dep.	82.9
			16.1		
	Dif.	lat.	14.7		

The dif. of long. found by Mercator's sailing is 113 miles, but by mid. lat. it is found

115 miles, equal to — — —	1° 55' W.
Long. left — — —	8 20 W.
Longitude in by account — —	10 15 W.

The diff. of long. found by mid. lat. still differs from that found by Mercator's sailing; the cause is the same as before, and as the ship has made so great a course we will still depend on mid. lat.

The lat. by observation differing from the lat. by account, I correct for the true longitude as follows, (it being three days since I had an observation before,) by Case II. page 177.)

		Mer. parts.
Last obs. lat.	45° 23' N.	3063
Ship's lat. by acc.	43 49 N.	2931
Mer. dif. lat. by account		132
Ship's long. at last obs.		8° 1' W.
Ship's long by acc. to-day		10 15 W.
Dif. long. since last obs.		2 14
Last obs. lat.	45° 23' N.	3063
Ship's lat. by obs.	43 34 N.	2910
Mer. dif. Lat. by observation		153

With the mer. dif. of lat. by account 132 and dif. of long. by account 134, the direct course since last obs. is found S. 45° 13' W. or 45 and the dist. 187 miles. With that dist. and the mer. dif. of lat. by obs. 153, the dif. of long. is found 108, this added to the dif. of long. by account 133, gives 241, which divided by 2, gives the true dif. of long. since last obs. 121 M. nearly, equal to 2° 1' W.

Long. in at last obs.	8 1' W.
Longitude in —	10 2 W.

The course found since last observation 45° 13' is of no farther use than to know what Case to correct by.

With the true course since last obs. 38° 20' and the proper diff. of lat. 109, the dep. is 1° 26' + 1° 53' W. = 3° 19'.

To find the Bearing and Distance of Cape Finisterre.

Latitude in	43° 34' N.	Mer. parts	2910	Longitude in	10° 02' W.
Cape's lat.	42 52 N.	Mer. parts	2852	Cape's long.	9 14 W.
Dif. of lat.	42	Mer. dif. of lat.	58	Dif. of longitude	48

With the mer. dif. of lat. and dif. of long. the direct course to Cape Finisterre is found S. 39° 57' E. and with that course and proper dif. of lat. the distance is found 54 miles.

H	K	F	Courses.	Winds.	Lee-way.	Remarks on board, Saturday, April 18, 1795.
2	4	5	W. S. W.	South.		These 24 hours moderate gales, with small showers of rain.
4	4	5				
6	4	5				
8	4					
10	4					
12	4					
2	3	5	S. W. by W.	S. by E.		
4	3	5				
6	3	5				
8	3					A great swell from the S. W. for which I allow 6 miles.
10	3					
12	3					Variation 1 Point west, per Azimuth.

Course.	Dist.	Dif. Lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Mer. Dist.	Diff. Long.	Long. in.	Bearing and Distance.
S. 53 30 W	84	50	67	42. 44		4.26	1.33	11.35	Funchal S. 23° 15' W Distant 660 miles.

In this day's work the swell is considered as a current, whose drift in 24 hours is 6 miles, the allowance made for the swell; and as it comes from the S. W. it heaves the ship towards the N. E. and the variation allowed upon it makes the last course N. E. by N. as in the Traverse Table.

With the dif. of lat. and dep. the course is found S. 53° 30' W. and the distance 84 miles.

Diff. lat.	00	50' S.	Mer. parts	
Latitude left	43	34 N.		2910
Latitude in	42	44		2841
Sum of lat.	86	18	Mer. dif. lat.	69
Middle lat.	43	09		
	90	00		
Comp. mid. lat.	46	51		

Traverse Table.

Courses.	Dist.	N.	S.	E.	W.
S. W. by W.	58		32.2		48.2
S. W.	32		22.6		22.6
N. E. by N.	6	5.0		3. 3	
		5.0	54.8	3.3	70.8
			5.0		3.3
		Diff. lat.	49.8	Dep.	67.5

The dep. 67 being added to yesterday's mer. dist. gives 4° 26' the mer. dist. this day.

The difference of longitude is found as before to be	1° 33' W.
Yesterday's longitude	10 2 W.
Longitude in this day	11 35 W.

To find the Bearings and Distance of Funchal.

Lat. in	42° 44' N.	Mer. parts	2841	Longitude in	11° 35' W.
Funchal's lat.	32 38 N.	Mer. parts	2073	Funchal's long.	17 5 W.
Dif. lat. 606 =	20 6	Mer. dif. lat.	768	Dif. long. 330 =	5 30

With the mer. dif. of lat. and dif. long. Funchal is found to bear S. 23° 15' W. and with that bearing taken as before, and the proper dif. of lat. the distance is 660 miles.

To find the Bearing and Distance of the intended Port on Mercator's Chart.

Lay a Ruler across Mercator's Chart, in lat. 42° 44', and set one foot of the compasses on the meridian of London, and the other in long. 11° 35' W. lay off that same distance from the meridian of London, by the edge of the ruler, and that will shew the ship's place. Then lay the ruler over the ship's place and Funchal, and take the nearest distance between the ruler and the centre of the compass; slide one foot along the side of the ruler, and the other foot will shew the course to be S. S. W. Again (keeping the ruler as before) take from the gradual parallel the dif. of lat. between the ship and port (10° 12') in your compasses, and slide one foot along the ruler, holding both points parallel to the N. and S. lines, till the other cuts the E. and W. lines; passing through the ship's place; the distance between where the point rested, by the edge of the ruler, and Funchal, being measured upon the graduated parallel, gives nearly 11°, or 660' miles for the distance. In like manner find the bearing and distance of any other place from the ship; or take the distance between Funchal and the ship in your compasses, and lay it on the meridian, placing one foot as much above Funchal as the other is below the ship's place, and that will be the dist. in degrees or in leagues, if the merid. is marked so.

P

H	K	F	Courses.	Winds.	Lee-way.	REMARKS on board, Sunday, April 19, 1795.
2	[illegible]	5	W. by N.	S. W. by S.		These 24 hours fresh gales, and clear weather.
4	4	5				
[illegible]	[illegible]	5				
8	5					
10	5					
12	5					
2	5	5	W. ½ N.	S. S. W. ½ W.	½	
4	5	5				
6	5	5				
8	5	5				
10	5	5				
12	4					Variation 1 point westerly.

Course.	Dist.	Diff. Lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Mer. Dist.	Diff. of Long.	Long. in	Bearing and Distance.
West.	120		120	42,44	42,30	6,20	2,43	14,12	Funchal S. 13° W. Distant 608 Miles.

The variation being allowed on both the courses, and the leeway upon the second, it will be found that the ship has sailed due West these last 24 hours, and by summing up the distances her whole distance is found to be 120 miles, which is also her departure; it is evident she has made no difference of latitude, therefore her latitude by account is the same as yesterday.

As the ship has sailed upon a parallel with the Equator, her difference of longitude is found by parallel sailing 2° 43' W.

by parallel sailing	2° 43'	W.
Yesterday's longitude	11 35	W.
Longitude in by account	14 18	W.

The latitude by observation not agreeing with the latitude by account, and it being two days since my last observation, I correct as follows, by Case III. Page 178.

Last Obs. lat.	43° 34'	Mer. parts	2910
Lat. in by acc.	42 44	Mer. parts	2841
Mer. dif. lat. by account since last obs.			69

With the Mer. diff. of lat. and diff. long. by account, the course since last obs. is found to be S. 75 W. and the distance 266 miles.

Long. in at last observation	10° 02' W.
Ship's long. by account	14 18 W.
Diff. long. by acc. since last obs.	4 16 W.

With that dist. and the mer. diff. of lat. by obs. the true diff. of long. since last observation is found to be 250 = 4° 10' W.

Long. in at last observation	10 2 W.
Longitude in	14 12

Last obs. lat.	43° 34'	M. parts	2910
This day's lat. by obs.	42 30	M. parts	2822
Mer. diff. lat. by obs. since last obs.			88

With the course since last observation S. 70° 30' W. and the proper diff. of lat. 64 miles, the departure (or Mer. dist.) since last observation is found 181 miles, equal to 3° 01 W.

Mer. dist. at last obs.	3 19 W.
True Mer. dist. this day	6 20 W.

To find the Bearing and Distance of Funchal in Madeira.

Latitude in	42° 30' N.	Mer. parts	2822	Longitude in	14° 12' W
Funchal's lat.	32 38 N.	Mer. parts	2073	Funchal's long.	17 5 W.
Diff. lat. 592 =	9 52	Mer. diff. lat.	749	Diff. longitude	2 53 = 173

With the mer. difference of latitude and difference of longitude the bearing of Funchal is found to be S. 13' W. and with that bearing taken as before, and the proper diff. of latitude, the distance is found 608 miles.

H	K	F	Courfes.	Winds.	Lee-way.	REMARKS on board, Monday, April 20th, 1795.
2	8		S. S. W.	N. W. by W.		Stiff gales, with fhowers of rain.
4	8					From 2 P. M. fair weather and moderate
6	8	5				gales.
8	8	5				
10	8	5				
12	8	5				
2	6	0				
4	6	0	S. $\frac{3}{4}$ E.	S. W. by W. $\frac{1}{4}$ W.	$\frac{1}{2}$	
6	5	5				
8	5	5				
10	5					
12	5					
						Variation 1 point wefterly per Amplitude.

Courfe	Dift.	Diff. Lat.	Dep.	Lat. by D. R.	Lat. by Obf.	Mer. Dift.	Diff. Long	Long. in.	Bearing and Diftance.
South.	170	170		39.46	39 40	6.20		14.12	Funchal S. 18° 16' W. Diftant 444 Miles.

Yefterday's lat.	42	30'	N.
Diff. of lat.	2	44	S.
Lat. in by account	39	46	N.

TRAVERSE TABLE.

Courfes.	Dift.	N.	S.	E.	W.
S. by W.	118		115.7		23.0
S. S. E. $\frac{1}{4}$ E.	54		48.8	23.1	
	Diff. lat.		164.5	23.1	23.0
				23.0	
				0.1	Dep.

Proper allowances being made for variation and lee-way, it appears from the Traverfe Table that the fhip has failed due South 164$\frac{1}{2}$ miles, and as fhe made no departure, her longitude in and mer. dift, is the fame as yefterday; but as by obfervation the fhip is found to be in lat. 39° 40' N. it is plain fhe has got 6 miles a-head of her reckoning, which 6 miles being added to the diftance by D. R. gives the true diftance and difference of latitude as above.

To find the Bearing and Diftance of Funchal.

Latitude in	39° 40' N.	Mer. parts	2597	Longitude in	14° 12' W.
Funchal's latitude	32 38 N.	Mer. parts	2073	Funchal's long.	17 5 W.
Diff. lat. 422 =	7 2	Mer. diff. lat.	524	Diff. long. 173 =	2 53

With the mer. diff. of lat. 524, and the diff. of long. in miles 173, the direct courfe to Funchal is found S. 18° 16', or 18° W. and with that courfe and the proper diff. of lat. 422, the diftance is found to be 444 miles.

Now a parallel of lat. through 39° 40' on the variation chart, cuts the variation lines in 11° 15' in longitude 14° 0' W. which confirms the longitude by account.

The variation charts might be of great ufe were they drawn upon a large fcale, and the lines of variations well laid down, but as the variation in moft places is continually altering, it renders them in a few years ufelefs; I would therefore advife the Mariner to truft more to his reckoning and lunar obfervations, fince the theory of the variation is not yet known.

H	K	F	Courses.	Winds.	Lee way.	REMARKS on board, Tuesday, April 21, 1795.
2	8		S. S. W. ¼ W.	N b. N ¾ W	½	Fresh gales and clear weather.
4	8					
6	8	5				
8	8	5				
10	8					
12	8	5				
2	8	4				
4	8	4				
6	8	6				
8	8	6				
10	8	5				
12	8					Variation ¾ point W. per Azimuth.

Course.	Dist.	Diff. Lat	Dep.	Lat. by D. R.	Lat. by Obs.	Mer. Dist.	Diff. Lon.	Long. in	Bearing and Distance.
S. by W. ½ W.	192	184	56	36.29	36.36	7.17	1.11	15.23	Funchal S. 19° 33' W. Distant 253 miles

By examining the Log-board it appears that the ship has sailed S. S. W. ¼ W. 200 Miles.

Latitude left	39° 40' N.	
Diff. Lat.	3 11 S.	
Lat. in by account	36 29 N.	

TRAVERSE TABLE.

Courses.	Dist.	N.	S.	E.	W.
S. by W. ½ W.	200	Diff. lat	191.0	Dep.	58.0

The latitude by observation not agreeing with the latitude by D. R. I correct as follows, by Case I. page 175.

With the course one point and a half, and the diff. of lat. by obs. 184, the distance is found to be 192 miles, and the dep. 56, which being added to the mer. dist. yesterday, 6° 21' W. gives the mer. dist. to-day 7° 17' W.

Yesterday's latitude	39° 40' N.	Mer. parts	2597
This day's obs. lat.	36 36 N.	Mer. parts	2363
Sum of latitudes	76 16	Mer. diff. lat.	234
Middle latitude	38 8		
	90 00		
Comp. mid. lat.	51 52		

The diff. of long. is found by Mercator or mid. lat. 1° 11' W.
Yesterday's long. 14 12 W.
Long. in this day 15 23 W.

To find the Bearing and Distance of Funchal.

Latitude in	36° 36' N.	Mer. parts	2363	Longitude in	15° 22' W.
Funchal's lat.	32 38 N.	Mer. parts	2073	Funchal's long.	17 05 W.
Diff. lat. 238	3 58	Mer. diff. lat.	290	Diff. long. 103 =	1 43

With the mer. diff. of lat. and the diff. of long. the bearing of Funchal is found, and with that bearing and the proper diff. of lat. the distance is found 253 miles.

H	K	F.	Courses.	Winds.	Lee way.	REMARKS on board, Wednesday, April 22, 1795.
2	4	3	W. by S. ½ W.	S. by W. ½ W.	½	These 24 hours moderate weather with rain.
4	4	5				
6	4	7				
8	5		W.S.W. ½ W.	S. ½ W.	½	
10	5	2				
12	5	3				
2	5	5	W. S. W.	South.	½	
4	5	5				
6	5	4				
8	5	1				
10	5		S. W. by W.	S. by E.	½	
12	4	5				Varia. ¾ P. W. per equal alt. of the sun.

Course.	Dist.	Diff. Lat.	Dep.	Lat by D. R.	Lat. by Obs.	Mer. Dist.	Diff. of Long.	Long. in	Bearing and Dist.
S. 65° W.	119	50	108	35.52	35.46	9.05	2.13	17.36	Func. S. 7° 44' E. Dist. 190 miles.

With the diff. of lat. and departure the course is found S. 68° 10' W. and the distance 118.6 Miles.

Yesterday's lat.	36° 36' N.	
Diff. of latitude	44 S.	
Lat. by account	35 52 N.	
Yesterday's lat.	36° 36' N.	M.pts.2363
Obs. lat.	35 46 N.	M.pts.2301
Diff. lat. by obs.	50	M. diff. lat. 62
Sum of lats.	72 22	
Middle latitude	36 11	
	90 00	
Com. mid. lat.	53 49	

TRAVERSE TABLE.

COURSES.	DIS.	N.	S.	E.	W.
W. by S. ½ W.	27		4.0		26.7
W. S. W. ¼ W.	31		10.4		29.2
S. W. by W. ¾ W.	43		18.4		38.9
S. W. ¾ W.	19		11.3		15.3
		D.lat.	44.1	Dep.	110.1

The latitude by observation not agreeing with the latitude by account, I correct as follows, by Case III. page 176.

With the proper diff. of lat. by obs. 50' and the distance 118.6 the true course is found 65° 04', and the departure 108 miles nearly.

The departure 108 being added to the mer. dist. yesterday, gives 9° 5' W. the mer. dist. to-day.

With the comp. of mid. lat. and dep. or with the course and mer. diff. of lat. 62' the diff. of long. is found by middle latitude or Mercator's sailing to be 133 miles = 2° 13' W.

Yesterday's longitude		15 23 W.
Longitude in	—	17 36 W.

To find the Bearing and Distance of Funchal in Madeira.

Latitude in	35° 46' N.	Mer. Parts	2301	Longitude in	17° 36' W.
Funchal's latitude	32 38 N.	Mer. Parts	2073	Funchal's long.	17 05 W.
Diff. of latitude	3 . 8	Mer. diff. of lat.	228	Diff. long.	31 E.

With the mer. diff. of lat. 228. and the diff. of long. 31', Funchal is found to bear S. 7° 44' E. and with that bearing (taken as before) and the proper diff. of latitude, the distance is found 190 miles.

H	K	F	Courses.	Winds.	Lee way.	Remarks on board, Thursday, Apr. 23, '95.
2	6	6	S. by E. ½ E.	S. W. ½ W.	½	These 24 hours moderate gales, and clear weather.
4	5	8				
6	5	8				
8	5	8				
10	5		S. S. E.	S. W.	½	
12	5	2				
2	5	3				
4	5	5	S. S. E. ½ E.	S. W. by S. ½ W.	½	
6	5	5				
8	5	5				
10	5	6	S. E. by E.	S. W. by S.	½	
12	5	4				Variation ½ point westerly.

Course.	Dist.	Dif. lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Mer. Dist.	Dif. long.	Long. in.	Bearing and Distance.
S. 35° 20′ E.	135	110	78	34 01	33 56	7 47	1 35	16 01	Funchal S. 34° 15′ W. Distance 94 miles.

With the diff. of lat. and dep. the course is found S. 37° 48′ E. and the distance 133 miles.

Yesterday's lat.	35° 46′ N.	
Diff. of latitude	1 45 S.	
Lat. by account	34 01 N.	
Obs. lat.	33 56 N.	M. pts. 2167
Yesterday's lat.	35 46 N.	M. pts. 2230
Prop. diff. lat. obs.	1 50	M. dist. 134
Sum of lat.	69 42	
Middle latitude	34 51	
	98 00	
Comp. mid. lat.	55 09	

TRAVERSE TABLE.

Courses.	Dist.	N.	S.	E.	W.
S. S. E. ¾ E.	48		41.2	24.7	
S. E. by S. ½ E.	31		24.9	18.5	
S. E. by S. ¾ E.	33		24.4	22.2	
S. E. ½ E.	22		14.8	16.3	
			Dif. lat. 105.3 S	81.7	Dep.

The latitude by observation differing from the latitude by account, I correct as follows, by Case II. page 179.

With the diff. of lat. 110 and the dist. 133, the dep. is found to be 75, which being added to the former dep. 82, gives 157, half this sum is the true dep. 78 miles; with the diff. of lat. 110 and the dep. 78, the true course is found S. 35° 20′ E. and the distance 135 miles.

The dep. 78 being subtracted from the mer. dist. yesterday, gives 7° 47′ W. the mer. dist. this day.

The diff. of long. is found by Mercator or Middle Latitude sailing, to be	1° 35′ E.
Yesterday's longitude	17 36 W.
Longitude in	16 01 W.

To find the Bearing and Distance of Funchal in Madeira.

Latitude in	33° 56′ N.	Mer. Parts	2167	Longitude in	16° 01′ W.
Funchal's lat.	32 38 N.	Mer. Parts	2073	Funchal's long.	17 05 W.
Difference of lat.	1 18	Mer. dif. of lat.	94	Diff. of long.	1 . 04

With the meridional difference of latitude and difference of longitude, the direct course to Funchal is S. 34° 15′ W. and with that course and the proper difference of latitude, the distance is found 94 miles.

H	K	F	Courſes.	Winds.	Lee-way.	Remarks on board, Friday, April 24th, 1795.
2	5	5	S. W. ¼ S.	E. by N.		Moderate gales and hazy. At 6 P. M. more clear, ſaw Porto Santo bear-
4	5	5				ing N. W. about 7 or 8 leagues.
6	4	5		Eaſt.		At 10 P. M. ſaw Madeira, bearing S. W. by S.
8	4	5				Diſtance 15 leagues.
10	3	5				Clear weather.
12	4			E. S. E.		At 10 P. M. came to anchor off Funchal, the
2	4					weſternmoſt point W. by N. the Loo-Rock
4	4			N. E.		N. by W. the Brazen Head E. by S. the
6	4					Deſerters from E. to S. E. Diſtance about 9
8	4					leagues.
10	4					Variation ¾ point.
12	[illegible]					

Courſe.	Diſt.	S.	W.	Lat. by D. R.	Lat. by Obſ.	Mer. Diſt.	Diff. long.	Long. in	Bearing and Diſtance.
S. 33° 45′ W.	95	79	53	32° 37′		8.40	1.3	17.4	Funchal, N. 1 mile.

The variation allowed upon the courſe, and alſo upon the bearing of the land taken at ten o'clock, being put into a Traverſe Table, and the diſtance run upon each courſe, with the diſtance you are from the land, will give the diſtance and difference of latitude and departure as above; with the complement of the middle latitude and departure, the difference of longitude is 63 = 1° 3′, which added to 16° 1′, the longitude in yeſterday at noon, gives 17° 4′, the longitude in by account; and as it agrees with the longitude of Funchal in the table, I conclude that my reckoning is juſt, and Funchal well laid down.

The ſhip's place in the preceding Journal is pricked off, and the bearing and diſtance at noon are alſo found by the Chart, in order to ſhew the young Navigator the method, and may be done with a black lead pencil, which he may either let ſtand or rub out when he pleaſes.

Between April 24, and May 12, lay moored in Funchal Road, Madeira.

H	K	F.	Courſes.	Winds.	Lee way.	Remarks on board, Tueſday, May 12, 1795.
2				N. E.		Freſh breezes and clear. At 4 P. M. unmoor-
4						ed ſhip and hove in to ½ of a cable on the
6						beſt bower.
8						
10						
12						Light breezes and clear.
2						At 6 A. M. weighed from Funchal Road and
4						made ſail. Lat. obſ. 32° 10′ N.
6						Variation 18 30 W.
8						
10						Ditto W. at noon the Southernmoſt Deſerta, N.
12						W. 4 or 5 leagues.

Courſe.	Diſt.	Diff. Lat.	Lat. by D. R.	Dep.	Lat by Obſ.	Mer. Diſt.	Diff. Long.	Long. in	Bearings and Diſt.
					32° 10′ N.				Southernmoſt Deſerta, N. W. 5 leagues.

I take my departure from the Southernmoſt Deſerta, which lies in lat. 32° 18′ N. long. 16° 25′ E.

Traverse Table.					

H	K	F	Courses.	Winds.	Lee-way.	REMARKS on board, Wednesday, May 13, 1795.
2	6	2	S. S. W.	N. N. E.		Light breezes and clear. Variation per amplitude 18° 30′ W.
4	3		S. S. W. $\frac{1}{4}$ W.			
6	2					
8	2					
10	2					Made and shortened sail occasionally.
12			Calm.			
2	4	4	S. S. W. $\frac{1}{4}$ W.	W. N. W.		
4	5	4				
6	6					
8	6	3				
10	5	6		N. W.		Fresh breezes and clear. Set studding sails.
12	4					Lat. by observation 30° 31′ N.

Course.	Dist.	Dif. Lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Mer. Dist.	Dif. of Long.	Long. in	Bearing and dist.
S. 1° 30′ E.	100	99	2.7	30.31 N	30.31 N	2.7	3 miles E.	16° 22′ W.	Salvages, S. 34° E. dist. 28 miles.

By taking my departure from the southernmost Deserta, which is in lat. 32.18 N. long. 16.25 W. and bearing from me yesterday at noon N. W. 5 leagues; I find the course answering to that bearing, corrected for variation, to be south 63° east, distant 15 miles, which I have set down in the Traverse Table as a course.

TRAVERSE TABLE.

Courses per log.	Courses corrected.	Dist.	N.	S.	E.	W.
S. E.	S. 63° E.	15		6.8	13.4	
S. S. W.	S. 4 W.	12		12.0		0.8
S. S. W. $\frac{1}{4}$ W.	S. 7 W.	81		80.4		9.9
		Dif. lat.		99.2	13.4	10.7
					10.7	
				Dep.	2.7	

With the difference of latitude and departure the course is found to be S. 1° 30′ E. distant 100 miles.

With the comp. mid. lat. the diff. of long. is found to be 3 miles.

Dif. lat.	1° 59′ S.				
Lat. left	32 10 N.	Mer. pts. 2040			
Lat. in	30 31	Mer. pts. 1924	Lat. salv. 30° 8′ N.	Mer. pts. 1898	Long. 16° 4′
Sum lats.	62 41	Mer. dist. 116	Lat. in 30 31 N.	Mer. pts. 1924	Lon. in 16 22
Mid. lat.	31 20		23	26	18
Co. mid. lat.	58 40				

With the mer. diff. lat. and diff. long. the Salvages are found to bear S. 34° E. dist. 28 miles.

H	K	F	Courses.	Winds.	Lee way.	Remarks on board, Thursday, May 14, 1795.
2	6	4	South.	West.		Fresh breezes and clear. All sails set.
4	6	2				
6	5	0				
8	4	2				
10	6	3				Variation 18° west.
12	5	4				
2	5	4	S. by W.	W. by N.		Fresh breezes and pleasant weather. Two sail in sight.
4	5					
6	3					
8	3	1				
10	2	4				
12	2			W. by S.		Light breezes and cloudy. In studding sails. Lat. obs. 28° 48′ N.

Course.	Dist.	Diff. Lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Mer. Dist.	Diff. of Long.	Long. in	Bearing and Distance.
S. 14° E	107	104	26	28.47 N.	28.48 N	29 E.	29 miles	15.53 W	Sta. Cruz, Teneriff. S.47°23′W.D.30 M

Courses being corrected for variation, I find by the Traverse Table the direct course of the ship to be S. 14° E. and the distance 107 miles.

Traverse Table.						
Courses per log.	Courses corrected.	Dist.	N.	S.	E.	W.
South.	S. 18° E.	67		63.7	20.7	
S. by W.	S. 7 E.	41		40.7	5.0	
		Diff. lat.		104.4	25.7	Dep.

Diff. of lat.	1° 44′ S.		
Lat. left	30 31 N.	Mer. parts	1924
Lat. in	28 47 N.	Mer. parts	1805
		Mer. diff.	119
Sum of lats.	59 18		
Mid. lat.	29 39		
Com. mid. lat.	60 21		

Lat. Teneriffe	28.27 N.—1782		Long. Tene.	16° 18′ W.
Lat. in	28.47 N.—1805		Long. in	15 53 W.
Diff. lat.	20 M. dif .23		Diff. long	25

With the comp. of mid. lat. the diff. of long. is found to be 29 miles.

With the mer. diff. lat. and diff. long. by Mercator, the Bay of Santa Cruz in Teneriffe is S. 47. 23 W. dist. 30 miles.

As this Journal is only intended to shew the Learner how to keep his reckoning at sea, the true Variation is not particularly attended to.

H	K	F	Courses.	Winds.	Lee-way.	Remarks on board, Friday, May 15, 1795.
2	3	4	S. S. E.	S. W.	1	Fresh breezes and cloudy.
4	3					
6	2	4				Handed top gallant sails and in first reef top sails.
8	3					At 6 the peak of Teneriffe bore by compass
10	3					W. S. W
12	2	4	W. N. W.	Ditto.	1	Fresh breezes and clear. Variation 18° W.
2	2	4				
4	2					Set top gallant sails. Hazy with rain. No
6	2					land in sight. No observation.
8	3					Light breezes and clear.
10	2	4	S. S. E.	Ditto.	1	At noon made Teneriffe, bearing W. by N.
12	2	4				dist. 12 leagues.

Course.	Dist.	Dif. Lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Mer. Dist.	Diff. Long.	Long. in.	Bearing and Distance.
S. 25° E.	20	18	8	28. 30		37E.	10 m. E.	15. 43 W.	Sta. Cruz, Teneriffe S.84°26'W.D.31M.

The courses being corrected for one point leeway, and 18° W. variation all these 24 hours I find by the Traverse Table the direct course of the ship to be S. 25° E. distance 20 miles.

Diff. of lat.	0° 18' S.	
Lat. left.	28 48 N.	
Lat. in	28 30 N.	
Sum lats.	57 18	
Mid. lat.	28 39	
Comp. mid. lat.	61 21	

TRAVERSE TABLE.

Courses per log.	Courses corrected.	Dist.	N.	S.	E.	W.
S. S. E.	S. 52° E.	30		18.5	23.6	
W. N. W.	N. 74 W.	24	6.6			23.1
S. S. E.	S. 52 E.	10		6.2	7.9	
			6.6	24.7	31.5	23.1
				6.6	23 1	
		Diff. lat.		18.1	8.4	Dep.

With the comp. of mid. lat. the diff. of long. is found to be 10 miles; and the bearing and distance of Santa Cruz by mid. lat. is found to be S. 84° 26' W. dist. 31 miles.

H	K	F	Courses.	Winds.	Lee-way.	Remarks on board, Saturday, May 16, 1795.
2	5		W. by N.	S. S. E.		Light breezes and clear. Made all sail.
4	5	4				
6	6					At 5 the east end of Teneriffe N. W. 4 miles;
8						at 7 anchored in 9 fathoms in Santa Cruz
10						Road, the town of Santa Cruz W. by N. half
12				Variable.		a mile.
2						Variation 17° 30' west.
4				West.		At 8 A. M. hoisted out the boats and went on
6						shore to wait on the Governor.
8						Moored ship with the small bower to the S. W.
10				Calm.		in 19 fathom and stream anchor to the N. E.
12				South.		in 10 fathom.

Course.	Dist.	Dif. lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Mer. Dist.	Diff. long.	Long. in	Bearing and Dist.
S. 84° W.	33	3	33	28.27N		4 mi. E.	37 m. W.	16° 20' W.	At anchor in Santa Cruz Rd Teneriffe

The Courses being corrected for 17° 30' W. variation, I find by the Traverse Table the true course to be S. 84° W. dist. 33 miles.

Diff. lat.	0° 3' S.	
Lat. left	28 30 N.	
Latitude	28 27	
Comp. mid. lat.	61 33	

TRAVERSE TABLE.

Course per log.	Course corrected.	Dist.	N.	S.	E.	W.
W. by N.	S. 84° W.	33		3.4		32.8
		Diff. lat.		3.4	Dep.	32.8

With the comp. of mid. lat. the diff. of long. is 37 miles.

An ABSTRACT of the foregoing JOURNAL.

Days.	Months. 1795.	Courses.	Dist.	Lat. by D. R.	Lat by Obs	Long. in	Bearings and Distances at Noon.
Sunday,	April 12	S. 26° 30′ W.	96	48° 21′ N.		6° 28′ W.	Funchal, S. 27° W. distant 1058 miles.
Monday,	April 13	S. 30° W.	108	46. 48 N.		7. 47 W.	Funchal, S. 26. 39 W. distant 951 miles.
Tuesday,	April 14	S. 8. 30 W.	97	45. 12 N.	45. 23 N.	8. 1 W.	Funchal, S. 28. 47 W. distant 873 miles.
Wednesday,	April 15	S. 9° E.	76	44. 8 N.		7. 44 W.	Funchal, S. 32. 24 W. distant 817 miles.
Thursday,	April 16	S. 81. 20 W.	25	44. 4 N.		8. 20 W.	Funchal, S. 30. 53 W. distant 799 miles.
Friday,	April 17	S. 80 W.	84	43. 49 N.	43. 34 N.	10. 2 W.	Funchal, S. 26. 49 W. distant 735 miles.
Saturday,	April 18	S. 53. 30. W.	84	42. 44 N.		11. 35 W.	Funchal, S. 23. 15 W. distant 660 miles.
Sunday,	April 19	West.	120	42. 44 N.	42. 30 N.	14. 12 W.	Funchal, S. 13. W. distant 608 miles.
Monday,	April 20	South.	170	39. 47 N.	39. 40 N.	14. 12 W.	Funchal, S. 18. 16 W. distant 444 miles.
Tuesday,	April 21	S. by W. ½ W.	192	39. 29 N.	39. 36 N.	15. 23 W.	Funchal, S. 19. 33 W. distant 253 miles.
Wednesday,	April 22	S. 65 W.	119	35. 52 N.	35. 46 N.	17. 36 W.	Funchal, S. 7. 44 W. distant 190 miles.
Thursday,	April 23	S. 25. 30 E.	135	34. 1 N.	33. 56 N.	16. 1 W.	Funchal. S. 34. 15 W. distant 94 miles.
Friday,	April 24	Came to an anchor in Funchal Road, where we lay till May 12th, and then sailed for Teneriffee.					
Tuesday,	May 12	S. 1. 30 E.	100	30. 31 N.	30. 31 N.	16. 22 W.	Salvages, S. 37. 52 E. distant 39 miles.
Wednesday,	May 13	S. 14 E.	107	28. 47 N.	28. 48 N.	15. 35 W.	Teneriffe, S. 47. 23 W. distant 30 miles.
Thursday,	May 14	S. 25 E.	20	28. 30 N.		15. 43 W.	Teneriffe, S. 84. 26 W. distant 31 miles.
Friday,	May 15	S. 84 W.	33	28. 27 N.		16. 20 W.	Anchored in Santa Cruz Road.

The Method of finding the LATITUDE *at* SEA, *by taking two Altitudes, either in the Forenoon or Afternoon, having the intermediate Time measured by a common Watch, with Ease and Accuracy, independent of the Sun's Meridian Altitude.*

GENERAL RULES.

1st. TO the ſecant of the latitude by account, add the ſecant of the ſun's declination, (rejecting their indexes) and call that ſum the logarithm ratio.*

2d. From the natural ſine of the greateſt altitude, ſubtract the natural ſine of the leaſt altitude, and find the logarithm of their difference, and write it under the logarithm ratio.

3d. Subtract the hours and minutes when the altitudes were taken from each other, and half the difference call half elapſed time.

4th. With half the elapſed time enter the tables, and from the column of half-elapſed time take out the logarithm anſwering thereto, and ſet it down under the logarithm ratio.

5th. Add theſe three logarithms together, and with their ſum enter the tables in the column of middle time, where, having found the logarithm neareſt thereto, take out the time correſponding to it, and put it down under half the elapſed time.

6th. Subtract the leſs from the greater, and the difference will be the time from noon, when the greateſt altitude was taken.

7th. With this time enter the tables, and from the column of riſing, take out the logarithm correſponding to it; from this logarithm ſubtract the logarithm ratio, the remainder will be the logarithm of a natural number, which, being found in the common table of logarithms, and added to the natural ſine of the greateſt altitude, will give the natural ſine of the ſun's meridian altitude.

Having the meridian altitude of the ſun at noon, the latitude is found by the uſual method.

N. B. If the latitude, found by the above proceſs, ſhould differ widely from the latitude by account, it will be proper to repeat the operation, uſing the latitude laſt found inſtead of the latitude by account, till the reſult gives a latitude nearly agreeing with the latitude uſed in the computation.

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* The arithmetical comp. of the co-ſine of any angle is equal to the logarithmic ſecant of that angle, omitting the firſt figure in the index; thus the ſecant of 46° 50' is 10,16487, and omitting the firſt figure 1, leaves 0,16487, the ſecant leſs radius, or the arithmet. comp. of co-ſine 46° 50'.

EXAMPLE

EXAMPLE I.

Being at sea in latitude 46° 50′ north by account, when the sun's declination was 11° 17′ N. at 10 H. 2 M. in the forenoon, the sun's altitude was 46° 55′, and at 11 H. 27 M. in the forenoon, the second altitude was 54° 9′. Required the true latitude, and true time of the day when the greatest altitude was taken?

Times. H. M. S.			
11 27 0	Lat. 46° 50′.	Secant ——	0.16487
10 2 0	Dec. 11 17	Secant ——	0.00848
Ela. T. 1 25 0		Added gives the log. ratio	0.17335
½ El. T. 0 42 30			

The sun's gr. alt. at 11 H. 27 M. is 54° 9′	Its nat. sine	81055
The sun's least alt. at 10 H. 2 M. is 46 55	Its nat. sine	73036
The remainder of diff. of nat. sines		8019

Log. ratio —— ——	0.17335
The common log. of the diff. Nat. Sine 8019	3.90412
In table XX. in col. ½ ela. time for 42 M. 30 S. is	0.73429
Their sum of the log. in middle time ——	4.81176
	H. M. S.
The Hours, Minutes, &c. for which by the tables is	1 15 30
Subtract half elapsed time —— ——	42 30
The diff. is the true space of time the sun had to rise to the meridian when the greatest altitude was taken — —	0 33 00

	H. M.
Time per watch	11 27
Sub. from	12 0
	0 33

Finding they agree, the watch is right.

Enter the tables with 33 M. under col. of rising, and you will find the log, ——	3.01488
From which subtract the log. ratio ——	0.17335
The natural number of which is 694 ——	2.84153
To the natural sine of the greatest alt. ——	81055
Add the natural number of the above log. ——	694
The sum is the natural sine of the sun's meridian altitude 54° 50′ ——	81749

The natural sines are found in Table XXII—The half elapsed time, &c. in table XX.

Sun's mer. alt.	90° 0'	
	54 50	
The ſun's zenith diſt.	35 10 S.	By obſerving the ſun's merid. altitude the ſame day, the latitude was found to be 46° 28' N.
The ſun's declination	11 17 N.	
Latitude —	46 27 N.	

EXAMPLE II.

Being at ſea in lat. 47° 19' N. by account, when the ſun's declination was 12° 16' N: at 10 H. 24 M. A. M. per watch, the ſun's alt. was 49° 9', at 1 H. 14 M. P. M. his alt. was 51° 59'. Required the latitude?

	H. M. S.				
	12 0 0				
	10 24 0				
		Alt.	Nat. Si.	Lat. 47° 19'	0.16880
	1 36 0	49° 9'	75642	Sun's decl. 12 16	0.01003
	1 14 0	51 59	78783		
				Log ratio	17883
Ela. T.	2 50 0	Diff. N. S. 3141		Its log.	3.49707
½ Ela. T.	1 25 0	Its log. in col. of half elapſ. time is			0.44077
Subtract	0 15 0	Col. of mid. time correſponding to			4.11667
True Ti.	1 10 0	Its log. in col. of riſing is —			3.66542
Ti. per W.	1 14 0	Log. ratio ſubt. —			0.17883
Wat. faſt.	0 4 0	3056 the nat. num. of this log.			3.48659
Nat. Si. Sun's gr. alt.		78783			

		90 00
Nat. Si. Sun's mer. alt.	81849 =	54 56
Sun's zenith diſt.	—	35 4 South.
Sun's declination	—	12 16 North.
Lat. in	—	47 20 North.

Here the Latitude found by computation may be relied on, as it differs but one mile from that uſed in the operation.

EXAMPLE III.

Being at ſea in lat. 50° 40' north per account, when the ſun's declination was 20° 0' ſouth, at 10 H. 17 M. A. M. per watch, the ſun's alt. was found 17° 13', at 11 H. 17 M. A. M. per watch, it was found 19° 41. Required the latitude?

Times.

	Times.	Alt.	Nat. Si.		
	H. M. S.			Lat. 50° 40′	0,19803
				Decl. 20 00	0,02701
	10 17 0	17° 13′ =	29599		
	11 17 0	19 41 =	33682	Log. ratio	0,22504
Ela. T.	1 0 0	Diff. Nat. Si. 4083		Its com. log.	3,61098
½ Ela. T.	0 30 0	Its log. from col. half-elap. time is			0,88430
	1 1 0	In col. of mid. time corresponding to			4,72032
Tr. time	0 31 0	From noon.	Its log. from col. of rising		2,96067
T. p. W.	0 43 0		Log. ratio sub.		0,22504
Wat. flow	0 12 0	544 N. num. of			2,73563
		33682 Nat. Si. greatest alt.			
	90° 0′				
	20 1	34226 Nat. Si. of sun's mer. alt. 20° 1′.			
Zen. dist.	69 59				
Declination	20 0 S.				
Latitude	49 59 N.				

But as this latitude differs 41 miles from that by account, it will be proper to repeat the operation, using the latitude last found instead of the latitude by account.

	H. M. S.			
½ Elapsed time	0 30 0	Lat.	49° 59′	0,19178
	1 0 0	Decl.	20 0	0,02701
		Log. ratio		0,21879
True time	0 30 0			3,61098
Time per watch	0 43 0			0,88430
			H. M.	
Watch slow	0 13 0	In col. mid. T.	1 0	4,71407
True time	0 30 0	Its log. in col. of rising is		2,93223
		Log. ratio		0,21879
		517 Nat. num. of		2,71344
		33682 Nat. S. gr. alt.		
Nat. S. sun's mer. alt.		34199 = 20° 0′		
		Zen. dist.	70 0	
		Decl.	20 0 S.	
		The lat.	50 0 North.	

The

The latitude laſt found, differing only one mile from that uſed in the operation, may be depended on as the true latitude. Hence it is plain, that the operation is repeated with very little additional trouble, but few alterations being neceſſary.

EXAMPLE IV.

Being at ſea in the latitude 60° 0′ north by account, when the ſun was on the equator, and conſequently had no declination, at 1 H. 0 M. P. M. per watch, his altitude was 28° 53′, and at 3 H. 0 M. P. M. per watch, it was 20° 42′. Required the true altitude?

	Times. H. M. S.			
		Alt. Nat. Si.	Lat. 60° 0′ =	0,30103
			Decl. 0 0 =	0,00000
	1 0 0	28 53 = 48303		
	3 0 0	20 42 = 35347	Log. ratio	0,30103
Elap. T.	2 0 0	12956	Its log.	4,11247
½ El. T.	1 0 0	Its log. in col. of ½ Elap. time		0,58700
	2 0 0	Its log. in col. of mid. time		5,00050
Ti.fr. N.	1 0 0	Its log. from col. of riſing		3,53243
Ti.per.W.	1 0 0		Log. ratio	0,30103
		1704 Nat. num.		3,23140
		48303		

90 0

Nat.Si. Sun's mer. alt. 50007 = 30° 0′ Sun's meridian alt.

60 0 Latitude.

The latitude by computation, coming the ſame with the latitude by account, ſhews that the latitude by account was right. From the foregoing examples it is plain, that the operation is the ſame, whether the ſun hath north or ſouth declination. And it will be the ſame whether the ſhip is in a north or ſouth latitude. It is alſo clear, that when the ſun has no declination, the ſecant, rejecting the index of the latitude, is the log. ratio.

EXAMPLE V.

Wanting to go through the N. Channel among the Maldives, and by account being in latitude 7° 40 N. the declination being then 22° 47′ N. at 7 H. 25 M. 40 S. A. M. the true altitude of the ſun's centre was 22° 30, and at 10 H. 21 M. 48 S. A. M. it was found 63° 40′. Required the ſhip's true latitude?

Times

	H. M. S.	Alt.	Nat. S.		
Times	10 31 48	63° 40′	89623	Lat. by ac. 7° 40′	0,00390
	7 25 40	22 30	38268	Declin. 22 47	0,03528
				Log. ratio	0,03918
Elap. T.	3 6 8		51355	Its log.	4,71058
½ El. T.	1 33 04	Its log. in col. of ½ elap. time is			0,40368
	3 1 30			H. M. S. 3 1 30	5,15344
True T.	1 28 26	Its log. in col. of rising is			3,86709
Ti.per.W.	1 28 12			Log. ratio	0,03918
Wat. flow	0 0 14		6728 Nat. num.		3,82791
		90 00	89623	Nat. Si. gr. alt.	
	Mer. alt.	74 29			
			96351	N. S. Sun's mer. alt. = 74° 29′.	
	Zen. dist.	15 31 N.			
	Decl.	22 47 N.			
	Lat. in	7 16 north.			

N. B. As the tables are only calculated to 30 seconds, the log. for any intermediate seconds is found by taking the difference between the log. next greater and next less; and saying, as 30 seconds is to that difference, so is the given seconds to the difference of the logarithms; or, if it be any even part, take such a part of the difference, and apply it to the next less logarithm; but in these operations a few seconds are not regarded.

Second Operation.

			Lat. 7° 16′	0,00350
			Dec. 22 47	0,03528
			Log. ratio	0,03878
	H. M. S.			4,71058
	3 1 30			0,40368
	1 33 0		H. M. S.	
			3 1 30	5,15304
True time	1 28 30			
				3,86709
Nat. Si. gr. alt.		89623	Log. ratio	0,03878
		6735 Nat. num.		
			Log.	3,82831
N. S. Sun's mer. alt.		96358 = 74 29.	Hence the lat. in is 7° 16′ N.	

The latitude last found, agreeing with that used in the operation, it may be taken as the true latitude; and the operation is repeated with very little additional trouble, few alterations being necessary. Hence it is plain, that if you are mistaken in the latitude by account, yet by repeating the work two or three times, making use of the latitude last found in the next operation, it will at last discover itself to be true, by being equal to the last supposition, which evidently shews the excellency of these tables.

In

In the former examples we have confidered both altitudes taken at the fame place or ftation; but as that is feldom the cafe at fea, the neceffary correction for any alteration of ftation may be readily made as follows:

	H.	M.
Suppofe the firft altitude in the forenoon, at —	10	26
The fecond altitude in the afternoon, at 2 h. 43 m.	14	43
Difference of longitude made is 30 miles W. equal to	0	2
	14	41
	10	26
Subtracted is the elapfed time — —	4	15

If a fhip has been failing to the eaftward, the above two minutes muft be added; but unlefs the difference of longitude be confiderable, it is not worth notice, as it will make a very inconfiderable error in the latitude.

Again, if the fhip fails or makes towards that point of the compafs which the fun bears upon, fhe muft raife the fun's altitude as many minutes as the miles fhe has run towards it; therefore the miles run towards the fun muft be added to the firft altitude; but if failing from the fun, the fame muft be fubtracted; if they are but few, they are not worth minding; and then the feaman may make a very good eftimation by looking at the log-board only, who, by that, will be able to afcertain the diftance failed to, or from, the fun, between the obfervations, which will be of fufficient exactnefs in the practice of navigation; and if the fhip makes an angle with the fun's bearing, it may be readily found by the table of difference of latitude and departure, and then either add or fubtract, according as the cafe requires; as may be feen in the following examples, which are inferted for the benefit of thofe who require a greater degree of accuracy.

EXAMPLE VI.

Suppofe a fhip from the Bay of Bifcay, bound to the Englifh Channel, in a brifk gale running N. by E. $\frac{3}{4}$ E. per compafs, at the rate of 9 knots per hour, at 10 H. 0 M. A. M. per watch; obferved the fun's altitude 13° 18′ bearing South $\frac{3}{4}$ E. by compafs, and at 1 H. 40 M. P.M. per watch, the fun's altitude again was found 14° 15′, the latitude by account being 49° 17′ N. and the fun's declination 23° 28′ S. Required the true latitude?

The Correction to the Firft Altitude.

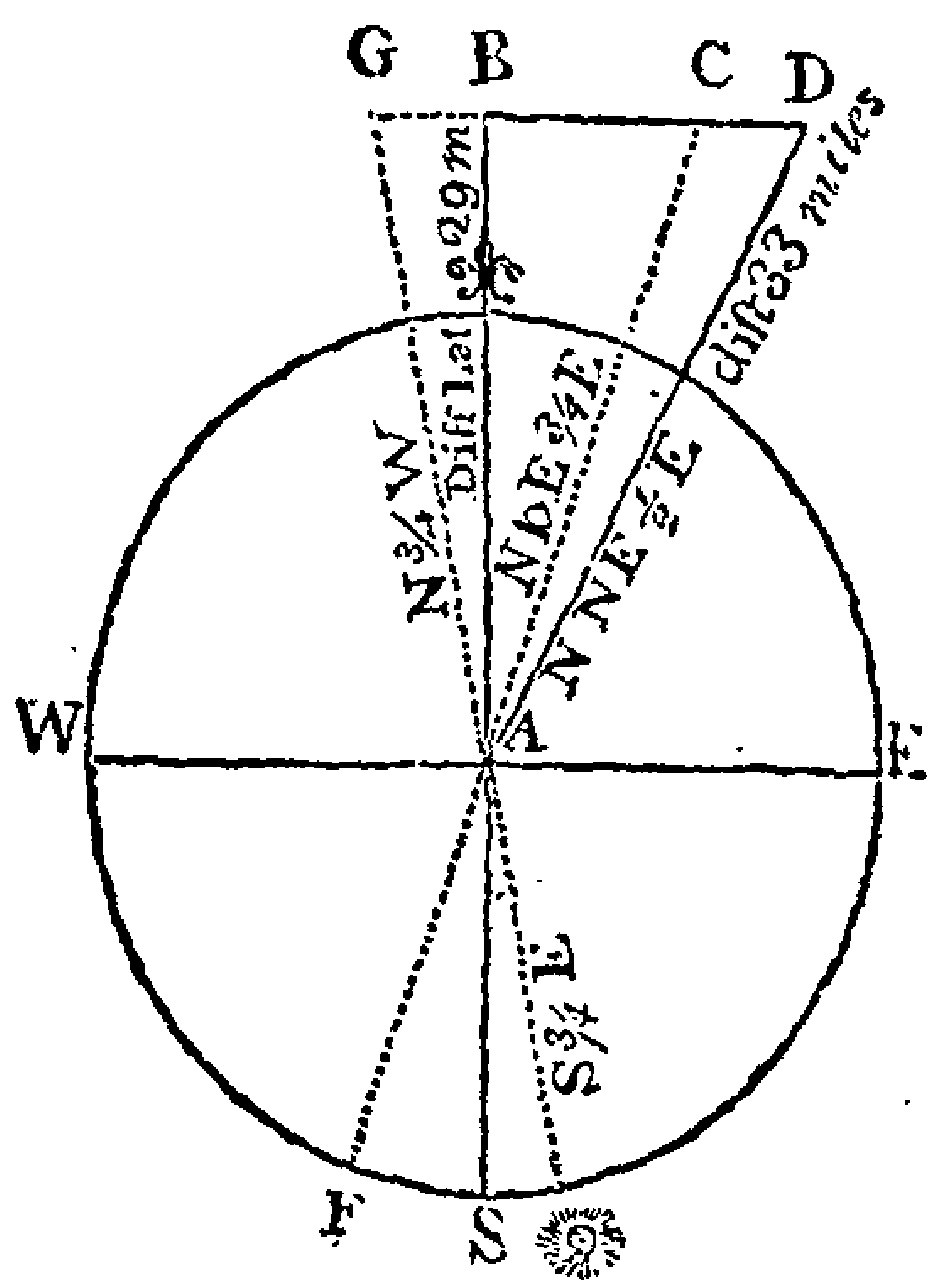
The time of the firft obfervation is 10 H. 0 M. A. M. and of the fecond 1 H. 40 M. P. M. the elapfed time is 3 H. 40 M. and the rate of failing is 9 miles per hour; then fay, by the Rule of Three, as 1 H. is to 9 miles, fo is 3 H. 40 M. to 33 miles, the diftance run in the elapfed time.

Again, the fun's bearing at the firft obfervation is fouth $\frac{3}{4}$ E. the oppofite point to which is N. $\frac{3}{4}$ W. or $\frac{3}{4}$ point, and the fhip's courfe during the elap. time is N. by E. $\frac{3}{4}$ E. $1\frac{3}{4}$ points, fo the angle of fhip's courfe with the fun's bearing is $2\frac{1}{2}$ points.

Now

Now in the table of difference of latitude and departure, to the course $2\frac{1}{2}$ points, and distance 33, the difference of latitude is 29, and the ship sails from the sun: therefore from the first observed altitude 13° 18′ take 29′, the remainder 12° 49′ the first altitude corrected, which is to be used in the operation, as follows:

Let the circle represent the compass N, S, E, W, and A the ship's place. Take the ship's course N. by E. $\frac{3}{4}$ E. or $1\frac{3}{4}$ point, and set it off from the north towards the east; take the sun's bearing S. $\frac{3}{4}$ E. or $\frac{3}{4}$ of a point, and set it off from the south towards the east; the opposite point is A G, N $\frac{3}{4}$ W. then will G A C be the angle the ship has made during the elapsed time, which angle being set off from the north (or meridian) to the east, will be the true course the ship has made from the sun, as the angle B A D. From A to D set off 33 miles, the distance sailed in the elapsed time, from D draw a line parallel to the E. and W. to cut the north or meridian line at B, then A B will be the difference of latitude 29 miles, that the ship has sailed from the sun during elapsed time; which being subtracted from the first altitude leaves the first altitude 12° 49′ which is to be used in the operation. Had the ship sailed towards the sun, the above 29 miles must have been added to the first altitude.



	H.	M.	S.	Alt. Nat. Si.		
					Lat. 49° 17′	0,18554
Times	10	0	0	14° 15′ = 24615	Decl. 23 28	0,03749
	1	40	0	12 49 = 22185		
					Log. ratio	0,22303
Ela. T.	3	40	0	Diff. Nat. Si. 2430	Its log.	3,38561
					Its log.	0,33559
½ El. T.	1	50	0			
	0	10	0	Time corresponding to		3,94423
	1	40	0	Its log. in col. of rising is		3,97170
				Log. ratio —	—	0,22303
		90	0	5606	Nat. num. of	3,74867
		17	35	24615		
Zen. dist.		72	25 S.	Nat. Si. M. Alt. 30221 = 17° 35′		
Declination		23	28 S.			
Latitude		48	57 N.			

But

But as the latitude by computation differs considerably from that by account, the work must be repeated.

			Latitude 48° 57′ =	0,18262
			Declination 23 28 =	0,03749
			Log. ratio	0,22011
		H. M. S.	Diff. N. S. 2430 Its log.	3,38561
		1 50 0	Its log.	0,33559
		0 10 0	Time answering to	3,94131
	90 0	1 40 0	Its log. in col. of rising	3,97170
	17 37		Log. ratio —	0,22011
Zen. dist.	72 23 S.	5644	Nat. num. of	3,75159
Declin.	23 28 S.	24615		
Tr. lat.	48 55 N.	30259	Nat. Si. mer. alt. 17° 37′.	

This latitude differing only 2 miles from that used in the computation, it may be depended upon as the true latitude.

EXAMPLE VII.

A ship sailing N. E. ½ E. by compass, at the rate of 9 knots an hour, at 0 H. 31 M. 40 S. P. M. per watch, I found the altitude of the sun's lower limb 28° 20′ above the horizon of the sea, the eye being elevated 20 feet above the surface of the water, and the sun's bearing by compass being at the same time S. by W. and at 2 H. 58 M. 20 S. P. M. by watch, the altitude of the sun's lower limb was 16° 41′ above the horizon, the eye being elevated as before, and the latitude by account, at the time of the last observation, was 48° 0′ north, and the declination 13° 17′ south. Required the true latitude at taking the last observation?

First observed alt. sun's lower limb.	28° 20′	Second ditto	16° 41′
Refraction to be subtracted	2		3
Correction for refraction	28 18		16 38
Dip of the horizon subtracted	4		4
Apparent alt.	28 14		16 34
Sun's semidiameter added	0 16		0 16
Correct altitude of sun's centre	28 30		16 50

Correction for the first Altitude.

The time of the first observation 0 H. 31 M. 40 S. P. M. of the second, 2 H. 58 M. 20 S. P. M. so the elapsed time is 2 H. 26 M. 40 S. and the rate of sailing is 9 miles per hour. Then as 1 H. : 9 miles :: 2 H. 26 M. 40 S. : 22 miles, the distance run in the elapsed time.

Again, the sun's bearing at the first observation is S. by W. the opposite point to which is N. by E. or 1 point. The

The ship's course during the elapsed time is N. E. ½ E. or 4½ pts.
So the angle of the ship's course with the sun's bearing is } N. E. by N. ½ E. 3½ pts.
In the table of difference of latitude and departure, to the course 3½ points, and distance 22 miles, the difference of latitude is 17 miles, while the ship sails from the sun.
Wherefore, first observed altitude 28° 30′—17′ = 28° 13′ the first correct altitude to be used in the operation.

	H. M. S.	Alt.	Nat. Si.			
Times	0 31 40	28° 13′	47281	Declin. Lat. by ac.	48° 0′	0,17449
				Declin.	13 17	0,01178
	2 58 20	16 50	28959			
				Log. ratio		0,18627
Ela. T.	2 26 40	Diff. Nat. Si.	18322	Its log.		4,26297
½ El. T.	1 13 20	Its log. from col. of ½ elapsed time				0,50232
	1 46 30	In col. of mid. time corresponding to				4,95156
	0 33 10	Its log. from col. of rising				3,01923
				Log. ratio		0,18627
		Nat. Si. gr. alt.	47281			
	90 0		681	Nat. num. of		2,83296
Mer. alt.	28 40					
		Nat. Si. mer. alt.	47962 = 28° 40′			
Zen. dist.	61 20 N.					
Decl.	13 17 S.					
Lat.	48 3 N.					

And as it differs but three miles from the latitude by account, it may be taken as the true latitude.

Questions for Exercise.

1st. Being at sea in latitude by account 39° 28′ N. when the sun's declination was 20° 41′ N. at 11 h. 30 m. 15 s. A. M. per watch, the altitude of the sun's lower limb was observed to be 68° 18′ 45″, and at 12 h. 26 m. 28 s. P. M. it was 70° 58′, the height of the eye being 21 feet above the surface of the sea. Required the true latitude of the ship?

Answer, 39° 28′ N.

2d. Being at sea in latitude 50° 40′ N. by account, at 10 h. 17 m. 30 s. A. M. per watch, the altitude of the sun's lower limb was observed to be 17° 4′¼, and at 11 h. 17 m. 30 s. it was 19° 31′¼, the declination being then 20° N. and the height of the eye 21 ft. above the sea. Required the latitude in?

Answer, 50° 0′ N.

 3d. Suppose

3d. Suppose a ship at sea in latitude 47° 34' N. by account, at 9h. 55m. 30s. by watch, the altitude of the sun's lower limb was 17° 24', bearing by compass S. by E. ¼ E. and at 12h. 54m. 10s. his altitude was 21° 45'½, the declination being then 19° 30' S. the height of the eye 20 feet above the sea, and the ship's course by compass was E. ½ S. at the rate of 7 knots per hour. What was the true latitude? Answer, 47° 24' N.

4th. At 11h. 28m. 20s. A. M. per watch, the altitude of the sun's lower limb was 28° 18', the sun bearing then S. by W. by compass. At 2h. 58m. 20s. P. M. his altitude was 16° 40', the height of the eye 20 feet, his declination being then 13° 17' N. and the latitude then by account 47° 50' N. the ship's course during the elapsed time was N. E. with her larboard tacks on board, sailing at the rate of 6 knots, and made half a point lee-way. What latitude was she in when the last altitude was taken? Answer, 48° 9' N.

By the ship's course per compass is to be understood, its course made good, lee-way, if any, being first allowed, or the course by compass, corrected for the lee-way only, but not for the variation. Had the variation of the compass been applied, both to the ship's course and the sun's bearing, it would not have made any difference in the operation or result, as the angle formed by them will always be the same, whether they are both estimated by the compass, or when the variation is allowed on both.

This method of finding the latitude is of excellent use, since there are so many circumstances at sea, which deny the opportunity of having the sun's meridian altitude; and as the knowing the true latitude is of the greatest consequence, especially in going into the English channel, &c. where there are frequent obstructions of clouds, every seaman ought to be ready at determining his latitude, by this method, whenever an opportunity offers, lest he should not see the sun upon the meridian.

NOTE.—The nearer to noon the observations are taken, the better; provided the elapsed time be not much less than half the interval of time, when they are both taken on the same side of noon, nor much greater than once and half the greater interval, when taken on different sides of noon.

To

To find the LATITUDE *by one* ALTITUDE *of the Sun, having your Watch previously regulated.*

RULE.

ADD together the co-sine of the latitude by account, the co-sine of the declination, the logarithm in the column of rising corresponding to the time from noon when the observation was taken, rejecting 20 in the index; the natural number of the remainder added to the natural sine of the observed altitude will give the natural sine of the meridian altitude from which the latitude may be obtained by the common rules.

EXAMPLE I.

Being at sea in latitude 49° 50' N. by account, when the sun's declination was 20° S. at 11 h. 28 m. per watch well regulated. The sun's altitude was 19° 41' to the southward of me. Required the true latitude?

Lat.	49 50	Co-sine	9.80957	Mer. alt.	20 3
Decl.	20 0	Co-sine	9.97299	Zen. dist.	69 57 N.
Time from noon	0 h. 32 m.	Log. rising	2.98820	Decl.	20 0 S.
	590	Nat. num.	2.77076	Latitude	49 57 N.
Obs. alt. 19 41	Sine 33682				
Mer. alt. 20 3	Sine 34272				

EXAMPLE II.

At sea in latitude by account 60° N. when the sun was on the equator at 1 h. 0 m. P. M. per watch well regulated. The sun's altitude was 28° 53' to the south of me. Required the latitude?

Lat.	60° N.	Co-sine	9.69897	Mer. alt.	30 0
Decl.	0	Co-sine	10.00000	Zen. dist.	60 0 N.
Time from noon	1 h.	log. rising	3.53243	Decl.	0 0
	1703	Nat. num.	3.23140	Lat.	60 0 N.
Obs. alt. 28 53	Sine 48303				
Mer. alt. 30 0	Sine 50006				

NOTES.

1. In the late editions of H. MOORE, he gives rules to determine the time and latitude by the same observation, which is impossible; for the latitude cannot be found by a single observation without you know exactly the time of taking it: therefore, to make use of this method, it would be best to regulate your watch by an altitude observed in the morning or evening, and then take another observation as near noon as possible, by which you may determine your latitude by the above method.

2. If

2. If the latitude by computation differs considerably from the latitude by account, it is best to repeat the operation, using the latitude last found instead of the latitude by account.

3. The change of altitude found by the rules given by H. MOORE is always equal to the difference between his supposed meridian altitude and the observed altitude; thus, in Ex. 1. page 217, Ed. 10. the supposed meridian altitude is 19° 20', the observed altitude 19° 41', their difference is 21', and his rule gives 21' to be added to the observed altitude 19° 41' to obtain the true 20° 2', as in page 218 of the same work. In this example the supposed meridian altitude is less than the observed altitude, which is impossible, (except the sun comes to the meridian below the pole,) had that not been the case the latitude by calculation would have been the same as the latitude by account, as in Example 2 and 3, of the same work.

4. As in using the preceding method it is necessary to regulate your watch, the following method may be used, which is simpler than that given in page 225, as it saves the trouble of finding the zenith distances.—This rule has often been given before in other authors.

To regulate a Watch.

ADD together the latitude, the correct altitude of the sun's center, and the polar distance; from the half sum subtract the sun's altitude and note the remainder.—Then add the co-secant of the polar distance, the secant of the latitude, (rejecting the indexes,) the co-sine of the half sum, and sine of the remainder; half the sum of these four logarithms sought in the table of sines will correspond to the hour of the day in the hour columns.

EXAMPLE.—(See page 226, Ex. 2.)

Given latitude 51° 30' N. sun's declination 6° 55' S. sun's correct central altitude 13° 41'. Required the time of observation?

Sun's altitude	13° 41'		
Latitude	51 30	Secant	0.20585
Polar distance	96 55	Co-secant	0.00317
Sum	162 6		
Half sum	81 3	Co-sine	9.19193
½ sum less sun's alt.	67 22	Sine	9.96520
		Sum	)19.36615
Hour 3 50 32 P. M.		Sine	9.68307
or 8 9 28 A. M.			

To

To find the Latitude by the Meridian Altitude of the Moon.

THE latitude may be found by the Moon's Meridian Altitude more accurately than by any other method except by the Sun. The common rule for working the obſervation is lengthy; but may be conſiderably ſhortened by the following approximation, which will give the latitude within 2 or 3 minutes and nearer when the altitudes are great.

To find the true time of the Moon's paſſing the Meridian.

In 6th page of the Nautical Almanac, find the time of the Moon's coming to the meridian of Greenwich for one day earlier than the ſea account and note the difference between this time and the time of her coming to the meridian the next day. With this daily difference enter the top column of Table I. adjoined, and againſt the ſhip's longitude in the ſide column is a number of minutes to be added to the above time of paſſing the meridian when in Weſt longitude; but ſubtracted in Eaſt; the ſum or difference will be the true time of the Moon's paſſing the meridian of the ſhip.

To find the Moon's Declination.

Find the time of her coming to the meridian as above; turn the ſhip's longitude into time, and add it thereto if in Weſt longitude; but ſubtract it in Eaſt, and the ſum or difference will be the time at Greenwich. Take out the Moon's declination from page 6th of the Nautical Almanac for the neareſt noon and midnight and note their difference, if of the ſame name, but ſum, if of different names: Then add the prop. log. of this difference or ſum to the prop. log. of one quarter the time at Greenwich (from which 12 hours muſt firſt be ſubtracted, when greater than 12) the ſum is the prop. log. of the correction, to be applied to the firſt declination, additive, if the declination is increaſing; ſubtractive, if decreaſing.

NOTES.

1ſt. When the difference of declination is more than 3° it cannot be found in the Table of prop. log. in which caſe, you muſt take its half and uſe it and double the quotient.

2d. When the correction of declination is ſubtractive and greater than the declination itſelf, the difference will be the true declination; but it will be of a different name from the firſt declination.

Having the Moon's Declination and Meridian Altitude, to find the Latitude.

To the obſerved altitude of the moon's lower limb add 12 minutes, but if her upper limb was obſerved, ſubtract 20 minutes; with this altitude enter Table II. adjoined, and take out the minutes correſponding, and add thereto which will give the correct central altitude; with this altitude and the moon's declination, found as above, the latitude may be found as by a common meridian altitude of the ſun.

TABLE I.

PROPORTIONAL PARTS.

Long	40′	43′	46	49′	52′	55	58′	61′	64′	67′
0	0	0	0	0	0	0	0	0	0	0
10	1	1	1	1	1	2	2	2	2	2
20	2	2	2	2	3	3	3	3	4	4
30	3	4	4	4	4	5	5	5	5	6
40	4	5	5	5	6	6	6	7	7	7
50	6	6	7	7	7	8	8	9	9	10
60	7	7	8	8	9	9	10	10	11	11
70	8	8	9	10	10	11	11	12	12	13
80	9	10	10	11	12	12	13	13	14	15
90	10	11	12	12	13	14	14	15	16	17
100	11	12	13	14	15	15	16	17	18	19
110	12	13	14	15	16	17	17	19	20	20
120	13	14	15	16	17	18	19	20	21	22
130	14	16	17	18	19	20	21	22	23	24
140	16	17	18	19	20	22	22	24	25	26
150	17	18	19	20	22	23	24	25	27	28
160	18	19	20	22	23	25	25	27	28	30
170	19	20	22	23	25	26	27	29	30	32
180	20	21	23	25	26	28	29	31	32	34

TABLE II.

Correction of moon's alt. for Par. and Refrac.

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

EXAMPLE I.

Oct. 7, 1800, Sea account, in long. 80° E. meridian altitude of moon's upper limb was observed to be 40° 25′ to the northward. Required the true latitude?

Oct. 7, Sea account, is Oct. 6, by Ephemeris, on which day the moon passes the meridian at 15 h. 4 m. and the next day at 15 h. 53 m. differing 49 m. In table I, under 49 and opposite the long. 80° is 11, which subtracted from 15 h. 4 m. leaves 14 h. 53 m. the true time of passing the meridian.

M. passes merid.	14 53		Oct. 6, at noon M's Decl.	21 42 N.
Ship's l. 80° in ti.	5 20		Midnight	23 32
Ti. at Greenwich	9 33		Difference	1 50
One quarter part	2 24	P. log. 0969	M's ob. alt. u. l.	40 25
Diff. of decl.	1 50	P. log 2139	Subtract	20
Corr. of decl.	1° 28′	3108		40 5
Decl. at noon	21 42		Add num. tab. II.	43
True decl.	23 10 N.		M's. true alt.	40 48
			M's. zen. dist.	49 12 S.
			M's. decl.	23 10 N.
			Latitude	26 2 S.

EXAMPLE II.

Nov. 21, Sea account, in long. 60° W. observed the meridian altitude of the moon's lower limb 60° 0' to the south of me. Required the true latitude?

Nov. 21, Sea account, or Nov. 20, by Ephemeris, the moon passes the meridian at 3 h. 54 m. the next day at 4 h. 54 m. differing 1 hour or 60', in Table I. under 61, and opposite the longitude 60° is 10' which added to 3. 54, gives 4 h. 4 m. the true time of the moon's passing the meridian.

	h.	m.	
☽ passes the meridian	4	4	
Long. 60° W. in time	4	0	
Time at Greenwich	8	4	
One quarter	2	1	P.log. 1725
Variation ☽ decl.	1	20	P.log. 3522
Correction of declin.	0	54	P.log. 5247
Dec. Nov. 20, at noon	27	9	
True decl. at time of obs.	26	15 N.	

Nov. 20, at noon, ☽ decl.	27	9 N.
Midnight	25	49
Variation	1	20
☽ Obs. alt. L. L.	60	0
Add		12
	60	12
Numb. Tab. II.		28
☽ True alt.	60	40
☽ Zen. dist.	29	20 N.
☽ Dec.	26	15 N.
Latitude	55	35 N.

To find the Latitude by the Meridian Altitude of a Planet.

In page 4th of the month of the Nautical Almanac take out the time of the planet's passing the meridian on the day nearest to that day on which the observation was made; this will be nearly the time of passing the meridian of the place of observation.

Turn the ship's longitude into time and add it to the time of passing the meridian, when in West longitude, but subtract it when in East longitude, the sum or difference is the time at Greenwich, nearly.

Take out the planet's declination for the days which immediately precedes and follows the day of observation, and note the difference; then say, as 6 days is to this difference, so is the number of days and hours difference between the day first taken from the Ephemeris and the time of observation at Greenwich: to the correction of declination, which is to be applied to the declination first marked in the Nautical Almanac, additive, if increasing, subtractive, if decreasing.

From the observed alt. of the Planet subtract 4 minutes for dip, subtract also the refraction and the remainder will be the correct altitude, from which and the declination we may find the latitude as for an observation of the sun.

EXAMPLE

EXAMPLE.

Dec. 23. 1800, Sea account, in long. 70° W. Jupiter passed the meridian to the southward of me, his altitude, being observed, was 45° 20'. Required the true latitude?

Dec. 23d. Sea account, is Dec. 22, by the Ephemeris; now Dec. 19, by the Nautical Almanac, Jupiter passes the meridian at 14h. 31'

To this add the longitude 70° W. in time		4	40
Time at Greenwich	Dec. 22,	19	11

Jupiter's declination Dec. 19,	19°	55'
25,	20	4
Difference		9

Then say, if 6 days give 9 minutes difference, what will 3d. 19 h. give, (or $3\frac{3}{4}$ days, which is the time elapsed from Dec. 19, to Dec. 22d. 19 h.)? The answer is 6 minutes, which added to 19° 55', because the declination is increasing, gives 20. 01, the true declination at the time of observation.

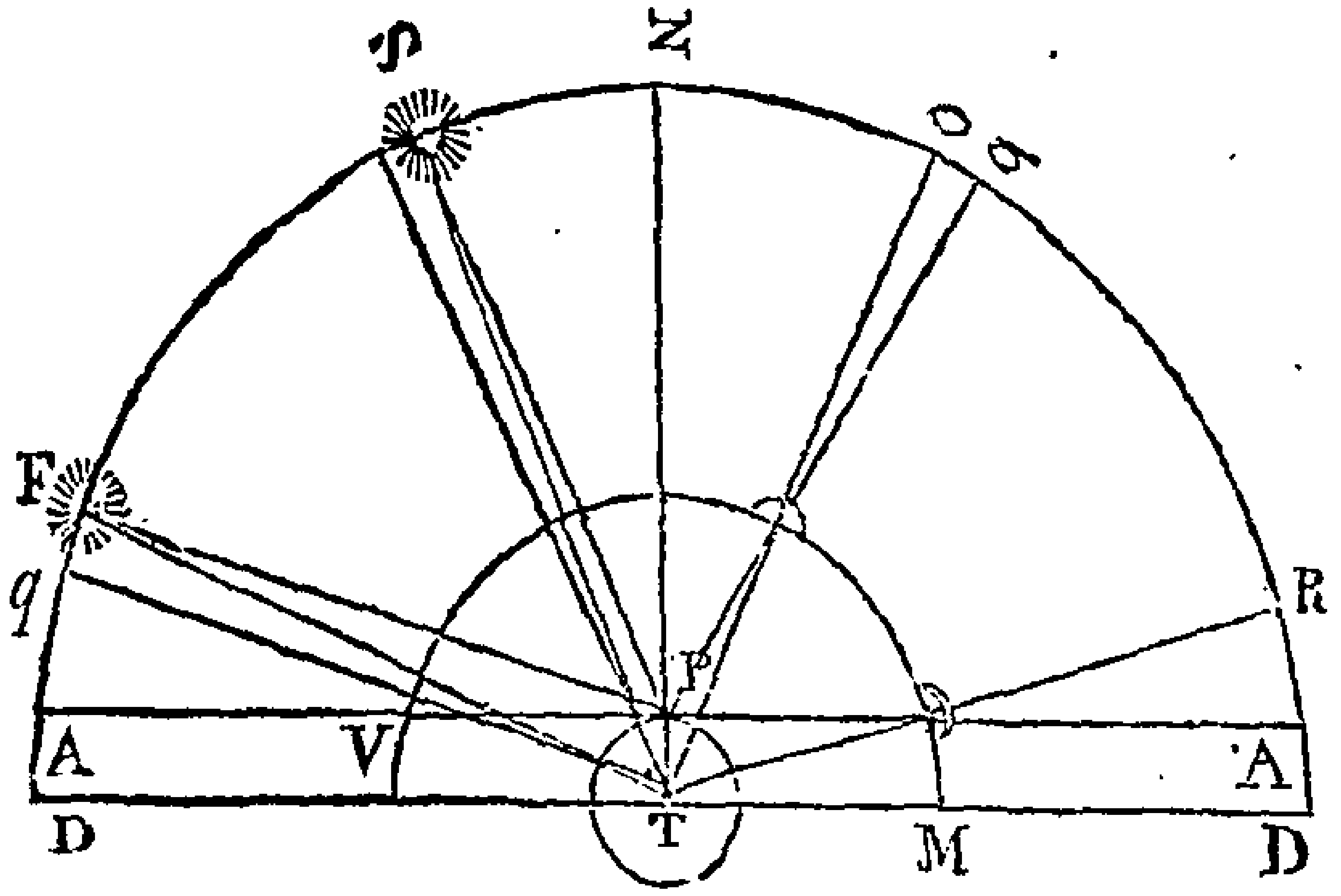
Jupiter's observed altitude	45°	20'
Sub. 4' for dip, and 1 for refraction		5
True altitude	45	15
Zen. dist.	44	45 N.
Declination	20	01 N.
True latitude	64	46 N.

OF THE PARALLAX.

PARALLAX is the difference between the altitude of the sun, moon, or star, and the altitude of the same object seen at the same time from the earth's surface; or it is the angle the earth's semi-diameter would appear under by an observer placed at the sun, moon, or star.

The parallax of the heavenly bodies are greatest when in the horizon, hence called the horizontal parallax; that of the moon's is set down in the Nautical Almanac for every noon and midnight, and lies between 54' and 62'; the parallax diminishes according to the altitude of the object, until it comes to the zenith, where it is nothing; the difference of the elevation of objects is called the parallax in altitude, and it is easy calculated by saying,

ing, as radius is to the horizontal parallax, ſo is the co-ſine of the altitude to the parallax in altitude: now, as all objects are depreſſed by their parallax, ſo they are elevated above their true altitudes by refraction.



Let P T repreſent the earth, T the centre, M ☽ V a part of the moon's orbit, D D a part of the ſun's orbit, and the rational as well as A A is the ſenſible horizon.

Now, an obſerver at T will ſee the moon in the line ☽ R, when another at P at the ſame time will ſee her in the line ☽ A in the ſenſible horizon, and the angle P ☽ T=M T ☽=A ☽ R is the horizontal parallax ſet down in the Nautical Almanac for every noon and midnight, and lies between 54′ and 62′; this angle diminiſhes as the object approaches the zenith; for ſuppoſe the moon in the line P *q* the ∠ *q* ☽ o=P ☽ T is leſs than the ∠A ☽ R= ∠ T ☽ P, ſtill diminiſhing until it comes to the nenith Z, where it is nothing. To find the diminution of parallax in altitude, ſay, as radius ∶ is to the horizontal parallax ∷ ſo is the co-ſine of the apparent altitude ∶ to the parallax in altitude.

The parallax of the moon is greater than any of the reſt of the planets, owing to her being neareſt the earth, the vaſt diſtance of the ſun and ſtars rendering their parallax ſo ſmall, that they are often neglected in nautical calculations; for ſuppoſe the ſun at F or S, then the ∠ TFP=*q*TF is the ſun's parallax, about 8½ ſeconds.

Having the earth's ſemi-diameter and the parallax of any of the planets, their diſtance may be found, by ſaying, ∶ as the tangent of the parallax ∶ is to the earth's ſemi-diameter in miles ∷ ſo is radius ∶ to the diſtance.

Having the diſtance, the parallax is found by ſaying, As the diſtance ∶ is to radius ∷ ſo is the earth's ſemi-diameter ∶ to the tangent of the parallax.

The earth's ſemi-diameter is 1146 nautical leagues, the ſun's diſtance from the earth is 27,809,344, the moon 69,059, Mercury 10,764,563, Venus 20,115,400, Mars 42,372,897, Jupiter 144,635,833, and Saturn 26[illegible]83,603 leagues.

To

To reduce the Sun's Declination from Noon at Greenwich, to the NOON under any other Meridian. By Table XIV.

R U L E.

1st. WITH the longitude in from Greenwich, in the top column expressed both in time and degrees, look for that answering nearest to your longitude in.

2nd. Look for the day of the month in the side column, the number of minutes, and seconds where that cuts (in the same col. of your longitude in) is either to be added to, or subtracted from the declination that day at Greenwich.

To know whether it is to be added, or subtracted, look at the top, and under the column of the day of the month you will see, add in east, or subtract in west, (and *vice versa*) which having done will give the true declination for the noon at the place of observation.

E X A M P L E.

Required the true declination, October 10, 1800, Sea account, in longitude 52° E. of Greenwich.

Sun's decl. Oct. 10 at Greenwich	6° 39′ 30″	per Ephemeris.
Varia. of decl. per tables Oct. 9 and long. 52° east gives	0 3 15	to be sub. in east long.
True decl. Oct. 10, in long. 52 E.	6 36 15	

To reduce the Sun's Declination from Noon at any Meridian, to any other Time under that Meridian.

R U L E.

1st. With the time from noon in the top of the column, look for that answering nearest to this time.

2d. Look for the day of the month in the side column, the number of minutes and seconds, where that cuts (in the same column of the time from noon, is either to be added to, or subtracted, from the declination that day at Greenwich, noon.

To know whether it is to be added or subtracted, look at the top, and under the column of the day of the month, you will see add afternoon, or subtract before noon (and *vice versa*) which you having done, will give you the true declination for any time differing from noon.

E X A M P L E I.

Required the sun's true declination October 10, 1800, Sea account, at 8 H. 21 M. in the forenoon, in longitude 52° east of Greenwich?

Variation of decl. Oct. 10, per table in long. 52° E. subtract in east longitude — —	0° 3′ 15″
Variation of Decl. for 3 h. 39 m. from noon Oct. 10, per tables to be subtracted before noon,	0 3 26
Sum of variations subtract — —	0 6 41
Sun's declination per Naut. Al. Oct. 10, at Greenwich	6 39 30
True decl. Oct. 10, in long. 52° E. at 8 h. 21 m. A. M.	6 32 49 S.

EXAMPLE

EXAMPLE II.

Required the ſun's true declination, May 9, 1800, Sea account, at 5h. 30m. P. M. and in longitude 35° 30' weſt of Greenwich ?

	H.	M.	S.
Varia. of declination May 9, in long. 35° 30' weſt Add in weſt longitude	0	1	41
Varia. of decl. for 5 h. 30 m. from noon May 9, per tables to be added afternoon,	0	3	52
Sum of Varia. Add, or correction of declination	0	5	33
Sun's declination May 8, per Ephemeris	17	5	59
Tr. decl. May 7, long. 35. 30 W. at 3 h. 30 m. P. M.	17	11	32

The above method will give the ſun's declination ſufficiently correct for all nautical purpoſes ; but thoſe who wiſh to come to the greateſt degree of exactneſs may uſe the following method.

Turn the ſhip's longitude into time by Table XIX. and add to it the time per watch, if the longitude be weſt, but ſubtract it if the longitude be eaſt, the ſum or difference will be the time at Greenwich, which call the reduced time.

Look in the Nautical Almanac for the given day, and in page 2d of the month ſtands the ſun's declination.

If the reduced time be in the morning, take the difference of declination between the noon before, and the noon after, the reduced time.

Then ſay by the Rule of Three,

As 24 hours : is to the daily difference of declination :: ſo is the reduced time : to a number of minutes and ſeconds, which being added to the declination the noon before, if it be increaſing, or ſubtracting it, if decreaſing, the ſum or difference will be the declination at the ſhip.

Note. Although the time uſed in the Nautical Almanac and ſea account differ one day from each other, yet the ſun's declination is marked the ſame for the ſame day of the month both in the Ephemeris and Epitome. The reaſon of this is, that all the numbers in the Nautical Almanac are marked down for the beginning of the day ; but the declination required by mariners is for the end of the ſea day : thus, if a perſon was finding his latitude from an obſervation made at the end of the ſea day, Oct. 10, he ſeeks the declination marked againſt Oct. 10, although the real ſea time is Oct. 10th. 24 h. or, Oct. 11th. 0 h. which is the ſame as Oct. 10th. 0h. by Ephemeris, conſequently the declination muſt be marked the ſame in both ſets of tables.

To find the apparent Time, and thereby regulate the going of the Watch, and First, by Equal Altitudes of the Sun.

AT the time when the watch ſtands in need of being regulated for the obſervations intended, let the ſun's altitude be taken at any convenient time in the forenoon. 2, 3, 4, or 5 hours diſtant from the meridian. Set down the altitude with the correſponding time exactly (the index being already ſet to the morning altitude :) note down the time of the ſame altitude in the afternoon ; half the ſum of theſe two times is the apparent time ſhewn by the clock or watch when the ſun was upon the meridian of that place. But it muſt here be obſerved, that, if the change of declination be conſiderable during the elapſed time, it muſt be allowed for, by adding the difference to, or ſubtracting it from, the ſecond altitude, according as it is increaſing or decreaſing. Leſt that an altitude taken in the forenoon cannot by the interpoſition of clouds have a correſponding one in the afternoon ; it is therefore proper to take ſeveral in the forenoon in order to ſecure a correſponding one in the afternoon. And, if ſeveral equal altitudes can be taken on both ſides of the meridian, it will be beſt to find the noons for each pair, and the mean of all the noons thus found for the true one.

When there is reaſon to believe that the watch gains or loſes conſiderably, other ſets of obſervations may be taken on ſucceſſive days, whereby the daily variation may be found and allowed for ; by which means the artiſt will have little more to do in finding his longitude by obſervation, than to reduce the obſerved diſtance of the objects to the true diſtance of their centres ; the ſhip's time being ſhewn by the watch previouſly regulated.

EXAMPLES.

May 20, 1796, ſuppoſe that at 8 h. 40 m. in the forenoon, and 3 h. 16 m. afternoon by watch, the ſun had equal altitudes, and the going of the watch be required?

	H.	M.
Now add together	12	0
	8	40
	3	16
	2,23	56
½ gives noon per watch	11	58
True noon —	12	0
Watch ſlow —		2

March 18, 1796, in lat. 49° N. ſuppoſe at 8 h. 10 m. 58 s. forenoon, and at 3 h. 58 m. 34 s. you have equal altitudes of the ſun. Required the going of the watch?

The diſtance of the time from noon when the firſt was taken is 3h. 49 m. 2 s. doubled is 7 h. 38 m. 4 s. and the daily decreaſe of declination at this time is 23 m. 41 s.

Now: as 24 h. : 23 m. 41 s. :: 7 h. 38 m. 4 s. : 7½ m.

Hence the index of the quadrant muſt be ſet 7½ m. forward on the arch, to correſpond with the morning altitude, whence the watch will be found 4 m. 46 s. too faſt.

Here it is ſuppoſed that the ſhip is lying by, or makes no way through the water ; but if ſhe is ſailing to or from the ſun, proper allowance muſt be made for her run. during the elapſed time ; but the following methods of finding the time will anſwer every purpoſe at ſea.

To

To find the apparent time by the Sun's Altitude.

The firſt of the methods here given, is rather the ſimpleſt, as it does not require the uſe of the table of natural ſines; it is alſo ſimilar to the rule given for working an azimuth, ſo that by making uſe of this method we need only burthen the memory with one rule for both problems. This method is a little ſimplified by means of the table of hours, added to the table of Log. Sines. In uſing the table of hours it ought to be noted, that, if the co-ſine of the number is marked at top, the name of the hour either A. M. or P. M is alſo to be found at the top, and the contrary. This method of finding the apparent time is as follows.

Find the ſhip's latitude and longitude by account at the time of obſervation by carrying the reckoning forward to that time. With a Quadrant well adjuſted take the altitude of the ſun's lower limb, to which add * 12 minutes (for ſemi-diameter and dip) and, ſubtracting the refraction, the remainder will be the apparent altitude, which, ſubtracted from 90°, gives the zenith diſtance.

Find the ſun's correct declination at the time of obſervation, and if the latitude and declination be both north or both ſouth, ſubtract the declination from 90° and you will have the polar diſtance; but, if one be north and the other ſouth, add the declination to 90 and you will have the polar diſtance.

Add together The zenith diſtance
The co-latitude, and
Polar diſtance into one ſum.

From half this ſum ſubtract the zenith diſtance, noting the half ſum and remainder, then add together

The log. co-ſecant of the co-lat. } rejecting the indexes.
Log. co-ſecant of the polar diſtance }
Log. ſine of half the ſum.
Log. ſine of the remainder, and

Half the ſum of theſe four logarithms being found among the co-ſines, correſponds in the adjoined column to the time of day, forenoon or afternoon, according as it is marked A. M. or P. M.

NOTE.—In all theſe examples, for finding the time, the odd ſeconds may be neglected in finding the logarithms, taking them for the neareſt minute.

EXAMPLE I.

Suppoſe on the 9th of May, 1800, Sea account, at 5h. 30m. 32s. P. M. per watch, in latitude 39° 54' N. long. 25° W. of Greenwich per account, the altitude of the ſun's lower limb was 15° 45' and conſequently his correct altitude 15° 54' the true declination being then 17° 11' N. Required the time of obſervation?

Obſ.

* This 12 miles is taken inſtead of the difference between the ſemi-diameter and dip, and is ſufficiently exact.

Obs. alt. Sun's L. L.	15° 45′	Lat.	39° 54′	
Add	12	From	90	
	15 57	Co-lat.	50 06	
Subtract Refraction	3			
Sun's true altitude	15 54			
	90			
Sun's zenith distance	74 06			
Comp. of lat.	50 06	Co-sec.	0.11511	
Pol. dist.	72 49	Co-sec.	0,01983	
Sum)	197 01			
½ Sum	98 31	Sine	9.99518	
Zen. Dist.	74 06			
Remainder	24 25	Sine	9.61634	
			2)19.74646	

Sun's Decl. May 9th. Sea acc. or May 8th. N. A.	17 5 59
Correct. for 25° 30′ long.	1 11
Ditto for 5h.30m. from noon	3 52
Correct declination	17 11 N.
From	90
Polar Distance	72 49

Co-sine 9.87323 corresponding to which in the column P. M. is the true hour of the day 5h. 33m. 28s.

EXAMPLE II.

Suppose in the forenoon 11th October, 1800, Sea account in lat. 51° 30′ N. long. 62° E. the altitude of the sun's lower limb should be found as under. Required the apparent time?

TIMES.		ALTIT.	
20°	14′	12°	28
20	19	13	20
20	30	14	51
3)61	3	40	39

October 11th, 20 H. 21 M. sea account, is October 10 D. 20 H. 21 M. by Ephemeris, and therefore wants 3h. 39m. of noon October 11th. by Ephemeris.

Sun's decl. at noon by Eph. Oct. 11		7° 2′ 15″
Corr. for long. 62° E: subt.	3′ 45″	7 11
Corr. for time 3h. 39′ sub.	3 26	
Sun's correct declination		6 55 4S.
		90
Pol. dist.		96 55

Mean	20 21	13 33		
Add		12		
		13 45	Latitude	51 30
Sub. Refraction		4		90
True altitude		13 41	Co-lat.	38 30
From		90		
Zen. Dist.		76 19		
Co-lat.		38 30	Co-secant	0.20585
Pol. Dist.		96 55	Co-secant	0.00317
	Sum)	211 44		
½ Sum		105 52	Sine	9.98313
Zen. Dist.		76 19		
Remainder		29 33	Sine	9.69301
				2)19.88516

Co-sine 9.94258 corresponding to which in column marked A. M. is the true time of day 8h. 9m. 28s.

Time per Watch	8 21
Watch too fast	11 32

Here

Here again it may be proper to obferve that as the day in the Nautical Almanac begins 12 hours later than the civil day, and 24 hours later than the fea day 20h. 21s. makes 8h. 21m. or 21 minutes paft 8 in the morning Oct. 11th of the civil day, and 8h. 21m. A. M. Oct. 11th according to fea account of time; therefore the end of the fea day, the noon of the civil day and beginning of the day in the Nautical Almanac are all at the fame time.

Examples to exercife the Learner.

1. In lat. 36° 39′ S. ☉ declination 9° 27′ N. the altitude of fun's lower limb in the morning was obferved 41° 34′. Required the apparent time?
Anfwer, 10h. 59m. 52s.

2. In lat. 36° 21′ S. ☉ declination 8° 44′ N. alt. ☉ L. L. in morning 40° 48′. Required the apparent time? Anfwer, 10h. 38m. 16s.

3. In lat. 29° 25′ N. ☉ declination 23° 20′ N. obferved alt. of fun's lower limb in the afternoon 14° 58′. Required the time?
Anfwer, 3h. 42m. 16s.

4. In lat. 3° 31′ S. ☉ declination 20° 03′ S. obferved alt. ☉ L. L. 38° 40′ in the afternoon. Required the time? Anfwer, 3h. 18m. 48s.

5. In lat. 13° 17′ N. ☉ declination 22° 10′ S. in the morning obferved altitude of ☉ L. L. 36° 25′. Required the time? Anf. 9h. 17m. 12s.

6. In lat. 21° 36′ S. fun's declination 3° 37′ S. obferved altitude of fun's L. L. 35° 47′. Required the time? Anf. 8h. 29m. 41s.

To find the apparent Time by the Altitude of a fixed Star.

Correct the obferved altitude for the dip and refraction, the dip being in general 4 minutes.

Find the fhip's latitude by account at the time of obfervation.

Find the ftar's right afcenfion and declination in Table XVI.

Then add together
Zenith diftance,
Co-latitude, and
Polar diftance into one fum.

From half this fum fubtract the zenith diftance, noting the half fum and remainder.

Then add together
Log. co-fec. of complement of the lat. } rejecting their indexes.
Log. co-fec. of polar diftance, }
Log. fine half the fum, and the
Log. fine remainder into one fum.

Half the fum of thefe four logarithms will be the log. co-fine of half hour angle.

Take out the correfponding time in the column marked P. M. Tab. XXV. and apply it to the ftar's right afcenfion, by fubtracting it when the ftar is eaft of the meridian, or adding it when it is weft of the meridian, their fum or difference will be the right afcenfion of the meridian or mid-heaven.

From

From the right aſcenſion of the meridian (increaſed by 24 if neceſſary) ſubtract the ſun's right aſcenſion the preceding noon at Greenwich, taken from page 2d of the month in the Nautical Almanac, the remainder will be the apparent time at ſhip nearly.

To this time apply the longitude of the ſhip from Greenwich, turned into time, by adding it when it is weſt, or ſubtracting it when it is eaſt, the ſum or difference will be the apparent time of the obſervation nearly by the meridian of Greenwich.

Then ſay, as 24 hours is to the daily variation of the ſun's right aſcenſion, ſo is this time to a number of minutes and ſeconds, which ſubtracted from the above time, leaves the correct apparent time at ſhip.

EXAMPLE I.

Suppoſe Sept. 9, 1800, Sea account, in lat. 7° 45′ S. long. 30° 18′ E. of Greenwich, the altitude of the ſtar Procyon, being then E. of the meridian, ſhould be 28° 16′ : Required the true time?

Star's obſ. alt.	28 16		Lat. by acc.	7 45	St. decl. Tab. XVI.	5 44 N.
Dip	4	Tab. XIII.		90	Add	90
	28 12		Co-lat.	82 15	Pol. Diſt.	95 44
Refraction	2	Tab. IX.				
Star's true alt.	28 10					
From	90					
Zen. diſt.	61 50					
Pol. Diſt.	95 44		Co-ſecant	0.00218		
Co-lat.	82 15		Co-ſecant	0.00398		
Sum	239 49					
½ Sum	119 55		Sine	9.93789		
Zen. Diſt.	61 50					
	58 05		Sine	9.92881		
			Sum	19.87286		

½ Sum co-ſine — — 9.93643 correſponding to which in column P. M. is —

	H.	M.	S.
½ Sum co-ſine 9.93643, P. M.	4h.	2m.	0s.
Star's Right Aſcenſion	7	28	51
Right Aſcenſion of the meridian	3	26	51
Increaſed by	24		
	27	26	51
Sept. 9th, Sea acc. is Sept. 8th. Ephem. when Sun's Right Aſcen. at noon	11	6	45
Time at ſhip nearly	16	20	6
Ship's longitude 30° 18′ E. in time	2	1	12
Time at Greenwich nearly	14	18	54

	H.	M.	S.
Sun's Right Aſcenſion, Sept. 8th.	11	6	45
Sept. 9th.	11	10	21
Daily difference		3	36

—Then as 24h. : 3m. 36s. :: 14h. 18m. to 2m. 9s. which ſubtracted from 16h. 20m. 6s. the time at the ſhip nearly, leaves 16h. 17m. 57s. the true time at the ſhip after noon or 4h. 17m. 57s. after midnight.

EXAMPLE II.

Suppose April 16th. 1800, Sea account, in lat. 48° 56' N. long. 66° W. the observed altitude of Aldebaran, when west of the meridian, should be 22° 24'. Required the apparent time at the ship?

Obs. alt. of Star	22° 24'	Lat. by acc.	48 56	*'s decl. Tab. XVI.	16 6 N.
Dip	4		90		90
	22 20	Co-lat.	41 04	Pol. dist.	73 54
Refraction	2				
True altitude	22 18				
	90				
Zen. dist.	67 42				
Pol. dist.	73 54	Co-secant	0.01738		
Co-lat.	41 04	Co-secant	0.18248		
Sum	182 40				
½ Sum	91 20	Sine	9.99988		
Zen. dist.	67 42				
Remainder	23 38	Sine	9.60302		
		Sum	19.80276		
		½ Sum co-sine	9.90138	corresponding to which in column P. M.	4h. 57m. 20s.

	h.	m.	s.
Star's Right Ascension	4	24	28
Right Ascension of Meridian	9	21	48
April 16th. Sea acc. is April 15th by Ephe. At noon April 15th. Sun's rt. as.	1	33	36
Apparent time at ship nearly	7	48	12
Long. 66° W. in time	4	24	
Apparent time at Greenwich	12	12	4

Sun's right ascension April 15th. 1h. 33m. 36s.
April 16th 1 37 18

Daily difference 3 42 then say as 24h. : 3m. 42s. :: 12h. 12m. : 1m. 53s. which subtracted from 7h. 48m. 12s. the apparent time at the ship nearly, leaves 7h. 46m. 19s. the correct time at the ship.

NOTE—This method of determining the time by the Stars is certain, could a good horizon be obtained; but as that is not always the case, it is best to regulate the watch by the Sun.

Another

Another Method of finding the apparent Time.

RULE.

When the sun or star's declination, and complement of latitude are both north or both south*, their sum, but if one be north, and the other south, their difference is the meridian altitude.

From the natural sine of the sun or star's meridian altitude, subtract the natural sine of the true altitude.

Then add together

The log. co-sec. of the comp. of the lat. } rejecting their indexes,
The log. sec. of the sun or star's decl. }
and The log. of the diff. of the natural sines into one sum.

The sum of these three logarithms, being found in the column of rising, Table XX. the hours, minutes, and seconds corresponding to it, will be the true time from the noon when the altitude was taken.

The two last examples may be worked by the above method.

EXAMPLE I.

May 9, 1800, Sea account, at 5h. 30m. 32s. P.M. per watch, in latitude 39° 54', longitude 25° west of Greenwich, by account, the altitude of the sun's lower limb was 15° 45'. Required the time of observation?

Obs. alt. of sun's L. L.	15 45	Lat.	39 54	Sun's decl. May 9, sea acc. or	
Add	12		90	May 8, Naut Al.	17 5 59
				Cor. 25° long.	1 11
	15 57	Co-lat.	50 06	Cor. 5h. 30m. P.M.	3 52
Subtract Refraction	3				
				Sun's declination	17 11 N
Sun's true altitude	15 4				

Co-lat.	50 06	Co-secant	0.11511
Declin.	17 11	Secant	0.01983
Mer. alt.	67 7	Nat. Si.	92243
Tr. alt.	15 54	Nat. Si.	27396

Difference of Nat. Sines 64847 Its log. 4.81189

4.94683 corresponding to which, in column of rising, is 5h. 33m. 30s. differing 2 seconds from the former method.

EXAMPLE II.

Oct. 11, 1800, at 8h. 21m. A. M. per watch, the altitude of the sun's lower limb was found to be 13° 33', the ship's latitude being 51° 30' N and longitude 62° E. Required the apparent time of observation?

Obs.

* If the sum exceeds 90° subtract it from 180, and the remainder will be the meridian altitude. (See the two last examples of the sun.) And it may be noted that when the sun passes the meridian to the northward, the zenith distance is called north, otherwise south

Obſ.alt.ſun's L.L.	13 33	Sh. l.	51° 30′	Oct. 11th d. 20 h. 21 m. Sea account, is Oct. 10th 20h. 21m. by Ephemeris, and therefore wants 3h. 39m. of noon, Oct. 11, by Ephemeris.
Add	12		90	
	13 45	Co-lat.	38 30	
Sub. Refrac.	4			Sun's decl. by Eph. Oct. 11, at noon 7 2 15
				Cor. for long. 62° Sub. 3 45 } 7 11
Sun's true altitude	13 41			Cor. for time 3 39 Sub. 3 26 }
				True declination 6 55 4

Co-lat.	38 30		Co-ſecant	0.20585	
Declin.	6 55		Secant	0.00317	
Mer. alt.	31 35	Nat. Sine	52374		
Tr. alt.	13 41	Nat. Sine	23656		
			28718	Its log.	4.45815
					4.66717

4.66717 correſponding to which in column of riſing (Table XX.) gives the true time from noon 3h. 50m. 30s.
which ſubtracted from 12 hours 12 0 0

leaves the time of day 8 9 30

How to know the Stars.

It ſometimes happens that for want of a map of the ſtars, or a celeſtial globe, many are at a loſs to know whether they have obſerved by the right ſtar or not, as there may ſome other ſtars come to the meridian nearly at the ſame time. But this may eaſily be proved, by finding the ſtar's meridian altitude as above; and if it nearly agrees with that on the quadrant, it muſt certainly be the right ſtar, otherwiſe not. The ſame may be obſerved of any of the planets.

To know when any ſtar comes to the meridian, or what ſtar will be on the meridian at any given time, ſee the explanation following Table XVI. and for their riſing and ſetting, with that of the moon and planets, ſee the directions following Table VIII. in this book.

NOTE 1. If an obſervation of the ſun has not been taken the preceding noon, or two altitudes to find the latitude, it may be aſcertained by taking the meridian altitude of the ſtar, either before or after the obſervation is made for finding the time.

NOTE 2. If the ſhip's longitude eaſt of Greenwich in time be greater than the apparent time at the ſhip, the apparent time muſt be increaſed by 24 hours before ſubtracting the longitude; and in this caſe, the ſun's right aſcenſion muſt be taken out of the Ephemeris for the preceding day of the month. And if the ſhip's longitude weſt of Greenwich in time, added to the apparent time at the place of the ſhip, makes more than 24 hours, 24 muſt be ſubtracted from the ſum, to obtain the apparent time at Greenwich; and the ſun's right aſcenſion muſt be taken out of the Ephemeris for the ſubſequent day of the month. The object, whether ſun or ſtar, whoſe altitude is taken for finding the time, muſt be at leaſt three or four points of the compaſs diſtant from the meridian; becauſe, when near to the meridian, the alteration in altitude is too ſlow for aſcertaining the time with proper exactneſs: but the nearer the object is to the eaſt or weſt the better,

ter, provided it be not leſs than 6° high; for the refraction is ſo variable and irregular near to the horizon, that the effect of refraction upon objects cannot be determined with ſufficient accuracy, when their altitudes are leſs than 6 degrees.

NOTE 3d. The obſerver muſt take the moon's diſt. from thoſe ſtars only, whoſe diſtance from her are ſet down in the Nautical Almanac, and the diſtances there ſet down afford him a ready means of knowing the ſtar from which her diſtance ought to be obſerved: by ſetting his index to the diſtance computed roughly at the apparent time, eſtimated nearly for the meridian of Greenwich, and then look to the eaſt or weſt of the moon, according as the diſtance of the ſtar is ſet down in the 8th, 9th, 10th, or 11th pages of the month in the Nautical Almanac, and having found the moon on the horizon-glaſs he will, by ſweeping with the quadrant or ſextant, to the right, or left, find the ſtar he wants, if above the horizon, and the air be clear, in a line perpendicular to that joining the moon's horns or her ſhorteſt axis produced.

The time at Greenwich is eſtimated roughly by turning the ſhip's ſuppoſed longitude from Greenwich into time, and adding it to, or ſubtracting it from, the apparent time at the ſhip, according as the longitude is eaſt or weſt, will give the apparent time nearly at Greenwich.

Take the diſtance of the objects out of the Nautical Almanac, both before and after this time;

Then ſay, as 3 hours, or 180 minutes: is to the difference of diſtance in 3 hours:: ſo is the difference between this nearly eſtimated time, and the next preceding time ſet down in the Nautical Almanac: to a number of minutes; which being added to the next preceding diſtance, if it is increaſing, or ſubtracting it, if it is decreaſing, will give the diſtance nearly at the time the obſervation is intended to be made, and to which the index of the ſextant or quadrant muſt be ſet.

Care muſt be taken not to confound the days in the Nautical Almanac with the civil days, as the civil day begins 12 hours before it; nor with the ſea day which begins 24 hours before it.

In finding the ſtars by this method it will often happen that two ſtars are ſwept upon, which are near each other, in which caſe the unexperienced obſerver would be at a loſs to know which one he muſt make uſe of; then the following deſcription will be of ſervice, which ſhews what ſtars are near the one ſought after, and will convince the obſerver that if the ſtar he ſweeps upon, anſwers the deſcription, he has diſcovered the right one. There are only nine ſtars, whoſe diſtances from the moon are marked in the Nautical Almanac, ſix of which are eaſily diſcovered; but the ſtars, Aldebaran, Fomalhaut and Pegaſus, are not eaſily diſtinguiſhed from the ſurrounding ſtars.

ARIETIS, Is a ſtar of the ſecond magnitude, and may be known by having another ſtar of the ſame magnitude, ſituated S. W. about $3\frac{1}{2}$ degrees; this ſtar might eaſily be taken for Arietis, the northernmoſt one is to be uſed.

ALDEBARAN, Or Bull's Eye is a very bright ſtar; there is not any very obvious mark by which it may be known.

POLLUX,

POLLUX	Is a bright Star; to the N. W. of it, about 5 degrees, is the Star Caſtor of the ſame magnitude, and you will almoſt always ſweep both at once; the Southernmoſt is the one to be uſed.
REGULUS R B * * · · c d	Or Lion's heart is a Star of the firſt magnitude, to the N. E. of it about 8 degrees is another of the ſame brightneſs, which might eaſily be miſtaken for Regulus. The ſouthernmoſt of the two is to be made uſe of. NOTE.—Near to theſe Stars, but a little to the weſtward are two ſmaller Stars of the ſecond magnitude, ſituated as in the adjoined figure; where R is Regulus, B the bright Star near it; c and d the two ſmaller Stars, one being between R, B. the other beyond B.
SPICA S. a b * · ·	Or Virgin's Spike is a bright ſtar with no other bright ſtar; to the S. W. 15 degrees, are four brightiſh ſtars forming a ſort of ſquare as in the adjoined figure; the two northernmoſt ſtars of this ſquare a, b, point directly to the ſtar Spica S. and by this mark it may be eaſily diſcovered.
ANTARES · * ·	Or Scorpion's heart is a very bright Star of a reddiſh colour; on each ſide of it, about 2 degrees diſtant, is a Star of the ſecond magnitude, forming nearly a ſtrait line with it as in the adjoined figure, no bright ſtar being near.
AQUILÆ · * ·	Or bright Star in the Eagle, is a very bright Star of the ſame colour as Antares, and has, like it, a Star on each ſide of it of the ſecond magnitude, about 2 degrees diſtant, as in the adjoined figure, forming a ſtrait line.
FOMALHAUT	Is a Star of high ſouth declination; it is of the firſt magnitude, has a number of bright Stars near it and no particular mark by which it may be known.
PEGASUS	Is a Star of the ſecond magnitude, and is but little uſed. It has, a little to the northward of it, three brightiſh Stars forming a triangle, the eaſternmoſt one being the brighteſt.

In damp weather it is very difficult to obſerve the altitude of the Stars on account of their dimneſs, particularly Pegaſus and Arietis. You muſt wipe the glaſſes of your quadrant often, and turn down the ſight vane, holding your eye in nearly the ſame place as the hole of the vane, for it often happens that you cannot ſee the ſtar, if you look through the hole of the vane, on account of the ſmall quantity of light admitted through it to the eye, the other eye at times ſhould be open ſo as to ſee the horizon, otherwiſe you would be liable to error in making the altitude greater than what it really is.

When the ſhip has a great motion, and the diſtance of the objects to be meaſured is great, it is difficult to uſe the teleſcope: Then the objects will ſometimes appear to lap over each other 2′ or 3′ and at other times to be as much apart: in ſuch caſes a number of diſtances ſhould be meaſured and the mean taken, always endeavoring to obtain that diſtance, which will make them lap over at times as much as they ſeparate at others.

The diſtance of the ſun from the moon, is meaſured much eaſier when the moon is low, becauſe the ſextant will then be held in a more vertical ſituation, when the moon is near the zenith, her diſtance from the ſun cannot be meaſured exactly without great difficulty, the obſerver being forced to place himſelf in a diſagreeable poſture. For this reaſon it will be eaſier to take an obſervation of the ſun and moon, when the moon is lower than the ſun, or when ſhe is about 20° high. When the obſervations are taken by the Moon and Star, the Star ought (for the ſame reaſon) to be lower than the Moon; but neither of the objects ought to be leſs than 10 degrees high on account of the uncertainty of their refraction. This remark being attended to, (as it may always be, in fair weather, by waiting till the objects are in the ſituation here mentioned) at which time the diſtance may be meaſured with the greateſt eaſe and accuracy.

The Method of finding the LONGITUDE *at* SEA.

THE ſurpriſing improvements made in navigation within the laſt thirty years, is beyond the moſt ſanguine expectation; and though ſeveral nations have contributed towards this important end, the Engliſh have (by the encouragement given by parliament, and the great improvements made in nautical inſtruments and calculations) outdone them all, ſo that, by help of the improved Sextant, the Nautical Almanac, and the Requiſite Tables, contained in this book, a ſkilful and expert obſerver can determine the longitude to a degree of certainty, that people unacquainted with the operation would ſcarcely think poſſible.

What is here meant by a ſkilful and expert obſerver, is, an artiſt who can in an inſtant bring the two limbs of the objects whoſe angular diſtance is to be meaſured into contact, in the centre of the inverted teleſcope, and, that can rectify any little defects, or errors that the inſtrument is liable to on account of its being handled or moved about, &c. To do which the following inſtructions may be found uſeful to the young artiſt.

1ſt. The inſtrument muſt be adjuſted thus: bring ⓪ on the nonius to coincide with ⓪ on the arch, then ſee if the index glaſs ſtands perpendicular to the plane of the inſtrument, if it does not, alter it by means of the ſcrews for that purpoſe: after which, the reflected image of the ſun muſt be brought directly over the true image, ſo that but one image appears: this being done, which is by no means difficult, the inſtrument is properly adjuſted, as the little ſpeculum will ſtand parallel to the great one.

But to prove the inſtrument after this adjuſtment, and to find if there is any index error, move the index forward on the arch, and bring the true and reflected images of the ſun's limbs into contact, and note what his diameter meaſures. Again, move the index backward on the part of the arch behind the ⓪, and bring the reflected and true images of their limbs into contact as before, and note what his diameter meaſures; half the difference between the two diameters is the index-error, which muſt be ſubtracted when the diameter meaſures more on the arch than on the extra arch, otherwiſe it muſt be added.

Suppoſe,

Suppose, for example, the sun's diameter measures when the index is advanced on the arch 34′, and at the same time when the index is put back on the extra arch 30′, the difference is 4′, then 2′ is the index error, which must be subtracted from all altitudes or angular distances taken, because the sun's diameter measured more on the arch before ⊕ than behind it.

After the index error is found, yet before the instrument is fit to take the angular distance between any objects, there is another adjustment requisite, which is, to set the axis of the telescope parallel to the plane of the instrument.

The method of doing this is, making observations of angles as much above 90° as possible, using the inverted telescope; in doing of which the wires in the focus of the eye-glass must be first placed parallel to the plane of the sextant, after which bring the sun and moon into very nice contact, on the centre of the wire nearest the sextant, taking care that the index is not the least moved, then direct the telescope in an instant so that the images may appear in the centre of the outer wire which is farthest from the sextant, and if the contact appear the same at this wire, the axis of the telescope is parallel to the plane of the sextant; on the contrary, if the limbs of the objects appear to separate at the wire which is farthest from the sextant, it is plain the object-end of the telescope is too far from the plane of the sextant, and must be corrected by turning one of the two screws of the ring into which the telescope is screwed and fixed, having previously unturned the other screw.

If the limbs of the images over-top each other at the aforesaid wire, it shews that the object-end of the telescope is too near the plane of the instrument, and consequently must be brought parallel, by means of the screws, and this method must be pursued until the distance of objects are found perfectly the same at each wire, which stands equi-distant from the centre of the telescope and parallel to each other, in which case the axis of the telescope will be exactly parallel to the plane of the sextant, and then you may proceed to measure the angles for the observations, observing to bring the limbs of the objects in exact contact, in the centre between the two wires before-mentioned.

To take the Observations requisite for determining the Longitude.

First, find the apparent time at the place of observation, by taking one or more altitudes of the sun, and noting the times by a good watch, from each observed altitude, or, from the mean of several altitudes compute the time; the difference between this time and that by the watch, will shew how much the watch is too fast or too slow, for in all cases the mean of several observations is most to be depended on, and the best time for making these observations of the sun's altitude is, when it changes quickest, or when he bears nearly east or west.

In observing the distance between the objects, three observers must be in readiness with their sextants or quadrants, well adjusted, as before directed; and the watch either suspended near one of the observers, or put into the hands of a fourth person appointed to note the times. The observer who takes the angular distance giving previous notice to the others

to

to be ready with the altitudes by the time he has finished his observation, which being done, the time, altitudes and distance should be carefully noted; and other sets of observations taken, which must be done within the space of 15 minutes, and then take the means, which will be preferable to any single observation. In taking the altitude of the moon, the limb that is the best defined, whether it be the upper or lower, must be brought to the horizon; if there are not a sufficient number of observers, then take the altitudes, the deficiency may be supplied by computing the altitudes after the distance is taken; the method of doing it will be shewn hereafter.

To measure the Distance between the Sun and Moon.

Turn down one of the screws, and hold the quadrant or sextant, so that its plane shall pass through the sun and moon; look at the moon through the transparent part of the horizon glass; and keeping her there, move the index gently until the sun's image is brought into the unsilvered part of the horizon-glass, bring the nearest limbs of both objects into contact; move the arch of the instrument gently up and down, and the sun will appear to rise and fall by the side of the moon. Move the index until their limbs exactly touch each other, when this is done the observation is made, and the index will shew the angular distance, which is best read off by a magnifying glass.

To take the Distance between the Moon and a Star.

Direct the plane of the instrument through both objects, look at the star through the bright part of the horizon-glass; keep it there, and bring the moon's image into the silvered part of the same glass; move the index gently, until the enlightened limb of the moon just touches the centre of the star, keep the star in sight, and move the arch of the instrument gently up and down, and the moon will appear to pass over the star, and then the observation is completed.

The round or well-defined limb of the moon, whether it be the nearest or farthest from the star, must be brought into contact with it. When the object to be seen by reflection is to the right hand of that seen directly, the instrument is held with its face upward; but when the object to be seen by reflection is to the left hand of that seen directly, the instrument is held with its face downward.

A readiness in the use of the quadrant and sextant is best gained by practice, which the learner may render familiar to himself by observing the angular distance of objects on land, or by candles placed in various positions in a room.

If the observation be made, as it ought to be, at the distance of two hours before or after noon, the true time may be found by the altitude of the sun, taken at the precise time of taking the distance; thus will any irregularity in the going of the watch be prevented from affecting the result of the observations.

If a night observation is to be taken, the watch should be regulated by the altitude of the sun the evening before, and its going compared with another taken the next morning; for the time found by the altitude of a star cannot so well be depended on, as the atmosphere in the night is precarious, though it may be sufficiently correct for finding the refraction used in determining the angular distance.

Preparation

Preparations necessary for working a Lunar Observation.

"TURN the longitude by account into time by Table XIX. and add it to the apparent time at the ship, if it be west, but subtract it, if it be east, the sum or difference will be the supposed time at Greenwich, which call reduced time."

"In page 7 of the month of the Nautical Almanac find the nearest noon and midnight both before and after the reduced time, take out the moon's semidiameter and Proportional logarithms for this noon and midnight and find their differences; taking care not to confound the days in the Nautical Almanac with the sea day, which begins 24 hours after it."

Then in Table (page 238) find the nearest hour of the reduced time, rejecting 12 hours, when more than 12, at the top column and the difference, above found, of the semidiameters and Proportional logarithms in the side column, the corresponding numbers, in the Angle of meeting, will be the corrections to be respectively applied to the first semidiameter and proportional logarithm, additive if increasing, but subtractive if decreasing: to the semidiameter thus found add its augmentation from Table XII. and you will have the correct semidiameter.

To the observed altitude of the sun's or moon's lower limb add 12 minutes; if their upper limb was used, subt. 20 minutes, and from the star's observed altitude subtract 4 minutes, and you will have the apparent altitudes.*

"To the observed distance of the moon from a star add the moon's semidiameter, if her nearest limb was observed, but subtract it if her farthest limb was observed; the sum or difference will be the apparent distance."

"But to the observed distance of the sun and moon add their semidiameters, the sum will be their apparent distance."

"From the sun's refraction in Table IX, take his parallax in altitude in Table XI. the remainder will be his correction in Altitude."

"The star's refraction is his correction."

"From the proportional logarithm, above found, increasing its index by 10, take the logarithm co-sine of the moon's apparent altitude, the remainder will be the prop. log. of the parallax in altitude; from which subtracting her refraction, the remainder will be the correction of the moon's altitude."

All these preparations are necessary by whatever method you work the observation; the most noted methods are those of Dunthorne, Lyons, Witchel, &c. and improvements on Dunthorne's method by Maskelyne, Croswell, &c.

Dunthorne's and similar methods have one great advantage, there being no difference of cases; but, their rules are lengthy by reason of the great exactness required in proportioning the logarithms to seconds. Lyon's and Witchel's methods do not labour under this inconvenience: but, in both their rules, they have various cases; sometimes the corrections are additive and sometimes subtractive, and learners find a difficulty in rightly applying them. The following method has all the advantages of Witchel's method, without labouring under this inconvenience. The corrections being always applied in the same manner, the logarithm sines, &c. need be taken to only four places of figures and to the nearest minute, it being quite unnecessary to proportion for the odd seconds, since an error of 5 minutes in either altitude will cause an error of only 10 seconds in the distance, and often less.

* To be strictly exact, we ought to subtract the dip of the horizon, and add or subtract the semidiameter of the object, according as the lower or upper limb was observed, but the application of the above numbers will always give the altitudes to sufficient exactness.

Seek the neareſt hour of the reduced time in the top column, and the difference of parallax, proportional logarithm, or ſemi-diameter for 12 hours in the ſide column, the correſponding number in the angle of meeting is the correction.

Time.	1	2	3	4	5	6	7	8	9	10	11	12
1	0	0	0	0	0	1	1	1	1	1	1	1
2	0	0	1	1	1	1	1	2	2	2	2	2
3	0	1	1	1	1	2	2	2	2	3	3	3
4	0	1	1	1	2	2	2	3	3	3	4	4
5	0	1	1	2	2	3	3	4	4	4	5	5
6	1	1	2	2	3	3	4	4	5	5	6	6
7	1	1	2	2	3	4	4	5	5	6	7	7
8	1	1	2	3	3	4	5	5	6	7	7	8
9	1	2	2	3	4	4	5	6	7	8	8	9
10	1	2	3	3	4	5	6	7	8	8	9	10
11	1	2	3	4	5	6	6	7	8	9	10	11
12	1	2	3	4	5	6	7	8	9	10	11	12
13	1	2	3	4	6	7	7	9	10	11	12	13
14	1	2	4	5	6	7	8	9	11	12	13	14
15	1	3	4	5	7	8	8	10	11	13	14	15
16	1	3	4	5	7	8	9	11	12	13	15	16
17	1	3	4	6	7	9	10	11	13	14	16	17
18	2	3	5	6	8	9	10	12	14	15	16	18
19	2	3	5	6	8	10	11	13	14	16	17	19
20	2	3	5	7	9	10	11	13	15	17	18	20
21	2	3	5	7	9	11	12	14	16	18	19	21
22	2	4	6	7	9	11	13	15	17	18	20	22
23	2	4	6	8	10	12	13	15	17	19	21	23
24	2	4	6	8	10	12	14	16	18	20	22	24
25	2	4	6	8	11	13	15	17	19	21	23	25
26	2	4	6	8	11	13	15	17	20	22	24	26
27	2	4	7	9	12	14	16	18	20	23	25	27
28	2	5	7	9	12	14	16	19	21	23	26	28
29	2	5	7	10	12	15	17	19	22	24	27	29
30	2	5	8	10	13	15	17	20	23	25	28	30
31	3	5	8	10	13	16	18	21	23	26	28	31
32	3	5	8	10	14	16	18	21	24	27	29	32
33	3	6	8	11	14	17	19	22	25	28	30	33
34	3	6	9	11	14	17	20	23	26	28	31	34
35	3	6	9	12	15	18	20	23	26	29	32	35
36	3	6	9	12	15	18	21	24	27	30	33	36
37	3	6	9	12	16	19	21	25	28	31	34	37
38	3	6	10	13	16	19	22	25	28	32	35	38
39	3	7	10	13	17	20	22	26	29	33	36	39
40	3	7	10	13	17	20	23	27	30	33	37	40
41	3	7	10	14	17	21	24	27	31	34	38	41
42	3	7	11	14	18	21	24	28	32	35	39	42
43	4	7	11	14	18	22	25	29	32	36	40	43
44	4	[illegible]	11	15	19	22	25	29	33	37	41	44
45	4	8	11	15	19	23	26	30	34	38	42	45

Rule for correcting the apparent Distance of the Moon from any Star.

ADD together the apparent zenith distances of the sun and moon and their apparent distance, and note the half sum of these three numbers. From this half sum subtract the moon's zenith distance and call the difference the first remainder. From the same half sum subtract the sun's zenith distance and call this difference the second remainder.

To the constant log. 9.6990 add the co-sec. of the half sum, and the sine of the apparent dist. the sum, rejecting 20 in the index, is a reserved logarithm.

To this reserved logarithm add the sine of the sun's zenith distance, the co-secant of the first remainder and the propor. log. of the correction of the sun's or star's altitude; the sum, rejecting 30 in the index, will be the prop. log. of the first correction.

To the reserved logarithm add the sine of the moon's zenith distance, the co-secant of the second remainder, and the prop. log. of the correction of the moon's altitude; the sum, rejecting 30 in the index, will be the prop. log. of the second correction.

Then to the apparent distance add the correction of the moon's altitude and the first correction, and subtract the sum of the second correction and the correction of the sun's altitude; the remainder is the corrected distance.

Take the difference between the correction of the moon's altitude and the second correction: with that enter Table XVIII. and under the corrected distance take out the number of seconds corresponding, and in the same column, opposite the correction of the moon's altitude, take out the number of seconds corresponding; the difference between these two numbers is a number of seconds to be added to the corrected distance, when less than 90 degrees; but subtracted, when above 90 degrees; the sum or difference will be the true distance.

NOTE. If the distance of the star and moon had been observed instead of that of the sun and moon, the rule would have been the same, only instead of SUN you must read STAR.

To determine the Longitude from the True Distance.

"IN the Nautical Almanac, among the distances of the objects, look for the computed distance between the moon and other observed object for that given day; if it is found there, the time at Greenwich will be found in the top column; but if it falls between them, as it generally will, take the difference between the distances that stand immediately before and after the computed distance, and also the difference between the distance, standing before it, and the computed distance."

Then from Table XXIII. take the prop. log. of the first found difference, and the prop. log. of the second found difference, and the difference between these two logarithms will be the prop. log. of a number of hours, minutes, and seconds; which, being added to the time standing over the first distance in the Nautical Almanac, will give the true time at Greenwich.

The difference between this Greenwich time and that at the ship, turned into degrees by Table XIX. will be the longitude of the place of observation; which will be east if the time at the ship be greater than that at Greenwich, but if it be less, the longitude will be west.

NOTE.—The character ☉ is for the sun, ☽ the moon, ✱ a star, dis. ☽ ✱ or ✱ ☾ signifies that the nearest limb of the moon was observed; but ✱ ☽ or ☾ ✱, signifies that their farthest limbs were observed; L. L. signifies lower limb, and U. L. upper limb of an object; S. D. semidiameter, P. L. proportional logarithm, N. A. Nautical Almanac, Z. D. zenith distance.

EXAMPLE I.

July 13th, 1800, at 9 hours, 30 min. P. M. Sea account, obſerved the diſtance of the Moon's fartheſt limb from the ſtar Aldebaran 57° 31' 5", the altitude of the Moon's lower limb being 60° 12', the Star's altitude 12° 30', longitude by account 30° E. Required the true Longitude?

	H. M.
July 13, Sea account, is July 12 by Nautical Almanac at	9 30
Longitude 30° in time	2
Reduced time	7 30

☽'s S. D. at noon	15° 17'	P. L. at noon	5065	App. diſt. ☽ ✱	57° 31' 15"	☽'s obſ. alt. L. L.	60 12
Midnight	15 11	Midnight	5093	Sub. ☽'s S. D.	15 27	Add	12
Difference	6	Difference	28	App. diſt.	57 15 48	☽'s app. alt.	60 24
							90
Proportional part	4	Proportional part	19				
						☽'s zen. diſt.	29 36
	15 13		10.5084				
Add Aug. from Table XII.	14	Co-ſi. ☽'s alt. 60° 24'	9.6937			✱'s obſ. alt.	12 30
						Subtract	4
☽'s true S. D.	15 27	Par. in alt. 27' 35" P.L.	8147				
		☽'s Ref. 0 33		✱'s Ref. 4' 14" is its cor. in alt.		✱'s app. alt.	12 26
							90 0
		Cor. ☽'s alt. 27 2					
						✱'s zen. diſt.	77 34

To find the distance.

Apparent distance	57° 16'
☽'s zenith distance	29 36
✱'s zenith distance	77 34
Sum	164 26
Half sum	82 13
☽'s zenith distance	29 36
First remainder	52 37
Half sum	82 13
✱'s zenith distance	77 34
Second Remainder	4 39

Constant logarithm			9.6990
Co-sec. half sum	82 13		10.0040
Sine distance	57 16		9.9249
Reserved logarithm			9.6279
✱'s zenith dist.	77 34	Sine	9.9897
First remainder	52 37	Co-sec.	10.0999
Cor. ✱'s alt.	4 14"	P. L.	1.6286
First correction	8 07	P. L.	1.3461

Reserved logarithm			9.6279
☽'s zen. dist.	29° 36'	Sine	9.6937
Second rem.	4 39	Co-sec.	11.0912
Cor. ☽'s alt.	27 2"	P. L.	8234
Second correct.	10 27	P. L.	1.2362

Apparent distance		57° 15' 48"
Add: First correction		8 7
Add: Correction ☽'s altitude		27 2
		57 50 57
Subtract: Second correction	10' 27"	
Subtract: Correction ✱'s altitude	4 14	14 41
		57 36 16
Correction, Table XVIII. 4"; Second correction 1; Diff. add		3
Correct distance		57 36 19

By Ephemeris, distance at 6h.	58° 24' 7"	
9h.	56 52 3	
Difference	1 32 4	P. L. ·2912
Distance at 6h.	58 24 7	
Correct distance	57 36 19	
Difference	47 48	P. L. 5758
Hour	1h. 33' 28"	P. L. 2846
Add	6 0 0	
Time at Greenwich	7 33 28	
Time at Ship	9 30 0	
Diff. is longitude in time	1 56 32	or 29° 8' E.

EXAMPLE II.

November 9th, 1800, Sea account, at 7 hours, 30 minutes, P. M. longitude by account 45° E. observed the distance of the nearest limbs of the moon and star Regulus 23° 14', altitude of moon's lower limb 40° 0', altitude of star 34° 30'.—— Required the true longitude?

	H.	M.
Nov. 9th, Sea account, is Nov. 8th, by Nautical Almanac, at	7	30
Longitude in time	3	0
Reduced time	4	30

☽'s S. D. at noon	14° 57'
Midnight	15 1
Difference	4
Proportional part	2
	14 59
Aug. (Tab. XII.)	10
☽'s S. D.	15 9

☽'s P. L. at noon	5159
Midnight	5140
Difference	19
Proportional part	8
Proportional log.	10.5151
Co-si. ☽'s alt. 40° 12'	9.8830
☽'s Par. 41' 59"	P.L. 6321
☽'s Refr. 1 7	
Cor. ☽'s alt. 40 52	

App. dist.	23 14 0
☽'s S. D.	15 9
	23 29 9

✱'s Refraction 1' 23" is its correction in altitude.

☽'s obs. alt. L. L.	40 0
Add	12
☽'s app. alt.	40 12
	90
☽'s zen. dist.	49 48
✱'s obs. alt.	34 30
Subtract	4
✱'s app. alt.	34 26
	90
✱'s zen. dist.	55 34

To find the distance.

Apparent distance	23° 29′	Constant log.			9.6990
☽'s zenith distance	49 48	Half sum	64 28	Co-sec.	10.0446
✳'s zenith distance	55 34	Distance	23 29	Sine	9 6004
Sum	128 51				
Half sum	64 26	Reserved logarithm			9.3442
☽'s zenith distance	49 48	✳'s zen. dist.	55° 34′	Sine	9.9163
First remainder	14 38	First remain.	14 38	Co-sec.	10.5975
Half sum	64 26	✳'s Cor. in alt.	1 23″	P. L.	2.1143
✳'s zenith distance	55 34	First correct.	1 55	P. L.	1.9723
Second remainder	8 52				

Reserved logarithm			9.3442
☽'s zen. dist.	49° 48′	Sine	9.8830
Second rem.	8 52	Co-sec.	10.8121
Cor. ☽'s alt.	40 52″	P. L.	6439
Second correct.	37 20	P. L.	6832

Apparent distance		23° 29′ 9″
Add First correction		1 55
Add Correction ☽'s altitude		40 52
		24 11 56
Subtract Second Correction	37 20	
Subtract Correction ✳'s altitude	1 23	38 43
		23 33 13
Correction, Table XVIII.	33	
Second correction	1	Diff. add 32
Correct distance		23 33 45

By Ephemeris, distance at 3h.	24° 23′ 45″	
6h.	22 54 13	
Difference	1 29 32	P. L. 3033
Distance at 3h.	24 23 45	
Correct distance	23 33 45	
Difference	50 0	P. L. 5563
Hour	1h. 40′ 31″	P. L. 2530
Add	3 0 0	
Time at Greenwich	4 40 31	
Time at Ship	7 30 0	
Diff. is the longitude in time	2 49 29	or 42° 22′ E.

EXAMPLE III.

May 18th, 1800, Sea account, longitude by account 53° Weſt, at 6 hours P. M. obſerved the diſtance of the ſun's and moon's neareſt limbs 63° 50' 19'', altitude of moon's upper limb 41° 20', altitude of ſun's lower limb 44° 48'.—Required the true longitude?

	H. M.
May 18th, Sea account, is May 17th, by Nautical Almanac, at	6 0
Longitude 53° in time	3 32
Reduced time	9 32

☽'s S. D. at noon	15' 15''
Midnight	15 10
Difference	5
Proportional part	4
	15 11
Aug. (Tab. XII.)	10
Sun's S. D.	15 21

☽'s P. L. at noon		5072
Midnight		5097
Difference		25
Proportional part		21
Proportional log.		10.5093
☽'s alt. 41° 0' Co-ſi.		9.8778
☽'s Par.	42 3	P.L.6315
☽'s Ref.	1 5	
Cor. ☽ alt.	40 58	

App. diſtance	63° 50' 19''
Moon's S. D.	15 21
Sun's S. D.	15 51
	64 21 31
Sun's refraction	57
Subtract ſun's par.	7
Cor. ſun's altitude	50

☽'s obſ. alt. U. L.	41 20
Subtract	20
☽'s apparent altitude	41 0
	90
☽'s zenith diſtance	49 0
Sun's obſerved alt.	44 48
Add	12
Sun's apparent altitude	45 0
	90
Sun's zenith diſtance	45 0

To find the distance.

Apparent distance	64° 22'
Moon's zenith distance	49
Sun's zenith distance	45
Sum	158 22
½ sum	79 11
Moon's zen. distance	49
1st Remainder	30 11
½ sum	79 11
Sun's zenith distance	45
2d. Remainder	34 11

Constant logarithm			9.6990
½ sum	79 11	Co-sec.	10.0078
Distance	64 22	Sine	9.9550
Reserved logarithm			9.6618
Sun's zen. dist.	45 0	Sine	9.8495
1st Remainder	30 11	Co-sec.	10.2986
Correct. sun's alt.	0' 50"	P. L.	2.3344
1st Correction	1 17	P. L.	2.1443

Reserved logarithm			9.6618
☽'s zenith dist.	49° 0'	Sine	9.8778
2d. Remainder	34 11	Co-sec.	10.2504
Correct. ☽'s alt.	40'58"	P. L.	6428
2d. Correction	1 6 27	P. L.	4328

Apparent distance			64°21'31"
Add	1st Correction		1 17
	Correction moon's altitude		40 58
			65 3 46
Subtract	2d. Correction	1 6 27	
	Cor. sun's alt.	50	1 7 17
			63 56 29
Corr. Tab. XVIII. first 6, second 2	Difference add		4
Correct distance			63 56 33

By Ephemeris dist. at 9h.	64° 11' 6"	
12h.	62 45 8	
Difference	1 25 58	P. L. 3209
Distance at 9h.	64 11 6	
Correct distance	63 56 33	
Difference	14 33	P.L. 1.0924
Hour	0 30 27	P. L. 7715
Add	9	
Time at Greenwich	9 30 27	
Time at Ship	6 0 0	
Diff. is ship's long. in time	3 30 27	or 52° 37' W.

EXAMPLE IV.

June 17th, Sea account, at 6h. 30m. P.M. in longitude 105° W. meafured the diftance of the neareft limbs of the fun and moon 57° 17′ 16″, altitude of moon's upper limb 40° 34′, altitude of fun's lower limb 48° 20′. Required the longitude?

	H. M.	
June 17th, Sea account, is June 16th, by Nautical Almanac, at	6 30	
Longitude 105° W. in time	7	
Reduced time	13 30	or 1h. 30m.

☽'s S. D. at midnight	14′ 53″
Noon, June 17th,	14 50
Difference	3
Prop. part	1
	14 52
Aug. (Tab. XII.)	10
☽'s S. D.	15 02

☽'s P. L. Midnight		5179
Noon		5193
Difference		14
Prop. part		2
P. L.		10.5181
☽'s alt. 40° 14′		Co-fi. 9.8828
☽'s par.	41 41	P. L. 6353
☽'s refrac.	1 7	
Cor. ☽'s alt.	40 34	

App. dift.	57° 17′ 16″
Sun's S. D.	15 47
☽'s S. D.	15 2
App. dift.	57 48 5
Sun's refraction	50
Sun's parr.	6
Cor. ☉'s alt.	44

☽'s obf. alt. U. L.	40° 34′
Sub.	20
☽'s app. alt.	40 14
	90
☽'s zen. dift.	49 46
Sun's obf. alt.	48 20
Add	12
Sun's app. alt.	48 32
	90
Sun's zen. dift.	41 28

To find the diſtance.

Apparent diſtance	57° 48'	Conſtant logarithm			9.6990					
Moon's zenith diſtance	49 46	½ ſum	74° 31'	Co-ſec.	10.0160					
Sun's zenith diſtance	41 28	Diſtance	57 48	Sine	9.9275					
Sum	149 2									
½ ſum	74 31	Reſerved log.			9.6425	Reſerved logarithm			9.6425	
Moon's zenith diſtance	49 46	☉'s zen. diſt.	41 28	Sine	9.8210	☽'s zen. diſt.	49° 46'	Sine	9.8828	
1ſt Remainder	24·45	1ſt Rem.	24 45	Co-ſec.	10.3781	2nd Rem.	33 3	Co-ſec.	10.2633	
½ ſum	74 31	Cor. ☉'s alt.	0' 44"	P. L.	2.3899	Cor. ☽'s alt.	40 34"	P. L.	6471	
Sun's zenith diſtance	41 28	1ſt Cor.	1 3	P. L.	2.2315	2d. Cor.	1 6 0	P. L.	4357	
2d. Remainder	33 3									

Apparent diſtance			57°48' 5"
Add 1ſt Correction			1 3
Correction ☽'s altitude			40 34
			58 29 42
Subtract	2d. Cor.	1 6 0	1 6 44
	Corr. ſun's alt.	44	
			57 22 58
Corr. Tab. XVIII.	firſt 10, ſecond 3	Difference, add	7
Correct diſtance			57 23 5

By Ephemeris diſt. at 12h.		58° 4' 41"	
	15h.	56 42 30	
Difference		1 22 11	P. L. 3405
Diſtance at 12h.		58 4 41	
Correct diſtance		57 23 5	
Difference		41 36	P. L. 6362
Hour		1 31 7	P. L. 2957
Add		12	
Time at Greenwich		13 31 7	
Time at Ship		6 30 0	
Diff. is longitude in time		7 1 7	= 105° 17' W.

EXAMPLE V.

April 15th, 1800, Sea account, longitude by account 61° E. the following observations were made, from which it is required to find the true longitude?

Times.	Dist. ☉ ☾	Alt. M's U.L.	Alt. S's L.L.
8 6 10	104 38 00	15 10	35 34
8 7 50	104 39 10	15 26	35 44
8 10 0	104 40 20	15 39	35 54
3) 24 24 0	313 57 30	46 15	107 12
8 8 0	104 39 10	15 25	35 44
A. M.	☉S.D. 15 59	Sub. 20	Add 12
	☽S.D. 16 12		
	105 11 21 app. dist.	15 05 app. alt.	35 56 app. alt.

Moon's app. alt. is	15° 05′	and her zen. dist.	74° 55′
Sun's app. alt.	35 56	and his zen. dist.	54 04
Sun's refraction	1′ 18″		
Sun's parallax	7		
Corr. of sun's altitude	1 11		

April 15th, Sea account, at 8h. 8m. A. M. is April 14th, Nautical Almanac,	20h. 8m.
Ship's Long. 61° E. in time	4 4
Reduced time	16 4 or 4h. 4m.

M's S.D. at midnight	16 10	P. log. (Tab. XXIII.)		4822
Noon April 15	16 4	P. log.		4849
Difference	6	Difference		27
Prop. part	2	Prop. part		9
	16 8	P. log.		10.4831
Aug.	4	Cor. M. alt.	15 5	9.9848
Moon's S. D.	16 12	M's par.	57′ 9″	P.L. 4983
		M's refr.	3 29	
		Cor. M. alt.	53 40	

To find the distance.

Distance	105° 11'	Constant logarithm		9.6990
Moon's zen. dist.	74 55	½ Sum 117° 5'	Co-sec.	10.0504
Sun's zen. dist.	54 4	Distance 105 11	Sine	9.9846
Sum	234 10			
½ Sum	117 05	Reserved logarithm		9.7340
Moon's zen. dist.	74 55	Sun's zen. dist. 54° 4'	Sine	9.9083
1st Remainder	42 10	1st. Remainder 42 10	Co-sec.	10.1731
½ Sum	117 5	Corr. sun's alt. 1' 11"	P. L.	2.1821
Sun's zen. dist.	54 4	1st. Corr. 1 49	P. L.	1.9975
2d. Remainder	63 1			

Reserved logarithm			9.7340
☽'s zen. dist.	74° 55'	Sine	9.9848
2d. Rem.	63 1	Co-sec.	10.0500
Corr. ☽'s alt.	53' 40"		5255
2d. Correction	1 31 24	P. L.	2943

Apparent distance		105° 11' 21"
Add 1st Correction		1 49
Corr. moon's altitude		53 40
		106 6 50
Sub. 2d. Corr.	1 31 24	
Corr. sun's alt.	1 11	1 32 35
		104 34 15
Corr. Table XVIII. first	6	
second	3	3
Correct distance		104 34 12

In Ephemeris at 15h. dist.	105° 5' 11"	
18h.	103 27 19	
Difference	1 37 52	P. L. 2646
Distance at 15h.	105 5 11	
True distance	104 34 12	
Difference	30 59	P. L. 7641
Time	0 56 59	P. L. 4995
Add	15	
Time at Greenwich	15 56 59	
Time at Ship	20 08 00	
Diff. is the long. in time	4 11 1	or 62° 45' E.

EXAMPLE VI.

March 9th, 1800, Sea account, in longitude by account 60° E. made the following obſervations; from which it is required to determine the longitude?

	Times.	Diſt. ✱ ☽	Alt. ☽'s L. L.	Al. ✱ Spica.
	8h. 17' 20"	66° 41' 20"	44° 6'	19° 52'
	18 25	66 42 25	44 14	20 1
	19 15	66 43 15	44 28	20 13
3)	24 55 0	200 7 0	132 48	60 6
	8 18 20	66 42 20	44 16	20 2
	P. M.	☽ ſ.d. 15 52	Add 12	Sub. 4
		66 26 28	44 28	19 58
		app. diſt.	app. alt.	app. alt.

Moon's app. alt. is 44° 28' and zenith diſtance 45° 32'
Star's app. alt. is 19 58 and zenith diſtance 70 02
Star's refraction 2' 35" is its correction in altitude.

March 9th, Sea account, is March 8th, by Nautical Almanac, at 8h. 18' 20" P. M.

Ship's Longitude in time	4 0 0
Reduced time	4 18 0

Moon's S.D. at noon	15' 39"	Prop. log.	4960
Midnight	15 46	Prop. log.	4930
Difference	7	Difference	30
Proportional part	2	Prop. part	10
	15 41	Prop. log.	10.4950
Augm. (Table XII.)	11	M's alt. 44° 28' Co-ſi.	9.8535
	15 52	M's par. 41' 5" P.L.	6415
		M's refr. 0 58	
		Cor. M's alt. 40 7	

To find the distance.

Distance	66 26	Constant logarithm			9.6990
Moon's zen. dist.	45 32	½ Sum	91° 0′	Co-sec.	10.0003
Star's zen. dist.	70 02	Dist.	66 26	Sine	9.9622
Sum	182 00				
½ Sum	91 00	Reserved logarithm			9.6615
Moon's zen. dist.	45 32	*'s zen. dist.	70°02′	Sine	9.9731
1st. Remainder	45 28	1st. Remainder	45 28	Co-sec.	10.1470
½ Sum	91 00	Corr. *'s alt.	2′ 35″	P. L.	1.8431
Star's zen. dist.	70 02	1st. Correction	4 16	P. L.	1.6247
2d. Remainder	20 58				

Reserved logarithm			9.6615
☽'s zen. dist.	45° 32′	Sine	9.8535
2d. Rem.	20 58	Co-sec.	10.4463
Corr. ☽'s alt.	40′ 7″	P. L.	6519
2d. Corr.	43 51	P. L.	6132

Apparent distance		66° 26′ 28″
Add 1st Correction		4 16
Corr. moon's altitude		40 7
		67 10 51
Sub. 2d. Correction	43 51 }	
Corr. star's alt.	2 35 }	46 26
		66 24 25
Corr. Tab. XVIII. first	6 } Diff. add	
second	0 }	6
Correct distance		66 24 31

In Ephemeris at 3h. dist.	67° 8′ 24″		
at 6h.	65 28 19		
Difference	1 40 5	P. L.	2549
Distance at 3h.	67 8 24		
Correct distance	66 24 31		
Difference	43 53	P. L.	6130
Hour	1 18 55	P. L.	3581
Add	3		
Time at Greenwich	4 18 55		
Time at Ship	8 18 20		
Difference is long. in time	3 59 25	or	59° 51′ E.

Here I have given one method of finding the longitude, illustrated by a sufficient number of examples, all of which are reduced to the year 1800, in order that the reader, or teacher, may have sufficient time to furnish himself with a N. A. for this year, which is now printed. But as many would wish to have some other method of reducing the distance, that, by comparing them together, they may not only have the advantage of proving their calculations, but also of making choice of which they prefer to work by; I have inserted another method, and as it is short, requires but four places of figures in the logarithms, besides the index; the preparations in both methods being exactly the same.

To find the true Distance, observe this general Rule.

First. Add the ☉'s or ✱'s and ☽'s apparent altitudes together, an dtake half the sum; and subtract the less from the greater, and take half the difference; then add together

The co-tangent of half the sum,
The tangent of half the difference, and
The co-tangent of half the apparent distance,

Their sum, rejecting 20 in the index, will be the log. tangent of an angle, which call A.

Secondly. When the ☉'s or ✱'s altitude is greater than the ☽'s, take the difference between the angle A and half the apparent distance, but if less take their sum. Then add together

The co-tangent of this sum or difference,
The co-tangent of ☉ or ✱'s apparent altitude, and
The proportional log. of the correction of ☉'s or ✱'s altitude;

Their sum, rejecting 20 in the index, will be the proportional logarithm of the first correction.

Thirdly. If the sum of angle A and half the apparent distance was taken in the last article, take now their difference; but if their difference, take now their sum. Then add together

The co-tangent of their sum or difference,
The co-tangent of ☽'s apparent altitude, and
The proportional log. of the correction of the ☽'s apparent altitude:

Their sum, rejecting 20 in the index, will be the proportional log. of the second correction.

Fourthly. When the angle A is less than half the apparent distance, the first correction must be added to, and the second subtracted from the apparent distance; but, when the angle A is greatest, their sum must be added to the apparent distance, when the ☉'s or ✱'s altitude is less than the ☽'s; but when the ☽'s altitude is least, their sum must be subtracted to give the corrected distance.

Fifthly. In Table XVIII. look for the corrected dist. in the top column and the correction of ☽'s alt. in the left-hand side column: take out the number of seconds that stand under the former and opposite to the latter. Look again in the same table for the corrected distance in top column, and the second correction in the left-hand side column; take out the

the number of seconds that stand under the former and opposite the latter, the difference between these two numbers will be the third correction, which must be added to the corrected distance, if less than 90°, but subtracted from it, if more than 90°; the sum, or difference, will be the true distance.

To illustrate this last method of reducing the apparent distance to the true distance, I shall take the apparent altitudes and distances as they stand in the three first examples, worked by the former method.

EXAMPLE I. (See Example I. page 240.)

Given the apparent altitude of the Moon's centre 60° 24′, altitude of Aldebaran 12° 26′. Distance of the centres of the Moon and Aldebaran 57° 15′ 48″; the prop. log. of Moon's horizontal parallax being 5084. Required the true distance?

After finding the correction of the ☽'s alt. 27′ 2″ and corr. of ✱'s alt. 4′ 14″ as Example I. preceding: Then proceed as follows:

☽'s app. alt.	60° 24′					
✱'s app. alt.	12 26					
Sum	72 50	Half sum	36° 25′		Co-tan.	10.1321
Difference	47 58	Half diff.	23 59		Tang.	9.6482
		Half app. dist.	28 38		Co-tan.	10.2628
		Angle A =	47 51		Tang.	10.0431
		Sum	76 29		Co-tan.	9.3809
		✱'s alt.	12 26		Co-tan.	10.6566
		Corr. ✱'s alt.		4′ 14″	P. L.	1.6286
		1st. Corr.		3 53	P. L.	1.6661
		Difference		19 13	Co-tan.	10.4577
		☽'s alt.		60 24	Co-tan.	9.7544
		Cor. ☽'s alt.		27′ 2″	P. L.	8234
		2d. Corr.		16 35		1.0355

Apparent distance	57° 15′ 48″
1st. Corr.	16 35
2d. Corr.	3 53
	57 36 16
Tab. XVIII. Correction	3
Corrected distance	57 36 19

EXAMPLE

EXAMPLE II. (See Example II. page 242.)

Given the apparent altitude of the Moon's centre 40° 12′, apparent altitude of Regulus 34° 26′, apparent diſtance of their centres 23 29 9. Moon's prop. log. 5151. Required the true diſtance?

Find the correction of the Moon's altitude 40′ 52″ and correction of ſtar's altitude 1′ 23″ as in Example II. preceding.

☽'s app. alt.	40° 12′						
✱'s app. alt.	34 26						
Sum	74 38	Half ſum	37° 19′			Co-tan.	10.1179
Diff.	5 46	Half diff.	2 53			Tang.	8.7021
		Half diſt.	11 45			Co-tan.	10.6819
		Angle A	17 37			Tang.	9.5019
		Sum	29 22			Co-tan.	10.2497
		✱'s app. alt.	34 26			Co-tan.	10.1640
		Corr. ✱'s alt.		1 23		P. L.	2.1143
		1ſt. Corr.		0 32		P. L.	2.5280
		Diff.		5 52		Co-tan.	10.9882
		☽'s app. alt.		40 12		Co-tan.	10.0731
		Corr. ☽'s alt.			40′ 52″		6439
		1ſt. Corr.		3 33		P. L.	1.7052

Apparent diſtance	23° 29′ 9″
1ſt. Corr.	0 32
2d. Corr.	3 33
Tab. XVIII. Correction	32
Correct diſtance	23 33 46

EXAMPLE

EXAMPLE III. (See Example III. page 244.)

Given Sun's apparent altitude 45°, Moon's apparent altitude 41°, apparent diſtance of their centres 64°21′ 31″, prop. log. of Moon's horizontal parallax 5093. Required the true diſtance?

Find as in Example III. preceding, the correction of the ſun's altitude 50″, and the correction of the moon's altitude 40 58.

☽'s app. alt.	41°				
☉'s app. alt.	45				
Sum	86	Half ſum	43° 0'	Co-tan.	10.0303
Difference	4	Half difference	2 0	Tang.	8.5431
		Half diſtance	32 11	Co-tan.	10.2011
		Angle A	3 25	Tang.	8.7745
		Difference	28 46	Co-tan.	10.2604
		☉'s altitude	45 0	Co-tan.	10.0000
		Corr. ☉'s alt.	0' 50″	P. L.	2.3344
		1ſt Corr.	0 27	P. L.	2.5948
		Sum	33 36	Co-tan.	10.1451
		☽'s alt.	41 00	Co-tan.	10.0608
		Cor. ☽'s alt.	40 58	P. L.	6428
		2d. Correction	25 30	P. L.	8487

Apparent diſtance	64 21 31
Add 1ſt. Correction	27
	64 21 58
2d. Correction	25 30
	63 56 28
Table XVIII. Corr.	3
Correct diſtance	63 56 31

Method of taking a Lunar Obſervation when you have only one Obſerver.

THREE obſervers are required to make the neceſſary obſervations for determining your longitude; one to meaſure the diſtance of the bodies, and two others to take their altitudes. If the altitudes were not obſerved, on account of not having a ſufficient number of inſtruments or obſervers, it has been cuſtomary to calculate them; there being given the latitude

latitude of the place, apparent time, right ascensions and declinations of the objects. These calculations are lengthy for the stars, and more so for the moon; and a considerable degree of accuracy is required in finding the moon's right ascension and declination from the Ephemeris, which must be liable to some error on account of the uncertainty of the ship's longitude. The following method is far more simple for obtaining those altitudes; it depends on the supposition that the altitudes increase or decrease uniformly, which will give them sufficiently near for any nautical purposes.

Before you measure the distance of the bodies, take their altitudes, and note the times by a watch, then measure the distance and note the time (or you may measure a number of distances and note the corresponding times, and take the mean of all the times and distances for the true distance and time;) after you have measured the distances, again measure the altitudes, and note the times; Then

Add together the proportional logarithm Table XXIII. of the variation of altitude of either of the objects between the two times of observing the altitudes and the prop. log. of the time elapsed between taking the first altitude and measuring the distance; from the sum subtract the prop. log. of the time elapsed between observing the two altitudes; the remainder will be the prop. log. of the correction of altitude, additive or subtractive, according as the altitude was increasing or decreasing; to the altitude thus corrected we must apply the correction for dip of the horizon Table X. and semidiameter as usual.

EXAMPLE.

Suppose the distances and altitudes of the bodies were observed as follows: It is required to find the altitudes at the time of measuring the mean distance?

	Time.	Dist. ☉ & ☽ N. C.
	2h. 3m 20s.	40°. 0′ 00″
	4 20	0 30
	5 50	1 30
Mean.	2 4 30	40 0 40

Time.	Observed Alt. ☽'s L.L.	Time.	Observed Al. ☉'s L.L.
2h. 2m. 0s.	20° 46′	2h. 2m. 30s.	40° 20′
6 10	21 20	7 0	39 12
4 10	34	4 30	1 8

Var. ☽ Alt.	34′	P. L.	7238
Time 1st Obs.	2h. 2′ 0″		
Mean Obs.	2 4 30		
Difference	2 30	P. L.	1.8573
			2.5811
Elapsed time between the two observations	4′ 10″	P.L.	1.6355
Correction in Alt.	0° 20′	P. L.	9456
1st. Alt. of ☽	20. 46	add	
☽ Alt. at time of obs.	21. 6		

Variation ☉'s alt.	1° 8′	P. L.	4228
Time 1st obs. ☉	2h. 2′ 30″		
Time mean obs.	2 4 30		
Difference	2 0	P. L.	1.9452
Sum	-	-	2.3680
Elapsed time between the two observations	4′ 30″	P.L.	1.6021
Correction of alt.	0° 31′	P. L.	7659
Subt. from ☉'s 1st alt.	40 20		
☉'s true alt. at time of obs.	39 49		

Thus,

Thus, at the time 2h. 4'. 30". the mean obferved diftance is 40° 0' 40", the altitude of the moon 21° 6', alt. of the fun 39° 49'; thefe altitudes muft be corrected for dip and femidiameter.

In this manner I have often obtained the altitudes in much lefs time than I could have obtained them by other calculations.

I have made ufe of the fame method of finding the fun's altitude, when I was taking an azimuth, noting the times of taking the obfervations by a watch, and taking two altitudes, one before, the other after the obfervation, and proportioning the altitudes as above.

If any perfon wifhes to calculate ftrictly the altitudes, obferve the three following cafes.

CASE I.

The appparent time, the fhip's latitude, longitude, and the ☉'s declination given, to find the true altitude of his centre.

RULE.

If the fhip's co. latitude and the ☉'s declination be both north or both fouth,* take their fum; but if one be north and the other fouth, their difference is the ☉'s meridian altitude.

With the apparent time from noon, enter table XX. and from the column of rifing take out the logarithm correfponding to it.

To this logarithm, add the log. co-fine of the latitude, and the log. co-fine of the ☉'s declination.

Their fum, rejecting 20 in the index, will be the logarithm of a natural number, which being fubtracted from the natural fine of the ☉'s meridian altitude, will leave the natural fine of his true altitude at the given time.

EXAMPLE I.

Required the true altitude of the ☉'s centre, in lat. 49° 57' N. and long. 135° W. July 26, 1800, at 6 H. 56 M. 30 S. in the morning, Sea account.

	12 0 0		
App. time	6 56 30		
Time from noon	5 3 30	Its log. in col. of rifing	4,87850
Latitude	49 57 0 N.	Its log. co-fine	9,80852
Decl. at that time	19 26 0 N.	Its log. co-fine	9,97452
Co. lat.	40 3	Reject 20 N. N. 45871 = log. =	4,66154
Mer. alt.	59 29	Nat. fine 86148	
		Nat. fine true alt. 40277 = 23° 45'.	

EXAMPLE

* The zenith diftance is called north when the fun is to the northward, when on the meridian; and called fouth when it bears fouth at paffing the meridian.

EXAMPLE II.

What will be the true altitude of the ⊙'s centre at London, November 26, 1800, at 3 H. 21 M. 30 S. apparent time in the afternoon: Sea account?

	H. M. S.			
App. time from noon	3 21 30	Its log. in col. of rising		4,55900
Latitude	51° 32′ N.	Log. co-sine		9,79383
Decl. at that time	20 49 S.	Log. co-sine		9,97068
Co. lat.	38 28 N.	Nat. numb.	21062 = log. =	432351
Mer. alt.	17 39	Nat. sine	30320	
Nat. sine true alt.	5 19	Nat. sine	09258	

CASE II.

The apparent Time, the Latitude and Longitude given, to find the Altitude of any of the known fixed Stars.

RULE.

Turn the longitude into time, and add it to, or subtract it from, the time at the ship, according as it is east or west, the sum or difference will be the time at Greenwich.

Take the ⊙'s Rt. Ascen. from the N. A. and proportion it to the time at Greenwich, and add it to the apparent time at the ship, which will give the Rt. Ascen. of the meridian, or mid-heaven.

Find the ✱'s Rt. Ascen. and declination in Table XVI. and take the difference between its Rt. Ascen. and the Rt. Ascen. of the meridian, which will be the distance of the ✱ from the meridian.

Having the ✱'s distance from the meridian, with its declination, and the ship's latitude, the true altitude is found in the same manner as has been shewn in the last examples of finding the true altitude of the sun.

EXAMPLE.

EXAMPLE.

What will be the true altitude of Aldebaran at Edinburgh, April 13, 1800, Sea account at 5h. 56m. 20s. P. M. apparent time ?

April 13, Sea account is April 12, Ephemeris time, at noon of which day ☉'s Rt. Afcen. - - - 1h. 22' 33"

	H. M. S.		
		Pro. part for 6 hours	55
Apparent time	5 56 20		
Long. 3° 6' W. time	12 24		1 23 28
App. time Green.	6 8 44		
Rt. Afcen. Edinb.	1 23 28		
Rt. Afcen. Merid.	7 32 12		
✱'s Rt. Afcen.	4 24 28		
✱'s dift. from merid.	3 7 44	Its log. in col. rifing	4.50127
Edinburgh's lat.	55° 58' N.	Co-fine	9.74794
✱'s declination	16 6 N.	Co-fine	9.98262
Co. lat.	34 2 N.	Nat. Numb. 17054 log.	4.23183
Merid. Alt.	50 8	Nat. fine 76754	
True Alt.	36 37	Nat. fine 59700	

Note. As Table XX. is only calculated to 30" the difference between the log. of 3h. 7m. 30s. and 3h. 8m. muft be taken, which is 218 ; Then say, as 30 : 218 :: 14 : 102 which added to 4.50025, the log. of 3h. 7m. 30s. gives 4.50127, the log. of 3h. 7m. 44s. as above.

CASE III.

The apparent Time, the Latitude and Longitude of the fhip being given, to find the true Altitude of the Moon's Centre.

RULE.

By Table XIX. turn the longitude into time, and if it be weft add it, but if it be eaft fubtract it from the apparent time at the fhip, and it will give the time at Greenwich.

Take the ☉'s Rt. Afcen. out of N. A. and proportion it to Greenwich time, which being added to the time at the fhip, the fum will be the right Afcenfion of the meridian or mid-heaven.

Take out of the N. A. the ☽'s Rt. Afcen. and declination, and proportion them to the time at Greenwich. Turn the ☽'s Rt. Afcen. into time, and take the difference between it and the Rt. Afcen. of the mid-heaven, which will be the diftance in time of the ☽ from the meridian.

Having the fhip's latitude, together with the ☽'s declination and diftance from the meridian, the true altitude is found, in the fame manner as has been fhewn in finding the true altitude of the ☉ and ✱.

EXAMPLE.

EXAMPLE.

What will be the Moon's true altitude August 25, 1800, Sea account at 1h. 20m. 6s. P. M. in lat. 42° 35′ N. Long. 70° W.

	H. M. S.		
Aug. 25, Sea acc. is Aug. 24 by Eph. at	1 20 6		
Long. 70° W. in time	4 40		
App. time at Greenwich	6 0		
☉'s Right Ascension	10 13 18		
App. time at ship	1 20 6		
Right Ascen. of the meridian	11 33 14		
☽'s right ascension in time	13 33 14		
☽'s dist. from the meridian	2 0 0	Log. rising	4.12702
Latitude	42° 35′	Co-sine	9.86705
☽'s declination	10° 19′ S.	Co-sine	9.99292
Co. latitude	47 25	Nat. num. 9705 Log.	3.98699
Merid. altitude	37 06	Nat. sine 60321	
Nat. sine of ☽'s merid. alt. 30° 25′		50616	

By the three last cases the true altitudes of the objects are found, therefore if the apparent altitudes be wanted, the difference between the ☉'s parallax and refraction must be added to the ☉'s true altitude, the refraction must be added to the true altitude of a star, and the difference between the ☽'s refraction and parallax in altitude must be subtracted from the true altitude of the ☽ thus found, to obtain the respective apparent altitudes of their centres.

To find the Longitude by the Eclipses of Jupiter's Satellites.

On the day preceding the evening on which it is proposed to observe an eclipse, look for the time when it will happen at Greenwich, in page 3d of the month in the Ephemeris. Find the difference of longitude either by a good map, sea chart, or dead reckoning.

Let the watch be regulated by the ☉ with all possible exactness to the apparent time. Turn the difference of longitude into time, and add it to, or subtract it from, the apparent time, according as it is east or west of Greenwich, the sum or difference will be nearly the time when the eclipse is to be looked for in that place. But as the longitude is uncertain, it will be proper to begin 20 or 30 minutes before.

Observe the hours, minutes and seconds of the beginning of the eclipse, called immersion, that is, the very instant that the satellite appears to enter into the shadow of Jupiter; or the emersion, that is, when it appears to come out of the same. The difference of time between the observed immersion, or emersion, and that set down in the N. A. being turned into degrees,

degrees, will give the difference of longitude between Greenwich and the place of observation.

These observations made on the first satellite, or that which moves nearest to the body of Jupiter, is the most proper for determining the longitude; and here it may be observed, that its emersions are not visible from the time of Jupiter's conjunction with the ☉ to the time of his opposition to the ☉, and that its immersions are not visible from the time of the planet's opposition to the ☉, to the time of its conjunction.

The configurations, or the positions in which Jupiter's satellites appear at Greenwich, are laid down every night when visible, in page 12th of the month in the Ephemeris.

EXAMPLE.

Suppose that on the 17th of August, 1800, in long. 157° 55′ west by account, an immersion of Jupiter's first satellite was observed at 12h. 29m. 20s. apparent time. Required the longitude?

				H.	M.	S.
At Greenwich, the immer. of 1st satellite that day will be				22	57	08
Observed immersion at	—	—		12	29	20
Difference in time	—	—		10	27	48

Turned into longitude gives 156° 57′½, and is west, because the time at Greenwich is more than at the place of observation; the error in longitude 58 miles.

As these eclipses happen almost daily, they afford the most ready means of determining the longitude of places on land, and then the longitudes of sea coasts might be better ascertained than they are at present; they might also be applied at sea, could they be observed with sufficient accuracy in a ship under sail, which can hardly be done, since the least motion of a telescope that magnifies sufficiently to make these observations, would throw the objects out of the field of view.

The eclipses of Jupiter's satellites may be well observed by one of Dolland's new achromatic telescopes of three feet in length, or by a reflecting telescope of 18 or 20 inches focal length.

To find the Longitude by the Eclipses of the Moon.

This is performed by comparing the times of the beginning or ending, as also the times when any number of digits are eclipsed, or when the earth's shadow begins to touch or leave any remarkable spot on the moon's face.

Then will the difference of time between the like observations made at different places, turned into degrees, be their difference of longitude.

But these eclipses happen too seldom to be of any general use at sea.

OBLIQUE

OBLIQUE TRIGONOMETRY.

AXIOM I.

In all plain triangles the ſides are in direct proportion to the ſines of their oppoſite angles.

To find a Side.

As the ſine of an angle
Is to its oppoſite ſide,
So is the ſine of either of the other angles in the ſame triangle
To the ſide oppoſite thereto.

To find an Angle.

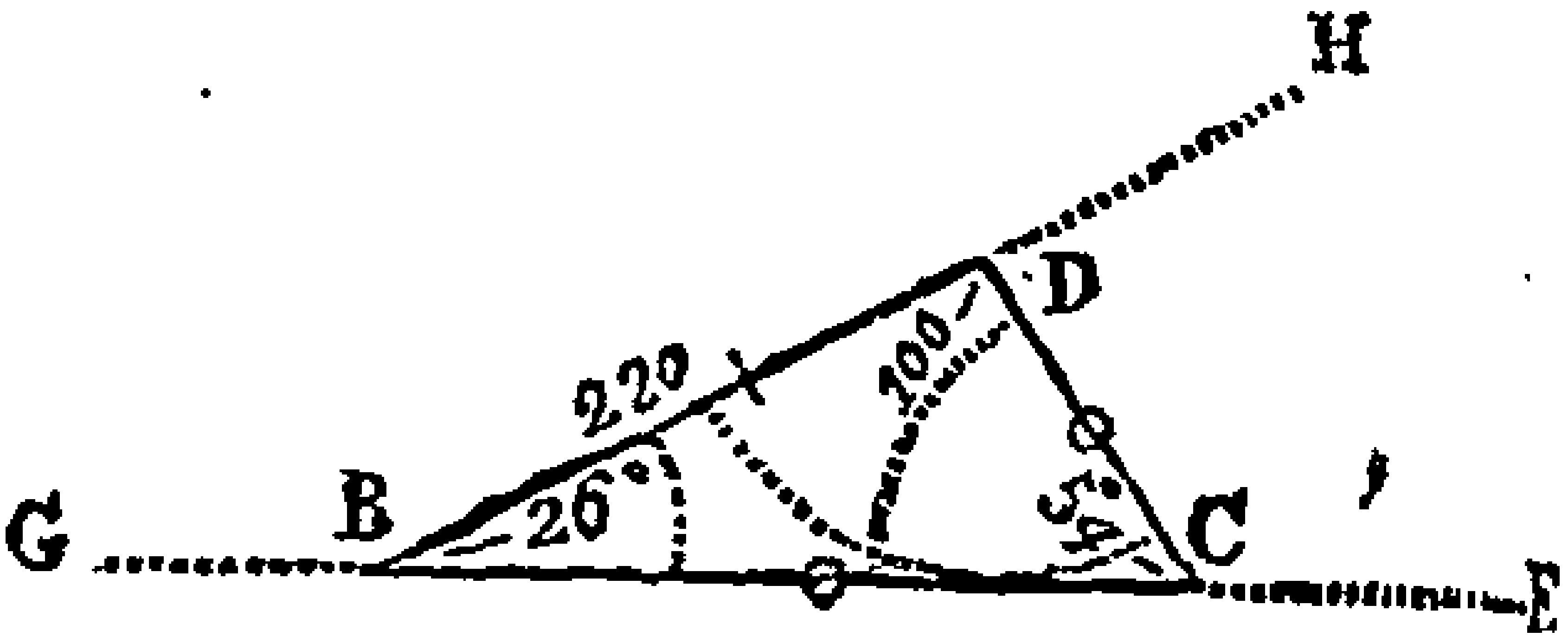
As any ſide given
Is to the ſine of its oppoſite angle,
So is either of the other ſides in the ſame triangle
To the ſine of its oppoſite angle.

CASE I.

Two angles and one ſide given, to find either of the legs?

The angle B D C = 100°
and angle D C B = 54°

And the leg. B D = 220
are given to find the ſides.



CONSTRUCTION.

Draw an indefinite line GE, add the two angles D and C together, and ſubtracting their ſum from 180° leaves the remaining angle B 26° on the line G E; on any point, as at B, deſcribe the angle B 26°, and on B H ſet off B D 220. On D make the angle B D C 100°, then D C will interſect the line G E in the point C, which completes the triangle, and B C will meaſure on the ſame ſcale from which B D was laid down 268 nearly, and D C 119 alſo on the ſame ſcale.

To find C B.		To find D C.	
As the ſine of the angle C 54°	9.90796	As ſine ang. C 54°	9.90796
Is to the ſide B D 220	2.34242	Is to the ſide B D 220	2.34242
So is ſupp. ſ. of ang. B C D 80°	9.99335	So is ſine ang. B 26°	9.64184
	12.33577		11.98426
	9.90796		9.90796
To the ſide B C 267.8	2.42781	To ſide D C 119.2	2.07630

By the Gunter.

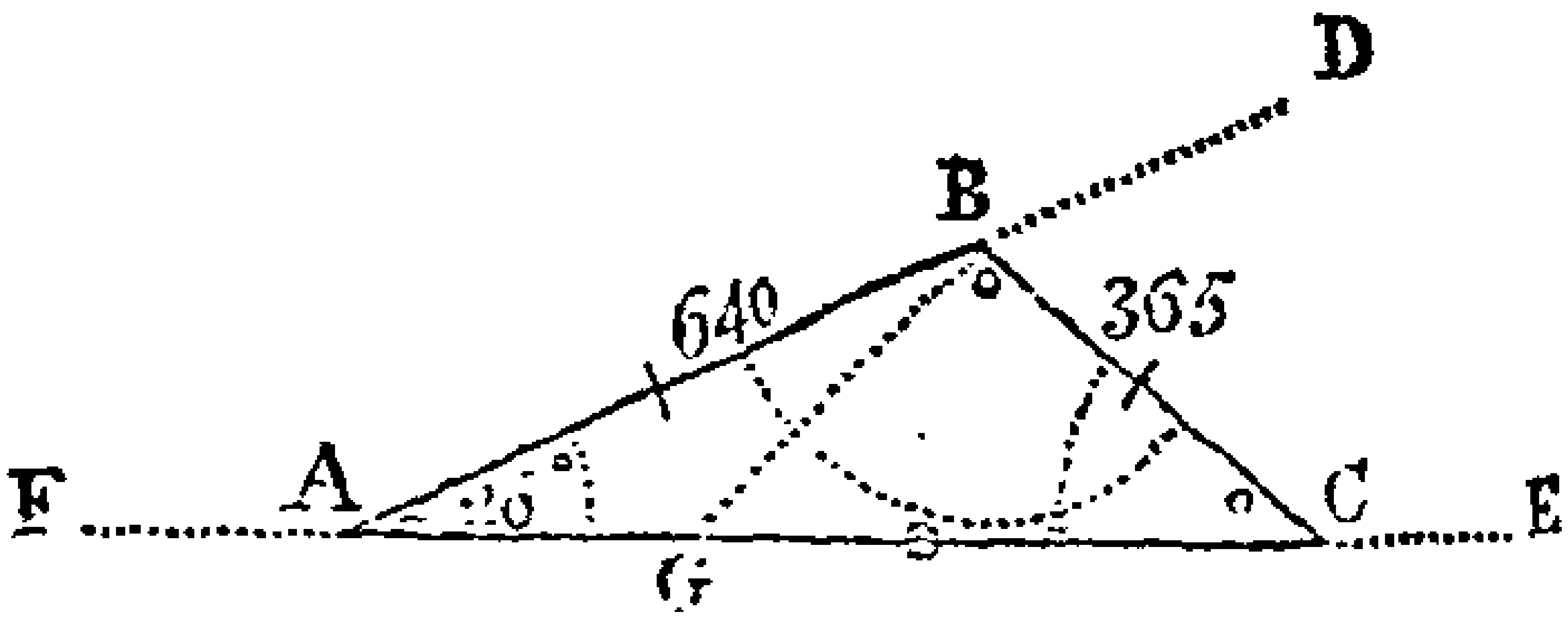
1ſt. The extent from 80° to 54° on the line of ſines will reach from 220 to 267, on the line of numbers for B C.

2d. The extent from 54° to 26° on the line of ſines will reach from 220 to 119, on the line of numbers for the ſide D C.

CASE II. and III.

Two ſides and an angle oppoſite to one of them being given, to find the other oppoſite angles and the third ſide?

The ſide B C 365, and the ſide A B 640, and angle A 26°, given to find the ſide A C, and angles ABC and BCA.



CON-

CONSTRUCTION.

Draw the indefinite line F E, and on any point therein, as at A, draw the angle D A E 26°. On A D ſet off A B = 640, then on B, with 365 in your compaſſes taken from the ſame ſcale, deſcribe an arch which will cut F E in the point C. Join B C, and it is done. A C will meaſure on the ſcale before uſed 809 nearly, the angle B will meaſure on the ſcale of chords 103¾, and angle C 50¼ nearly.

Proportion by Axiom II.

To find the angle C.		To find A C.	
As the ſide B C 365	2.56229	As ſine angle C 50° 14′	9.88573
Is to the ſine of angle A 26°	9.64184	Is to A B 640	2.80618
So is the ſide A B 640	2.80618	So is ſine ang. B, or its ſuppl. 76° 14′	9.98734
	12.44802		12.79352
	2.56229		9.88573
To ſign angle C 50° 14′	9.88573	To ſide A C 808.7	2.90779

To ſign angle C	50°	14′
Angle A add	26	0
Subtract	76	14
from	180	
Angle B	103	46

It may be proper to obſerve, that if the given angle be obtuſe, the angle ſought will be acute; but when the given angle is acute, and oppoſite a given leſſer ſide, then the required angle is doubtful whether acute or obtuſe, it ought therefore to be determined before the operation; for it is plain the above proportion produces 59° 17′ for the required angle, but as it is obtuſe, its ſupplement to 180° muſt be taken, viz. 120° 43′.

By the Gunter.

1ſt. The extent from 365 to 640 on the line of numbers will reach from 26° to 50° 14′, on the line of ſines equal the angle B.

2d. The extent from 50° 14′ to 76° 14′ on the ſines, will reach from 640 to 809, on the line of numbers equal A C.

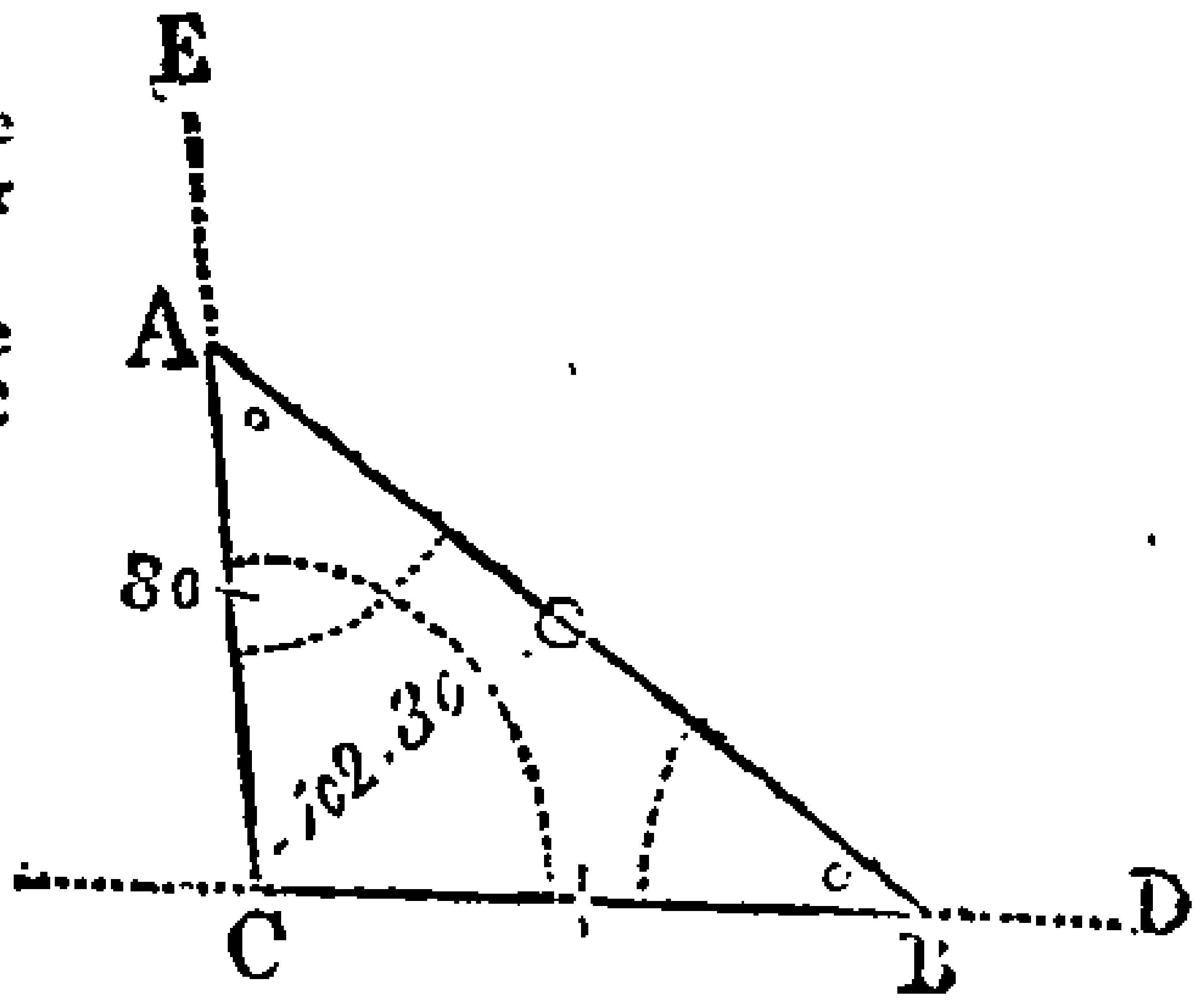
AXIOM II.

In every plane triangle it will be as the ſum of any two ſides is to their difference, ſo is the tangent of half the ſum of the angles oppoſite theſe ſides, to the tangent of half their difference, which half difference being added to half the ſum of the angles gives the greater angle, but being ſubtracted, the remainder will be the leſſer angle.

CASE IV. and V.

Two ſides and their contained angle being given, to find either of the other angles, and the third ſide?

The ſide B C 110m. A C 80m. and angle B C A 102° 30′, to find the angle B A C and C B A.



CONSTRUCTION.

Draw the indefinite right line C D, on which ſet off C B = 110, make the angle A C B = 102° 30′, then on A C, ſet off C A 80, join A B, and it is done, for A B will meaſure on the former ſcale 149, and the angles A and B will meaſure 45° 58′, and 31° 32′ reſpectively on the line of chords.

The

The proportion by axiom III. will be,

To find the angles B and A.			To find the side A B by axiom II.		
As the sum of the sides AC & BC 190		2.27875	As sine ang. B	31° 32′	9.71850
Is to their difference,	30	1.47712	Is to A C	80	1.90309
So is tan. ½ sum oppo. angles	38° 45′	9.90449	So is sine ang. C	102 30	9.98958
			or its sup.	77 30	
		11.38161			11.89267
		2.27875			9.71850
To tang. half diff.	7° 13′	= 9.10286	To side A B 149.3		2.17417

By Gunter.

1st. The extent from 190 to 30, on the line of numbers, will reach from 38° 45′ to 7° 13′, on the line of tangents for half difference.

2d. The extent from 77° 30′, which is the supplement of 102° 30′ to 180° to 31° 32′, on the line of sines will reach from 80° to 149,3 on the line of numbers for the side AB required.

The learner may be at a loss how to know to which angles the above sum and diff. belong, but let him remember the biggest angle is opposite the biggest side, and the contrary, which will determine it.

AXIOM III.

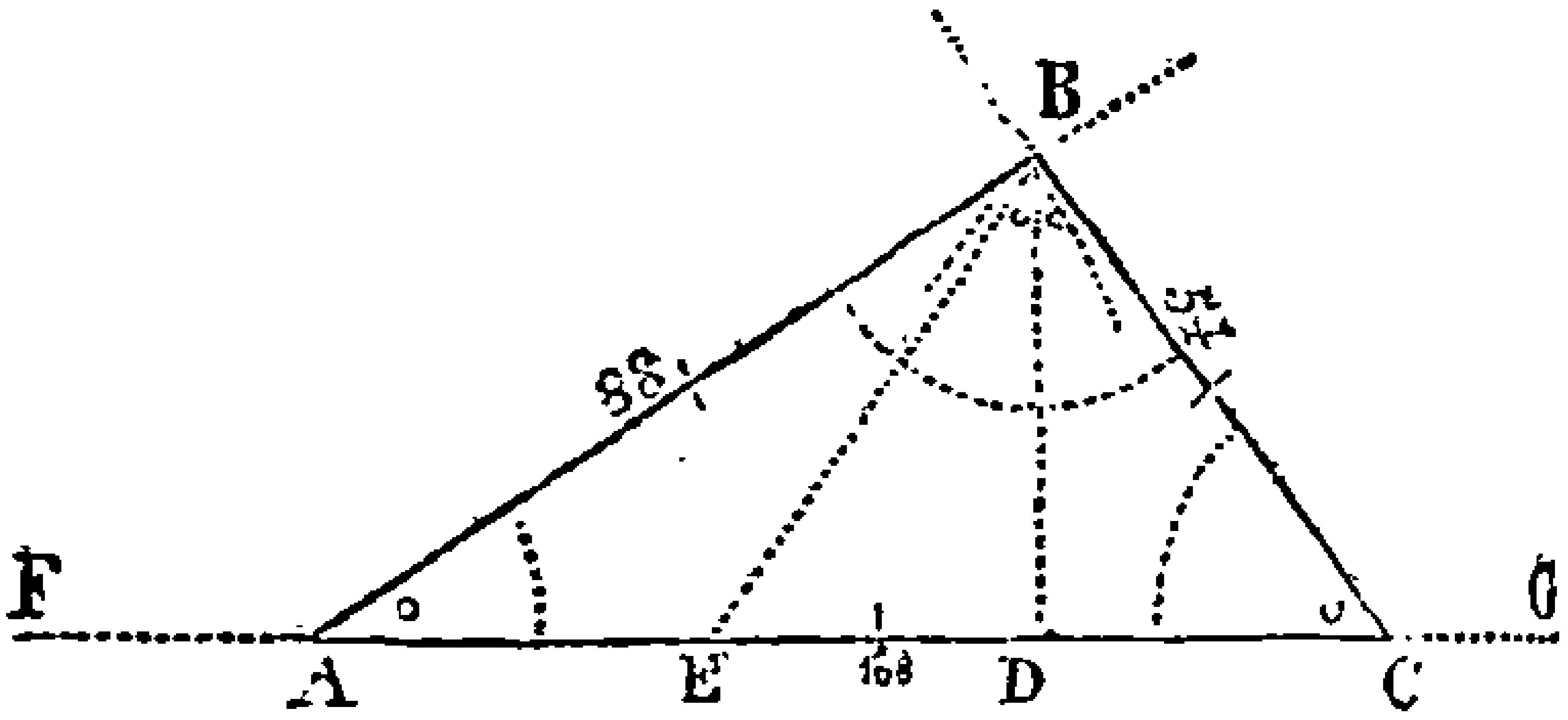
In any plane triangle, it will be
As the greatest side
Is to the sum of the other two sides,
So is the difference of those sides
To the difference of the segments of the base made by a perpendicular, let fall from the angle opposite the base.

And half the difference of the segments added to half their sum will give the greater segment, but if subtracted from their half sum will leave the lesser segment, the triangle being thus cut, becomes 2 right-angled triangles, the hypothenuses and bases of which are given, to find the angles by axiom I.

CASE VI.

The three sides of a plane triangle given to find the angles?

The side BA 88, BC 54, AC 108, given, to find the angles ABC, BAC, BCA.



CONSTRUCTION.

Draw the indefinite right line F G, on which from any point therein, as at A, set off AC 108, then 88 in your compasses, and one foot on the point A, sweep an arch also with the distance 54 in your compasses, and one point on C, sweep another arch intersecting the former arch in the point B, and it is done; B A, B C, A C, will measure 88 54 108 respectively on the same scale.

The proportion by axiom III.

88		To find A E = A D — D C the diff. of segments.			
54					
142	Sum of shortest sides	As the side A C		108	2.03342
34	Diff. ditto	Is to the sum of sides A B and B C		142	2.15229
		So is diff. sides A B and B C		34	1.53148
Half base	54				3.68377
Half diff. segm.	22.35				2.03342
A D	76,35	Great segment			
D C	31,65	Least segm. To A E the diff. of segmt. base	44,	7	1.65035
		Half	22,	35	

Having divided the triangle into two right-angled triangles, the hypothenuse and bases of which are given, to find the angles by axiom I. as follows:

To find the angle DAB.

As the hypothenuse AB 88		1.94448
Is to radius	90° 00′	10
So is side AD the great seg. 76. 35		1.88281
To sine ang. ABD	60° 11′	9.93833
	90	
The comp. is ang. A = 29 49		

To find the angle DBC.

As hypoth. BC 54		1.73239
Is to radius	90° 00′	10
So is DC	31 65	1.50037
To si. ang. BDC	35° 53′	9.76798
	90	

Its com. ang. C = 54 07 + ang. A 29° 49′ = 83° 56′ and 180° − 83° 56′ = ang. B 96° 4′

OBLIQUE SAILING.

We come next to the doctrine of oblique triangles applied to problems of sailing; and though it may be applied to the measuring of inaccessible objects, yet we shall confine it to those problems which are more immediately necessary in navigation, and is chiefly used in taking the maps of harbours, sea-coasts, &c. as follows:

Oblique Sailing exemplified by proper Examples.

CASE I.

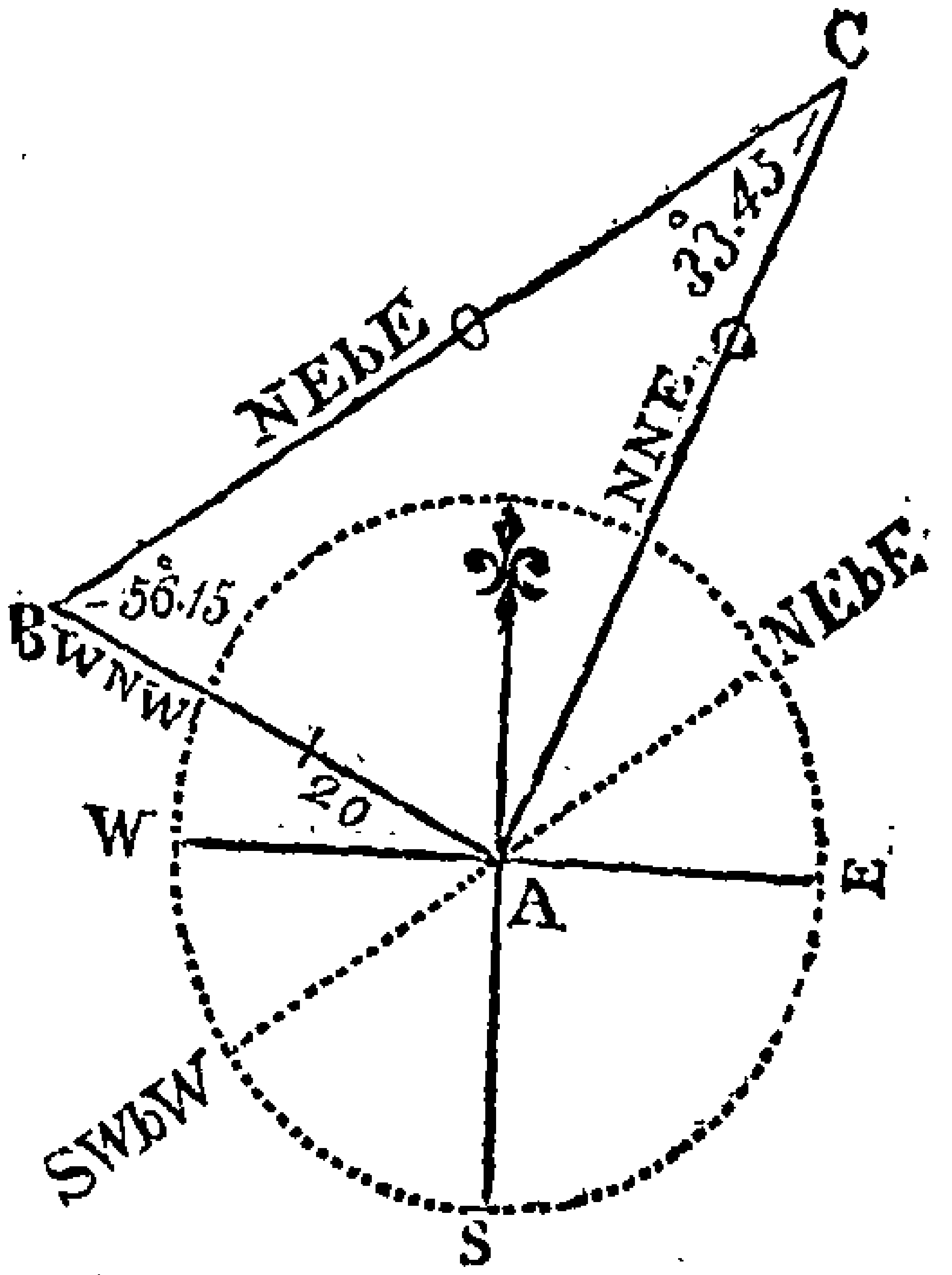
The bearing and distance of two places from each other, as also the bearing of each of them from a third place, being given, to find the distance from the said third place to each of the other two places.

EXAMPLE I.

Coasting along shore, I saw a cape of land which bore from me N. N. E. I stood away W. N. W. 20 miles, and the same cape bore from me N. E. by E. I would know the distance of the ship at both stations from the cape?

CONSTRUCTION.

Having drawn the compass N. E. S. W. let A represent the place of the ship at her first station, from whence, through the N. N. E. point, draw the indefinite right line CA, also through the W. N. W. point, draw another indefinite right line, BA, and set off thereon 20 miles from a scale of equal parts from A to B, through the centre of the compass also draw the N. E. by E. and S. W. by W. points, and parallel thereto from the point B, draw the line BC, meeting the N. N. E. in the point C, and it is done; now from the N. eastward 2 points, and from the N. westward 6 points, together make 8 points for the ∠BAC, also the difference between the N. E. by E. and N. N. E. points are 3, = 33° 45′ = ∠B CA the other ∠ being a right ∠, the angle CBA will be the complement of 33° 45′ = 56° 15′.



To find the distance AC.

As radius 90°		10.00000
: AB 20 miles		1.30103
:: Tang. ∠ B = 56° 15′		10.17511
: AC dist. from her 1st station 29.93 miles.		1.47614

To find the distance BC.

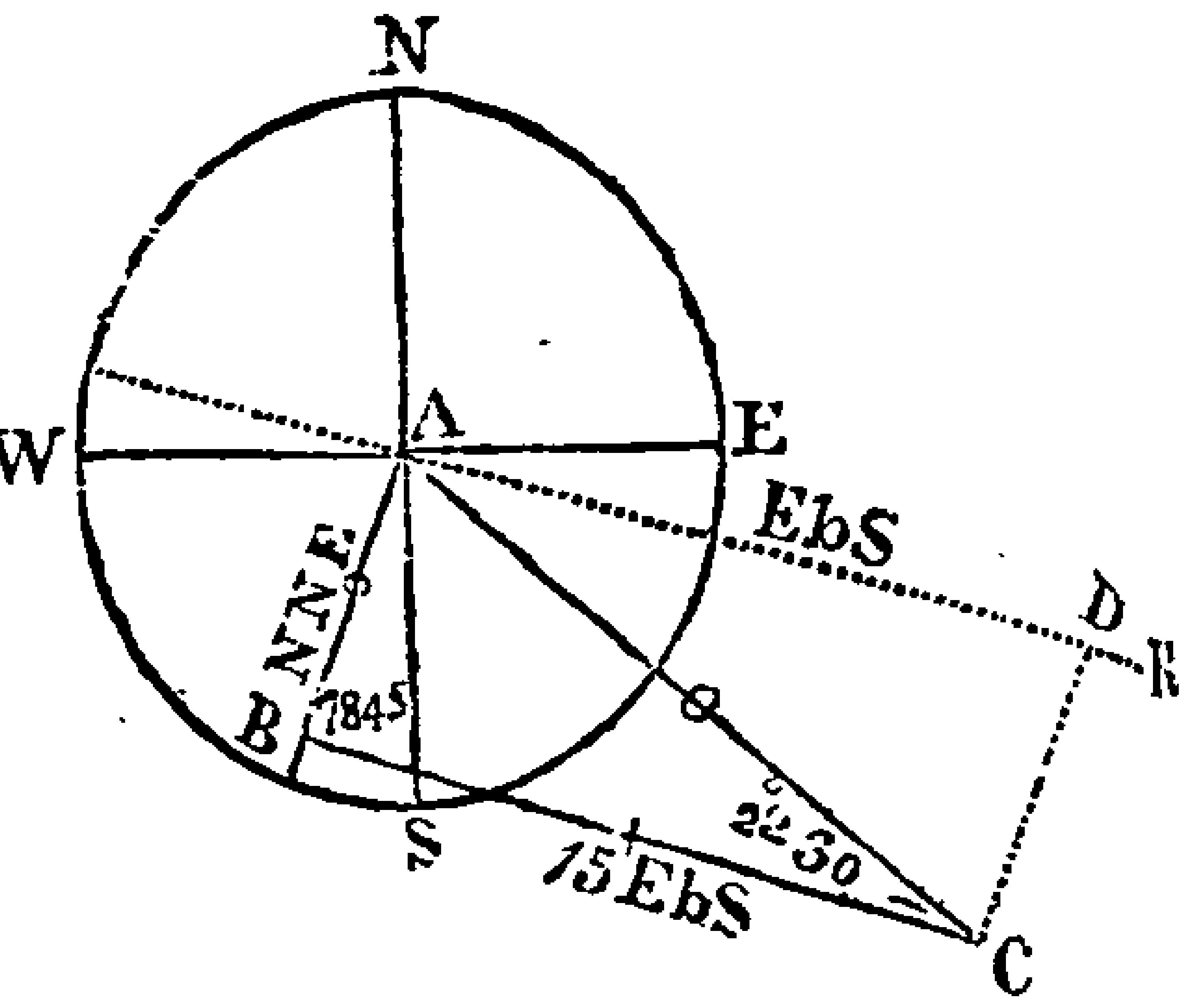
As radius 90°	10.00000
: BA = 20 miles	1.30103
:: Sec. ∠ B 56° 15′	10.25526
: Dist. BC = 36 miles =	1.55629

EXAMPLE II.

Being at sea, I saw two headlands, whose bearing from one another I find by the chart to be W. by N. and E. by S. distance 15 miles, the northernmost bore from me S. S. W. and southernmost S. E. by E. I demand my distance to each of the said headlands?

CONSTRUCTION.

Having drawn the compass, set off the bearings as AB the S.S.W. bearing and AC the S. E. by E. course, draw through the centre the dotted line representing the bearings of the two places one from another, and from A towards R, on this line, set off from any scale of equal parts, 15 miles, from A to D, and draw D C parallel to B A until it cuts A C at the point C, through C draw B C parallel to A D and it is done.



Calculation of the Angles.

Between N. N. E and E. by S. is 7 points, or 78° 45′ = ∠ABC, between S. S. W. and S. E. by E. is 7 points, or 78° 45′ = the ∠BAC, consequently the ∠s ABC, and BAC = 14 points taken together, wherefore taking 14 from 16 the number of points in a triangle remains 2 points, or 22° 30′ for the remaining ∠ BAC.

Calculation of the sides.

As sine ∠ A 78° 45′ =	9.99157	It being an isosceles triangle.
Is to B C = 15 miles	1.17609	A C = B C = 15 miles.
So is sine ∠ C 22° 30′ =	9.58284	
	10.75893	
	9.99157	
To AB = 5.853 miles	0.76736	

This example and the first, are used for finding the distance of a ship from any head-land, &c. when the ship is about to take her departure from the land.

CASE II.

The bearings and distance of two places from each other, and the distance of one of these places and the bearing of the other from a third place being given, to find the bearing of the first, and the distance of the second from the third place.

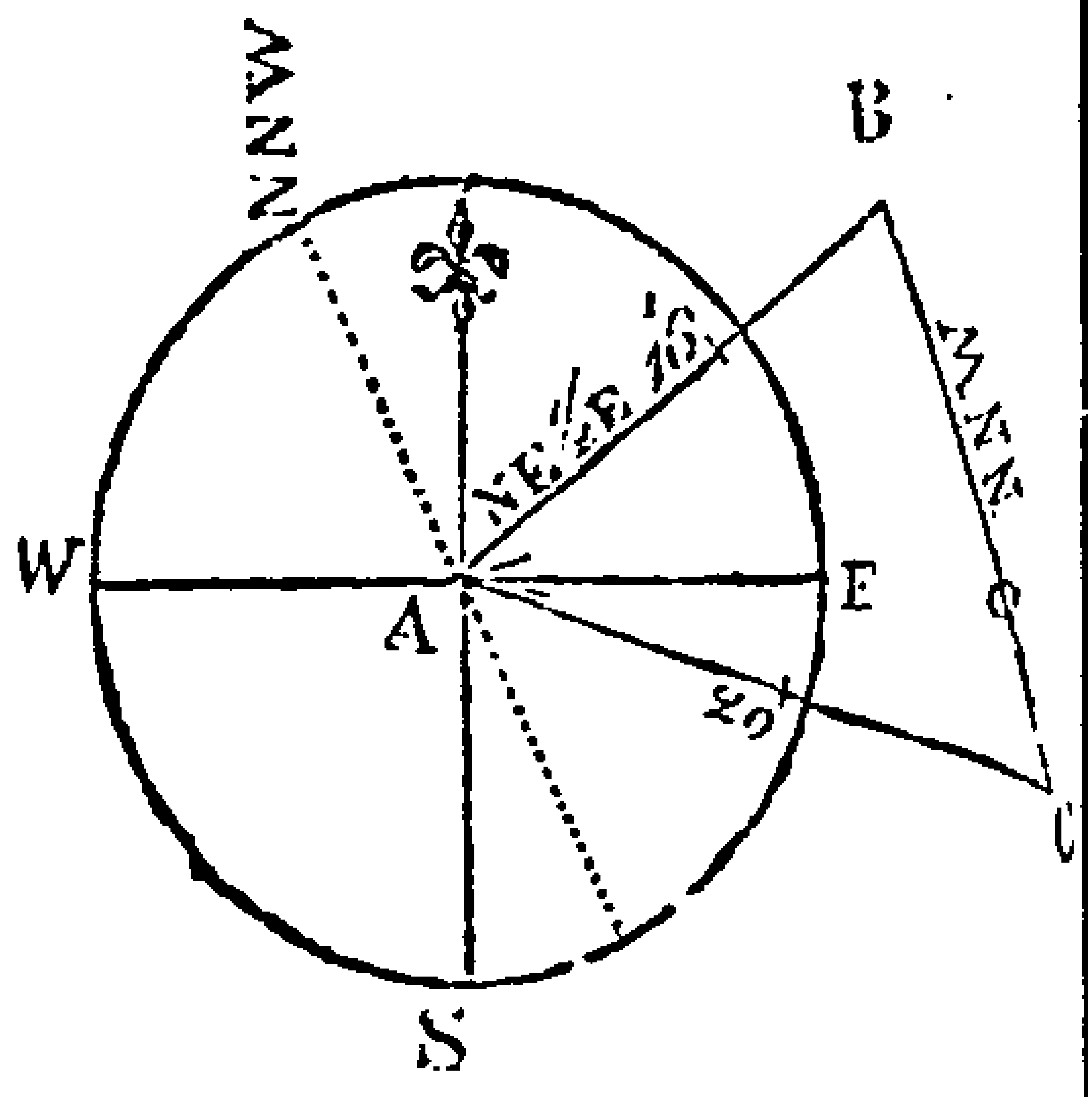
EXAMPLE.

Admit two ships sail from the said road, one sails N. E. ½ E. easterly 16 miles, the other sails 20 miles, and then finds the first to bear N. N. W. I demand the distance between the two ships?

CONSTRUCTION.

1st. Having drawn the compass, let A be the place the ships departed from, and draw the N. E. ½ E. line A B equal 16 miles.

2. From B draw the right line B C parallel to N. N. W. then with 20 miles between the compasses, setting one foot in A, with the other cross the line B C as in C, and join A C, then is the ∠ BAC the course which the second ship steered, reckoned from the N. E. ½ E. southerly, to find which;



Calculation of the Angles.

From B to C bears S. S. E. the oppofite point to N. N. W. which is 2 points, alfo A bears from the fame point B, S. W. ½ W. the oppofite point to N. E. ½ E. which is 4½ points and two from the S. eafterly, make 6½ points for the ∠ ABC, from whence you find the ∠ C thus:

As the fide AC = 20 miles		1.30103
Is to fine of the ∠ A B C = 73°		9.98087
So is the fide A B 16 miles		1.20412
		11.18499
		1.30103
To fine of the ∠ C	49° 57′	9.88396
For N. N. W. add	22 30	
Sum makes	72 27 from the N. wefterly.	

Which being counted from the N. N. W. makes A C to bear from N. 72° 27′ wefterly, whence the fhip's courfe was from A to C. 72° 27′ eafterly, or E. S. E. ½ E. nearly.

To find the Diftance of the two Ships from one another.

The ∠ ABC = 73° 07′		As fine ∠ ABC = 73° 07′	9.98087
∠ C =	49 57	Is to fide A C = 20	1.30103
Sum	123 4	So is fine ∠ A 56 56	9.92326
	180		11 22429
∠ A	56 56		9.98087
		To fide B C = 17,52 miles	1.24342

CASE III.

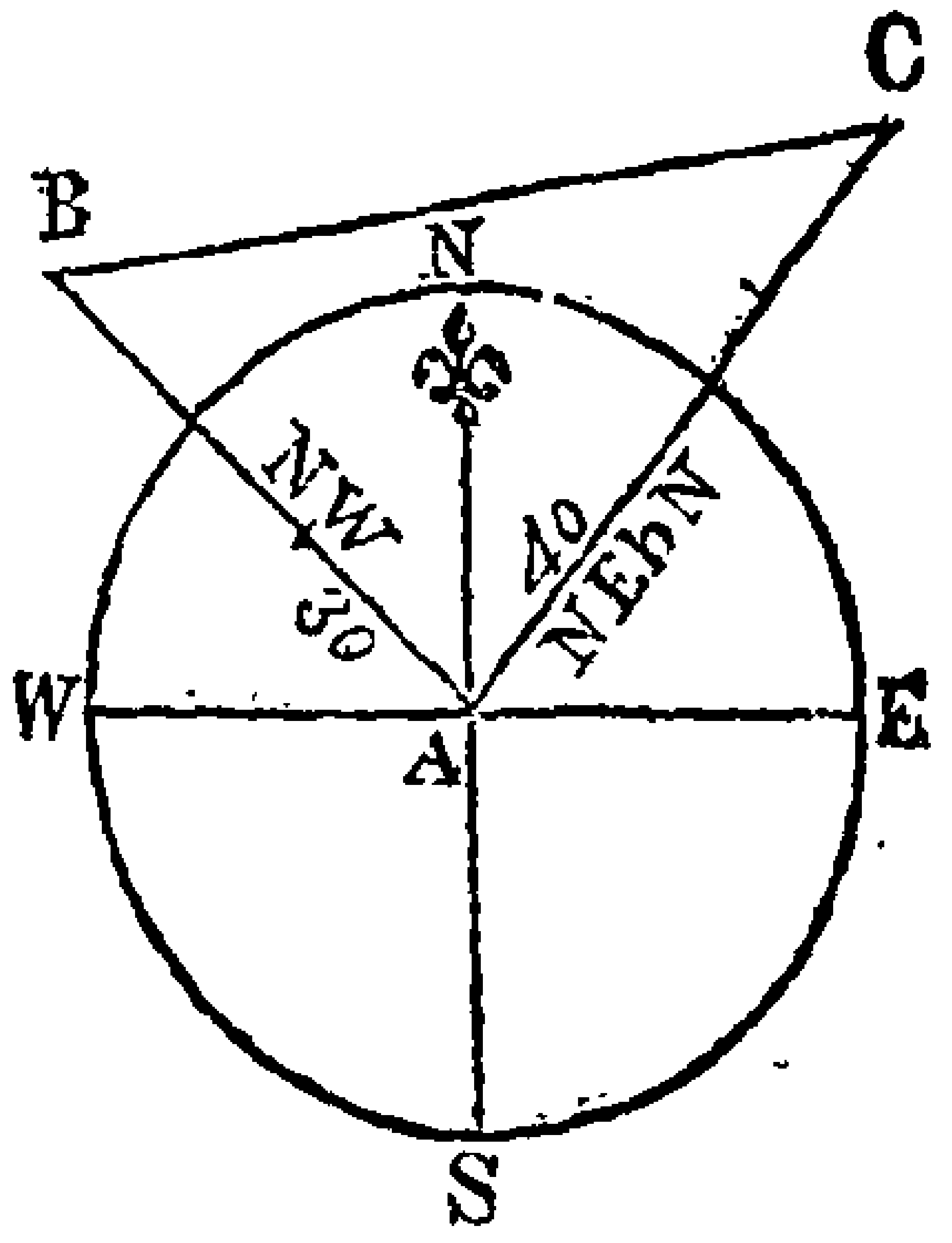
The bearings and diftances of any two places from a third being given, to find the bearings of the faid places, and their diftance from each other.

EXAMPLE.

Admit two fhips fet fail from the fame port, one whereof fails N. W. 30 miles, the other fails N. E. by N. 40 miles. I demand their bearings and diftance from each other.

CONSTRUCTION.

From A fet off the N. W. courfe A B, which make 30 miles, alfo draw the fecond fhip's courfe A C, and fet off thereon 40 miles, from the fame fcale before ufed, join B C, and it is done.



To calculate the angles.

N. E. by N. 3 points	33° 45′
N. W. 4 points	45
Sum = ∠ B A C	78 45
	180
	2)101 15
½ fum opp. angles	50 37

As ſum of ſide A B & A C = 70		1,84510
Is to their difference	10	1,00000
So is tan. ½ ſum opp. ∠s 50° 37′ ∠		10.08570
		11,08570
		1,84510
To tang. ½ diff.	0 52½	9,24060
Sum = Angle B	60 30	
Diff. = Angle C	40 45	
Angle A	78 45	
Sum	180 0	
Angle C	40 45	
N. E. by N.	33 45	
Sum	74 30 the bearing from C, or W. by S. ½ S. nearly.	

To find the diſtance from each other.

As the ſi. ang. B 60° 30′		9,93970
Is to ſide A C 40 miles		1,60206
So is ſine ang. A 78° 45′		9,99157
		11,59363
		9,93970
To their diſt. B C = 45.8		1.65393

CASE IV.

The mutual diſtances of three places from each other, and alſo the bearing of any two of them being given, to find the ſeveral bearings of theſe two from the third place.

EXAMPLE.

Admit there be two ports lying E. by N. and W. by S. diſtance 400 miles; a ſhip from the eaſternmoſt ſails northerly, 450,7 miles, another from the weſternmoſt ſails 300 miles and meets the firſt, I demand the courſe ſteered by each ſhip?

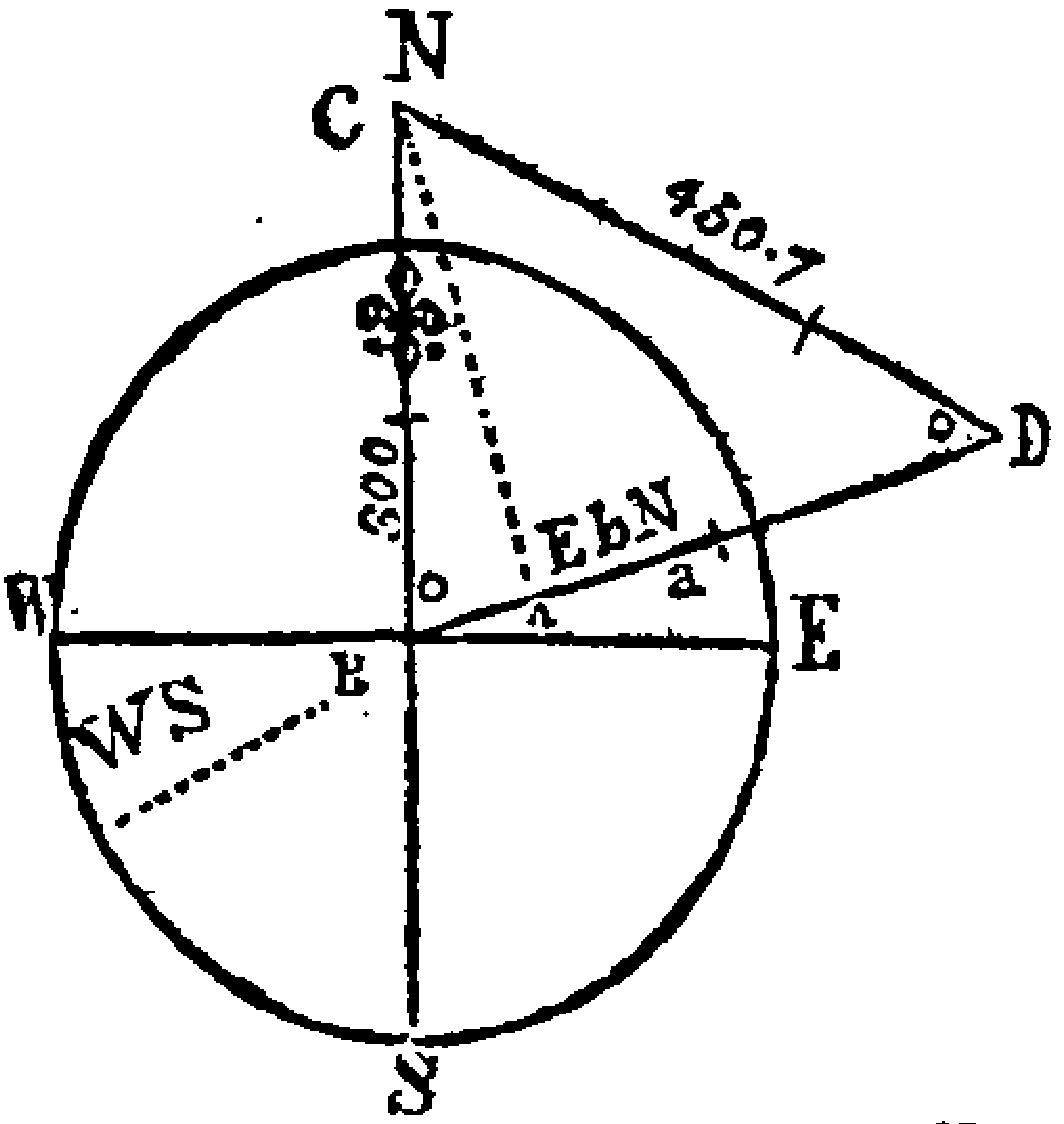
CONSTRUCTION.

1ſt. Having drawn the compaſs N. E. S. W. let B, the centre, repreſent the weſternmoſt port, and draw the E. by N. line B D, on which ſet off 400 miles to D, then will D be the eaſternmoſt port.

2d. With 300 between your compaſſes, and one foot on B, deſcribe an arch.

3d. With 450 in your compaſſes, and one foot on D, deſcribe another arch interſecting the former arch, as at C, join C B and C D.

4th. Making B D the baſe from C, let fall the perpendicular C A thereon, which will divide the oblique-angled triangle BCD into two right-angled triangles B C A and A C D.



By Axiom III.

As the baſe B D 400		2,60206
Is to ſum of ſides BC and CD 750,7		2,87547
So is diff. of ſides BC and CD 150,7		2.17811
		5,05358
		2,60206
To diff. ſegts. of baſe	282,8	2,45152
Half which	141,4	
Add to ½ baſe	200,0	
Sum is gr. ſegt. A D =	341,4	
Diff. = the leſſ. ſegt. AB	58,6	

To find the courſe from B, *in* ∠ BCA.

As hypoth.	300	2,47712
Is to radius	90°	10,00000
So is AB	58.6	1,76790
		11,76790
		2,47712
Co-ſine ang. B	78° 44′	9,29078
Add. E. by N.	11 15	
Sum E,	89 59 N. or the courſe is N. from B, the weſternmoſt ſhip's port.	

To find the courſe from D, *in* ∠ ACD.

As the hypoth.	450,7	2,65389
Is to radius	90°	10,00000
So is A D	341,4	2,53326
		12,53326
		2,65389
To co-ſine ang. D	40° 46	9,87937
Subtract E. by N.	11 15	
Remains W.	29.31 N. for the ſhip's courſe from D, the eaſternmoſt port.	

CASE V.

The bearings of two or more places from two different stations, as also the bearings and distance of the said stations from each other being given, to find the bearings and distance of the said places from each other.

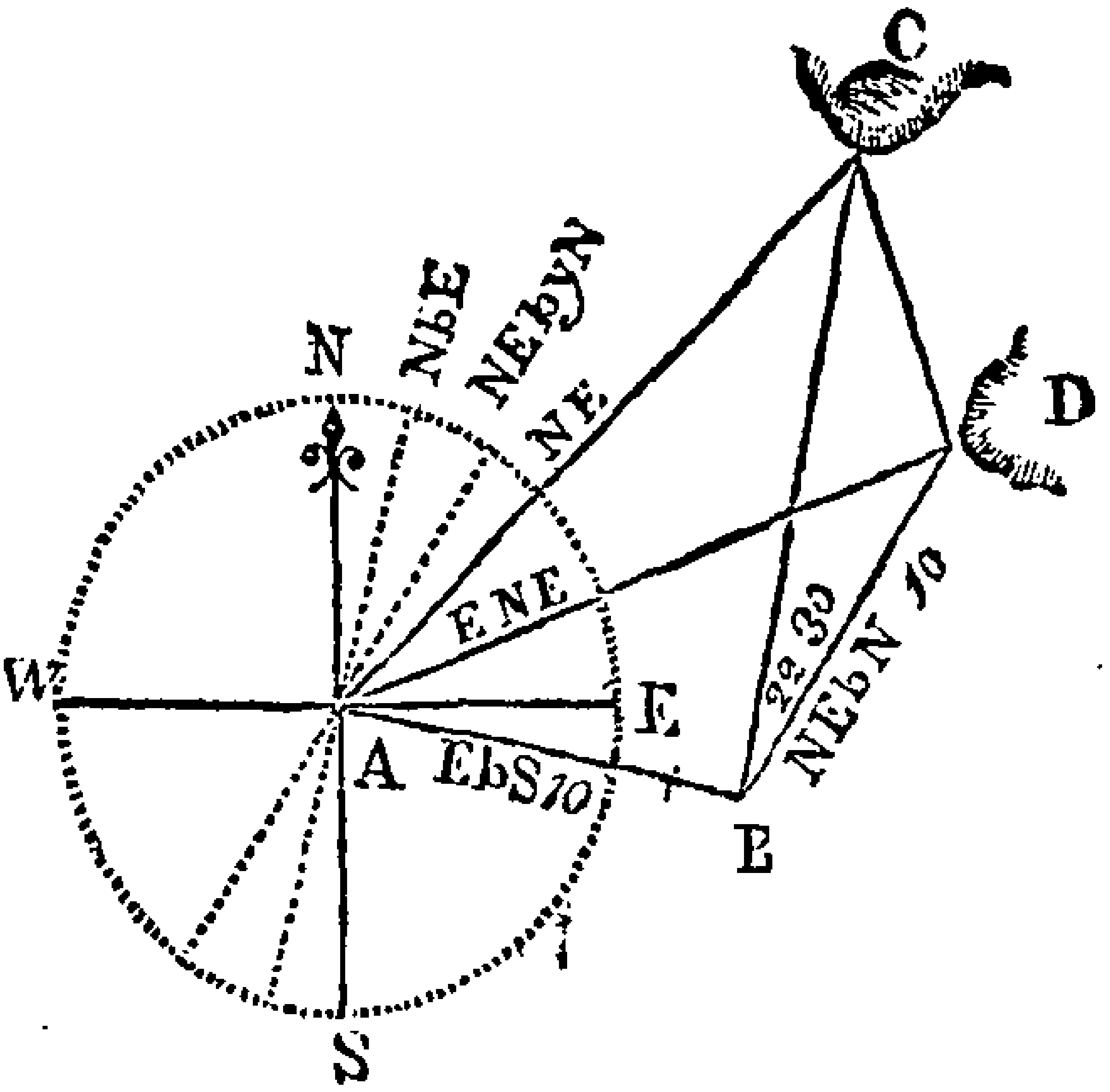
This case is a compound of the first and second cases.

EXAMPLE.

Coasting along shore, I saw two headlands, the first bore from me N. E. the second E. N. E: and after I had sailed E. by S. 10 miles, the first bore from me N. by E. and the second N. E. by N. I demand the bearings of the two headlands from each other?

CONSTRUCTION.

1st. Having drawn the compass N. E. S. W. let A represent the place of the ship, from whence draw the N. E. line A C, the E. N. E. line A D, and the E. by S. line A B = 10 miles, then will B be the second ship's station.



2d. From B draw the line B C parallel to the N. by E. where this intersects the N. E. line, as in C, gives the first headland.

3d. Also from B draw the line B D parallel to the N E. by N. where this intersects the E. N. E. line, as in D, gives the second headland.

4th. Join the points C and D, then will C D be the distance of the headlands from each other, and the ∠ ACD their bearing from the N. E. line, to find which by

CALCULATION.

First you must find the distance of both headlands from both stations.

1. In the △ ABC all the ∠s are given, and one side AB 10 miles.

Betwixt E. by S. and N. by E. are eight points, consequently, the ∠ ABC is right-angled.

Betwixt N. E. and E. by S. is 5 points, or ∠ C A B = 56° 15'. Its comp. = ∠ ACB = 33° 45'. In △ ACB.

As sine ∠ ACB = 33° 45' =		9,74474
: side A B	= 10	1,00000
: : sine ∠ C A B = 56 15		9,91985
: B C	14,96	1,17511

or 15 miles nearly.

2. In the △ A D B.

Betwixt E. N. E. and E. by S. = 3 points = ∠ D A B 33° 45'.

Betwixt E.N.E. and N.E. by N. is 3 points, so that the ∠ADB = 33° 45', now there are 2 ∠s equal, consequently there must be two sides equal, viz. the sides opposite those angles, that is, the side A B = the side B D = 10 miles; and the △ ABD is an isosceles △.

180	
22	30
2)157	30
78	45

Lastly, In the △ CBD is given the side C B 14,96, the side B D 10 miles, and ∠CBD. For betwixt the N. by E. and N. E. by N. is 2 points, or the ∠ C B D = 22° 30'.

As sum of sides BC & BD = 24,96		1,39724
: diff. sides BC and BD	4,96	0,69548
: : tang. ½ sum opp. ∠s = 78° 45'		10,70134
		11,39682
		1,39724
: tang. ½ difference	44, 58	9,99958
∠CDB	123 43	
∠BCD	33 47	

As sine ∠ BCD	33° 47'	9,74512
: B D	10 miles	1,00000
: : sine ∠ CBD	22 30	9,58284
: CD = the distance of both	6,8 82	0,83772

Again,

From ∠ BCD = 33 47
Subtract N. by E. 11 15

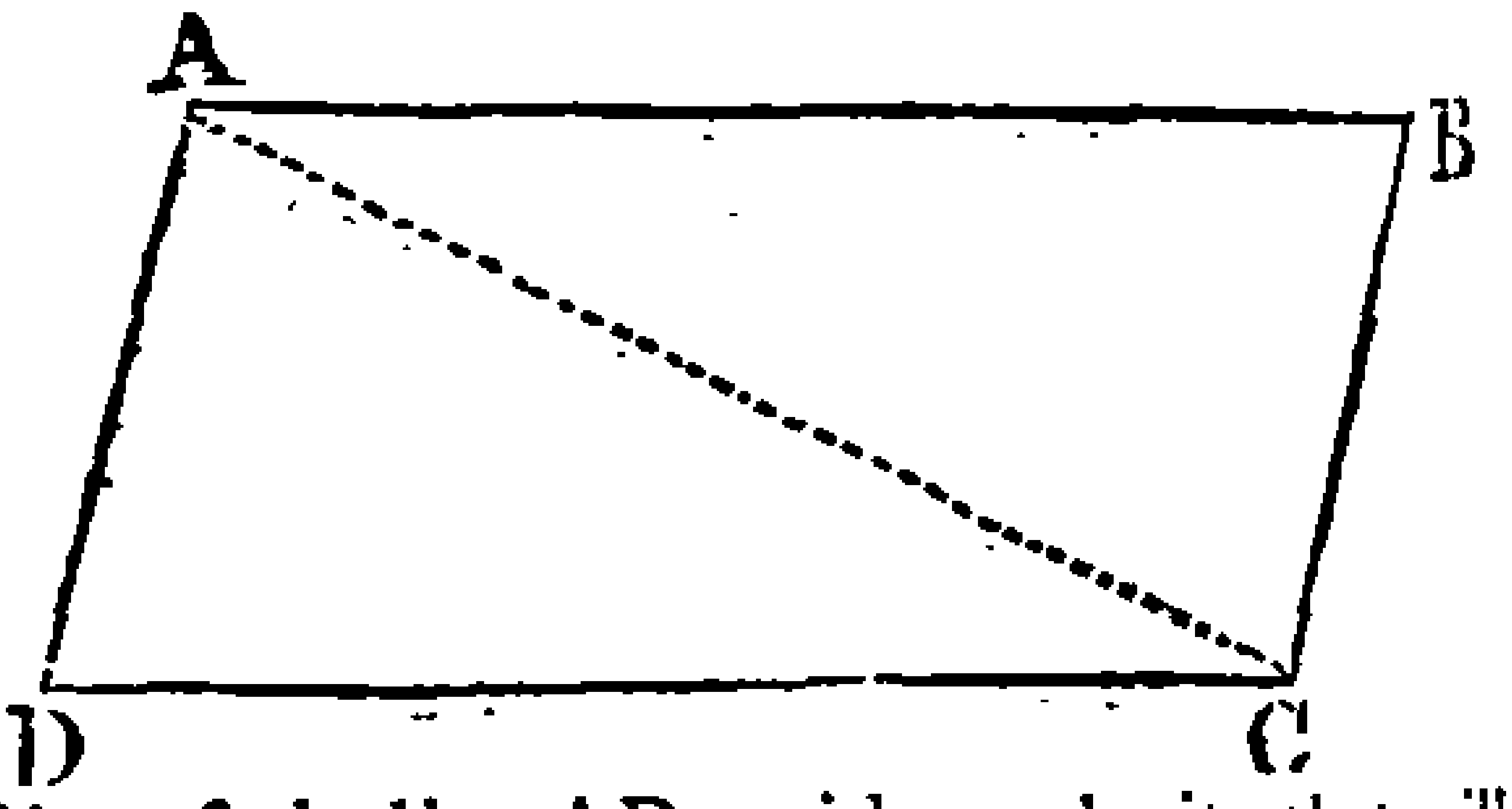
22 32 that is D bears from C. S. 22° 32' E. or S. S. E. and C bears the contrary from D.

CURRENT SAILING.

CURRENTS are certain ſettings of the ſtream, by means of which all bodies moving therein are compelled to alter their courſe, and ſubmit to the motion impreſſed upon them by it; whence, if a current ſets with the courſe of a ſhip, it augments her motion by as much as the drift or rate of driving it.

Thus, if a ſhip ſails N. N. E. 20 miles, in a current that ſets N. N. E. 8 miles, in the ſame time her true courſe will be N. N. E. 28 miles in that time; but if a current ſets againſt a ſhip, it leſſens her velocity by juſt ſo much as the current's drift is.

So that if the ſhip ſails N. E. 49 miles, in a current that ſets S. W. 10 miles in that time, then her true courſe will be N. E. 39 miles; and if in the ſame time that the ſhip ſails N. E. 49 miles in a current that ſets S. W. 59 miles, then the ſhip will fall a-ſtern, and her true courſe will be S. W. 10 miles; but if the ſhip thwarts the current, it not only leſſens or augments her velocity, but gives her a new motion, compounded of that of the ſhip and current; that is,



If a body be agitated by two motions at the ſame time, the one with a certain velocity that will carry it according to the direction of the line AB, the length AB in a certain ſpace of time, the other according to the direction of the line AD, with a velocity that will carry it to the diſtance AD in the ſame time, then the body will deſcribe the diagonal AC, and at the end of that time will be found in the point C.

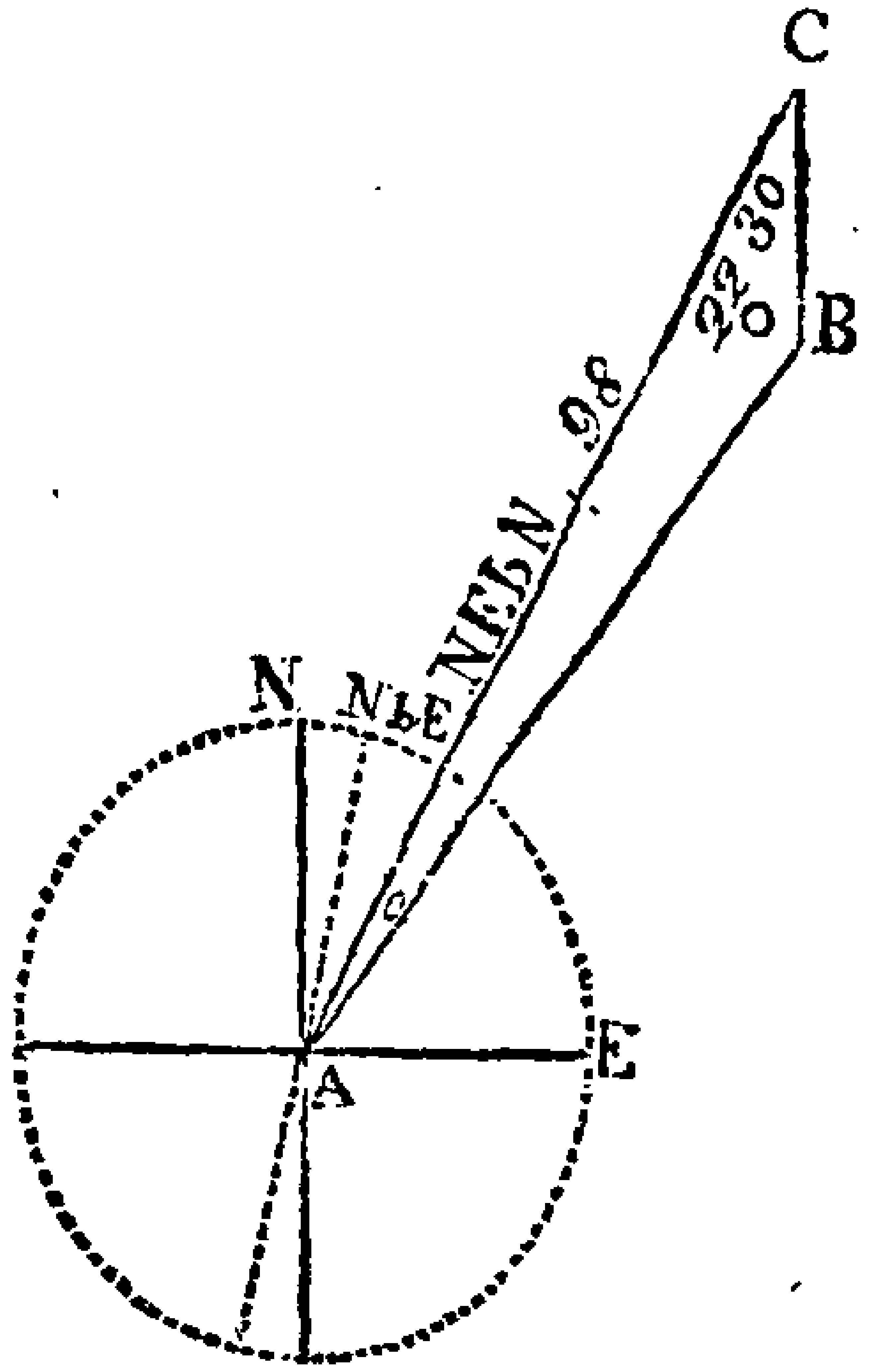
The ſetting and drifts of the moſt remarkable tides and currents are pretty well known, but if in unknown currents, the uſual way to find the ſetting and drift is thus:

Let three or four men take a boat a little way from the ſhip, and by a rope faſtened to the boat's ſtern, let down an heavy iron pot, or loaded kettle, into the ſea, to the depth of 80 or 100 fathoms when it can be, whereby the boat will ride almoſt as ſteady as at anchor, then heave the log, and the number of knots run out in half a minute will give the miles which the current runs per hour, and the bearing of the log ſhews the ſetting of the current.

EXAMPLE I.

If a ſhip ſails 98 miles N. E. by N. in a current that ſets S. by W. 27 miles in the ſame time. What is her true courſe and diſtance?

CALCULA-



CALCULATION.

The opposite point to S. by W. is N. by E. which taken from N. E. by N. leaves 2 points = 22° 30' between them: for the < C being thus given in the △ A C B together with the two sides including it, viz. AC, CB to find <s C A B and A B C, and distance A B by Axiom III.

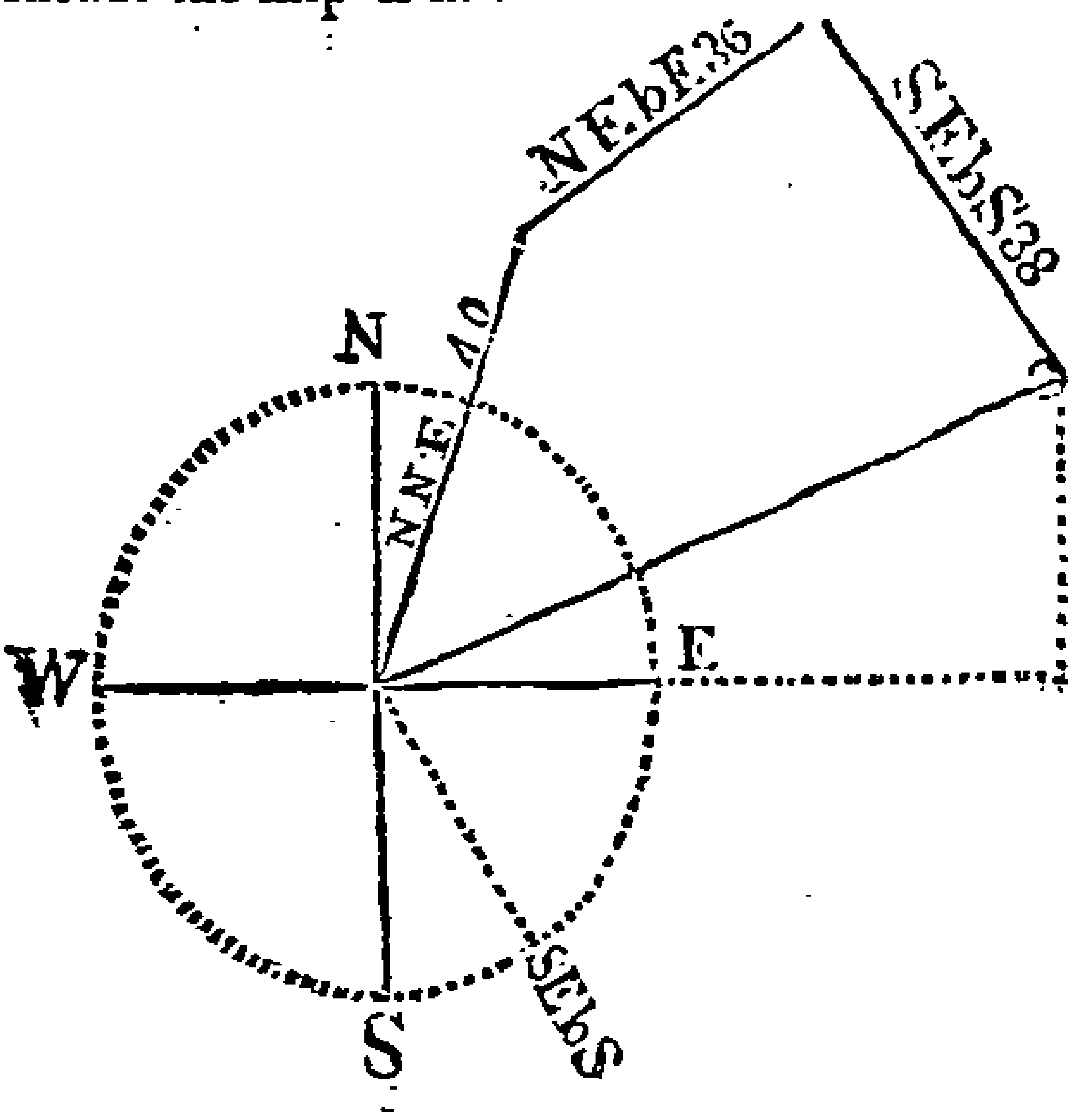
98 } 27 } 125	As sum of the sides	125		2.09691
Diff. 71	Is to their difference	71		1.85126
	So is tang. ½ sum opp. <s	78°	45'	10.70134
180°				
22 30'				12.55260
				2.09691
2)157 30				
	To tang. ½ their difference	70	42	10.45569
78 45				
	< B =	149	27	
	< A =	8	3	
	< C =	22	30	
	Sum of <'s	180	0	

To find the Distance by Axiom I.

As sine < A	8° 3'	=	9.14624
Is to CB	27 miles		1.43136
So is sine < C	22 30		9.58284
			11.01420
			9.14624
To distance AB	73,78		1.86796

EXAMPLE II.

If a ſhip from the latitude 38° 40′ ſails N. N. E. 40, then N. E. by E. 36 miles, in a current that ſets S. E. by S. 38 miles, in the ſame time that the ſhip ſails 40 miles; I demand the diſtance from her firſt place, and alſo the latitude the ſhip is in?



CONSTRUCTION.

Having drawn the compaſs, draw the N. N. E. courſe equal to 40 miles, to the end of which join the N. E. by E. line, and ſet off thereon 36 from the ſame ſcale, from the end of the laſt N. E. by E. line ſet off the diſtance of the current's drift, viz. S. E. by S. 38 miles, that is, as 40, the run of the ſhip, is to 20 the run of the current, ſo is 76 the whole run of the ſhip to 38 the drift of the current, then from the end of that line to the ſhip's firſt place, will be the diſtance, and the < being meaſured will be the ſhip's courſe, and a line let fall from this laſt point on the parallel of the ſhip's firſt place, will give on that parallel the departure from her firſt meridian.

This may be done by calculation; but that being tedious we ſhall omit it, and ſhew how it may be done by a traverſe, in which we ſhall conſider the current as a ſingle courſe.

Courſes	Miles.	Northing	Southing.	Eaſting.	Weſting.
N. N. E.	40	37.0		15.3	
N. E. by E.	36	20.0		29.9	
S. E. by S.	38		31.6	21.1	
		57.0	31.6	66.3	
		31.6			
		25.4			

As diff. lat.	25.4 miles	1.40483
Is to radius		10.00000
So is departure	66.3 miles	1.82151
To tang. course 69° 3' from N. Easterly or nearly E. N. E. ¼ E.		10.41668

As sine of course 69° 3'	9.97030
Is to dep. 66,3 miles	1.82151
So is radius	10
To distance 70 miles	1.85121

The Manner of Surveying Coasts and Harbours.

HAVING, in the former part of this work, treated on those branches of knowledge which ought to be acquired by every one who undertakes the conducting of ships to remote parts; I think it incumbent on me to give some directions concerning another branch, which, though of great importance, seems to be too much neglected; namely, the drawing of Drafts or Charts of the several Coasts along which they sail, and also of those Harbours into which they go. I shall now proceed to shew the reader how the business of taking the bearing of any part of a coast, and of plotting or delineating it may be performed.

1. Bring the ship to the most convenient place from whence you can see the most distinguished points of land, and the most remarkable objects on shore, and note their bearings down in your station book, as also keep a rough draft on a sheet of paper, note thereon the station 1.

2. Bring the ship to the most convenient station or spot you find, and take the bearings of the most remarkable points and spots you before observed when at first station, and obtain if you can the distance of your vessel, from your first station, from the bearings and distance of some noted points on shore, it will be preferable; but if you have no distances on shore of object, from one another, you must, in this case, obtain it carefully by your log; also note these bearings down in your rough draft as well as in your book, making a base line to represent the bearing of your ship at her first station, and placing from some scale thereon the distance and bearing of your former station, which will be station 2, from whence draw the last mentioned bearings, and note their intersections with the same objects before seen; a line drawn through all these intersections, making it resemble as much as you can all the turnings and windings of the land you see, carrying your eye from point to point on shore, and making the same wavings or windings in your draft.

3. Note particularly on shore such remarkable objects that lie in one line, for objects that are in leading marks, as houses, churches, steeples, mountains, &c.

As alſo ſuch particular objects as open from one another, one, two, or three points or more, it will aſſiſt to correct thereby.

4. If you can from a third ſtation take in like manner the bearing and diſtance of your former two ſtations, and alſo of all the former objects, you will from thence be able to detect if any error ſhould have been committed; each ſtation ſhould be if poſſible in the bearing of two remarkable ſpots in one, what opening theſe make with one another at 3d. ſtation, will determine.

To take a Draft of a Coaſt in ſailing along Shore.

HAVING brought the ſhip to the moſt convenient place from whence the principal points of the Coaſt or Bay may be ſeen, either caſt anchor if it is convenient, or lie as ſteady as poſſible; or, if the coaſt is too ſhoal, let the obſervations and meaſures be done in a boat; then, while the veſſel is in a ſtationary ſituation, take with the azimuth compaſs, or ſextant, the bearings in degrees, &c. of ſuch points of the coaſt as form the moſt material projections or hollows; write down theſe bearings, and make a rough ſketch of the coaſt, obſerving carefully to mark the points whoſe bearings were taken with letters, for the ſake of reference.

Then let the ſhip or boat run in a direct line along, which muſt be carefully meaſured by the log, or otherwiſe, one, two, or three miles, more or leſs, until ſhe comes to a ſituation from whence the ſame points before obſerved can be ſeen again: there let the veſſel lie as in the foregoing ſtation, and again obſerve the reſpective bearings and leading-marks where two points or bearings, as mountains, churches, trees and houſes, any two remarkable objects in one, in degrees, &c. of the ſame noted points, which are alſo to be wrote down, and a rough ſketch of the coaſt ſhould be alſo taken from this ſtation, for which purpoſe prepare an obſervation table, in which write diſtinctly and regularly the ſeveral celeſtial obſervations, bearings, diſtances, meaſured by the log-line, the rocks, ſhoals, ſoundings, overfalls, races of tides, and other remarks that may be made along the coaſt; the table may conſiſt of ſeven or eight columns diſpoſed in the following order:

NOTE.—The ſextant will be found the readieſt and moſt correct inſtrument to take the angles, by being held in an horizontal poſition, by which means any two objects not exceeding 120° may be brought into contact; it will not be amiſs to take material points by the compaſs, and intermediate ones by the ſextant or quadrant.

Obſervations

Obſervations in Navigating the Coaſt———, from Cape——— to Point———, being —— Miles, meaſured by the Log, the Courſe from Station I. to II. being S. $\frac{1}{4}$ W.

Remarks on the Tides and the Nature and Dimenſions of Rocks. Shoals and Anchorage.	Bearings of Rocks. Shoals, and theſe eſtimated diſtances. when on a line with the Points or Heads of the Coaſts.	Bearings and Diſtances taken at these Diſtances.	Time and Diſtance ſailed from Station I.	Bearings at Station I.	Meridian Altitude of ☉	Year, Month, and Day.
	Points & Heads. M.	Fath.	H. M. Mi.		D. M.	
This rock is dry at low water, and ſeemed 100 yards in length, from N. W. to S. W. a leading Mark to it is.—		A.N.5° W. 22 B.W.20°S.	1 27 $\frac{3}{4}$ 11 45 5			

In like manner proceed to the ſecond Station, and ſo on, until the whole Survey is completed.

While the veſſel is running the baſe line from ſtation to ſtation, an accurate appearance of the coaſt ſhould be made, to do which let four expert perſons be appointed, one to take the bearing exactly with an azimuth compaſs; one to overſee the running out of the log-line, and to keep an account of the ſhip's way, ſo as to be readily able to tell the diſtance run when required; the third to attend the heaving of the lead, to write down the ſoundings and bearings of one or two head points, or remarkable points of the coaſt, taking at each depth; the fourth a draftſman, to draw out the neceſſary bearings and diſtances, and delineate the figures and windings

of

of the coast at each station, and to correct their forms and dimensions when the ship is sailing along the land. Then let the several bearings be corrected by the variation to reduce them to their true positions; then in some convenient part of a sheet of paper, describe a circle, the larger the better, on which lay off the several bearings taken from the first station, and let them be numbered 1, 2, 3, &c. on the outside of the circle; also lay down the several bearings taken at the 2d. station, let these be numbered with the same figures on the inside of the circle.

Draw a line to express the ship's run, both in length and course, and from the end of the line, expressing the first station, draw lines parallel to the respective bearings taken at that end, and note it in the circle; mark the intersection of each pair of lines, directed to the same point with the numbers annexed to their bearings; and through the intersection so marked, draw by hand a curved line; observe to wave the line in and out, as near as can be like the bending of the coast itself.

Against each part draw the appearance of the elevated, or low ground, in the sketches, distinguishing rocks, cliffs, or high lands, low lands, sand hills, &c. If there are any currents, or eddies, express them in their proper places by darts or arrows, the points being turned that way the currents set; put in the several soundings at low water, in small figures, distinguishing whether fathoms, or feet; shew the time of high water on the full and change days, by Roman figures, and tell the rise in feet, put in a compass, with a scale of miles or leagues, such as the vessel's run was laid down by; add the name of the place, the coast, and the latitude and longitude, as true as can be obtained.

If there is a shoal or sand on the coast, let it be taken by a boat sailing round it, and keeping an account of the courses, distances and soundings, to be put in the draft; the boat must, from some part of the sand or shoal, take the bearings of two points on the coast, where bearings have been taken from the ship, or the bearing of the boat or some part of the shoal, or some beacon in that place must be taken by the ship, at the stations where she takes the bearings of the shore; for by either of these means one point of the sand being obtained, the rest of it can be laid down from the boat's account.

If the coast to be drawn is a bay or harbour winding in such a manner, that all its parts cannot be seen at two stations; let as many bases or lines be drawn and exactly measured, as may be found necessary, observing that the several distances run should join to one another, in the nature of a traverse; that each new set of objects, or points observed, should be taken from two stations at the end of a known distance, and that the objects whose bearings are taken do not so much extend beyond the limits of the base, as to make angles with it less than about $\frac{1}{2}$ or $\frac{3}{4}$ of a point, but rather reserve such objects for the next measured base line; for when lines lie very obliquely to one another their intersections are not easily ascertained.

Thus may a coast of any extent be surveyed, by carefully measuring of stationary base lines, and from their ends drawing angles to each other.

If any particular parts of the harbour cannot be conveniently seen from either station, take the boat into those places, and having well examined them, make sketches thereof, estimating the length and breadth of the several inlets, either by the rowing or sailing of the boat; take as many bearings,

bearings, soundings, and other notes as may be thought necessary; then annex these particular views in their proper places in the general draft.

If there are any dangerous sands or rocks, besides inserting them in their proper places, there should be a double line drawn through that point, on one or more objects ashore; and for this purpose choose a church, mill, house, noted tree, a clift, or any remarkable thing that can be distinctly seen at sea, and which can be brought to bear in the same right line with the point to be avoided; but if that point is under water, there must be two land marks brought to bear with the danger, either in a right line, when it can be, or in two lines, and those two lines, and those land marks may be put down in their proper places, by their intersection of two objects in one bearing, and two objects in another bearing; which will give the station of the ship, and the distance and the bearing of the danger from that station noted, when near or on it; but if two such intersections cannot be obtained, it must be put down from the two points on shore, in one with the computed distance therefrom, or from the intersection bearings of two single points on shore.

It should be remarked in the draft, what places, if any, are unfit for anchorage, and what are fit, by writing rocky ground, foul anchorage, good anchorage; and in the latter, to draw the figure of an anchor. Also if there is any particular channel more convenient to sail through than another, it is to be pointed out by lines drawn to its entrance, from two or more noted marks on shore.

The foregoing method of surveying a coast supposes in general, that it is taken by a ship in her passage along, not having an opportunity of going ashore.—But when circumstances will permit the measures and observations to be made on land, the survey can be more accurately taken than on the water.

To Survey an Harbour by Observation Ashore.

MAKE an eye-draft of the place to be surveyed; and in going round its coast, fix in the most remarkable points and bends of the shore station staves, or straight poles, tall enough to be seen at a considerable distance: but if at any of those places there is a noted tree, house, or any other remarkable thing, that object may serve instead of a station staff; and it will be convenient to black the staves, and tie a piece of white bunting to the top of each; then in the eye-draft put letters at the noted points, or marks, for distinction sake.

Choose the most level spot of ground, wherein a base line may be measured, of one or more half miles in length, or a length of not less than a tenth part of the distance of the two extreme objects marked for observing, and let the direction of the measured base line be so laid out, that from both ends of it as many of the station staves before planted, or the objects before remarked, may be seen; the bearing or position of this base must be determined by degrees and minutes, and also its length must be accurately measured to feet and parts, either by a measuring chain, or by a piece of log-line of 100 feet long, properly marked at the end of every 10 feet.

From one end of the base observe, with any instrument proper to take bearings, the position or bearing in degrees and minutes, of all the staves

on

or objects within view, and write them down orderly; do the same from the end of the base, and let all the bearings be corrected by the variation of the compass.

Then these measures and corrected bearings being plotted or laid down, will give the most conspicuous points on shore, the intermediate spaces are to be filled up from the sketches of them made on the spot.

But if any such objects should spread on either hand, so far from beyond the limits of the base, that at either end thereof, the other end and those objects or staves should appear nearly in the same direction, or to make ∠s of, not exceeding 10°: or, if some of the remarked objects can be seen only from one end of the base, then let the bearings of such objects be taken from a place whose position has been determined from both ends of the measured base; or, if there are several remarked objects which cannot be seen from neither end of the base lines, let the bearings of such objects be taken from each of the two points whose position has been taken from both ends of the base, or it may on some occasions be proper to choose another place on which another base of a convenient length may be measured, and from the extremities of which the ends of the first base may be seen, and also as many as can be of the remaining objects which lay too obliquely for the first base, or which could not be seen from it; in such manner proceed until the bearings are taken of all the points judged necessary for completing the survey of the limits of the harbour.

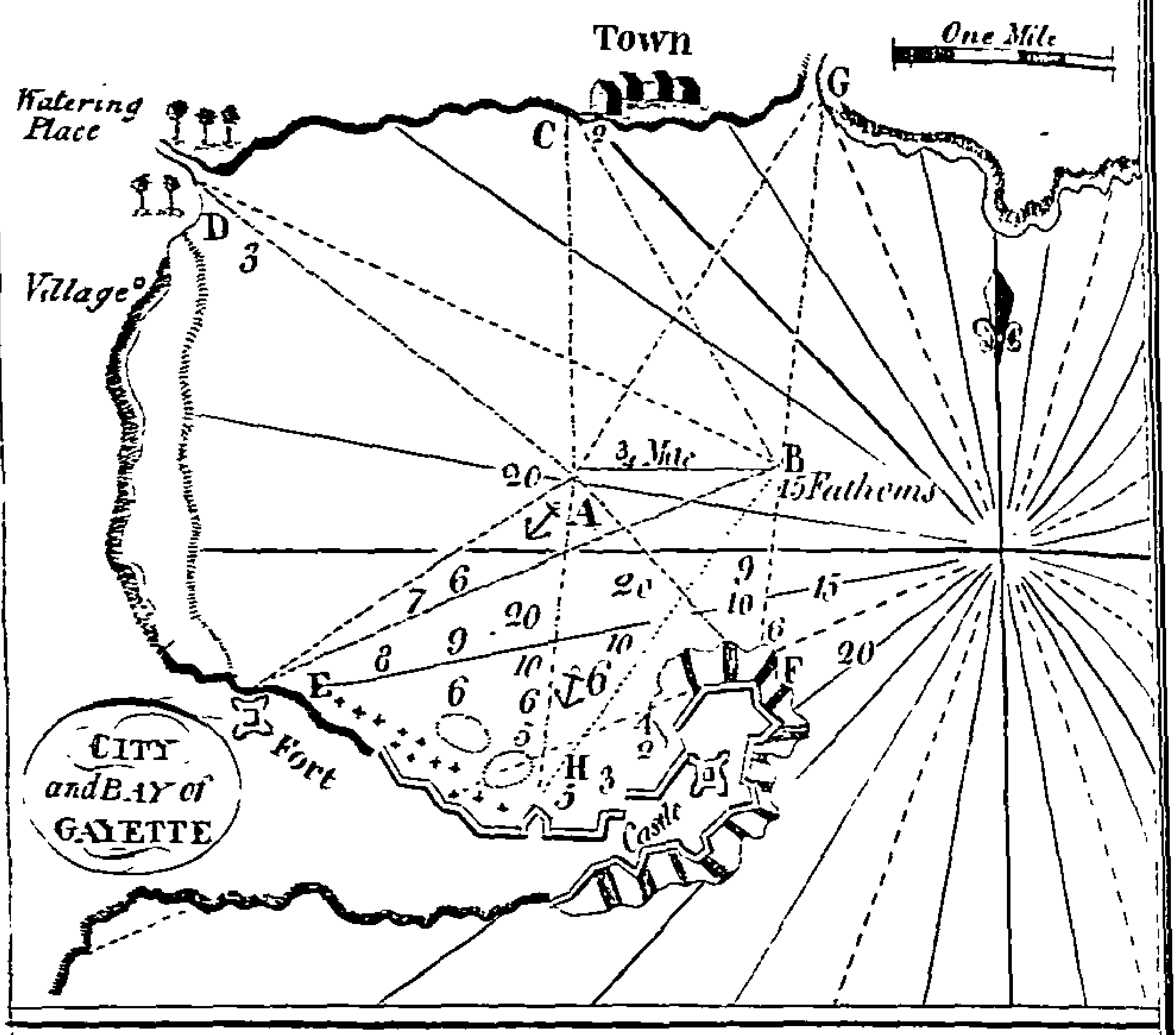
If a base line of a sufficient length cannot be measured in one right line, it may be taken in two adjoining lines, as the two sides of a triangle, the included angle being accurately taken, and the bearing of either line.

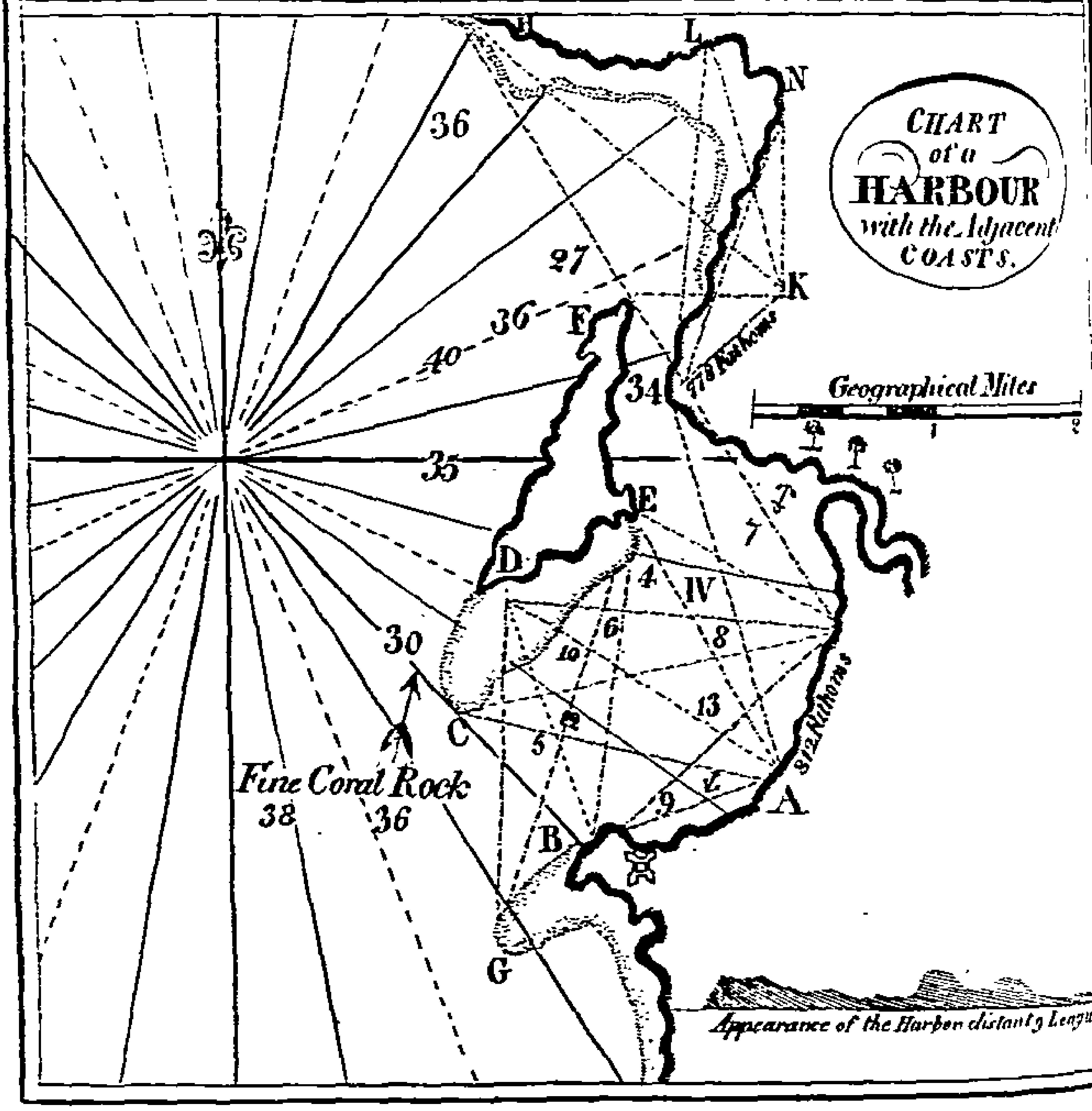
When the outlines or limits of an harbour, bay, road, &c. are delineated by the preceding precepts, let a small vessel go out to sea to take drawings of the appearance of the land, and its bearings, sail likewise into the harbour, and draw the appearance of its entrance, take particular notice if there are any false resemblance of the entrance by which ships may be deceived and run into danger; or when any two objects being brought in a line, or in one, will lead into the harbour without danger; when it can be done, search for the best anchoring places, and if possible denote those places, by bringing two objects in one, if not the exact bearings of two or three other objects, so that the places may be easily determined, the chart being correctly drawn, a compass, with the variation, and scale properly fitted to the plan, the isles, rocks, sands, &c. marked in their proper places, with their soundings at low water, and the winds open to them, the best track with the soundings all the way to those anchoring places, the proper sailing marks to avoid dangers; the winds, if any troublesome ones, which prevail, and at what seasons; the places where fresh water can be got, the name of the place, the country in, on what sea, the latitude and longitude, a sketch of the appearance the place makes at sea upon a known rhumb, and at an estimated distance, and whatever else a judicious seaman shall think proper to insert; then is the plan fit for all nautical purposes, and may be embellished with proper colours, if necessary.

Sea drawings, taken according to the foregoing precepts, besides the real use they are of, cannot fail to recommend the young mariner, who surveys and constructs them, to the notice of his Superiors.

To

SURVEYING.





Newburyport, Published by Edmund M. Blunt.

To reduce a Draft to a smaller Scale.

WITH a black lead pencil draw the draft to be reduced all over with cross lines, forming exact squares, draw the clean paper for the copy all over with the same number of squares, but their sides larger or smaller in proportion to the intended size of the scale, such as $\frac{1}{2}$, $\frac{1}{4}$, &c. length of the other, distinguish by a stronger mark, with a figure every fifth or sixth row of squares in both, so that the several corresponding squares may be readily perceived, then, in each of the squares of the draft, draw, by the eye, a curve on the paper, similar to that in the square of your copying draft, till the whole is copied, make the black lines with India or other ink, and when drawn, the black-lead lines may be rubbed out with bread or India rubber.

I here give two Examples as an elucidation of what has last been said.

EXAMPLE I.

AB is the Base Line, equal to $\frac{3}{4}$ Mile.

BG=N. 5° E.	1	Station at B, with Bearings.	AG=N. E. by N.	1	Station at A, with Bearings.
BC=N. 25 W.	2		AC=N.	2	
BD=N. 53 W.	3		AD=S. by W.	3	
BE=W. S. W.	4		AE=S. W. by W.	4	
BH=S.W.byS.$\frac{1}{2}$W.	5		AH=S. $\frac{1}{2}$ W.	5	
BF=S.	6		AF=S.E.	6	

These instruments give the points GC DE HF in order from each station; that is, BG and AG intersects, as also BC and AC, &c.

Observe, the last letter must be the same in both bearings, and it will be the best to follow the bearings one way all round the compass from the first station; as also when arrived at the second station, begin with your first object seen at first station, and follow the letters round belonging to each object, by which the last letter in each bearing will successively follow in order.

This is an example when on board ship, but in the following

EXAMPLE II.

This harbour was surveyed by base lines taken on shore, which, when it can be done, is far preferable.

The base line AB 812 fathoms was taken, as by directions on the most even spot on shore; now, beginning from the point A:

AB=W. by S. $\frac{1}{2}$ S.	Bearings from Station A.	GB=S. S. W.	Bearings from Station G.
AC=W. by N.		GC=W. by S. $\frac{1}{4}$ S.	
AD=W.N.W.$\frac{3}{4}$N.		GD=W. $\frac{3}{4}$ N.	
AE=N.N.W.$\frac{3}{4}$W.		GE=W.N. W. $\frac{1}{4}$ N.	
AF=N.byW.$\frac{1}{2}$W.		GF=N.W.byN.$\frac{1}{4}$N.	
AG=N. N. E.	812 fathoms.		

Bearings from Station F.	Bearings from Station K.
FE and FH=N.W.byN.$\frac{1}{4}$N.in one.	KF=S.W.$\frac{1}{4}$W.
FI=N.$\frac{1}{4}$E.	KE=W.$\frac{1}{2}$S.
FK=N.E.$\frac{3}{4}$ E. 773 fathom.	KH=N.W.$\frac{3}{4}$N.
	KT=N.byW.$\frac{1}{2}$W.
	NN=N.$\frac{1}{4}$E.

Through

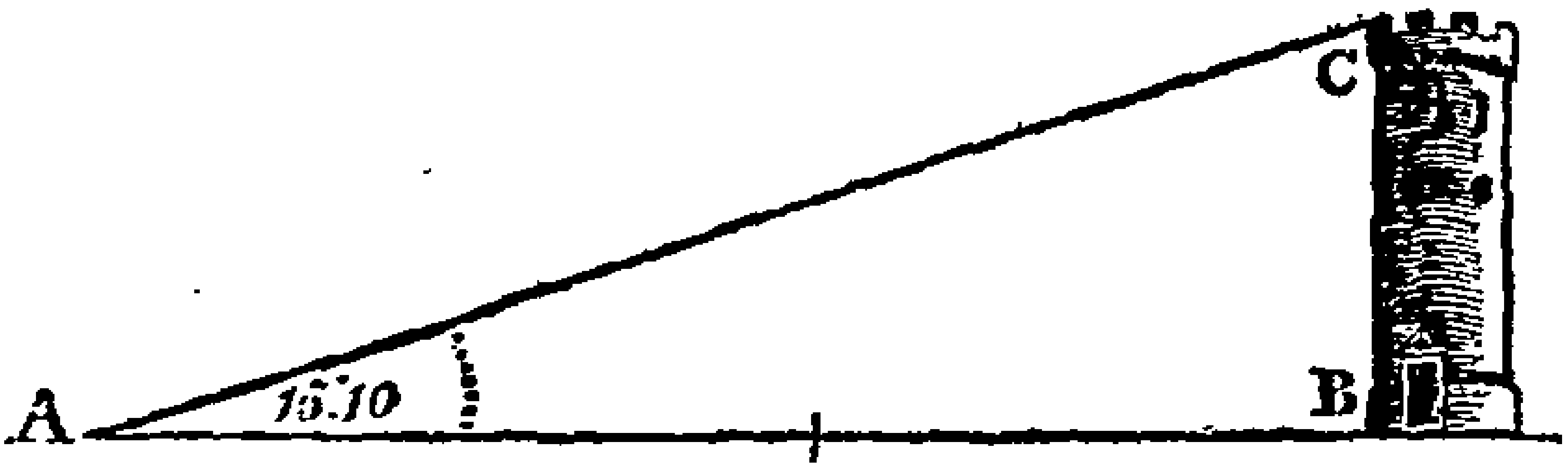
Through the interſections of the bearing draw the configuration of the land, as before directed, and finiſh the drawing by the inſtructions there given, which, if well heeded, no difficulty will materially occur.

To find the Height and Diſtances of Objects at Sea.

WHEN the object is perpendicular, and the diſtance to it can be meaſured, find the angle of latitude with a quadrant, and meaſure the diſtance to it as exact as poſſible, and then you have the <s and baſe, to find the perpendicular; or, if you go backward or forward until the angle of altitude be 45°, the diſtance between you and the object will be the perpendicular height.

EXAMPLE I.

Being 96 fathoms from the bottom of a tower, I find its altitude, after allowing for the height of my eye, above the water 50° 10'. Required the height?

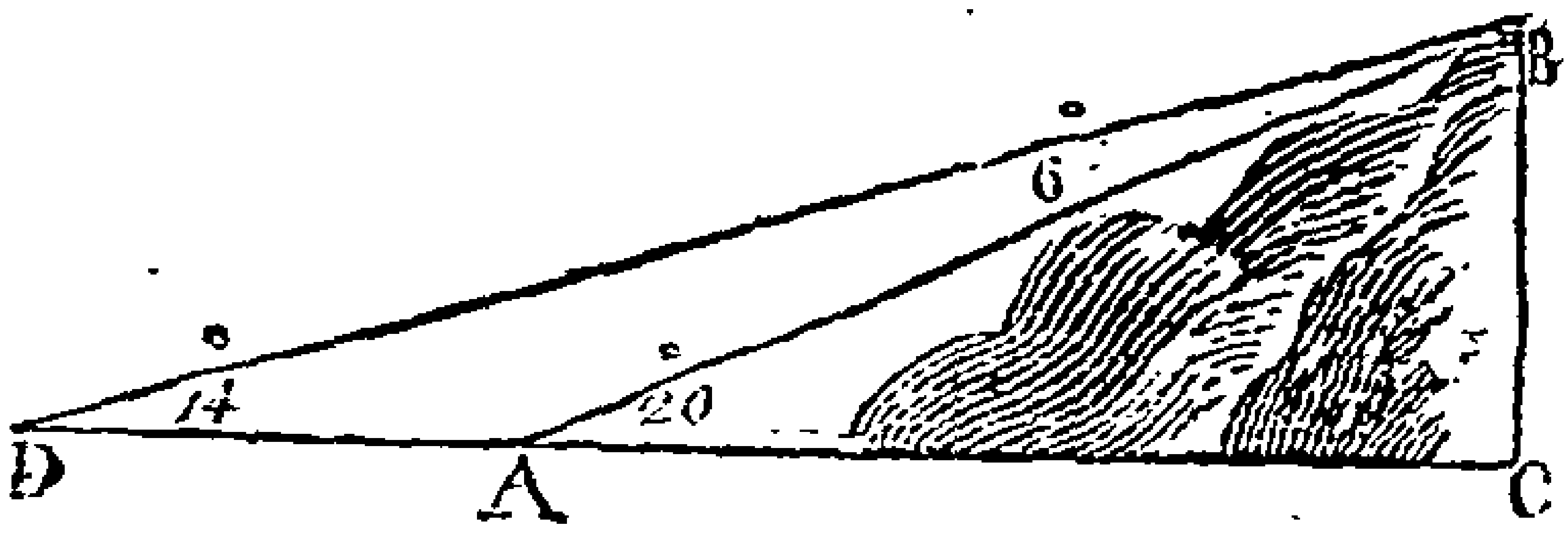


Draw A B = 96, upon B erect the perpendicular B C; and draw A C, making an angle with A B = 15° 10' till it cuts B C in C, then will B C be the height of the tower.

As radius 90° 00'	10.00000
Is to the diſtance 96 fathoms	1.98[illegible]7
So is tang. ang. A. 15° 10'	9.[illegible]
To the height B C 26.2	1.41535

EXAMPLE II.

Being at ſea, I obſerved the altitude of a mountain, and found it 20°, and then ſailing from it in a direct line four miles, I found the altitude of the mountain to be 14°, dip and refraction allowed for. I require the perpendicular height?



CONSTRUCTION.

CONSTRUCTION.

Draw the horizontal line DC

On any point A make the ∠BAC=20°, from A fet off 4 miles to D, on D make the ∠BDC=14°, and from where the line DB cuts the line AB as at B, let fall the perpendicular BC on the bafe DC, and DC meafured will be the perpendicular height required.

∠A=160°
∠D=14°

Sum 174° which taken from 180° gives the ∠DBA=6°. Then it will be

As fine∠DBA=6°	9.01923
: BD=4 miles	0.60206
: : Sine∠BDA 14°	9.38363
	9.98574
	9.01923
: AB=9.258	=0.96651

Then △ ABC given AB = 9,258 and ∠A find BC.

Radius		10.00000
: AB	9.258	0.96651
: : Sine∠20		9.53405
: BC = 3.166		0.50056

So that the height of the mountain is 3 miles $\frac{166}{1000}$ = 1 furlong, 13 poles, &c.

NOTE. In finding the ∠ DAB fee Prob. 5th in Geometry, (page 18.)

Of the Curvature of the Earth.

MOST perfons know, that if they are raifed above the furface of the adjacent land or water, they can not only fee different objects that lie on that furface better, but alfo fee thofe more and more remote as they advance higher. The irregularity of the furface of the land will not be fubjected to any one rule that will give the diftance to which objects may be feen at different elevations; but at fea, where there is generally an uniform curvature of the water, upon the fuppofition of the fpherical form of the earth, thofe diftances may be eafily computed.

RULE.

To the earth's femidiameter add the height of the eye, multiply the fum by the height, then the fquare root of the product is the diftance at which an object on the furface of the water can be feen by an eye fo elevated; and by this rule was table XVII. computed, the diameter of the earth being taken at 41798117 feet, according to Sir Ifaac Newton's meafures. This table may be ufefully applied to eftimate the diftance of an object at fea, the elevation of that object above its horizon being known.

EXAMPLE I.

Sailing towards a head-land, on which is a light-houfe elevated 600 feet above the furface of the water, we faw the lights at night juft appear in the horizon; how far were we at that time diftant from that light-houfe?

Look in table XVII. for 600 feet in the column marked height in feet, and right against it, in the column marked distance in miles, is 29.994. So that the distance may be reckoned about 30 miles.

EXAMPLE II.

Being in company with some merchants walking on a sandy shore, on the look-out for a vessel which was expected, whose top-gallant-mast was 140 feet above the surface, allowance being made for her immersion in the water, we observed through the telescope a ship's vane just appearing in the horizon. How far off is that ship, supposing it the vessel expected? Answer, against 140 feet, the height, stands 14.488, that is her distance; here is no allowance made for the heighth of the eye above the horizon; but it is obvious, that the higher the eye, the farther it can see: now as objects are seen in a straight line, and that line is a tangent to the earth's surface, therefore it follows, that to find the distance of two elevated objects, when the right line joining them touches the surface of the earth, between those objects look for the distance answering each height, and their sum is the distance required.

Thus, in the second example, suppose the eye raised six feet above the water's edge, it can see an object on the surface 2.999, or 3 miles off. This distance added to $14\frac{1}{2}$ miles, makes the distance of the ship to be $17\frac{1}{2}$ miles.

EXAMPLE III.

A man being on the main-top-gallant-mast of a man of war 200 feet above the water, sees an 100 gun ship she had engaged the day before hull-to; how far were those ships distant from one another?

A ship of 100 guns, or a first rate man of war, is above 60 feet from the keel to the rails, from which deduct about 20, leaves 40 for the height of her quarter-deck above water. Now a ship is seen to hull-to when her upper works just appear.

Then 200 feet high gives	17.316 miles.
And against 40 stands	7.744
	25.060 miles is her distance.

EXPLANATION

Face Page 283.

EXPLANATION of the PLATE describing the RIGGING, &c. of a FIRST-RATE SHIP of WAR.

1 BOWSPRIT
2 Yard and sail
3 Gammoning
4 Horse
5 Bobstay
6 Spritsail sheets
7 Pendants
8 Braces and pendants
9 Halyards
10 Liffts
11 Clewlines
12 Spritsail horses
13 Buntlines
14 Standing liffts
15 Spritsail tops
16 Flying jibboom
17 Flying jib, stay, and sails
18 Halyards
19 Sheets
20 Horses
21 SPRITSAIL TOP MAST
22 Shrouds
23 Yard and sail
24 Sheets
25 Liffts
26 Braces and pendants
27 Cap
28 Jack-staff
29 Truck
30 Union Jack
31 FORE-MAST
32 Runner and tackle
33 Shrouds
34 Lanyards
35 Stay and lanyard
36 Preventer stay and lanyard
37 Woolding the mast
38 Yard and sail
39 Horses
40 Top
41 Crowfoot
42 Jeers
43 Yard-tackles
44 Liffts
45 Braces and pendants
46 Sheets
47 Fore tacks
48 Bowlines and bridles
49 Fore buntlines
50 Fore leechlines
51 Fore top-rope
52 Puttock shrouds
53 FORE TOP-MAST
54 Shrouds and lanyards
55 Yard and sail
56 Stay and sail
57 Runner
58 Backstays
59 Halyards
60 Liffts
61 Braces and pendants
62 Horses
63 Clewlines
64 Bowlines and bridles
65 Reef-tackles
66 Sheets
67 Buntlines
68 Crosstrees
69 Cap
70 FORETOP GAL. MAST
71 Shrouds and lanyards
72 Yard and Sail
73 Backstays
74 Stay
75 Liffts
76 Clewlines
77 Braces and Pendants
78 Bowlines and bridles
79 Flag-staff
80 Truck
81 Flag-staff stay
82 Burgee
83 MAIN-MAST
84 Shrouds
85 Lanyards
86 Runner and tackle
87 Pendant of the gornet
88 Guy of ditto
89 Fall of ditto
90 Stay
91 Preventer stay
92 Stay-tackle
93 Woolding the mast
94 Jeers
95 Yard tackles
96 Liffts
97 Braces and Pendants
98 Horses
99 Sheets
100 Tacks
101 Bowlines and bridles
102 Crowfoot
103 Top-rope
104 Top
105 Buntlines
106 Leechlines
107 Yard and sail
108 MAIN TOP-MAST
109 Shrouds and lanyards
110 Yard and sail
111 Puttock shrouds
112 Backstays
113 Stay
114 Staysail & stay & halyard
115 Runners
116 Halyards
117 Liffts
118 Clewlines
119 Braces and pendants
120 Horses
121 Sheets
122 Bowlines and bridles
123 Buntlines
124 Reef-tackles
125 Crosstrees
126 Caps
127 MAINTOP G.-MAST.
128 Shrouds and halyards
129 Yard and sail
130 Backstays
131 Stay
132 Staysail and halyards
133 Liffts
134 Braces and pendants
135 Bowlines and bridles
136 Clewlines
137 Flag-staff
138 Truck
139 Flag-staff stay
140 American standard
141 MIZEN MAST
142 Shrouds and lanyards
143 Pendants and burtons
144 Yard and sail
145 Crowfoot
146 Sheet
147 Pendant lines
148 Peekbrails
149 Staysail
150 Stay
151 Derrick and span
152 Top
153 Cross-jack yard
154 Cross-jack lifts
155 Cross-jack braces
156 Cross-jack slings
157 MIZEN TOP-MAST
158 Shrouds and lanyards
159 Yard and sail
160 Backstays
161 Stay
162 Halyards
163 Liffts
164 Braces and pendant
165 Bowlines and bridles
166 Sheets
167 Clewlines
168 Staysail
169 Crosstrees
170 Cap
171 Flag-staff
172 Flag-staff stay
173 Truck
174 Union-Jack
175 Ensign staff
176 Truck
177 Ensign
178 Poop-ladder
179 Bower cable

HULL.

A Cat-head
B Fore channels
C Main channels
D Mizen channels
E Entering port
F Hause-holes
G Poop lanthorns
H Chesstrees
I Head
K Stern

[Though the following may be thought useless to Seamen, it may not be to many Teachers and Learners, as there are excellent mathematicians who, on account of their being far distant from any sea port, are at a Loss for the Terms made use of at Sea.]

AN EXPLANATION OF SEA TERMS.

AFT, or *Abaft*. The sternmost part of the ship: carry aft any thing; that is, carry towards the stern. The mast rakes aft, that is, hangs towards the stern. How chears fore and aft? That is, how fares all the ship's company?

Amain. The old term for yield, used by men of war to an enemy; but it now signifies any thing done suddenly, or at once, by a number of men.

Aloft. Over head, or above.

Anchor. The instrument by which a ship is held. The anchor is foul: that is, the cable has got about the fluke of the anchor. The anchor is a peek: that is, directly under the hawse-hole of the ship. The anchor is a cock-bill, that is, hangs up and down the ship's side.

Awning. A shelter or screen of canvas, spread over the decks of a ship to keep off the heat of the sun. Spread the awning, extend it so as to cover the deck. Furl the awning, that is, roll it up.

Aloof, is distance. Keep aloof, that is, keep at a distance.

Avast. A term used for stop, or stay; as, avast heaving, don't heave any more.

Athwart. Across.

Bale. Bale the boat; that is, to lade or throw the water out of her.

Ballast, is either pigs of iron, stones, or gravel, which last is called shingle ballast; and their use is to bring the ship down to her bearings in the water, which her provisions and stores will not do. Trim the ballast, that is, spread it about, and lay it even. The ballast shoots, that is, it shifts, or runs over from one side of the hold to the other.

Barge. A carvel-built boat, that rows with ten or twelve oars.

Bearing, signifies the point of the compass which any two or more places bear from each other, or how any place bears from the ship by the compass; or it may be said to bear on the beam, abaft the beam, on the bow, the head or stern, &c.

Bearings of a ship, is that line which is formed by the water upon her sides when she is at anchor, with her proportion of ballast, and stores on board. To bear to, is to sail into an harbour, &c. Bear round up; that is, put her right before the wind. Bring your guns to bear, is to point them to the object.

Bearing-up, or *Bearing-away*. The act of changing the course of a ship, in order to make her run before the wind, after she had sailed some time with a side wind, or close hauled: it is generally performed to arrive at some port under the lee, or to avoid some imminent danger occasioned by a violent storm, leak, or enemy in sight.—This phrase, which is absurd enough, seems to have been derived from the motion of the helm by which this effect is produced; as the helm is then borne up to the windward or weather side of the ship. Otherwise it is a direct contradiction in terms, to say that a ship bears up, when she goes before the wind; since the current of the wind as well as that of a river is always understood to determine the situation of objects or places within its limits. In the first sense we say, up to windward and down to leeward; as in the latter we say, up or down river. This expression, however, although extremely improper, is commonly adopted in the general instructions of our navy, printed by authority, instead of bearing down, or bearing away.

Belay. To make fast any running rope; as belay the main brace, or make it fast.

Bend. To apply to, and fasten; as, bend the sails, apply them to the yards, and fasten them; unbend the sails, that is, cast them off, and take them from the yards; her sails are unbent, she has none fixed; bend the cable, make it fast to the anchor.

Birth. A place; as the ship's birth, the place where she is moored; an officers birth, his place in the ship to eat or sleep in; birth the ship's company, that is, allot them their places to mess in; birth the hammocks, point out where each man's hammock is to hang.

Bight of a rope. Any part between the two ends. Bight, a narrow inlet of the sea.

Bilge. To break. The ship is bilged, that is, her planks are broken in by violence.

Binnacle. A kind of box to contain the compasses in upon deck.

Bitts. Very large pieces of timber in the fore part of a ship, round which the cables are fastened when the ship is at anchor. After bitts, a smaller kind of bitts upon the quarter deck, for belaying the running rigging to.

Bonnet of a sail. Is an additional piece of canvas put to the sail in moderate weather to hold more wind. Lace on the bonnet, that is, fasten it to the sail. Shake off the bonnet, take it off.

Board. To board a ship, is to enter it in a hostile manner.

Board and *Board*, is when two ships touch each other. To make a board, is making a stretch upon any tack, when a ship is working upon a wind. To board it up, that is to turn to windward. The ship has made a stern-board, that is, when she loses ground in working upon a wind.

Break-bulk. To open the hold and take goods thereout.

Batten. A thin piece of wood. Batten down the hatches, is to lay battens upon the tarpaulins, which are over the hatches in bad weather, nail them down that they may not be washed off.

Buoy. A floating conical cask, moored upon shoals, to shew where the danger is; also used to anchors to shew where they lie, in case of the cable breaking.

Block. A piece of wood with running sheaves or wheels in it, through which the running rigging is passed. to add to the purchase.

Braces. The ropes by which the yards are turned about to form the sails to the wind.

Bowsprit. A large mast or piece of timber which stands out from the bows of a ship.

Bulk-head. A partition.

Bolt-rope. The rope which goes round a sail, and to which the canvas is sewed.

Bow-lines. Lines made fast to the sides of the sails to haul them forward when upon a wind, which being hauled tort, enables the ship to come nearer to the wind.

Bunt-lines. Lines that come down from the top of the mast to the beam of the outside of the sail, and by which the bunt or belly of the sail is hauled up outwards.

Broach-to. Is when a ship on a sudden lays her broadside to the sea, and is dangerous in bad weather.

Chace. A pursuit. To chace, to pursue. The chace, the vessel pursued.

Careening. To bring a ship down on one side, so as to get at the other side to repair or clean it.

Caulking. Filling the seams of a ship with oakum.

Cun. To direct. To cun a ship, is to direct the man at the helm how to steer.

Course. The point of the compass upon which the ship sails. Courses, a ship's lower sails; as the fore-sail is the fore course, the main-sail the main course, &c. The ship is under her courses, that is, has no sail set but the main-sail, fore-sail, and mizen.

Coxswain. The person who steers the boat.

Come no near. Is said by the man at the cun when the ship is upon a wind, and is coming too near the wind.

Chains. A place built on the sides of the ship projecting out, and at which the shrouds are fastened, for the purpose of giving them a greater angle than they could have if fastened to the ship's side, and of course giving them greater power to secure the mast.

Chain-plates, are plates of iron fastened to the ship's sides under the chains, and to these plates the dead eyes are fastened by other plates.

Capstan. An instrument by which the anchor is weighed out of the ground, it being a great mechanical power, and is used for setting up the shrouds, and other work where great purchases are required.

Cat-heads. The timbers on ship's-bows with sheaves in them, by which the anchor is purchased from the hawse, and to which it is secured to the ship's side.

Cap-size. Overturn. The boat capsised, that is, overset. Capsise the quoil of rope, that is, turn it over.

Call. A silver pipe used by the boatswain and his mates when on duty.

Clew. To haul up the sails by the clew-lines.

Clew-lines, are ropes which come down from the mast to the lower corners of the sails, and by which the corners or clews of the sails are hauled up.

Crow-foot, is a number of small lines spread from the fore parts of the tops, by means of the piece of wood through which they pass, and being hauled tort upon the stays, they prevent the foot of the top sails catching under the top rim; they are also used to suspend the awnings.

Crank. The ship is crank, that is, she has not a sufficient cargo or ballast to render her capable of bearing sail, without being exposed to the danger of oversetting.

Dead-water. The eddie water at the stern of a ship.

Douce. To strike or haul down; as, douce the top-gallant sails, that is, lower them.

Dunnage. A quantity of loose wood, &c. laid at the bottom of a ship, to keep the goods from being damaged.

Dog-vane. A small vane with feathers and cork, and placed on the ship's quarter for the men at the cun and helm, to see the course of the wind by.

Dog-watch. The watches from four to six, and from six to eight in the evening.

Dispart. A piece of ordnance to find the difference of the diameters betwixt the breach and the mouth of the cannon.

Dead lights. A kind of window shutter for the windows in the stern of a ship, used in very bad weather only.

Dead-wind. The wind right againſt the ſhip, or blowing from the very point to which ſhe wants to go.
Dead eyes. Blocks of wood through which the lanyards of the ſhrowds are reeved.
Driver. A large ſail ſet upon the mizen yards in light winds.
Drive. The ſhip drives, that is, her anchor comes through the ground.
Down-hall. The rope by which any ſail is hauled down; as the jibb down haul.
Enſign. The flag worn at the ſtern of a ſhip.
Engagement. Action or fight.
Entering-port. A large port in the ſides of three-deckers leading into the middle deck, to ſave the trouble of going up the ſhip's ſide to get on board.
End for end A term uſed when a rope runs all out a block, and is unreeved; or in coming to an anchor, if the ſtoppers are not well put on, and the cable runs all out, it is ſaid to have gone out end for end.
Elbow, in the hawſe. Is when a ſhip being moored, has gone round upon the ſhifting of the tides, twice the wrong way, ſo as to lay the cables one over the other: having gone once wrong, ſhe makes a croſs in the hawſe, and going three times wrong, ſhe makes a round turn.
Fathom. A meaſure of ſix feet.
Fack, or Fake. One circle of any rope or cable quoiled.
Furl the ſail. Wrap it up cloſe and bind it upon the yard.
Fiſh. A large piece of wood. Fiſh the maſt, apply a large piece of wood to it to ſtrengthen it.
Flag. A general name for colours worn and uſed by ſhips of war.
Fall-off. To fall to leeward, or a-ſtern.
Foreward. To the fore part of the ſhip.
Forecaſtle. The upper deck in the fore part of the ſhip.
Freſhen the Ballaſt. Divide or ſeparate it.
Fid. A ſquare bar of wood or iron, with ſhoulders at one end; it is uſed to ſupport the weight of the top-maſt, when erected at the head of a lower-maſt.
Fid for ſplicing. A large piece of wood of a conical figure, uſed to extend the ſtrands and layers of cables in ſplicing.
Fore-reach. To ſhoot a-head, or go paſt another veſſel.
Fiſh-hook. A large hook by which the anchor is received from under the hawſe, and brought to the cat-head: and the tackle which is uſed for this purpoſe is called the fiſh-tackle.
Gage of the ſhip. Her depth of water, or what water ſhe draws.
Graving. To burn off the filth from her bottom.
Gripe of a ſhip. That thin part of her which is under counter; and to which the ſtern-poſt joins. The ſhip gripes, that is, turns her head too much to the wind.
Ground-tier. That is, the tier of water-caſks which is loweſt in the hold, and is among the ſhingle ballaſt.
Ground-tackle. Is cables, anchors, grapenels, hawſers, &c.
Grappling-iron. A thing in the nature of an anchor, with four or ſix flukes to it.
Gammon the bowſprit. Secure it by turns of a ſtrong rope paſſed round it, and into the cut-water, to prevent it from having too much motion.
Girt. The ſhip is girt with her cables when ſhe is too tight moored.
Gun-Room. A diviſion of the lower deck abaft, incloſed with net-work, for the uſe of the gunner and junior-lieutenant, and in which their cabbins ſtand.
Gunnel. The large timber that runs along upon the upper part of a ſhip's ſide.
Gaſket. The rope which is paſſed round the ſail to bind it to the yard when it is furled.
Grommet. A piece of rope laid into a circular form, and uſed for large boats, oars inſtead of row locks, and alſo for many other purpoſes.
Helm. The inſtrument by which the ſhip is ſteered, and includes both the wheel and the tiller, as one general term.
Hard-a-lee. That is, the tiller is quite down to leeward.
Hard-a-weather. Put the tiller quite up to windward.
Haul. Pull.
Heave the capſtan. That is, turn it round with the bars.
Heave handſomely. Heave gently or leiſurely.
Heave hearty. Heave ſtrong and quick.
Heave of the ſea, is the power that the ſwell of the ſea has upon a ſhip in driving her out, or faſter on, in her courſe, and for which allowance is made in the day's work.
Hail. To call to another ſhip.
Halyards. The ropes by which the ſails are hoiſted, as the top-ſail halyards, the jibb halyards, &c.
Hawſe-holes. The holes in the bows of the ſhip through which the cables paſs. Freſhen hawſe, veer out more cable. Clap a ſervice in the hawſe, put ſomewhat round the cable

at the hawse-hole to prevent its chafing. To clear hawse, is to untwist the cables where a ship is moored, and has got a foul hawse, Athwart hawse is to be across or before another ship's head.

Hawser. A small kind of cable.

Hitch. To make fast.

Hoist. To hawl, sway, or lift up.

Heel, or incline. She heels to port, that is, inclines or lays down upon her larboard or left side.

Hold, is the space between the lower deck and the bottom of a ship, and where her stores, &c. lie. To stow the hold, is to place the things in it.

Hull of the ship. The body of it. To lay a hull, is to lay to, with only a small sail in a gale of wind. To hull a vessel, is to fire a shot into any part of her hull.

Hull-down, is when a ship is so far off, that you can only see her masts.

Hulk. A ship without masts or rigging; also a vessel to remove masts into or out of ships by means of sheers, from whence they are called sheer hulks.

Jeer-blocks. The blocks through which jeers are reeved.

Jeers. The ropes by which the lower yards are suspended.

Jolly-boat. A small boat.

Jib. The foremost sail of a ship, set upon a boom which runs out from the bowsprit.

Jib-boom. A spar that runs out upon the bowsprit.

Junk. Old cable, or old rope.

Knot, signifies a mile.

Keel-haul. To drag a person backwards and forwards under a ship's keel for certain offences.

Knippers. A large kind of plated rope, which being twisted round the messenger and cable in weighing, bind them together.

Log, and *Log-line,* by which the ship's path is measured, and her rate of going ascertained. Log board, on which is marked the transactions of the ship, and from thence it is copied into the log-book every twelve hours.

Larboard. Left; as, larboard side, left side.

Labours. That is, the ship rolls and tumbles much.

Landfall. The discovery of the land.

Land-locked. Sheltered all round by the land, so that there is no view of the sea.

Lash. To bind.

Latch-by, signifies high enough, or lower.

Lee-ward. With the wind, or towards the point to which the wind blows.

Lee-shore, is that upon or against which the wind blows.

Luff, or *Loofe,* signifies come nearer to the wind, or bring the ship's head up more to windward.

List. Incline. The ship has a list to port, that is, she heels to the larboard.

Lanyards of the shrouds, are the small ropes at the ends of them, by which they are hove taught, or tight.

Lifts. The ropes which come to the ends of the yards from the mast-heads, and by which the yards are tossed up and down.

Mast. The upright timber or trees on which the yards and sails are set.

Mizen-mast. The mast which stands abaft, and from which its rigging and sails are named; as of the sails, mizen, mizen-top-sail, &c. and so also are the other sails, &c. named from the other masts.

Moor, is to secure a ship with two anchors.

Mend the service. Put on more service.

Mouse. A kind of ball or knob, wrought upon the collar of the stays.

Muster. To assemble.

Messenger. A small kind of cable, which being brought to the capstan, and the cable by which the ship rides made fast to it, it purchases the anchor.

Nun-buoy. The kind of buoys used by ships of war.

Neap-tides. The tides in the first and last quarter of the moon, and are not either so high, so low, or so rapid as spring tides. A ship is said to be beneaped, when she has not water enough to take her off the ground, or over the bar, &c.

Nothing-off. A term used by the man at the cun to the steersman, directing him not to go from the wind.

Narrows. A small passage between two lands.

Offing. To seaward from the land. A ship is in the offing, that is, she is to seaward, at a distance from the land She stands for the offing, that is, towards the sea.

Over-board. Out of the ship; as, he fell over-board, meaning, he fell out of, or from the ship.

On board. Within the ship; as, he is come on board.

Oakum. Old rope untwisted and pulled open.

Orlop. The deck on which the cables are stowed.

Over-haul. To clear away and disentangle any rope; also to come up with the chase; as, we over-haul her, that is, we gain ground of her.
Pay the seams. That is, to pour hot pitch and tar upon the seams after caulking:
Purchase. To purchase the anchor, is to loosen it out of the ground.
Peek. To ride a stay-peek, is when the cable and the fore-stay form a line. To ride a short peek, is when the cable is so much in as to destroy the line formed by the stay-peek. To ride with the yards a peek, is to have them topped up by contrary lifts, so as to represent St. Andrew's cross.
Ports. The holes in the ship's sides from which the gun's are fired.
Pudding and dolphin. A large and lesser pad made of ropes, and put round the masts under the lower yards.
Pay out the cable. That is shove it out at the hawse holes.
Pendant. The long narrow flag worn at the mast head by all ships of the navy. Brace pendants are those ropes which secure the brace-blocks to the yard arms, and are always double, in case of one being shot away, the other may secure the yards in its proper position.
Parcel a rope. Is to put a quantity of old canvas round it before the service is put on.
Parcel a seam. Is to lay a narrow piece of canvas over it after it is caulked, before it is payed.
Port. Used for larboard, or the left side; also a harbour or haven.
Points. A number of plaited ropes made fast to the sails for the purpose of reefing.
Quoil, is a rope or cable laid up round, one fake over another.
Quarters. The respective stations of the officers and people in time of action. Quartering, distributing the men into different places. Quarter-bill, the list of the ship's company, with their stations for action noticed.
Quarter-wind, is when the wind blows in abaft the main shrouds.
Reeve. To reeve a rope, is to put it through a block, and to unreeve it, is to take out of the block.
Rouse in the cable. Haul it in, and make it taught, or tight.
Reach of a river. The distance between any two points of land that lie in a right line from each other.
Ride at anchor, is when a ship is held by her anchors, and is not driven by wind or tide. To ride athwart, is to ride with the ship's side to the tide. To ride hawse fallen, is when the water breaks into the hawse in a rough sea.
Road. A place near the land where ships may anchor, but which is not sheltered.
Rounding. Old ropes fastened on the cable near the anchor to keep it from chafing.
Ratlines. The small ropes fastened to the shrouds, by which the men go aloft.
Rother, or *Rudder.* The machine by which the ship is steered.
Rullock. The nitch in a boat's side, in which the oars are used.
Strike. A term for yield, or surrender, used to an enemy.
Splice. To make two ends of ropes fast together by untwisting them, and then putting the strands of one piece with the strands of the other.
Serve. To wind something about a rope to prevent it from chafing or fretting. The service is the thing so wound about the rope.
Seize. To bind or make fast.
Scends, or *sends.* When the ship's head or stern falls deep in the trough of the sea.
Settle. To lower; as settle the top sail halyards, lower them.
Sound. To try the depth of water; also a deep bay.
Sheer. The sheer of the ship is the curve that is between the head and the stern, upon her side. The ship sheers about, that is, she goes in and out.
Sheers, are spars lashed together, and raised up for the purpose of getting out or in a mast.
Scud. To go right before the wind; and going in this direction without any sail set is called spooning.
Steeve. Turning up. The bowsprit steeves too much, that is, it is too upright.
Spring-tides, are the tides at new and full moon, which flow highest, and ebb lowest.
Spilling-lines, are ropes contrived to keep the sails from being blown away when they are clewed up, in blowing weather.
Starboard. The right side.
Star-fixes. are large pieces of timber which comes abaft the pump well.
Steering-line, is a line that goes round a small barrel, abaft the barrel of the wheel, and coming to the front beam of the poop deck, moves the tell-tale with the turning of the wheel, and keeps it always in such position, as to shew the position of the tiller.
Spear of the pump. The handle of an hand-pump.
Steady. A term used by the man at the cun to the steersman, when sailing before the wind, to keep her as she goes.
Sway-away. Hoist.

Stretch out. A term used to men in a boat when they should pull strong.
Swabb. A kind of large mop made of junk to clean a ship's deck with.
Sennit. A small platted rope, made from rope yarns.
Stem. She does not stem the tide; that is, she does not go through it, or cannot make head way against it, for want of wind.
Sued or Sewed. When a ship is on shore, and the water leaves her, she is said to be sued: if the water leaves her two feet, she sues, or is sued, two feet.
Stays. Large ropes coming from the mast heads down before the masts, to prevent them from springing, when the ship is sending deep.
Spring-stays, are rather smaller than the stays, and placed above them, and intended to answer the purpose of the stay if it should be shot away, &c.
Spring. To break; as, to spring a mast or yard, is to split or break it.
Shank-painter. The rope by which the shank of the anchor is held up to the ship's side; is also made fast to a piece of iron chain, in which the shank of the anchor lodges.
Stoppers. Large kind of ropes, which being fastened to the cable in different places abaft the bitts, are an additional security to the ship at anchor.
Tack. To go about.
Try-sail. A small sail used by cutters and brigs in blowing weather.
Tell-tale. An instrument which traverses upon an index in the front of the poop deck, to shew the position of the tiller.
Traverse. To go backwards and forwards.
Tiller. A large piece of wood, or beam, put into the head of the rudder, and by means of which the rudder is moved.
Tort, or *taut,* signifies tight.
Trice, trice up. To haul up and fasten.
Tarpaulin. A cloth of canvas covered with tar and saw-dust, or some other composition, so as to make it water proof.
Tide-gate. A place where the tide runs strong.
Tide it up. To go with the tide against the wind.
Tow. To drag. The ship tows her boats, that is, drags or draws them after her.
Truck. A round piece of wood put upon the top of flag-staves, with sheaves, on each side for the halyards of the flags to reeve in.
Tier. A row; as a tier of guns, a tier of casks, a tier of ships, &c.
Trunions of a gun, are the arms or pieces of iron by which it hangs on the carriage.
Tampions, or *Tomkins.* The bung, or piece of wood, by which the mouth of the cannon is filled to keep out wet.
Truck of a gun carriage, is the wheel upon which it runs.
Uvrou. The piece of wood by which the legs of the crow-foot are extended.
Unfurl. Cast loose the gasket of the sail.
Unbend. Cast off the sail from the yard.
Under way. When a ship is sailing, she is said to be under way.
Veer. Let out, as veer away the cable.
Veer, or wear the ship, that is, put her about with her head to leeward, the contrary to tacking.
Veer. Shift. The wind veers, that is, it shifts or changes.
Viol, or *Voyol.* A block through which the messenger passes in weighing the anchor. A large messenger is called a viol.
Vane. A small kind of flag worn at each mast-head.
Wake. The path or track impressed on the water by the ship's passing through it, leaving a smoothness in the sea behind it. A ship is said to come into the wake of another when she follows her in the same track, and is chiefly done in bringing ships to, or in forming the line of battle.
Weather. To weather any thing is to get to windward of it.
Wales, are strong timbers that go round a ship a little above her water-line.
Water-line. The line made by the water's edge when a ship has her full proportion of stores, &c. on board.
Warp. To warp a ship is to draw her against the wind, &c. by means of anchors and hawsers carried out.
Warp. A hawser, or small cable.
Woold. To would is to bind round with ropes, as the mast is woulded.
Weigh. To haul up, as weigh the anchor.
Wind-ward. Against the wind, or towards the point from which the wind blows.
Yaws. The ship yaws, that is, goes in and out, not steady.
Yards. The timbers upon which the sails are spread.

The following Questions and Answers are recommended to the Perusal of young Gentlemen belonging to the Sea, in order to refresh their Memories.

Quest. HOW do you find the golden number ?

Ans. I add one to the given year, and divide the sum by 19, the remainder will be the golden number.

Q. How do you find the moon's age ?

A. In the table for the readily finding the day of the month on which the new moon will fall, (page 138) I find the golden number for the year in the first column, opposite which, under the month is the day of the moon's change; the day after it is the first day of the moon's age, and the number of days after will give her age.

Q. How do you find the moon's southing, or the time of her coming to the meridian ?

A. I multiply the moon's age by 48, and divide the product by 60 ; the quotient will be the hours, and the remainder the minutes when she is on the meridian past noon ; Or, I may multiply the moon's age by 4, and divide the product by 5, the quotient will be the hours and the remainder multiplied by 12 will be the minutes when she souths, or is on the meridian, in the afternoon : But if this time should exceed 12, I subtract 12 from it, and the remainder will be the time of her southing in the morning.

Q. How do you find the time of high water at any place ?

A. I find the moon's age in the Table of Times, (page 138) and the hours and minutes opposite to which being added to the time of high water on the change and full days, at any place, will, if it does not exceed 12 hours, give the time of high water there in the afternoon of the given day; but if it does exceed 12, I take 12 from it, and the remainder shews the time of high water in the morning.

Q. Suppose that you go into an harbour, and find by your watch that it is high water at any hour of the day; by what means do you find the times when it is high water on full and change days in that place.

A. I find the time of the moon's southing on that day, and subtract it from the time of high water at the given place, if I can, and that will be the time of high water. If I cannot, I add 12 to it, and then subtract the above time ; the remainder will be the time of high water at the given place, on full and change days.

Q. How do you find the zenith distance of any object ?

A. By correcting the altitude for the dip, refraction, and semi-diameter, and then subtracting it from 90°, the remainder will be the zenith distance, which will be either north or south, according as the object bears of me.

Q. Suppose the zenith distance 10° north, and the declination 20° north, what latitude are you in, and of what name ?

A. Ten degrees north.

Q. The sun is in your zenith, what latitude are you in ?

A. The same as the declination is, whether north or south.

Q. Your zenith distance is 20° north, and your declination is 20° north, what latitude are you in ?

A. Upon the equator, and consequently in no latitude.

Q. Suppose that your zenith distance is 50° south, and the declination 10° north, what latitude are you in ?

A. Sixty degrees north.

Q. Suppose your zenith distance is 45° north, and the declination 15° south, what latitude are you in ?

A. Sixty degrees south.

Q. Suppose your zenith distance is 45° north, and the declination 15° north, what latitude are you in ?

A. Thirty degrees south.

Q. What do you mean by the word amplitude ?

A. The true amplitude is the number of degrees that the sun, moon, or stars, rise and set, to the northward or southward of the true east or west. The magnetic amplitude is the number of degrees they rise or set to the northward or southward of the east or west point of the compass.

Q. How do you find the true amplitude ?

A. As the co-sine of the latitude : is to the radius : so is the sine of the sun or star's declination to the sine of the true amplitude. Or if the secant of the latitude be added to the sine of the sun or star's declination, the sum (rejecting 10 in the index) will be the log. sine of the true amplitude.

Q. But suppose the evening or morning proves cloudy, and you cannot see the sun or star, how will you find the variation of the compass?

A. By an azimuth.

Q. What do you mean by an azimuth?

A. The true azimuth is the distance of the sun or star from the true north or south at every degree and minute of altitude. The magnetic azimuth is their distance, at each degree and minute of altitude from the north or south point of the compass.

Q. How do you find the true azimuth?

A. By adding the complement of the latitude, the complement of the altitude, and the sun or star's polar distance into one sum; from half this sum I subtract the polar distance, noting the half-sum and the remainder: Then, to the arithmetical complement of the co-sine of the latitude, I add the arithmetical complement of the co-sine of the altitude; the log. sines of the half sum and the remainder; half the sum of these four logarithms will give the co-sine of half the true azimuth, which being doubled is the true azimuth, reckoned from the north in north latitude, and from the south in south latitude.

Or, it may be found thus: To the log. co-secants of the co-latitude and altitude, add the log. sines of the half sum and the remainder; half the sum of these four logarithms (rejecting 20 in the index) will be the log. co-sine of half the true azimuth, as before.

Q. You have given the true amplitude or azimuth by calculation, and the magnetic amplitude or azimuth by observation; how do you find the variation?

A. By placing both the amplitudes or azimuths before me, then if the true amplitude or azimuth be to the right hand of the magnetic, or observed, the variation is east, but if it be to the left hand, it is west.

Q. You have the latitude and longitude the ship is in, consequently her place, how do you shape her course, or in other words, find her course and distance to any other place, whose latitude and longitude is known?

A. It may be found briefly by the tables of difference of latitude and departure, but by logarithms I will say,

As the meridional difference of latitude : is to radius : : so is the difference of longitude: to the tangent of the course. And,

As the co-sine of the course : is to the proper difference of latitude : : so is radius to the distance.

Q. You have the difference of latitude and departure made good in the 24 hours, how do you find the course and distance, and the ship's place, by logarithms?

A. As the difference of latitude : is to radius : : so is the departure : to the tangent of the course. And,

As the co-sine of the course : is to the difference of latitude : so is radius : to the distance made good in the 24 hours.

Having the latitude and longitude left, and the difference of latitude, I find the latitude in, and the meridional difference of latitude; I then say,

As the co-sine of the course : is to the meridional difference of latitude, : : so is the sine of the course : to the difference of longitude. Or, as the proper difference of latitude : is to the departure : : so is the meridional difference of latitude : to the difference of longitude. Having the longitude left, and the difference, the longitude in is found by addition or subtraction, as the case requires.

Q. You have now the ship's place by calculation, how do you find it on a Mercator's Chart?

A. By laying a rule across the Chart on the ship's latitude, and taking her longitude in my compasses, and setting one point on the meridian, by the side of the ruler, I turn the other east or west, according as the longitude is, (by the side of the ruler) and it will point out the ship's place.

Q. You have now the ship's place, how do you find her bearing and distance to any other known place?

A. By laying a ruler over the point where the ship is, and the given place, and with the compasses I take the nearest distance between the ruler and the center of some compass on the Chart; and slide the compasses along the ruler, (keeping both points perpendicular to it) the farthest point from the ruler will shew the course or bearing, between the ship and place.

Again: I take the distance between the ship and place in the compasses, and then lay one point on the meridian as much below the ship's place, as the other is above the given place: that distance, reckoned in degrees, leagues, or miles on the meridian, according as it is divided, will be the distance.

Q. You are ordered to a ship, she is lying in dock; prepare to take her out of dock.

A. I would take on board what kentledge was necessary, stream-anchor and cable, kedge-anchor, hawser, and towline, with some spare-ropes for guys, to keep her fair for the dock-gates; buoy and buoy ropes, for stream and kedge.

Q. When your ship is out of dock, what is first to be done?

A. I would take on board the remainder of the kentledge and level the hold; by laying the kentledge from the fore part of the fore-hatchway to the after-part of the after-hatchway.

Q. If you are taking in bales, how would you dunnage, and which part of the ship most?

A. I would dunnage six inches and mostly about the well, main hatchway, the wake of the chains and floor timbers.

Q. Suppose you have one and a half foot water in your hold, and your ship heels four streaks; what dunnage ought you to have to preserve the cargo?

A. Three feet.

Q. How would you moor your ship at Gravesend?

A. I would come to with my small bower, veer the service into the hawse, and then hang my best bower anchor to the long boat, and with the tide drop her a-stern: when the cable is taut, let go the anchor, first letting go the shank-rope, to keep the cable more taut.

Q. How would you hang the anchor to the long-boat?

A. Take the buoy-rope over the roller (which is in the middle of the stern of the long-boat), bring the bight round the main thwart, cockbill the anchor, hook the cat to the anchor, and lower away, until the flukes of the anchor are clear of the boats bottom, then make fast the buoy-rope, have a shank-rope through the ring, (which is at the boat's stern-post), pass it round the shank of the anchor, make it fast to the after-thwart, lower away and unhook the cat, then veer away the cable; be careful to heave the buoy over-board before you let go the anchor.

Q. How do you moor in the Downs?

A. With my best bower to the south-west, I would veer away with the last quarter flood, and moor with the small bower to the north-east.

Q. Where is the best anchoring in the Downs?

A. Upper Deal church and castle in one, in eight or nine fathoms water?

Q. What are the marks for anchoring in the Downs;

A. The South Foreland S. S. W. Deal castle bearing W. and Sandown castle N. W.

Q. How would you unmoor in the Downs with the wind at north?

A. I would splice my stream cable to my small bower, and veer away at half ebb, that I might have time to stow my best bower, and shorten in my small bower cable, before the ship tends to windward.

Q. Proceed to unmoor ship as it is done in the navy.

A. I would send for the master to see the hawse is clear, turn all hands up to unmoor ship, lay the capstan-bars for shipping, call the mate to see the messenger passed for the best bower, rig the davit out, because I will take it up the first quarter flood, get the cat and fish to pass for the best bower, stretch along the fish tackle; quarter masters down in the tier, and stand by to veer away the small bower cable; ship the capstan-bars, pin and swift them; clap on the stoppers before the bitts, and bring to the messenger. At the same time unbit the best bower, rowse aft the slack of the cable; heave taught, take off the stoppers, hold on the messenger, and heave away; veer away the small bower-cable; clap on the nippers: Thick and dry for weighing, heave cheerly; the anchor's away, keep fast the small bower cable; quarter master take hold of the helm; look out for the anchor; the anchor is in sight; heave and paul the capstan;

NOTE. All cables ought to be 120 fathoms in length, and are in proportion to each other, as the cubes of their diameters. The number of threads of which a cable is composed being always proportioned to the length and thickness, and the weight and value of it is determined by this number. The number of threads and weight of cables of different circumferences may be seen in the following table:

Circumference in inches.	Threads or Rope Yarns.	Weight in Pounds.
9	393	1572
10	485	1940
11	598	2394
12	699	2796
13	821	3284
14	952	3808
15	1095	4372
16	1244	4976
17	1404	5616
18	1574	6295
19	1754	7016
20	1943	7772

capstan; hook the cat; haul taught, and take a turn; surge the messenger round the capstan; take off the nippers; out cable; cable enough; haul cat; belay the catfall; pass the stoppers; hook the fish; try fish by hand; haul away the fish; belay the fish tackle-fall; pass the shank painter; bowse to the stock-tackle; belay the shank painter; make fast the stopper and stock lashing; come up cat and fish; unhook both; haul the buoy in; then shift the messenger for the small bower and bring to, clap on the stoppers before the bitts and unbit the cable; rowse aft the slack of the cable; man the capstan; hold on the messenger; forecastle-men; rig out the davit for the small bower; when the anchor is a-peak, send the top men to loose the sails: man the yards; stretch along the top sail sheets; let go the topsail; reef tackles, bunt-lines and clue-lines; foot the sails out of the top; haul home the top-sail sheets; stretch along the top-sail halyards and man them; quarter-master and boatswain's mates attend to the braces; hoist away the top-sails; belay the halyards; trim the sails; heave up the anchor; stow it as before, and haul the buoy in.

Q. How would you unmoor with the wind S. E. or S.?

A. Veer on the best bower-cable, and take the small bower anchor up first; and proceed as before, then to heave in to the short service on the best bower, &c. If the anchor has great hold and afraid of stranding the messenger, clear away the main capstan and lash a block, or purchase blocks, on the cable, and one to the main-mast, or one to the two ports a-breast of the main-mast; reeve a hawser through them, and heave on both capstans.

Q. Suppose you are close upon a wind, in moderate weather, with all your sails set, how will you tack the ship?

A. I would hand down the lee-bow-lines, stretch along the weather-braces, the weather-sheets and lee-tacks; then put the helm a-lee, let go the fore-sheet, lee fore-top-sail, brace and fore-top-bow-line, jib, and stay-sail-sheets: and haul them taught. When the fore-top-sail touches, brace to and help her; when aback brace up and help her; when the wind is out of her after-sails, raise tacks and sheets; shift the stay-sail tacks, and haul over the stay-sail sheets; cant sprit-sail yard, when the wind is rather ½ a point on the bow if sure of coming about, haul the main-sail. *N. B.* One watch of the top-men on the quarter-deck, and fore-castle to set up the weather-breast-back-stays: If she has stern-way, shift the helm and square the sprit-sail-yard; haul on board the main tack and aft the main-sheet. Brace up the main yard when the after-sails are full; haul off all; and haul on board the fore-tack; keep in the weather-braces forward, and let her come to, then brace up; haul aft the fore-sheet, jib and stay-sail sheets; set up the back-stays when head to the wind, and haul the bow-lines; then haul taught the weather braces, lee-tacks and weather-sheets; have the braces let go at once; when the word is given to haul main-sail, (all the hands on the braces should keep hauling taught in for the run) the yards will swing of themselves.

Q. How would you tack a ship under her three top-sails?

A. I would put the helm a-lee, ease off the fore-top-sail brace, keep fast the fore-top-bow-line; when the fore-top-sail touches, brace to and help her; when the wind is a-head, haul the main top-sail and shift the helm: then brace up the main-yard, and haul the main-top-bowline; when the after-sails are full, let go and haul; keep in the weather-braces forward, and when she comes to brace up sharp, haul the main and fore-top bow-lines, and haul taught the weather braces.

Q. How do you veer, or, wear a ship with all her sails set?

A. I would haul the mizen up, and the mizen-stay-sail down, or trail it up, hard a weather the helm, shiver the mizen-top-sail, let go the main and main-top-bow-lines, ease off the main-sheet, the lee main-brace, and round in the weather-braces. When the wind is abaft the beam, raise the main-tack; when the wind is aft, square the head-yards, and get the other tacks on board; haul aft the sheets, shift the jibb and stay-sail sheets over the stays, and as she comes to, haul the mizen out; hoist the mizen stay-sail, and haul aft the sheet; brace the head-yards up, haul the bow-lines, and trim all sharp. If a fresh wind, and should be proper to shorten sail, in top-gallant-sails, down jib and stay-sails, take one or two reefs in the top-sails.

Q. It blows hard, would have you proceed to close reef the top-sails?

A. I would let run the halyards, and haul the yards close down by the clue-lines and down-haul tackles; if the wind is large, man the clue-lines and bunt lines, let go the sheets, and clue them close up; haul in the weather brace, and spill the sail as much as possible; then haul out the reef tackles, send men up and haul out the weather earing first, then the lee one, and reef away, hauling the other reefs up before the yard: If the ship is upon a wind when the top-sail yard is down, let go the bow-lines. It is mostly the way to man the clue-lines and the bunt-lines, to ease off the lee-sheet and clue it up; then man the weather-brace, let go the lee-brace, ease off the weather-sheet and clue it up; hauling in the weather-brace and bunt-lines at the same time; when the sail is spilled, haul out the reef-tackles and reef as before. But to keep the sail from splitting or shaking (especially if it be wet) it is the best way to man the clue-lines, bunt-lines, and weather-braces, let go the lee-brace, ease off the weather-sheet, hauling up the clue-line, and in with the weather-brace at the same time; when in enough, ease off the lee-sheet, clue up, &c. N. B. To set a top-sail on a wind when it blows strong, always haul the lee sheet home first, then the weather ones, &c. &c.

Q. It blows harder, you must take in your top-sails?

A. I would take in the fore and mizen top-sails first, because it will ease the ship forward, (for when it blows hard we generally have a head sea, and she keeps too the better) let go the fore-top-bow-line, lower away the halyards, man the clue-lines and bunt-lines, clue close up, and haul out the reef-tackles, haul in the weather brace, steady the lee-brace, haul taught the top-sail halyards; send the people up to hand the sail, and when up, before they go on the yard, I'll clap the rolling tackle on to steady her, (all the top-sails should be taken in the same way) after that, if squally, take in the main top-sail, and then the ship is under her courses.

Q. How would you veer a ship under her courses?

A. I would haul the mizen and main-sail up, and down with the mizen-stay-sail, square the after yards, hard a weather the helm, man the weather fore-brace, and ease off the lee-brace and fore bow-line; ease off the fore-tack, and stand by to haul on board the other: keep her large if room, until I get the tack on board and belay it; then luff up to the wind, haul aft the fore-sheet and brace up the fore-yard, set the after-sails, aboard main tack, aft the main sheet, brace all up, and haul the bow-lines; when my sails are trimmed, shift the rolling tackles on the top-sail yards.

Q. Suppose you are lying too in a hard gale of wind, under a reef main-sail, you want the ship's head on the other tack; how will you veer in a great sea?

A. I will watch her falling off, and put the helm a weather, when she does, ease off the main-sheet; if that will not do, I'll man the fore shrouds, and get tarpaulins and hammocks or spare canvas up, and spread it: If that will not do, I will haul aft the main-sheet, and put the helm a-lee, then send hands out to the sprit-sail yard with hammocks and gaskets to stop the sprit-sail (called bailancing) within the lee clue-line; block and loose the lee yard-arm, then haul aft the sheet, clap the helm hard a-weather, ease off the main-sheet, round in the weather brace, gather aft the other sheet, haul the main tack on board; when she is before the wind, square the sprit-sail yard, clue the sail up and furl it; ease the helm down a-lee, brace the yards up, haul the main-sheet aft, bowse the bow-line up, lash the helm three parts a-lee, and she will lay to as before.

Q. Suppose she will not veer after all you have done?

A. I will loose the goose-wings of the foresail; if that will not do, set the foresail and veer her under her courses, or haul the main-sail up; if by hauling the main-sail up and furling it she does not veer, lower down the mizen-yard; if that will not do, lower down the cross-jack yard and mizen-top-mast; if that will not do, cut away the mizen mast.

Q. How do you cast a ship, when intending to get under way?

A. If I am to cast her to starboard, I would haul in my larboard braces forward, and let my after-yards lay square; I may hoist the fore top-mast-stay-sail, and keep the sheet to windward to help her; If I am to cast her to port, I would haul in the contrary braces, when cast, fill the head-sails and brace up as circumstances require. *N. B.* If a ship is wind rode, as soon as the anchor is right up and down, put the helm the way you would have her cast, setting in the same braces abaft, and the contrary forward: but if she is tide rode, the helm must be put the contrary way to which you would have her cast, and set in the braces forward; which ever way the helm is, the braces abaft must be the contrary.

Q. It blows hard, and you split your top-sail?

A. I would let go the bow-line, haul in the weather-brace, and lower away the halyards, clue up the lee-sheet, haul up the bunt-lines, start the weather-sheet, belay the clue-lines and bunt-lines, unbend the sail, bend another: then either furl or set it, as circumstances require.

Q. You are lying to in a hard gale of wind, and split your main-sail?

A. I will haul it up carefully, unbend the sail, and bend another, get on board the main tack, and haul aft the sheet; when the sail is set, get a tackle on the weather leach to secure the tack, and a preventer sheet; but in small ships they get the lee tack aft for a preventer sheet.

Q. Suppose you are on a wind, and let the ship come up in the wind, and are all aback, what will you do?

A. I will box her off, and suppose she will not box off, I will haul the mizen up, let go the main and main top bow-lines, the lee-main and maintop-sail braces, and lay all square abaft, put the helm to leeward, if she has stern-way, when the wind is abaft the beam shift the helm; and, as she gets head-way, haul in a little of the after braces, haul the mizen out, brace up sharp abaft, and haul the bow-lines; and then I am on the same tack as before.

Q. Suppose you are on a wind, close upon the land, and standing on must run on shore, and you can clear the land on the other tack; but it blows hard and a head fwell, that fhe will not ftay; and fhould you veer you would be on fhore, how would you get upon the other tack?

A. I would club haul her; this is done by putting the helm a lee, and letting go the lee anchor, and bringing her head up to wind; then cut the cable and haul about the after-fails; and when they are full, brace about the head-fails, haul on board the fore-tack, and brace up the other way.

Q. If by accident your fhip is brought by the lee, what would you do?

A. When a fhip is brought by the lee, it is commonly occafioned by a large fea, and by the neglect of the helm's-man. When the wind is two or three points on the quarter, the fhip taking a lurch, brings the wind on the other fide, and lays the fails all dead to the maft; as the yards are braced up, fhe then having little way, and the helm being of little fervice. I would therefore brace about the head-fails the other way and keep the main-top-fail fhivering; when fhe gathers way, and brings the wind aft again, raife the fore tack and fquare the head-fails; trim the fails as they were before, and bring her to her courfe again. *N. B.* It is dangerous to bring a fhip by the lee in a gale of wind, for fhe lying entirely againft the fea, her fails can be of little fervice till they are braced about.

Q. Coming into foundings from a long voyage, I would have you prepare for going into port and anchoring.

A. I'll order the cables to be bent; thus get their ends up, reeve, haufe, and ring ropes to haul them out, the forecaftle men to clinch them, and quarter-mafter to clap the bends on, reeve the runners and tackles, unftow the anchors, bend the buoys and bow-ropes, fingle the ftoppers and fhank painters, bit the bower-cables with a long range, have the dog ftoppers to pafs, fee the tiers clear, have hand leads and lines in the chains, fend down the top-ropes, reeve the top-tackle-falls, unfling the lower yards, when the cables are bent, &c. clap the hawfe bucklers on.

Q. You are off the Eddyftone, the wind at S. W. in a hard gale, under a reef fore-fail, and you muft anchor in Plymouth found, how will you bring up for the fafety of the fhip, and with what anchor?

A. To give myfelf time for anchoring, I will haul my fore-fail up, get the fheet anchor over the fide, and bit the cable to the after-bits with a range, get down top gallant mafts, and fprit-fail yard, in fore and aft, unfid the top-mafts and ftretch along the jeers, clap the wing ftopper on the fecond cable of the beft bower; being all clear, I'll fet my fore fail and fteer in for the Sound, and when I am near the place I intend to anchor in, I'll man the fore-clue garnets, and ftand by to lower the yards and top-maft, being ready, lower away, haul the fore-fail clofe up, and furl it a Portland, clap rolling tackles on the lower yards, and heel ropes on the top-mafts; having the marks on to anchor, ftream the beft bower buoy, and fee that it goes clear of the fhip, and when I intend to bring up, put the helm down, and haul the mizen out, then let go the anchor and veer away at leaft one and a half cable before I check her; fhould the fhip drive with two cables out, on the beft bower, ftream the fmall bower-buoy and let go the anchor, which will allow me to veer a cable on the fmall bower, this will bring her up if it blows ever fo hard, and I have ftill the fheet anchor to ftand by; when I have brought up, and double-bitted and ftopped the cables, I'll get the top-fail yards fore and aft in the tops, and make the fhip as fnug as poffible; as foon as the gale is over, get the anchors up and moor properly. The beft method is to unbend the fmall bower buoy rope from the anchor, it being liable to get foul of the beft bower cable, by the buoy going over and over again of the faid cable, which has been often the cafe.

N. B. In coming from the weftward with a hard gale of wind, and bound into the Downs take the fame method.

Q. Suppofe you are on a lee fhore, and had neither room to veer or ftay, nor any anchoring ground, how would you put the fhip's head round the other way.

A. I would put my helm hard a-lee, when fhe comes head to wind raife the fore and main tacks directly, make a run with my weather braces and lay all aback at once, then haul forwards my lee tacks and bow-lines as far as I can, that the fhip may fall round on her heel, and when the main-fail begins to fhiver, I would haul it up, fill my head fails, and fhift the helm hard a weather; when the wind comes on the other quarter, haul on board the main tack, and bring her clofe to the wind.

Q. Suppofe you were on a lee-fhore, and could clear the danger on the other tack, although not room to veer and a fea on fhe will not ftay, and you had good anchoring ground, what would you do?

A. When I faw the danger I would take a good hawfer and lead it out of one of the quarter ports, and bend it to the anchor to lee-ward; the other part I would bring to the capftan, fhip the bars, and when I clap the helm a-lee, and as foon as the wind is out of the main-fail haul it up, let go the anchor, and heave on the fpring to caft her, becaufe the cable fhould not check her. When fhe comes head to wind, brace about the main-yard, haul on board the tack, and cut away the cable and spring; when the main-sail fills, set the fore-sail, haul on board the tack; and trim her to the wind.

Q. Suppose it blows hard, you cannot carry your courses, night coming on, and it is likely to blow harder, what will you do?

A. I will haul the fore-sail up and furl it, balance the mizen, haul it out to keep her to, then haul up the weather main clue-garnet and buntline, then the lee-clue-garnet-buntlines and leach-lines, square the yards, and get strops round the mast above the booms to hook the yard tackles to for rolling tackles, then reef the sail, when reefed, haul on board the tack, get aft the sheet handsomely, tend the braces, bowse up the bowline and haul up the mizen.

Q. You are just abreast of Portland, the wind has taken you back; you have all sails set, and have no time to take them in, for you will be on shore or in the Race presently, how will you proceed?

A. If she has head-way, I will put the helm-a-port, let go the fore-sheet and larboard braces; as soon as the after-sails shiver, haul down all the studding-sails; if it blows fresh take in top-gallant-sails, brace up the after yards; when full, brace up forward and haul on board the fore-tack, trim all sharp, haul taut the bow-lines, then haul the weather-braces.

Q. Suppose you are turning over the Flats with your top-sails and fore-sail, you endeavour to put about, but she will not stay, there is a sand a-head within a cable's length of you, what will you do?

A. I will heave all aback, and when she has stern-way shift the helm; when she has paid well off, brace about the head-sails and shiver the after-sails; then she will veer round and stand off.

Q. You are in a gale of wind, and split your fore course, what will you do?

A. I'll man the weather fore clue-garnet, bunt-lines and leach-lines, ease off the fore-tack, and when clued up, man the lee-clue-garnet and haul it close up; then let go the lee-brace, haul taut the lifts and braces, send hands to unbend the sail; when another is bent, and I want to set it, I will haul on board the fore-tack, and haul aft the fore-sheet, brace the yard up and haul the bow-line.

Q. It blows hard, and you want to reef your courses, how would you proceed?

A. I will clear away the top-sail sheets and lifts, man the down-haul tackles, lower away the jeers, let go the bow-lines, and clue the sails up round the weather-braces, haul taut the lifts, braces, and rolling-tackles; then send hands up to reef the sails; when I want to set them, I will proceed with the sails as before.

Q. Suppose it blows hard at S. W. and you are drove from your anchors in the Downs, what would you do?

A. I would steer for the Gull-stream, which I shall know by having the upper Light on the South Foreland to bear S. W. by S. then steer away between the N. E. and N. E. by N. which will carry me between the Brake and the Goodwin Sands, keeping to the Goodwin in nine or ten fathoms, and to the Brake in seven or six.

Q. You are standing on a wind with all your sails set; your enemy is in sight, standing towards you, how do you clear your ship for action?

A. I will turn all hands up to clear ship, up all hammocks, the quarter-masters to stow them in the netting, and on the gang-way; get the top-men's hammocks up in the top; down all chests in the hold; quarter-masters stow them; take in all the small sails; sling the lower yard with top-chains, get the puddings and dolphins up; then sling the top-sail yards half-mast or close up; stop the top-sail sheets, stoppers on the jeers, or else rack them; gunners get the match-tubs between every two guns, matches, powder-horns, crows, and handspikes sufficient for every gun; all hands to quarters, keep silence and mind the word of command, fire not a gun until the word of command is given; mind you do not fire a shot in vain. Now I have all the three masts in one, fire!

Q. Suppose you are in chase of an enemy's ship of war, upon a wind, with all your sails set; she is right a-head, on which side will you engage her?

A. I will engage her to leeward, by reason she cannot put away before the wind, and if there is any thing of a sea, he may not be able to fight her lower tier of guns. If light breezes and hot weather, it would be better to engage to windward, to let them receive the smoke and heat of the fire.

Q. You are chasing from the wind, and carry away your main-top-mast, how will you proceed?

A. I would haul up the main-sail and send hands up into the top with a rope or hawser, to clap on that part of the mast that hangs down, then cut the lanvards of the main top-mast shrouds, and lower away, cast off the hawser, reeve it to send the stump down, clear away the rigging, unsling the main yard, get the foretackle on it and bowse forward the yard, then lower the stump upon deck, and get the spare top-mast ready for the cross-trees, clap the hawser on and sway it up high enough for the rigging.

Q. You are lying to in a hard gale of wind under your main course, you carry away your main-mast, how will you proceed to clear the wreck ?

A. I will clap my helm a-weather, brace my fore and fore-top sail yards full, then call all hands to get pole-axes, &c. to clear away the rigging.

Q. Why will you put the ship before the wind ?

A. Because the mast will go a-stern clear of the rudder, and prevent its damaging the ship.

Q. You are going large and see a ship in the wind's eye, how will you proceed to chase her ?

A. I will turn all hands up, get my tacks on board, brace up my yards and haul aft the sheets; haul the bow-lines, let the jib and stay-sails, keep her full, and by making short boards and turn directly to windward, which will prevent her putting away large.

Q. Suppose you were to carry away your bowsprit, what would you do ?

A. I would immediately veer ship, and keep her before the wind ; and then, for the security of the fore mast, I would carry forward the fore-runners and tackles, and bowse them well taut, till I can get a hawser or sufficient rope, and clinch it round the mast-head, and secure it to the bits of the forecastle or the cat-heads : then take the best spar I have, and make a jury bowsprit of it.

Q. Having a fair wind, how will you set your fore-top-mast studding-sail, on the larboard side?

A. First haul taut the truss tackles, and bowse the fore yard close to ; then haul taut the larboard fore-lift, and starboard fore-top-sail clue-line, on board ships of War the top buttons are on the top-sail yards to keep them square when studding-sails are set, (the top-sails, lifts, and clue-lines not thought of) the fore-top men down on the fore-yard, and rig out the larboard studding-sail boom, first sending down the studding-sail tack and outer halyards up to the fore-top-sail larboard yard-arm ; and reeve the halyards, send them down and bend them ; the tack being bent and all ready, man the halyards and hoist away, haul out the tack, &c. If the wind is on the beam or quartering, set it abaft the topsail ; if right aft, before the top-sail, (which is done by a man standing on the fore yard arm, with the leach of the studding-sail in his hands.)

Q. Suppose you are in an engagement, and your main-top-mast stay is shot away, how will you secure your mast ?

A. I will send my shifting back-stay forward by the main-top-mast stay-sail halyards, and reeve it through a block abaft the fore-mast head, bowse it taught, and that will secure the mast.

Q. Your ship comes to against her helm, what will you do ?

A. I will haul my mizen up, and shiver the after-sails.

Q. She comes to yet, if she stays she will be on board some other ship ?

A. I'll let go the lee-fore and fore-top-sail braces, raise the fore tack and let go the bow lines, haul in the weather braces and box her off.

Q. How do you splice your cables ?

A. I will put the whole strands of the best or small bower cables twice each way, and point each strand with a tail of three fathoms each ; then seize them with quarter and end seizing to make them lie snug, which is the readiest way for clearing the hawse. They being soon spliced and unspliced when pointed.

Q. How would you mark the lead-line ?

A. Black leather at 2 and 3 fathoms, white at 5, red at 7, black at 10, white at 13, (some seamen use black at 10 and 13) white at 15 as at 5, red at 17 as at 7, two knots at 20 fathoms, and so on, an additional knot at every 10 fathoms, with a single knot between each 10 fathoms to mark the line at every five fathoms.

Q. You are sent down in the dark for a top-sail, how do you know a main sail from a fore-sail, or a main-top-sail from a fore-top-sail ?

A. If it has three bow-line cringles it is a main-sail, if it has but two, it is a fore-sail ; if it is marled abaft the foot rope, it is a main-sail, if before, it is a fore-sail : If a main top-sail, it has four bow-line cringles, if a fore-top-sail but three ; all top-sails are marled to the rope, because the foot-rope is served.

Q. The sheers are alongside, how do you get them in ?

A. Par-buckle them in with their heads aft on the poop, and get the fore and main runners on them for guys ; lash on two fourfold blocks, reeve the masting-falls, get girt-lines on the head of the sheers to steady the mast-head, put heel lashings on the sheers, with good oak planks under them, to transport them forward on ; lash one of the fourfold blocks forward to the stem, and bring the fall to the capstan ; heave the sheers high enough : when done, I'll take forward two runners and tackles to assist the sheers, take the mizen-mast first in, then raise the sheers erect, take in the main-mast, bowse the heels of the sheers forward, and keep them upright to take in the fore-mast.

Q. How do you rigg a lower mast ?

A. I will lash on the girt-line-blocks, put on the bolsters, parcel and tar them, put over the runner and tackle-pendants, then the foremost of the starboard-shrouds, then the larboard, and so on; then the stay and spring stay, seize in the dead eyes for the shrouds, and the hearts for the stay, reeve the lanyards, set up the rigging, get the top over head, and bolt it, rattle down the shrouds, and seize on the cat-harpin-legs, hook the futtock shrouds, and hitch them, seize down the ends, lash the hanging jeer-blocks under the top, with the strops under the stays, lead up and lash to the mast-head, get the cap into the top for the head of the top-mast, and lash the blocks on for the main-lifts.

Q. How do you get a top and cap over?

A. Make fast a girt line-block, on each side of the mast-head, reeve the girt-lines and pass them under the top, and make them fast to the afterpart of the top, stop them to the bolt holes in the middle and fore-part of the top, then sway away: when high enough, cut the upper stops having a guy on the after part of the top-brim, and the top will fall over the mast-head, then lower away, and put it in its birth, haul upon the guy and bolt it, lay the cap steady over the trussel-trees for the top-mast-head, to receive it; when the top-mast-head is through it, lash the cap to the top-mast-head, sway away the top-mast till high enough, then place the cap on the mast-head, and drive it down.

Q. How do you rig a main-top-mast?

A. I will tar the mast-head, get the cross-trees over, fix the bolsters and parcel them, put over burton-pendants, then the shrouds, breast-back-stay, proper and spring-stay, and cap, sway up the mast and fid it, seize in the dead eyes, stay the mast, set up the shrouds, rattle them down, lash the bullock-blocks to the mast-head.

Q. How do you rig a top-gallant-mast?

A. I will send down the top-rope, reeve it through the sheave-hole, and make it fast round the hounds of the mast, and standing part of the rope, leaving enough end to make fast to the cap, which done, sway away, when the head is through the cap, make fast the spare end or standing part of the top-rope to the cap, cut the seizing, clap on the grommet, then the shrouds, back-stays and stay, sway up the mast, fid it, and set the rigging up.

Q. How do you rig a bowsprit?

A. I will lash the collar fore-stay for the bob-stays and bowsprit shrouds, then the collar for the spring-stays, then the block for the top-mast-stay, fix the man-rope, gammon the bowsprit, and set bob-stays and shrouds up.

Q. How do you rig a jib-boom?

A. I will put over the traveller, horses, and guys, the top-gallant stay-block, and lash on the blocks for the top gallant-bowline, and jibb-down-haul-block to the traveller.

Q. How do you rig a lower-yard?

A. I will get athwart the gunwale, lash the jeers, quarter clue-garnets, bunt-line, leach-lines and slab-line blocks, then put over the yard-arms, the horses brace pendants, the yard-tackle pendants, then the top-sail sheet, and lift-blocks, reeve the jeers, braces, lifts, and yard-tackle falls, truss parcels, sway the yard up, and haul all taut.

Q. How do you rig a fore top-sail yard?

A. I will reeve a hawser for a top-rope, through the bollock block, and send it down, and having put over the horses, make the top-rope fast to the middle of the yard, stopping it to the yard-arm, sway it up above the top, put over the brace-pendants and lift-blocks, reeve the lifts and braces, cut the yard-arm-seizing, and cross the yard, lash the tye, bunt-line and clue-line blocks, reeve the tye and halyards, sway it up above the cap, and parcel it, reeve the clue-lines, bunt-lines and reef-tackles.

Q. How do you rig a top-gallant-yard?

A. I will seize the clue-line-blocks on, put the horses over the yard-arms, sway it up to the cap, and rig the yard arms, by putting on the brace-pendants and lifts, then cross the yard and parcel it.

Q. You have lost your rudder at sea, what method will you take to stear the ship?

A. I will take a large spar, or part of a top-mast, and cut it flat in the form of a stern-post, bore holes at proper distances in that part which is to be the fore part of the preventer, or additional stern-post, then take the thickest plank I have on board, and make it as near as I can into the form of a rudder, bore holes at proper distances in the fore part of it, and in the after-part of the preventer stern-post to correspond with each other; and reeve rope grammets through those holes in the rudder and after-part of the stern-post for the rudder to play upon.

Through the preventer stern-post reeve guys, and at the fore-part of them fix tackles, and then put the machine over-board; when I get it in proper position or in a line with the ship's stern-post, lash the upper part of the preventer-post to the upper part of the ship's stern-post, then hook tackles at or near the main-chains, and bowse taut on the guys to confine it to the lower part of the preventer stern-post;—having holes bored through the preventer and proper stern-post, I will run an iron bolt through both, taking care not to touch the rudder, which will prevent the false stern-post from rising up or falling down.

By the guys on the after-part of the rudder, and tackles fixed to them, I may steer the ship. I must take care to bowse taut the tackles on the preventer stern-post to keep it close to the proper stern-post.

Q. Your ſhip is leaky, you cannot keep her free by the pumps, what will you do?

A. I will take a ſpare top-ſail, or ſome other ſail, and ſpread it upon the deck, cover it all over with oakum, and bind it to the ſail with a needle and twine in ſeveral places to keep it faſt to the ſail, then take an hawſer and cut it into proper lengths to go under the ſhip's bottom, and come in over the gunnel, put theſe hawſers about four feet diſtant under the ſail, and make them faſt with their middle to the middle of the ſails, each leach beginning at the head and leaving off at the clues:—Then put the ſail overboard keeping the oakum ſide to the ſhip's bottom, and haul up the ends of the hawſers on the other ſide by a hauling line which I have ſwept the ſhip with, numbering each end fore and aft; then eaſe away on the hawſer's ends on that ſide I have put the ſail over, and keep hauling at the ſame time on the hawſer's ends on the oppoſite ſide when the ſail is properly down, which is known by marking the hawſer, I will then clap on tackles and bowſe all taut, keeping the ſail cloſe to the ſhip's bottom the oakum will be drawn in, and ſtop the leak. The ſail may be covered with horſe dung or any filth I have on board, which will be drawn in and ſtop the leak.

Q. Suppoſe the wind northerly, & you were in a ſhip's hawſe in the Downs, what would you do?

A. I would wait until the ſhip tends to windward, and heave up my anchor as ſhe is tending.

Q. How would you work a ſhip out of the Downs with the wind ſoutherly?

A. I would ſtand to the Goodwin Sand in 10 or 11 fathoms, it being ſteep too; and to the ſhore in 8 fathoms water.

Q. Is there any danger in going out of the Downs?

A. Yes; between Deal and Walmer Caſtles there are ſhoals near the ſhore, not having more than 16 or 17 feet of water on them at ſpring tides; as I draw towards the Foreland, I would ſtand in ſhore, to 10 or 9 fathoms, and off to the South Sand-head, Upper Deal and Walmer Caſtles in one, will lead me clear off; Deal Church being open with Walmer Caſtle about a ſhip's length, I muſt ſtand out till I bring the lights in one, then I am clear off the South Sand-head; and when the light-houſe opens to the weſtward of Folkſtone Church with Hay Clifts, it leads me clear. I muſt take care not to ſhut in the Hope-land, and the South Sand-head will lie off three miles.—To ſail out of the Downs to the weſtward, and the wind at S. W. I will begin to unmoor at a quarter flood, weigh at high water, and caſt her in ſhore. But to ſail to the eaſtward with the wind weſterly, I would begin to unmoor at half ebb, take up my beſt bower, and weigh at low water.

Q. The wind at N. E. in moderate weather you mean to turn up the Swin, at what time of the tide would you weigh?

A. At ſlack water, looſe the ſails and up anchor.

Q. What are the marks for running through the Gull Stream?

A. To keep the upper light-houſe on the South Foreland, in one with the weſternmoſt end of the ſouthernmoſt clift in Old Stain's Bay; which is a ſwamp that lies between the two clifts a large half mile to the ſouthward of Kingſdown upon the South Foreland.

Q. How do you know when you can weather the South Sand-head?

A. When Upper Deal Mill is open to the Southward of Walmer Caſtle, or when the light-houſes are in one, and Folkſtone Church is open with Hay-Clift, I am clear.

Q. Suppoſe you were coming into the Downs with the wind at S. W. blowing hard, which way would you lay your ſhip's head to bring her up?

A. I would lay the ſhip's head to the eaſtward, and come to with my beſt bower, but if with the ſmall bower, I would heave her head in ſhore.

Q. For what reaſon would you do ſo?

A. I ſhould then keep the cable clear of the cut-water.

Q. What is the courſe from the South Foreland to Dungeneſs, and what are the dangers?

A. From the South Foreland to Dungeneſs, the courſe is S. W. by W. $\frac{1}{2}$ W. diſtance 7 leagues. The Ripraps lie N. E. and S. W. about 5 leagues in length, the N. E. end bears from Dover Caſtle S. S. E. 4 leagues, from Folkſtone S. E. by S. Calais ſteeple bears from it S. E. and Calais Clifts S. S. E. 3 leagues, the S. W. end bears from Dungeneſs E. S. E. 4 leagues, on the N. E. part there are about 15 or 16 feet at low water, on the S. W. end 4 or 5 fathoms, it is ſteep too on both ſides, having 20 and 22 fathoms cloſe to it. To the weſtward of Folkſtone, there is a ledge of rocks that runs a large mile off the ſhore, I would come no nearer in than 14 fathoms.

About 4 miles E. by N. from Dungeneſs, there is a ſhoal with not more than 12 feet on it, which I ſhall avoid by keeping in 10 fathoms.

Q. Where will you anchor, and in what depth of water under Dungeneſs?

A. I would anchor with the Neſs Point S. W. by W. the light-houſe W. S. W. athwart Romney Town, in 8, 9, or 10 fathoms water.

There is a ſhoal about two miles to the weſtward of the Neſs, with only 18 feet on it at low ſpring tides, the Neſs Light bears from it N. E. by E. 12 fathoms cloſe to it.

Q. What is the courſe from Dungeneſs to Beachy-head and what are the dangers?

A. W. $\frac{1}{2}$ S. diſtance about nine leagues.

Off the high land of Fairleigh there is a ſhoal of rocky ground with 14 feet on it, and lies pretty cloſe in. In the Channel off Dungeneſs, there is 24 fathoms and off Beachy-head, from 26 to 30 fathoms; I will, in thick weather, keep in 15 or 20 fathoms, from the Neſs to Beachy-head. When I deepen my water, haul to the northward, but if I ſhoal it, haul to the ſouthward. In clear weather I may ſtand in ſhore until Beachy-head bears W. by N. and not have leſs than 10 fathoms of water, muſt then tack to avoid Pemſey Shoal, which lies about two miles off the ſhore, with Pemſey Church bearing N. and Beachy-head W. by S. 14 feet on it.

There is a ſhoal with 14 feet on it and lies with Beachy-head W. ½ N. 7 or 8 miles, Pemſey Church N. N. W. 7 miles, and Fairleigh E. by N. 12 miles; E. by S. 6 miles from Beachy-head is the Horſe of Willington, a ſmall ſhoal, having 16 feet on it at low water.

Q. Being off Beachy-head, at the cloſe of a winter's evening, in a gale of wind at N. E. bound to Spithead, what is beſt to be done?

A. I would lie to with my ſhip's head to the N. N. W. till morning, then ſhe will drive about a channel courſe at the rate of two knots an hour, allowing that what ſhe would looſe in the ebb, ſhe would gain in the flood, and be in a fair way in the morning; I would come no nearer to the Owers than 18 or 20 fathoms.

Q. What is the courſe and dangers between Beachy-head and Dunnoſe?

A. The courſe is W. by N. ½ N. diſtance about 20 leagues.

The dangers are, Owers, the mark to go clear off the eaſt part of them, is the white way on Brow Hill in one with Chicheſter Church, a little to the eaſtward of Pegham Church, and the mark to clear the weſt-end, is St. Rook's Hill in one with Chicheſter Church, they bear from Culver Cliff E. S. E. ½ S. about 4 leagues: *there is a floating light on them which has been ſhifted ſeveral times:* in going down Channel, if I keep Dunnoſe W. N. W. northerly, will carry me without them, I will come no nearer to them in thick weather than 18 or 20 fathoms.

Q. You are coming from the weſtward and off Dunnoſe, what would you do?

A. I would ſteer N. E. keeping Sandown Caſtle clear of Culver Cliff until St Helen's Mark, which is a white building, is open of the Red Cliff bearing W. by N. then I may run in between Bembridge Ledge and the Princeſſa Shoal, but with a ſhip of a great draught of water, it is beſt to go without the Princeſſa Shoal, until I get the Kickergill on the S. W. part of Monkton Fort, and run into Spithead between the Buoy of the Dean and the Buoy of the Warner.

N. B. In going for Spithead from the eaſtward, there are 5 black buoys lying on the Dean and Horſe, they muſt be all left on the ſtarboard-ſide, the outer one is called the Eaſt Buoy of Dean, it lies in 27 feet water, the marks for it are, the flagſtaff of Portſmouth platform, a little open to the weſtward of a round centry-box of South Sea Caſtle, bearing N. by W. ½ W. with Dunnoſe open of Culver Cliff.

From the outer buoy to the next, is W. N. W. about one mile and a quarter, it lies in 6 fathoms; the third, formerly the firſt buoy of the Dean, lies in 4 fathoms; the buoy of the Warner bears weſt ſoutherly from this buoy about 1¼ mile, from the third to the fourth or Elbow buoy, is S. E. and N. W.; it lies in three fathoms.

The Buoy of the Horſe bears from the third buoy N. N. W. about 1½ mile, and lies in 3½ fathoms; from this laſt buoy to the firſt buoy of Sturbridge, is W. ½ N. the Royal George lies in 13 fathoms, ¾ of a mile to the N. W. of the Edgar, the buoy of the Royal George, that of Noman's Land, and the Kickergill lie all in a line.

The two buoys of the Princeſſa Shoal, lie N. E. by N. and S. W. by S. of each other, diſtance about a mile; they lie each in five fathoms with 4½ between them, the marks for the inner buoy, which is white, are Sandown Caſtle in one with Culver white Cliff, and Nettleſtone Point on Bembridge Point, the buoy of Bembridge Ledge is black, and the Nob buoy is red, they lie E. N. E. and W. S. W. of each other, with Dunnoſe open of Culver Cliff.

Q. Suppoſe you were to the northward of Bembridge Point, bound to Spithead, and the buoys were all gone, what would you do?

A. I would bring St. Helen's Church to bear W. and keep in 12 fathoms, and ſteer N. by W. towards the Dean, keeping Aſhdown mark above the trees, will lead me into Spithead abreaſt of Ride; if it is thick weather and the wind ſoutherly, I will come no nearer to Bembridge Ledge than ſix fathoms, and ſteer N. W. by N. but if the wind is on the other ſide, I would come no nearer the Dean and Horſe than 10 fathoms; obſerving the courſe and tides, I will anchor at Spithead with South Sea Caſtle N. E. by E. and the Kicker Point N. W. in 14 fathoms. Eaſt Indiamen and Merchant ſhips generally anchor on the Mother Bank to the weſtward of the Sturbridge buoy in 10 or 15 fathoms; if I am obliged to turn into Spithead, I may turn the Kickergill on each ſide of Fort Monkton and come no nearer the Warner than 12 fathoms, nor to the Dean than 9 or 10 fathoms, nor to Noman's Land than 16 or 18 fathoms being cloſe to it.

Q. How do you come to anchor at St. Helen's?

A. I would keep Sandown Castle just open of Culver Cliffs, and bring St. Helen's Church a sail's breadth open of the Red Cliffs of Bembridge Point, and anchor in 8 or 9 fathoms.

Q. Suppose you were moored at Spithead with a cable and an half on the best bower, and one on the small bower, you have orders to sail, at what time of the tide would you unmoor, and which anchor would you take up first?

A. I would begin to unmoor at the first of the flood, and take up my small bower first.

Q. In sailing within the Isle of White and through the Needles, what are your observations?

A. To keep clear of the West Middle, I would keep South Sea Castle a sail's breadth open of the Kicker Point until I open West Cowes Castle, then steer directly for Hurst Castle, and when abreast of it, borrow pretty near it, then steer for the Needles Point; the leading mark through the Needles is the Light-house in one with Hurst Castle, bearing N. E. by E. ¼ E. I must be careful to keep the Vanes of the Windmill which stands on the island in sight, to keep me clear of Warding's Ledge; great regard must be had to the tides, for the flood sets on the Needles, and the ebb on the Shingles with great velocity. *N. B.* To the northward of the West Middle lies the Bramble; the Bramble and West Middle have each two buoys on them, if I sail to the northward of the West Middle I must sail between it and the Bramble, having the Bramble on the starboard side; when I come to West Cowes Castle, I must give it a good birth, as there is a ledge of rocks that lie off it: Warding Rock lies on the Island Side with a buoy on it, when I come near the Needles, must give them a good birth to avoid the Chalk Rock.

Q. What is your course from Dunnose to Portland?

A. W. by N. 16 leagues.

Q. If you are forced into Portland, what precautions are necessary?

A. I must take care of the Shambles, they bear from Portland Lights, which lie north and south of each other; N. W. by W. 4 miles with only 14 feet on them at low water; to sail into the Road from the westward, I must keep close to the Bill, and keep my lead going; when I am round the East Point, haul up and anchor against the Pier, in 9 or 10 fathoms, with the Bill bearing S. S. E. Portland Castle S. S. W. and Weymouth Castle N. W. In sailing out of Portland Road, I must keep Week Church open of the Stone Pier, and that will carry me clear to the eastward of the Shambles.

It flows hard from the Road to the Bill E. S. E. 7 hours, and the flood sets right of the Bill 9 hours.

N. B. In case I should be embayed to the westward of Portland, and no possibility of getting out, between Burton and Chiswell, where it ebbs 9 hours and flows only 3 hours, where is a steep beach of pebbles, I would there run my ship on shore with as much sail as I could carry, especially at the beginning of an ebb, and remain on board for three or four seas, when I may get on shore with safety?

Q. What is the course from Portland to Torbay, and how do you anchor there?

A. The course is W. N. W. and distance about 14 leagues; to anchor in the bay, I would bring the Berry Head to bear S. by E. or S. S. E. and Brixham Church on with the Pier Head; the best anchoring for small ships is 1½ miles from Brixham Pier Head, in 7 fathoms.

Q. What is your course from the Berry Head to the Start?

A. S. W. about 6 leagues.

Q. Is there any danger near the Start?

A. Yes, about 2 miles to the eastward of the Start, there is a shoal with not more than 3 fathoms on it, the Bolt Head being kept open of the Start Point will carry me clear of it.

Q. What is your course from the Start to the Edistone?

A. W. ½ S. 7 leagues.

Q. What is your course from the Start to the Ramhead?

A. W. N. W. 7 leagues.

Q. What is to be observed in sailing into Plymouth Sound?

A. If coming from the westward and am got round the Ramhead, I must give Penlee Point a good birth, by reason of a ledge of rocks that lies off from it, then haul N. N. E. ½ E. for anchoring; the leading mark in is Plymouth Church, open with the west part of the Citadel. In going into the Sound I may anchor in Causand Bay, in 20 fathoms, with Penlee Point S. W. and the town of Causand W. N. W.

The leading mark to carry me in between the Knap and Shovel, is Plymouth old Church, on with a white patch on the Hoa.

I may go into the Sound on the east side, between the Tinker and Shagstone, by keeping Mount Batton a sail's breadth open of Staden Point, and keep in that direction until Maker's Church bears N. W. and Withy Edge open, then haul over to the eastward and anchor.

Q. How do you sail into Hamoaze?

A. I would keep Kingsand open of Redding Point, until the large House at Stoke touches the East side of Mill Bay; steer in until the Obelisk comes on with Block house Point; keep in that direction, till the easternmost Summer House on Mount Edgecomb side, comes open with the point within which it stands; then steer for it, until the east point of Mount Wise comes open with Block-house Point; then steer mid-channel for Stone-house Pool, till Drake's Island is shut within Block-house Point: I must not open it till South Down comes open with the Obelisk, then steer up the harbour with the side of Drake's Island just touching Passage Point, which will lead me to the southward of the Harbour Shoal, on the outer part of which there is a rock, with only 16 feet on it, but on any other part, there is $3\frac{1}{2}$ fathoms.

N. B. The marks to know the Sound when I am coming from sea in the day time, are, Ram Church, which stands to the northward of the Ramhead, and a square tower standing on the highest part of the land.

Q. You are bound into Falmouth, how would you proceed?

A. In going to Falmouth, there is a rock, called the Block Rock, with a pole on it, and shews itself at half tide; it lies nearest to the west shore; I may sail in on either side of it, but the east side is the best. If I would sail into Carrick road, I must keep in the fair way, and my lead going as there is a narrow deep channel all the way, of 16 or 18 fathoms. I may borrow on St. Maw's side in 5 or 6 fathoms. The best anchoring in Carrick Road, is St. Maw's Castle E. S. E. and lay my easternmost anchor in 16 or 18 fathoms, and my westernmost anchor in 4 or 5 fathoms. Just past St. Maw's there is a sand that is steep to, called St. Maw's Sand, and lies almost half channel over.

N. B. Great ship's anchor, with Manacle Point, on with the point of Falmouth, or a great house, that is to the westward of Penryn, just open Trefusis Point in 18 fathoms.—The Manacles lie from Falmouth about S. S. E.

Q. How do you know the Lizard when you first make it?

A. It is the southernmost land on the coast, and may be seen 7 or 8 leagues off, in 42 fathoms.

Q. How does the Land's-End appear when you make it?

A. It appears in hummocks with a church on it, and may be seen 7 or 8 leagues off, in 54 fathoms.

Q. What are the dangers off the Land's-End?

A. Many:—1st. The Runnel-stone lies about 16 miles S.S. W. from Toll-peden-penwith.

2d, N. E. by N. from the Runnel stone, there is a rock called the Leawmean, which appears at half ebb, with a passage between it and the main, seldom used by any but coasters.

3d, The Wolf Rock; bears from the Land's End S. W. by W. distance 3 leagues; it is small and may be seen at half tide; the largest of the Brazen Rocks, kept open of the outermost of the Long Ships *(on which there is a light-house erected)* will lead me clean to the westward of the Wolf.

4th, The Long Ships lie N. W. by N. about 3 miles from the S. W. point of the Land's End, and 1 mile W. N. W. from the westernmost point, they are high, and may be seen 4 or 5 leagues off.

5th, The Kettle-bottom, is a shoal with only 6 feet on it, and lies about half way between the northernmost part of the Long Ships, and the west point of the Land's End.

6th, The Bresam Rocks lie about 3 miles N. E. by N. from the Long Ships.

7th, The seven Stones, are a row of rocks that come not above water, but the sea always breaks over them; they lie from the Land's End W. S. W. $\frac{1}{2}$ S. distant 7 leagues; and from St. Martin's Head, Scilly N. N. E. distant 3 leagues.

Q. If you are forced into Mount's Bay, where would be the safest anchoring ground?

A. Mount's Bay lies between the Lizard and the Land's End; there is a high Island on the east side, and a Castle on the west side of it, called St. Michael's Mount; from the east side of it lies a ledge of rocks, near a league into the sea; the Coast is full of rocks, and not safe to anchor in. To sail into the Bay I must bring St. Paul's Steeple W. and keep over to the west shore, and make St. Clement's Island, which is before the town of Mouse-hole, having the castle on the starboard side; I shall then see a large sandy bay, and, when within the island, there is good anchoring in 7 or 8 fathoms, land-locked from winds but a S. E. wind.

Q. If you are bound, or forced to go into Scilly, what would you do?

A. I would steer for St. Mary's Sound, and run in for the southernmost point of St. Mary's Island, called Penninis Point, minding to keep the lead going, and approach no nearer than 5 fathoms water; about N. W. of Penninis Point, a little more than half a mile, is the Woolpack, the shoal lies near to the shore; I must continue to run in 5 or 6 fathoms, keeping pretty close to St. Mary's Island to avoid the Spanish Ledge, which lies about half a mile W. by S. from Penninis Point; some part of this shoal may be seen at low water, and part of the Woolpack shews itself before low water; when I have got abreast of the Woolpack, to which I must give a good birth, about a cable's length, and steer for the Stevel Rock which is bold to; when I am abreast of the Stevel, must steer N. W. by W. until little Crow Island comes on with Bantscarren Point; then steer N. N. E. until Crow Island comes open a ship's length of Bantscarren Point, or bring the Castle which is on St. Mary's Island, to bear S. S. E. and anchor in 6 or 5 fathoms water.

Remarks calculated to assist Commanders when sailing into the British Channel.

AS Mariners know that their reckonings are always uncertain, in proportion to the length of their several passages from the times of their last departures, it is natural to suppose, that they must, when approaching to any difficult and dangerous navigation, experience great anxiety of mind for the issue. As the British Channel has proved fatal to many, it may fairly be ranked among those places which are deemed dangerous to ships, in their approach after long passages; and, therefore, all those who are entrusted with the conducting ships through it, ought to acquire such knowledge as may enable them to perform the duties of their important office. Channel coasters, by the frequency of their passing and repassing through it, acquire such knowledge as those who are employed in foreign voyages cannot pretend to: hence it becomes necessary to furnish the latter with some useful information; more especially, as it is next to impossible for the human mind, when engaged in various pursuits, to remember every necessary article, such as the course and distance from one place to another, the precise situation of rocks and shoals, and the direction and strength of the tide in the various places. Commanders of ships, when coming from abroad, and about to enter the British Channel, must be exceedingly anxious to accomplish the ultimate design of their voyage, by bringing their respective ships safely into port. To the assistance of such, the following observations are intended to contribute: they are founded on experience, and will, if properly observed, prove highly serviceable; especially when long nights, or thick weather, augment those dangers which attend the Channel navigation.

Ships, in approaching the Channel from a long passage, should not only try for soundings in time, but run, if possible, in the latitude of 47° 25′ North. Having, in that parallel, got soundings in 82 fathoms, fine white sand with black and yellow specks, you may be sure that you are near the outer edge of the bank; and about 50 leagues to the westward of Scilly. By running 16 or 17 leagues further to the eastward, in the same parallel of latitude, you will have 90 fathoms, fine white sand; and continuing to run 4 leagues more to the eastward, you will shoalen your water to 82 fathoms. Soon afterwards, you will have 72 and 75 fathoms, fine white sand with sometimes a mixture of green; and in proceeding 16 or 17 leagues further to the eastward, in this latitude, you will have 72, 75, 77, and 80 fathoms. The soundings will be, for the most part, fine sand, but different in colour: some of them will be white sand, mixed with yellow specks; and others fine green sand, with some mud. In the latitude of 48° 23′ North, and 61 leagues to the westward of Ushant, lies the Sole Bank. It stretches about S. S. E. and N. N. W. 12 leagues in length and 4 in breadth; and has 64 fathoms on it, fine grey sand.

The following are the Soundings in the Parallels of 48° 20′, and 48° 30′, with their several Depths of Water and Distances from the Island of USHANT.

Dist. from USHANT.	QUALITIES OF THE SOUNDINGS.	Depth in Fathoms.
Leagues.		
52 —	Fine grey sand, mixed with black	— 92
49 —	Fine grey sand, mixed with shells and broken bits	— 106
46 —	Grey sand, mixed with bits of brown shells	— 110
43 —	Grey sand, mixed with bits of shells and brown sand	— 108
40 —	Grey sand, mixed with bits of shells and gravel	— 117
37 —	Grey sand, mixed with shells and gravel	— 104
35 —	Grey sand, mixed with small cornet shells	— 110
32 —	Sand mixed with gravel, shells, and small cornets	— 108
29 —	Whitish grey sand and flat stones	— 108
24 —	Light grey sand, with bits of shells	— 100
21 —	Coarse sand, with bits of cockle shells	— 98
18 —	Light grey sand, with bits of brown and yellow shells and small stones	— 90
15 —	Light grey sand, mixed with barley beards	— 84
14 —	Whitish grey sand, bits of shells and fine cornets	— 80
11 —	Light grey sand, mixed with barley beards and small shells	— 79
9 —	Fine grey sand, with bits of shells	— 75
8 —	Grey sand, spotted with red, and mixed with bits of shells	— 73
6 —	Whitish coarse shining sand, with fine shells	— 70
4 —	Whitish coarse shining sand, mixed with barley beards and coral	— 65
2 —	Whitish coarse sand	— 64

When running for the channel in latitude 49° 25', which is the best latitude, and you have run so far to the eastward as to shoalen your water to 65 or 67 fathoms, and the soundings are shells and small yellow stones or red sand, you may thence conclude that you are abreast of Scilly; or if you have 68 fathoms, white sand with grey specks, and sometimes shells and stones, Scilly will then bear about N. E. from you, distance 10 leagues. Your soundings will always inform you whether you are to the northward or southward of Scilly. In the latitude of Scilly you will have oozy ground, in 60, 65, 75, or 80 fathoms. W. N. W. 10 leagues from Scilly, lies Jones's Bank, on which you will have but 30, 35, and 40 fathoms; and, a little to the southward of it, you will have 72 and 75 fathoms. In running for the channel, in the latitude of 49° 30', you will have the following depths of water and soundings, when you are abreast Scilly; namely, 60 fathoms, oozy and broken shells; 64 fathoms, white sand with grey specks; 65 fathoms, shells and stones; and 55 fathoms, fine grey sand. The soundings near Scilly, are very different from all others in this latitude: pieces of rotten rock as broad as a small bean, and of a stone colour, will come up with the lead, which will not be the case any where else in the same parallel. More to the southward you will have deep water, with fine sand, interspersed with black specks like ground pepper. In the night, or in foggy weather, you should come no nearer Scilly than 60 fathoms; for, in that depth you will not be more than 6 or 7 leagues from it. Abreast of Scilly, in the latitude of 49° 20', you will have 70 fathoms, branny or yellow and white sand; and to the eastward of Scilly, in the latitude of 49° 8', you will have 56 or 58 fathoms, coarse sand. You should then steer more to the northward, and endeavour to make the land about the Lizard; you may safely make it in the night, as well as in the day, if the weather be clear: for the Light-houses stand so high, and the Coast is so clear, that you may, without danger, come within half a mile of the point. If the weather proves so thick that you cannot safely make the land, come no nearer to the Lizard than 45 fathoms; for, in that depth you will not be more than three leagues off the point: your soundings there will be pebble stones and scallop shells.

Ships, when coming into the channel, ought always, if possible, to make the land about the Lizard; because it is the most proper place for a land fall: and should they afterwards meet with thick weather, which frequently happens, they will not only know how to steer, but also how they advance up the channel, which will become more and more necessary in proportion to the contraction of its boundaries. Some, by neglecting this precaution, have, contrary to their expectation, got on the south side of the channel. This error is greatly owing to the strong indraught between the islands of Guernsey and Jersey, and on the coast of Britanny, which ought always to be guarded against, especially in thick weather. It frequently happens that ships, coming into the channel, have not had an observation for some days back, which, together with the operation of scant and contrary winds, and the setting of the tides, tend to perplex and bewilder the most experienced mariner, when thick weather prevents him from getting a sight of the land. The variation of the compass in the entrance of the channel, taken on board of the British ship Europe, in October, 1782, was 23° 14' W. but as the variation is continually increasing, at the rate of about a degree in every 5 years and a half, it will be necessary to add 11 minutes for every year, subsequent to the year 1782, which will give you the variation at any time pretty exact.

N. B. For Directions for sailing on the Coast and into the harbours of the United States, see *American Coast Pilot*, published by EDMUND M. BLUNT, and for sale by all the Booksellers and Ship-Chandlers on the Continent.

TABLE I. Difference of Latitude and Departure for ¼ Point.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.0	61	60.6	03.0	121	120.9	05.9	181	180.8	08.9	241	240.7	11.8
2	02.0	00.1	62	61.9	03.0	22	121.9	06.0	82	181.8	08.9	42	241.7	11.9
3	03.0	00.1	63	62.9	03.1	23	122.9	06.0	83	182.8	09.0	43	242.7	11.9
4	04.0	00.2	64	63.9	03.1	24	123.9	06.1	84	183.8	09.0	44	243.7	12.0
5	05.0	00.2	65	64.9	03.2	25	124.9	06.1	85	184.8	09.1	45	244.7	12.0
6	06.0	00.3	66	65.9	03.2	26	125.8	06.2	86	185.8	09.1	46	245.7	12.1
7	07.0	00.3	67	66.9	03.3	27	126.8	06.2	87	186.8	09.2	47	246.7	12.1
8	08.0	00.4	68	67.9	03.3	28	127.8	06.3	88	187.8	09.2	48	247.7	12.2
9	09.0	00.4	69	68.9	03.4	29	128.8	06.3	89	188.8	09.3	49	248.7	12.2
10	10.0	00.5	70	69.9	03.4	30	129.8	06.4	90	189.8	09.3	50	249.7	12.3
11	11.0	00.5	71	70.9	03.5	131	130.8	06.4	191	190.8	09.4	251	250.7	12.3
12	12.0	00.6	72	71.9	03.5	32	131.8	06.5	92	191.8	09.4	52	251.7	12.4
13	13.0	00.6	73	72.9	03.6	33	132.8	06.5	93	192.8	09.5	53	252.7	12.4
14	14.0	00.7	74	73.9	03.6	34	133.8	06.6	94	193.8	09.5	54	253.7	12.5
15	15.0	00.7	75	74.9	03.7	35	134.8	06.6	95	194.8	09.6	55	254.7	12.5
16	16.0	00.8	76	75.9	03.7	36	135.8	06.7	96	195.8	09.6	56	255.7	12.6
17	17.0	00.8	77	76.9	03.8	37	136.8	06.7	97	196.8	09.7	57	256.7	12.6
18	18.0	00.9	78	77.9	03.8	38	137.8	06.8	98	197.8	09.7	58	257.7	12.7
19	19.0	00.9	79	78.9	03.9	39	138.8	06.8	99	198.8	09.8	59	258.7	12.7
20	10.0	01.0	80	79.9	03.9	40	139.8	06.9	200	199.8	09.8	60	259.7	12.8
21	21.0	01.0	81	80.9	04.0	141	140.8	06.9	201	200.8	09.9	261	260.7	12.8
22	22.0	01.1	82	81.9	04.0	42	141.8	07.0	02	201.8	09.9	62	261.7	12.9
23	23.0	01.1	83	82.9	04.1	43	142.8	07.0	03	202.8	10.0	63	262.7	12.9
24	24.0	01.2	84	83.9	04.1	44	143.8	07.1	04	203.8	10.0	64	263.7	13.0
25	25.0	01.2	85	84.9	04.2	45	144.8	07.1	05	204.8	10.1	65	264.7	13.0
26	26.0	01.3	86	85.4	04.2	46	145.8	07.2	06	205.8	10.1	66	265.7	13.1
27	27.0	01.3	87	86.9	04.3	47	146.8	07.2	07	206.8	10.2	67	266.7	13.1
28	28.0	01.4	88	87.9	04.3	48	147.8	07.3	08	207.7	10.2	68	267.7	13.2
29	29.0	01.4	89	88.9	04.4	49	148.8	07.3	09	208.7	10.3	69	268.7	13.2
30	30.0	01.5	90	89.9	04.4	50	149.8	07.4	10	209.7	10.3	70	269.7	13.3
31	31.0	01.5	91	90.9	04.5	151	150.8	07.4	211	210.7	10.4	271	270.7	13.3
32	32.0	01.6	92	91.9	04.5	52	151.8	07.5	12	211.7	10.4	72	271.7	13.4
33	33.0	01.6	93	92.9	04.6	53	152.8	07.5	13	212.7	10.5	73	272.7	13.4
34	34.0	01.7	94	93.9	04.6	54	153.8	07.6	14	213.7	10.5	74	273.7	13.5
35	35.0	01.7	95	94.9	04.7	55	154.8	07.6	15	214.7	10.6	75	274.7	13.5
36	36.0	01.8	96	95.9	04.7	56	155.8	07.7	16	215.7	10.6	76	275.7	13.6
37	37.0	01.8	97	96.9	04.8	57	156.8	07.7	17	216.7	10.7	77	276.7	13.6
38	38.0	01.9	98	97.9	04.8	58	157.8	07.8	18	217.7	10.7	78	277.7	13.7
39	39.0	01.9	99	98.9	04.9	59	158.8	07.8	19	218.7	10.8	79	278.7	13.7
40	40.9	02.0	100	99.9	04.9	60	159.8	07.9	20	219.7	10.8	80	279.7	13.8
41	41.0	02.0	101	100.9	05.0	161	160.8	07.9	221	220.7	10.9	281	280.7	13.8
42	41.9	02.1	02	101.9	05.0	62	161.8	08.0	22	221.7	10.9	82	281.7	13.9
43	42.9	02.1	03	102.9	05.1	63	162.8	08.0	23	222.7	11.0	83	282.7	13.9
44	43.9	02.2	04	103.9	05.1	64	163.8	08.1	24	223.7	11.0	84	283.7	14.0
45	44.9	02.2	05	104.9	05.2	65	164.8	08.1	25	224.7	11.1	85	284.7	14.0
46	45.9	02.3	06	105.9	05.2	66	165.8	08.2	26	225.7	11.1	86	285.7	14.1
47	46.9	02.3	07	106.9	05.3	67	166.8	08.2	27	226.7	11.2	87	286.7	14.1
48	47.9	02.4	08	107.9	05.3	68	167.8	08.3	28	227.7	11.2	88	287.7	14.2
49	48.9	02.4	09	108.9	05.4	69	168.8	08.3	29	228.7	11.3	89	288.7	14.2
50	49.9	02.5	10	109.9	05.4	70	169.8	08.4	30	229.7	11.3	90	289.7	14.3
51	50.9	02.5	111	110.9	05.5	171	170.8	08.4	231	230.7	11.4	291	290.7	14.3
52	51.9	02.6	12	111.9	05.5	72	171.8	08.5	32	231.7	11.4	92	291.6	14.4
53	52.9	02.6	13	112.9	05.5	73	172.8	08.5	33	232.7	11.5	93	292.6	14.4
54	53.9	02.7	14	113.9	05.6	74	173.8	08.5	34	233.7	11.5	94	293.6	14.5
55	54.9	02.7	15	114.9	05.6	75	174.8	08.6	35	234.7	11.5	95	294.6	14.5
56	55.9	02.8	16	115.9	05.7	76	175.8	08.6	36	235.7	11.6	96	295.6	14.5
57	56.9	02.8	17	116.9	05.7	77	176.8	08.7	37	236.7	11.6	97	296.6	14.6
58	57.9	02.9	18	117.9	05.8	78	177.8	08.7	38	237.7	11.7	98	297.6	14.6
59	58.9	02.9	19	118.9	05.8	79	178.8	08.8	39	238.7	11.7	99	298.6	14.7
60	59.9	02.9	20	119.9	05.9	80	179.8	08.8	40	239.7	11.8	300	299.6	14.7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

[For 7¼ Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.1	61	60.7	06.0	121	120.4	11.8	181	180.1	17.7	241	239.8	23.6
2	02.0	00.2	62	61.7	06.1	22	121.4	11.9	82	181.1	17.8	42	240.8	23.7
3	03.0	00.3	63	62.7	06.2	23	122.4	12.0	83	182.1	17.9	43	241.8	23.8
4	04.0	00.4	64	63.7	06.3	24	123.4	12.1	84	183.1	18.0	44	242.8	23.9
5	05.0	00.5	65	64.7	06.4	25	124.4	12.2	85	184.1	18.1	45	243.8	24.0
6	06.0	00.6	66	65.7	06.5	26	125.4	12.3	86	185.1	18.2	46	244.8	24.1
7	07.0	00.7	67	66.7	06.6	27	126.4	12.4	87	186.1	18.3	47	245.8	24.2
8	08.0	00.8	68	67.7	06.7	28	127.4	12.5	88	187.1	18.4	48	246.8	24.3
9	09.0	00.9	69	68.7	06.7	29	128.4	12.6	89	188.1	18.5	49	247.8	24.4
10	10.0	01.0	70	69.7	06.8	30	129.4	12.7	90	189.1	18.6	50	248.8	24.5
11	10.9	01.1	71	70.7	06.9	131	130.4	12.8	191	190.1	18.7	251	249.8	24.6
12	11.9	01.2	72	71.7	07.0	32	131.4	12.9	92	191.1	18.8	52	250.8	24.7
13	12.9	01.3	73	72.6	07.1	33	132.4	13.0	93	192.1	18.9	53	251.8	24.8
14	13.9	01.4	74	73.6	07.2	34	133.4	13.1	94	193.1	19.0	54	252.8	24.9
15	14.9	01.5	75	74.6	07.3	35	134.4	13.2	95	194.1	19.1	55	253.8	25.0
16	15.9	01.6	76	75.6	07.4	36	135.3	13.3	96	195.1	19.2	56	254.8	25.1
17	16.9	01.7	77	76.6	07.5	37	136.3	13.4	97	196.1	19.3	57	255.8	25.2
18	17.9	01.8	78	77.6	07.6	38	137.3	13.5	98	197.0	19.4	58	256.8	25.3
19	18.9	01.9	79	78.6	07.7	39	138.3	13.6	99	198.0	19.5	59	257.8	25.4
20	19.9	02.0	80	79.6	07.8	40	139.3	13.7	200	199.0	19.6	60	258.8	25.5
21	20.9	02.1	81	80.6	07.9	141	140.3	13.8	201	200.0	19.7	261	259.7	25.6
22	21.9	02.2	82	81.6	08.0	42	141.3	13.9	02	201.0	19.8	62	260.7	25.7
23	22.9	02.2	83	82.6	08.1	43	142.3	14.0	03	202.0	19.9	63	261.7	25.8
24	23.9	02.3	84	83.6	08.2	44	143.3	14.1	04	203.0	20.0	64	262.7	25.9
25	24.9	02.4	85	84.6	08.3	45	144.3	14.2	05	204.0	20.1	65	263.7	26.0
26	25.9	02.5	86	85.6	08.4	46	145.3	14.3	06	205.0	20.2	66	264.7	26.1
27	26.9	02.6	87	86.6	08.5	47	146.3	14.4	07	206.0	20.2	67	265.7	26.2
28	27.9	02.7	88	87.6	08.6	48	147.3	14.5	08	207.0	20.3	68	266.7	26.3
29	28.9	02.8	89	88.6	08.7	49	148.3	14.6	09	208.0	20.4	69	267.7	26.4
30	29.9	02.9	90	89.6	08.8	50	149.3	14.7	10	209.0	20.5	70	268.7	26.5
31	30.9	03.0	91	90.6	08.9	151	150.3	14.8	211	210.0	20.6	271	269.7	26.6
32	31.8	03.1	92	91.6	09.0	52	151.3	14.9	12	211.0	20.7	72	270.7	26.7
33	32.8	03.2	93	92.6	09.1	53	152.3	15.0	13	212.0	20.8	73	271.7	26.8
34	33.8	03.3	94	93.5	09.2	54	153.3	15.1	14	213.0	20.9	74	272.7	26.9
35	34.8	03.4	95	94.5	09.3	55	154.3	15.2	15	214.0	21.0	75	273.7	27.0
36	35.8	03.5	96	95.5	09.4	56	155.3	15.3	16	215.0	21.1	76	274.7	27.1
37	36.8	03.6	97	96.5	09.5	57	156.2	15.4	17	216.0	21.2	77	275.7	27.2
38	37.8	03.7	98	97.5	09.6	58	157.2	15.5	18	217.0	21.3	78	276.7	27.3
39	38.8	03.8	99	98.5	09.7	59	158.2	15.6	19	217.9	21.4	79	277.7	27.4
40	39.8	03.0	100	99.5	09.8	60	159.2	15.7	20	218.9	21.5	80	278.7	27.5
41	40.8	04.0	101	100.5	09.9	161	160.2	15.7	221	219.9	21.6	281	279.6	27.6
42	41.8	04.1	02	101.5	10.0	62	161.2	15.8	22	220.9	21.7	82	280.6	27.7
43	42.8	04.2	03	102.5	10.1	63	162.2	15.9	23	221.9	21.8	83	281.6	27.8
44	43.8	04.3	04	103.5	10.2	64	163.2	16.0	24	222.9	21.9	84	282.6	27.9
45	44.8	04.4	05	104.5	10.3	65	164.2	16.1	25	223.9	22.0	85	283.6	28.0
46	45.8	04.5	06	105.5	10.4	66	165.2	16.2	26	224.9	22.1	86	284.6	28.1
47	46.8	04.6	07	106.5	10.5	67	166.2	16.3	27	225.9	22.2	87	285.6	28.2
48	47.8	04.7	08	107.5	10.6	68	167.2	16.4	28	226.9	22.3	88	286.6	28.3
49	48.8	04.8	09	108.5	10.7	69	168.2	16.5	29	227.9	22.4	89	287.6	28.4
50	49.8	04.9	10	109.5	10.8	70	169.2	16.6	30	228.9	22.5	90	288.6	28.5
51	50.8	05.0	111	110.5	10.9	171	170.2	16.7	231	229.9	22.6	291	289.6	28.6
52	51.8	05.1	12	111.5	11.0	72	171.2	16.8	32	230.9	22.7	92	290.6	28.7
53	52.7	05.2	13	112.5	11.1	73	172.2	16.9	33	231.9	22.8	93	291.6	28.8
54	53.7	05.3	14	113.5	11.2	74	173.2	17.0	34	232.9	22.9	94	292.6	28.9
55	54.7	05.4	15	114.4	11.2	75	174.2	17.1	35	233.9	23.0	95	293.6	29.0
56	55.7	05.5	16	115.4	11.3	76	175.2	17.2	36	234.9	23.1	96	294.6	29.1
57	56.7	05.6	17	116.4	11.4	77	176.2	17.3	37	235.9	23.2	97	295.6	29.2
58	57.7	05.7	18	117.4	11.5	78	177.1	17.4	38	236.9	23.3	98	296.6	29.2
59	58.7	05.8	19	118.4	11.6	79	178.1	17.5	39	237.9	23.4	99	297.6	29.3
60	59.7	05.9	20	119.4	11.7	80	179.1	17.6	40	238.8	23.5	300	298.6	29.4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.1	61	60.3	08.9	121	119.7	17.7	181	179.0	26.5	241	238.4	35.3
2	02.0	00.3	62	61.3	09.1	22	120.7	17.8	82	180.0	26.7	42	239.4	35.5
3	03.0	00.4	63	62.3	09.2	23	121.7	18.0	83	181.0	26.8	43	240.4	35.6
4	04.0	00.6	64	63.3	09.4	24	122.7	18.2	84	182.0	27.0	44	241.3	35.8
5	04.9	00.7	65	64.3	09.5	25	123.6	18.3	85	183.0	27.1	45	242.3	35.9
6	05.9	00.9	66	65.3	09.7	26	124.6	18.5	86	184.0	27.3	46	243.3	36.1
7	06.9	01.0	67	66.3	09.8	27	125.6	18.6	87	185.0	27.4	47	244.3	36.2
8	07.9	01.2	68	67.3	10.0	28	126.6	18.8	88	186.0	27.6	48	245.3	36.4
9	08.9	01.3	69	68.2	10.1	29	127.6	18.9	89	186.9	27.7	49	246.3	36.5
10	09.9	01.5	70	69.2	10.3	30	128.6	19.1	90	187.9	27.9	50	247.3	36.7
11	10.9	01.6	71	70.2	10.4	131	129.6	19.2	191	188.9	28.0	251	248.3	36.8
12	11.9	01.8	72	71.2	10.6	32	130.6	19.4	92	189.9	28.2	52	249.3	37.0
13	12.9	01.9	73	72.2	10.7	33	131.6	19.5	93	190.9	28.3	53	250.3	37.1
14	13.8	02.1	74	73.2	10.8	34	132.5	19.6	94	191.9	28.5	54	251.3	37.3
15	14.8	02.2	75	74.2	11.0	35	133.5	19.8	95	192.9	28.6	55	252.2	37.4
16	15.8	02.3	76	75.2	11.1	36	134.5	19.9	96	193.9	28.7	56	253.2	37.5
17	16.8	02.5	77	76.2	11.2	37	135.5	20.1	97	194.8	28.9	57	254.2	37.7
18	17.8	02.6	78	77.1	11.4	38	136.5	20.2	98	195.8	29.0	58	255.2	37.8
19	18.8	02.8	79	78.1	11.6	39	137.5	20.4	99	196.8	29.2	59	256.2	38.0
20	19.8	02.9	80	79.1	11.7	40	138.5	20.5	200	197.8	29.3	60	257.2	38.1
21	20.8	03.1	81	80.1	11.9	141	139.5	20.7	201	198.8	29.5	261	258.2	38.3
22	21.8	03.2	82	81.1	12.0	42	140.5	20.8	02	199.8	29.6	62	259.1	38.4
23	22.7	03.4	83	82.1	12.2	43	141.4	21.0	03	200.8	29.8	63	260.1	38.6
24	23.7	03.5	84	83.1	12.3	44	142.4	21.1	04	201.8	29.9	64	261.1	38.7
25	24.7	03.7	85	84.1	12.5	45	143.4	21.3	05	202.8	30.1	65	262.1	38.9
26	25.7	03.8	86	85.1	12.6	46	144.4	21.4	06	203.8	30.2	66	263.1	39.0
27	26.7	04.0	87	86.1	12.8	47	145.4	21.6	07	204.7	30.4	67	264.1	39.2
28	27.7	04.1	88	87.0	12.9	48	146.4	21.7	08	205.7	30.5	68	265.1	39.3
29	28.7	04.3	89	88.0	13.0	49	147.4	21.8	09	206.7	30.6	69	266.1	39.5
30	29.7	04.4	90	89.0	13.2	50	148.4	22.0	10	207.7	30.8	70	267.1	39.6
31	30.7	04.5	91	90.0	13.3	151	149.4	22.1	211	208.7	30.9	271	268.1	39.7
32	31.7	04.7	92	91.0	13.5	52	150.3	22.3	12	209.7	31.1	72	269.0	39.9
33	32.6	04.8	93	92.0	13.6	53	151.3	22.4	13	210.7	31.2	73	270.0	40.0
34	33.6	05.0	94	93.0	13.8	54	152.3	22.6	14	211.7	31.4	74	271.0	40.2
35	34.6	05.1	95	94.0	13.9	55	153.3	22.7	15	212.7	31.5	75	272.0	40.3
36	35.6	05.3	96	95.0	14.1	56	154.3	22.9	16	213.7	31.7	76	273.0	40.5
37	36.6	05.4	97	95.9	14.2	57	155.3	23.0	17	214.6	31.8	77	274.0	40.6
38	37.6	05.6	98	96.9	14.4	58	156.3	23.2	18	215.6	32.0	78	275.0	40.8
39	38.6	05.7	99	97.9	14.5	59	157.3	23.3	19	216.6	32.1	79	276.0	40.9
40	39.6	05.9	100	98.9	14.7	60	158.3	23.5	20	217.6	32.3	80	277.0	41.1
41	40.6	06.0	101	99.9	14.8	161	159.2	23.6	221	218.6	32.4	281	277.9	41.2
42	41.5	06.2	02	100.9	15.0	62	160.2	23.8	22	219.6	32.6	82	278.9	41.4
43	42.5	06.3	03	101.9	15.1	63	161.2	23.9	23	220.6	32.7	83	279.9	41.5
44	43.5	06.5	04	102.9	15.3	64	162.2	24.0	24	221.6	32.8	84	280.9	41.6
45	44.5	06.6	05	103.9	15.4	65	163.2	24.2	25	222.6	33.0	85	281.9	41.8
46	45.5	06.7	06	104.8	15.5	66	164.2	24.3	26	223.5	33.1	86	282.9	41.9
47	46.5	06.9	07	105.8	15.7	67	165.2	24.5	27	224.5	33.3	87	283.9	42.1
48	47.5	07.0	08	106.8	15.8	68	166.2	24.6	28	225.5	33.4	88	284.9	42.2
49	48.5	07.2	09	107.8	16.0	69	167.2	24.8	29	226.5	33.6	89	285.9	42.4
50	49.5	07.3	10	108.8	16.1	70	168.1	24.9	30	227.5	33.7	90	286.9	42.5
51	50.4	07.5	111	109.8	16.3	171	169.1	25.1	231	228.5	33.9	291	287.8	42.7
52	51.4	07.6	12	110.8	16.4	72	170.1	25.2	32	229.5	34.0	92	288.8	42.8
53	52.4	07.8	13	111.8	16.6	73	171.1	25.4	33	230.5	34.2	93	289.8	43.0
54	53.4	07.9	14	112.8	16.7	74	172.1	25.5	34	231.5	34.3	94	290.8	43.1
55	54.4	08.1	15	113.7	16.9	75	173.1	25.7	35	232.4	34.5	95	291.8	43.3
56	55.4	08.2	16	114.7	17.0	76	174.1	25.8	36	233.4	34.6	96	292.8	43.4
57	56.4	08.4	17	115.7	17.2	77	175.1	26.0	37	234.4	34.8	97	293.8	43.6
58	57.4	08.5	18	116.7	17.3	78	176.1	26.1	38	235.4	34.9	98	294.8	43.7
59	58.4	08.6	19	117.7	17.5	79	177.1	26.3	39	236.4	35.0	99	295.8	43.8
60	59.3	08.8	20	118.7	17.6	80	178.0	26.4	40	237.4	35.2	300	296.8	44.0
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

[For $7\frac{1}{4}$ Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.2	61	59.8	11.9	121	118.7	23.6	181	177.5	35.3	241	236.3	47.0
2	02.0	00.4	62	60.8	12.1	22	119.6	23.8	82	178.5	35.5	42	237.3	47.2
3	02.9	00.6	63	61.8	12.3	23	120.6	24.0	83	179.5	35.7	43	238.3	47.4
4	03.9	00.8	64	62.8	12.5	24	121.6	24.2	84	180.4	35.9	44	239.3	47.6
5	04.9	01.0	65	63.7	12.7	25	122.6	24.4	85	181.4	36.1	45	240.3	47.8
6	05.9	01.2	66	64.7	12.9	26	123.6	24.6	86	182.4	36.3	46	241.2	48.0
7	06.9	01.4	67	65.7	13.1	27	124.5	24.8	87	183.4	36.5	47	242.2	48.2
8	07.8	01.6	68	66.7	13.3	28	125.5	25.0	88	184.4	36.7	48	243.2	48.4
9	08.8	01.8	69	67.7	13.5	29	126.5	25.2	89	185.3	36.9	49	244.2	48.6
10	09.8	02.0	70	68.6	13.7	30	127.5	25.4	90	186.3	37.1	50	245.2	48.8
11	10.8	02.1	71	69.6	13.9	131	128.5	25.6	191	187.3	37.3	251	246.1	49.0
12	11.8	02.3	72	70.6	14.0	32	129.5	25.8	92	188.3	37.5	52	247.1	49.2
13	12.7	02.5	73	71.6	14.2	33	130.4	26.0	93	189.3	37.7	53	248.1	49.4
14	13.7	02.7	74	72.6	14.4	34	131.4	26.1	94	190.2	37.9	54	249.1	49.6
15	14.7	02.9	75	73.6	14.6	35	132.4	26.3	95	191.2	38.0	55	250.1	49.8
16	15.7	03.1	76	74.5	14.8	36	133.4	26.5	96	192.2	38.2	56	251.1	50.0
17	16.7	03.3	77	75.5	15.0	37	134.4	26.7	97	193.2	38.4	57	252.1	50.1
18	17.7	03.5	78	76.5	15.2	38	135.3	26.9	98	194.2	38.6	58	253.0	50.3
19	18.6	03.7	79	77.5	15.4	39	136.3	27.1	99	195.2	38.8	59	254.0	50.5
20	19.6	03.9	80	78.5	15.6	40	137.3	27.3	200	196.1	39.0	60	255.0	50.7
21	20.6	04.1	81	79.4	15.8	141	138.3	27.5	201	197.1	39.2	261	256.0	50.9
22	21.6	04.3	82	80.4	16.0	42	139.3	27.7	02	198.1	39.4	62	256.9	51.1
23	22.6	04.5	83	81.4	16.2	43	140.2	27.9	03	199.1	39.6	63	257.9	51.3
24	23.5	04.7	84	82.4	16.4	44	141.2	28.1	04	200.1	39.8	64	258.9	51.5
25	24.5	04.9	85	83.4	16.6	45	142.2	28.3	05	201.0	40.0	65	259.9	51.7
26	25.5	05.1	86	84.3	16.8	46	143.2	28.5	06	202.0	40.2	66	260.9	51.9
27	26.5	05.3	87	85.3	17.0	47	144.2	28.7	07	203.0	40.4	67	261.8	52.1
28	27.5	05.5	88	86.3	17.2	48	145.1	28.9	08	204.0	40.6	68	262.8	52.3
29	28.4	05.7	89	87.3	17.4	49	146.1	29.1	09	205.0	40.8	69	263.8	52.5
30	29.4	05.9	90	88.3	17.6	50	147.1	29.2	10	205.9	41.0	70	264.8	52.7
31	30.4	06.0	91	89.2	17.8	151	148.1	29.5	211	206.9	41.2	271	265.8	52.9
32	31.4	06.2	92	90.2	18.0	52	149.1	29.7	12	207.9	41.4	72	266.7	53.1
33	32.4	06.4	93	91.2	18.1	53	150.0	29.9	13	208.9	41.6	73	267.7	53.3
34	33.3	06.6	94	92.2	18.3	54	151.0	30.0	14	209.9	41.8	74	268.7	53.5
35	34.3	06.8	95	93.2	18.5	55	152.0	30.2	15	210.8	42.0	75	269.7	53.7
36	35.3	07.0	96	94.1	18.7	56	153.0	30.4	16	211.8	42.1	76	270.7	53.9
37	36.3	07.2	97	95.1	18.9	57	154.0	30.6	17	212.8	42.3	77	271.6	54.0
38	37.3	07.4	98	96.1	19.1	58	154.9	30.8	18	213.8	42.5	78	272.6	54.2
39	38.2	07.6	99	97.1	19.3	59	155.9	31.0	19	214.8	42.7	79	273.6	54.4
40	39.2	07.8	100	98.1	19.5	60	156.9	31.2	20	215.7	42.9	80	274.6	54.6
41	40.2	08.0	101	99.1	19.7	161	157.9	31.4	221	216.7	43.1	281	275.6	54.8
42	41.2	08.2	02	100.0	19.9	62	158.9	31.6	22	217.7	43.3	82	276.5	55.0
43	42.2	08.4	03	101.0	20.1	63	159.8	31.8	23	218.7	43.5	83	277.5	55.2
44	43.2	08.6	04	102.0	20.3	64	160.8	32.0	24	219.7	43.7	84	278.5	55.4
45	44.1	08.8	05	103.0	20.5	65	161.8	32.2	25	220.6	43.9	85	279.5	55.6
46	45.1	09.0	06	104.0	20.7	66	162.8	32.4	26	221.6	44.1	86	280.5	55.8
47	46.1	09.2	07	104.9	20.9	67	163.8	32.6	27	222.6	44.3	87	281.5	56.0
48	47.1	09.4	08	105.9	21.1	68	164.7	32.8	28	223.6	44.5	88	282.4	56.2
49	48.1	09.6	09	106.9	21.3	69	165.7	33.0	29	224.6	44.7	89	283.4	56.4
50	49.0	09.8	10	107.9	21.5	70	166.7	33.2	30	225.6	44.9	90	284.4	56.6
51	50.0	10.0	111	108.9	21.7	171	167.7	33.4	231	226.5	45.1	291	285.4	56.8
52	51.0	10.1	12	109.8	21.9	72	168.7	33.6	32	227.5	45.3	92	286.4	57.0
53	52.0	10.3	13	110.8	22.0	73	169.7	33.8	33	228.5	45.5	93	287.3	57.2
54	53.0	10.5	14	111.8	22.2	74	170.6	34.0	34	229.5	45.7	94	288.3	57.4
55	53.9	10.7	15	112.8	22.4	75	171.6	34.1	35	230.5	45.9	95	289.3	57.6
56	54.9	10.9	16	113.8	22.6	76	172.6	34.3	36	231.4	46.0	96	290.3	57.8
57	55.9	11.1	17	114.7	22.8	77	173.6	34.5	37	232.4	46.2	97	291.3	58.0
58	56.9	11.3	18	115.7	23.0	78	174.6	34.7	38	233.4	46.4	98	292.2	58.1
59	57.9	11.5	19	116.7	23.2	79	175.5	34.9	39	234.4	46.6	99	293.2	58.3
60	58.8	11.7	20	117.7	23.4	80	176.5	35.1	40	235.4	46.8	300	294.2	58.5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

 [For 7 Points.

TABLE I. Difference of Latitude and Departure for $1\frac{1}{4}$ Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.2	61	59.2	14.8	121	117.4	29.4	181	175.6	44.0	241	233.8	58.6
2	01.9	00.5	62	60.1	15.1	22	118.3	29.6	82	176.5	44.2	42	234.7	58.8
3	02.9	00.7	63	61.1	15.3	23	119.3	29.9	83	177.5	44.5	43	235.7	59.0
4	03.9	01.0	64	62.1	15.6	24	120.3	30.1	84	178.5	44.7	44	236.7	59.3
5	04.9	01.2	65	63.1	15.8	25	121.3	30.4	85	179.5	45.0	45	237.7	59.5
6	05.8	01.5	66	64.0	16.0	26	122.2	30.6	86	180.4	45.2	46	238.6	59.8
7	06.8	01.7	67	65.0	16.3	27	123.2	30.9	87	181.4	45.4	47	239.6	60.0
8	07.8	01.9	68	66.0	16.5	28	124.2	31.1	88	182.4	45.7	48	240.6	60.3
9	08.7	02.2	69	66.9	16.8	29	125.1	31.3	89	183.3	45.9	49	241.5	60.5
10	09.7	02.4	70	67.9	17.0	30	126.1	31.6	90	184.3	46.2	50	242.5	60.7
11	10.7	02.7	71	68.9	17.3	131	127.1	31.8	191	185.3	46.4	251	243.5	61.0
12	11.6	02.9	72	69.8	17.5	32	128.0	32.1	92	186.2	46.7	52	244.4	61.2
13	12.6	03.2	73	70.8	17.7	33	129.0	32.3	93	187.2	46.9	53	245.4	61.5
14	13.6	03.4	74	71.8	18.0	34	130.0	32.6	94	188.2	47.1	54	246.4	61.7
15	14.6	03.6	75	72.8	18.2	35	131.0	32.8	95	189.2	47.4	55	247.4	62.0
16	15.5	03.9	76	73.7	18.5	36	131.9	33.0	96	190.1	47.6	56	248.3	62.2
17	16.5	04.1	77	74.7	18.7	37	132.9	33.3	97	191.1	47.9	57	249.3	62.5
18	17.5	04.4	78	75.7	19.0	38	133.9	33.5	98	192.1	48.1	58	250.3	62.7
19	18.4	04.6	79	76.6	19.2	39	134.8	33.8	99	193.0	48.4	59	251.2	62.9
20	19.4	04.9	80	77.6	19.4	40	135.8	34.0	200	194.0	48.6	60	252.2	63.2
21	20.4	05.1	81	78.6	19.7	141	136.8	34.3	201	195.0	48.8	261	253.2	63.4
22	21.3	05.3	82	79.5	19.9	42	137.7	34.5	02	195.9	49.1	62	254.1	63.7
23	22.3	05.6	83	80.5	20.2	43	138.7	34.7	03	196.9	49.3	63	255.1	63.9
24	23.3	05.8	84	81.5	20.4	44	139.7	35.0	04	197.9	49.6	64	256.1	64.2
25	24.3	06.1	85	82.5	20.7	45	140.7	35.2	05	198.9	49.8	65	257.1	64.4
26	25.2	06.3	86	83.4	20.9	46	141.6	35.5	06	199.8	50.1	66	258.0	64.6
27	26.2	06.6	87	84.4	21.1	47	142.6	35.7	07	200.8	50.3	67	259.0	64.9
28	27.2	06.8	88	85.4	21.4	48	143.6	36.0	08	201.8	50.5	68	260.0	65.1
29	28.1	07.0	89	86.3	21.6	49	144.5	36.2	09	202.7	50.8	69	260.9	65.4
30	29.1	07.3	90	87.3	21.9	50	145.5	36.5	10	203.7	51.0	70	261.9	65.6
31	30.1	07.5	91	88.3	22.1	151	146.5	36.7	211	204.7	51.3	271	262.9	65.9
32	31.0	07.8	92	89.2	22.4	52	147.4	36.9	12	205.6	51.5	72	263.8	66.1
33	32.0	08.0	93	90.2	22.6	53	148.4	37.2	13	206.6	51.8	73	264.8	66.3
34	33.0	08.3	94	91.2	22.8	54	149.4	37.4	14	207.6	52.0	74	265.8	66.6
35	34.0	08.5	95	92.2	23.1	55	150.4	37.7	15	208.6	52.2	75	266.8	66.8
36	34.9	08.7	96	93.1	23.3	56	151.3	37.9	16	209.5	32.5	76	267.7	67.1
37	35.9	09.0	97	94.1	23.6	57	152.3	38.2	17	210.5	52.7	77	268.7	67.3
38	36.9	09.2	98	95.1	23.8	58	153.3	38.4	18	211.5	53.0	78	269.7	67.6
39	37.8	09.5	99	96.0	24.1	59	154.2	38.6	19	212.4	53.2	79	270.6	67.8
40	38.8	09.7	100	97.0	24.3	60	155.2	38.9	20	213.4	53.5	80	271.6	68.0
41	39.8	10.0	101	98.0	24.5	161	156.2	39.1	221	214.4	53.7	281	272.6	68.3
42	40.7	10.2	02	98.9	24.8	62	157.1	39.4	22	215.3	53.9	82	273.5	68.5
43	41.7	10.4	03	99.9	25.0	63	158.1	39.6	23	216.3	54.2	83	274.5	68.8
44	42.7	10.7	04	100.9	25.3	64	159.1	39.9	24	217.3	54.4	84	275.5	69.0
45	43.7	10.9	05	101.9	25.5	65	160.1	40.1	25	218.3	54.7	85	276.5	69.3
46	44.6	11.2	06	102.8	25.8	66	161.0	40.3	26	219.2	54.9	86	277.4	69.5
47	45.6	11.4	07	103.8	26.0	67	162.0	40.6	27	220.2	55.2	87	278.4	69.7
48	46.6	11.7	08	104.8	26.2	68	163.0	40.8	28	221.2	55.4	88	279.4	70.0
49	47.5	11.9	09	105.7	26.5	69	163.9	41.1	29	222.1	55.6	89	280.3	70.2
50	48.5	12.2	10	106.7	26.7	70	164.9	41.3	30	223.1	55.9	90	281.3	70.5
51	49.5	12.4	111	107.7	27.0	171	165.9	41.6	231	224.1	56.1	291	282.3	70.7
52	50.4	12.6	12	108.6	27.2	72	166.8	41.8	32	225.0	56.4	92	283.2	71.0
53	51.4	12.9	13	109.6	27.5	73	167.8	42.0	33	226.0	56.6	93	284.2	71.2
54	52.4	13.1	14	110.6	27.7	74	168.8	42.3	34	227.0	56.9	94	285.2	71.4
55	53.4	13.4	15	111.6	27.9	75	169.8	42.5	35	228.0	57.1	95	286.2	71.7
56	54.3	13.6	16	112.5	28.2	76	170.7	42.8	36	228.9	57.3	96	287.1	71.9
57	55.3	13.9	17	113.5	28.4	77	171.7	43.0	37	229.9	57.6	97	288.1	72.2
58	56.3	14.1	18	114.5	28.7	78	172.7	43.3	38	230.9	57.8	98	289.1	72.4
59	57.2	14.3	19	115.4	28.9	79	173.6	43.5	39	231.8	58.1	99	290.0	72.7
60	58.2	14.6	20	116.4	29.2	80	174.6	43.7	40	232.8	58.3	300	291.0	72.9
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

[For $6\frac{3}{4}$ Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.3	61	58.4	17.7	121	115.8	35.1	181	173.2	52.5	241	230.6	69.9
2	01.9	00.6	62	59.3	18.0	22	116.8	35.4	82	174.2	52.8	42	231.6	70.2
3	02.9	00.9	63	60.3	18.3	23	117.7	35.7	83	175.1	53.1	43	232.5	70.5
4	03.8	01.2	64	61.2	18.6	24	118.7	36.0	84	176.1	53.4	44	233.5	70.8
5	04.8	01.5	65	62.2	18.9	25	119.6	36.3	85	177.0	53.7	45	234.5	71.0
6	05.7	01.7	66	63.2	19.1	26	120.6	36.5	86	178.0	53.9	46	235.4	71.3
7	06.7	02.0	67	64.1	19.4	27	121.5	36.8	87	179.0	54.2	47	236.4	71.6
8	07.7	02.3	68	65.1	19.7	28	122.5	37.1	88	179.9	54.5	48	237.3	71.9
9	08.6	02.6	69	66.0	20.0	29	123.5	37.4	89	180.9	54.8	49	238.3	72.2
10	09.6	02.9	70	67.0	20.3	30	124.4	37.7	90	181.8	55.1	50	239.2	72.5
11	10.5	03.2	71	67.9	20.6	131	125.4	38.0	191	182.8	55.4	251	240.2	72.8
12	11.5	03.5	72	68.9	20.9	32	126.3	38.3	92	183.7	55.7	52	241.2	73.1
13	12.4	03.8	73	69.9	21.2	33	127.3	38.6	93	184.7	56.0	53	242.1	73.4
14	13.4	04.1	74	70.8	21.5	34	128.2	38.9	94	185.7	56.3	54	243.1	73.7
15	14.4	04.4	75	71.8	21.8	35	129.2	39.2	95	186.6	56.6	55	244.0	74.0
16	15.3	04.6	76	72.7	22.0	36	130.2	39.4	96	187.6	56.8	56	245.0	74.2
17	16.3	04.9	77	73.7	22.3	37	131.1	39.7	97	188.5	57.1	57	245.9	74.5
18	17.2	05.2	78	74.6	22.6	38	132.1	40.0	98	189.5	57.4	58	246.9	74.8
19	18.2	05.5	79	75.6	22.9	39	133.0	40.3	99	190.4	57.7	59	247.9	75.1
20	19.1	05.8	80	76.6	23.2	40	134.0	40.6	200	191.4	58.0	60	248.8	75.4
21	20.1	06.1	81	77.5	23.5	141	134.9	40.9	201	192.4	58.3	261	249.8	75.7
22	21.1	06.4	82	78.5	23.8	42	135.9	41.2	02	193.3	58.6	62	250.7	76.0
23	22.0	06.7	83	79.4	24.1	43	136.9	41.5	03	194.3	58.9	63	251.7	76.3
24	23.0	07.0	84	80.4	24.4	44	137.8	41.8	04	195.2	59.2	64	252.6	76.6
25	23.9	07.3	85	81.3	24.7	45	138.8	42.1	05	196.2	59.5	65	253.6	76.9
26	24.9	07.5	86	82.3	24.9	46	139.7	42.3	06	197.1	59.7	66	254.6	77.1
27	25.9	07.8	87	83.3	25.2	47	140.7	42.6	07	198.1	60.0	67	255.5	77.4
28	26.8	08.1	88	84.2	25.5	48	141.6	42.9	08	199.1	60.3	68	256.5	77.7
29	27.8	08.4	89	85.2	25.8	49	142.6	43.2	09	200.0	60.6	69	257.4	78.0
30	28.7	08.7	90	86.1	26.1	50	143.5	43.5	10	201.0	60.9	70	258.4	78.3
31	29.7	09.0	91	87.1	26.4	151	144.5	43.8	211	201.9	61.2	271	259.3	78.6
32	30.6	09.3	92	88.0	26.7	52	145.5	44.1	12	202.9	61.5	72	260.3	78.9
33	31.6	09.6	93	89.0	27.0	53	146.4	44.4	13	203.8	61.8	73	261.3	79.2
34	32.5	09.9	94	90.0	27.3	54	147.4	44.7	14	204.8	62.1	74	262.2	79.5
35	33.5	10.2	95	90.9	27.6	55	148.3	45.0	15	205.8	62.4	75	263.2	79.8
36	34.5	10.4	96	91.9	27.8	56	149.3	45.2	16	206.7	62.6	76	264.1	80.0
37	35.4	10.7	97	92.8	28.1	57	150.2	45.5	17	207.7	62.9	77	265.1	80.3
38	36.4	11.0	98	93.8	28.4	58	151.2	45.8	18	208.6	63.2	78	266.0	80.6
39	37.3	11.3	99	94.7	28.7	59	152.2	46.1	19	209.6	63.5	79	267.0	80.9
40	38.3	11.6	100	95.7	29.0	60	153.1	46.4	20	210.5	63.8	80	268.0	81.2
41	39.2	11.9	101	96.7	29.3	161	154.1	46.7	221	211.5	64.1	281	268.9	81.5
42	40.2	12.2	02	97.6	29.6	62	155.0	47.0	22	212.5	64.4	82	269.9	81.8
43	41.2	12.5	03	98.6	29.9	63	156.0	47.3	23	213.4	64.7	83	270.8	82.1
44	42.1	12.8	04	99.5	30.2	64	156.9	47.6	24	214.4	65.0	84	271.8	82.4
45	43.1	13.1	05	100.5	30.5	65	157.9	47.9	25	215.3	65.3	85	272.7	82.7
46	44.0	13.3	06	101.4	30.7	66	158.9	48.1	26	216.3	65.5	86	273.7	82.9
47	45.0	13.6	07	102.4	31.0	67	159.8	48.4	27	217.2	65.8	87	274.7	83.2
48	45.9	13.9	08	103.4	31.3	68	160.8	48.7	28	218.2	66.1	88	275.6	83.5
49	46.9	14.2	09	104.3	31.6	69	161.7	49.0	29	219.2	66.4	89	276.6	83.8
50	47.9	14.5	10	105.3	31.9	70	162.7	49.3	30	220.1	66.7	90	277.5	84.1
51	48.8	14.8	111	106.2	32.2	171	163.6	49.6	231	221.1	67.0	291	278.5	84.4
52	49.8	15.1	12	107.2	32.5	72	164.6	49.9	32	222.0	67.3	92	279.4	84.7
53	50.7	15.4	13	108.1	32.8	73	165.6	50.2	33	223.0	67.6	93	280.4	85.0
54	51.7	15.7	14	109.1	33.1	74	166.5	50.5	34	223.9	67.9	94	281.4	85.3
55	52.6	16.0	15	110.1	33.4	75	167.5	50.8	35	224.9	68.2	95	282.3	85.6
56	53.6	16.2	16	111.0	33.6	76	168.4	51.0	36	225.9	68.4	96	283.3	85.8
57	54.5	16.5	17	112.0	33.9	77	169.4	51.3	37	226.8	68.7	97	284.2	86.1
58	55.5	16.8	18	112.9	34.2	78	170.3	51.6	38	227.8	69.0	98	285.2	86.4
59	56.5	17.1	19	113.9	34.5	79	171.3	51.9	39	228.7	69.3	99	286.1	86.7
60	57.4	17.4	20	114.8	34.8	80	172.3	52.2	40	229.7	69.6	300	287.1	87.0
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep	Lat.	Dist	Dep.	Lat.

[For 6½ Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.3	61	57.4	20.5	121	113.9	40.8	81	170.4	61.0	241	226.9	81.2
2	01.9	00.7	62	58.4	20.9	22	114.9	41.1	82	171.4	61.3	42	227.8	81.5
3	02.8	01.0	63	59.3	21.2	23	115.8	41.4	83	172.3	61.6	43	228.8	81.8
4	03.8	01.3	64	60.3	21.6	24	116.7	41.8	84	173.2	62.0	44	229.7	82.2
5	04.7	01.7	65	61.2	21.9	25	117.7	42.1	85	174.2	62.3	45	230.7	82.5
6	05.6	02.0	66	62.1	22.2	26	118.6	42.4	86	175.1	62.6	46	231.6	82.9
7	06.6	02.4	67	63.1	22.6	27	119.6	42.8	87	176.1	63.0	47	232.5	83.2
8	07.5	02.7	68	64.0	22.9	28	120.5	43.1	88	177.0	63.3	48	233.5	83.5
9	08.5	03.0	69	65.0	23.2	29	121.5	43.4	89	177.9	63.7	49	234.4	83.9
10	09.4	03.4	70	65.9	23.6	30	122.4	43.8	90	178.9	64.0	50	235.4	84.2
11	10.4	03.7	71	66.8	23.9	131	123.3	44.1	191	179.8	64.3	251	236.3	84.5
12	11.3	04.0	72	67.8	24.2	32	124.3	44.5	92	180.8	64.7	52	237.3	84.9
13	12.2	04.4	73	68.7	24.6	33	125.2	44.8	93	181.7	65.0	53	238.2	85.2
14	13.2	04.7	74	69.7	24.9	34	126.2	45.1	94	182.6	65.3	54	239.1	85.5
15	14.1	05.1	75	70.6	25.3	35	127.1	45.5	95	183.6	65.7	55	240.1	85.9
16	15.1	05.4	76	71.6	25.6	36	128.0	45.8	96	184.5	66.0	56	241.0	86.2
17	16.0	05.7	77	72.5	25.9	37	129.0	46.1	97	185.5	66.3	57	242.0	86.6
18	17.0	06.1	78	73.4	26.3	38	129.9	46.5	98	186.4	66.7	58	242.9	86.9
19	17.9	06.4	79	74.4	26.6	39	130.9	46.8	99	187.4	67.0	59	243.8	87.2
20	18.8	06.7	80	75.3	26.9	40	131.8	47.2	200	188.3	67.4	60	244.8	87.6
21	19.8	07.1	81	76.3	27.3	141	132.8	47.5	201	189.2	67.7	261	245.7	87.9
22	20.7	07.4	82	77.2	27.6	42	133.7	47.8	02	190.2	68.0	62	246.7	88.2
23	21.7	07.7	83	78.1	28.0	43	134.6	48.2	03	191.1	68.4	63	247.6	88.6
24	22.6	08.1	84	79.1	28.3	44	135.6	48.5	04	192.1	68.7	64	248.6	88.9
25	23.5	08.4	85	80.0	28.6	45	136.5	48.8	05	193.0	69.0	65	249.5	89.2
26	24.5	08.8	86	81.0	29.0	46	137.5	49.2	06	194.0	69.4	66	250.4	89.6
27	25.4	09.1	87	81.9	29.3	47	138.4	49.5	07	194.9	69.7	67	251.4	89.9
28	26.4	09.4	88	82.8	29.6	48	139.3	49.8	08	195.8	70.1	68	252.3	90.3
29	27.3	09.8	89	83.8	30.0	49	140.3	50.2	09	196.8	70.4	69	253.3	90.6
30	28.2	10.1	90	84.7	30.3	50	141.2	50.5	10	197.7	70.7	70	254.2	90.9
31	29.2	10.4	91	85.7	30.6	151	142.2	50.9	211	198.7	71.1	271	255.1	91.3
32	30.1	10.8	92	86.6	31.0	52	143.1	51.2	12	199.6	71.4	72	256.1	91.6
33	31.1	11.1	93	87.6	31.3	53	144.0	51.5	13	200.5	71.7	73	257.0	91.9
34	32.0	11.5	94	88.5	31.7	54	145.0	51.9	14	201.5	72.1	74	258.0	92.3
35	33.0	11.8	95	89.4	32.0	55	145.9	52.2	15	202.4	72.4	75	258.9	92.6
36	33.9	12.1	96	90.4	32.3	56	146.9	52.5	16	203.3	72.7	76	259.9	93.0
37	34.8	12.5	97	91.3	32.7	57	147.8	52.9	17	204.3	73.1	77	260.8	93.3
38	35.8	12.8	98	92.3	33.0	58	148.8	53.2	18	205.2	73.4	78	261.7	93.6
39	36.7	13.1	99	93.2	33.3	59	149.7	53.6	19	206.2	73.8	79	262.7	94.0
40	37.7	13.5	100	94.2	33.7	60	150.6	53.9	20	207.1	74.1	80	263.6	94.3
41	38.6	13.8	101	95.1	34.0	161	151.6	54.2	221	208.1	74.4	281	264.6	94.6
42	39.5	14.1	02	96.0	34.4	62	152.5	54.6	22	209.0	74.8	82	265.5	95.0
43	40.5	14.5	03	97.0	34.7	63	153.5	54.9	23	210.0	75.1	83	266.4	95.3
44	41.4	14.8	04	97.9	35.0	64	154.4	55.2	24	210.9	75.4	84	267.4	95.6
45	42.4	15.2	05	98.9	35.4	65	155.3	55.6	25	211.8	75.8	85	268.3	96.0
46	43.3	15.5	06	99.8	35.7	66	156.3	55.9	26	212.8	76.1	86	269.3	96.3
47	44.3	15.8	07	100.8	36.0	67	157.2	56.2	27	213.7	76.5	87	270.2	96.7
48	45.2	16.2	08	101.7	36.4	68	158.2	56.6	28	214.7	76.8	88	271.2	97.0
49	46.1	16.5	09	102.7	36.7	69	159.1	56.9	29	215.6	77.1	89	272.1	97.3
50	47.1	16.8	10	103.6	37.0	70	160.1	57.3	30	216.5	77.5	90	273.0	97.7
51	48.0	17.2	111	104.5	37.4	171	161.0	57.6	231	217.5	77.8	291	274.0	98.0
52	49.0	17.5	12	105.4	37.7	72	161.9	57.9	32	218.4	78.1	92	274.9	98.3
53	49.9	17.9	13	106.4	38.1	73	162.9	58.3	33	219.4	78.5	93	275.9	98.7
54	50.8	18.2	14	107.3	38.4	74	163.8	58.6	34	220.3	78.8	94	276.8	99.0
55	51.8	18.5	15	108.3	38.7	75	164.8	58.9	35	221.3	79.1	95	277.7	99.4
56	52.7	18.9	16	109.2	39.1	76	165.7	59.3	36	222.2	79.5	96	278.7	99.7
57	53.7	19.2	17	110.2	39.4	77	166.6	59.6	37	223.1	79.8	97	279.6	100.0
58	54.6	19.5	18	111.1	39.7	78	167.6	60.0	38	224.1	80.2	98	280.6	100.4
59	55.5	19.9	19	112.0	40.1	79	168.5	60.3	39	225.0	80.5	99	281.5	100.7
60	56.5	20.2	20	113.0	40.4	80	169.5	60.6	40	226.0	80.8	300	282.5	101.0
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.4	61	56.4	23.3	121	111.8	46.3	181	167.2	69.3	241	222.7	92.2
2	01.8	00.8	62	57.3	23.7	22	112.7	46.7	82	168.2	69.7	42	223.6	92.6
3	02.8	01.1	63	58.2	24.1	23	113.6	47.1	83	169.1	70.0	43	224.5	93.0
4	03.7	01.5	64	59.1	24.5	24	114.6	47.5	84	170.0	70.4	44	225.4	93.4
5	04.6	01.9	65	60.1	24.9	25	115.5	47.8	85	170.9	70.8	45	226.4	93.8
6	05.5	02.3	66	61.0	25.3	26	116.4	48.2	86	171.9	71.2	46	227.3	94.1
7	06.5	02.7	67	61.9	25.6	27	117.3	48.6	87	172.8	71.6	47	228.2	94.5
8	07.4	03.1	68	62.8	26.0	28	118.3	49.0	88	173.7	72.0	48	229.1	94.9
9	08.3	03.4	69	63.8	26.4	29	119.2	49.4	89	174.6	72.3	49	230.1	95.3
10	09.2	03.8	70	64.7	26.8	30	120.1	49.8	90	175.6	72.7	50	231.0	95.7
11	10.2	04.2	71	65.6	27.2	131	121.0	50.1	191	176.5	73.1	251	231.9	96.1
12	11.1	04.6	72	66.5	27.6	32	122.0	50.5	92	177.4	73.5	52	232.8	96.4
13	12.0	05.0	73	67.5	27.9	33	122.9	50.9	93	178.3	73.9	53	233.8	96.8
14	12.9	05.4	74	68.4	28.3	34	123.8	51.3	94	179.2	74.2	54	234.7	97.2
15	13.9	05.7	75	69.3	28.7	35	124.7	51.7	95	180.2	74.6	55	235.6	97.6
16	14.8	06.1	76	70.2	29.1	36	125.7	52.0	96	181.1	75.0	56	236.5	98.0
17	15.7	06.5	77	71.1	29.5	37	126.6	52.4	97	182.0	75.4	57	237.5	98.4
18	16.6	06.9	78	72.1	29.9	38	127.5	52.8	98	182.9	75.8	58	238.4	98.7
19	17.6	07.3	79	73.0	30.2	39	128.4	53.2	99	183.9	76.2	59	239.3	99.1
20	18.5	07.7	80	73.9	30.6	40	129.4	53.6	200	184.8	76.5	60	240.2	99.5
21	19.4	08.0	81	74.8	31.0	141	130.3	54.0	201	185.7	76.9	261	241.1	99.9
22	20.3	08.4	82	75.8	31.4	42	131.2	54.3	02	186.6	77.3	62	242.1	100.3
23	21.3	08.8	83	76.7	31.8	43	132.1	54.7	03	187.6	77.7	63	243.0	100.7
24	22.2	09.2	84	77.6	32.1	44	133.0	55.1	04	188.5	78.1	64	243.9	101.0
25	23.1	09.6	85	78.5	32.5	45	134.0	55.5	05	189.4	78.5	65	244.8	101.4
26	24.0	10.0	86	79.5	32.9	46	134.9	55.9	06	190.3	78.8	66	245.8	101.8
27	24.9	10.3	87	80.4	33.3	47	135.8	56.3	07	191.3	79.2	67	246.7	102.2
28	25.9	10.7	88	81.3	33.7	48	136.7	56.6	08	192.2	79.6	68	247.6	102.6
29	26.8	11.1	89	82.2	34.1	49	137.7	57.0	09	193.1	80.0	69	248.5	103.0
30	27.7	11.5	90	83.2	34.4	50	138.6	57.4	10	194.0	80.4	70	249.5	103.3
31	28.6	11.9	91	84.1	34.8	151	139.5	57.8	211	194.9	80.8	271	250.4	103.7
32	29.6	12.2	92	85.0	35.2	52	140.4	58.2	12	195.9	81.1	72	251.3	104.1
33	30.5	12.6	93	85.9	35.6	53	141.4	58.6	13	196.8	81.5	73	252.2	104.5
34	31.4	13.0	94	86.9	36.0	54	142.3	58.9	14	197.7	81.9	74	253.2	104.9
35	32.3	13.4	95	87.8	36.4	55	143.2	59.3	15	198.6	82.3	75	254.1	105.2
36	33.3	13.8	96	88.7	36.7	56	144.1	59.7	16	199.6	82.7	76	255.0	105.6
37	34.2	14.2	97	89.6	37.1	57	145.1	60.1	17	200.5	83.0	77	255.9	106.0
38	35.1	14.5	98	90.6	37.5	58	146.0	60.5	18	201.4	83.4	78	256.9	106.4
39	36.0	14.9	99	91.5	37.9	59	146.9	60.9	19	202.3	83.8	79	257.8	106.8
40	37.0	15.3	100	92.4	38.3	60	147.8	61.2	20	203.3	84.2	80	258.7	107.1
41	37.9	15.7	101	93.3	38.7	161	148.8	61.6	221	204.2	84.6	281	259.6	107.5
42	38.8	16.1	02	94.2	39.0	62	149.7	62.0	22	205.1	85.0	82	260.6	107.9
43	39.7	16.5	03	95.1	39.4	63	150.6	62.4	23	206.0	85.3	83	261.5	108.3
44	40.6	16.8	04	96.1	39.8	64	151.5	62.8	24	207.0	85.7	84	262.4	108.7
45	41.6	17.2	05	97.0	40.2	65	152.5	63.1	25	207.9	86.1	85	263.3	109.1
46	42.5	17.6	06	97.9	40.6	66	153.4	63.5	26	208.8	86.5	86	264.2	109.5
47	43.4	18.0	07	98.9	41.0	67	154.3	63.9	27	209.7	86.9	87	265.2	109.8
48	44.4	18.4	08	99.8	41.3	68	155.2	64.3	28	210.7	87.3	88	266.1	110.2
49	45.3	18.8	09	100.7	41.7	69	156.1	64.7	29	211.6	87.6	89	267.0	110.6
50	46.2	19.1	10	101.6	42.1	70	157.1	65.1	30	212.5	88.0	90	267.0	111.0
51	47.1	19.5	111	102.6	42.5	171	158.0	65.4	231	213.4	88.4	291	268.9	111.4
52	48.0	19.9	12	103.5	42.9	72	158.9	65.8	32	214.4	88.8	92	269.8	111.8
53	49.0	20.3	13	104.4	43.2	73	159.8	66.2	33	215.3	89.2	93	270.7	112.1
54	49.9	20.7	14	105.3	43.6	74	160.8	66.6	34	216.2	89.6	94	271.6	112.5
55	50.8	21.0	15	106.3	44.0	75	161.7	67.0	35	217.1	89.9	95	272.6	112.9
56	51.7	21.4	16	107.2	44.4	76	162.6	67.4	36	218.0	90.3	96	273.5	113.3
57	52.7	21.8	17	108.1	44.8	77	163.5	67.7	37	219.0	90.7	97	274.4	113.7
58	53.6	22.2	18	109.0	45.2	78	164.5	68.1	38	219.9	91.1	98	275.3	114.0
59	54.5	22.6	19	109.9	45.5	79	165.4	68.5	39	220.8	91.5	99	276.3	114.4
60	55.4	23.0	20	110.9	45.9	80	166.3	68.9	40	221.7	91.9	300	277.2	114.8
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.4	61	55.1	26.1	121	109.4	51.7	181	163.6	77.4	241	217.8	103.0
2	01.8	00.9	62	56.0	26.5	22	110.3	52.2	82	164.5	77.8	42	218.7	103.5
3	02.7	01.3	63	57.0	26.9	23	111.2	52.6	83	165.4	78.2	43	219.6	103.9
4	03.6	01.7	64	57.9	27.4	24	112.1	53.0	84	166.3	78.7	44	220.5	104.3
5	04.5	02.1	65	58.8	27.8	25	113.0	53.5	85	167.2	79.1	45	221.4	104.8
6	05.4	02.6	66	59.7	28.2	26	113.9	53.9	86	168.1	79.5	46	222.4	105.2
7	06.3	03.0	67	60.6	28.6	27	114.8	54.3	87	169.0	80.0	47	223.3	105.6
8	07.2	03.4	68	61.5	29.1	28	115.7	54.7	88	169.9	80.4	48	224.2	106.0
9	08.1	03.8	69	62.4	29.5	29	116.6	55.2	89	170.8	80.8	49	225.1	106.5
10	09.0	04.3	70	63.3	29.9	30	117.5	55.6	90	171.7	81.2	50	226.0	106.9
11	09.9	04.7	71	64.2	30.4	131	118.4	56.0	191	172.6	81.7	251	226.9	107.3
12	10.8	05.1	72	65.1	30.8	32	119.3	56.4	92	173.6	82.1	52	227.8	107.8
13	11.8	05.6	73	66.0	31.2	33	120.2	56.9	93	174.5	82.5	53	228.7	108.2
14	12.7	06.0	74	66.9	31.6	34	121.1	57.3	94	175.4	83.0	54	229.6	108.6
15	13.6	06.4	75	67.8	32.1	35	122.0	57.7	95	176.3	83.4	55	230.5	109.0
16	14.5	06.8	76	68.7	32.5	36	122.9	58.2	96	177.2	83.8	56	231.4	109.5
17	15.4	07.3	77	69.6	32.9	37	123.8	58.6	97	178.1	84.2	57	232.3	109.9
18	16.3	07.7	78	70.5	33.4	38	124.7	59.0	98	179.0	84.7	58	233.2	110.3
19	17.2	08.1	79	71.4	33.8	39	125.6	59.4	99	179.9	85.1	59	234.1	110.7
20	18.1	08.6	80	72.3	34.2	40	126.5	59.9	200	180.8	85.5	60	235.0	111.2
21	19.0	09.0	81	73.2	34.6	141	127.4	60.3	201	181.7	85.9	261	235.9	111.6
22	19.9	09.4	82	74.1	35.1	42	128.4	60.7	02	182.6	86.4	62	236.8	112.0
23	20.8	09.8	83	75.0	35.5	43	129.3	61.1	03	183.5	86.8	63	237.7	112.5
24	21.7	10.3	84	75.9	35.9	44	130.2	61.6	04	184.4	87.2	64	238.6	112.9
25	22.6	10.7	85	76.8	36.3	45	131.1	62.0	05	185.3	87.7	65	239.5	113.3
26	23.5	11.1	86	77.7	36.8	46	132.0	62.4	06	186.2	88.1	66	240.4	113.7
27	24.4	11.5	87	78.6	37.2	47	132.9	62.9	07	187.1	88.5	67	241.3	114.2
28	25.3	12.0	88	79.6	37.6	48	133.8	63.3	08	188.0	88.9	68	242.2	114.6
29	26.2	12.4	89	80.5	38.1	49	134.7	63.7	09	188.9	89.4	69	243.1	115.0
30	27.1	12.8	90	81.4	38.5	50	135.6	64.1	10	189.8	89.8	70	244.0	115.5
31	28.0	13.3	91	82.3	38.9	151	136.5	64.6	211	190.7	90.2	271	245.0	115.9
32	28.9	13.7	92	83.2	39.3	52	137.4	65.0	12	191.6	90.6	72	245.9	116.3
33	29.8	14.1	93	84.1	39.8	53	138.3	65.4	13	192.5	91.1	73	246.8	116.7
34	30.7	14.5	94	85.0	40.2	54	139.2	65.8	14	193.4	91.5	74	247.7	117.2
35	31.6	15.0	95	85.9	40.6	55	140.1	66.3	15	194.3	91.9	75	248.6	117.6
36	32.5	15.4	96	86.8	41.0	56	141.0	66.7	16	195.2	92.4	76	249.5	118.0
37	33.4	15.8	97	87.7	41.5	57	141.9	67.1	17	196.1	92.8	77	250.4	118.4
38	34.4	16.2	98	88.6	41.9	58	142.8	67.6	18	197.0	93.2	78	251.3	118.9
39	35.3	16.7	99	89.5	42.3	59	143.7	68.0	19	197.9	93.6	79	252.2	119.3
40	36.2	17.1	100	90.4	42.8	60	144.6	68.4	20	198.8	94.1	80	253.1	119.7
41	37.1	17.5	101	91.3	43.2	161	145.5	68.8	221	199.8	94.5	281	254.0	120.2
42	38.0	18.0	02	92.2	43.6	62	146.4	69.3	22	200.7	94.9	82	254.9	120.6
43	38.9	18.4	03	93.1	44.0	63	147.3	69.7	23	201.6	95.4	83	255.8	121.0
44	39.8	18.8	04	94.0	44.5	64	148.2	70.1	24	202.5	95.8	84	256.7	121.4
45	40.7	19.2	05	94.9	44.9	65	149.1	70.6	25	203.4	96.2	85	257.6	121.9
46	41.6	19.7	06	95.8	45.3	66	150.0	71.0	26	204.3	96.6	86	258.5	122.3
47	42.5	20.1	07	96.7	45.8	67	151.0	71.4	27	205.2	97.1	87	259.4	122.7
48	43.4	20.5	08	97.6	46.2	68	151.9	71.8	28	206.1	97.5	88	260.3	123.1
49	44.3	21.0	09	98.5	46.6	69	152.8	72.3	29	207.0	97.9	89	261.2	123.6
50	45.2	21.4	10	99.4	47.0	70	153.7	72.7	30	207.9	98.3	90	262.1	124.0
51	46.1	21.8	111	100.3	47.5	171	154.6	73.1	231	208.8	98.8	291	263.0	124.4
52	47.0	22.2	12	101.2	47.9	72	155.5	73.5	32	209.7	99.2	92	263.9	124.9
53	47.9	22.7	13	102.1	48.3	73	156.4	74.0	33	210.6	99.6	93	264.8	125.3
54	48.8	23.1	14	103.0	48.7	74	157.3	74.4	34	211.5	100.1	94	265.7	125.7
55	49.7	23.5	15	103.9	49.2	75	158.2	74.8	35	212.4	100.5	95	266.6	126.1
56	50.6	23.9	16	104.8	49.6	76	159.1	75.3	36	213.3	100.9	96	267.6	126.6
57	51.5	24.4	17	105.8	50.0	77	160.0	75.7	37	214.2	01.3	97	268.5	127.0
58	52.4	24.8	18	106.7	50.5	78	160.9	76.1	38	215.1	101.8	98	269.4	127.4
59	53.3	25.2	19	107.6	50.9	79	161.8	76.5	39	216.0	102.2	99	270.3	127.8
60	54.2	25.7	20	108.5	51.3	80	162.7	77.0	40	216.9	102.6	300	271.2	128.3
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.5	61	53.8	28.7	121	106.7	57.0	181	159.6	85.3	241	212.6	113.5
2	01.8	00.9	62	54.7	29.2	22	107.6	57.5	82	160.5	85.8	42	213.4	114.0
3	02.6	01.4	63	55.6	29.7	23	108.5	58.0	83	161.4	86.2	43	214.3	114.5
4	03.5	01.9	64	56.4	30.2	24	109.4	58.4	84	162.3	86.7	44	215.2	115.0
5	04.4	02.4	65	57.3	30.6	25	110.3	58.9	85	163.2	87.2	45	216.1	115.4
6	05.3	02.8	66	58.2	31.1	26	111.2	59.4	86	164.1	87.6	46	217.0	115.9
7	06.2	03.3	67	59.1	31.6	27	112.1	59.8	87	164.9	88.1	47	217.9	116.4
8	07.1	03.8	68	60.0	32.0	28	112.9	60.3	88	165.8	88.6	48	218.7	116.8
9	07.9	04.2	69	60.9	32.5	29	113.8	60.8	89	166.7	89.1	49	219.6	117.3
10	08.8	04.7	70	61.7	33.0	30	114.7	61.3	90	167.6	89.5	50	220.5	117.8
11	09.7	05.2	71	62.6	33.5	131	115.5	61.7	191	168.5	90.0	251	221.4	118.3
12	10.6	05.7	72	63.5	33.9	32	116.4	62.2	92	169.3	90.5	52	222.3	118.7
13	11.5	06.1	73	64.4	34.4	33	117.3	62.7	93	170.2	90.9	53	223.1	119.2
14	12.3	06.6	74	65.3	34.9	34	118.2	63.2	94	171.1	91.4	54	224.0	119.7
15	13.2	07.1	75	66.2	35.3	35	119.1	63.6	95	172.0	91.9	55	224.9	120.1
16	14.1	07.5	76	67.0	35.8	36	120.0	64.1	96	172.9	92.4	56	225.8	120.6
17	15.0	08.0	77	67.9	36.3	37	120.8	64.5	97	173.8	92.8	57	226.7	121.1
18	15.9	08.5	78	68.8	36.8	38	121.7	65.0	98	174.6	93.3	58	227.6	121.6
19	16.8	09.0	79	69.7	37.2	39	122.6	65.5	99	175.5	93.8	59	228.4	122.0
20	17.6	09.4	80	70.6	37.7	40	123.5	66.0	200	176.4	94.2	60	229.3	122.5
21	18.5	09.9	81	71.4	38.2	141	124.4	66.4	201	177.3	94.7	261	230.2	123.0
22	19.4	10.4	82	72.3	38.6	42	125.2	66.9	02	178.2	95.2	62	231.1	123.4
23	20.3	10.8	83	73.2	39.1	43	126.1	67.4	03	179.0	95.6	63	232.	123.9
24	21.2	11.3	84	74.1	39.6	44	127.0	67.8	04	179.9	96.1	64	232.8	124.4
25	22.1	11.8	85	75.0	40.1	45	127.9	68.3	05	180.8	96.6	65	233.7	124.9
26	22.9	12.3	86	75.9	40.5	46	128.8	68.8	06	181.7	97.1	66	234.6	125.3
27	23.8	12.7	87	76.7	41.0	47	129.6	69.3	07	182.6	97.5	67	235.5	125.8
28	24.7	13.2	88	77.6	41.5	48	130.5	69.7	08	183.5	98.0	68	236.4	126.3
29	25.6	13.7	89	78.5	42.0	49	131.4	70.2	09	184.3	98.5	69	237.3	126.8
30	26.5	14.1	90	79.4	42.4	50	132.3	70.7	10	185.2	98.9	70	238.1	127.2
31	27.3	14.6	91	80.3	42.9	151	133.2	71.1	211	186.1	99.4	271	239.0	127.7
32	28.2	15.1	92	81.1	43.4	52	134.1	71.6	12	187.0	99.9	72	239.9	128.2
33	29.1	15.5	93	82.0	43.8	53	134.9	72.1	13	187.9	100.4	73	240.8	128.6
34	30.0	16.0	94	82.9	44.3	54	135.8	72.6	14	188.7	100.8	74	241.7	129.1
35	30.9	16.5	95	83.8	44.8	55	136.7	73.0	15	189.6	101.3	75	242.5	129.6
36	31.7	17.0	96	84.7	45.2	56	137.6	73.5	16	190.5	101.8	76	243.4	130.0
37	32.6	17.4	97	85.6	45.7	57	138.5	74.0	17	191.4	102.2	77	244.3	130.5
38	33.5	17.9	98	86.4	46.2	58	139.4	74.4	18	192.3	102.7	78	245.2	131.0
39	34.4	18.4	99	87.3	46.6	59	140.2	74.9	19	193.2	103.2	79	246.1	131.5
40	35.3	18.8	100	88.2	47.1	60	141.1	75.4	20	194.0	103.7	80	247.0	131.9
41	36.2	19.3	101	89.1	47.6	161	142.0	75.9	221	194.9	104.1	281	247.8	132.4
42	37.0	19.8	02	90.0	48.1	62	142.9	76.3	22	195.8	104.6	82	248.7	132.9
43	37.9	20.3	03	90.8	48.5	63	143.8	76.8	23	196.7	105.1	83	249.6	133.3
44	38.8	20.7	04	91.7	49.0	64	144.6	77.3	24	197.6	105.5	84	250.5	133.8
45	39.7	21.2	05	92.6	49.5	65	145.5	77.7	25	198.4	106.0	85	251.4	134.3
46	40.6	21.7	06	93.5	49.9	66	146.4	77.2	26	199.3	106.5	86	252.3	134.8
47	41.5	22.1	07	94.4	50.4	67	147.3	78.7	27	200.2	107.0	87	253.1	135.2
48	42.3	22.6	08	95.3	50.9	68	148.2	78.2	28	201.1	107.4	88	254.0	135.7
49	43.2	23.1	09	96.1	51.4	69	149.1	79.6	29	202.0	107.9	89	254.9	136.2
50	44.1	23.6	10	97.0	51.8	70	149.9	80.1	30	202.9	108.4	90	255.8	136.6
51	45.0	24.0	111	97.9	52.3	171	150.8	80.6	231	203.7	108.8	291	256.7	137.1
52	45.9	24.5	12	98.8	52.8	72	151.7	81.0	32	204.6	109.3	92	257.5	137.6
53	46.7	25.0	13	99.7	53.2	73	152.6	81.5	33	205.5	109.8	93	258.4	138.1
54	47.6	25.4	14	100.5	53.7	74	153.5	82.0	34	206.4	110.3	94	259.3	138.5
55	48.5	25.9	15	101.4	54.2	75	154.3	82.5	35	207.3	110.7	95	260.2	139.0
56	49.4	26.4	16	102.3	54.7	76	155.2	82.9	36	208.2	111.2	96	261.1	139.5
57	50.3	26.9	17	103.2	55.1	77	156.1	83.4	37	209.0	111.7	97	262.0	139.9
58	51.2	27.3	18	104.1	55.6	78	157.0	83.9	38	209.9	112.1	98	262.8	140.4
59	52.0	27.8	19	105.0	56.1	79	157.9	84.3	39	210.8	112.6	99	263.7	140.9
60	52.9	28.3	20	105.8	56.5	80	158.8	84.8	40	211.7	113.1	300	264.6	141.4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep
1	00.9	00.6	61	52.3	31.4	121	103.8	62.2	181	155.2	93.0	241	206.7	123.9
2	01.7	01.0	62	53.2	31.9	22	104.6	62.7	82	156.1	93.5	42	207.6	124.4
3	02.6	01.5	63	54.0	32.4	23	105.5	63.2	83	157.0	94.0	43	208.4	124.9
4	03.4	02.1	64	54.9	32.9	24	106.4	63.7	84	157.8	94.6	44	209.3	125.4
5	04.3	02.6	65	55.8	33.4	25	107.2	64.2	85	158.7	95.1	45	210.1	125.9
6	05.1	03.1	66	56.6	33.9	26	108.1	64.8	86	159.5	95.6	46	211.0	126.4
7	06.0	03.6	67	57.5	34.4	27	108.9	65.3	87	160.4	96.1	47	211.9	126.9
8	06.9	04.1	68	58.3	35.0	28	109.8	65.8	88	161.2	96.6	48	212.7	127.4
9	07.7	04.6	69	59.2	35.5	29	110.6	66.3	89	162.1	97.1	49	213.6	128.0
10	08.6	05.1	70	60.0	36.0	30	111.5	66.8	90	163.0	97.6	50	214.4	128.5
11	09.4	05.7	71	60.9	36.5	131	112.4	67.3	191	163.8	98.2	251	215.3	129.0
12	10.3	06.2	72	61.8	37.0	32	113.2	67.8	92	164.7	98.7	52	216.1	129.5
13	11.2	06.7	73	62.6	37.6	33	114.1	68.4	93	165.5	99.2	53	217.0	130.0
14	12.0	07.2	74	63.5	38.1	34	114.9	68.9	94	166.4	99.7	54	217.9	130.5
15	12.9	07.7	75	64.3	38.6	35	115.8	69.4	95	167.3	100.2	55	218.7	131.0
16	13.7	08.2	76	65.2	39.1	36	116.6	69.9	96	168.1	100.7	56	219.6	131.5
17	14.6	08.7	77	66.0	39.6	37	117.5	70.4	97	169.0	101.2	57	220.4	132.1
18	15.4	09.3	78	66.9	40.1	38	118.4	70.9	98	169.8	101.8	58	221.3	132.6
19	16.3	09.8	79	67.8	40.6	39	119.2	71.4	99	170.7	102.3	59	222.1	133.1
20	17.2	10.3	80	68.6	41.1	40	120.1	72.0	200	171.5	102.8	60	223.0	133.6
21	18.0	10.8	81	69.5	41.6	141	120.9	72.5	201	172.4	103.3	261	223.9	134.1
22	18.9	11.3	82	70.3	42.2	42	121.8	73.0	02	173.3	103.8	62	224.7	134.6
23	19.7	11.8	83	71.2	42.7	43	122.7	73.5	03	174.1	104.3	63	225.6	135.2
24	20.6	12.3	84	72.0	43.2	44	123.5	74.0	04	175.0	104.8	64	226.4	135.7
25	21.4	12.9	85	72.9	43.7	45	124.4	74.6	05	175.8	105.4	65	227.3	136.2
26	22.3	13.4	86	73.8	44.2	46	125.2	75.1	06	176.7	105.9	66	228.1	136.7
27	23.2	13.9	87	74.6	44.7	47	126.1	75.6	07	177.5	106.4	67	229.0	137.2
28	24.0	14.4	88	75.5	45.2	48	126.9	76.1	08	178.4	106.9	68	229.9	137.7
29	24.9	14.9	89	76.3	45.7	49	127.8	76.6	09	179.3	107.4	69	230.7	138.2
30	25.7	15.4	90	77.2	46.3	50	128.7	77.1	10	180.1	107.9	70	231.6	138.8
31	26.6	15.9	91	78.1	46.8	151	129.5	77.6	211	181.0	108.4	271	232.4	139.3
32	27.4	16.4	92	78.9	47.3	52	130.4	78.1	12	181.8	109.0	72	233.3	139.8
33	28.3	17.0	93	79.8	47.8	53	131.2	78.6	13	182.7	109.5	73	234.2	140.3
34	29.2	17.5	94	80.6	48.3	54	132.1	79.1	14	183.5	110.0	74	235.0	140.8
35	30.0	18.0	95	81.5	48.8	55	132.9	79.7	15	184.4	110.5	75	235.9	141.3
36	30.9	18.5	96	82.3	49.3	56	133.8	80.2	16	185.3	111.0	76	236.7	141.8
37	31.7	19.0	97	83.2	49.9	57	134.7	80.7	17	186.1	111.5	77	237.6	142.4
38	32.6	19.5	98	84.1	50.4	58	135.5	81.2	18	187.0	112.0	78	238.4	142.9
39	33.5	20.0	99	84.9	50.9	59	136.4	81.7	19	187.8	112.6	79	239.3	143.4
40	34.3	20.6	100	85.8	51.4	60	137.2	82.2	20	188.7	113.1	80	240.2	143.9
41	35.2	21.1	101	86.6	51.9	161	138.1	82.7	221	189.6	113.6	281	241.0	144.4
42	36.0	21.6	02	87.5	52.4	62	138.9	83.3	22	190.4	114.1	82	241.9	144.9
43	36.9	22.1	03	88.3	52.9	63	139.8	83.8	23	191.3	114.6	83	242.7	145.4
44	37.7	22.6	04	89.2	53.4	64	140.7	84.3	24	192.1	115.1	84	243.6	146.0
45	38.6	23.1	05	90.1	54.0	65	141.5	84.8	25	193.0	115.6	85	244.4	146.5
46	39.5	23.6	06	90.9	54.5	66	142.4	85.3	26	193.8	116.1	86	245.3	147.0
47	40.3	24.2	07	91.8	55.0	67	143.2	85.8	27	194.7	116.7	87	246.2	147.5
48	41.2	24.7	08	92.6	55.5	68	144.1	86.3	28	195.6	117.2	88	247.0	148.0
49	42.0	25.2	09	93.5	56.0	69	145.0	86.9	29	196.4	117.7	89	247.9	148.5
50	42.9	25.7	10	94.3	56.5	70	145.8	87.4	30	197.3	118.2	90	248.7	149.0
51	43.7	26.2	11	95.2	57.0	171	146.7	87.9	231	198.1	118.7	291	249.6	149.6
52	44.6	26.7	12	96.1	57.6	72	147.5	88.4	32	199.0	119.2	92	250.4	150.1
53	45.5	27.2	13	96.9	58.1	73	148.4	88.9	33	199.8	119.7	93	251.3	150.6
54	46.3	27.8	14	97.8	58.6	74	149.2	89.4	34	200.7	120.3	94	252.2	151.1
55	47.2	28.3	15	98.6	59.1	75	150.1	89.9	35	201.6	120.8	95	253.0	151.6
56	48.0	28.8	16	99.5	59.6	76	151.0	90.4	36	202.4	121.3	96	253.9	152.1
57	48.9	29.3	17	100.4	60.1	77	151.8	91.0	37	203.3	121.8	97	254.7	152.6
58	49.7	29.8	18	101.2	60.6	78	152.7	91.5	38	204.1	122.3	98	255.6	153.1
59	50.6	30.3	19	102.1	61.2	79	153.5	92.0	39	205.0	122.8	99	256.5	153.7
60	51.5	30.8	120	102.9	61.7	80	154.4	92.5	40	205.8	123.3	300	257.3	154.2
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	50.7	33.9	121	100.6	67.2	181	150.5	100.5	241	200.4	133.9
2	01.7	01.1	62	51.5	34.4	22	101.4	67.8	82	151.3	101.1	42	201.2	134.4
3	02.5	01.7	63	52.4	35.0	23	102.3	68.3	83	152.1	101.7	43	202.0	135.0
4	03.3	02.2	64	53.2	35.6	24	103.1	68.9	84	153.0	102.2	44	202.8	135.6
5	04.2	02.8	65	54.0	36.1	25	103.9	69.4	85	153.8	102.8	45	203.7	136.1
6	05.0	03.3	66	54.9	36.7	26	104.8	70.0	86	154.6	103.3	46	204.5	136.7
7	05.8	03.9	67	55.7	37.2	27	105.6	70.5	87	155.5	103.9	47	205.3	137.2
8	06.7	04.4	68	56.5	37.8	28	106.4	71.1	88	156.3	104.4	48	206.2	137.8
9	07.5	05.0	69	57.4	38.3	29	107.2	71.7	89	157.1	105.0	49	207.0	138.3
10	08.3	05.6	70	58.2	38.9	30	108.1	72.2	90	158.0	105.5	50	207.8	138.9
11	09.1	06.1	71	59.0	39.4	131	108.9	72.8	191	158.8	106.1	251	208.7	139.4
12	10.0	06.7	72	59.9	40.0	32	109.7	73.3	92	159.6	106.7	52	209.5	140.0
13	10.8	07.2	73	60.7	40.6	33	110.6	73.9	93	160.4	107.2	53	210.3	140.6
14	11.6	07.8	74	61.5	41.1	34	111.4	74.4	94	161.3	107.8	54	211.2	141.1
15	12.5	08.3	75	62.4	41.7	35	112.2	75.0	95	162.1	108.3	55	212.0	141.7
16	13.3	08.9	76	63.2	42.2	36	113.1	75.5	96	162.9	108.9	56	212.8	142.2
17	14.1	09.4	77	64.0	42.8	37	113.9	76.1	97	163.8	109.4	57	213.7	142.8
18	15.0	10.0	78	64.8	43.3	38	114.7	76.7	98	164.6	110.0	58	214.5	143.3
19	15.8	10.6	79	65.7	43.9	39	115.6	77.2	99	165.4	110.5	59	215.3	143.9
20	16.6	11.1	80	66.5	44.4	40	116.4	77.8	200	166.3	111.1	60	216.1	144.4
21	17.5	11.7	81	67.3	45.0	141	117.2	78.3	201	167.1	111.7	261	217.0	145.0
22	18.3	12.2	82	68.2	45.6	42	118.1	78.9	02	167.9	112.2	62	217.8	145.5
23	19.1	12.8	83	69.0	46.1	43	118.9	79.4	03	168.8	112.8	63	218.6	146.1
24	20.0	13.3	84	69.8	46.7	44	119.7	80.0	04	169.6	113.3	64	219.5	146.7
25	20.8	13.9	85	70.7	47.2	45	120.5	80.5	05	170.4	113.9	65	220.3	147.2
26	21.6	14.4	86	71.5	47.8	46	121.4	81.1	06	171.3	114.4	66	221.1	147.8
27	22.4	15.0	87	72.3	48.3	47	122.2	81.7	07	172.1	115.0	67	222.0	148.3
28	23.3	15.6	88	73.2	48.9	48	123.0	82.2	08	172.9	115.5	68	222.8	148.9
29	24.1	16.1	89	74.0	49.4	49	123.9	82.8	09	173.8	116.1	69	223.6	149.4
30	24.9	16.7	90	74.8	50.0	50	124.7	83.3	10	174.6	116.7	70	224.5	150.0
31	25.8	17.2	91	75.7	50.6	151	125.5	83.9	211	175.4	117.2	271	225.3	150.5
32	26.6	17.8	92	76.5	51.1	52	126.4	84.4	12	176.2	117.8	72	226.1	151.1
33	27.4	18.3	93	77.3	51.7	53	127.2	85.0	13	177.1	118.3	73	227.0	151.7
34	28.3	18.9	94	78.1	52.2	54	128.0	85.5	14	177.9	118.9	74	227.8	152.2
35	29.1	19.4	95	79.0	52.8	55	128.9	86.1	15	178.7	119.4	75	228.6	152.8
36	29.9	20.0	96	79.8	53.3	56	129.7	86.7	16	179.6	120.0	76	229.4	153.3
37	30.8	20.6	97	80.6	53.9	57	130.5	87.2	17	180.4	120.5	77	230.3	153.9
38	31.6	21.1	98	81.5	54.4	58	131.4	87.8	18	181.2	121.1	78	231.1	154.4
39	32.4	21.7	99	82.3	55.0	59	132.2	88.3	19	182.1	121.7	79	231.9	155.0
40	33.3	22.2	100	83.1	55.6	60	133.0	88.9	20	182.9	122.2	80	232.8	155.5
41	34.1	22.8	101	84.0	56.1	161	133.8	89.4	221	183.7	122.8	281	233.6	156.1
42	34.9	23.3	02	84.8	56.7	62	134.7	90.0	22	184.6	123.3	82	234.4	156.7
43	35.8	23.9	03	85.6	57.2	63	135.5	90.5	23	185.4	123.9	83	235.3	157.2
44	36.6	24.4	04	86.5	57.8	64	136.3	91.1	24	186.2	124.4	84	236.1	157.8
45	37.4	25.0	05	87.3	58.3	65	137.2	91.7	25	187.1	125.0	85	236.9	158.3
46	38.2	25.6	06	88.1	58.9	66	138.0	92.2	26	187.9	125.5	86	237.8	158.9
47	39.1	26.1	07	89.0	59.4	67	138.8	92.8	27	188.7	126.1	87	238.6	159.4
48	39.9	26.7	08	89.8	60.0	68	139.7	93.3	28	189.5	126.7	88	239.4	160.0
49	40.7	27.2	09	90.6	60.5	69	140.5	93.9	29	190.4	127.2	89	240.3	160.5
50	41.6	27.8	10	91.4	61.1	70	141.3	94.4	30	191.2	127.8	90	241.1	161.1
51	42.4	28.3	11	92.3	61.7	171	142.2	95.0	231	192.0	128.3	291	241.9	161.7
52	43.2	28.9	12	93.1	62.2	72	143.0	95.5	32	192.9	128.9	92	242.8	162.2
53	44.1	29.4	13	93.9	62.8	73	143.8	96.1	33	193.7	129.4	93	243.6	162.8
54	44.9	30.0	14	94.8	63.3	74	144.7	96.7	34	194.5	130.0	94	244.4	163.3
55	45.7	30.6	15	95.6	63.9	75	145.5	97.2	35	195.4	130.5	95	245.2	163.9
56	46.6	31.1	16	96.4	64.4	76	146.3	97.8	36	196.2	131.1	96	246.1	164.4
57	47.4	31.7	17	97.3	65.0	77	147.1	98.3	37	197.0	131.7	97	246.9	165.0
58	48.2	32.2	18	98.1	65.5	78	148.0	98.9	38	197.9	132.2	98	247.7	165.5
59	49.1	32.8	19	98.9	66.1	79	148.8	99.4	39	198.7	132.8	99	248.5	166.1
60	49.9	33.3	120	99.8	66.7	80	149.6	100.0	40	199.5	133.3	300	249.4	166.7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	49.0	36.3	121	97.2	72.1	181	145.4	107.8	241	193.5	143.6
2	01.6	01.2	62	49.8	36.9	22	98,0	72.7	82	146.2	108.4	42	194.3	144.2
3	02.4	01,8	63	50.6	37.5	23	98.8	73.3	83	147.0	109.0	43	195.1	144.8
4	03.2	02.4	64	51,4	38.1	24	99.6	73.9	84	147.8	109.6	44	195.9	145.4
5	04.0	03.0	65	52,2	38.7	25	100.4	74.5	85	148.6	110.2	45	196.7	146.0
6	04.8	03.6	66	53.0	39.3	26	101.2	75.1	86	149.4	110.8	46	197.5	146.6
7	05.6	04.2	67	53.8	39.9	27	102.0	75.7	87	150.2	111.4	47	198.4	147.1
8	06.4	04.8	68	54.6	40.5	28	102.8	76.3	88	151.0	112.0	48	199.2	147.7
9	07.2	05.4	69	55.4	41.1	29	103.6	76.9	89	151.8	112.6	49	200.0	148.3
10	08.0	06.0	70	56.2	41.7	30	104.4	77.4	90	152.6	113.2	50	200.8	148.9
11	08.8	06.6	71	57.0	42.3	131	105.2	78.0	191	153.4	113.8	251	201.6	149.5
12	09.6	07.1	72	57.8	42.9	32	106.0	78.6	92	154.2	114.4	52	202.4	150.1
13	10.4	07.7	73	58.6	43.5	33	106.8	79.2	93	155.0	115.0	53	203.2	150.7
14	11.2	08.3	74	59.4	44.1	34	107.6	79.8	94	155.8	115.6	54	204.0	151.3
15	12.0	08.9	75	60.2	44.7	35	108.4	80.4	95	156.6	116.2	55	204.8	151.9
16	12.8	09.5	76	61.0	45.3	36	109.2	81.0	96	157.4	116.8	56	205.6	152.5
17	13.7	10.1	77	61.8	45.9	37	110.0	81.6	97	158.2	117.4	57	206.4	153.1
18	14.5	10.7	78	62.6	46,5	38	110.8	82.2	98	159.0	118.0	58	207.2	153,7
19	15.3	11.3	79	63.4	47.1	39	111.6	82.8	99	159.8	118.6	59	208.0	154.3
20	16.1	11.9	80	64.2	47.7	40	112.4	83.4	200	160.6	119.1	60	208.8	154.9
21	16.9	12.5	81	65.0	48.3	141	113.2	84.0	201	161.4	119.7	261	209.6	155.5
22	17.7	13.1	82	65.8	48.9	42	114.0	84.6	02	162.2	120.3	62	210.4	156.1
23	18.5	13.7	83	66.7	49.4	43	114.8	85.2	03	163.0	120.9	63	211.2	156.7
24	19.3	14.3	84	67.5	50.0	44	115.6	85.8	04	163.8	121.5	64	212.0	157.3
25	20.1	14.9	85	68.3	50.6	45	116.4	86.4	05	164,6	122.1	65	212.8	157.9
26	20.9	15.5	86	69.1	51.2	46	117.2	87,0	06	165.4	122.7	66	213.6	158,5
27	21.7	16.1	87	69.9	51.8	47	118.0	87.6	07	166.2	123.3	67	214.4	159.1
28	22,5	16.7	88	70.7	52.4	48	118.8	88.2	08	167.0	123.9	68	215.2	159.7
29	23.3	17.3	89	71.5	53.0	49	119.7	88.8	09	167,8	124.5	69	216.0	160.3
30	24.1	17.9	90	72.3	53.6	50	120.5	89.4	10	168.6	125.1	70	216.8	160.9
31	24.9	18.5	91	73.1	54.2	151	121.3	90.0	211	169.4	125.7	271	217.6	161.4
32	25.7	19.1	92	73.9	54.8	52	122.1	90.6	12	170.2	126.3	72	218.4	162.0
33	26.5	19.7	93	74.7	55.4	53	122.9	91.1	13	171.0	126.9	73	219.2	162.6
34	27.3	20.3	94	75.5	56.0	54	123,7	91.7	14	171.8	127.5	74	220.0	163.2
35	28.1	20.9	95	76.3	56.6	55	124.5	92.3	15	172.7	128.1	75	220.8	163.8
36	28.9	21.4	96	77.1	57.2	56	125.3	92.9	16	173.5	128.7	76	221.6	164.4
37	29.7	22.0	97	77.9	57.8	57	126.1	93.5	17	174.3	129.3	77	222.4	165.0
38	30.5	22.6	98	78.7	58.4	58	126.9	94.1	18	175.1	129.9	78	223.2	165.6
39	31.3	23,2	99	79.5	59.0	59	127,7	94.7	19	175.9	130.5	79	224.0	166.2
40	32.1	23,8	100	80.3	59.6	60	128.5	95.3	20	176.7	131.1	80	224.8	166.8
41	32.9	24.4	101	81.1	60.2	161	129.3	95.9	221	177.5	131.7	281	225.7	167.4
42	33.7	25.0	02	81.9	60.8	62	130,1	96.5	22	178.3	132.3	82	226.5	168.0
43	34.5	25.6	03	82.7	61.4	63	130.9	97.1	23	179.1	132.9	83	227.3	168.6
44	35.3	26.2	04	83,5	62.0	64	131.7	97.7	24	179.9	133.4	84	228.1	169,2
45	36.1	26.8	05	84.3	62.6	65	132.5	98,3	25	180.7	134.0	85	228.9	169,8
46	36.9	27.4	06	85.1	63.1	66	133.3	98.9	26	181.5	134.6	86	229.7	170.4
47	37.7	28.0	07	85.9	63.7	67	134.1	99.5	27	182.3	135.2	87	230.5	171.0
48	38.5	28,6	08	86.7	64.3	68	134.9	100.1	28	183.1	135.8	88	231.3	171.6
49	39.3	29.2	09	87.5	64.9	69	135.7	100.7	29	183.9	136.4	89	232.1	172.2
50	40.2	29.8	10	88.3	65.5	70	136.5	101.3	30	184.7	137.0	90	232.9	172,8
51	41.0	30.4	111	89.1	66.1	71	137.3	101.9	231	185.5	137.6	291	233.7	173.4
52	41.8	31.0	12	89.9	66.7	72	138.1	102,5	32	186.3	138.2	92	234.5	174.0
53	42.6	31.6	13	90.7	67.3	73	138.9	103.1	33	187.1	138.8	93	235.3	174.6
54	43.4	32.2	14	91.5	67.9	74	139.7	103.7	34	187.9	139.4	94	236.1	175,1
55	44.2	32,8	15	92.4	68.5	75	140.5	104.3	35	188.7	140.0	95	236.9	175.7
56	45.0	33.4	16	93.2	69.1	76	141.3	104.9	36	189.5	140.6	96	237.7	176.3
57	45.8	34.0	17	94.0	69.7	77	142.1	105.4	37	190.3	141.2	97	238.5	176.9
58	46.6	34.6	18	94.8	70.3	78	142.9	106.0	38	191.1	141.8	98	239.3	177.5
59	47.4	35.1	19	95.6	70,9	79	143.7	106.6	39	191.9	142.4	99	240.1	178.1
60	48.2	35.7	20	96.4	71.5	80	144.5	107.2	40	192.7	143.0	300	240.9	178.7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	47.1	38.7	121	93.5	76.7	181	139.9	114.8	241	186.2	152
2	01.5	01.3	62	47.9	39.3	22	94.3	77.4	82	140.6	115.4	42	187.0	153
3	02.3	01.9	63	48.7	40.0	23	95.1	78.0	83	141.4	116.0	43	187.8	154
4	03.1	02.5	64	49.5	40.6	24	95.8	78.6	84	142.2	116.6	44	188.6	154
5	03.9	03.2	65	50.2	41.2	25	96.6	79.3	85	143.0	117.3	45	189.3	155
6	04.6	03.8	66	51.0	41.9	26	97.4	79.9	86	143.7	118.0	46	190.1	156
7	05.4	04.4	67	51.8	42.5	27	98.1	80.5	87	144.5	118.6	47	190.9	156
8	06.2	05.1	68	52.6	43.1	28	98.9	81.2	88	145.3	119.2	48	191.6	157
9	07.0	05.7	69	53.3	43.8	29	99.7	81.8	89	146.1	119.9	49	192.4	157
10	07.7	06.3	70	54.1	44.4	30	100.5	82.4	90	146.8	120.5	50	193.2	158
11	08.5	07.0	71	54.9	45.0	131	101.2	83.1	191	147.6	121.1	251	194.0	159
12	09.3	07.6	72	55.6	45.7	32	102.0	83.7	92	148.4	121.8	52	194.7	159
13	10.1	08.2	73	56.4	46.3	33	102.8	84.3	93	149.1	122.4	53	195.5	160
14	10.8	08.9	74	57.2	46.9	34	103.6	85.0	94	149.9	123.0	54	196.3	161
15	11.6	09.5	75	58.0	47.6	35	104.3	85.6	95	150.7	123.7	55	197.1	161
16	12.4	10.1	76	58.7	48.2	36	105.1	86.2	96	151.4	124.3	56	197.8	162
17	13.1	10.8	77	59.5	48.8	37	105.9	86.9	97	152.2	124.9	57	198.6	163
18	13.9	11.4	78	60.3	49.5	38	106.6	87.5	98	153.0	125.6	58	199.4	163
19	14.7	12.0	79	61.1	50.1	39	107.4	88.1	99	153.8	126.2	59	200.1	164
20	15.5	12.7	80	61.8	50.7	40	108.2	88.8	200	154.6	126.8	60	200.9	164
21	16.2	13.3	81	62.6	51.4	141	109.0	89.4	201	155.3	127.5	261	201.7	165
22	17.0	14.0	82	63.4	52.0	42	109.7	90.0	02	156.1	128.1	62	202.5	166
23	17.8	14.6	83	64.1	52.6	43	110.5	90.7	03	156.9	128.7	63	203.2	166
24	18.5	15.2	84	64.9	53.3	44	111.3	91.3	04	157.6	129.4	64	204.0	167
25	19.3	15.9	85	65.7	53.9	45	112.1	92.0	05	158.4	130.0	65	204.8	168
26	20.1	16.5	86	66.5	54.5	46	112.8	92.6	06	159.2	130.6	66	205.6	168
27	20.9	17.1	87	67.2	55.2	47	113.6	93.2	07	160.0	131.3	67	206.3	169
28	21.6	17.8	88	68.0	55.8	48	114.4	93.9	08	160.7	131.9	68	207.1	170
29	22.4	18.4	89	68.8	56.4	49	115.1	94.5	09	161.5	132.5	69	207.9	170
30	23.2	19.0	90	69.6	57.1	50	115.9	95.1	10	162.3	133.2	70	208.6	171
31	24.0	19.7	91	70.3	57.7	151	116.7	95.8	211	163.1	133.8	271	209.4	171
32	24.7	20.3	92	71.1	58.3	52	117.5	96.4	12	163.8	134.4	72	210.2	172
33	25.5	20.9	93	71.9	59.0	53	118.2	97.0	13	164.6	135.1	73	211.0	173
34	26.3	21.6	94	72.6	59.6	54	119.0	97.7	14	165.4	135.7	74	211.7	173
35	27.1	22.2	95	73.4	60.2	55	119.8	98.3	15	166.1	136.3	75	212.5	174
36	27.8	22.8	96	74.2	60.9	56	120.6	98.9	16	166.9	137.0	76	213.3	175
37	28.6	23.5	97	75.0	61.5	57	121.3	99.6	17	167.7	137.6	77	214.1	175
38	29.4	24.1	98	75.7	62.1	58	122.1	100.2	18	168.5	138.2	78	214.8	176
39	30.1	24.7	99	76.5	62.8	59	122.9	100.8	19	169.2	138.9	79	215.6	176
40	30.9	25.4	100	77.2	63.4	60	123.6	101.5	20	170.0	139.5	80	216.4	177
41	31.7	26.0	101	78.0	64.0	161	124.4	102.1	221	170.8	140.1	281	217.1	178
42	32.5	26.6	02	78.8	64.7	62	125.2	102.7	22	171.6	140.8	82	217.9	178
43	33.2	27.3	03	79.6	65.3	63	126.0	103.4	23	172.3	141.4	83	218.7	179
44	34.0	27.9	04	80.4	66.0	64	126.7	104.0	24	173.1	142.0	84	219.5	180
45	34.8	28.5	05	81.1	66.6	65	127.5	104.6	25	173.9	142.7	85	220.2	180
46	35.6	29.2	06	81.9	67.2	66	128.3	105.3	26	174.6	143.3	86	221.0	181
47	36.3	29.8	07	82.7	67.9	67	129.1	105.9	27	175.4	144.0	87	221.8	182
48	37.1	30.4	08	83.5	68.5	68	129.8	106.5	28	176.2	144.6	88	222.6	182
49	37.9	31.1	09	84.2	69.1	69	130.6	107.2	29	177.0	145.2	89	223.3	183
50	38.6	31.7	10	85.0	69.8	70	131.4	107.8	30	177.7	145.9	90	224.1	18[illegible]
51	39.4	32.3	111	85.8	70.4	171	132.1	108.4	231	178.5	146.5	291	224.9	184
52	40.2	33.0	12	86.6	71.0	72	132.9	109.1	32	179.3	147.2	92	225.6	185
53	41.0	33.6	13	87.3	71.7	73	133.7	109.7	33	180.1	147.8	93	226.4	185
54	41.7	34.2	14	88.1	72.3	74	134.5	110.3	34	180.8	148.4	94	227.2	186
55	42.5	34.9	15	88.9	72.9	75	135.2	111.0	35	181.6	149.0	95	228.0	187
56	43.3	35.5	16	89.6	73.6	76	136.0	111.6	36	182.4	149.7	96	228.7	187
57	44.1	36.1	17	90.4	74.2	77	136.8	112.2	37	183.1	150.3	97	229.5	188
58	44.8	36.8	18	91.2	74.8	78	137.6	112.9	38	183.9	150.9	98	230.3	189
59	45.6	37.4	19	92.0	75.5	79	138.3	113.5	39	184.7	151.6	99	231.1	189
60	46.4	38.0	20	92.7	76.1	80	139.1	114.1	40	185.5	152.2	300	231.8	19[illegible]
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.7	00.7	61	45.2	41.0	121	89.6	81.2	181	134.1	121.5	241	178.5	161.8
2	01.5	01.3	62	45.9	41.6	22	90.4	81.9	82	134.8	122.2	42	179.3	162.5
3	02.2	02.0	63	46.7	42.3	23	91.1	82.6	83	135.6	122.9	43	180.0	163.2
4	03.0	02.7	64	47.4	43.0	24	91.9	83.3	84	136.3	123.5	44	180.7	163.8
5	03.7	03.4	65	48.2	43.6	25	92.6	83.9	85	137.0	124.2	45	181.5	164.5
6	04.4	04.0	66	48.9	44.3	26	93.3	84.6	86	137.8	124.9	46	182.2	165.2
7	05.2	04.7	67	49.6	45.0	27	94.1	85.3	87	138.5	125.6	47	183.0	165.8
8	05.9	05.4	68	50.4	45.7	28	94.8	85.9	88	139.3	126.2	48	183.7	166.5
9	06.7	06.0	69	51.1	46.3	29	95.6	86.6	89	140.0	126.9	49	184.4	167.2
10	07.4	06.7	70	51.9	47.0	30	96.3	87.3	90	140.7	127.6	50	185.2	167.9
11	08.2	07.4	71	52.6	47.7	131	97.0	88.0	191	141.5	128.2	251	185.9	168.5
12	08.9	08.1	72	53.3	48.3	32	97.8	88.6	92	142.2	128.9	52	186.7	169.2
13	09.6	08.7	73	54.1	49.0	33	98.5	89.3	93	143.0	129.6	53	187.4	169.9
14	10.4	09.4	74	54.8	49.7	34	99.3	90.0	94	143.7	130.3	54	188.2	170.5
15	11.1	10.1	75	55.6	50.4	35	100.0	90.6	95	144.4	130.9	55	188.9	171.2
16	11.9	10.7	76	56.3	51.0	36	100.7	91.3	96	145.2	131.6	56	189.6	171.9
17	12.6	11.4	77	57.0	51.7	37	101.5	92.0	97	145.9	132.3	57	190.4	172.6
18	13.3	12.1	78	57.8	52.4	38	102.2	92.7	98	146.7	132.9	58	191.1	173.2
19	14.1	12.8	79	58.5	53.0	39	103.0	93.3	99	147.4	133.6	59	191.9	173.9
20	14.8	13.4	80	59.3	53.7	40	103.7	94.0	200	148.2	134.3	60	192.6	174.6
21	15.6	14.1	81	60.0	54.4	141	104.4	94.7	201	148.9	135.0	261	193.3	175.2
22	16.3	14.8	82	60.7	55.1	42	105.2	95.3	02	149.6	135.6	62	194.1	175.9
23	17.0	15.4	83	61.5	55.8	43	105.9	96.0	03	150.4	136.3	63	194.8	176.6
24	17.8	16.1	84	62.2	56.4	44	106.7	96.7	04	151.1	137.0	64	195.6	177.3
25	18.5	16.8	85	63.0	57.1	45	107.4	97.4	05	151.9	137.6	65	196.3	177.9
26	19.3	17.5	86	63.7	57.7	46	108.2	98.0	06	152.6	138.3	66	197.0	178.6
27	20.0	18.1	87	64.4	58.4	47	108.9	98.7	07	153.3	139.0	67	197.8	179.3
28	20.7	18.8	88	65.2	59.1	48	109.6	99.4	08	154.1	139.7	68	198.5	179.9
29	21.5	19.5	89	65.9	59.8	49	110.4	100.0	09	154.8	140.3	69	199.3	180.6
30	22.2	20.1	90	66.7	60.4	50	111.1	100.7	10	155.6	141.0	70	200.0	181.3
31	23.0	20.8	91	67.4	61.1	151	111.9	101.4	211	156.3	141.7	271	200.7	182.0
32	23.7	21.5	92	68.2	61.8	52	112.6	102.1	12	157.0	142.3	72	201.5	182.6
33	24.4	22.2	93	68.9	62.4	53	113.3	102.7	13	157.8	143.0	73	202.2	183.3
34	25.2	22.8	94	69.6	63.1	54	114.1	103.4	14	158.5	143.7	74	203.0	184.0
35	25.9	23.5	95	70.4	63.8	55	114.8	104.1	15	159.3	144.4	75	203.7	184.6
36	26.7	24.2	96	71.1	64.5	56	115.6	104.7	16	160.0	145.0	76	204.4	185.3
37	27.4	24.8	97	71.9	65.1	57	116.3	105.4	17	160.7	145.7	77	205.2	186.0
38	28.2	25.5	98	72.6	65.8	58	117.0	106.1	18	161.5	146.4	78	205.9	186.7
39	28.9	26.2	99	73.3	66.5	59	117.8	106.8	19	162.2	147.0	79	206.7	187.3
40	29.6	26.9	100	74.1	67.1	60	118.5	107.4	20	163.0	147.7	80	207.4	188.0
41	30.4	27.5	101	74.8	67.8	161	119.3	108.1	221	163.7	148.4	281	208.2	188.7
42	31.1	28.2	02	75.6	68.5	62	120.0	108.8	22	164.4	149.1	82	208.9	189.3
43	31.9	28.9	03	76.3	69.2	63	120.7	109.4	23	165.2	149.7	83	209.6	190.0
44	32.6	29.5	04	77.0	69.8	64	121.5	110.1	24	165.9	150.4	84	210.4	190.7
45	33.3	30.2	05	77.8	70.5	65	122.2	110.8	25	166.7	151.1	85	211.1	191.4
46	34.1	30.9	06	78.5	71.2	66	123.0	111.5	26	167.4	151.7	86	211.9	192.0
47	34.8	31.6	07	79.3	71.8	67	123.7	112.1	27	168.2	152.4	87	212.6	192.7
48	35.6	32.2	08	80.0	72.5	68	124.4	112.8	28	168.9	153.1	88	213.3	193.4
49	36.3	32.9	09	80.7	73.2	69	125.2	113.5	29	169.6	153.8	89	214.1	194.0
50	37.0	33.6	10	81.5	73.9	70	125.9	114.1	30	170.4	154.5	90	214.8	194.7
51	37.8	34.2	111	82.2	74.5	171	126.7	114.8	231	171.1	155.1	291	215.6	195.4
52	38.5	34.9	12	83.0	75.2	72	127.4	115.5	32	171.9	155.8	92	216.3	196.1
53	39.3	35.6	13	83.7	75.9	73	128.2	116.2	33	172.6	156.4	93	217.0	196.7
54	40.0	36.3	14	84.4	76.5	74	128.9	116.8	34	173.3	157.1	94	217.8	197.4
55	40.7	36.9	15	85.2	77.2	75	129.6	117.5	35	174.1	157.8	95	218.5	198.1
56	41.5	37.6	16	85.9	77.9	76	130.4	118.2	36	174.8	158.5	96	219.3	198.7
57	42.2	38.3	17	86.7	78.6	77	131.1	118.8	37	175.6	159.1	97	220.0	199.4
58	43.0	38.9	18	87.5	79.2	78	131.9	119.5	38	176.3	159.8	98	220.7	200.1
59	43.7	39.6	19	88.2	79.9	79	132.6	120.2	39	177.0	160.5	99	221.5	200.8
60	44.5	40.3	20	88.9	80.6	80	133.3	120.9	40	177.8	161.1	300	222.2	201.4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.7	00.7	61	43.1	43.1	121	85.6	85.6	181	128.0	128.0	241	170.4	170.4
2	01.4	01.4	62	43.8	43.8	22	86.3	86.3	82	128.7	128.7	42	171.1	171.1
3	02.1	02.1	63	44.5	44.5	23	87.0	87.0	83	129.4	129.4	43	171.8	171.8
4	02.8	02.8	64	45.3	45.3	24	87.7	87.7	84	130.1	130.1	44	172.5	172.5
5	03.5	03.5	65	46.0	46.0	25	88.4	88.4	85	130.8	130.8	45	173.2	173.2
6	04.2	04.2	66	46.7	46.7	26	89.1	89.1	86	131.5	131.5	46	173.9	173.9
7	04.9	04.9	67	47.4	47.4	27	89.8	89.8	87	132.2	132.2	47	174.6	174.6
8	05.7	05.7	68	48.1	48.1	28	90.5	90.5	88	132.9	132.9	48	175.4	175.4
9	06.4	06.4	69	48.8	48.8	29	91.2	91.2	89	133.6	133.6	49	176.1	176.1
10	07.1	07.1	70	49.5	49.5	30	91.9	91.9	90	134.3	134.3	50	176.8	176.8
11	07.8	07.8	71	50.2	50.2	131	92.7	92.7	191	135.1	135.1	251	177.5	177.5
12	08.5	08.5	72	50.9	50.9	32	93.3	93.3	92	135.8	135.8	52	178.2	178.2
13	09.2	09.2	73	51.6	51.6	33	94.0	94.0	93	136.5	136.5	53	178.9	178.9
14	09.9	09.9	74	52.3	52.3	34	94.7	94.7	94	137.2	137.2	54	179.6	179.6
15	10.6	10.6	75	53.0	53.0	35	95.5	95.5	95	137.9	137.9	55	180.3	180.3
16	11.3	11.3	76	53.7	53.7	36	96.2	96.2	96	138.6	138.6	56	181.0	181.0
17	12.0	12.0	77	54.4	54.4	37	96.9	96.9	97	139.3	139.3	57	181.7	181.7
18	12.7	12.7	78	55.2	55.2	38	97.6	97.6	98	140.0	140.0	58	182.4	182.4
19	13.4	13.4	79	55.9	55.9	39	98.3	98.3	99	140.7	140.7	59	183.1	183.1
20	14.1	14.1	80	56.6	56.6	40	99.0	99.0	200	141.4	141.4	60	183.8	183.8
21	14.8	14.8	81	57.3	57.3	141	99.7	99.7	201	142.1	142.1	261	184.5	184.5
22	15.6	15.6	82	58.0	58.0	42	100.4	100.4	02	142.8	142.8	62	185.3	185.3
23	16.3	16.3	83	58.7	58.7	43	101.1	101.1	03	143.5	143.5	63	186.0	186.0
24	17.0	17.0	84	59.4	59.4	44	101.8	101.8	04	144.2	144.2	64	186.7	186.7
25	17.7	17.7	85	60.1	60.1	45	102.5	102.5	05	144.9	144.9	65	187.4	187.4
26	18.4	18.4	86	60.8	60.8	46	103.2	103.2	06	145.7	145.7	66	188.1	188.1
27	19.1	19.1	87	61.5	61.5	47	103.9	103.9	07	146.4	146.4	67	188.8	188.8
28	19.8	19.8	88	62.2	62.2	48	104.6	104.6	08	147.1	147.1	68	189.5	189.5
29	20.5	20.5	89	62.9	62.9	49	105.4	105.4	09	147.8	147.8	69	190.2	190.2
30	21.2	21.2	90	63.6	63.6	50	106.1	106.1	10	148.5	148.5	70	190.9	190.9
31	21.9	21.9	91	64.3	64.3	151	106.8	106.8	211	149.2	149.2	271	191.6	191.6
32	22.6	22.6	92	65.1	65.1	52	107.5	107.5	12	149.9	149.9	72	192.3	192.3
33	23.3	23.3	93	65.8	65.8	53	108.2	108.2	13	150.6	150.6	73	193.0	193.0
34	24.0	24.0	94	66.5	66.5	54	108.9	108.9	14	151.3	151.3	74	193.7	193.7
35	24.7	24.7	95	67.2	67.2	55	109.6	109.6	15	152.0	152.0	75	194.4	194.4
36	25.5	25.5	96	67.9	67.9	56	110.3	110.3	16	152.7	152.7	76	195.2	195.2
37	26.2	26.2	97	68.6	68.6	57	111.0	111.0	17	153.4	153.4	77	195.9	195.9
38	26.9	26.9	98	69.3	69.3	58	111.7	111.7	18	154.1	154.1	78	196.6	196.6
39	27.6	27.6	99	70.0	70.0	59	112.4	112.4	19	154.8	154.8	79	197.3	197.3
40	28.3	28.3	100	70.7	70.7	60	113.1	113.1	20	155.6	155.6	80	198.0	198.0
41	29.0	29.0	101	71.4	71.4	161	113.8	113.8	221	156.3	156.3	281	198.7	198.7
42	29.7	29.7	02	72.1	72.1	62	114.5	114.5	22	157.0	157.0	82	199.4	199.4
43	30.4	30.4	03	72.8	72.8	63	115.3	115.3	23	157.7	157.7	83	200.1	200.1
44	31.1	31.1	04	73.5	73.5	64	116.0	116.0	24	158.4	158.4	84	200.8	200.8
45	31.8	31.8	05	74.2	74.2	65	116.7	116.7	25	159.1	159.1	85	201.5	201.5
46	32.5	32.5	06	74.9	74.9	66	117.4	117.4	26	159.8	159.8	86	202.2	202.2
47	33.2	33.2	07	75.7	75.7	67	118.1	118.1	27	160.5	160.5	87	202.9	202.9
48	33.9	33.9	08	76.4	76.4	68	118.8	118.8	28	161.2	161.2	88	203.6	203.6
49	34.6	34.6	09	77.1	77.1	69	119.5	119.5	29	161.9	161.9	89	204.3	204.3
50	35.4	35.4	10	77.8	77.8	70	120.2	120.2	30	162.6	162.6	90	205.1	205.1
51	36.1	36.1	111	78.5	78.5	171	120.9	120.9	231	163.3	163.3	291	205.8	205.8
52	36.8	36.8	12	79.2	79.2	72	121.6	121.6	32	164.0	164.0	92	206.5	206.5
53	37.5	37.5	13	79.9	79.9	73	122.3	122.3	33	164.7	164.7	93	207.2	207.2
54	38.2	38.2	14	80.6	80.6	74	123.0	123.0	34	165.5	165.5	94	207.9	207.9
55	38.9	38.9	15	81.3	81.3	75	123.7	123.7	35	166.2	166.2	95	208.6	208.6
56	39.6	39.6	16	82.0	82.0	76	124.4	124.4	36	166.9	166.9	96	209.3	209.3
57	40.3	40.3	17	82.7	82.7	77	125.2	125.2	37	167.6	167.6	97	210.0	210.0
58	41.0	41.0	18	83.4	83.4	78	125.9	125.9	38	168.3	168.3	98	210.7	210.7
59	41.7	41.7	19	84.1	84.1	79	126.6	126.6	39	169.0	169.0	99	211.4	211.4
60	42.4	42.4	20	84.8	84.8	80	127.3	127.3	40	169.7	169.7	300	212.1	212.1
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

[For 4 Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.0	61	61.0	01.1	121	121.0	02.1	181	181.0	03.1	241	241.0	04.1
2	02.0	00.0	62	62.0	01.1	22	122.0	02.1	82	182.0	03.1	42	242.0	04.2
3	03.0	00.1	63	63.0	01.1	23	123.0	02.1	83	183.0	03.2	43	243.0	04.2
4	04.0	00.1	64	64.0	01.1	24	124.0	02.2	84	184.0	03.2	44	244.0	04.2
5	05.0	00.1	65	65.0	01.1	25	125.0	02.2	85	185.0	03.2	45	245.0	04.2
6	06.0	00.1	66	66.0	01.2	26	126.0	02.2	86	186.0	03.2	46	246.0	04.2
7	07.0	00.1	67	67.0	01.2	27	127.0	02.2	87	187.0	03.2	47	247.0	04.2
8	08.0	00.1	68	68.0	01.2	28	128.0	02.2	88	188.0	03.2	48	248.0	04.3
9	09.0	00.2	69	69.0	01.2	29	129.0	02.2	89	189.0	03.3	49	249.0	04.3
10	10.0	00.2	70	70.0	01.2	30	130.0	02.3	90	190.0	03.3	50	250.0	04.3
11	11.0	00.2	71	71.0	01.2	131	131.0	02.3	191	191.0	03.3	251	251.0	04.3
12	12.0	00.2	72	72.0	01.3	32	132.0	02.3	92	192.0	03.3	52	252.0	04.3
13	13.0	00.2	73	73.0	01.3	33	133.0	02.3	93	193.0	03.3	53	253.0	04.3
14	14.0	00.2	74	74.0	01.3	34	134.0	02.3	94	194.0	03.3	54	254.0	04.4
15	15.0	00.3	75	75.0	01.3	35	135.0	02.3	95	195.0	03.4	55	255.0	04.4
16	16.0	00.3	76	76.0	01.3	36	136.0	02.4	96	196.0	03.4	56	256.0	04.4
17	17.0	00.3	77	77.0	01.3	37	137.0	02.4	97	197.0	03.4	57	257.0	04.4
18	18.0	00.3	78	78.0	01.4	38	138.0	02.4	98	198.0	03.4	58	258.0	04.4
19	19.0	00.3	79	79.0	01.4	39	139.0	02.4	99	199.0	03.4	59	259.0	04.4
20	20.0	00.4	80	80.0	01.4	40	140.0	02.4	200	200.0	03.4	60	260.0	04.5
21	21.0	00.4	81	81.0	01.4	141	141.0	02.4	201	201.0	03.5	261	261.0	04.5
22	22.0	00.4	82	82.0	01.4	42	142.0	02.5	02	202.0	03.5	62	262.0	04.5
23	23.0	00.4	83	83.0	01.5	43	143.0	02.5	03	203.0	03.5	63	263.0	04.5
24	24.0	00.4	84	84.0	01.5	44	144.0	02.5	04	204.0	03.5	64	264.0	04.5
25	25.0	00.4	85	85.0	01.5	45	145.0	02.5	05	205.0	03.5	65	265.0	04.6
26	26.0	00.5	86	86.0	01.5	46	146.0	02.5	06	206.0	03.5	66	266.0	04.6
27	27.0	00.5	87	87.0	01.5	47	147.0	02.5	07	207.0	03.6	67	267.0	04.6
28	28.0	00.5	88	88.0	01.6	48	148.0	02.6	08	208.0	03.6	68	268.0	04.6
29	29.0	00.5	89	89.0	01.6	49	149.0	02.6	09	209.0	03.6	69	269.0	04.6
30	30.0	00.5	90	90.0	01.6	50	150.0	02.6	10	210.0	03.6	70	270.0	04.6
31	31.0	00.5	91	91.0	01.6	151	151.0	02.6	211	211.0	03.6	271	271.0	04.7
32	32.0	00.6	92	92.0	01.6	52	152.0	02.6	12	212.0	03.6	72	272.0	04.7
33	33.0	00.6	93	93.0	01.6	53	153.0	02.6	13	213.0	03.7	73	273.0	04.7
34	34.0	00.6	94	94.0	01.6	54	154.0	02.7	14	214.0	03.7	74	274.0	04.7
35	35.0	00.6	95	95.0	01.7	55	155.0	02.7	15	215.0	03.7	75	275.0	04.7
36	36.0	00.6	96	96.0	01.7	56	156.0	02.7	16	216.0	03.7	76	276.0	04.7
37	37.0	00.6	97	97.0	01.7	57	157.0	02.7	17	217.0	03.7	77	277.0	04.8
38	38.0	00.7	98	98.0	01.7	58	158.0	02.7	18	218.0	03.8	78	278.0	04.8
39	39.0	00.7	99	99.0	01.7	59	159.0	02.7	19	219.0	03.8	79	279.0	04.8
40	40.0	00.7	100	100.0	01.7	60	160.0	02.8	20	220.0	03.8	80	280.0	04.8
41	41.0	00.7	101	101.0	01.8	161	161.0	02.8	221	221.0	03.8	281	281.0	04.8
42	42.0	00.7	02	102.0	01.8	62	162.0	02.8	22	222.0	03.8	82	282.0	04.8
43	43.0	00.8	03	103.0	01.8	63	163.0	02.8	23	223.0	03.8	83	283.0	04.9
44	44.0	00.8	04	104.0	01.8	6	164.0	02.8	24	224.0	03.9	84	284.0	04.9
45	45.0	00.8	05	105.0	01.8	65	165.0	02.9	25	225.0	03.9	85	285.0	04.9
46	46.0	00.8	06	106.0	01.8	66	166.0	02.9	26	226.0	03.9	86	286.0	04.9
47	47.0	00.8	07	107.0	01.9	67	167.0	02.9	27	227.0	03.9	87	287.0	04.9
48	48.0	00.8	08	108.0	01.9	68	168.0	02.9	28	228.0	03.9	88	288.0	04.9
49	49.0	00.9	09	109.0	01.9	69	169.0	02.9	29	229.0	03.9	89	289.0	05.0
50	50.0	00.9	10	110.0	01.9	70	170.0	02.9	30	230.0	04.0	90	290.0	05.0
51	51.0	00.9	111	111.0	01.9	171	171.0	03.0	231	231.0	04.0	291	291.0	05.0
52	52.0	00.9	12	112.0	01.9	72	172.0	03.0	32	232.0	04.0	92	292.0	05.0
53	53.0	00.9	13	113.0	02.0	73	173.0	03.0	33	233.0	04.0	93	293.0	05.0
54	54.0	00.9	14	114.0	02.0	74	174.0	03.0	34	234.0	04.0	94	294.0	05.0
55	55.0	01.0	15	115.0	02.0	75	175.0	03.0	35	235.0	04.0	95	295.0	05.1
56	56.0	01.0	16	116.0	02.0	76	176.0	03.0	36	236.0	04.1	96	296.0	05.1
57	57.0	01.0	17	117.0	02.0	77	177.0	03.1	37	237.0	04.1	97	297.0	05.1
58	58.0	01.0	18	118.0	02.1	78	178.0	03.1	38	238.0	04.1	98	298.0	05.1
59	59.0	01.0	19	119.0	02.1	79	179.0	03.1	39	239.0	04.1	99	299.0	05.1
60	60.0	01.1	20	120.0	02.1	80	180.0	03.1	40	240.0	04.1	300	300.0	05.1
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

[For 89 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.0	61	61.0	02.1	121	120.9	04.2	181	180.9	06.3	241	240.9	08.4
2	02.0	00.1	62	62.0	02.2	22	121.9	04.3	82	181.9	06.4	42	241.9	08.5
3	03.0	00.1	63	63.0	02.2	23	122.9	04.3	83	182.9	06.4	43	242.9	08.5
4	04.0	00.1	64	64.0	02.2	24	123.9	04.3	84	183.9	06.4	44	243.9	08.5
5	05.0	00.2	65	65.0	02.3	25	124.9	04.4	85	184.9	06.5	45	244.9	08.6
6	06.0	00.2	66	66.0	02.3	26	125.9	04.4	86	185.9	06.5	46	245.9	08.6
7	07.0	00.2	67	67.0	02.3	27	126.9	04.4	87	186.9	06.5	47	246.9	08.6
8	08.0	00.3	68	68.0	02.4	28	127.9	04.5	88	187.9	06.6	48	247.9	08.7
9	09.0	00.3	69	69.0	02.4	29	128.9	04.5	89	188.9	06.6	49	248.9	08.7
10	10.0	00.3	70	70.0	02.4	30	129.9	04.6	90	189.9	06.7	50	249.9	08.8
11	11.0	00.4	71	71.0	02.5	131	130.9	04.6	191	190.9	06.7	251	250.8	08.8
12	12.0	00.4	72	72.0	02.5	32	131.9	04.6	92	191.9	06.7	52	251.8	08.8
13	13.0	00.5	73	73.0	02.5	33	132.9	04.7	93	192.9	06.8	53	252.8	08.9
14	14.0	00.5	74	74.0	02.6	34	133.9	04.7	94	193.9	06.8	54	253.8	08.9
15	15.0	00.5	75	75.0	02.6	35	134.9	04.7	95	194.9	06.8	55	254.8	08.9
16	16.0	00.6	76	76.0	02.7	36	135.9	04.8	96	195.9	06.9	56	255.8	09.0
17	17.0	00.6	77	77.0	02.7	37	136.9	04.8	97	196.9	06.9	57	256.8	09.0
18	18.0	00.6	78	78.0	02.7	38	137.9	04.8	98	197.9	06.9	58	257.8	09.0
19	19.0	00.7	79	79.0	02.8	39	138.9	04.9	99	198.9	07.0	59	258.8	09.1
20	20.0	00.7	80	80.0	02.8	40	139.9	04.9	200	199.9	07.0	60	259.8	09.1
21	21.0	00.7	81	81.0	02.8	141	140.9	04.9	201	200.9	07.0	261	260.8	09.1
22	22.0	00.8	82	81.9	02.9	42	141.9	05.0	02	201.9	07.1	62	261.8	09.2
23	23.0	00.8	83	82.9	02.9	43	142.9	05.0	03	202.9	07.1	63	262.8	09.2
24	24.0	00.8	84	83.9	02.9	44	143.9	05.0	04	203.9	07.1	64	263.8	09.2
25	25.0	00.9	85	84.9	03.0	45	144.9	05.1	05	204.9	07.2	65	264.8	09.3
26	26.0	00.9	86	85.9	03.0	46	145.9	05.1	06	205.9	07.2	66	265.8	09.3
27	27.0	00.9	87	86.9	03.0	47	146.9	05.1	07	206.9	07.2	67	266.8	09.3
28	28.0	01.0	88	87.9	03.1	48	147.9	05.2	08	207.9	07.3	68	267.8	09.4
29	29.0	01.0	89	88.9	03.1	49	148.9	05.2	09	208.9	07.3	69	268.8	09.4
30	30.0	01.1	90	89.9	03.1	50	149.9	05.3	10	209.9	07.4	70	269.8	09.5
31	31.0	01.1	91	90.9	03.2	151	150.9	05.3	211	210.9	07.4	271	270.8	09.5
32	32.0	01.1	92	91.9	03.2	52	151.9	05.3	12	211.9	07.4	72	271.8	09.5
33	33.0	01.2	93	92.9	03.2	53	152.9	05.4	13	212.9	07.5	73	272.8	09.6
34	34.0	01.2	94	93.9	03.3	54	153.9	05.4	14	213.9	07.5	74	273.8	09.6
35	35.0	01.2	95	94.9	03.3	55	154.9	05.4	15	214.9	07.5	75	274.8	09.6
36	36.0	01.3	96	95.9	03.4	56	155.9	05.5	16	215.9	07.6	76	275.8	09.7
37	37.0	01.3	97	96.9	03.4	57	156.9	05.5	17	216.9	07.6	77	276.8	09.7
38	38.0	01.3	98	97.9	03.4	58	157.9	05.5	18	217.9	07.6	78	277.8	09.7
39	39.0	01.4	99	98.9	03.5	59	158.9	05.6	19	218.9	07.7	79	278.8	09.8
40	40.0	01.4	100	99.9	03.5	60	159.9	05.6	20	219.9	07.7	80	279.8	09.8
41	41.0	01.4	101	100.9	03.5	161	160.9	05.6	221	220.9	07.7	281	280.8	09.8
42	42.0	01.5	02	101.9	03.6	62	161.9	05.7	22	221.9	07.8	82	281.8	09.9
43	43.0	01.5	03	102.9	03.6	63	162.9	05.7	23	222.9	07.8	83	282.8	09.9
44	44.0	01.5	04	103.9	03.6	64	163.9	05.7	24	223.9	07.8	84	283.8	09.9
45	45.0	01.6	05	104.9	03.7	65	164.9	05.8	25	224.9	07.9	85	284.8	10.0
46	46.0	01.6	06	105.9	03.7	66	165.9	05.8	26	225.9	07.9	86	285.8	10.0
47	47.0	01.6	07	106.9	03.7	67	166.9	05.8	27	226.9	07.9	87	286.8	10.0
48	48.0	01.7	08	107.9	03.8	68	167.9	05.9	28	227.9	08.0	88	287.8	10.1
49	49.0	01.7	09	108.9	03.8	69	168.9	05.9	29	228.9	08.0	89	288.8	10.1
50	50.0	01.7	10	109.9	03.8	70	169.9	06.0	30	229.9	08.1	90	289.8	10.2
51	51.0	01.8	111	110.9	03.9	171	170.9	06.0	231	230.9	08.1	291	290.8	10.2
52	52.0	01.8	12	111.9	03.9	72	171.9	06.0	32	231.9	08.1	92	291.8	10.2
53	53.0	01.8	13	112.9	04.0	73	172.9	06.1	33	232.9	08.2	93	292.8	10.3
54	54.0	01.9	14	113.9	04.0	74	173.9	06.1	34	233.9	08.2	94	293.8	10.3
55	55.0	01.9	15	114.9	04.0	75	174.9	06.1	35	234.9	08.2	95	294.8	10.3
56	56.0	02.0	16	115.9	04.1	76	175.9	06.2	36	235.9	08.3	96	295.8	10.4
57	57.0	02.0	17	116.9	04.1	77	176.9	06.2	37	236.9	08.3	97	296.8	10.4
58	58.0	02.0	18	117.9	04.1	78	177.9	06.2	38	237.9	08.3	98	297.8	10.4
59	59.0	02.1	19	118.9	04.2	79	178.9	06.3	39	238.9	08.4	99	298.8	10.5
60	60.0	02.1	20	119.9	04.2	80	179.9	06.3	40	239.9	08.4	300	299.8	10.5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.1	61	60.9	03.2	121	120.8	06.3	181	180.7	09.5	241	240.7	12.6
2	02.0	00.1	62	61.9	03.2	22	121.8	06.4	82	181.7	09.5	42	241.7	12.7
3	03.0	00.2	63	62.9	03.3	23	122.8	06.4	83	182.7	09.6	43	242.7	12.7
4	04.0	00.2	64	63.9	03.3	24	123.8	06.5	84	183.7	09.6	44	243.7	12.8
5	05.0	00.3	65	64.9	03.4	25	124.8	06.5	85	184.7	09.7	45	244.7	12.8
6	06.0	00.3	66	65.9	03.5	26	125.8	06.6	86	185.7	09.7	46	245.7	12.9
7	07.0	00.4	67	66.9	03.5	27	126.8	06.6	87	186.7	09.8	47	246.7	12.9
8	08.0	00.4	68	67.9	03.6	28	127.8	06.7	88	187.7	09.8	48	247.7	13.0
9	09.0	00.5	69	68.9	03.6	29	128.8	06.8	89	188.7	09.9	49	248.7	13.0
10	10.0	00.5	70	69.9	03.7	30	129.8	06.8	90	189.7	09.9	50	249.7	13.1
11	11.0	00.6	71	70.9	03.7	131	130.8	06.9	191	190.7	10.0	251	250.6	13.1
12	12.0	00.6	72	71.9	03.8	32	131.8	06.9	92	191.7	10.0	52	251.6	13.2
13	13.0	00.7	73	72.9	03.8	33	132.8	07.0	93	192.7	10.1	53	252.6	13.2
14	14.0	00.7	74	73.9	03.9	34	133.8	07.0	94	193.7	10.1	54	253.6	13.3
15	15.0	00.8	75	74.9	03.9	35	134.8	07.1	95	194.7	10.2	55	254.6	13.3
16	16.0	00.8	76	75.9	04.0	36	135.8	07.1	96	195.7	10.3	56	255.6	13.4
17	17.0	00.9	77	76.9	04.0	37	136.8	07.2	97	196.7	10.3	57	256.6	13.4
18	18.0	00.9	78	77.9	04.1	38	137.8	07.2	98	197.7	10.4	58	257.6	13.5
19	19.0	01.0	79	78.9	04.1	39	138.8	07.3	99	198.7	10.4	59	258.6	13.6
20	20.0	01.0	80	79.9	04.2	40	139.8	07.3	200	109.7	10.5	60	259.6	13.6
21	21.0	01.1	81	80.9	04.2	141	140.8	07.4	201	200.7	10.5	261	260.6	13.7
22	22.0	01.1	82	81.9	04.3	42	141.8	07.4	02	201.7	10.6	62	261.6	13.7
23	23.0	01.2	83	82.9	04.3	43	142.8	07.5	03	202.7	10.6	63	262.6	13.8
24	24.0	01.3	84	83.9	04.4	44	143.8	07.5	04	203.7	10.7	64	263.6	13.8
25	25.0	01.3	85	84.9	04.4	45	144.8	07.6	05	204.7	10.7	65	264.6	13.9
26	26.0	01.4	86	85.9	04.5	46	145.8	07.6	06	205.7	10.8	66	265.6	13.9
27	27.0	01.4	87	86.9	04.6	47	146.8	07.7	07	206.7	10.8	67	266.6	14.0
28	28.0	01.5	88	87.9	04.6	48	147.8	07.7	08	207.7	10.9	68	267.6	14.0
29	29.0	01.5	89	88.9	04.7	49	148.8	07.8	09	208.7	10.9	69	268.6	14.1
30	30.0	01.6	90	89.9	04.7	50	149.8	07.9	10	209.7	11.0	70	269.6	14.1
31	31.0	01.6	91	90.9	04.8	151	150.8	07.9	211	210.7	11.0	271	270.6	14.2
32	32.0	01.7	92	91.9	04.8	52	151.8	08.0	12	211.7	11.1	72	271.6	14.2
33	33.0	01.7	93	92.9	04.9	53	152.8	08.0	13	212.7	11.1	73	272.6	14.3
34	34.0	01.8	94	93.9	04.9	54	153.8	08.1	14	213.7	11.2	74	273.6	14.3
35	35.0	01.8	95	94.9	05.0	55	154.8	08.1	15	214.7	11.2	75	274.6	14.4
36	35.9	01.9	96	95.9	05.0	56	155.8	08.2	16	215.7	11.3	76	275.6	14.4
37	36.9	01.9	97	96.9	05.1	57	156.8	08.2	17	216.7	11.4	77	276.6	14.5
38	37.9	02.0	98	97.9	05.1	58	157.8	08.3	18	217.7	11.4	78	277.6	14.5
39	38.9	02.0	99	98.9	05.2	59	158.8	08.3	19	218.7	11.5	79	278.6	14.6
40	39.9	02.1	100	99.9	05.2	60	159.8	08.4	20	219.7	11.5	80	279.6	14.7
41	40.9	02.1	101	100.9	05.3	161	160.8	08.4	221	220.7	11.6	281	280.6	14.7
42	41.9	02.2	02	101.9	05.3	62	161.8	08.5	22	221.7	11.6	82	281.6	14.8
43	42.9	02.2	03	102.9	05.4	63	162.8	08.5	23	222.7	11.7	83	282.6	14.8
44	43.9	02.3	04	103.9	05.4	64	163.8	08.6	24	223.7	11.7	84	283.6	14.9
45	44.9	02.4	05	104.9	05.5	65	164.8	08.6	25	224.7	11.8	85	284.6	14.9
46	45.9	02.4	06	105.9	05.5	66	165.8	08.7	26	225.7	11.8	86	285.6	15.0
47	46.9	02.5	07	106.9	05.6	67	166.8	08.7	27	226.7	11.9	87	286.6	15.0
48	47.9	02.5	08	107.8	05.7	68	167.8	08.8	28	227.7	11.9	88	287.6	15.1
49	48.9	02.6	09	108.8	05.7	69	168.8	08.8	29	228.7	12.0	89	288.6	15.1
50	49.9	02.6	10	109.8	05.8	70	169.8	08.9	30	229.7	12.0	90	289.6	15.2
51	50.9	02.7	111	110.8	05.8	171	170.8	09.0	231	230.7	12.1	291	290.6	15.2
52	51.9	02.7	12	111.8	05.9	72	171.8	09.0	32	231.7	12.1	92	291.6	15.3
53	52.9	02.8	13	112.8	05.9	73	172.8	09.1	33	232.7	12.2	93	292.6	15.3
54	53.9	02.8	14	113.8	06.0	74	173.8	09.1	34	233.7	12.2	94	293.6	15.4
55	54.9	02.9	15	114.8	06.0	75	174.8	09.2	35	234.7	12.3	95	294.6	15.4
56	55.9	02.9	16	115.8	06.1	76	175.8	09.2	36	235.7	12.3	96	295.6	15.5
57	56.9	03.0	17	116.8	06.1	77	176.8	09.3	37	236.7	12.4	97	296.6	15.5
58	57.9	03.0	18	117.8	06.2	78	177.8	09.3	38	237.7	12.5	98	297.6	15.6
59	58.9	03.1	19	118.8	06.2	79	178.8	09.4	39	238.7	12.5	99	298.6	15.6
60	59.9	03.1	20	119.8	06.3	80	179.8	09.4	40	239.7	12.6	300	299.6	15.7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.1	61	60.9	04.3	121	120.7	08.4	181	180.6	12.6	241	240.4	16.8
2	02.0	00.1	62	61.9	04.3	22	121.7	08.5	82	181.6	12.7	42	241.4	16.9
3	03.0	00.2	63	62.8	04.4	23	122.7	08.6	83	182.6	12.8	43	242.4	16.9
4	04.0	00.3	64	63.8	04.5	24	123.7	08.6	84	183.6	12.8	44	243.4	17.0
5	05.0	00.3	65	64.8	04.5	25	124.7	08.7	85	184.6	12.9	45	244.4	17.1
6	06.0	00.4	66	65.8	04.6	26	125.7	08.8	86	185.6	13.0	46	245.4	17.1
7	07.0	00.5	67	66.8	04.7	27	126.7	08.9	87	186.6	13.0	47	246.4	17.2
8	08.0	00.6	68	67.8	04.7	28	127.7	08.9	88	187.5	13.1	48	247.4	17.3
9	09.0	00.6	69	68.8	04.8	29	128.7	09.0	89	188.5	13.2	49	248.4	17.4
10	10.0	00.7	70	69.8	04.9	30	129.7	09.1	90	189.5	13.2	50	249.4	17.4
11	11.0	00.8	71	70.8	05.0	131	130.7	09.1	191	190.5	13.3	251	250.4	17.5
12	12.0	00.8	72	71.8	05.0	32	131.7	09.2	92	191.5	13.4	52	251.4	17.6
13	13.0	00.9	73	72.8	05.1	33	132.7	09.3	93	192.5	13.5	53	252.4	17.6
14	14.0	01.0	74	73.8	05.2	34	133.7	09.3	94	193.5	13.5	54	253.4	17.7
15	15.0	01.0	75	74.8	05.2	35	134.7	09.4	95	194.5	13.6	55	254.4	17.8
16	16.0	01.1	76	75.8	05.3	36	135.7	09.5	96	195.5	13.7	56	255.4	17.8
17	17.0	01.2	77	76.8	05.4	37	136.7	09.5	97	196.5	13.7	57	256.4	17.9
18	18.0	01.3	78	77.8	05.4	38	137.7	09.6	98	197.5	13.8	58	257.4	18.0
19	19.0	01.3	79	78.8	05.5	39	138.7	09.7	99	198.5	13.9	59	258.4	18.1
20	20.0	01.4	80	79.8	05.6	40	139.7	09.8	200	199.5	13.9	60	259.4	18.1
21	20.9	01.5	81	80.8	05.7	141	140.7	09.8	201	200.5	14.0	261	260.4	18.2
22	21.9	01.5	82	81.8	05.7	42	141.7	09.9	02	201.5	14.1	62	261.4	18.3
23	22.9	01.6	83	82.8	05.8	43	142.7	10.0	03	202.5	14.1	63	262.4	18.3
24	23.9	01.7	84	83.8	05.9	44	143.7	10.0	04	203.5	14.2	64	263.4	18.4
25	24.9	01.7	85	84.8	05.9	45	144.7	10.1	05	204.5	14.3	65	264.4	18.5
26	25.9	01.8	86	85.8	06.0	46	145.6	10.2	06	205.5	14.4	66	265.4	18.5
27	26.9	01.9	87	86.8	06.1	47	146.6	10.2	07	206.5	14.4	67	266.4	18.6
28	27.9	02.0	88	87.8	06.1	48	147.6	10.3	08	207.5	14.5	68	267.4	18.7
29	28.9	02.0	89	88.8	06.2	49	148.6	10.4	09	208.5	14.6	69	268.4	18.7
30	29.9	02.1	90	89.8	06.3	50	149.6	10.5	10	209.5	14.6	70	269.3	18.8
31	30.9	02.2	91	90.8	06.4	151	150.6	10.5	211	210.5	14.7	271	270.3	18.9
32	31.9	02.2	92	91.8	06.4	52	151.6	10.6	12	211.5	14.8	72	271.3	19.0
33	32.9	02.3	93	92.8	06.5	53	152.6	10.7	13	212.5	14.8	73	272.3	19.0
34	33.9	02.4	94	93.8	06.6	54	153.6	10.7	14	213.5	14.9	74	273.3	19.1
35	34.9	02.4	95	94.8	06.6	55	154.6	10.8	15	214.5	15.0	75	274.3	19.2
36	35.9	02.5	96	95.8	06.7	56	155.6	10.9	16	215.5	15.1	76	275.3	19.2
37	36.9	02.6	97	96.8	06.8	57	156.6	10.9	17	216.5	15.1	77	276.3	19.3
38	37.9	02.7	98	97.8	06.8	58	157.6	11.0	18	217.5	15.2	78	277.3	19.4
39	38.9	02.7	99	98.8	06.9	59	158.6	11.1	19	218.5	15.3	79	278.3	19.4
40	39.9	02.8	100	99.8	07.0	60	159.6	11.2	20	219.5	15.3	80	279.3	19.5
41	40.9	02.9	101	100.8	07.0	161	160.6	11.2	221	220.5	15.4	281	280.3	19.6
42	41.9	02.9	02	101.8	07.1	62	161.6	11.3	22	221.5	15.5	82	281.3	19.7
43	42.9	03.0	03	102.8	07.2	63	162.6	11.4	23	222.5	15.5	83	282.3	19.7
44	43.9	03.1	04	103.8	07.2	64	163.6	11.4	24	223.5	15.6	84	283.3	19.8
45	44.9	03.1	05	104.7	07.3	65	164.6	11.5	25	224.5	15.7	85	284.3	19.9
46	45.9	03.2	06	105.7	07.4	66	165.6	11.6	26	225.5	15.8	86	285.3	19.9
47	46.9	03.3	07	106.7	07.5	67	166.6	11.6	27	226.5	15.8	87	286.3	20.0
48	47.9	03.4	08	107.7	07.5	68	167.6	11.7	28	227.5	15.9	88	287.3	20.1
49	48.9	03.4	09	108.7	07.6	69	168.6	11.8	29	228.5	16.0	89	288.3	20.1
50	49.9	03.5	10	109.7	07.7	70	169.6	11.8	30	229.4	16.0	90	289.3	20.2
51	50.9	03.6	111	110.7	07.7	171	170.6	11.9	231	230.4	16.1	291	290.3	20.3
52	51.9	03.6	12	111.7	07.8	72	171.6	12.0	32	231.4	16.2	92	291.3	20.4
53	52.9	03.7	13	112.7	07.9	73	172.6	12.1	33	232.4	16.2	93	292.3	20.4
54	53.9	03.8	14	113.7	07.9	74	173.6	12.1	34	233.4	16.3	94	293.3	20.5
55	54.9	03.8	15	114.7	08.0	75	174.6	12.2	35	234.4	16.4	95	294.3	20.6
56	55.9	03.9	16	115.7	08.1	76	175.6	12.3	36	235.4	16.4	96	295.3	20.6
57	56.9	04.0	17	116.7	08.2	77	176.6	12.3	37	236.4	16.5	97	296.3	20.7
58	57.9	04.0	18	117.7	08.2	78	177.6	12.4	38	237.4	16.6	98	297.3	20.8
59	58.9	04.1	19	118.7	08.3	79	178.6	12.5	39	238.4	16.7	99	298.3	20.8
60	59.9	04.2	20	119.7	08.4	80	179.6	12.5	40	239.4	16.7	300	299.3	20.9
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.1	61	60.8	05.3	121	120.5	10.5	181	180.3	15.7	241	240.1	21.0
2	02.0	00.2	62	61.8	05.4	22	121.5	10.6	82	181.3	15.8	42	241.1	21.1
3	03.0	00.3	63	62.8	05.5	23	122.5	10.7	83	182.3	15.9	43	242.1	21.1
4	04.0	00.3	64	63.8	05.6	24	123.5	10.8	84	183.3	16.0	44	243.1	21.2
5	05.0	00.4	65	64.8	05.7	25	124.5	10.9	85	184.3	16.1	45	244.1	21.3
6	06.0	00.5	66	65.7	05.8	26	125.5	11.0	86	185.3	16.2	46	245.1	21.4
7	07.0	00.6	67	66.7	05.8	27	126.5	11.1	87	186.3	16.3	47	246.1	21.5
8	08.0	00.7	68	67.7	05.9	28	127.5	11.2	88	187.3	16.4	48	247.1	21.6
9	09.0	00.8	69	68.7	06.0	29	128.5	11.3	89	188.3	16.4	49	248.1	21.7
10	10.0	00.9	70	69.7	06.1	30	129.5	11.4	90	189.3	16.5	50	249.1	21.8
11	11.0	01.0	71	70.7	06.2	131	130.5	11.4	191	190.3	16.6	251	250.0	21.8
12	12.0	01.0	72	71.7	06.3	32	131.5	11.5	92	191.3	16.7	52	251.0	21.9
13	12.9	01.1	73	72.7	06.4	33	132.5	11.6	93	192.3	16.8	53	252.0	22.0
14	13.9	01.2	74	73.7	06.5	34	133.5	11.7	94	193.3	16.9	54	253.0	22.1
15	14.9	01.3	75	74.7	06.5	35	134.5	11.7	95	194.3	17.0	55	254.0	22.2
16	15.9	01.4	76	75.7	06.6	36	135.5	11.8	96	195.3	17.1	56	255.0	22.3
17	16.9	01.5	77	76.7	06.7	37	136.5	11.9	97	196.3	17.2	57	256.0	22.4
18	17.9	01.6	78	77.7	06.8	38	137.5	12.0	98	197.2	17.3	58	257.0	22.4
19	18.9	01.7	79	78.7	06.9	39	138.5	12.1	99	198.2	17.3	59	258.0	22.5
20	19.9	01.7	80	79.7	07.0	40	139.5	12.2	200	199.2	17.4	60	259.0	22.6
21	20.9	01.8	81	80.7	07.1	141	140.5	12.3	201	200.2	17.5	261	260.0	22.7
22	21.9	01.9	82	81.7	07.2	42	141.5	12.4	02	201.2	17.6	62	261.0	22.8
23	22.9	02.0	83	82.7	07.2	43	142.5	12.4	03	202.2	17.7	63	262.0	22.9
24	23.9	02.1	84	83.7	07.3	44	143.5	12.5	04	203.2	17.7	64	263.0	23.0
25	24.9	02.2	85	84.7	07.4	45	144.4	12.6	05	204.2	17.8	65	264.0	23.1
26	25.9	02.3	86	85.7	07.5	46	145.4	12.7	06	205.2	17.9	66	265.0	23.1
27	26.9	02.4	87	86.7	07.6	47	146.4	12.8	07	206.2	18.0	67	266.0	23.2
28	27.9	02.4	88	87.7	07.7	48	147.4	12.9	08	207.2	18.1	68	267.0	23.3
29	28.9	02.5	89	88.7	07.8	49	148.4	13.0	09	208.2	18.2	69	268.0	23.4
30	29.9	02.6	90	89.7	07.8	50	149.4	13.1	10	209.2	18.3	70	269.0	23.5
31	30.9	02.7	91	90.7	07.9	151	150.4	13.1	211	210.2	18.4	271	270.0	23.6
32	31.9	02.8	92	91.6	08.0	52	151.4	13.2	12	211.2	18.4	72	271.0	23.7
33	32.9	02.9	93	92.6	08.1	53	152.4	13.3	13	212.2	18.5	73	272.0	23.8
34	33.9	03.0	94	93.6	08.2	54	153.4	13.4	14	213.2	18.6	74	273.0	23.8
35	34.9	03.1	95	94.6	08.3	55	154.4	13.5	15	214.2	18.7	75	274.0	23.9
36	35.9	03.1	96	95.6	08.4	56	155.4	13.6	16	215.2	18.8	76	275.0	24.0
37	36.9	03.2	97	96.6	08.5	57	156.4	13.7	17	216.2	18.9	77	275.9	24.1
38	37.9	03.3	98	97.6	08.5	58	157.4	13.7	18	217.2	19.0	78	276.9	24.2
39	38.9	03.4	99	98.6	08.6	59	158.4	13.8	19	218.2	19.1	79	277.9	24.3
40	39.8	03.5	100	99.6	08.7	60	159.4	13.9	20	219.2	19.1	80	278.9	24.4
41	40.8	03.6	101	100.6	08.8	161	160.4	14.0	221	220.2	19.2	281	279.9	24.4
42	41.8	03.7	02	101.6	08.9	62	161.4	14.1	22	221.2	19.3	82	280.9	24.5
43	42.8	03.8	03	102.6	09.0	63	162.4	14.2	23	222.2	19.4	83	281.9	24.6
44	43.8	03.8	04	103.6	09.0	64	163.4	14.3	24	223.1	19.5	84	282.9	24.7
45	44.8	03.9	05	104.6	09.1	65	164.4	14.4	25	224.1	19.6	85	283.9	24.8
46	45.8	04.0	06	105.6	09.2	66	165.4	14.4	26	225.1	19.7	86	284.9	24.9
47	46.8	04.1	07	106.6	09.3	67	166.4	14.5	27	226.1	19.7	87	285.9	25.0
48	47.8	04.2	08	107.6	09.4	68	167.4	14.6	28	227.1	19.8	88	286.9	25.1
49	48.8	04.3	09	108.6	09.5	69	168.4	14.7	29	228.1	19.9	89	287.9	25.1
50	49.8	04.4	10	109.6	09.6	70	169.4	14.8	30	229.1	20.0	00	288.9	25.2
51	50.8	04.4	111	110.6	09.7	171	170.4	14.9	231	230.1	20.1	291	289.9	25.3
52	51.8	04.5	12	111.6	09.7	72	171.3	15.0	32	231.1	20.2	92	290.9	25.4
53	52.8	04.6	13	112.6	09.8	73	172.3	15.1	33	232.1	20.3	93	291.9	25.5
54	53.8	04.7	14	113.6	09.9	74	173.3	15.1	34	233.1	20.4	94	292.9	25.6
55	54.8	04.8	15	114.6	10.0	75	174.3	15.2	35	234.1	20.4	95	293.9	25.7
56	55.8	04.9	16	115.6	10.1	76	175.3	15.3	36	235.1	20.5	96	294.9	25.8
57	56.8	05.0	17	116.6	10.2	77	176.3	15.4	37	236.1	20.6	97	295.9	25.8
58	57.8	05.1	18	117.6	10.3	78	177.3	15.5	38	237.1	20.7	98	296.9	25.9
59	58.8	05.1	19	118.5	10.4	79	178.3	15.6	39	238.1	20.8	99	297.9	26.0
60	59.8	05.2	20	119.5	10.4	80	179.3	15.7	40	239.1	20.9	300	298.9	26.1
Dist	Dep	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.1	61	60.7	06.4	121	120.3	12.6	181	180.0	18.9	241	239.7	25.2
2	02.0	00.2	62	61.7	06.5	22	121.3	12.7	82	181.0	19.0	42	240.7	25.3
3	03.0	00.3	63	62.7	06.6	23	122.3	12.9	83	182.0	19.1	43	241.7	25.4
4	04.0	00.4	64	63.6	06.7	24	123.3	13.0	84	183.0	19.2	44	242.7	25.5
5	05.0	00.5	65	64.6	06.8	25	124.3	13.1	85	184.0	19.3	45	243.7	25.6
6	06.0	00.6	66	65.6	06.9	26	125.3	13.2	86	185.0	19.4	46	244.6	25.7
7	07.0	00.7	67	66.6	07.0	27	126.3	13.3	87	186.0	19.5	47	245.6	25.8
8	08.0	00.8	68	67.6	07.1	28	127.3	13.4	88	187.0	19.6	48	246.6	25.9
9	08.9	00.9	69	68.6	07.2	29	128.3	13.5	89	188.0	19.8	49	247.6	26.0
10	09.9	01.0	70	69.6	07.3	30	129.3	13.6	90	189.0	19.9	50	248.6	26.1
11	10.9	01.1	71	70.6	07.4	131	130.3	13.7	191	189.9	20.0	251	249.6	26.2
12	11.9	01.3	72	71.6	07.5	32	131.3	13.8	92	190.9	20.1	52	250.6	26.3
13	12.9	01.4	73	72.6	07.6	33	132.3	13.9	93	191.9	20.2	53	251.6	26.4
14	13.9	01.5	74	73.6	07.7	34	133.3	14.0	94	192.9	20.3	54	252.6	26.5
15	14.9	01.6	75	74.6	07.8	35	134.3	14.1	95	193.9	20.4	55	253.6	26.6
16	15.9	01.7	76	75.6	07.9	36	135.3	14.2	96	194.9	20.5	56	254.6	26.8
17	16.9	01.8	77	76.6	08.0	37	136.2	14.3	97	195.9	20.6	57	255.6	26.9
18	17.9	01.9	78	77.6	08.1	38	137.2	14.4	98	196.9	20.7	58	256.6	27.0
19	18.9	02.0	79	78.6	08.3	39	138.2	14.5	99	197.9	20.8	59	257.6	27.1
20	19.9	02.1	80	79.6	08.4	40	139.2	14.6	200	198.9	20.9	60	258.6	27.2
21	20.9	02.2	81	80.6	08.5	141	140.2	14.7	201	199.9	21.0	261	259.6	27.3
22	21.9	02.3	82	81.5	08.6	42	141.2	14.8	02	200.9	21.1	62	260.6	27.4
23	22.9	02.4	83	82.5	08.7	43	142.2	14.9	03	201.9	21.2	63	261.6	27.5
24	23.9	02.5	84	83.5	08.8	44	143.2	15.0	04	202.9	21.3	64	262.5	27.6
25	24.9	02.6	85	84.5	08.9	45	144.2	15.2	05	203.9	21.4	65	263.5	27.7
26	25.9	02.7	86	85.5	09.0	46	145.2	15.3	06	204.9	21.5	66	264.5	27.8
27	26.9	02.8	87	86.5	09.1	47	146.2	15.4	07	205.9	21.6	67	265.5	27.9
28	27.8	02.9	88	87.5	09.2	48	147.2	15.5	08	206.9	21.7	68	266.5	28.0
29	28.8	03.0	89	88.5	09.3	49	148.2	15.6	09	207.9	21.8	69	267.5	28.1
30	29.8	03.1	90	89.5	09.4	50	149.2	15.7	10	208.8	21.9	70	268.5	28.2
31	30.8	03.2	91	90.5	09.5	151	150.2	15.8	211	209.8	22.0	271	269.5	28.3
32	31.8	03.3	92	91.5	09.6	52	151.2	15.9	12	210.8	22.2	72	270.5	28.4
33	32.8	03.4	93	92.5	09.7	53	152.2	16.0	13	211.8	22.3	73	271.5	28.5
34	33.8	03.6	94	93.5	09.8	54	153.2	16.1	14	212.8	22.4	74	272.5	28.6
35	34.8	03.7	95	94.5	09.9	55	154.1	16.2	15	213.8	22.5	75	273.5	28.7
36	35.8	03.8	96	95.5	10.0	56	155.1	16.3	16	214.8	22.6	76	274.5	28.8
37	36.8	03.9	97	96.5	10.1	57	156.1	16.4	17	215.8	22.7	77	275.5	28.9
38	37.8	04.0	98	97.5	10.2	58	157.1	16.5	18	216.8	22.8	78	276.5	29.1
39	38.8	04.1	99	98.5	10.3	59	158.1	16.6	19	217.8	22.9	79	277.5	29.2
40	39.8	04.2	100	99.5	10.5	60	159.1	16.7	20	218.8	23.0	80	278.5	29.3
41	40.8	04.3	101	100.4	10.6	161	160.1	16.8	221	219.8	23.1	281	279.5	29.4
42	41.8	04.4	02	101.4	10.7	62	161.1	16.9	22	220.8	23.2	82	280.4	29.5
43	42.8	04.5	03	102.4	10.8	63	162.1	17.0	23	221.8	23.3	83	281.4	29.6
44	43.8	04.6	04	103.4	10.9	64	163.1	17.1	24	222.8	23.4	84	282.4	29.7
45	44.8	04.7	05	104.4	11.0	65	164.1	17.2	25	223.8	23.5	85	283.4	29.8
46	45.7	04.8	06	105.4	11.1	66	165.1	17.3	26	224.8	23.6	86	284.4	29.9
47	46.7	04.9	07	106.4	11.2	67	166.1	17.5	27	225.8	23.7	87	285.4	30.0
48	47.7	05.0	08	107.4	11.3	68	167.1	17.6	28	226.7	23.8	88	286.4	30.1
49	48.7	05.1	09	108.4	11.4	69	168.1	17.7	29	227.7	23.9	89	287.4	30.2
50	49.7	05.2	10	109.4	11.5	70	169.1	17.8	30	228.7	24.0	00	288.4	30.3
51	50.7	05.3	111	110.4	11.6	171	170.1	17.9	231	229.7	24.1	291	289.4	30.4
52	51.7	05.4	12	111.4	11.7	72	171.1	18.0	32	230.7	24.2	92	290.4	30.5
53	52.7	05.5	13	112.4	11.8	73	172.0	18.1	33	231.7	24.3	93	291.4	30.6
54	53.7	05.6	14	113.4	11.9	74	173.0	18.2	34	232.7	24.5	94	292.4	30.7
55	54.7	05.7	15	114.4	12.0	75	174.0	18.3	35	233.7	24.6	95	293.4	30.8
56	55.7	05.9	16	115.4	12.1	76	175.0	18.4	36	234.7	24.7	96	294.4	30.9
57	56.7	06.0	17	116.4	12.2	77	176.0	18.5	37	235.7	24.8	97	295.4	31.0
58	57.7	06.1	18	117.4	12.3	78	177.0	18.6	38	236.7	24.9	98	296.4	31.1
59	58.7	06.2	19	118.3	12.4	79	178.0	18.7	39	237.7	25.0	99	297.4	31.2
60	59.7	06.3	20	119.3	12.5	80	179.0	18.8	40	238.7	25.1	300	298.4	31.4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

[For 84 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.1	61	60.5	07.4	121	120.1	14.7	181	179.6	22.0	241	239.2	29.3
2	02.0	00.2	62	61.5	07.5	22	121.1	14.9	82	180.6	22.2	42	240.2	29.5
3	03.0	00.4	63	62.5	07.7	23	122.1	15.0	83	181.6	22.3	43	241.2	29.6
4	04.0	00.5	64	63.5	07.8	24	123.1	15.1	84	182.6	22.4	44	242.2	29.7
5	05.0	00.6	65	64.5	07.9	25	124.1	15.2	85	183.6	22.5	45	243.2	29.8
6	06.0	00.7	66	65.5	08.0	26	125.1	15.3	86	184.6	22.7	46	244.1	29.9
7	06.9	00.9	67	66.5	08.2	27	126.0	15.5	87	185.6	22.8	47	245.1	30.1
8	07.9	01.0	68	67.5	08.3	28	127.0	15.6	88	186.6	22.9	48	246.1	30.2
9	08.9	01.1	69	68.5	08.4	29	128.0	15.7	89	187.6	23.0	49	247.1	30.3
10	09.9	01.2	70	69.5	08.5	30	129.0	15.8	90	188.6	23.1	50	248.1	30.4
11	10.9	01.3	71	70.5	08.6	131	130.0	16.0	191	189.6	23.3	251	249.1	30.6
12	11.9	01.5	72	71.5	08.8	32	131.0	16.1	92	190.6	23.4	52	250.1	30.7
13	12.9	01.6	73	72.5	08.9	33	132.0	16.2	93	191.6	23.5	53	251.1	30.8
14	13.9	01.7	74	73.4	09.0	34	133.0	16.3	94	192.5	23.6	54	252.1	30.9
15	14.9	01.8	75	74.4	09.1	35	134.0	16.4	95	193.5	23.7	55	253.1	31.0
16	15.9	01.9	76	75.4	09.3	36	135.0	16.6	96	194.5	23.9	56	254.1	31.2
17	16.9	02.1	77	76.4	09.4	37	136.0	16.7	97	195.5	24.0	57	255.1	31.3
18	17.9	02.2	78	77.4	09.5	38	137.0	16.8	98	196.5	24.1	58	256.1	31.4
19	18.9	02.3	79	78.4	09.6	39	138.0	16.9	99	197.5	24.2	59	257.1	31.5
20	19.9	02.4	80	79.4	09.7	40	130.0	17.1	200	198.5	24.4	60	258.1	31.7
21	20.8	02.6	81	80.4	09.9	141	139.9	17.2	201	199.5	24.5	261	259.0	31.8
22	21.8	02.7	82	81.4	10.0	42	140.9	17.3	02	200.5	24.6	62	260.0	31.9
23	22.8	02.8	83	82.4	10.1	43	141.9	17.4	03	201.5	24.7	63	261.0	32.0
24	23.8	02.9	84	83.4	10.2	44	142.9	17.5	04	202.5	24.8	64	262.0	32.1
25	24.8	03.0	85	84.4	10.4	45	143.9	17.7	05	203.5	25.0	65	263.0	32.3
26	25.8	03.2	86	85.4	10.5	46	144.9	17.8	06	204.5	25.1	66	264.0	32.4
27	26.8	03.3	87	86.3	10.6	47	145.9	17.9	07	205.4	25.2	67	265.0	32.5
28	27.8	03.4	88	87.3	10.7	48	146.9	18.0	08	206.4	25.3	68	266.0	32.6
29	28.8	03.5	89	88.3	10.8	49	147.9	18.1	09	207.4	25.4	69	267.0	32.8
30	29.8	03.7	90	89.3	11.0	50	148.9	18.3	10	208.4	25.6	70	268.0	32.9
31	30.8	03.8	91	90.3	11.1	151	149.9	18.4	211	209.4	25.7	271	269.0	33.0
32	31.8	03.9	92	91.3	11.2	52	150.9	18.5	12	210.4	25.8	72	270.0	33.1
33	32.8	04.0	93	92.3	11.3	53	151.9	18.6	13	211.4	25.9	73	271.0	33.2
34	33.7	04.1	94	93.3	11.5	54	152.8	18.7	14	212.4	26.1	74	271.9	33.4
35	34.7	04.3	95	94.3	11.6	55	153.8	18.9	15	213.4	26.2	75	272.9	33.5
36	35.7	04.4	96	95.3	11.7	56	154.8	19.0	16	214.4	26.3	76	273.9	33.6
37	36.7	04.5	97	96.3	11.8	57	155.8	19.1	17	215.4	26.4	77	274.9	33.7
38	37.7	04.6	98	97.3	11.9	58	156.8	19.2	18	216.4	26.5	78	275.9	33.9
39	38.7	04.8	99	98.3	12.1	59	157.8	19.4	19	217.4	26.7	79	276.9	34.0
40	39.7	04.9	100	99.3	12.2	60	158.8	19.5	20	218.4	26.8	80	277.9	34.1
41	40.7	05.0	101	100.2	12.3	161	159.8	19.6	221	219.3	26.9	281	278.9	34.2
42	41.7	05.1	02	101.2	12.4	62	160.8	19.7	22	220.3	27.0	82	279.9	34.3
43	42.7	05.2	03	102.2	12.5	63	161.8	19.8	23	221.3	27.2	83	280.9	34.5
44	43.7	05.4	04	103.2	12.7	64	162.8	20.0	24	222.3	27.3	84	281.9	34.6
45	44.7	05.5	05	104.2	12.8	65	163.8	20.1	25	223.3	27.4	85	282.9	34.7
46	45.7	05.6	06	105.2	12.9	66	164.8	20.2	26	224.3	27.5	86	283.9	34.8
47	46.6	05.7	07	106.2	13.0	67	165.7	20.3	27	225.3	27.6	87	284.8	34.9
48	47.6	05.8	08	107.2	13.1	68	166.7	20.5	28	226.3	27.8	88	285.8	35.1
49	48.6	06.0	09	108.2	13.3	69	167.7	20.6	29	227.3	27.9	89	286.8	35.2
50	49.6	06.1	10	109.2	13.4	70	168.7	20.7	30	228.3	28.0	90	287.8	35.3
51	50.6	06.2	111	110.2	13.5	171	169.7	20.8	231	229.3	28.1	291	288.8	35.4
52	51.6	06.3	12	111.2	13.6	72	170.7	20.9	32	230.3	28.3	92	289.8	35.5
53	52.6	06.5	13	112.2	13.8	73	171.7	21.1	33	231.3	28.4	93	290.8	35.7
54	53.6	06.6	14	113.1	13.9	74	172.7	21.2	34	232.2	28.5	94	291.8	35.8
55	54.6	06.7	15	114.1	14.0	75	173.7	21.3	35	233.2	28.6	95	292.8	35.9
56	55.6	06.8	16	115.1	14.1	76	174.7	21.4	36	234.2	28.7	96	293.8	36.0
57	56.6	06.9	17	116.1	14.2	77	175.7	21.6	37	235.2	28.9	97	294.8	36.2
58	57.6	07.1	18	117.1	14.4	78	176.7	21.7	38	236.2	29.0	98	295.8	36.3
59	58.6	07.2	19	118.1	14.5	79	177.7	21.8	39	237.2	29.1	99	296.8	36.4
60	59.6	07.3	20	119.1	14.6	80	178.7	21.9	40	238.2	29.2	300	297.8	36.5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.1	61	60.4	08.5	121	119.8	16.8	181	179.2	25.2	241	238.7	33.5
2	02.0	00.3	62	61.4	08.6	22	120.8	17.0	82	180.2	25.3	42	239.7	33.7
3	03.0	00.4	63	62.4	08.8	23	121.8	17.1	83	181.2	25.5	43	240.6	33.8
4	04.0	00.6	64	63.4	08.9	24	122.8	17.3	84	182.2	25.6	44	241.6	34.0
5	05.0	00.7	65	64.4	09.0	25	123.8	17.4	85	183.2	25.8	45	242.6	34.1
6	05.9	00.8	66	65.4	09.2	26	124.8	17.5	86	184.2	25.9	46	243.6	34.2
7	06.9	01.0	67	66.4	09.3	27	125.8	17.7	87	185.2	26.0	47	244.6	34.4
8	07.9	01.1	68	67.3	09.5	28	126.8	17.8	88	186.2	26.2	48	245.6	34.5
9	08.9	01.3	69	68.3	09.6	29	127.7	18.0	89	187.2	26.3	49	246.6	34.7
10	09.9	01.4	70	69.3	09.7	30	128.7	18.1	90	188.2	26.4	50	247.6	34.8
11	10.9	01.5	71	70.3	09.9	131	129.7	18.2	191	189.1	26.6	251	248.6	34.9
12	11.9	01.7	72	71.3	10.0	32	130.7	18.4	92	190.1	26.7	52	249.6	35.1
13	12.9	01.8	73	72.3	10.2	33	131.7	18.5	93	191.1	26.9	53	250.5	35.2
14	13.9	01.9	74	73.3	10.3	34	132.7	18.7	94	192.1	27.0	54	251.5	35.4
15	14.9	02.1	75	74.3	10.4	35	133.7	18.8	95	193.1	27.1	55	252.5	35.5
16	15.8	02.2	76	75.3	10.6	36	134.7	18.9	96	194.1	27.3	56	253.5	35.6
17	16.8	02.4	77	76.3	10.7	37	135.7	19.1	97	195.1	27.4	57	254.5	35.8
18	17.8	02.5	78	77.2	10.9	38	136.7	19.2	98	196.1	27.6	58	255.5	35.9
19	18.8	02.6	79	78.2	11.0	39	137.7	19.3	99	197.1	27.7	59	256.5	36.1
20	19.8	02.8	80	79.2	11.1	40	138.6	19.5	200	198.1	27.8	60	257.5	36.2
21	20.8	02.9	81	80.2	11.3	141	139.6	19.6	201	199.0	28.0	261	258.5	36.3
22	21.8	03.1	82	81.2	11.4	42	140.6	19.8	02	200.0	28.1	62	259.5	36.5
23	22.8	03.2	83	82.2	11.6	43	141.6	19.9	03	201.0	28.3	63	260.4	36.6
24	23.8	03.3	84	83.2	11.7	44	142.6	20.0	04	202.0	28.4	64	261.4	36.7
25	24.8	03.5	85	84.2	11.8	45	143.6	20.2	05	203.0	28.5	65	262.4	36.9
26	25.7	03.6	86	85.2	12.0	46	144.6	20.3	06	204.0	28.7	66	263.4	37.0
27	26.7	03.8	87	86.2	12.1	47	145.6	20.5	07	205.0	28.8	67	264.4	37.2
28	27.7	03.9	88	87.1	12.2	48	146.6	20.6	08	206.0	29.0	68	265.4	37.3
29	28.7	04.0	89	88.1	12.4	49	147.6	20.7	09	207.0	29.1	69	266.4	37.4
30	29.7	04.2	90	89.1	12.5	50	148.5	20.9	10	208.0	29.2	70	267.4	37.6
31	30.7	04.3	91	90.1	12.7	151	149.5	21.0	211	209.0	29.4	271	268.4	37.7
32	31.7	04.5	92	91.1	12.8	52	150.5	21.2	12	209.9	29.5	72	269.4	37.9
33	32.7	04.6	93	92.1	12.9	53	151.5	21.3	13	210.9	29.6	73	270.4	38.0
34	33.7	04.7	94	93.1	13.1	54	152.5	21.4	14	211.9	29.8	74	271.3	38.1
35	34.7	04.9	95	94.1	13.2	55	153.5	21.6	15	212.9	29.9	75	272.3	38.3
36	35.7	05.0	96	95.1	13.4	56	154.5	21.7	16	213.9	30.1	76	273.3	38.4
37	36.6	05.2	97	96.1	13.5	57	155.5	21.9	17	214.9	30.2	77	274.3	38.5
38	37.6	05.4	98	97.0	13.6	58	156.5	22.0	18	215.9	30.3	78	275.3	38.7
39	38.6	05.5	99	98.0	13.8	59	157.5	22.1	19	216.9	30.5	79	276.3	38.8
40	39.6	05.6	100	99.0	13.9	60	158.4	22.3	20	217.9	30.6	80	277.3	39.0
41	40.6	05.7	101	100.0	14.1	161	159.4	22.4	221	218.9	30.8	281	278.3	39.1
42	41.6	05.8	02	101.0	14.2	62	160.4	22.6	22	219.8	30.9	82	279.3	39.3
43	42.6	06.0	03	102.0	14.3	63	161.4	22.7	23	220.8	31.0	83	280.3	39.4
44	43.6	06.1	04	103.0	14.5	64	162.4	22.8	24	221.8	31.2	84	281.2	39.5
45	44.6	06.3	05	104.0	14.6	65	163.4	23.0	25	222.8	31.3	85	282.2	39.7
46	45.6	06.4	06	105.0	14.8	66	164.4	23.1	26	223.8	31.5	86	283.2	39.8
47	46.5	06.5	07	106.0	14.9	67	165.4	23.2	27	224.8	31.6	87	284.2	40.0
48	47.5	06.7	08	107.0	15.0	68	166.4	23.4	28	225.8	31.7	88	285.2	40.1
49	48.5	06.8	09	107.9	15.2	69	167.4	23.5	29	226.8	31.9	89	286.2	40.2
50	49.5	07.0	10	108.9	15.3	70	168.4	23.7	30	227.8	32.0	90	287.2	40.4
51	50.5	07.1	111	109.9	15.5	171	169.3	23.8	231	228.8	32.2	291	288.2	40.5
52	51.5	07.2	12	110.9	15.6	72	170.3	23.9	32	229.7	32.3	92	289.2	40.6
53	52.5	07.4	13	111.9	15.7	73	171.3	24.1	33	230.7	32.4	93	290.2	40.8
54	53.5	07.5	14	112.9	15.9	74	172.3	24.2	34	231.7	32.6	94	291.1	40.9
55	54.5	07.7	15	113.9	16.0	75	173.3	24.3	35	232.7	32.7	95	292.1	41.1
56	55.5	07.8	16	114.9	16.1	76	174.3	24.5	36	233.7	32.9	96	293.1	41.2
57	56.4	07.9	17	115.9	16.3	77	175.3	24.6	37	234.7	33.0	97	294.1	41.3
58	57.4	08.1	18	116.9	16.4	78	176.3	24.7	38	235.7	33.1	98	295.1	41.5
59	58.4	08.2	19	117.8	16.6	79	177.3	24.9	39	236.7	33.3	99	296.1	41.6
60	59.4	08.4	20	118.8	16.7	80	178.3	25.1	40	237.7	33.4	300	297.1	41.8
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.2	61	60.2	09.5	121	119.5	18.9	181	178.8	28.3	241	238.0	37.7
2	02.0	00.3	62	61.2	09.7	22	120.5	19.1	82	179.8	28.5	42	239.0	37.8
3	03.0	00.5	63	62.2	09.9	23	121.5	19.2	83	180.7	28.6	43	240.0	38.0
4	04.0	00.6	64	63.2	10.0	24	122.5	19.4	84	181.7	28.8	44	241.0	38.2
5	04.9	00.8	65	64.2	10.2	25	123.5	19.6	85	182.7	28.9	45	242.0	38.3
6	05.9	00.9	66	65.2	10.3	26	124.5	19.7	86	183.7	29.1	46	243.0	38.5
7	06.9	01.1	67	66.2	10.5	27	125.4	19.9	87	184.7	29.2	47	244.0	38.6
8	07.9	01.3	68	67.2	10.6	28	126.4	20.0	88	185.7	29.4	48	244.9	38.8
9	08.9	01.4	69	68.2	10.8	29	127.4	20.2	89	186.7	29.6	49	245.9	38.9
10	09.9	01.6	70	69.1	11.0	30	128.4	20.3	90	187.7	29.7	50	246.9	39.1
11	10.9	01.7	71	70.1	11.1	131	129.4	20.5	191	188.7	29.9	251	247.9	39.3
12	11.9	01.9	72	71.1	11.3	32	130.4	20.6	92	189.6	30.0	52	248.9	39.4
13	12.9	02.0	73	72.1	11.4	33	131.4	20.8	93	190.6	30.2	53	249.9	39.6
14	13.8	02.2	74	73.1	11.6	34	132.4	21.0	94	191.6	30.3	54	250.9	39.7
15	14.8	02.3	75	74.1	11.7	35	133.3	21.1	95	192.6	30.5	55	251.9	39.9
16	15.8	02.5	76	75.1	11.9	36	134.3	21.3	96	193.6	30.7	56	252.9	40.0
17	16.8	02.7	77	76.1	12.0	37	135.3	21.4	97	194.6	30.8	57	253.8	40.2
18	17.8	02.8	78	77.0	12.2	38	136.3	21.6	98	195.6	31.0	58	254.8	40.4
19	18.8	03.0	79	78.0	12.4	39	137.3	21.7	99	196.6	31.1	59	255.8	40.5
20	19.8	03.1	80	79.0	12.5	40	138.3	21.9	200	197.5	31.3	60	256.8	40.7
21	20.7	03.3	81	80.0	12.7	141	139.3	22.1	201	198.5	31.4	261	257.8	40.8
22	21.7	03.4	82	81.0	12.8	42	140.3	22.2	02	199.5	31.6	62	258.8	41.0
23	22.7	03.6	83	82.0	13.0	43	141.2	22.4	03	200.5	31.7	63	259.8	41.1
24	23.7	03.8	84	83.0	13.1	44	142.2	22.5	04	201.5	31.9	64	260.8	41.3
25	24.7	03.9	85	84.0	13.3	45	143.2	22.7	05	202.5	32.1	65	261.7	41.4
26	25.7	04.1	86	84.9	13.5	46	144.2	22.8	06	203.5	32.2	66	262.7	41.6
27	26.7	04.2	87	85.9	13.6	47	145.2	23.0	07	204.5	32.4	67	263.7	41.8
28	27.7	04.4	88	86.9	13.8	48	146.2	23.1	08	205.4	32.5	68	264.7	41.9
29	28.6	04.5	89	87.9	13.9	49	147.2	23.3	09	206.4	32.7	69	265.7	42.1
30	29.6	04.7	90	88.9	14.1	50	148.2	23.5	10	207.4	32.8	70	266.7	42.2
31	30.6	04.8	91	89.9	14.2	151	149.1	23.6	211	208.4	33.0	271	267.7	42.4
32	31.6	05.0	92	90.9	14.4	52	150.1	23.8	12	209.4	33.2	72	268.7	42.5
33	32.6	05.2	93	91.9	14.5	53	151.1	23.9	13	210.4	33.3	73	269.6	42.7
34	33.6	05.3	94	92.8	14.7	54	152.1	24.1	14	211.4	33.5	74	270.6	42.9
35	34.6	05.5	95	93.8	14.9	55	153.1	24.2	15	212.4	33.6	75	271.6	43.0
36	35.6	05.6	96	94.8	15.0	56	154.1	24.4	16	213.3	33.8	76	272.6	43.2
37	36.5	05.8	97	95.8	15.2	57	155.1	24.6	17	214.3	33.9	77	273.6	43.3
38	37.5	05.9	98	96.8	15.3	58	156.1	24.7	18	215.3	34.1	78	274.6	43.5
39	38.5	06.1	99	97.8	15.5	59	157.0	24.9	19	216.3	34.3	79	275.6	43.6
40	39.5	06.3	100	98.8	15.6	60	158.0	25.0	20	217.3	34.4	80	276.6	43.8
41	40.5	06.4	101	99.8	15.8	161	159.0	25.2	221	218.3	34.6	281	277.5	43.9
42	41.5	06.6	02	100.7	16.0	62	160.0	25.3	22	219.3	34.7	82	278.5	44.1
43	42.5	06.7	03	101.7	16.1	63	161.0	25.5	23	220.3	34.9	83	279.5	44.3
44	43.5	06.9	04	102.7	16.3	64	162.0	25.6	24	221.2	35.0	84	280.5	44.4
45	44.4	07.0	05	103.7	16.4	65	163.0	25.8	25	222.2	35.2	85	281.5	44.6
46	45.4	07.2	06	104.7	16.6	66	164.0	26.0	26	223.2	35.3	86	282.5	44.7
47	46.4	07.4	07	105.7	16.7	67	164.9	26.1	27	224.2	35.5	87	283.5	44.9
48	47.4	07.5	08	106.7	16.9	68	165.9	26.3	28	225.2	35.7	88	284.5	45.0
49	48.4	07.7	09	107.7	17.0	69	166.9	26.4	29	226.2	35.8	89	285.4	45.2
50	49.4	07.8	10	108.6	17.2	70	167.9	26.6	30	227.2	36.0	90	286.4	45.4
51	50.4	08.0	111	109.6	17.4	171	168.9	26.7	231	228.2	36.1	291	287.4	45.5
52	51.4	08.1	12	110.6	17.5	72	169.9	26.9	32	229.1	36.3	92	288.4	45.7
53	52.3	08.3	13	111.6	17.7	73	170.9	27.1	33	230.1	36.4	93	289.4	45.8
54	53.3	08.4	14	112.6	17.8	74	171.9	27.2	34	231.1	36.6	94	290.4	46.0
55	54.3	08.6	15	113.6	18.0	75	172.8	27.4	35	232.1	36.8	95	291.4	46.1
56	55.3	08.8	16	114.6	18.1	76	173.8	27.5	36	233.1	36.9	96	292.4	46.3
57	56.3	08.9	17	115.6	18.3	77	174.8	27.7	37	234.1	37.1	97	293.3	46.5
58	57.3	09.1	18	116.5	18.5	78	175.8	27.8	38	235.1	37.2	98	294.3	46.6
59	58.3	09.2	19	117.5	18.6	79	176.8	28.0	39	236.1	37.4	99	295.3	46.8
60	59.3	09.4	20	118.5	18.8	80	177.8	28.2	40	237.0	37.5	300	296.3	46.9
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.2	61	60.1	10.6	121	119.2	21.0	181	178.2	31.4	241	237.3	41.8
2	02.0	00.3	62	61.1	10.8	22	120.1	21.2	82	179.2	31.6	42	238.3	42.0
3	03.0	00.5	63	62.0	10.9	23	121.1	21.3	83	180.2	31.7	43	239.3	42.1
4	03.9	00.7	64	63.0	11.1	24	122.1	21.5	84	181.2	31.9	44	240.3	42.3
5	04.9	00.9	65	64.0	11.2	25	123.1	21.7	85	182.2	32.1	45	241.3	42.5
6	05.9	01.0	66	65.0	11.4	26	124.1	21.8	86	183.2	32.3	46	242.3	42.7
7	06.9	01.2	67	66.0	11.6	27	125.1	22.0	87	184.2	32.4	47	243.2	42.8
8	07.9	01.4	68	67.0	11.8	28	126.1	22.2	88	185.1	32.6	48	244.2	43.0
9	08.9	01.6	69	68.0	12.0	29	127.0	22.4	89	186.1	32.8	49	245.2	43.2
10	09.8	01.7	70	68.9	12.1	30	128.0	22.5	90	187.1	32.9	50	246.2	43.4
11	10.8	01.9	71	69.9	12.3	131	129.0	22.7	191	188.1	33.1	251	247.2	43.5
12	11.8	02.1	72	70.9	12.5	32	130.0	22.9	92	189.1	33.3	52	248.2	43.7
13	12.8	02.3	73	71.9	12.7	33	131.0	23.1	93	190.1	33.5	53	249.2	43.9
14	13.8	02.4	74	72.9	12.8	34	132.0	23.2	94	191.0	33.6	54	250.1	44.0
15	14.8	02.6	75	73.9	13.0	35	132.9	23.4	95	192.0	33.8	55	251.1	44.2
16	15.8	02.8	76	74.8	13.2	36	133.9	23.6	96	193.0	34.0	56	252.1	44.4
17	16.7	02.9	77	75.8	13.4	37	134.9	23.8	97	194.0	34.2	57	253.1	44.6
18	17.7	03.1	78	76.8	13.5	38	135.9	23.9	98	195.0	34.3	58	254.1	44.7
19	18.7	03.3	79	77.8	13.7	39	136.9	24.1	99	196.0	34.5	59	255.1	44.9
20	19.7	03.5	80	78.8	13.9	40	137.9	24.3	200	197.0	34.7	60	256.0	45.1
21	20.7	03.6	81	79.8	14.0	141	138.9	24.4	201	197.9	34.9	261	257.0	45.3
22	21.7	03.8	82	80.8	14.2	42	139.8	24.6	02	198.9	35.0	62	258.0	45.4
23	22.7	04.0	83	81.7	14.4	43	140.8	24.8	03	199.9	35.2	63	259.0	45.6
24	23.6	04.2	84	82.7	14.6	44	141.8	25.0	04	200.9	35.4	64	260.0	45.8
25	24.6	04.3	85	83.7	14.7	45	142.8	25.1	05	201.9	35.5	65	261.0	46.0
26	25.6	04.5	86	84.7	14.9	46	143.8	25.3	06	202.9	35.7	66	262.0	46.1
27	26.6	04.7	87	85.7	15.1	47	144.8	25.5	07	203.9	35.9	67	262.9	46.3
28	27.6	04.9	88	86.7	15.3	48	145.7	25.7	08	204.8	36.1	68	263.9	46.5
29	28.6	05.0	89	87.6	15.4	49	146.7	25.8	09	205.8	36.2	69	264.9	46.6
30	29.5	05.2	90	88.6	15.6	50	147.7	26.0	10	206.8	36.4	70	265.9	46.8
31	30.5	05.4	91	89.6	15.8	151	148.7	26.2	211	207.8	36.6	271	266.9	47.0
32	31.5	05.5	92	90.6	16.0	52	149.7	26.4	12	208.8	36.8	72	267.9	47.2
33	32.5	05.7	93	91.6	16.1	53	150.7	26.5	13	209.8	36.9	73	268.9	47.3
34	33.5	05.9	94	92.6	16.3	54	151.7	26.7	14	210.7	37.1	74	269.8	47.5
35	34.5	06.1	95	93.6	16.5	55	152.6	26.9	15	211.7	37.3	75	270.8	47.7
36	35.5	06.2	96	94.5	16.6	56	153.6	27.1	16	212.7	37.5	76	271.8	47.9
37	36.4	06.4	97	95.5	16.8	57	154.6	27.2	17	213.7	37.6	77	272.8	48.0
38	37.4	06.6	98	96.5	17.0	58	155.6	27.4	18	214.7	37.8	78	273.8	48.2
39	38.4	06.8	99	97.5	17.2	59	156.6	27.6	19	215.7	38.0	79	274.8	48.4
40	39.4	06.9	100	98.5	17.3	60	157.6	27.7	20	216.7	38.1	80	275.7	48.6
41	40.4	07.1	101	99.5	17.5	161	158.6	27.9	221	217.6	38.3	281	276.7	48.7
42	41.4	07.3	02	100.4	17.7	62	159.5	28.1	22	218.6	38.5	82	277.7	48.9
43	42.3	07.5	03	101.4	17.9	63	160.5	28.3	23	219.6	38.7	83	278.7	49.1
44	43.3	07.6	04	102.4	18.0	64	161.5	28.4	24	220.6	38.8	84	279.7	49.2
45	44.3	07.8	05	103.4	18.2	65	162.5	28.6	25	221.6	39.0	85	280.7	49.4
46	45.3	08.0	06	104.4	18.4	66	163.5	28.8	26	222.6	39.2	86	281.6	49.6
47	46.3	08.1	07	105.4	18.6	67	164.5	29.0	27	223.5	39.4	87	282.6	49.8
48	47.3	08.3	08	106.4	18.7	68	165.4	29.1	28	224.5	39.5	88	283.6	49.9
49	48.3	08.5	09	107.3	18.9	69	166.4	29.3	29	225.5	39.7	89	284.6	50.1
50	49.2	08.7	10	108.3	19.1	70	167.4	29.5	30	226.5	39.9	90	285.6	50.3
51	50.2	08.8	111	109.3	19.2	171	168.4	29.7	231	227.5	40.1	291	286.6	50.5
52	51.2	09.0	12	110.3	19.4	72	169.4	29.8	32	228.5	40.2	92	287.6	50.6
53	52.2	09.2	13	111.3	19.6	73	170.4	30.0	33	229.5	40.4	93	288.5	50.8
54	53.2	09.4	14	112.3	19.8	74	171.4	30.2	34	230.4	40.6	94	289.5	51.0
55	54.2	09.5	15	113.3	19.9	75	172.3	30.3	35	231.4	40.7	95	290.5	51.2
56	55.1	09.7	16	114.2	20.1	76	173.3	30.5	36	232.4	40.9	96	291.5	51.3
57	56.1	09.9	17	115.2	20.3	77	174.3	30.7	37	233.4	41.1	97	292.5	51.5
58	57.1	10.1	18	116.2	20.5	78	175.3	30.9	38	234.4	41.3	98	293.5	51.7
59	58.1	10.2	19	117.2	20.6	79	176.3	31.0	39	235.4	41.4	99	294.5	51.8
60	59.1	10.4	20	118.2	20.8	80	177.3	31.2	40	236.4	41.6	300	295.4	52.0
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.2	61	59.9	11.6	121	118.8	23.1	181	177.7	34.5	241	236.6	46.0
2	02.0	00.4	62	60.9	11.8	22	119.8	23.3	82	178.6	34.7	42	237.5	46.2
3	02.9	00.6	63	61.8	12.0	23	120.7	23.5	83	179.6	34.9	43	238.5	46.4
4	03.9	00.8	64	62.8	12.2	24	121.7	23.7	84	180.6	35.1	44	239.5	46.6
5	04.9	01.0	65	63.8	12.4	25	122.7	23.9	85	181.6	35.3	45	240.5	46.8
6	05.9	01.1	66	64.8	12.6	26	123.7	24.0	86	182.6	35.5	46	241.5	47.0
7	06.9	01.3	67	65.8	12.8	27	124.7	24.2	87	183.6	35.7	47	242.5	47.1
8	07.9	01.5	68	66.7	13.0	28	125.6	24.4	88	184.5	35.9	48	243.4	47.3
9	08.8	01.7	69	67.7	13.2	29	126.6	24.6	89	185.5	36.1	49	244.4	47.5
10	09.8	01.9	70	68.7	13.4	30	127.6	24.8	90	186.5	36.3	50	245.4	47.7
11	10.8	02.1	71	69.7	13.5	131	128.6	25.0	191	187.5	36.4	251	246.4	47.9
12	11.8	02.3	72	70.7	13.7	32	129.6	25.2	92	188.5	36.6	52	247.4	48.1
13	12.8	02.5	73	71.7	13.9	33	130.6	25.4	93	189.4	36.8	53	248.3	48.3
14	13.7	02.7	74	72.6	14.1	34	131.5	25.6	94	190.4	37.0	54	249.3	48.5
15	14.7	02.9	75	73.6	14.3	35	132.5	25.8	95	191.4	37.2	55	250.3	48.7
16	15.7	03.1	76	74.6	14.5	36	133.5	25.9	96	192.4	37.4	56	251.3	48.8
17	16.7	03.2	77	75.6	14.7	37	134.5	26.1	97	193.4	37.6	57	252.3	49.0
18	17.7	03.4	78	76.6	14.9	38	135.5	26.3	98	194.4	37.8	58	253.2	49.2
19	18.7	03.6	79	77.5	15.1	39	136.4	26.5	99	195.3	38.0	59	254.2	49.4
20	19.6	03.8	80	78.5	15.3	40	137.4	26.7	200	196.3	38.2	60	255.2	49.6
21	20.6	04.0	81	79.5	15.5	141	138.4	26.9	201	197.3	38.4	261	256.2	49.8
22	21.6	04.2	82	80.5	15.6	42	139.4	27.1	02	198.3	38.5	62	257.2	50.0
23	22.6	04.4	83	81.5	15.8	43	140.4	27.3	03	199.3	38.7	63	258.2	50.2
24	23.6	04.6	84	82.5	16.0	44	141.3	27.5	04	200.2	38.9	64	259.1	50.4
25	24.5	04.8	85	83.4	16.2	45	142.3	27.7	05	201.2	39.1	65	260.1	50.6
26	25.5	05.0	86	84.4	16.4	46	143.3	27.9	06	202.2	39.3	66	261.1	50.8
27	26.5	05.2	87	85.4	16.6	47	144.3	28.0	07	203.2	39.5	67	262.1	50.9
28	27.5	05.3	88	86.4	16.8	48	145.3	28.2	08	204.2	39.7	68	263.1	51.1
29	28.5	05.5	89	87.4	17.0	49	146.3	28.4	09	205.2	39.9	69	264.0	51.3
30	29.4	05.7	90	88.3	17.2	50	147.2	28.6	10	206.1	40.1	70	265.0	51.5
31	30.4	05.9	91	89.3	17.4	151	148.2	28.8	211	207.1	40.3	271	266.0	51.7
32	31.4	06.1	92	90.3	17.6	52	149.2	29.0	12	208.1	40.4	72	267.0	51.9
33	32.4	06.3	93	91.3	17.7	53	150.2	29.2	13	209.1	40.6	73	268.0	52.1
34	33.4	06.5	94	92.3	17.9	54	151.2	29.4	14	210.1	40.8	74	269.0	52.3
35	34.4	06.7	95	93.3	18.1	55	152.1	29.6	15	211.0	41.0	75	269.9	52.5
36	35.3	06.9	96	94.2	18.3	56	153.1	29.8	16	212.0	41.2	76	270.9	52.7
37	36.3	07.1	97	95.2	18.5	57	154.1	30.0	17	213.0	41.4	77	271.9	52.9
38	37.3	07.3	98	96.2	18.7	58	155.1	30.1	18	214.0	41.6	78	272.9	53.0
39	38.3	07.4	99	97.2	18.9	59	156.1	30.3	19	215.0	41.8	79	273.9	53.2
40	39.3	07.6	100	98.2	19.1	60	157.1	30.5	20	215.9	42.0	80	274.8	53.4
41	40.2	07.8	101	99.1	19.3	161	158.0	30.7	221	216.9	42.2	281	275.8	53.6
42	41.2	08.0	02	100.1	19.5	62	159.0	30.9	22	217.9	42.4	82	276.8	53.8
43	42.2	08.2	03	101.1	19.7	63	160.0	31.1	23	218.9	42.5	83	277.8	54.0
44	43.2	08.4	04	102.1	19.8	64	161.0	31.3	24	219.9	42.7	84	278.8	54.2
45	44.2	08.6	05	103.1	20.0	65	162.0	31.5	25	220.9	42.9	85	279.8	54.4
46	45.2	08.8	06	104.0	20.2	66	162.9	31.7	26	221.8	43.1	86	280.7	54.6
47	46.1	09.0	07	105.0	20.4	67	163.9	31.9	27	222.8	43.3	87	281.7	54.8
48	47.1	09.2	08	106.0	20.6	68	164.9	32.1	28	223.8	43.5	88	282.7	55.0
49	48.1	09.3	09	107.0	20.8	69	165.9	32.2	29	224.8	43.7	89	283.7	55.1
50	49.1	09.5	10	108.0	21.0	70	166.9	32.4	30	225.8	43.9	90	284.7	55.3
51	50.1	09.7	111	109.0	21.2	71	167.9	32.6	231	226.7	44.1	291	285.6	55.5
52	51.0	09.9	12	109.9	21.4	72	168.8	32.8	32	227.7	44.3	92	286.6	55.7
53	52.0	10.1	13	110.9	21.6	73	169.8	33.0	33	228.7	44.5	93	287.6	55.9
54	53.0	10.3	14	111.9	21.8	74	170.8	33.2	34	229.7	44.6	94	288.6	56.1
55	54.0	10.5	15	112.9	21.9	75	171.8	33.4	35	230.7	44.8	95	289.6	56.3
56	55.0	10.7	16	113.9	22.1	76	172.8	33.6	36	231.7	45.0	96	290.5	56.5
57	56.0	10.9	17	114.8	22.3	77	173.7	33.8	37	232.6	45.2	97	291.5	56.7
58	56.9	11.1	18	115.8	22.5	78	174.7	34.0	38	233.6	45.4	98	292.5	56.9
59	57.9	11.3	19	116.8	22.7	79	175.7	34.2	39	234.6	45.6	99	293.5	57.0
60	58.9	11.4	20	117.8	22.9	80	176.7	34.3	40	235.6	45.8	300	294.5	57.2
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.2	61	59.7	12.7	121	118.3	25.2	181	177.0	37.6	241	235.7	50.1
2	02.0	00.4	62	60.6	12.9	22	119.3	25.4	82	178.0	37.9	42	236.7	50.3
3	02.9	00.6	63	61.6	13.1	23	120.3	25.6	83	179.0	38.1	43	237.7	50.5
4	03.9	00.8	64	62.6	13.3	24	121.3	25.8	84	180.0	38.3	44	238.6	50.8
5	04.9	01.0	65	63.6	13.5	25	122.3	26.0	85	180.9	38.5	45	239.6	51.0
6	05.9	01.2	66	64.5	13.7	26	123.2	26.2	86	181.9	38.7	46	240.6	51.2
7	06.8	01.5	67	65.5	13.9	27	124.2	26.4	87	182.9	38.9	47	241.6	51.4
8	07.8	01.7	68	66.5	14.1	28	125.2	26.6	88	183.9	39.1	48	242.5	51.6
9	08.8	01.9	69	67.5	14.4	29	126.2	26.8	89	184.8	39.3	49	243.5	51.8
10	09.8	02.1	70	68.5	14.6	30	127.1	27.0	90	185.8	39.5	50	244.5	52.0
11	10.8	02.3	71	69.4	14.8	131	128.1	27.2	191	186.8	39.7	251	245.5	52.2
12	11.7	02.5	72	70.4	15.0	32	129.1	27.5	92	187.8	39.9	52	246.5	52.4
13	12.7	02.7	73	71.4	15.2	33	130.1	27.7	93	188.8	40.1	53	247.4	52.6
14	13.7	02.9	74	72.4	15.4	34	131.1	27.9	94	189.7	40.4	54	248.4	52.8
15	14.7	03.1	75	73.4	15.6	35	132.0	28.1	95	190.7	40.6	55	249.4	53.0
16	15.6	03.3	76	74.3	15.8	36	133.0	28.3	96	191.7	40.8	56	250.4	53.2
17	16.6	03.5	77	75.3	16.0	37	134.0	28.5	97	192.7	41.0	57	251.3	53.5
18	17.6	03.7	78	76.3	16.2	38	135.0	28.7	98	193.6	41.2	58	252.3	53.7
19	18.6	04.0	79	77.3	16.4	39	135.9	28.9	99	194.6	41.4	59	253.3	53.9
20	19.6	04.2	80	78.2	16.6	40	136.9	29.1	200	195.6	41.6	60	254.3	54.1
21	20.5	04.4	81	79.2	16.8	141	137.9	29.3	201	196.6	41.8	261	255.3	54.3
22	21.5	04.6	82	80.2	17.1	42	138.9	29.5	02	197.6	42.0	62	256.2	54.5
23	22.5	04.8	83	81.2	17.3	43	139.9	29.7	03	198.5	42.2	63	257.2	54.7
24	23.5	05.0	84	82.2	17.5	44	140.8	30.0	04	199.5	42.4	64	258.2	54.9
25	24.5	05.2	85	83.1	17.7	45	141.8	30.2	05	200.5	42.6	65	259.2	55.1
26	25.4	05.4	86	84.1	17.9	46	142.8	30.4	06	201.5	42.8	66	260.1	55.3
27	26.4	05.6	87	85.1	18.1	47	143.8	30.6	07	202.4	43.1	67	261.1	55.5
28	27.4	05.8	88	86.1	18.3	48	144.7	30.8	08	203.4	43.3	68	262.1	55.7
29	28.4	06.0	89	87.0	18.5	49	145.7	31.0	09	204.4	43.5	69	263.1	56.0
30	29.3	06.2	90	88.0	18.7	50	146.7	31.2	10	205.4	43.7	70	264.1	56.2
31	30.3	06.4	91	89.0	18.9	151	147.7	31.4	211	206.4	43.9	271	265.0	56.4
32	31.3	06.7	92	90.0	19.1	52	148.7	31.6	12	207.3	44.1	72	266.0	56.6
33	32.3	06.9	93	91.0	19.3	53	149.7	31.8	13	208.3	44.3	73	267.0	56.8
34	33.3	07.1	94	91.9	19.6	54	150.6	32.0	14	209.3	44.5	74	268.0	57.0
35	34.2	07.3	95	92.9	19.8	55	151.6	32.2	15	210.3	44.7	75	269.0	57.2
36	35.2	07.5	96	93.9	20.0	56	152.6	32.4	16	211.2	44.9	76	269.9	57.4
37	36.2	07.7	97	94.9	20.2	57	153.6	32.7	17	212.2	45.1	77	270.9	57.6
38	37.2	07.9	98	95.9	20.4	58	154.5	32.9	18	213.2	45.3	78	271.9	57.8
39	38.1	08.1	99	96.8	20.6	59	155.5	33.1	19	214.2	45.6	79	272.9	58.0
40	39.1	08.3	100	97.8	20.8	60	156.5	33.3	20	215.2	45.8	80	273.8	58.2
41	40.1	08.5	101	98.8	21.0	161	157.5	33.5	221	216.1	46.0	281	274.8	58.4
42	41.1	08.7	02	99.8	21.2	62	158.4	33.7	22	217.1	46.2	82	275.8	58.7
43	42.1	08.9	03	100.7	21.4	63	159.4	33.9	23	218.1	46.4	83	276.8	58.9
44	43.0	09.1	04	101.7	21.6	64	160.4	34.1	24	219.1	46.6	84	277.8	59.1
45	44.0	09.4	05	102.7	21.8	65	161.4	34.3	25	220.1	46.8	85	278.7	59.3
46	45.0	09.6	06	103.7	22.0	66	162.3	34.5	26	221.0	47.0	86	279.7	59.5
47	46.0	09.8	07	104.6	22.2	67	163.3	34.7	27	222.0	47.2	87	280.7	59.7
48	46.9	10.0	08	105.6	22.5	68	164.3	34.9	28	223.0	47.4	88	281.7	59.9
49	47.9	10.2	09	106.6	22.7	69	165.3	35.2	29	224.0	47.6	89	282.6	60.1
50	48.9	10.4	10	107.6	22.9	70	166.3	35.4	30	225.0	47.8	90	283.6	60.3
51	49.9	10.6	111	108.6	23.1	171	167.2	35.6	231	225.9	48.0	291	284.6	60.5
52	50.9	10.8	12	109.5	23.3	72	168.2	35.8	32	226.9	48.3	92	285.6	60.7
53	51.8	11.0	13	110.5	23.5	73	169.2	36.0	33	227.9	48.5	93	286.6	60.9
54	52.8	11.2	14	111.5	23.7	74	170.2	36.2	34	228.9	48.7	94	287.5	61.2
55	53.8	11.4	15	112.5	23.9	75	171.2	36.4	35	229.8	48.9	95	288.5	61.4
56	54.8	11.6	16	113.4	24.1	76	172.1	36.6	36	230.8	49.1	96	289.5	61.6
57	55.7	11.9	17	114.4	24.3	77	173.1	36.8	37	231.8	49.3	97	290.5	61.8
58	56.7	12.1	18	115.4	24.5	78	174.1	37.0	38	232.8	49.5	98	291.4	62.0
59	57.7	12.3	19	116.4	24.8	79	175.1	37.2	39	233.7	49.7	99	292.4	62.2
60	58.7	12.5	20	117.4	25.0	80	176.0	37.4	40	234.7	49.9	300	293.4	62.4
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.2	61	59.4	13.7	121	117.9	27.2	181	176.4	40.7	241	234.8	54.2
2	01.9	00.4	62	60.4	13.9	22	118.9	27.4	82	177.3	40.9	42	235.8	54.4
3	02.9	00.7	63	61.4	14.2	23	119.8	27.7	83	178.3	41.2	43	236.8	54.7
4	03.9	00.9	64	62.4	14.4	24	120.8	27.9	84	179.3	41.4	44	237.8	54.9
5	04.9	01.1	65	63.3	14.6	25	121.8	28.1	85	180.3	41.6	45	238.7	55.1
6	05.8	01.3	66	64.3	14.8	26	122.8	28.3	86	181.2	41.8	46	239.7	55.3
7	06.8	01.6	67	65.3	15.1	27	123.7	28.6	87	182.2	42.1	47	240.7	55.6
8	07.8	01.8	68	66.3	15.3	28	124.7	28.8	88	183.2	42.3	48	241.6	55.8
9	08.8	02.0	69	67.2	15.5	29	125.7	29.0	89	184.2	42.5	49	242.6	56.0
10	09.7	02.2	70	68.2	15.7	30	126.7	29.2	90	185.1	42.7	50	243.6	56.2
11	10.7	02.5	71	69.2	16.0	131	127.6	29.5	191	186.1	43.0	251	244.6	56.5
12	11.7	02.7	72	70.2	16.2	32	128.6	29.7	92	187.1	43.2	52	245.5	56.7
13	12.7	02.9	73	71.1	16.4	33	129.6	29.9	93	188.1	43.4	53	246.5	56.9
14	13.6	03.1	74	72.1	16.6	34	130.6	30.1	94	189.0	43.6	54	247.5	57.1
15	14.6	03.4	75	73.1	16.9	35	131.5	30.4	95	190.0	43.9	55	248.5	57.4
16	15.6	03.6	76	74.1	17.1	36	132.5	30.6	96	191.0	44.1	56	249.4	57.6
17	16.6	03.8	77	75.0	17.3	37	133.5	30.8	97	192.0	44.3	57	250.4	57.8
18	17.5	04.0	78	76.0	17.5	38	134.5	31.0	98	192.9	44.5	58	251.4	58.0
19	18.5	04.3	79	77.0	17.8	39	135.4	31.3	99	193.9	44.8	59	252.4	58.3
20	19.5	04.5	80	78.0	18.0	40	136.4	31.5	200	194.0	45.0	60	253.3	58.5
21	20.5	04.7	81	78.9	18.2	141	137.4	31.7	201	195.9	45.2	261	254.3	58.7
22	21.4	04.9	82	79.9	18.4	42	138.4	31.9	02	196.8	45.4	62	255.3	58.9
23	22.4	05.2	83	80.9	18.7	43	139.3	32.2	03	197.8	45.7	63	256.3	59.2
24	23.4	05.4	84	81.8	18.9	44	140.3	32.4	04	198.8	45.9	64	257.2	59.4
25	24.4	05.6	85	82.8	19.1	45	141.3	32.6	05	199.7	46.1	65	258.2	59.6
26	25.3	05.8	86	83.8	19.3	46	142.3	32.8	06	200.7	46.3	66	259.2	59.8
27	26.3	06.1	87	84.8	19.6	47	143.2	33.1	07	201.7	46.6	67	260.2	60.1
28	27.3	06.3	88	85.7	19.8	48	144.2	33.3	08	202.7	46.8	68	261.1	60.3
29	28.3	06.5	89	86.7	20.0	49	145.2	33.5	09	203.6	47.0	69	262.1	60.5
30	29.2	06.7	90	87.7	20.2	50	146.2	33.7	10	204.6	47.2	70	263.1	60.7
31	30.2	07.0	91	88.7	20.5	151	147.1	34.0	211	205.6	47.5	271	264.1	61.0
32	31.2	07.2	92	89.6	20.7	52	148.1	34.2	12	206.6	47.7	72	265.0	61.2
33	32.2	07.4	93	90.6	20.9	53	149.1	34.4	13	207.5	47.9	73	266.0	61.4
34	33.1	07.6	94	91.6	21.1	54	150.1	34.6	14	208.5	48.1	74	267.0	61.6
35	34.1	07.9	95	92.6	21.4	55	151.0	34.9	15	209.5	48.4	75	268.0	61.9
36	35.1	08.1	96	93.5	21.6	56	152.0	35.1	16	210.5	48.6	76	268.9	62.1
37	36.1	08.3	97	94.5	21.8	57	153.0	35.3	17	211.4	48.8	77	269.9	62.3
38	37.0	08.5	98	95.5	22.0	58	154.0	35.5	18	212.4	49.0	78	270.9	62.5
39	38.0	08.8	99	96.5	22.3	59	154.9	35.8	19	213.4	49.3	79	271.9	62.8
40	39.0	09.0	100	97.4	22.5	60	155.9	36.0	20	214.1	49.5	80	272.8	63.0
41	39.9	09.2	101	98.4	22.7	161	156.9	36.2	221	215.3	49.7	281	273.8	63.2
42	40.9	09.4	02	99.4	22.9	62	157.9	36.4	22	216.3	49.9	82	274.8	63.4
43	41.9	09.7	03	100.4	23.2	63	158.8	36.7	23	217.3	50.2	83	275.8	63.7
44	42.9	09.9	04	101.3	23.4	64	159.8	36.9	24	218.3	50.4	84	276.7	63.9
45	43.8	10.1	05	102.3	23.6	65	160.8	37.1	25	219.2	50.6	85	277.7	64.1
46	44.8	10.3	06	103.3	23.8	66	161.7	37.3	26	220.2	50.8	86	278.7	64.3
47	45.8	10.6	07	104.3	24.1	67	162.7	37.6	27	221.2	51.1	87	279.6	64.6
48	46.8	10.8	08	105.2	24.3	68	163.7	37.8	28	222.2	51.3	88	280.6	64.8
49	47.7	11.0	09	106.2	24.5	69	164.7	38.0	29	223.1	51.5	89	281.6	65.0
50	48.7	11.2	10	107.2	24.7	70	165.6	38.2	30	224.1	51.7	90	282.6	65.2
51	49.7	11.5	111	108.2	25.0	171	166.6	38.5	231	225.1	52.0	291	283.5	65.5
52	50.7	11.7	12	109.1	25.2	72	167.6	38.7	32	226.1	52.2	92	284.5	65.7
53	51.6	11.9	13	110.1	25.4	73	168.6	38.9	33	227.0	52.4	93	285.5	65.9
54	52.6	12.1	14	111.1	25.6	74	169.5	39.1	34	228.0	52.6	94	286.5	66.1
55	53.6	12.4	15	112.1	25.9	75	160.5	39.4	35	229.0	52.9	95	287.4	66.4
56	54.6	12.6	16	113.0	26.1	76	171.5	39.6	36	230.0	53.1	96	288.4	66.6
57	55.5	12.8	17	114.0	26.3	77	172.5	39.8	37	230.9	53.3	97	289.4	66.8
58	56.5	13.0	18	115.0	26.5	78	173.4	40.0	38	231.9	53.5	98	290.4	67.0
59	57.5	13.3	19	116.0	26.8	79	174.4	40.2	39	232.9	53.8	99	291.3	67.3
60	58.5	13.5	20	116.9	27.0	80	175.4	40.5	40	233.9	54.0	300	292.3	67.5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.2	61	59.2	14.8	121	117.4	29.3	181	175.6	43.8	241	233.8	58.3
2	01.9	00.5	62	60.2	15.0	22	118.4	29.5	82	176.6	44.0	42	234.8	58.6
3	02.9	00.7	63	61.1	15.2	23	119.3	29.8	83	177.6	44.3	43	235.8	58.8
4	03.9	01.0	64	62.1	15.5	24	120.3	30.0	84	178.5	44.5	44	236.7	59.0
5	04.9	01.2	65	63.1	15.7	25	121.3	30.2	85	179.5	44.8	45	237.7	59.3
6	05.8	01.5	66	64.0	16.0	26	122.3	30.5	86	180.5	45.0	46	238.7	59.5
7	06.8	01.7	67	65.0	16.2	27	123.2	30.7	87	181.4	45.3	47	239.7	59.8
8	07.8	01.9	68	66.0	16.5	28	124.2	31.0	88	182.4	45.5	48	240.6	60.0
9	08.7	02.2	69	66.9	16.7	29	125.2	31.2	89	183.4	45.7	49	241.6	60.3
10	09.7	02.4	70	67.9	16.9	30	126.1	31.5	90	184.4	46.0	50	242.6	60.5
11	10.7	02.7	71	68.9	17.2	131	127.1	31.7	191	185.3	46.2	251	243.5	60.7
12	11.6	02.9	72	69.9	17.4	32	128.1	31.9	92	186.3	46.5	52	244.5	61.0
13	12.6	03.1	73	70.8	17.7	33	129.0	32.2	93	187.3	46.7	53	245.5	61.2
14	13.6	03.4	74	71.8	17.9	34	130.0	32.4	94	188.2	46.9	54	246.4	61.5
15	14.6	03.6	75	72.8	18.1	35	131.0	32.7	95	189.2	47.2	55	247.4	61.7
16	15.5	03.9	76	73.7	18.4	36	132.0	32.9	96	190.2	47.4	56	248.4	62.0
17	16.5	04.1	77	74.7	18.6	37	132.9	33.2	97	191.1	47.7	57	249.4	62.2
18	17.5	04.4	78	75.7	18.9	38	133.9	33.4	98	192.1	47.9	58	250.3	62.4
19	18.4	04.6	79	76.7	19.1	39	134.9	33.6	99	193.1	48.2	59	251.3	62.7
20	19.4	04.8	80	77.6	19.4	40	135.8	33.9	200	194.1	48.4	60	252.3	62.9
21	20.4	05.1	81	78.6	19.6	141	136.8	34.1	201	195.0	48.6	261	253.2	63.2
22	21.3	05.3	82	79.6	19.8	42	137.8	34.4	02	196.0	48.9	62	254.2	63.4
23	22.3	05.6	83	80.5	20.1	43	138.7	34.6	03	197.0	49.1	63	255.2	63.6
24	23.3	05.8	84	81.5	20.3	44	139.7	34.8	04	197.9	49.4	64	256.2	63.9
25	24.3	06.0	85	82.5	20.6	45	140.7	35.1	05	198.9	49.6	65	257.1	64.1
26	25.2	06.3	86	83.4	20.8	46	141.7	35.3	06	199.9	49.9	66	258.1	64.4
27	26.2	06.5	87	84.4	21.1	47	142.6	35.6	07	200.8	50.1	67	259.1	64.6
28	27.2	06.8	88	85.4	21.3	48	143.6	35.8	08	201.8	50.3	68	260.0	64.9
29	28.1	07.0	89	86.4	21.5	49	144.6	36.1	09	202.8	50.6	69	261.0	65.1
30	29.1	07.3	90	87.3	21.8	50	145.5	36.3	10	203.8	50.8	70	262.0	65.3
31	30.1	07.5	91	88.3	22.0	151	146.5	36.5	211	204.7	51.1	271	262.9	65.6
32	31.0	07.7	92	89.3	22.3	52	147.5	36.8	12	205.7	51.3	72	263.9	65.8
33	32.0	08.0	93	90.2	22.5	53	148.5	37.0	13	206.7	51.5	73	264.9	66.1
34	33.0	08.2	94	91.2	22.7	54	149.4	37.3	14	207.6	51.8	74	265.9	66.3
35	34.0	08.5	95	92.2	23.0	55	150.4	37.5	15	208.6	52.0	75	266.8	66.5
36	34.9	08.7	96	93.1	23.2	56	151.4	37.7	16	209.6	52.3	76	267.8	66.8
37	35.9	09.0	97	94.1	23.5	57	152.3	38.0	17	210.5	52.5	77	268.8	67.0
38	36.9	09.2	98	95.1	23.7	58	153.3	38.2	18	211.5	52.8	78	269.7	67.3
39	37.8	09.4	99	96.1	24.0	59	154.3	38.5	19	212.5	53.0	79	270.7	67.5
40	38.8	09.7	100	97.0	24.2	60	155.2	38.7	20	213.5	53.2	80	271.7	67.8
41	39.8	09.9	101	98.0	24.4	161	156.2	39.0	221	214.4	53.5	281	272.6	68.0
42	40.8	10.2	02	99.0	24.7	62	157.2	39.2	22	215.4	53.7	82	273.6	68.2
43	41.7	10.4	03	99.9	24.9	63	158.2	39.4	23	216.4	54.0	83	274.6	68.5
44	42.7	10.6	04	100.9	25.2	64	159.1	39.7	24	217.3	54.2	84	275.6	68.7
45	43.7	10.9	05	101.9	25.4	65	160.1	39.9	25	218.3	54.4	85	276.5	69.0
46	44.6	11.1	06	102.8	25.7	66	161.1	40.2	26	219.3	54.7	86	277.5	69.2
47	45.6	11.4	07	103.8	25.9	67	162.0	40.4	27	220.3	54.9	87	278.5	69.5
48	46.6	11.6	08	104.8	26.1	68	163.0	40.7	28	221.2	55.2	88	279.4	69.7
49	47.5	11.9	09	105.8	26.4	69	164.0	40.9	29	222.2	55.4	89	280.4	69.9
50	48.5	12.1	10	106.7	26.6	70	164.9	41.1	30	223.2	55.7	90	281.4	70.2
51	49.5	12.3	111	107.7	26.9	171	165.9	41.4	231	224.1	55.9	291	282.3	70.4
52	50.5	12.6	12	108.7	27.1	72	166.9	41.6	32	225.1	56.1	92	283.3	70.7
53	51.4	12.8	13	109.6	27.3	73	167.9	41.9	33	226.1	56.4	93	284.3	70.9
54	52.4	13.1	14	110.6	27.6	74	168.8	42.1	34	227.1	56.6	94	285.3	71.1
55	53.4	13.3	15	111.6	27.8	75	169.8	42.3	35	228.1	56.9	95	286.2	71.4
56	54.3	13.6	16	112.6	28.1	76	170.8	42.6	36	229.0	57.1	96	287.2	71.6
57	55.3	13.8	17	113.5	28.3	77	171.7	42.8	37	230.0	57.4	97	288.2	71.9
58	56.3	14.0	18	114.5	28.6	78	172.7	43.1	38	230.9	57.6	98	289.1	72.1
59	57.2	14.3	19	115.5	28.8	79	173.7	43.3	39	231.9	57.8	99	290.1	72.4
60	58.2	14.5	20	116.4	29.0	80	174.6	43.5	40	232.9	58.1	300	291.1	72.6
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

TABLE II. Difference of Latitude and Departure for 15 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.3	61	58.9	15.8	121	116.9	31.3	181	174.8	46.8	241	232.8	62.4
2	01.9	00.5	62	59.9	16.0	22	117.8	31.6	82	175.8	47.1	42	233.7	62.6
3	02.9	00.8	63	60.9	16.3	23	118.8	31.8	83	176.8	47.4	43	234.7	62.9
4	03.9	01.0	64	61.8	16.6	24	119.8	32.1	84	177.7	47.6	44	235.7	63.1
5	04.8	01.3	65	62.8	16.8	25	120.7	32.4	85	178.7	47.9	45	236.6	63.4
6	05.8	01.6	66	63.7	17.1	26	121.7	32.6	86	179.7	48.1	46	237.6	63.7
7	06.8	01.8	67	64.7	17.3	27	122.7	32.9	87	180.6	48.4	47	238.6	63.9
8	07.7	02.1	68	65.7	17.6	28	123.6	33.1	88	181.6	48.7	48	239.5	64.2
9	08.7	02.3	69	66.6	17.9	29	124.6	33.4	89	182.6	48.9	49	240.5	64.4
10	09.7	02.6	70	67.6	18.1	30	125.6	33.6	90	183.5	49.2	50	241.5	64.7
11	10.6	02.8	71	68.6	18.4	131	126.5	33.9	191	184.5	49.4	251	242.4	65.0
12	11.6	03.1	72	69.5	18.6	32	127.5	34.2	92	185.5	49.7	52	243.4	65.2
13	12.6	03.4	73	70.5	18.9	33	128.5	34.4	93	186.4	49.9	53	244.4	65.5
14	13.5	03.6	74	71.5	19.2	34	129.4	34.7	94	187.4	50.2	54	245.3	65.7
15	14.5	03.9	75	72.4	19.4	35	130.4	34.9	95	188.4	50.5	55	246.3	66.0
16	15.5	04.1	76	73.4	19.7	36	131.4	35.2	96	189.3	50.7	56	247.3	66.3
17	16.4	04.4	77	74.4	19.9	37	132.3	35.5	97	190.3	51.0	57	248.2	66.5
18	17.4	04.7	78	75.3	20.2	38	133.3	35.7	98	191.2	51.2	58	249.2	66.8
19	18.4	04.9	79	76.3	20.4	39	134.3	36.0	99	192.2	51.5	59	250.2	67.0
20	19.3	05.2	80	77.3	20.7	40	135.2	36.2	200	193.2	51.8	60	251.1	67.3
21	20.3	05.4	81	78.2	21.0	141	136.2	36.5	201	194.1	52.0	261	252.1	67.5
22	21.2	05.7	82	79.2	21.2	42	137.2	36.7	02	195.1	52.3	62	253.1	67.8
23	22.2	06.0	83	80.2	21.5	43	138.1	37.0	03	196.1	52.5	63	254.0	68.1
24	23.2	06.2	84	81.1	21.7	44	139.1	37.3	04	197.0	52.8	64	255.0	68.3
25	24.1	06.5	85	82.1	22.0	45	140.1	37.5	05	198.0	53.1	65	256.0	68.6
26	25.1	06.7	86	83.1	22.3	46	141.0	37.8	06	199.0	53.3	66	256.9	68.8
27	26.1	07.0	87	84.0	22.5	47	142.0	38.0	07	199.9	53.6	67	257.9	69.1
28	27.0	07.2	88	85.0	22.8	48	143.0	38.3	08	200.9	53.8	68	258.9	69.4
29	28.0	07.5	89	86.0	23.0	49	143.9	38.6	09	201.9	54.1	69	259.8	69.6
30	29.0	07.8	90	86.9	23.3	50	144.9	38.8	10	202.8	54.3	70	260.8	69.9
31	29.9	08.0	91	87.9	23.6	151	145.8	39.1	211	203.8	54.6	271	261.8	70.1
32	30.9	08.3	92	88.9	23.8	52	146.8	39.3	12	204.8	54.9	72	262.7	70.4
33	31.9	08.5	93	89.8	24.1	53	147.8	39.6	13	205.7	55.1	73	263.7	70.7
34	32.8	08.8	94	90.8	24.3	54	148.7	39.9	14	206.7	55.4	74	264.7	70.9
35	33.8	09.1	95	91.8	24.6	55	149.7	40.1	15	207.7	55.6	75	265.6	71.2
36	34.8	09.3	96	92.7	24.8	56	150.7	40.4	16	208.6	55.9	76	266.6	71.4
37	35.7	09.6	97	93.7	25.1	57	151.6	40.6	17	209.6	56.1	77	267.6	71.7
38	36.7	09.8	98	94.7	25.4	58	152.6	40.9	18	210.6	56.4	78	268.5	71.9
39	37.7	10.1	99	95.6	25.6	59	153.6	41.1	19	211.5	56.7	79	269.5	72.2
40	38.6	10.4	100	96.6	25.9	60	154.5	41.4	20	212.5	56.9	80	270.5	72.5
41	39.6	10.6	101	97.6	26.1	161	155.5	41.7	221	213.5	57.2	281	271.4	72.7
42	40.6	10.9	02	98.5	26.4	62	156.5	41.9	22	214.4	57.5	82	272.4	73.0
43	41.5	11.1	03	99.5	26.7	63	157.4	42.2	23	215.4	57.7	83	273.4	73.2
44	42.5	11.4	04	100.5	26.9	64	158.4	42.4	24	216.4	58.0	84	274.3	73.5
45	43.5	11.6	05	101.4	27.2	65	159.4	42.7	25	217.3	58.2	85	275.3	73.8
46	44.4	11.9	06	102.4	27.4	66	160.3	43.0	26	218.3	58.5	86	276.2	74.0
47	45.4	12.2	07	103.4	27.7	67	161.3	43.2	27	219.3	58.7	87	277.2	74.3
48	46.4	12.4	08	104.3	28.0	68	162.3	43.5	28	220.2	59.0	88	278.2	74.5
49	47.3	12.7	09	105.3	28.2	69	163.2	43.7	29	221.2	59.3	89	279.1	74.8
50	48.3	12.9	10	106.2	28.5	70	164.2	44.0	30	222.2	59.5	90	280.1	75.0
51	49.3	13.2	11	107.2	28.7	171	165.2	44.3	231	223.1	59.8	291	281.1	75.3
52	50.2	13.5	12	108.2	29.0	72	166.1	44.5	32	224.1	60.0	92	282.0	75.6
53	51.2	13.7	13	109.1	29.2	73	167.1	44.8	33	225.1	60.3	93	283.0	75.8
54	52.2	14.0	14	110.1	29.5	74	168.1	45.0	34	226.0	60.6	94	284.0	76.1
55	53.1	14.2	15	111.1	29.8	75	169.0	45.3	35	227.0	60.8	95	284.9	76.3
56	54.1	4.5	16	112.0	30.0	76	170.0	45.5	36	228.0	61.1	96	285.9	76.6
57	55.1	14.8	17	113.0	30.3	77	171.0	45.8	37	228.9	61.3	97	286.9	76.9
58	56.0	15.0	18	114.0	30.5	78	171.9	46.1	38	229.9	61.6	98	287.8	77.1
59	57.0	15.3	19	114.9	30.8	79	172.9	46.3	39	230.9	61.9	99	288.8	77.4
60	58.0	15.5	120	115.9	31.1	80	173.9	46.6	40	231.8	62.1	300	289.8	77.6
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

[For 75 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.3	61	58.6	16.8	121	116.3	33.3	181	174.0	49.9	241	231.6	66.4
2	01.9	00.6	62	59.6	17.1	22	117.3	33.6	82	174.9	50.2	42	232.6	66.7
3	02.9	00.8	63	60.6	17.4	23	118.2	33.9	83	175.9	50.4	43	233.6	67.0
4	03.8	01.1	64	61.5	17.6	24	119.2	34.2	84	176.8	50.7	44	234.5	67.2
5	04.8	01.4	65	62.5	17.9	25	120.1	34.4	85	177.8	51.0	45	235.5	67.5
6	05.8	01.7	66	63.4	18.2	26	121.1	34.7	86	178.8	51.3	46	236.4	67.8
7	06.7	01.9	67	64.4	18.5	27	122.1	35.0	87	179.7	51.5	47	237.4	68.1
8	07.7	02.2	68	65.4	18.7	28	123.0	35.3	88	180.7	51.8	48	238.4	68.3
9	08.7	02.5	69	66.3	19.0	29	124.0	35.6	89	181.7	52.1	49	239.3	68.6
10	09.6	02.8	70	67.3	19.3	30	125.0	35.8	90	182.6	52.4	50	240.3	68.9
11	10.6	03.0	71	68.2	19.6	131	125.9	36.1	191	183.6	52.6	251	241.2	69.2
12	11.5	03.3	72	69.2	19.8	32	126.9	36.4	92	184.5	52.9	52	242.2	69.5
13	12.5	03.6	73	70.2	20.1	33	127.8	36.7	93	185.5	53.2	53	243.2	69.7
14	13.5	03.9	74	71.1	20.4	34	128.8	36.9	94	186.5	53.5	54	244.1	70.0
15	14.4	04.1	75	72.1	20.7	35	129.8	37.2	95	187.4	53.7	55	245.1	70.3
16	15.4	04.4	76	73.1	20.9	36	130.7	37.5	96	188.4	54.0	56	246.0	70.6
17	16.3	04.7	77	74.0	21.2	37	131.7	37.8	97	189.3	54.3	57	247.0	70.8
18	17.3	05.0	78	75.0	21.5	38	132.7	38.0	98	190.3	54.6	58	248.0	71.1
19	18.3	05.2	79	75.9	21.8	39	133.6	38.3	99	191.3	54.8	59	248.9	71.4
20	19.2	05.5	80	76.9	22.1	40	134.6	38.6	200	192.2	55.1	60	249.9	71.7
21	20.2	05.8	81	77.9	22.3	141	135.5	38.9	201	193.2	55.4	261	250.9	71.9
22	21.1	06.1	82	78.8	22.6	42	136.5	39.1	02	194.1	55.7	62	251.8	72.2
23	22.1	06.3	83	79.8	22.9	43	137.5	39.4	03	195.1	55.9	63	252.8	72.5
24	23.1	06.6	84	80.7	23.2	44	138.4	39.7	04	196.1	56.2	64	253.7	72.8
25	24.0	06.9	85	81.7	23.4	45	139.4	40.0	05	197.0	56.5	65	254.7	73.0
26	25.0	07.2	86	82.7	23.7	46	140.3	40.2	06	198.0	56.8	66	255.7	73.3
27	26.0	07.4	87	83.6	24.0	47	141.3	40.5	07	199.0	57.0	67	256.6	73.6
28	26.9	07.7	88	84.6	24.3	48	142.3	40.8	08	199.9	57.3	68	257.6	73.9
29	27.9	08.0	89	85.5	24.5	49	143.2	41.1	09	200.9	57.6	69	258.5	74.1
30	28.8	08.3	90	86.5	24.8	50	144.2	41.3	10	201.8	57.9	70	259.5	74.4
31	29.8	08.5	91	87.5	25.1	151	145.1	41.6	211	202.8	58.2	271	260.5	74.7
32	30.8	08.8	92	88.4	25.4	52	146.1	41.9	12	203.8	58.4	72	261.4	75.0
33	31.7	09.1	93	89.4	25.6	53	147.1	42.2	13	204.7	58.7	73	262.4	75.2
34	32.7	09.4	94	90.4	25.9	54	148.0	42.4	14	205.7	59.0	74	263.3	75.5
35	33.6	09.6	95	91.3	26.2	55	149.0	42.7	15	206.7	59.3	75	264.3	75.8
36	34.6	09.9	96	92.3	26.5	56	149.9	43.0	16	207.6	59.5	76	265.3	76.1
37	35.6	10.2	97	93.2	26.7	57	150.9	43.3	17	208.6	59.8	77	266.2	76.3
38	36.5	10.5	98	94.2	27.0	58	151.9	43.6	18	209.5	60.1	78	267.2	76.6
39	37.5	10.7	99	95.2	27.3	59	152.8	43.8	19	210.5	60.4	79	268.2	76.9
40	38.5	11.0	100	96.1	27.6	60	153.8	44.1	20	211.4	60.6	80	269.1	77.2
41	39.4	11.3	101	97.1	27.8	161	154.7	44.4	221	212.4	60.9	281	270.1	77.4
42	40.4	11.6	02	98.0	28.1	62	155.7	44.6	22	213.4	61.2	82	271.0	77.7
43	41.3	11.9	03	99.0	28.4	63	156.7	44.9	23	214.3	61.5	83	272.0	78.0
44	42.3	12.1	04	100.0	28.7	64	157.6	45.2	24	215.3	61.7	84	273.0	78.3
45	43.3	12.4	05	100.9	28.9	65	158.6	45.5	25	216.3	62.0	85	273.9	78.5
46	44.2	12.7	06	101.9	29.2	66	159.5	45.7	26	217.2	62.3	86	274.9	78.8
47	45.2	13.0	07	102.8	29.5	67	160.5	46.0	27	218.2	62.6	87	275.8	79.1
48	46.1	13.2	08	103.8	29.8	68	161.5	46.3	28	219.1	62.8	88	276.8	79.4
49	47.1	13.5	09	104.8	30.0	69	162.4	46.6	29	220.1	63.1	89	277.8	79.6
50	48.1	13.8	10	105.7	30.3	70	163.4	46.9	30	221.1	63.4	90	278.7	79.9
51	49.0	14.1	11	106.7	30.6	171	164.4	47.1	231	222.0	63.7	291	279.7	80.2
52	50.0	14.3	12	107.6	30.9	72	165.3	47.4	32	223.0	63.9	92	280.6	80.5
53	50.9	14.6	13	108.6	31.1	73	166.3	47.7	33	223.9	64.2	93	281.6	80.8
54	51.9	14.9	14	109.6	31.4	74	167.2	48.0	34	224.9	64.5	94	282.6	81.0
55	52.9	15.2	15	110.5	31.7	75	168.2	48.2	35	225.9	64.8	95	283.5	81.3
56	53.8	15.4	16	111.5	32.0	76	169.2	48.5	36	226.8	65.0	96	284.5	81.6
57	54.8	15.7	17	112.5	32.2	77	170.1	48.8	37	227.8	65.3	97	285.5	81.9
58	55.7	16.0	18	113.4	32.5	78	171.1	49.1	38	228.7	65.6	98	286.4	82.1
59	56.7	16.3	19	114.4	32.8	79	172.0	49.3	39	229.7	65.9	99	287.4	82.4
60	57.7	16.5	120	115.4	33.1	80	173.0	49.6	40	230.7	66.1	300	288.3	82.7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.3	61	58.3	17.8	121	115.7	35.4	181	173.1	52.9	241	230.5	70.4
2	01.9	00.6	62	59.3	18.1	22	116.7	35.7	82	174.0	53.2	42	231.4	70.7
3	02.9	00.9	63	60.2	18.4	23	117.6	36.0	83	175.0	53.5	43	232.4	71.0
4	03.8	01.2	64	61.2	18.7	24	118.6	36.2	84	175.9	53.8	44	233.3	71.3
5	04.8	01.5	65	62.2	19.0	25	119.5	36.5	85	176.9	54.1	45	234.3	71.6
6	05.7	01.8	66	63.1	19.3	26	120.5	36.8	86	177.9	54.4	46	235.2	71.9
7	06.7	02.0	67	64.1	19.6	27	121.4	37.1	87	178.8	54.7	47	236.2	72.1
8	07.6	02.3	68	65.0	19.9	28	122.4	37.4	88	179.8	55.0	48	237.1	72.4
9	08.6	02.6	69	66.0	20.2	29	123.4	37.7	89	180.7	55.2	49	238.1	72.7
10	09.6	02.9	70	66.9	20.5	30	124.3	38.0	90	181.7	55.5	50	239.1	73.0
11	10.5	03.2	71	67.9	20.8	131	125.3	38.3	191	182.6	55.8	251	240.0	73.3
12	11.5	03.5	72	68.8	21.0	32	126.2	38.6	92	183.6	56.1	52	241.0	73.6
13	12.4	03.8	73	69.8	21.3	33	127.2	38.9	93	184.6	56.4	53	241.9	73.9
14	13.4	04.1	74	70.8	21.6	34	128.1	39.2	94	185.5	56.7	54	242.9	74.1
15	14.3	04.4	75	71.7	21.9	35	129.1	39.5	95	186.5	57.0	55	243.8	74.4
16	15.3	04.7	76	72.7	22.2	36	130.0	39.8	96	187.4	57.3	56	244.8	74.7
17	16.3	05.0	77	73.6	22.5	37	131.0	40.0	97	188.4	57.6	57	245.8	75.0
18	17.2	05.3	78	74.6	22.8	38	132.0	40.3	98	189.3	57.9	58	246.7	75.3
19	18.2	05.6	79	75.5	23.1	39	132.9	40.6	99	190.3	58.2	59	247.7	75.6
20	19.1	05.8	80	76.5	23.4	40	133.9	40.9	200	191.2	58.5	60	248.6	75.9
21	20.1	06.1	81	77.5	23.7	141	134.8	41.2	201	192.2	58.8	261	249.6	76.2
22	21.0	06.4	82	78.4	24.0	42	135.8	41.5	02	193.2	59.0	62	250.5	76.5
23	22.0	06.7	83	79.4	24.3	43	136.7	41.8	03	194.1	59.3	63	251.5	76.8
24	22.9	07.0	84	80.3	24.6	44	137.7	42.1	04	195.1	59.6	64	252.4	77.1
25	23.9	07.3	85	81.3	24.8	45	138.7	42.4	05	196.0	59.9	65	253.4	77.4
26	24.9	07.6	86	82.2	25.1	46	139.6	42.7	06	197.0	60.2	66	254.4	77.7
27	25.8	07.9	87	83.2	25.4	47	140.6	43.0	07	197.9	60.5	67	255.3	77.9
28	26.8	08.2	88	84.1	25.7	48	141.5	43.3	08	198.9	60.8	68	256.3	78.2
29	27.7	08.5	89	85.1	26.0	49	142.5	43.6	09	199.8	61.1	69	257.2	78.5
30	28.7	08.8	90	86.1	26.3	50	143.4	43.8	10	200.8	61.4	70	258.2	78.8
31	29.6	09.1	91	87.0	26.6	151	144.4	44.1	211	201.8	61.7	271	259.1	79.1
32	30.6	09.4	92	88.0	26.9	52	145.3	44.4	12	202.7	62.0	72	260.1	79.4
33	31.6	09.6	93	88.9	27.2	53	146.3	44.7	13	203.7	62.3	73	261.1	79.7
34	32.5	09.9	94	89.9	27.5	54	147.3	45.0	14	204.6	62.6	74	262.0	80.0
35	33.5	10.2	95	90.8	27.8	55	148.2	45.3	15	205.6	62.8	75	263.0	80.3
36	34.4	10.5	96	91.8	28.1	56	149.2	45.6	16	206.5	63.1	76	263.9	80.6
37	35.4	10.8	97	92.8	28.4	57	150.1	45.9	17	207.5	63.4	77	264.9	80.9
38	36.3	11.1	98	93.7	28.6	58	151.1	46.2	18	208.5	63.7	78	265.8	81.2
39	37.3	11.4	99	94.7	28.9	59	152.0	46.5	19	209.4	64.0	79	266.8	81.5
40	38.2	11.7	100	95.6	29.2	60	153.0	46.8	20	210.4	64.3	80	267.7	81.7
41	39.2	12.0	101	96.6	29.5	161	154.0	47.1	221	211.3	64.6	281	268.7	82.0
42	40.2	12.3	02	97.5	29.8	62	154.9	47.4	22	212.3	64.9	82	269.7	82.3
43	41.1	12.6	03	98.5	30.1	63	155.9	47.6	23	213.2	65.2	83	270.6	82.6
44	42.1	12.9	04	99.4	30.4	64	156.8	47.9	24	214.2	65.5	84	271.6	82.9
45	43.0	13.2	05	100.4	30.7	65	157.8	48.2	25	215.2	65.8	85	272.5	83.2
46	44.0	13.4	06	101.4	31.0	66	158.7	48.5	26	216.1	66.1	86	273.5	83.5
47	44.9	13.7	07	102.3	31.3	67	159.7	48.8	27	217.1	66.4	87	274.4	83.8
48	45.9	14.0	08	103.3	31.6	68	160.6	49.1	28	218.0	66.6	88	275.4	84.1
49	46.9	14.3	09	104.2	31.9	69	161.6	49.4	29	219.0	66.9	89	276.4	84.4
50	47.8	14.6	10	105.2	32.2	70	162.6	49.7	30	219.9	67.2	90	277.3	84.7
51	48.8	14.9	11	106.1	32.4	171	163.5	50.0	231	220.9	67.5	291	278.3	85.0
52	49.7	15.2	12	107.1	32.7	72	164.5	50.3	32	221.8	67.8	92	279.2	85.3
53	50.7	15.5	13	108.1	33.0	73	165.4	50.6	33	222.8	68.1	93	280.2	85.5
54	51.6	15.8	14	109.0	33.3	74	166.4	50.9	34	223.8	68.4	94	281.1	35.8
55	52.6	16.1	15	110.0	33.6	75	167.3	51.2	35	224.7	68.7	95	282.1	86.1
56	53.5	16.4	16	110.9	33.9	76	168.3	51.4	36	225.7	69.0	96	283.0	86.4
57	54.5	16.7	17	111.9	34.2	77	169.3	51.7	37	226.6	69.3	97	284.0	86.7
58	55.5	17.0	18	112.8	34.5	78	170.2	52.0	38	227.6	69.6	98	285.0	87.0
59	56.4	17.2	19	113.8	34.8	79	171.2	52.3	39	228.5	69.9	99	285.9	87.3
60	57.4	17.5	120	114.7	35.1	80	172.1	52.6	40	229.5	70.2	300	286.9	87.6
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.3	61	58.0	18.8	121	115.1	37.4	181	172.1	55.9	241	229.2	74.5
2	01.9	00.6	62	59.0	19.2	22	116.0	37.7	82	173.1	56.2	42	230.1	74.8
3	02.9	00.9	63	59.9	19.5	23	117.0	38.0	83	174.0	56.5	43	231.1	75.1
4	03.8	01.2	64	60.9	19.8	24	117.9	38.3	84	175.0	56.9	44	232.0	75.4
5	04.8	01.5	65	61.8	20.1	25	118.9	38.6	85	175.9	57.2	45	233.0	75.7
6	05.7	01.9	66	62.8	20.4	26	119.8	38.9	86	176.9	57.5	46	233.9	76.0
7	06.7	02.2	67	63.7	20.7	27	120.8	39.2	87	177.8	57.8	47	234.9	76.3
8	07.6	02.5	68	64.7	21.0	28	121.7	39.6	88	178.8	58.1	48	235.8	76.6
9	08.6	02.8	69	65.6	21.3	29	122.7	39.9	89	179.7	58.4	49	236.8	76.9
10	09.5	03.1	70	66.6	21.6	30	123.6	40.2	90	180.7	58.7	50	237.8	77.3
11	10.5	03.4	71	67.5	21.9	131	124.6	40.5	191	181.6	59.0	251	238.7	77.6
12	11.4	03.7	72	68.5	22.2	32	125.5	40.8	92	182.6	59.3	52	239.7	77.9
13	12.4	04.0	73	69.4	22.6	33	126.5	41.1	93	183.5	59.6	53	240.6	78.2
14	13.3	04.3	74	70.4	22.9	34	127.4	41.4	94	184.5	59.9	54	241.6	78.5
15	14.3	04.6	75	71.3	23.2	35	128.4	41.7	95	185.4	60.3	55	242.5	78.8
16	15.2	04.9	76	72.3	23.5	36	129.3	42.0	96	186.4	60.6	56	243.5	79.1
17	16.2	05.3	77	73.2	23.8	37	130.3	42.3	97	187.3	60.9	57	244.4	79.4
18	17.1	05.6	78	74.2	24.1	38	131.2	42.6	98	188.3	61.2	58	245.4	79.7
19	18.1	05.9	79	75.1	24.4	39	132.2	43.0	99	189.2	61.5	59	246.3	80.0
20	19.0	06.2	80	76.1	24.7	40	133.1	43.3	200	190.2	61.8	60	247.3	80.3
21	20.0	06.5	81	77.0	25.0	141	134.1	43.6	201	191.2	62.1	261	248.2	80.6
22	20.9	06.8	82	78.0	25.3	42	135.0	43.9	02	192.1	62.4	62	249.2	81.0
23	21.9	07.1	83	78.9	25.6	43	136.0	44.2	03	193.1	62.7	63	250.1	81.3
24	22.8	07.4	84	79.9	26.0	44	136.9	44.5	04	194.0	63.0	64	251.1	81.6
25	23.8	07.7	85	80.8	26.3	45	137.9	44.8	05	195.0	63.3	65	252.0	81.9
26	24.7	08.0	86	81.8	26.6	46	138.8	45.1	06	195.9	63.7	66	253.0	82.2
27	25.7	08.3	87	82.7	26.9	47	139.8	45.4	07	196.9	64.0	67	253.9	82.5
28	26.6	08.7	88	83.7	27.2	48	140.7	45.7	08	197.8	64.3	68	254.9	82.8
29	27.6	09.0	89	84.6	27.5	49	141.7	46.0	09	198.8	64.6	69	255.8	83.1
30	28.5	09.3	90	85.6	27.8	50	142.7	46.3	10	199.7	64.9	70	256.8	83.4
31	29.5	09.6	91	86.5	28.1	151	143.6	46.7	211	200.7	65.2	271	257.7	83.7
32	30.4	09.9	92	87.5	28.4	52	144.6	47.0	12	201.6	65.5	72	258.7	84.0
33	31.4	10.2	93	88.4	28.7	53	145.5	47.3	13	202.6	65.8	73	259.6	84.4
34	32.3	10.5	94	89.4	29.0	54	146.5	47.6	14	203.5	66.1	74	260.6	84.7
35	33.3	10.8	95	90.3	29.4	55	147.4	47.9	15	204.5	66.4	75	261.5	85.0
36	34.2	11.1	96	91.3	29.7	56	148.4	48.2	16	205.4	66.7	76	262.5	85.3
37	35.2	11.4	97	92.2	30.0	57	149.3	48.5	17	206.4	67.1	77	263.4	85.6
38	36.1	11.7	98	93.2	30.3	58	150.3	48.8	18	207.3	67.4	78	264.4	85.9
39	37.1	12.1	99	94.1	30.6	59	151.2	49.1	19	208.3	67.7	79	265.3	86.2
40	38.0	12.4	100	95.1	30.9	60	152.2	49.4	20	209.2	68.0	80	266.3	86.5
41	39.0	12.7	101	96.1	31.2	161	153.1	49.7	221	210.2	68.3	281	267.2	86.8
42	39.9	13.0	02	97.0	31.5	62	154.1	50.1	22	211.1	68.6	82	268.2	87.1
43	40.9	13.3	03	98.0	31.8	63	155.0	50.4	23	212.1	68.9	83	269.1	87.4
44	41.8	13.6	04	98.9	32.1	64	156.0	50.7	24	213.0	69.2	84	270.1	87.8
45	42.8	13.9	05	99.9	32.4	65	156.9	51.0	25	214.0	69.5	85	271.0	88.1
46	43.7	14.2	06	100.8	32.8	66	157.9	51.3	26	214.9	69.8	86	272.0	88.4
47	44.7	14.5	07	101.8	33.1	67	158.8	51.6	27	215.9	70.1	87	272.9	88.7
48	45.6	14.8	08	102.7	33.4	68	159.8	51.9	28	216.8	70.5	88	273.9	89.0
49	46.6	15.1	09	103.7	33.7	69	160.7	52.2	29	217.8	70.8	89	274.8	89.3
50	47.6	15.5	10	104.6	34.0	70	161.7	52.5	30	218.7	71.1	90	275.8	89.6
51	48.5	15.8	11	105.6	34.3	171	162.6	52.8	231	219.7	71.4	291	276.7	89.9
52	49.5	16.1	12	106.5	34.6	72	163.6	53.1	32	220.6	71.7	92	277.7	90.2
53	50.4	16.4	13	107.5	34.9	73	164.5	53.5	33	221.6	72.0	93	278.6	90.5
54	51.4	16.7	14	108.4	35.2	74	165.5	53.8	34	222.5	72.3	94	279.6	[illegible]
55	52.3	17.0	15	109.4	35.5	75	166.4	54.1	35	223.5	72.6	95	280.5	91.2
56	53.3	17.3	16	110.3	35.8	76	167.4	54.4	36	224.4	72.9	96	281.5	91.5
57	54.2	17.6	17	111.3	36.2	77	168.3	54.7	37	225.4	73.2	97	[illegible]	91.8
58	55.2	17.9	18	112.2	36.5	78	169.3	55.0	38	226.3	73.5	98	283.4	92.1
59	56.1	18.2	19	113.2	36.8	79	170.2	55.3	39	227.3	73.9	99	284.3	92.4
60	57.1	18.5	120	114.1	37.1	80	171.2	55.6	40	228.2	74.2	300	285.3	92.7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.3	61	57.7	19.9	121	114.4	39.4	181	171.1	58.9	241	227.9	78.5
2	01.9	00.7	62	58.6	20.2	22	115.3	39.7	82	172.1	59.3	42	228.8	78.8
3	02.8	01.0	63	59.6	20.5	23	116.3	40.0	83	173.0	59.6	43	229.7	79.1
4	03.8	01.3	64	60.5	20.8	24	117.2	40.4	84	174.0	59.9	44	230.7	79.4
5	04.7	01.6	65	61.5	21.2	25	118.2	40.7	85	174.9	60.2	45	231.6	79.8
6	05.7	02.0	66	62.4	21.5	26	119.1	41.0	86	175.9	60.6	46	232.6	80.1
7	06.6	02.3	67	63.3	21.8	27	120.1	41.4	87	176.8	60.9	47	233.5	80.4
8	07.6	02.6	68	64.3	22.1	28	121.0	41.7	88	177.7	61.2	48	234.5	80.7
9	08.5	02.9	69	65.2	22.5	29	122.0	42.0	89	178.7	61.5	49	235.4	81.1
10	09.5	03.3	70	66.2	22.8	30	122.9	42.3	90	179.6	61.9	50	236.4	81.4
11	10.4	03.6	71	67.1	23.1	131	123.9	42.7	191	180.6	62.2	251	237.3	81.7
12	11.3	03.9	72	68.1	23.4	32	124.8	43.0	92	181.5	62.5	52	238.3	82.1
13	12.3	04.2	73	69.0	23.8	33	125.7	43.3	93	182.5	62.8	53	239.2	82.4
14	13.2	04.6	74	70.0	24.1	34	126.7	43.6	94	183.4	63.2	54	240.1	82.7
15	14.2	04.9	75	70.9	24.4	35	127.6	44.0	95	184.4	63.5	55	241.1	83.0
16	15.1	05.2	76	71.9	24.7	36	128.6	44.3	96	185.3	63.8	56	242.0	83.4
17	16.1	05.5	77	72.8	25.1	37	129.5	44.6	97	186.3	64.1	57	243.0	83.7
18	17.0	05.9	78	73.7	25.4	38	130.5	44.9	98	187.2	64.5	58	243.9	84.0
19	18.0	06.2	79	74.7	25.7	39	131.4	45.3	99	188.1	64.8	59	244.9	84.3
20	18.9	06.5	80	75.6	26.0	40	132.4	45.6	200	189.1	65.1	60	245.8	84.7
21	19.9	06.8	81	76.6	26.4	141	133.3	45.9	201	190.0	65.4	261	246.8	85.0
22	20.8	07.2	82	77.5	26.7	42	134.3	46.2	02	191.0	65.8	62	247.7	85.3
23	21.7	07.5	83	78.5	27.0	43	135.2	46.6	03	191.9	66.1	63	248.7	85.6
24	22.7	07.8	84	79.4	27.4	44	136.1	46.9	04	192.9	66.4	64	249.6	86.0
25	23.6	08.1	85	80.4	27.7	45	137.1	47.2	05	193.8	66.7	65	250.5	86.3
26	24.6	08.5	86	81.3	28.0	46	138.0	47.5	06	194.8	67.1	66	251.5	86.6
27	25.5	08.8	87	82.3	28.3	47	139.0	47.9	07	195.7	67.4	67	252.4	86.9
28	26.5	09.1	88	83.2	28.7	48	139.9	48.2	08	196.7	67.7	68	253.4	87.3
29	27.4	09.4	89	84.1	29.0	49	140.9	48.5	09	197.6	68.1	69	254.3	87.6
30	28.4	09.8	90	85.1	29.3	50	141.8	48.8	10	198.5	68.4	70	255.3	87.9
31	29.3	10.1	91	86.0	29.6	151	142.8	49.2	211	199.5	68.7	271	256.2	88.2
32	30.3	10.4	92	87.0	30.0	52	143.7	49.5	12	200.4	69.0	72	257.2	88.6
33	31.2	10.7	93	87.9	30.3	53	144.7	49.8	13	201.4	69.4	73	258.1	88.9
34	32.1	11.1	94	88.9	30.6	54	145.6	50.1	14	202.3	69.7	74	259.1	89.2
35	33.1	11.4	95	89.8	30.9	55	146.5	50.5	15	203.3	70.0	75	260.0	89.5
36	34.0	11.7	96	90.8	31.3	56	147.5	50.8	16	204.2	70.3	76	260.9	89.9
37	35.0	12.0	97	91.7	31.6	57	148.4	51.1	17	205.2	70.7	77	261.9	90.2
38	35.9	12.4	98	92.7	31.9	58	149.4	51.4	18	206.1	71.0	78	262.8	90.5
39	36.9	12.7	99	93.6	32.2	59	150.3	51.8	19	207.1	71.3	79	263.8	90.8
40	37.8	13.0	100	94.5	32.6	60	151.3	52.1	20	208.0	71.6	80	264.7	91.2
41	38.8	13.3	101	95.5	32.9	161	152.2	52.4	221	208.9	72.0	281	265.7	91.5
42	39.7	13.7	02	96.4	33.2	62	153.2	52.7	22	209.9	72.3	82	266.6	91.8
43	40.7	14.0	03	97.4	33.5	63	154.1	53.1	23	210.8	72.6	83	267.6	92.1
44	41.6	14.3	04	98.3	33.9	64	155.1	53.4	24	211.8	72.9	84	268.5	92.5
45	42.5	14.7	05	99.3	34.2	65	156.0	53.7	25	212.7	73.3	85	269.5	92.8
46	43.5	15.0	06	100.2	34.5	66	156.9	54.0	26	213.7	73.6	86	270.4	93.1
47	44.4	15.3	07	101.2	34.8	67	157.9	54.4	27	214.6	73.9	87	271.3	93.4
48	45.4	15.6	08	102.1	35.2	68	158.8	54.7	28	215.6	74.2	88	272.3	93.8
49	46.3	16.0	09	103.1	35.5	69	159.8	55.0	29	216.5	74.6	89	273.2	94.1
50	47.3	16.3	10	104.0	35.8	70	160.7	55.4	30	217.5	74.9	90	274.2	94.4
51	48.2	16.6	111	104.9	36.1	171	161.7	55.7	231	218.4	75.2	291	275.1	94.7
52	49.2	16.9	12	105.9	36.5	72	162.6	56.0	32	219.3	75.5	92	276.1	95.1
53	50.1	17.3	13	106.8	36.8	73	163.6	56.3	33	220.3	75.9	93	277.0	95.4
54	51.1	17.6	14	107.8	37.1	74	164.5	56.7	34	221.2	76.2	94	278.0	95.7
55	52.0	17.9	15	108.7	37.4	75	165.5	57.0	35	222.2	76.5	95	278.9	96.1
56	52.9	18.2	16	109.7	37.8	76	166.4	57.3	36	223.1	76.8	96	279.9	96.4
57	53.9	18.6	17	110.6	38.1	77	167.3	57.6	37	224.1	77.2	97	280.8	96.7
58	54.8	18.9	18	111.6	38.4	78	168.3	58.0	38	225.0	77.5	98	281.7	97.0
59	55.8	19.2	19	112.5	38.7	79	169.2	58.3	39	226.0	77.8	99	282.7	97.4
60	56.7	19.5	20	113.5	39.1	80	170.2	58.6	40	226.9	78.1	300	283.6	97.7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.
1	00.9	00.3	61	57.3	20.9	121	113.7	41.4	181	170.1	61.9	241	226.5	82.4
2	01.9	00.7	62	58.3	21.2	22	114.6	41.7	82	171.0	62.2	42	227.4	82.8
3	02.8	01.0	63	59.2	21.5	23	115.6	42.1	83	172.0	62.6	43	228.3	83.1
4	03.8	01.4	64	60.1	21.9	24	116.5	42.4	84	172.9	62.9	44	229.3	83.4
5	04.7	01.7	65	61.1	22.2	25	117.5	42.8	85	173.8	63.3	45	230.2	83.8
6	05.6	02.1	66	62.0	22.6	26	118.4	43.1	86	174.8	63.6	46	231.2	84.1
7	06.6	02.4	67	63.0	22.9	27	119.3	43.4	87	175.7	64,0	47	232.1	84.5
8	07.5	02.7	68	63.9	23.3	28	120.3	43.8	88	176.7	64.3	48	233.0	84.8
9	08.5	03.1	69	64.8	23.6	29	121.2	44.1	89	177.6	64.6	49	234.0	85.2
10	09.4	03.4	70	65.8	23.9	30	122.2	44.5	90	178.5	65.0	50	234.9	85.5
11	10.3	03.8	71	66.7	24.3	131	123.1	44.8	191	179.5	65.3	251	235.9	85.8
12	11.3	04.1	72	67.7	24.6	32	124.0	45.1	92	180.4	65.7	52	236.8	86.2
13	12.2	04.4	73	68.6	25.0	33	125.0	45.5	93	181.4	66.0	53	237.7	86.5
14	13.2	04.8	74	69.5	25.3	34	125.9	45.8	94	182.3	66.3	54	238.7	86.9
15	14.1	05.1	75	70.5	25.7	35	126.9	46.2	95	183.2	66.7	55	239.6	87.2
16	15.0	05.5	76	71.4	26.0	36	127.8	46.5	96	184.2	67.0	56	240.6	87.6
17	16.0	05.8	77	72.4	26.3	37	128.7	46.9	97	185.1	67.4	57	241.5	87.9
18	16.9	06.2	78	73.3	26.7	38	129.7	47.2	98	186.1	67.7	58	242.4	88.2
19	17.9	06.5	79	74.2	27.0	39	130.6	47.5	99	187.0	68.1	59	243.4	88.6
20	18.8	06.8	80	75.2	27.4	40	131.6	47.9	200	187.9	68.4	60	244.3	88.9
21	19.7	07.2	81	76.1	27.7	41	132.5	48.2	201	188.9	68.7	261	245.3	89.3
22	20.7	07.5	82	77.1	28.0	42	133.4	48.6	02	189.8	69.1	62	246.2	89.6
23	21.6	07.9	83	78.0	28.4	43	134.4	48.9	03	190.8	69.4	63	247.1	89.9
24	22.6	08.2	84	78.9	28.7	44	135.3	49.2	04	191.7	69.8	64	248.1	90.3
25	23.5	08.6	85	79.9	29.1	45	136.3	49.6	05	192.6	70.1	65	249.0	90.6
26	24.4	08.9	86	80,8	29.4	46	137.2	49.9	06	193.6	70.5	66	250.0	91.0
27	25.4	09.2	87	81.8	29.8	47	138.1	50.3	07	194.5	70.8	67	250.9	91.3
28	26.3	09.6	88	82.7	30.1	48	139.1	50.6	08	195.5	71.1	68	251.8	91.7
29	27.3	09.9	89	83.6	30.4	49	140.0	51.0	09	196.4	71.5	69	252.8	92.0
30	28.2	10.3	90	84.6	30.8	50	141.0	51.3	10	197.3	71.8	70	253.7	92.3
31	29.1	10.6	91	85.5	31.1	151	141.9	51.6	211	198.3	72.2	271	254.7	92.7
32	30.1	10.9	92	86.5	31.5	52	142.8	52.0	12	199,2	72.5	72	255.6	93.0
33	31,0	11.3	93	87.4	31.8	53	143.8	52.3	13	200.2	72.8	73	256.5	93.4
34	31.9	11.6	94	88.3	32.1	54	144.7	52.7	14	201.1	73.2	74	257.5	93.7
35	32.9	12.0	95	89.3	32.5	55	145,7	53.0	15	202.0	73.5	75	258.4	94.1
36	33.8	12.3	96	90.2	32.8	56	146.6	53.4	16	203.0	73.9	76	259.4	94.4
37	34.8	12.7	97	91,2	33.2	57	147.5	53.7	17	203.9	74.2	77	260.3	94.7
38	35.7	13.0	98	92.1	33.5	58	148.5	54.0	18	204.9	74.6	78	261.2	95.1
39	36.6	13.3	99	93.0	33.9	59	149.4	54.4	19	205.8	74.9	79	262.2	95.4
40	37.6	13.7	100	94.0	34.2	60	150.4	54.7	20	206.7	75.2	80	263.1	95.8
41	38.5	14.0	101	94.9	34.5	161	151.3	55.1	221	207.7	75.6	281	264.1	96.1
42	39.5	14.4	02	95.8	34.9	62	152.2	55.4	22	208.6	75.9	82	265.0	96.4
43	40.4	14.7	03	96.8	35.2	63	153.2	55.7	23	209.6	76.3	83	265.9	96.8
44	41.3	15.0	04	97.7	35.6	64	154.1	56.1	24	210.5	76.6	84	266.9	97.1
45	42.3	15.4	05	98.7	35.9	65	155.1	56.4	25	211.4	77.0	85	267.8	97.5
46	43.2	15.7	06	99.6	36.3	66	156.0	56.8	26	212.4	77.3	86	268.8	97.8
47	44.2	16.1	07	100.5	36.6	67	156.9	57.1	27	213.3	77.6	87	269.7	98.2
48	45.1	16.4	08	101.5	36.9	68	157.9	57.5	28	214.3	78.0	88	270.6	98.5
49	46.0	16.8	09	102.4	37.3	69	158.8	57,8	29	215.2	78.3	89	271.6	98.8
50	47.0	17.1	10	103.4	37.6	70	159.7	58.1	30	216.1	78,7	90	272.5	99.2
51	47.9	17.4	111	104.3	38.0	171	160.7	58.5	231	217.1	79.0	291	273.5	99.5
52	48.9	17.8	12	105.2	38.3	72	161.6	58.8	32	218.0	79.3	92	274.4	99.9
53	49,8	18.1	13	106.2	38.6	73	162.6	59.2	33	219.0	79.7	93	275.3	100.2
54	50.7	18.5	14	107.1	39.0	74	163.5	59.5	34	219.9	80.0	94	276.3	100.6
55	51.7	18.8	15	108.1	39.3	75	164.4	59.9	35	220.8	80.4	95	277.2	100,9
56	52.6	19.2	16	109.0	39.7	76	165.4	60.2	36	221.8	80.7	96	278.2	101.2
57	53.6	19.5	17	109.9	40.0	77	166.3	60.5	37	222.7	81.1	97	279.1	101.6
58	54.5	19.8	18	110.9	40.4	78	167.3	60,9	38	223.6	81.4	98	280.0	101.9
59	55.4	20.2	19	111.8	40.7	79	168.2	61.2	39	224.6	81.7	99	281.0	102.3
60	56.4	20.5	20	112.8	41.0	80	169.1	61.6	40	225.5	82.1	300	281.9	102.6
Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.4	61	56.9	21.9	121	113.0	43.4	181	169.0	64.9	241	225.0	86.4
2	01.9	00.7	62	57.9	22.2	22	113.9	43.7	82	169.9	65.2	42	225.9	86.7
3	02.8	01.1	63	58.8	22.6	23	114.9	44.1	83	170.9	65.6	43	226.9	87.1
4	03.7	01.4	64	59.7	22.9	24	115.8	44.4	84	171.8	65.6	44	227.8	87.4
5	04.7	01.8	65	60.7	23.3	25	116.7	44.8	85	172.7	66.3	45	228.7	87.8
6	05.6	02.2	66	61.6	23.7	26	117.7	45.2	86	173.7	66.7	46	229.7	88.2
7	06.5	02.5	67	62.5	24.0	27	118.6	45.5	87	174.6	67.0	47	230.6	88.5
8	07.5	02.9	68	63.5	24.4	28	119.5	45.9	88	175.5	67.4	48	231.5	88.9
9	08.4	03.2	69	64.4	24.7	29	120.5	46.2	89	176.5	67.7	49	232.5	89.2
10	09.3	03.6	70	65.3	25.1	30	121.4	46.6	90	177.4	68.1	50	233.4	89.6
11	10.3	03.9	71	66.3	25.4	131	122.3	47.0	191	178.3	68.5	251	234.3	90.0
12	11.2	04.3	72	67.2	25.8	32	123.3	47.3	92	179.3	68.8	52	235.3	90.3
13	12.1	04.6	73	68.1	26.2	33	124.2	47.7	93	180.2	69.2	53	236.2	90.7
14	13.1	05.0	74	69.1	26.5	34	125.1	48.0	94	181.1	69.5	54	237.1	91.0
15	14.0	05.4	75	70.0	26.9	35	126.1	48.4	95	182.1	69.9	55	238.1	91.4
16	14.9	05.7	76	70.9	27.2	36	127.0	48.7	96	183.0	70.2	56	239.0	91.8
17	15.9	06.1	77	71.9	27.6	37	127.9	49.1	97	183.9	70.6	57	239.9	92.1
18	16.8	06.5	78	72.8	28.0	38	128.9	49.5	98	184.9	71.0	58	240.9	92.5
19	17.7	06.8	79	73.7	28.3	39	129.8	49.8	99	185.8	71.3	59	241.8	92.8
20	18.7	07.2	80	74.7	28.7	40	130.7	50.2	200	186.7	71.7	60	242.7	93.2
21	19.6	07.5	81	75.6	29.0	141	131.7	50.5	201	187.6	72.0	261	243.7	93.5
22	20.5	07.9	82	76.5	29.4	42	132.6	50.9	02	188.6	72.4	62	244.6	93.9
23	21.5	08.2	83	77.5	29.7	43	133.5	51.3	03	189.5	72.8	63	245.5	94.3
24	22.4	08.6	84	78.4	30.1	44	134.5	51.6	04	190.4	73.1	64	246.5	94.6
25	23.3	09.0	85	79.3	30.5	45	135.4	52.0	05	191.4	73.5	65	247.4	95.0
26	24.3	09.3	86	80.3	30.8	46	136.3	52.3	06	192.3	73.8	66	248.3	95.3
27	25.2	09.7	87	81.2	31.2	47	137.3	52.7	07	193.2	74.2	67	249.3	95.7
28	26.1	10.0	88	82.1	31.5	48	138.2	53.0	08	194.2	74.5	68	250.2	96.1
29	27.1	10.4	89	83.1	31.9	49	139.1	53.4	09	195.1	74.9	69	251.1	96.4
30	28.0	10.8	90	84.0	32.3	50	140.1	53.8	10	196.0	75.3	70	252.1	96.8
31	28.9	11.1	91	84.9	32.6	151	141.0	54.1	211	197.0	75.6	271	253.0	97.1
32	29.9	11.5	92	85.9	33.0	52	141.9	54.5	12	197.9	76.0	72	253.9	97.5
33	30.8	11.8	93	86.8	33.3	53	142.9	54.8	13	198.8	76.3	73	254.9	97.8
34	31.7	12.2	94	87.7	33.7	54	143.8	55.2	14	199.8	76.7	74	255.8	98.2
35	32.7	12.5	95	88.7	34.0	55	144.7	55.6	15	200.7	77.1	75	256.7	98.6
36	33.6	12.9	96	89.6	34.4	56	145.7	55.9	16	201.6	77.4	76	257.7	98.9
37	34.5	13.3	97	90.5	34.8	57	146.6	56.3	17	202.6	77.8	77	258.6	99.3
38	35.5	13.6	98	91.5	35.1	58	147.5	56.6	18	203.5	78.1	78	259.5	99.6
39	36.4	14.0	99	92.4	35.5	59	148.5	57.0	19	204.4	78.5	79	260.5	100.0
40	37.3	14.3	100	93.4	35.8	60	149.4	57.3	20	205.4	78.8	80	261.4	100.4
41	38.3	14.7	101	94.3	36.2	161	150.3	57.7	221	206.3	79.2	281	262.3	100.7
42	39.2	15.1	02	95.3	36.6	62	151.3	58.1	22	207.2	79.6	82	263.3	101.1
43	40.1	15.4	03	96.2	36.9	63	152.2	58.4	23	208.2	79.9	83	264.2	101.4
44	41.1	15.8	04	97.1	37.3	64	153.1	58.8	24	209.1	80.3	84	265.1	101.8
45	42.0	16.1	05	98.1	37.6	65	154.1	59.1	25	210.0	80.6	85	266.1	102.1
46	42.9	16.5	06	99.0	38.0	66	155.0	59.5	26	211.0	81.0	86	267.0	102.5
47	43.9	16.8	07	99.9	38.3	67	155.9	59.9	27	211.9	81.4	87	267.9	102.9
48	44.8	17.2	08	100.9	38.7	68	156.9	60.2	28	212.8	81.7	88	268.9	103.2
49	45.7	17.6	09	101.8	39.1	69	157.8	60.6	29	213.8	82.1	89	269.8	103.6
50	46.7	17.9	10	102.7	39.4	70	158.7	60.9	30	214.7	82.4	90	270.7	103.9
51	47.6	18.3	111	103.7	39.8	71	159.7	61.3	231	215.6	82.8	291	271.7	104.3
52	48.5	18.6	12	104.6	40.1	72	160.6	61.6	32	216.6	83.1	92	272.6	104.7
53	49.5	19.0	13	105.5	40.5	73	161.5	62.0	33	217.5	83.5	93	273.5	105.0
54	50.4	19.4	14	106.5	40.9	74	162.5	62.4	34	218.4	83.9	94	274.5	105.4
55	51.3	19.7	15	107.4	41.2	75	163.4	62.7	35	219.4	84.2	95	275.4	105.7
56	52.3	20.1	16	108.3	41.6	76	164.3	63.1	36	220.3	84.6	96	276.3	106.1
57	53.2	20.4	17	109.3	41.9	77	165.3	63.4	37	221.2	84.9	97	277.3	106.4
58	54.1	20.8	18	110.2	42.3	78	166.2	63.8	38	222.2	85.3	98	278.2	106.8
59	55.1	21.1	19	111.1	42.6	79	167.1	64.2	39	223.1	85.7	99	279.1	107.2
60	56.0	21.5	20	112.1	43.0	80	168.1	64.5	40	224.1	86.0	300	280.1	107.5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.4	61	56.6	22.9	121	112.2	45.3	181	167.8	67.8	241	223.5	90.3
2	01.9	00.7	62	57.5	23.2	22	113.1	45.7	82	168.8	68.2	42	224.4	90.7
3	02.8	01.1	63	58.4	23.6	23	114.0	46.1	83	169.7	68.6	43	225.3	91.0
4	03.7	01.5	64	59.3	24.0	24	115.0	46.5	84	170.6	68.9	44	226.2	91.4
5	04.6	01.9	65	60.3	24.3	25	115.9	46.8	85	171.5	69.3	45	227.2	91.8
6	05.6	02.2	66	61.2	24.7	26	116.8	47.2	86	172.5	69.7	46	228.1	92.2
7	06.5	02.6	67	62.1	25.1	27	117.8	47.6	87	173.4	70.1	47	229.0	92.5
8	07.4	03.0	68	63.0	25.5	28	118.7	47.9	88	174.3	70.4	48	229.9	92.9
9	08.3	03.4	69	64.0	25.8	29	119.6	48.3	89	175.2	70.8	49	230.9	93.3
10	09.3	03.7	70	64.9	26.2	30	120.5	48.7	90	176.2	71.2	50	231.8	93.7
11	10.2	04.1	71	65.8	26.6	131	121.5	49.1	191	177.1	71.5	251	232.7	94.0
12	11.1	04.5	72	66.8	27.0	32	122.4	49.4	92	178.0	71.9	52	233.7	94.4
13	12.1	04.9	73	67.7	27.3	33	123.3	49.8	93	178.9	72.3	53	234.6	94.8
14	13.0	05.2	74	68.6	27.7	34	124.2	50.2	94	179.8	72.7	54	235.5	95.2
15	13.9	05.6	75	69.5	28.1	35	125.2	50.6	95	180.8	73.0	55	236.4	95.5
16	14.8	06.0	76	70.5	28.5	36	126.1	50.9	96	181.7	73.4	56	237.4	95.9
17	15.8	06.4	77	71.4	28.8	37	127.0	51.3	97	182.7	73.8	57	238.3	96.3
18	16.7	06.7	78	72.3	29.2	38	128.0	51.7	98	183.6	74.2	58	239.2	96.6
19	17.6	07.1	79	73.2	29.6	39	128.9	52.1	99	184.5	74.5	59	240.1	97.0
20	18.5	07.5	80	74.2	30.0	40	129.8	52.4	200	185.4	74.9	60	241.1	97.4
21	19.5	07.9	81	75.1	30.3	141	130.7	52.8	201	186.4	75.3	261	242.0	97.8
22	20.4	08.2	82	76.0	30.7	42	131.7	53.2	02	187.3	75.7	62	242.9	98.1
23	21.3	08.6	83	77.0	31.1	43	132.6	53.6	03	188.2	76.0	63	243.9	98.5
24	22.3	09.0	84	77.9	31.5	44	133.5	53.9	04	189.1	76.4	64	244.8	98.9
25	23.2	09.4	85	78.8	31.8	45	134.4	54.3	05	190.1	76.8	65	245.7	99.3
26	24.1	09.7	86	79.7	32.2	46	135.4	54.7	06	191.0	77.2	66	246.6	99.6
27	25.0	10.1	87	80.7	32.6	47	136.3	55.1	07	191.9	77.5	67	247.6	100.0
28	26.0	10.5	88	81.6	33.0	48	137.2	55.4	08	192.9	77.9	68	248.5	100.4
29	26.9	10.9	89	82.5	33.3	49	138.2	55.8	09	193.8	78.3	69	249.4	100.8
30	27.8	11.2	90	83.4	33.7	50	139.1	56.2	10	194.7	78.7	70	250.3	101.1
31	28.7	11.6	91	84.4	34.1	151	140.0	56.6	211	195.6	79.0	271	251.3	101.5
32	29.7	12.0	92	85.3	34.5	52	140.9	56.9	12	196.6	79.4	72	252.2	101.9
33	30.6	12.4	93	86.2	34.8	53	141.9	57.3	13	197.5	79.8	73	253.1	102.3
34	31.5	12.7	94	87.2	35.2	54	142.8	57.7	14	198.4	80.2	74	254.1	102.6
35	32.5	13.1	95	88.1	35.6	55	143.7	58.1	15	199.3	80.5	75	255.0	103.0
36	33.4	13.5	96	89.0	36.0	56	144.6	58.4	16	200.3	80.9	76	255.9	103.4
37	34.3	13.9	97	89.9	36.3	57	145.6	58.8	17	201.2	81.3	77	256.8	103.8
38	35.2	14.2	98	90.9	36.7	58	146.5	59.2	18	202.1	81.7	78	257.8	104.1
39	36.2	14.6	99	91.8	37.1	59	147.4	59.6	19	203.1	82.0	79	258.7	104.5
40	37.1	15.0	100	92.7	37.5	60	148.3	59.9	20	204.0	82.4	80	259.6	104.9
41	38.0	15.4	101	93.6	37.8	161	149.3	60.3	221	204.9	82.8	281	260.5	105.3
42	38.9	15.7	02	94.6	38.2	62	150.2	60.7	22	205.8	83.2	82	261.5	105.6
43	39.9	16.1	03	95.5	38.6	63	151.1	61.1	23	206.7	83.5	83	262.4	106.0
44	40.8	16.5	04	96.4	39.0	64	152.1	61.4	24	207.7	83.9	84	263.3	106.4
45	41.7	16.9	05	97.4	39.3	65	153.0	61.8	25	208.6	84.3	85	264.3	106.8
46	42.7	17.2	06	98.3	39.7	66	153.9	62.2	26	209.5	84.7	86	265.2	107.1
47	43.6	17.6	07	99.2	40.1	67	154.8	62.6	27	210.5	85.0	87	266.1	107.5
48	44.5	18.0	08	100.1	40.5	68	155.8	62.9	28	211.4	85.4	88	267.0	107.9
49	45.4	18.4	09	101.1	40.8	69	156.7	63.3	29	212.3	85.8	89	268.0	108.3
50	46.4	18.7	10	102.0	41.2	70	157.6	63.7	30	213.2	86.2	90	268.9	108.6
51	47.3	19.1	111	102.9	41.6	71	158.6	64.1	231	214.2	86.5	291	169.8	109.0
52	48.2	19.5	12	103.8	42.0	72	159.5	64.4	32	215.1	86.9	92	270.7	109.4
53	49.1	19.9	13	104.8	42.3	73	160.4	64.8	33	216.0	87.3	93	271.7	109.8
54	50.1	20.2	14	105.7	42.7	74	161.3	65.2	34	217.0	87.7	94	272.6	110.1
55	51.0	20.6	15	106.6	43.1	75	162.3	65.6	35	217.9	88.0	95	273.5	110.5
56	51.9	21.0	16	107.6	43.5	76	163.2	65.9	36	218.8	88.4	96	274.5	110.9
57	52.9	21.4	17	108.5	43.8	77	164.1	66.3	37	219.7	88.8	97	275.4	111.3
58	53.8	21.7	18	109.4	44.2	78	165.0	66.7	38	220.7	89.2	98	276.3	111.6
59	54.7	22.1	19	110.3	44.6	79	166.0	67.1	39	221.6	89.5	99	277.2	112.0
60	55.6	22.5	20	111.3	45.0	80	166.9	67.4	40	222.5	89.9	300	278.2	112.4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

TABLE II. Difference of Latitude and Departure for 23 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.4	61	56.1	23.8	121	111.4	47.3	181	166.6	70.7	241	221.8	94.1
2	01.8	00.8	62	57.1	24.2	22	112.3	47.7	82	167.5	71.1	42	222.8	94.5
3	02.8	01.2	63	58.0	24.6	23	113.2	48.1	83	168.5	71.5	43	223.7	94.9
4	03.7	01.6	64	58.9	25.0	24	114.1	48.4	84	169.4	71.9	44	224.6	95.3
5	04.6	02.0	65	59.8	25.4	25	115.1	48.8	85	170.3	72.3	45	225.5	95.7
6	05.5	02.3	66	60.8	25.8	26	116.0	49.2	86	171.2	72.7	46	226.4	96.1
7	06.4	02.7	67	61.7	26.2	27	116.9	49.6	87	172.2	73.1	47	227.4	96.5
8	07.4	03.1	68	62.6	26.6	28	117.8	50.0	88	173.1	73.5	48	228.3	96.9
9	08.3	03.5	69	63.5	27.0	29	118.7	50.4	89	174.0	73.8	49	229.2	97.3
10	09.2	03.9	70	64.4	27.3	30	119.7	50.8	90	174.9	74.2	50	230.1	97.7
11	10.1	04.3	71	65.4	27.7	131	120.6	51.2	191	175.8	74.6	251	231.0	98.1
12	11.0	04.7	72	66.3	28.1	32	121.5	51.6	92	176.7	75.0	52	232.0	98.5
13	12.0	05.1	73	67.2	28.5	33	122.4	52.0	93	177.7	75.4	53	232.9	98.8
14	12.9	05.5	74	68.1	28.9	34	123.3	52.4	94	178.6	75.8	54	233.8	99.2
15	13.8	05.9	75	69.0	29.3	35	124.3	52.7	95	179.5	76.2	55	234.7	99.6
16	14.7	06.3	76	70.0	29.7	36	125.2	53.1	96	180.4	76.6	56	235.6	100.0
17	15.6	06.6	77	70.9	30.1	37	126.1	53.5	97	181.3	77.0	57	236.6	100.4
18	16.6	07.0	78	71.8	30.5	38	127.0	53.9	98	182.3	77.4	58	237.5	100.8
19	17.5	07.4	79	72.7	30.9	39	127.9	54.3	99	183.2	77.7	59	238.4	101.2
20	18.4	07.8	80	73.6	31.3	40	128.9	54.7	200	184.1	78.1	60	239.3	101.6
21	19.3	08.2	81	74.6	31.6	141	129.8	55.1	201	185.0	78.5	261	240.2	102.0
22	20.3	08.6	82	75.5	32.0	42	130.7	55.5	02	185.9	78.9	62	241.2	102.4
23	21.2	09.0	83	76.4	32.4	43	131.6	55.9	03	186.9	79.3	63	242.1	102.8
24	22.1	09.4	84	77.3	32.8	44	142.6	56.3	04	187.8	79.7	64	243.0	103.1
25	23.0	09.8	85	78.2	33.2	45	133.5	56.7	05	188.7	80.1	65	243.9	103.5
26	23.9	10.2	86	79.2	33.6	46	134.4	57.0	06	189.6	80.5	66	244.9	103.9
27	24.9	10.5	87	80.1	34.0	47	135.3	57.4	07	190.5	80.9	67	245.8	104.3
28	25.8	10.9	88	81.0	34.4	48	136.2	57.8	08	191.5	81.3	68	246.7	104.7
29	26.7	11.3	89	81.9	34.8	49	137.2	58.2	09	192.4	81.7	69	247.6	105.1
30	27.6	11.7	90	82.8	35.2	50	138.1	58.6	10	193.3	82.0	70	248.5	105.5
31	28.5	12.1	91	83.8	35.6	151	139.0	59.0	211	194.2	82.4	271	249.5	105.9
32	29.5	12.5	92	84.7	35.9	52	139.9	59.4	12	195.1	82.8	72	250.4	106.3
33	30.4	12.9	93	85.6	36.3	53	140.8	59.8	13	196.1	83.2	73	251.3	106.7
34	31.3	13.3	94	86.5	36.7	54	141.8	60.2	14	197.0	83.6	74	252.2	107.1
35	32.2	13.7	95	87.4	37.1	55	142.7	60.6	15	197.9	84.0	75	253.1	107.4
36	33.1	14.1	96	88.4	37.5	56	143.6	60.9	16	198.8	84.4	76	254.1	107.8
37	34.1	14.5	97	89.3	37.9	57	144.5	61.3	17	199.7	84.8	77	255.0	108.2
38	35.0	14.8	98	90.2	38.3	58	145.4	61.7	18	200.7	85.2	78	255.9	108.6
39	35.9	15.2	99	91.1	38.7	59	146.4	62.1	19	201.6	85.6	79	256.8	109.0
40	36.8	15.6	100	92.0	39.1	60	147.3	62.5	20	202.5	86.0	80	257.7	109.4
41	37.7	16.0	101	93.0	39.5	161	148.2	62.9	221	203.4	86.3	281	258.7	109.8
42	38.7	16.4	02	93.9	39.9	62	149.1	63.3	22	204.4	86.7	82	259.6	110.2
43	39.6	16.8	03	94.8	40.2	63	150.0	63.7	23	205.3	87.1	83	260.5	110.6
44	40.5	17.2	04	95.7	40.6	64	151.0	64.1	24	206.2	87.5	84	261.4	111.0
45	41.4	17.6	05	96.7	41.0	65	151.9	64.5	25	207.1	87.9	85	262.3	111.3
46	42.3	18.0	06	97.6	41.4	66	152.8	64.9	26	208.0	88.3	86	263.3	111.7
47	43.3	18.4	07	98.5	41.8	67	153.7	65.2	27	209.0	88.7	87	264.2	112.1
48	44.2	18.8	08	99.4	42.2	68	154.6	65.6	28	209.9	89.1	88	265.1	112.5
49	45.1	19.1	09	100.3	42.6	69	155.6	66.0	29	210.8	89.5	89	266.0	112.9
50	46.0	19.5	10	101.3	43.0	70	156.5	66.4	30	211.7	89.9	90	266.9	113.3
51	46.9	19.9	111	102.2	43.4	171	157.4	66.8	231	212.6	90.3	291	267.9	113.7
52	47.9	20.3	12	103.1	43.8	72	158.3	67.2	32	213.6	90.6	92	268.8	114.1
53	48.8	20.7	13	104.0	44.1	73	159.2	67.6	33	214.5	91.0	93	269.7	114.5
54	49.7	21.1	14	104.9	44.5	74	160.2	68.0	34	215.4	91.4	94	270.6	114.9
55	50.6	21.5	15	105.9	44.9	75	161.1	68.4	35	216.3	91.8	95	271.5	115.3
56	51.5	21.9	16	106.8	45.3	76	162.0	68.8	36	217.2	92.2	96	272.5	115.6
57	52.5	22.3	17	107.7	45.7	77	162.9	69.2	37	218.2	92.6	97	273.4	116.0
58	53.4	22.7	18	108.6	46.1	78	163.8	69.5	38	219.1	93.0	98	274.3	116.4
59	54.3	23.1	19	109.5	46.5	79	164.8	69.9	39	220.0	93.4	99	275.2	116.8
60	55.2	23.4	20	110.5	46.9	80	165.7	70.3	40	220.9	93.8	300	276.2	117.2
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

[For 67 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.4	61	55.7	24.8	121	110.5	49.2	181	165.3	73.6	241	220.2	98.0
2	01.8	00.8	62	56.6	25.2	22	111.4	49.6	82	166.3	74.0	42	221.1	98.4
3	02.7	01.2	63	57.6	25.6	23	112.4	50.0	83	167.2	74.4	43	222.0	98.8
4	03.7	01.6	64	58.5	26.0	24	113.3	50.4	84	168.1	74.8	44	222.9	99.2
5	04.6	02.0	65	59.4	26.4	25	114.2	50.8	85	169.0	75.2	45	223.8	99.6
6	05.5	02.4	66	60.3	26.8	26	115.1	51.2	86	169.9	75.6	46	224.7	100.0
7	06.4	02.8	67	61.2	27.2	27	116.0	51.7	87	170.8	76.1	47	225.6	100.5
8	07.3	03.3	68	62.1	27.7	28	116.9	52.1	88	171.7	76.5	48	226.5	100.9
9	08.2	03.7	69	63.0	28.1	29	117.8	52.5	89	172.7	76.9	49	227.5	101.3
10	09.1	04.1	70	63.9	28.5	30	118.8	52.9	90	173.6	77.3	50	228.4	101.7
11	10.0	04.5	71	64.9	28.9	131	119.7	53.3	191	174.5	77.7	251	229.3	102.1
12	11.0	04.9	72	65.8	29.3	32	120.6	53.7	92	175.4	78.1	52	230.2	102.5
13	11.9	05.3	73	66.7	29.7	33	121.5	54.1	93	176.3	78.5	53	231.1	102.9
14	12.8	05.7	74	67.6	30.1	34	122.4	54.5	94	177.2	78.9	54	232.0	103.3
15	13.7	06.1	75	68.5	30.5	35	123.3	54.9	95	178.1	79.3	55	232.9	103.7
16	14.6	06.5	76	69.4	30.9	36	124.2	55.3	96	179.0	79.7	56	233.9	104.1
17	15.5	06.9	77	70.3	31.3	37	125.1	55.7	97	180.0	80.1	57	234.8	104.5
18	16.4	07.3	78	71.3	31.7	38	126.1	56.1	98	180.9	80.5	58	235.7	104.9
19	17.4	07.7	79	72.2	32.1	39	127.0	56.5	99	181.8	80.9	59	236.6	105.3
20	18.3	08.1	80	73.1	32.5	40	127.9	56.9	200	182.7	81.3	60	237.5	105.7
21	19.2	08.5	81	74.0	32.9	141	128.8	57.3	201	183.6	81.7	261	238.4	106.1
22	20.1	08.9	82	74.9	33.3	42	129.7	57.8	02	184.5	82.2	62	239.3	106.6
23	21.0	09.4	83	75.8	33.8	43	130.6	58.2	03	185.4	82.6	63	240.3	107.0
24	21.9	09.8	84	76.7	34.2	44	131.5	58.6	04	186.4	83.0	64	241.2	107.4
25	22.8	10.2	85	77.7	34.6	45	132.5	59.0	05	187.3	83.4	65	242.1	107.8
26	23.8	10.6	86	78.6	35.0	46	133.4	59.4	06	188.2	83.8	66	243.0	108.2
27	24.7	11.0	87	79.5	35.4	47	134.3	59.8	07	189.1	84.2	67	243.9	108.6
28	25.6	11.4	88	80.4	35.8	48	135.2	60.2	08	190.0	84.6	68	244.8	109.0
29	26.5	11.8	89	81.3	36.2	49	136.1	60.6	09	190.9	85.0	69	245.7	109.4
30	27.4	12.2	90	82.2	36.6	50	137.0	61.0	10	191.8	85.4	70	246.6	109.8
31	28.3	12.6	91	83.1	37.0	151	137.9	61.4	211	192.7	85.8	271	247.6	110.2
32	29.2	13.0	92	84.0	37.4	52	138.9	61.8	12	193.7	86.2	72	248.5	110.6
33	30.1	13.4	93	85.0	37.8	53	139.8	62.2	13	194.6	86.6	73	249.4	111.0
34	31.1	13.8	94	85.9	38.2	54	140.7	62.6	14	195.5	87.0	74	250.3	111.4
35	32.0	14.2	95	86.8	38.6	55	141.6	63.0	15	196.4	87.4	75	251.2	111.8
36	32.9	14.6	96	87.7	39.0	56	142.5	63.4	16	197.3	87.8	76	252.1	112.3
37	33.8	15.0	97	88.6	39.4	57	143.4	63.9	17	198.2	88.3	77	253.0	112.7
38	34.7	15.5	98	89.5	39.9	58	144.3	64.3	18	199.1	88.7	78	254.0	113.1
39	35.6	15.9	99	90.4	40.3	59	145.2	64.7	19	200.1	89.1	79	254.9	113.5
40	36.5	16.3	100	91.4	40.7	60	146.2	65.1	20	201.0	89.5	80	255.8	113.9
41	37.5	16.7	101	92.3	41.1	161	147.1	65.5	221	201.9	89.9	281	256.7	114.3
42	38.4	17.1	02	93.2	41.5	62	148.0	65.9	22	202.8	90.3	82	257.6	114.7
43	39.3	17.5	03	94.1	41.9	63	148.9	66.3	23	203.7	90.7	83	258.5	115.1
44	40.2	17.9	04	95.0	42.3	64	149.8	66.7	24	204.6	91.1	84	259.4	115.5
45	41.1	18.3	05	95.9	42.7	65	150.7	67.1	25	205.5	91.5	85	260.3	115.9
46	42.0	18.7	06	96.8	43.1	66	151.6	67.5	26	206.5	91.9	86	261.3	116.3
47	42.9	19.1	07	97.7	43.5	67	152.6	67.9	27	207.4	92.3	87	262.2	116.7
48	43.8	19.5	08	98.7	43.9	68	153.5	68.3	28	208.3	92.7	88	263.1	117.1
49	44.8	19.9	09	99.6	44.3	69	154.4	68.7	29	209.2	93.1	89	264.0	117.5
50	45.7	20.3	10	100.5	44.7	70	155.3	69.1	30	210.1	93.5	90	264.9	117.9
51	46.6	20.7	111	101.4	45.1	171	156.2	69.6	231	211.0	93.9	291	265.8	118.3
52	47.5	21.1	12	102.3	45.6	72	157.1	70.0	32	211.9	94.4	92	266.7	118.8
53	48.4	21.6	13	103.2	46.0	73	158.0	70.4	33	212.8	94.8	93	267.7	119.2
54	49.3	22.0	14	104.1	46.4	74	158.9	70.8	34	213.8	95.2	94	268.6	119.6
55	50.2	22.4	15	105.1	46.8	75	159.9	71.2	35	214.7	95.6	95	269.5	120.0
56	51.2	22.8	16	106.0	47.2	76	160.8	71.6	36	215.6	96.0	96	270.4	120.4
57	52.1	23.2	17	106.9	47.6	77	161.7	72.0	37	216.5	96.4	97	271.3	120.8
58	53.0	23.6	18	107.8	48.0	78	162.6	72.4	38	217.4	96.8	98	272.2	121.2
59	53.9	24.0	19	108.7	48.4	79	163.5	72.8	39	218.3	97.2	99	273.1	121.6
60	54.8	24.4	20	109.6	48.8	80	164.4	73.2	40	219.2	97.6	300	274.1	122.0
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Lat.	Dep.	Dist.	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.4	61	55.3	25.8	121	109.7	51.1	181	164.0	76.5	241	218.4	101.8
2	01.8	00.8	62	56.2	26.2	22	110.6	51.6	82	164.9	76.9	42	219.3	102.3
3	02.7	01.3	63	57.1	26.6	23	111.5	52.0	83	165.9	77.3	43	220.2	102.7
4	03.6	01.7	64	58.0	27.0	24	112.4	52.4	84	166.8	77.8	44	221.1	103.1
5	04.5	02.1	65	58.9	27.5	25	113.3	52.8	85	167.7	78.2	45	222.0	103.5
6	05.4	02.5	66	59.8	27.9	26	114.2	53.2	86	168.6	78.6	46	222.9	104.0
7	06.3	03.0	67	60.7	28.3	27	115.1	53.7	87	169.5	79.0	47	223.9	104.4
8	07.3	03.4	68	61.6	28.7	28	116.0	54.1	88	170.4	79.4	48	224.8	104.8
9	08.2	03.8	69	62.5	29.2	29	116.9	54.5	89	171.3	79.9	49	225.7	105.2
10	09.1	04.2	70	63.4	29.6	30	117.8	54.9	90	172.2	80.3	50	226.6	105.7
11	10.0	04.6	71	64.3	30.0	131	118.7	55.4	191	173.1	80.7	251	227.5	106.1
12	10.9	05.0	72	65.3	30.4	32	119.6	55.8	92	174.0	81.1	52	228.4	106.5
13	11.8	05.5	73	66.2	30.8	33	120.5	56.2	93	174.9	81.6	53	229.3	106.9
14	12.7	05.9	74	67.1	31.3	34	121.4	56.6	94	175.8	82.0	54	230.2	107.3
15	13.6	06.3	75	68.0	31.7	35	122.4	57.1	95	176.7	82.4	55	231.1	107.8
16	14.5	06.8	76	68.9	32.1	36	123.3	57.5	96	177.6	82.8	56	232.0	108.2
17	15.4	07.2	77	69.8	32.5	37	124.2	57.9	97	178.5	83.3	57	232.9	108.6
18	16.3	07.6	78	70.7	33.0	38	125.1	58.3	98	179.4	83.7	58	233.8	109.0
19	17.2	08.0	79	71.6	33.4	39	126.0	58.7	99	180.4	84.1	59	234.7	109.5
20	18.1	08.5	80	72.5	33.8	40	126.9	59.2	200	181.3	84.5	60	235.6	109.9
21	19.0	08.9	81	73.4	34.2	141	127.8	59.6	201	182.2	84.9	261	236.5	110.3
22	19.9	09.3	82	74.3	34.7	42	128.7	60.0	02	183.1	85.4	62	237.5	110.7
23	20.8	09.7	83	75.2	35.1	43	129.6	60.4	03	184.0	85.8	63	238.4	111.1
24	21.8	10.1	84	76.1	35.5	44	130.5	60.9	04	184.9	86.2	64	239.3	111.6
25	22.7	10.6	85	77.0	35.9	45	131.4	61.3	05	185.8	86.6	65	240.2	112.0
26	23.6	11.0	86	77.9	36.3	46	132.3	61.7	06	186.7	87.1	66	241.1	112.4
27	24.5	11.4	87	78.8	36.8	47	133.2	62.1	07	187.6	87.5	67	242.0	112.8
28	25.4	11.8	88	79.8	37.2	48	134.1	62.5	08	188.5	87.9	68	242.9	113.3
29	26.3	12.3	89	80.7	37.6	49	135.0	63.0	09	189.4	88.3	69	243.8	113.7
30	27.2	12.7	90	81.6	38.0	50	135.9	63.4	10	190.3	88.7	70	244.7	114.1
31	28.1	13.1	91	82.5	38.5	151	136.9	63.8	211	191.2	89.2	271	245.6	114.5
32	29.0	13.5	92	83.4	38.9	52	137.8	64.2	12	192.1	89.6	72	246.5	114.9
33	29.9	13.9	93	84.3	39.3	53	138.7	64.7	13	193.0	90.0	73	247.4	115.4
34	30.8	14.4	94	85.2	39.7	54	139.6	65.1	14	193.9	90.4	74	248.3	115.8
35	31.7	14.8	95	86.1	40.1	55	140.5	65.5	15	194.9	90.9	75	249.2	116.2
36	32.6	15.2	96	87.0	40.6	56	141.4	65.9	16	195.8	91.3	76	250.1	116.6
37	33.5	15.6	97	87.9	41.0	57	142.3	66.3	17	196.7	91.7	77	251.0	117.1
38	34.4	16.1	98	88.8	41.4	58	143.2	66.8	18	197.6	92.1	78	252.0	117.5
39	35.3	16.5	99	89.7	41.8	59	144.1	67.2	19	198.5	92.6	79	252.9	117.9
40	36.3	16.9	100	90.6	42.3	60	145.0	67.6	20	199.4	93.0	80	253.8	118.3
41	37.2	17.2	101	91.5	42.7	161	145.9	68.0	221	200.3	93.4	281	254.7	118.8
42	38.1	17.7	02	92.4	43.1	62	146.8	68.5	22	201.2	93.8	82	255.6	119.2
43	39.0	18.2	03	93.3	43.5	63	147.7	68.9	23	202.1	94.2	83	256.5	119.6
44	39.9	18.6	04	94.3	44.0	64	148.6	69.3	24	203.0	94.7	84	257.4	120.0
45	40.8	19.0	05	95.2	44.4	65	149.5	69.7	25	203.9	95.1	85	258.3	120.4
46	41.7	19.4	06	96.1	44.8	66	150.4	70.2	26	204.8	95.5	86	259.2	120.9
47	42.6	19.9	07	97.0	45.2	67	151.4	70.6	27	205.7	95.9	87	260.1	121.3
48	43.5	20.3	08	97.9	45.6	68	152.3	71.0	28	206.6	96.4	88	261.0	121.7
49	44.4	20.7	09	98.8	46.1	69	153.2	71.4	29	207.5	96.8	89	261.9	122.1
50	45.3	21.1	10	99.7	46.5	70	154.1	71.8	30	208.4	97.2	90	262.8	122.6
51	46.2	21.6	111	100.6	46.9	171	155.0	72.3	231	209.4	97.6	291	263.7	123.0
52	47.1	22.0	12	101.5	47.3	72	155.9	72.7	32	210.3	98.0	92	264.6	123.4
53	48.0	22.4	13	102.4	47.8	73	156.8	73.1	33	211.2	98.5	93	265.5	123.8
54	48.9	22.8	14	103.3	48.2	74	157.7	73.5	34	212.1	98.9	94	266.5	124.2
55	49.8	23.2	15	104.2	48.6	75	158.6	74.0	35	213.0	99.3	95	267.4	124.7
56	50.8	23.7	16	105.1	49.0	76	159.5	74.4	36	213.9	99.7	96	268.3	125.1
57	51.7	24.1	17	106.0	49.4	77	160.4	74.8	37	214.8	100.2	97	269.2	125.5
58	52.6	24.5	18	106.9	49.9	78	161.3	75.2	38	215.7	100.6	98	270.1	125.9
59	53.5	24.9	19	107.8	50.3	79	162.2	75.6	39	216.6	101.0	99	271.0	126.4
60	54.4	25.4	20	108.8	50.7	80	163.1	76.1	40	217.5	101.4	300	271.9	126.8
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0.9	0.4	61	54.8	26.7	121	108.8	53.0	181	162.7	79.4	241	216.6	105.7
2	1.8	0.9	62	55.7	27.2	22	109.7	53.5	82	163.6	79.8	42	217.5	106.1
3	2.7	1.3	63	56.6	27.6	23	110.6	53.9	83	164.5	80.2	43	218.4	106.5
4	3.6	1.8	64	57.5	28.1	24	111.5	54.4	84	165.4	80.7	44	219.3	107.0
5	4.5	2.2	65	58.4	28.5	25	112.4	54.8	85	166.3	81.1	45	220.2	107.4
6	5.4	2.6	66	59.3	28.9	26	113.2	55.2	86	167.2	81.5	46	221.1	107.8
7	6.3	3.1	67	60.2	29.4	27	114.1	55.7	87	168.1	82.0	47	222.0	108.3
8	7.2	3.5	68	61.1	29.8	28	115.0	56.1	88	169.0	82.4	48	222.9	108.7
9	8.1	3.9	69	62.0	30.2	29	115.9	56.6	89	169.9	82.9	49	223.8	109.2
10	9.0	4.4	70	62.9	30.7	30	116.8	57.0	90	170.8	83.3	50	224.7	109.6
11	9.9	4.8	71	63.8	31.1	131	117.7	57.4	191	171.7	83.7	251	225.6	110.0
12	10.8	5.3	72	64.7	31.6	32	118.6	57.9	92	172.6	84.2	52	226.5	110.5
13	11.7	5.7	73	65.6	32.0	33	119.5	58.3	93	173.5	84.6	53	227.4	110.9
14	12.6	6.1	74	66.5	32.4	34	120.4	58.7	94	174.4	85.0	54	228.3	111.4
15	13.5	6.6	75	67.4	32.9	35	121.3	59.2	95	175.3	85.5	55	229.2	111.8
16	14.4	7.0	76	68.3	33.3	36	122.2	59.6	96	176.2	85.9	56	230.1	112.2
17	15.3	7.5	77	69.2	33.8	37	123.1	60.1	97	177.1	86.4	57	231.0	112.7
18	16.2	7.9	78	70.1	34.2	38	124.0	60.5	98	178.0	86.8	58	231.9	113.1
19	17.1	8.3	79	71.0	34.6	39	124.9	60.9	99	178.9	87.2	59	232.8	113.5
20	18.0	8.8	80	71.9	35.1	40	125.8	61.4	200	179.8	87.7	60	233.7	114.0
21	18.9	9.2	81	72.8	35.5	141	126.7	61.8	201	180.7	88.1	261	234.6	114.4
22	19.8	9.6	82	73.7	35.9	42	127.6	62.3	02	181.6	88.6	62	235.5	114.9
23	20.7	10.1	83	74.6	36.4	43	128.5	62.7	03	182.5	89.0	63	236.4	115.3
24	21.6	10.5	84	75.5	36.8	44	129.4	63.1	04	183.4	89.4	64	237.3	115.7
25	22.5	11.0	85	76.4	37.3	45	130.3	63.6	05	184.3	89.9	65	238.2	116.2
26	23.4	11.4	86	77.3	37.7	46	131.2	64.0	06	185.2	90.3	66	239.1	116.6
27	24.3	11.8	87	78.2	38.1	47	132.1	64.4	07	186.1	90.7	67	240.0	117.1
28	25.2	12.3	88	79.1	38.6	48	133.0	64.9	08	187.0	91.2	68	240.9	117.5
29	26.1	12.7	89	80.0	39.0	49	133.9	65.3	09	187.8	91.6	69	241.8	117.9
30	27.0	13.2	90	80.9	39.5	50	134.8	65.8	10	188.7	92.1	70	242.7	118.4
31	27.9	13.6	91	81.8	39.9	151	135.7	66.2	211	189.6	92.5	271	243.6	118.8
32	28.8	14.0	92	82.7	40.3	52	136.6	66.6	12	190.5	92.9	72	244.5	119.2
33	29.7	14.5	93	83.6	40.8	53	137.5	67.1	13	191.4	93.4	73	245.4	119.7
34	30.6	14.9	94	84.5	41.2	54	138.4	67.5	14	192.3	93.8	74	246.3	120.1
35	31.5	15.3	95	85.4	41.6	55	139.3	68.0	15	193.2	94.3	75	247.2	120.6
36	32.4	15.8	96	86.3	42.1	56	140.2	68.4	16	194.1	94.7	76	248.1	121.0
37	33.3	16.2	97	87.2	42.5	57	141.1	68.8	17	195.0	95.1	77	249.0	121.4
38	34.2	16.7	98	88.1	43.0	58	142.0	69.3	18	195.9	95.6	78	249.9	121.9
39	35.1	17.1	99	89.0	43.4	59	142.9	69.7	19	196.8	96.0	79	250.8	122.3
40	36.0	17.5	100	89.9	43.8	60	143.8	70.1	20	197.7	96.4	80	251.7	122.7
41	36.9	18.0	101	90.8	44.3	161	144.7	70.6	221	198.6	96.9	281	252.6	123.2
42	37.7	18.4	02	91.7	44.7	62	145.6	71.0	22	199.5	97.3	82	253.5	123.6
43	38.6	18.9	03	92.6	45.2	63	146.5	71.5	23	200.4	97.8	83	254.4	124.1
44	39.5	19.3	04	93.5	45.6	64	147.4	71.9	24	201.3	98.2	84	255.3	124.5
45	40.4	19.7	05	94.4	46.0	65	148.3	72.3	25	202.2	98.6	85	256.2	124.9
46	41.3	20.2	06	95.3	46.5	66	149.2	72.8	26	203.1	99.1	86	257.1	125.4
47	42.2	20.6	07	96.2	46.9	67	150.1	73.2	27	204.0	99.5	87	258.0	125.8
48	43.1	21.0	08	97.1	47.3	68	151.0	73.7	28	204.9	100.0	88	258.9	126.3
49	44.0	21.5	09	98.0	47.8	69	151.9	74.1	29	205.8	100.4	89	259.8	126.7
50	44.9	21.9	10	98.9	48.2	70	152.8	74.5	30	206.7	100.8	90	260.7	127.1
51	45.8	22.4	111	99.8	48.7	171	153.7	75.0	231	207.6	101.3	291	261.6	127.6
52	46.7	22.8	12	100.7	49.1	72	154.6	75.4	32	208.5	101.7	92	262.4	128.0
53	47.6	23.2	13	101.6	49.5	73	155.5	75.8	33	209.4	102.1	93	263.3	128.5
54	48.5	23.7	14	102.5	50.0	74	156.4	76.3	34	210.3	102.6	94	264.2	128.9
55	49.4	24.1	15	103.4	50.4	75	157.3	76.7	35	211.2	103.0	95	265.1	129.3
56	50.3	24.5	16	104.3	50.9	76	158.2	77.2	36	212.1	103.5	96	266.0	129.8
57	51.2	25.0	17	105.2	51.3	77	159.1	77.6	37	213.0	103.9	97	266.9	130.2
58	52.1	25.4	18	106.1	51.7	78	160.0	78.0	38	213.9	104.3	98	267.8	130.6
59	53.0	25.9	19	107.0	52.2	79	160.9	78.5	39	214.8	104.8	99	268.7	131.1
60	53.9	26.3	20	107.9	52.6	80	161.8	78.9	40	215.7	105.2	300	269.6	131.5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.5	61	54.4	27.7	121	107.8	54.9	181	161.3	82.2	241	214.7	109.4
2	01.8	00.9	62	55.2	28.1	22	108.7	55.4	82	162.2	82.6	42	215.6	109.9
3	02.7	01.4	63	56.1	28.6	23	109.6	55.8	83	163.1	83.1	43	216.5	110.3
4	03.6	01.8	64	57.0	29.1	24	110.5	56.3	84	163.9	83.5	44	217.4	110.8
5	04.5	02.3	65	57.9	29.5	25	111.4	56.8	85	164.8	84.0	45	218.3	111.2
6	05.3	02.7	66	58.8	30.0	26	112.3	57.2	86	165.7	84.4	46	219.2	111.7
7	06.2	03.2	67	59.7	30.4	27	113.2	57.7	87	166.6	84.9	47	220.1	112.1
8	07.1	03.6	68	60.6	30.9	28	114.0	58.1	88	167.5	85.4	48	221.0	112.6
9	08.0	04.1	69	61.5	31.3	29	114.9	58.6	89	168.4	85.8	49	221.9	113.0
10	08.9	04.5	70	62.4	31.8	30	115.8	59.0	90	169.3	86.3	50	222.8	113.5
11	09.8	05.0	71	63.3	32.2	131	116.7	59.5	191	170.2	86.	251	223.6	114.0
12	10.7	05.4	72	64.2	32.7	32	117.6	59.9	92	171.1	87.2	52	224.5	114.4
13	11.6	05.9	73	65.0	33.1	33	118.5	60.4	93	172.0	87.6	53	225.4	114.9
14	12.5	06.4	74	65.9	33.6	34	119.4	60.8	94	172.9	88.1	54	226.3	115.3
15	13.4	06.8	75	66.8	34.1	35	120.3	61.3	95	173.7	88.5	55	227.2	115.8
16	14.3	07.3	76	67.7	34.5	36	121.2	61.7	96	174.6	89.0	56	228.1	116.2
17	15.1	07.7	77	68.6	35.0	37	122.1	62.2	97	175.5	89.4	57	229.0	116.7
18	16.0	08.2	78	69.5	35.4	38	123.0	62.7	98	176.4	89.9	58	229.9	117.1
19	16.9	08.6	79	70.4	35.9	39	123.8	63.1	99	177.3	90.3	59	230.8	117.6
20	17.8	09.1	80	71.3	36.3	40	124.7	63.6	200	178.2	90.8	60	231.7	118.0
21	18.7	09.5	81	72.2	36.8	141	125.6	64.0	201	179.1	91.3	261	232.6	118.5
22	19.6	10.0	82	73.1	37.2	42	126.5	64.5	02	180.0	91.7	62	233.4	118.9
23	20.5	10.4	83	74.0	37.7	43	127.4	64.9	03	180.9	92.2	63	234.3	119.4
24	21.4	10.9	84	74.8	38.1	44	128.3	65.4	04	181.8	92.6	64	235.2	119.9
25	22.3	11.4	85	75.7	38.6	45	129.2	65.8	05	182.7	93.1	65	236.1	120.3
26	23.2	11.8	86	76.6	39.0	46	130.1	66.3	06	183.5	93.5	66	237.0	120.8
27	24.1	12.3	87	77.5	39.5	47	131.0	66.7	07	184.4	94.	67	237.9	121.2
28	24.9	12.7	88	78.4	40.0	48	131.9	67.2	08	185.3	94.4	68	238.8	121.7
29	25.8	13.2	89	79.3	40.4	49	132.8	67.6	09	186.2	94.9	69	239.7	122.1
30	26.7	13.6	90	80.2	40.9	50	133.7	68.1	10	187.1	95.3	70	240.6	122.6
31	27.6	14.1	91	81.1	41.3	151	134.5	68.6	211	188.0	95.8	271	241.5	123.1
32	28.5	14.5	92	82.0	41.8	52	135.4	69.0	12	188.9	96.2	72	242.4	123.5
33	29.4	15.0	93	82.9	42.2	53	136.3	69.5	13	189.8	96.7	73	243.2	123.9
34	30.3	15.4	94	83.8	42.7	54	137.2	69.9	14	190.7	97.2	74	244.1	124.4
35	31.2	15.9	95	84.6	43.1	55	138.1	70.4	15	191.6	97.6	75	245.0	124.9
36	32.1	16.3	96	85.5	43.6	56	139.0	70.8	16	192.5	98.1	76	245.9	125.3
37	33.0	16.8	97	86.4	44.0	57	139.9	71.3	17	193.3	98.5	77	246.8	125.8
38	33.9	17.3	98	87.3	44.5	58	140.8	71.7	18	194.2	99.0	78	247.7	126.2
39	34.7	17.7	99	88.2	44.9	59	141.7	72.2	19	195.1	99.4	79	248.6	126.7
40	35.6	18.2	100	89.1	45.4	60	142.6	72.6	20	196.0	99.9	80	249.5	127.1
41	36.5	18.6	101	90.0	45.9	161	143.5	73.1	221	196.9	100.3	281	250.4	127.6
42	37.4	19.1	02	90.9	46.3	62	144.3	73.5	22	197.8	100.8	82	251.3	128.0
43	38.3	19.5	03	91.8	46.8	63	145.2	74.0	23	198.7	101.2	83	252.2	128.5
44	39.2	20.0	04	92.7	47.2	64	146.1	74.5	24	199.6	101.7	84	253.0	128.9
45	40.1	20.4	05	93.6	47.7	65	147.0	74.9	25	200.5	102.2	85	253.9	129.4
46	41.0	20.9	06	94.4	48.1	66	147.9	75.4	26	201.4	102.6	86	254.8	129.8
47	41.9	21.3	07	95.3	48.6	67	148.8	75.8	27	202.3	103.1	87	255.7	130.3
48	42.8	21.8	08	96.2	49.0	68	149.7	76.3	28	203.1	103.5	88	256.6	130.8
49	43.7	22.2	09	97.1	49.5	69	150.6	76.7	29	204.0	104.0	89	257.5	131.2
50	44.6	22.7	10	98.0	49.9	70	151.5	77.2	30	204.9	104.4	90	258.4	131.7
51	45.4	23.2	111	98.9	50.4	171	152.4	77.6	231	205.8	104.9	291	259.3	132.1
52	46.3	23.6	12	99.8	50.8	72	153.3	78.1	32	206.7	105.3	92	260.2	132.6
53	47.2	24.1	13	100.7	51.3	73	154.1	78.5	33	207.6	105.8	93	261.1	133.0
54	48.1	24.5	14	101.6	51.8	74	155.0	79.0	34	208.5	106.2	94	262.0	133.5
55	49.0	25.0	15	102.5	52.2	75	155.9	79.5	35	209.4	106.7	95	262.8	133.9
56	49.9	25.4	16	103.4	52.7	76	156.8	79.9	36	210.3	107.1	96	263.7	134.4
57	50.8	25.9	17	104.2	53.1	77	157.7	80.4	37	211.2	107.6	97	264.6	134.8
58	51.7	26.3	18	105.1	53.6	78	158.6	80.8	38	212.1	108.1	98	265.5	135.3
59	52.6	26.8	19	106.0	54.0	79	159.5	81.3	39	212.9	108.5	99	266.4	135.7
60	53.5	27.2	20	106.9	54.5	80	160.4	81.7	40	213.8	109.0	300	267.3	136.2
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.5	61	53.9	28.6	121	106.8	56.8	181	159.8	85.0	241	212.8	113.1
2	01.8	00.9	62	54.7	29.1	22	107.7	57.3	82	160.7	85.4	42	213.7	113.6
3	02.6	01.4	63	55.6	29.6	23	108.6	57.7	83	161.6	85.9	43	214.6	114.1
4	03.5	01.9	64	56.5	30.0	24	109.5	58.2	84	162.5	86.4	44	215.5	114.6
5	04.4	02.3	65	57.4	30.5	25	110.4	58.7	85	163.4	86.9	45	216.3	115.0
6	05.3	02.8	66	58.3	31.0	26	111.3	59.2	86	164.2	87.3	46	217.2	115.5
7	06.2	03.3	67	59.2	31.5	27	112.1	59.6	87	165.1	87.8	47	218.1	115.9
8	07.1	03.8	68	60.0	31.9	28	113.0	60.1	88	166.0	88.3	48	219.0	116.4
9	07.9	04.3	69	60.9	32.4	29	113.9	60.6	89	166.9	88.7	49	219.9	116.9
10	08.8	04.7	70	61.8	32.9	30	114.8	61.0	90	167.8	89.2	50	220.7	117.4
11	09.7	05.2	71	62.7	33.3	131	115.7	61.5	191	168.7	89.7	251	221.6	117.8
12	10.6	05.6	72	63.6	33.8	32	116.6	62.0	92	169.5	90.1	52	222.5	118.3
13	11.5	06.1	73	64.5	34.3	33	117.4	62.4	93	170.4	90.6	53	223.4	118.8
14	12.4	06.6	74	65.3	34.7	34	118.3	62.9	94	171.3	91.1	54	224.3	119.2
15	13.2	07.0	75	66.2	35.2	35	119.2	63.4	95	172.2	91.6	55	225.2	119.7
16	14.1	07.5	76	67.1	35.7	36	120.1	63.9	96	173.1	92.0	56	226.0	120.2
17	15.0	08.0	77	68.0	36.2	37	121.0	64.3	97	174.0	92.5	57	226.9	120.7
18	15.9	08.5	78	68.9	36.6	38	121.9	64.8	98	174.8	93.0	58	227.8	121.1
19	16.8	08.9	79	69.8	37.1	39	122.7	65.3	99	175.7	93.4	59	228.7	121.6
20	17.7	09.4	80	70.6	37.6	40	123.6	65.7	200	176.6	93.9	60	229.6	122.1
21	18.5	09.9	81	71.5	38.0	141	124.5	66.2	201	177.5	94.4	261	230.5	122.5
22	19.4	10.3	82	72.4	38.5	42	125.4	66.7	02	178.4	94.8	62	231.3	123.0
23	20.3	10.8	83	73.3	39.0	43	126.3	67.1	03	179.2	95.3	63	232.2	123.5
24	21.2	11.3	84	74.2	39.4	44	127.2	67.6	04	180.1	95.8	64	233.1	123.9
25	22.1	11.7	85	75.1	39.9	45	128.0	68.1	05	181.0	96.2	65	234.0	124.4
26	23.0	12.2	86	75.9	40.4	46	128.9	68.5	06	181.9	96.7	66	234.9	124.9
27	23.8	12.7	87	76.8	40.8	47	129.8	69.0	07	182.8	97.2	67	235.7	125.4
28	24.7	13.1	88	77.7	41.3	48	130.7	69.5	08	183.7	97.7	68	236.6	125.8
29	25.6	13.6	89	78.6	41.8	49	131.6	70.0	09	184.5	98.1	69	237.5	126.3
30	26.5	14.1	90	79.5	42.3	50	132.5	70.4	10	185.4	98.6	70	238.4	126.8
31	27.4	14.6	91	80.4	42.7	151	133.3	70.9	211	186.3	99.1	271	239.3	127.2
32	28.3	15.0	92	81.2	43.2	52	134.2	71.4	12	187.2	99.5	72	240.2	127.7
33	29.1	15.5	93	82.1	43.7	53	135.1	71.8	13	188.1	100.0	73	241.1	128.2
34	30.0	16.0	94	83.0	44.1	54	136.0	72.3	14	189.0	100.5	74	241.9	128.6
35	30.9	16.4	95	83.9	44.6	55	136.9	72.8	15	189.8	100.9	75	242.8	129.1
36	31.8	16.9	96	84.8	45.1	56	137.7	73.2	16	190.7	101.4	76	243.7	129.6
37	32.7	17.4	97	85.7	45.5	57	138.6	73.7	17	191.6	101.9	77	244.6	130.0
38	33.6	17.8	98	86.5	46.0	58	139.5	74.2	18	192.5	102.4	78	245.5	130.5
39	34.5	18.3	99	87.4	46.5	59	140.4	74.6	19	193.4	102.8	79	246.4	131.0
40	35.3	18.8	100	88.3	47.0	60	141.3	75.1	20	194.2	103.3	80	247.2	131.5
41	36.2	19.2	101	89.2	47.4	161	142.2	75.6	221	195.1	103.8	281	248.1	131.9
42	37.1	19.7	02	90.1	47.9	62	143.0	76.1	22	196.0	104.2	82	249.0	132.4
43	38.0	20.2	03	90.9	48.4	63	143.9	76.5	23	196.9	104.7	83	249.9	132.9
44	38.9	20.7	04	91.8	48.8	64	144.8	77.0	24	197.8	105.2	84	250.8	133.3
45	39.7	21.1	05	92.7	49.3	65	145.7	77.5	25	198.7	105.6	85	251.7	133.8
46	40.6	21.6	06	93.6	49.8	66	146.6	77.9	26	199.6	106.1	86	252.5	134.3
47	41.5	22.1	07	94.5	50.2	67	147.5	78.4	27	200.4	106.6	87	253.4	134.7
48	42.4	22.5	08	95.4	50.7	68	148.3	78.9	28	201.3	107.0	88	254.3	135.2
49	43.3	23.0	09	96.2	51.2	69	149.2	79.3	29	202.2	107.5	89	255.2	135.7
50	44.1	23.5	10	97.1	51.6	70	150.1	79.8	30	203.1	108.0	90	256.1	136.1
51	45.0	23.9	111	98.0	52.1	171	151.0	80.3	231	204.0	108.5	291	257.0	136.6
52	45.9	24.4	12	98.9	52.6	72	151.9	80.8	32	204.9	108.9	92	257.8	137.1
53	46.8	24.9	13	99.8	53.1	73	152.8	81.2	33	205.7	109.4	93	258.7	137.6
54	47.7	25.4	14	100.7	53.5	74	153.6	81.7	34	206.6	109.9	94	259.6	138.0
55	48.6	25.8	15	101.5	54.0	75	154.5	82.2	35	207.5	110.3	95	260.5	138.5
56	49.4	26.3	16	102.4	54.5	76	155.4	82.6	36	208.4	110.8	96	261.4	139.0
57	50.3	26.8	17	103.3	54.9	77	156.3	83.1	37	209.3	111.3	97	262.2	139.4
58	51.2	27.2	18	104.2	55.4	78	157.2	83.6	38	210.2	111.7	98	263.1	139.9
59	52.1	27.7	19	105.1	55.9	79	158.1	84.0	39	211.0	112.2	99	264.0	140.4
60	53.0	28.2	20	106.0	56.3	80	158.9	84.5	40	212.9	112.7	300	264.9	140.8
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.5	61	53.4	29.6	121	105.8	58.7	181	158.3	87.7	241	210.8	116.8
2	01.7	01.0	62	54.2	30.1	22	106.7	59.1	82	159.2	88.2	42	211.7	117.3
3	02.6	01.5	63	55.1	30.5	23	107.6	59.6	83	160.1	88.7	43	212.5	117.8
4	03.5	01.9	64	56.0	31.0	24	108.5	60.1	84	160.9	89.2	44	213.4	118.3
5	04.4	02.4	65	56.8	31.5	25	109.3	60.6	85	161.8	89.7	45	214.3	118.8
6	05.2	02.9	66	57.7	32.0	26	110.2	61.1	86	162.7	90.2	46	215.2	119.3
7	06.1	03.4	67	58.6	32.5	27	111.1	61.6	87	163.6	90.7	47	216.0	119.7
8	07.0	03.9	68	59.5	35.0	28	111.9	62.1	88	164.4	91.1	48	216.9	120.2
9	07.9	04.4	69	60.3	35.5	29	112.8	62.5	89	165.3	91.6	49	217.8	120.7
10	08.7	04.8	70	61.2	33.9	30	113.7	63.0	90	166.2	92.1	50	218.7	121.2
11	09.6	05.3	71	62.1	34.4	131	114.6	63.5	191	167.0	92.6	251	219.5	121.7
12	10.5	05.8	72	63.0	34.9	32	115.4	64.0	92	167.9	93.1	52	220.4	122.2
13	11.4	06.3	73	63.8	35.4	33	116.3	64.5	93	168.8	93.6	53	221.3	122.7
14	12.2	06.8	74	64.7	35.9	34	117.2	65.0	94	169.7	94.1	54	222.2	123.1
15	13.1	07.3	75	65.6	36.4	35	118.1	65.4	95	170.5	94.5	55	223.0	123.6
16	14.0	07.8	76	66.5	36.8	36	118.9	65.9	96	171.4	95.0	56	223.9	124.1
17	14.9	08.2	77	67.3	37.3	37	119.8	66.4	97	172.3	95.5	57	224.8	124.6
18	15.7	08.7	78	68.2	57.8	38	120.7	66.9	98	173.2	96.0	58	225.6	125.1
19	16.6	09.2	79	69.1	38.3	39	121.6	67.4	99	174.0	96.5	59	226.5	125.6
20	17.5	09.7	80	70.0	58.8	40	122.4	67.9	200	174.9	97.0	60	227.4	126.0
21	18.4	10.2	81	70.8	39.3	141	123.3	68.4	201	175.8	97.4	261	228.3	126.5
22	19.2	10.7	82	71.7	39.8	42	124.2	68.9	02	176.7	97.9	62	229.1	127.0
23	20.1	11.2	83	72.6	40.2	43	125.1	69.3	03	177.5	98.4	63	230.0	127.5
24	21.0	11.6	84	73.5	40.7	44	125.9	69.8	04	178.4	98.9	64	230.9	128.0
25	21.9	12.1	85	74.3	41.2	45	126.8	70.3	05	179.3	99.4	65	231.8	128.5
26	22.7	12.6	86	75.2	41.7	46	127.7	70.8	06	180.-	99.9	66	232.6	129.0
27	23.6	13.1	87	76.1	42.2	47	128.6	71.3	07	181.0	100.4	67	233.5	129.4
28	24.5	13.6	88	77.0	42.7	48	129.4	71.8	08	181.9	100.8	68	234.4	129.9
29	25.4	14.1	89	77.8	43.1	49	130.3	72.2	09	182.8	101.3	69	235.3	130.4
30	26.2	14.5	90	78.7	43.6	50	131.2	72.7	10	183.7	101.8	70	236.1	130.9
31	27.1	15.0	91	79.6	44.1	151	132.1	73.2	211	184.5	102.3	271	237.0	131.4
32	28.0	15.5	92	80.5	44.6	52	132.9	73.7	12	185.4	102.8	72	237.9	131.9
33	28.9	16.0	93	81.3	45.1	53	133.8	74.2	13	186.3	103.3	73	238.8	132.4
34	29.7	16.5	94	82.2	45.6	54	134.7	74.7	14	187.2	103.7	74	239.6	132.8
35	30.6	17.0	95	83.1	46.1	55	135.6	75.1	15	188.0	104.2	75	240.5	133.3
36	31.5	17.5	96	84.0	46.5	56	136.4	75.6	16	188.9	104.7	76	241.4	133.8
37	32.4	17.9	97	84.8	47.0	57	137.3	76.1	17	189.8	105.2	77	242.3	134.3
38	33.2	18.4	98	85.7	47.5	58	138.2	76.6	18	190.7	105.7	78	243.1	134.8
39	34.1	18.9	99	86.6	48.0	59	139.1	77.1	19	191.5	106.2	79	244.0	135.3
40	35.0	19.4	100	87.5	48.5	60	139.9	77.6	20	192.4	106.7	80	244.0	135.7
41	35.9	19.9	101	88.3	49.0	161	140.8	78.1	221	193.3	107.1	281	245.8	136.2
42	36.7	20.4	02	89.2	49.4	62	141.7	78.5	22	194.2	107.6	82	246.6	136.7
43	37.6	20.8	03	90.1	49.9	63	142.6	79.0	23	195.0	108.1	83	247.5	137.2
44	38.5	21.3	04	91.0	50.4	64	143.4	79.5	24	195.9	108.6	84	248.4	137.7
45	39.4	21.8	05	91.8	50.9	65	144.3	80.0	25	196.8	109.1	85	249.3	138.2
46	40.2	22.3	06	92.7	51.4	66	145.2	80.5	26	197.7	109.6	86	250.1	138.7
47	41.1	22.8	07	93.6	51.9	67	146.1	81.0	27	198.5	100.0	87	251.0	139.1
48	42.0	23.3	08	94.5	52.3	68	146.9	81.4	28	199.4	110.5	88	251.9	139.6
49	42.9	23.8	09	95.3	52.8	69	147.8	81.9	29	200.3	111.0	89	252.8	140.1
50	43.7	24.2	10	96.2	53.3	70	148.-	82.4	30	201.2	111.5	00	253.6	140.6
51	44.6	24.7	111	97.1	53.8	171	149.6	82.9	231	202.0	112.0	291	254.5	141.1
52	45.5	25.2	12	98.0	54.3	72	150.4	83.4	32	202.9	112.5	92	255.4	141.6
53	46.4	25.7	13	98.8	54.8	73	151.3	83.9	33	203.8	113.0	93	256.3	142.0
54	47.2	26.2	14	99.7	55.3	74	152.2	84.4	34	204.7	113.4	94	257.1	142.5
55	48.1	26.7	15	100.6	55.8	75	153.1	84.8	35	205.5	113.9	95	258.0	143.0
56	49.0	27.1	16	101.5	56.2	76	153.9	85.3	36	206.4	114.4	96	258.9	143.5
57	49.9	27.6	17	102.3	56.7	77	154.8	85.8	37	207.3	114.9	97	259.8	144.0
58	50.7	28.1	18	103.2	57.2	78	155.7	86.3	38	208.2	115.4	98	260.6	144.5
59	51.6	28.6	19	104.1	57.7	79	156.6	86.8	39	209.0	115.9	99	261.5	145.0
60	52.5	29.1	20	105.0	58.2	80	157.4	87.3	40	209.9	116.4	300	262.4	145.4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

 [For 61 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.5	61	52.8	30.5	121	104.8	60.5	181	156.7	90.5	241	208.7	120.5
2	01.7	01.0	62	53.7	31.0	22	105.7	61.0	82	157.6	91.0	42	209.6	121.0
3	02.6	01.5	63	54.6	31.5	23	106.5	61.5	83	158.5	91.5	43	210.4	121.5
4	03.5	02.0	64	55.4	32.0	24	107.4	62.0	84	159.3	92.0	44	211.3	122.0
5	04.3	02.5	65	56.3	32.5	25	108.3	62.5	85	160.2	92.5	45	212.2	122.5
6	05.2	03.0	66	57.2	33.0	26	109.1	63.0	86	161.1	93.0	46	213.0	123.0
7	06.1	03.5	67	58.0	33.5	27	110.0	63.5	87	161.9	93.5	47	213.9	123.5
8	06.9	04.0	68	58.9	34.0	28	110.9	64.0	88	162.8	94.0	48	214.8	124.0
9	07.8	04.5	69	59.8	34.5	29	111.7	64.5	89	163.7	94.5	49	215.6	124.5
10	08.7	05.0	70	60.6	35.0	30	112.6	65.0	90	164.5	95.0	50	216.5	125.0
11	09.5	05.5	71	61.5	35.5	131	113.4	65.5	191	165.4	95.5	251	217.4	125.5
12	10.4	06.0	72	62.4	36.0	32	114.3	66.0	92	166.3	96.0	52	218.2	126.0
13	11.3	06.5	73	63.2	36.5	33	115.2	66.5	93	167.1	96.5	53	219.1	126.5
14	12.1	07.0	74	64.1	37.0	34	116.0	67.0	94	168.0	97.0	54	220.0	127.0
15	13.0	07.5	75	65.0	37.5	35	116.9	67.5	95	168.9	97.5	55	220.8	127.5
16	13.9	08.0	76	65.8	38.0	36	117.8	68.0	96	169.7	98.0	56	221.7	128.0
17	14.7	08.5	77	66.7	38.5	37	118.6	68.5	97	170.6	98.5	57	222.6	128.5
18	15.6	09.0	78	67.5	39.0	38	119.5	69.0	98	171.5	99.0	58	223.4	129.0
19	16.5	09.5	79	68.4	39.5	39	120.4	69.5	99	172.3	99.5	59	224.3	129.5
20	17.3	10.0	80	69.3	40.0	40	121.2	70.0	200	173.2	100.0	60	225.2	130.0
21	18.2	10.5	81	70.1	40.5	141	122.1	70.5	201	174.1	100.5	261	226.0	130.5
22	19.1	11.0	82	71.0	41.0	42	123.0	71.0	02	174.9	101.0	62	226.9	131.0
23	19.9	11.5	83	71.9	41.5	43	123.8	71.5	03	175.8	101.5	63	227.8	131.5
24	20.8	12.0	84	72.7	42.0	44	124.7	72.0	04	176.7	102.0	64	228.6	132.0
25	21.7	12.5	85	73.6	42.5	45	125.6	72.5	05	177.5	102.5	65	229.5	132.5
26	22.5	13.0	86	74.5	43.0	46	126.4	73.0	06	178.4	103.0	66	230.4	133.0
27	23.4	13.5	87	75.3	43.5	47	127.3	73.5	07	179.3	103.5	67	231.2	133.5
28	24.2	14.0	88	76.2	44.0	48	128.2	74.0	08	180.1	104.0	68	232.1	134.0
29	25.1	14.5	89	77.1	44.5	49	129.0	74.5	09	181.0	104.5	69	233.0	134.5
30	26.0	15.0	90	77.9	45.0	50	129.9	75.0	10	181.9	105.0	70	233.8	135.0
31	26.8	15.5	91	78.8	45.5	151	130.8	75.5	211	182.7	105.5	271	234.7	135.5
32	27.7	16.0	92	79.7	46.0	52	131.7	76.0	12	183.6	106.0	72	235.6	136.0
33	28.6	16.5	93	80.5	46.5	53	132.5	76.5	13	184.5	106.5	73	236.4	136.5
34	29.4	17.0	94	81.4	47.0	54	133.4	77.0	14	185.3	107.0	74	237.3	137.0
35	30.3	17.5	95	82.3	47.5	55	134.2	77.5	15	186.2	107.5	75	238.2	137.5
36	31.2	18.0	96	83.1	48.0	56	135.1	78.0	16	187.1	108.0	76	239.0	138.0
37	32.0	18.5	97	84.0	48.5	57	136.0	78.5	17	187.9	108.5	77	239.9	138.5
38	32.9	19.0	98	84.9	49.0	58	136.8	79.0	18	188.8	109.0	78	240.7	139.0
39	33.8	19.5	99	85.7	49.5	59	137.7	79.5	19	189.7	109.5	79	241.6	139.5
40	34.6	20.0	100	86.6	50.0	60	138.6	80.0	20	190.5	110.0	80	242.5	140.0
41	35.5	20.5	101	87.5	50.5	161	139.4	80.5	221	191.4	110.5	281	243.3	140.5
42	36.4	21.0	02	88.3	51.0	62	140.3	81.0	22	192.3	111.0	82	244.2	141.0
43	37.2	21.5	03	89.2	51.5	63	141.2	81.5	23	193.1	111.5	83	245.1	141.5
44	38.1	22.0	04	90.1	52.0	64	142.0	82.0	24	194.0	112.0	84	245.9	142.0
45	39.0	22.5	05	90.9	52.5	65	142.9	82.5	25	194.9	112.5	85	246.8	142.5
46	39.8	23.0	06	91.8	53.0	66	143.8	83.0	26	195.7	113.0	86	247.7	143.0
47	40.7	23.5	07	92.7	53.5	67	144.6	83.5	27	196.6	113.5	87	248.5	143.5
48	41.5	24.0	08	93.5	54.0	68	145.5	84.0	28	197.4	114.0	88	249.4	144.0
49	42.4	24.5	09	94.4	54.5	69	146.4	84.5	29	198.3	114.5	89	250.3	144.5
50	43.3	25.0	10	95.3	55.0	70	147.2	85.0	30	199.2	115.0	90	251.1	145.0
51	44.2	25.5	111	96.1	55.5	171	148.1	85.5	231	200.0	115.5	291	252.0	145.5
52	45.0	26.0	12	97.0	56.0	72	149.0	86.0	32	200.9	116.0	92	252.9	146.0
53	45.9	26.5	13	97.9	56.5	73	149.8	86.5	33	201.8	116.5	93	253.7	146.5
54	46.8	27.0	14	98.7	57.0	74	150.7	87.0	34	202.6	117.0	94	254.6	147.0
55	47.6	27.5	15	99.6	57.5	75	151.6	87.5	35	203.5	117.5	95	255.5	147.5
56	48.5	28.0	16	100.5	58.0	76	152.4	88.0	36	204.4	118.0	96	256.3	148.0
57	49.4	28.5	17	101.3	58.5	77	153.3	88.5	37	205.2	118.5	97	257.2	148.5
58	50.2	29.0	18	102.2	59.0	78	154.2	89.0	38	206.1	119.0	98	258.1	149.0
59	51.1	29.5	19	103.1	59.5	79	155.0	89.5	39	207.0	119.5	99	258.9	149.5
60	52.0	30.0	20	103.9	60.0	80	155.9	90.0	40	207.8	120.0	300	259.8	150.0
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.5	61	52.3	31.4	121	103.7	62.3	181	155.1	93.2	241	206.5	124.1
2	01.7	01.0	62	53.1	31.9	22	104.6	62.8	82	156.0	93.7	42	207.4	124.6
3	02.6	01.5	63	54.0	32.4	23	105.4	63.3	83	156.8	94.2	43	208.3	125.1
4	03.4	02.1	64	54.8	33.0	24	106.3	63.9	84	157.7	94.8	44	209.1	125.6
5	04.3	02.6	65	55.7	33.5	25	107.1	64.4	85	158.5	95.3	45	210.0	126.2
6	05.1	03.1	66	56.6	34.0	26	108.0	64.9	86	159.4	95.8	46	210.8	126.7
7	06.0	03.6	67	57.4	34.5	27	108.8	65.4	87	160.3	96.3	47	211.7	127.2
8	06.9	04.1	68	58.3	35.0	28	109.7	65.9	88	161.1	96.8	48	212.5	127.7
9	07.7	04.6	69	59.1	35.5	29	110.6	66.4	89	162.0	97.3	49	213.4	128.2
10	08.6	05.2	70	60.0	36.1	30	111.4	67.0	90	162.8	97.9	50	214.3	128.8
11	09.4	05.7	71	60.8	36.6	131	112.3	67.5	191	163.7	98.4	251	215.1	129.3
12	10.3	06.2	72	61.7	37.1	32	113.1	68.0	92	164.5	98.9	52	216.0	129.8
13	11.1	06.7	73	62.6	37.6	33	114.0	68.5	93	165.4	99.4	53	216.8	130.3
14	12.0	07.2	74	63.4	38.1	34	114.8	69.0	94	166.3	99.9	54	217.7	130.8
15	12.9	07.7	75	64.3	38.6	35	115.7	69.5	95	167.1	100.4	55	218.5	131.3
16	13.7	08.2	76	65.1	39.1	36	116.6	70.0	96	168.0	100.9	56	219.4	131.8
17	14.6	08.8	77	66.0	39.7	37	117.4	70.6	97	168.8	101.5	57	220.2	132.4
18	15.4	09.3	78	66.8	40.2	38	118.3	71.1	98	169.7	102.0	58	221.1	132.9
19	16.3	09.8	79	67.7	40.7	39	119.1	71.6	99	170.5	102.5	59	222.0	133.4
20	17.1	10.3	80	68.6	41.2	40	120.0	72.1	200	171.4	103.0	60	222.8	133.9
21	18.0	10.8	81	69.4	41.7	141	120.8	72.6	201	172.3	103.5	261	223.7	134.4
22	18.9	11.3	82	70.3	42.2	42	121.7	73.1	02	173.1	104.0	62	224.5	134.9
23	19.7	11.8	83	71.1	42.7	43	122.6	73.6	03	174.0	104.5	63	225.4	135.4
24	20.6	12.4	84	72.0	43.3	44	123.4	74.2	04	174.8	105.0	64	226.2	136.0
25	21.4	12.9	85	72.8	43.8	45	124.3	74.7	05	175.7	105.6	65	227.1	136.5
26	22.3	13.4	86	73.7	44.3	46	125.1	75.2	06	176.5	106.1	66	228.0	137.0
27	23.1	13.9	87	74.6	44.8	47	126.0	75.7	07	177.4	106.6	67	228.8	137.5
28	24.0	14.4	88	75.4	45.3	48	126.8	76.2	08	178.3	107.1	68	229.7	138.0
29	24.9	14.9	89	76.3	45.8	49	127.7	76.7	09	179.1	107.6	69	230.5	138.5
30	25.7	15.4	90	77.1	46.4	50	128.6	77.3	10	180.0	108.2	70	231.4	139.1
31	26.6	16.0	91	78.0	46.9	151	129.4	77.8	211	180.8	108.7	271	232.2	139.6
32	27.4	16.5	92	78.8	47.4	52	130.3	78.3	12	181.7	109.2	72	233.1	140.1
33	28.3	17.0	93	79.7	47.9	53	131.1	78.8	13	182.5	109.7	73	234.0	140.6
34	29.1	17.5	94	80.6	48.4	54	132.0	79.3	14	183.4	110.2	74	234.8	141.1
35	30.0	18.0	95	81.4	48.9	55	132.8	79.8	15	184.3	110.7	75	235.7	141.6
36	30.9	18.5	96	82.3	49.4	56	133.7	80.3	16	185.1	111.2	76	236.5	142.1
37	31.7	19.1	97	83.1	50.0	57	134.5	80.9	17	186.0	111.8	77	237.4	142.7
38	32.6	19.6	98	84.0	50.5	58	135.4	81.4	18	186.8	112.3	78	238.2	143.2
39	33.4	20.1	99	84.8	51.0	59	136.3	81.9	19	187.7	112.8	79	239.1	143.7
40	34.3	20.6	100	85.7	51.5	60	137.1	82.4	20	188.5	113.3	80	240.0	144.2
41	35.1	21.1	101	86.6	52.0	161	138.0	82.9	221	189.4	113.8	281	240.8	144.7
42	36.0	21.6	02	87.4	52.5	62	138.8	83.4	22	190.3	114.3	82	241.7	145.2
43	36.9	22.1	03	88.3	53.0	63	139.7	83.9	23	191.1	114.8	83	242.5	145.7
44	37.7	22.6	04	89.1	53.6	64	140.5	84.5	24	192.0	115.4	84	243.4	146.3
45	38.6	23.2	05	90.0	54.1	65	141.4	85.0	25	192.8	115.9	85	244.2	146.8
46	39.4	23.7	06	90.8	54.6	66	142.3	85.5	26	193.7	116.4	86	245.1	147.3
47	40.3	24.2	07	91.7	55.1	67	143.1	86.0	27	194.5	116.9	87	246.0	147.8
48	41.1	24.7	08	92.6	55.6	68	144.0	86.5	28	195.4	117.4	88	246.8	148.3
49	42.0	25.2	09	93.4	56.1	69	144.8	87.0	29	196.3	117.9	89	247.7	148.8
50	42.9	25.8	10	94.3	56.7	70	145.7	87.6	30	197.1	118.5	90	248.5	149.4
51	43.7	26.3	111	95.1	57.2	171	146.5	88.1	231	198.0	119.0	291	249.4	149.9
52	44.6	26.8	12	96.0	57.7	72	147.4	88.6	32	198.8	119.5	92	250.2	150.4
53	45.4	27.3	13	96.8	58.2	73	148.3	89.1	33	199.7	120.0	93	251.1	150.9
54	46.3	27.8	14	97.7	58.7	74	149.1	89.6	34	200.5	120.5	94	252.0	151.4
55	47.1	28.3	15	98.6	59.2	75	150.0	90.1	35	201.4	121.0	95	252.8	151.9
56	48.0	28.8	16	99.4	59.7	76	150.8	90.6	36	202.3	121.5	96	253.7	152.4
57	48.8	29.4	17	100.3	60.3	77	151.7	91.2	37	203.1	122.1	97	254.5	153.0
58	49.7	29.9	18	101.1	60.8	78	152.5	91.7	38	204.0	122.6	98	255.4	153.5
59	50.6	30.4	19	102.0	61.3	79	153.4	92.2	39	204.8	123.1	99	256.2	154.0
60	51.4	30.9	20	102.8	61.8	80	154.3	92.7	40	205.7	123.6	300	257.1	154.5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.8	00.5	61	51.7	32.3	121	102.6	64.1	181	153.5	95.9	241	204.4	127.7
2	01.7	01.1	62	52.6	32.9	22	103.5	64.7	82	154.3	96.5	42	205.2	128.3
3	02.5	01.6	63	53.4	33.4	23	104.3	65.2	83	155.2	97.0	43	206.1	128.8
4	03.4	02.1	64	54.3	33.9	24	105.2	65.7	84	156.0	97.5	44	206.9	129.3
5	04.2	02.6	65	55.1	34.5	25	106.0	66.3	85	156.9	98.1	45	207.8	129.9
6	05.1	03.2	66	56.0	35.0	26	106.8	66.8	86	157.7	98.6	46	208.6	130.4
7	05.9	03.7	67	56.8	35.5	27	107.7	67.3	87	158.6	99.1	47	209.5	130.9
8	06.8	04.2	68	57.7	36.0	28	108.5	67.8	88	159.4	99.6	48	210.3	131.4
9	07.6	04.8	69	58.5	36.6	29	109.4	68.4	89	160.3	100.2	49	211.2	132.0
10	08.5	05.3	70	59.4	37.1	30	110.2	68.9	90	161.1	100.7	50	212.0	132.5
11	09.3	05.8	71	60.2	37.6	131	111.1	69.4	191	162.0	101.2	251	212.8	133.0
12	10.2	06.4	72	61.1	38.2	32	111.9	70.0	92	162.8	101.8	52	213.7	133.6
13	11.0	06.9	73	61.9	38.7	33	112.8	70.5	93	163.7	102.3	53	214.5	134.1
14	11.9	07.4	74	62.8	39.2	34	113.6	71.0	94	164.5	102.8	54	215.4	134.6
15	12.7	08.0	75	63.6	39.8	35	114.5	71.6	95	165.4	103.4	55	216.2	135.2
16	13.6	08.5	76	64.4	40.3	36	115.3	72.1	96	166.2	103.9	56	217.1	135.7
17	14.4	09.0	77	65.3	40.8	37	116.2	72.6	97	167.1	104.4	57	217.9	136.2
18	15.3	09.5	78	66.1	41.3	38	117.0	73.1	98	167.9	104.9	58	218.8	136.7
19	16.1	10.1	79	67.0	41.9	39	117.9	73.7	99	168.8	105.5	59	219.6	137.3
20	17.0	10.6	80	67.8	42.4	40	118.8	74.2	200	169.6	106.0	60	220.5	137.8
21	17.8	11.1	81	68.7	42.9	141	119.6	74.7	201	170.4	106.5	261	221.3	138.3
22	18.7	11.7	82	69.5	43.5	42	120.4	75.3	02	171.3	107.1	62	222.2	138.9
23	19.5	12.2	83	70.4	44.0	43	121.3	75.8	03	172.1	107.6	63	223.0	139.4
24	20.4	12.7	84	71.2	44.5	44	122.1	76.3	04	173.0	108.1	64	223.9	139.9
25	21.2	13.3	85	72.1	45.1	45	123.0	76.9	05	173.8	108.7	65	224.7	140.5
26	22.0	13.8	86	72.9	45.6	46	123.8	77.4	06	174.7	109.2	66	225.6	141.0
27	22.9	14.3	87	73.8	46.1	47	124.7	77.9	07	175.5	109.7	67	226.4	141.5
28	23.7	14.8	88	74.6	46.6	48	125.5	78.4	08	176.4	110.2	68	227.3	142.0
29	24.6	15.4	89	75.5	47.2	49	126.4	79.0	09	177.2	110.8	69	228.1	142.6
30	25.4	15.9	90	76.3	47.7	50	127.2	79.5	10	178.1	111.3	70	229.0	143.1
31	26.3	16.4	91	77.2	48.2	151	128.0	80.0	211	178.9	111.8	271	229.8	143.6
32	27.1	17.0	92	78.0	48.8	52	128.9	80.6	12	179.8	112.4	72	230.7	144.2
33	28.0	17.5	93	78.9	49.3	53	129.7	81.1	13	180.5	112.9	73	231.5	144.7
34	28.8	18.0	94	79.7	49.8	54	130.6	81.6	14	181.4	113.4	74	232.4	145.2
35	29.7	18.6	95	80.6	50.4	55	131.4	82.2	15	182.3	114.0	75	233.2	145.8
36	30.5	19.1	96	81.4	50.9	56	132.3	82.7	16	183.2	114.5	76	234.0	146.3
37	31.4	19.6	97	82.3	51.4	57	133.1	83.2	17	184.0	115.0	77	234.9	146.8
38	32.2	20.1	98	83.1	51.9	58	134.0	83.7	18	184.9	115.5	78	235.7	147.3
39	33.1	20.7	99	84.0	52.5	59	134.8	84.3	19	185.7	116.1	79	236.6	147.9
40	33.9	21.2	100	84.8	53.0	60	135.7	84.8	20	186.6	116.6	80	237.4	148.4
41	34.8	21.7	101	85.6	53.5	161	136.5	85.3	221	187.4	117.1	281	238.3	148.9
42	35.6	22.3	02	86.5	54.1	62	137.4	85.9	22	188.3	117.7	82	239.1	149.5
43	36.5	22.8	03	87.3	54.6	63	138.2	86.4	23	189.1	118.2	83	240.0	150.0
44	37.3	23.3	04	88.2	55.1	64	139.1	86.9	24	190.0	118.7	84	240.8	150.5
45	38.2	23.9	05	89.0	55.7	65	139.9	87.5	25	190.8	119.3	85	241.7	151.1
46	39.0	24.4	06	89.9	56.2	66	140.8	88.0	26	191.6	119.8	86	242.5	151.6
47	39.9	24.9	07	90.7	56.7	67	141.6	88.5	27	192.5	120.3	87	243.4	152.1
48	40.7	25.4	08	91.6	57.2	68	142.5	89.0	28	193.3	120.8	88	244.2	152.6
49	41.6	26.0	09	92.4	57.8	69	143.3	89.6	29	194.2	121.4	89	245.1	153.2
50	42.4	26.5	10	93.3	58.3	70	144.2	90.1	30	195.0	121.9	90	245.9	153.7
51	43.3	27.0	111	94.1	58.8	171	145.0	90.6	231	195.9	122.4	291	246.8	154.2
52	44.1	27.6	12	95.0	59.4	72	145.9	91.2	32	196.7	123.0	92	247.6	154.8
53	44.9	28.1	13	95.8	59.9	73	146.7	91.7	33	197.6	123.5	93	248.5	155.3
54	45.8	28.6	14	96.7	60.4	74	147.6	92.2	34	198.4	124.0	94	249.3	155.8
55	46.6	29.2	15	97.5	61.0	75	148.4	92.8	35	199.3	124.6	95	250.2	156.4
56	47.5	29.7	16	98.4	61.5	76	149.2	93.3	36	200.1	125.1	96	251.0	156.9
57	48.3	30.2	17	99.2	62.0	77	150.1	93.8	37	201.0	125.6	97	251.9	157.4
58	49.2	30.7	18	100.1	62.5	78	150.9	94.3	38	201.8	126.1	98	252.7	157.9
59	50.0	31.3	19	100.9	63.1	79	151.8	94.9	39	202.7	126.7	99	253.6	158.5
60	50.9	31.8	20	101.8	63.6	80	152.6	95.4	40	203.5	127.2	300	254.4	159.0
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.5	61	51.2	33.2	121	101.5	65.9	181	151.8	98.6	241	202.1	131.2
2	01.7	01.1	62	52.0	33.8	22	102.3	66.4	82	152.6	99.1	42	202.9	131.8
3	02.5	01.6	63	52.8	34.3	23	103.1	67.0	83	153.5	99.7	43	203.8	132.3
4	03.4	02.2	64	53.7	34.9	24	104.0	67.5	84	154.3	100.2	44	204.6	132.9
5	04.2	02.7	65	54.5	35.4	25	104.8	68.1	85	155.1	100.8	45	205.5	153.4
6	05.0	03.3	66	55.3	35.9	26	105.7	68.6	86	156.0	101.3	46	206.3	134.0
7	05.9	03.8	67	56.2	36.5	27	106.5	69.2	87	156.8	101.8	47	207.1	134.5
8	06.7	04.4	68	57.0	37.0	28	107.3	69.7	88	157.7	102.4	48	208.0	135.1
9	07.5	04.9	69	57.9	37.6	29	108.2	70.3	89	158.5	102.9	49	208.8	135.6
10	08.4	05.4	70	58.7	38.1	30	109.0	70.8	90	159.3	103.5	50	209.7	136.2
11	09.2	06.0	71	59.5	38.7	131	109.9	71.3	191	160.2	104.0	251	210.5	136.7
12	10.1	06.5	72	60.4	39.2	32	110.7	71.9	92	161.0	104.6	52	211.3	137.2
13	10.9	07.1	73	61.2	39.8	33	111.5	72.4	93	161.8	105.1	53	212.2	137.8
14	11.7	07.6	74	62.1	40.3	34	112.4	73.0	94	162.7	105.7	54	213.0	138.3
15	12.6	08.2	75	62.9	40.8	35	113.2	73.5	95	163.5	106.2	55	213.8	138.9
16	13.4	08.7	76	63.7	41.4	36	114.0	74.1	96	164.4	106.7	56	214.7	139.4
17	14.3	09.3	77	64.6	41.9	37	114.9	74.6	97	165.2	107.3	57	215.5	140.0
18	15.1	09.8	78	65.4	42.5	38	115.7	75.2	98	166.0	107.8	58	216.4	140.5
19	15.9	10.3	79	66.2	43.0	39	116.6	75.7	99	166.9	108.4	59	217.2	141.1
20	16.8	10.9	80	67.1	43.6	40	117.4	76.2	200	167.7	108.9	60	218.0	141.6
21	17.6	11.4	81	67.9	44.1	141	118.2	76.8	201	168.6	109.5	261	218.9	142.1
22	18.4	12.0	82	68.8	44.7	42	119.1	77.3	02	169.4	110.0	62	219.7	142.7
23	19.3	12.5	83	69.6	45.2	43	119.9	77.9	03	170.2	110.6	63	220.6	143.2
24	20.1	13.1	84	70.4	45.7	44	120.8	78.4	04	171.1	111.1	64	221.4	143.8
25	21.0	13.6	85	71.3	46.3	45	121.6	79.0	05	171.9	111.6	65	222.2	144.3
26	21.8	14.2	86	72.1	46.8	46	122.4	79.5	06	172.8	112.2	66	223.1	144.9
27	22.6	14.7	87	73.0	47.4	47	123.3	80.1	07	173.6	112.7	67	223.9	145.4
28	23.5	15.2	88	73.8	47.9	48	124.1	80.6	08	174.4	113.3	68	224.7	146.0
29	24.3	5.8	89	74.6	48.5	49	125.0	81.1	09	175.3	113.8	69	225.6	146.5
30	25.2	16.3	90	75.5	49.0	50	125.8	81.7	10	176.1	114.4	70	226.4	147.1
31	26.0	16.9	61	76.3	49.6	151	126.6	82.2	211	176.9	114.9	271	227.3	147.6
32	26.8	17.4	92	77.2	50.1	52	127.5	82.8	12	177.8	115.5	72	228.1	148.1
33	27.7	18.0	93	78.0	50.6	53	128.3	83.3	13	178.6	116.0	73	228.9	148.7
34	28.5	18.5	94	78 8	51.2	54	129.1	83.9	14	179.5	116.5	74	229.8	149.2
35	29.4	19.1	95	79.7	51.7	55	130.0	84.4	15	180.3	117.1	75	230.6	149.8
36	30.2	19.6	96	80.5	52.3	56	130.8	85.0	16	181.1	117.6	76	231.5	150.3
37	31.0	20.2	97	81.3	52.8	57	131.7	85.5	17	182.0	118.2	77	232.3	150.9
38	31.9	20.7	98	82.2	53.4	58	132.5	86.0	18	182.8	118.7	78	233.1	151.4
39	32.7	21.2	99	83.0	53.9	59	133.3	86.6	19	183.7	119.3	79	234.0	151.9
40	33.5	21.8	100	83.9	54.5	60	134.2	87.1	20	184.5	119.8	80	234.8	152.5
41	34.4	22.3	101	84.7	55.0	161	135.0	87.7	221	185.3	120.4	281	235.6	153.0
42	35.2	22.9	02	85.5	55.5	62	135.9	88.2	22	186.2	120.9	82	236.5	153.6
43	36.1	23.4	03	86.4	56.1	63	136.7	88.8	23	187.0	121.4	83	237.3	154.1
44	36.9	24.0	04	87.2	56.6	64	137.5	89.3	24	187.8	122.0	84	238.2	154.7
45	37.7	24.5	05	88.1	57.2	65	138.4	89.9	25	188.7	122.5	85	239.0	155.2
46	38.6	25.1	06	88.9	57.7	66	139.2	90.4	26	189.5	123.1	86	239.8	155.8
47	39.4	25.6	07	89.7	58.3	67	140.0	90.9	27	190.4	123.6	87	240.7	156.3
48	40.3	26.1	08	90.6	58.8	68	140.9	91.5	28	191.2	124.2	88	241.5	156.8
49	41.1	26.7	09	91.4	59.4	69	141.7	92.0	29	192.0	124.7	89	242.4	157.4
50	41.9	27.2	10	92.2	59.9	70	142.6	92.6	30	192.9	125.3	90	243.2	157.9
51	42.8	27.8	11	93.1	60.5	171	143.4	93.1	231	193.7	125.8	291	244.0	158.5
52	43.6	28.3	12	93.9	61.0	72	144.2	93.7	32	194.6	126.3	92	244.9	159.0
53	44.4	28.9	13	94.8	61.5	73	145.1	94.2	33	195.4	126.9	93	245.7	159.6
54	45.3	29.4	14	95.6	62.1	74	145.9	94.8	34	196.2	127.4	94	246.5	160.1
55	46.1	30.0	15	96.4	62.6	75	146.8	95.3	35	197.1	128.0	95	247.4	160.7
56	47.0	30.5	16	97.3	63.2	76	147.6	95.8	36	197.9	128.5	96	248.2	161.2
57	47.8	31.0	17	98.1	63.7	77	148.4	96.4	37	198.7	129.1	97	249.1	161.7
58	48.6	31.6	18	99.0	64.3	78	149.3	96.9	38	199.6	129.6	98	249.9	162.3
59	49.5	32.1	19	99.8	64.8	79	150.1	97.5	39	200.4	130.2	99	250.7	162.8
60	50.3	32.7	120	100.6	65.4	80	150.9	98.0	40	201.3	130.7	300	251.6	163.4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.8	00.6	61	50.6	34.1	121	100.3	67.7	181	150.0	101.2	241	199.8	134.8
2	01.7	01.1	62	51.4	34.7	22	101.1	68.2	82	150.9	101.8	42	200.6	135.3
3	02.5	01.7	63	52.2	35.2	23	102.0	68.8	83	151.7	102.3	43	201.4	135.9
4	03.3	02.2	64	53.1	35.8	24	102.8	69.3	84	152.5	102.9	44	202.3	136.4
5	04.1	02.8	65	53.9	36.3	25	103.6	69.9	85	153.4	103.5	45	203.1	137.0
6	05.0	03.4	66	54.7	36.9	26	104.5	70.5	86	154.2	104.0	46	203.9	137.6
7	05.8	03.9	67	55.5	37.5	27	105.3	71.0	87	155.0	104.6	47	204.8	138.1
8	06.6	04.5	68	56.4	38.0	28	106.1	71.6	88	155.9	105.1	48	205.6	138.7
9	07.5	05.0	69	57.2	38.6	29	106.9	72.1	89	156.7	105.7	49	206.4	139.2
10	08.3	05.6	70	58.0	39.1	30	107.8	72.7	90	157.5	106.2	50	207.3	139.8
11	09.1	06.2	71	58.9	39.7	131	108.6	73.3	191	158.3	106.8	251	208.1	140.4
12	09.9	06.7	72	59.7	40.3	32	109.4	73.8	92	159.2	107.4	52	208.9	140.9
13	10.8	07.3	73	60.5	40.8	33	110.3	74.4	93	160.0	107.9	53	209.7	141.5
14	11.6	07.8	74	61.3	41.4	34	111.1	74.9	94	160.8	108.5	54	210.6	142.0
15	12.4	08.4	75	62.2	41.9	35	111.9	75.5	95	161.7	109.0	55	211.4	142.6
16	13.3	08.9	76	63.0	42.5	36	112.7	76.1	96	162.5	109.6	56	212.2	143.2
17	14.1	09.5	77	63.8	43.1	37	113.6	76.6	97	163.3	110.2	57	213.1	143.7
18	14.9	10.1	78	64.7	43.6	38	114.4	77.2	98	164.1	110.7	58	213.9	144.3
19	15.8	10.6	79	65.5	44.2	39	115.2	77.7	99	165.0	111.3	59	214.7	144.8
20	16.6	11.2	80	66.3	44.7	40	116.1	78.3	200	165.8	111.8	60	215.5	145.4
21	17.4	11.7	81	67.1	45.3	141	116.9	78.8	201	166.6	112.4	261	216.4	146.0
22	18.2	12.3	82	68.0	45.9	42	117.7	79.4	02	167.5	113.0	62	217.2	146.5
23	19.1	12.9	83	68.8	46.4	43	118.5	80.0	03	168.3	113.5	63	218.0	147.1
24	19.9	13.4	84	69.6	47.0	44	119.4	80.5	04	169.1	114.1	64	218.9	147.6
25	20.7	14.0	85	70.5	47.5	45	120.2	81.1	05	169.9	114.6	65	219.7	148.2
26	21.6	14.5	86	71.3	48.1	46	121.0	81.6	06	170.8	115.2	66	220.5	148.7
27	22.4	15.1	87	72.1	48.7	47	121.9	82.2	07	171.6	115.8	67	221.3	149.3
28	23.2	15.7	88	73.0	49.2	48	122.7	82.8	08	172.4	116.3	68	222.2	149.9
29	24.0	16.2	89	73.8	49.8	49	123.5	83.3	09	173.3	116.9	69	223.0	150.4
30	24.9	16.8	90	74.6	50.3	50	124.4	83.9	10	174.1	117.4	70	223.8	151.0
31	25.7	17.3	91	75.4	50.9	151	125.2	84.4	211	174.9	118.0	271	224.7	151.5
32	26.5	17.9	92	76.3	51.4	52	126.0	85.0	12	175.7	118.6	72	225.5	152.1
33	27.4	18.5	93	77.1	52.0	53	126.8	85.6	13	176.6	119.1	73	226.3	152.7
34	28.2	19.0	94	77.9	52.6	54	127.7	86.1	14	177.4	119.7	74	227.1	153.2
35	29.0	19.6	95	78.8	53.1	55	128.5	86.7	15	178.2	120.2	75	228.0	153.8
36	29.8	20.1	96	79.6	53.7	56	129.3	87.2	16	179.1	120.8	76	228.8	154.3
37	30.7	20.7	97	80.4	54.2	57	130.2	87.8	17	179.9	121.3	77	229.6	154.9
38	31.5	21.2	98	81.2	54.8	58	131.0	88.4	18	180.7	121.9	78	230.5	155.5
39	32.3	21.8	99	82.1	55.4	59	131.8	88.9	19	181.6	122.5	79	231.3	156.0
40	33.2	22.4	100	82.9	55.9	60	132.6	89.5	20	182.4	123.0	80	232.1	156.6
41	34.0	22.8	101	83.7	56.5	161	133.5	90.0	221	183.2	123.6	281	232.9	157.1
42	34.8	23.5	02	84.6	57.0	62	134.3	90.6	22	184.0	124.1	82	233.8	157.7
43	35.6	24.0	03	85.4	57.6	63	135.1	91.1	23	184.9	124.7	83	234.6	158.3
44	36.5	24.6	04	86.2	58.2	64	136.0	91.7	24	185.7	125.3	84	235.4	158.8
45	37.3	25.2	05	87.0	58.7	65	136.8	92.3	25	186.5	125.8	85	236.3	159.4
46	38.1	25.7	06	87.9	59.3	66	137.6	92.8	26	187.4	126.4	86	237.1	159.9
47	39.0	26.3	07	88.7	59.8	67	138.4	93.4	27	188.2	126.9	87	237.9	160.5
48	39.8	26.8	08	89.5	60.4	68	139.3	93.9	28	189.0	127.5	88	238.8	161.0
49	40.6	27.4	09	90.4	61.0	69	140.1	94.5	29	189.8	128.1	89	239.6	161.6
50	41.5	28.0	10	91.2	61.5	70	140.9	95.1	30	190.7	128.6	90	240.4	162.2
51	42.3	28.5	11	92.0	62.1	171	141.8	95.6	231	191.5	129.2	291	241.2	162.7
52	43.1	29.1	12	92.8	62.6	72	142.6	96.2	32	192.3	129.7	92	242.1	163.3
53	43.9	29.6	13	93.7	63.2	73	143.4	96.7	33	193.2	130.3	93	242.9	163.8
54	44.8	30.2	14	94.5	63.7	74	144.2	97.3	34	194.0	130.9	94	243.7	164.4
55	45.6	30.8	15	95.3	64.3	75	145.1	97.9	35	194.8	131.4	95	244.6	165.0
56	46.4	31.3	16	96.2	64.9	76	145.9	98.4	36	195.6	132.0	96	245.4	165.6
57	47.3	31.9	17	97.0	65.4	77	146.7	99.0	37	195.5	132.5	97	246.2	166.1
58	48.1	32.4	18	97.8	66.0	78	147.6	99.5	38	197.3	133.1	98	247.0	166.6
59	48.9	33.0	19	98.7	66.5	79	148.4	100.1	39	198.1	133.6	99	247.9	167.2
60	49.7	33.6	120	99.5	67.1	80	149.2	100.7	40	199.0	134.2	300	248.7	167.8
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	50.0	35.0	121	99.1	69.4	181	148.2	103.8	241	197.4	138.2
2	01.6	01.1	62	50.8	35.6	22	99.9	70.0	82	149.1	104.4	42	198.2	138.8
3	02.5	01.7	63	51.6	36.1	23	100.7	70.5	83	149.9	105.0	43	199.0	139.4
4	03.3	02.3	64	52.4	36.7	24	101.6	71.1	84	150.7	105.5	44	199.8	139.9
5	04.1	02.9	65	53.2	37.3	25	102.4	71.7	85	151.5	106.1	45	200.6	140.5
6	04.9	03.4	66	54.1	37.9	26	103.2	72.3	86	152.3	106.7	46	201.5	141.1
7	05.7	04.0	67	54.9	38.4	27	104.0	72.8	87	153.1	107.2	47	202.3	141.7
8	06.6	04.6	68	55.7	39.0	28	104.8	73.4	88	154.0	107.8	48	203.1	142.2
9	07.4	05.2	69	56.5	39.6	29	105.6	74.0	89	154.8	108.4	49	203.9	142.8
10	08.2	05.7	70	57.3	40.1	30	106.5	74.6	90	155.6	109.0	50	204.7	143.4
11	09.0	06.3	71	58.1	40.7	131	107.3	75.1	191	156.4	109.5	251	205.6	143.9
12	09.8	06.9	72	59.0	41.3	32	108.1	75.7	92	157.2	110.1	52	206.4	144.5
13	10.6	07.5	73	59.8	41.9	33	108.9	76.3	93	158.1	110.7	53	207.2	145.1
14	11.5	08.0	74	60.6	42.4	34	109.7	76.8	94	158.9	111.3	54	208.0	145.7
15	12.3	08.6	75	61.4	43.0	35	110.6	77.4	95	159.7	111.8	55	208.8	146.2
16	13.1	09.2	76	62.2	43.6	36	111.4	78.0	96	160.5	112.4	56	209.6	146.8
17	13.9	09.7	77	63.1	44.2	37	112.2	78.6	97	161.3	113.0	57	210.5	147.4
18	14.7	10.3	78	63.9	44.7	38	113.0	79.1	98	162.2	113.6	58	211.3	148.0
19	15.6	10.9	79	64.7	45.3	39	113.8	79.7	99	163.0	114.1	59	212.1	148.5
20	16.4	11.5	80	65.5	45.9	40	114.6	80.3	200	163.8	114.7	60	212.9	149.1
21	17.2	12.0	81	66.3	46.5	141	115.5	80.9	201	164.6	115.3	261	213.8	149.7
22	18.0	12.6	82	67.2	47.0	42	116.3	81.4	02	165.4	115.8	62	214.6	150.3
23	18.8	13.2	83	68.0	47.6	43	117.1	82.0	03	166.3	116.4	63	215.4	150.8
24	19.6	13.8	84	68.8	48.2	44	157.9	82.6	04	167.1	117.0	64	216.2	151.4
25	20.5	14.3	85	69.6	48.7	45	118.8	83.2	05	167.9	117.6	65	217.0	152.0
26	21.3	14.9	86	70.4	49.3	46	119.6	83.7	06	168.7	118.1	66	217.8	152.6
27	22.1	15.5	87	71.3	49.9	47	120.4	84.3	07	169.5	118.7	67	218.7	153.1
28	22.9	16.1	88	72.1	50.5	48	121.2	84.9	08	170.3	119.3	68	219.5	153.7
29	23.8	16.6	89	72.9	51.0	49	122.0	85.5	09	171.2	119.9	69	220.3	154.3
30	24.6	17.2	90	73.7	51.6	50	122.8	86.0	10	172.0	120.4	70	221.1	154.8
31	25.4	17.8	91	74.5	52.2	151	123.7	86.6	211	172.8	121.0	271	221.9	155.4
32	26.2	18.4	92	75.3	52.8	52	124.5	87.2	12	173.6	121.6	72	222.8	156.0
33	27.0	18.9	93	76.2	53.3	53	125.3	87.7	13	174.4	122.2	73	223.6	156.6
34	27.8	19.5	94	77.0	53.9	54	126.1	88.3	14	175.3	122.7	74	224.4	157.1
35	28.7	20.1	95	77.8	54.5	55	126.9	88.9	15	176.1	123.3	75	225.2	157.7
36	29.5	20.6	96	78.6	55.1	56	127.8	89.5	16	176.9	123.9	76	226.0	158.3
37	30.3	21.2	97	79.4	55.6	57	128.6	90.0	17	177.7	124.4	77	226.9	158.9
38	31.1	21.8	98	80.3	56.2	58	129.4	90.6	18	178.5	125.0	78	227.7	159.4
39	31.9	22.4	99	81.1	56.8	59	130.2	91.2	19	179.4	125.6	79	228.5	160.0
40	32.8	22.9	100	81.9	57.4	60	131.0	91.8	20	180.2	126.2	80	229.3	160.6
41	33.6	23.5	101	82.7	57.9	161	131.9	92.3	221	181.0	126.7	281	230.1	161.2
42	34.4	24.1	02	83.5	58.5	62	132.7	92.9	22	181.8	127.3	82	231.0	161.7
43	35.2	24.7	03	84.4	59.1	63	133.5	93.5	23	182.6	127.9	83	231.8	162.3
44	36.0	25.2	04	85.2	59.6	64	134.3	94.1	24	183.5	128.5	84	232.6	162.9
45	36.9	25.8	05	86.0	60.2	65	135.1	94.6	25	184.2	129.0	85	233.4	163.4
46	37.7	26.4	06	86.8	60.8	66	136.0	95.2	26	185.1	129.6	86	234.2	164.0
47	38.5	27.0	07	87.6	61.4	67	136.8	95.8	27	185.9	130.2	87	235.0	164.6
48	39.3	27.5	08	88.5	61.9	68	137.6	96.3	28	186.7	130.8	88	235.9	165.2
49	40.1	28.1	09	89.3	62.5	69	138.4	96.9	29	187.5	131.3	89	236.7	165.7
50	41.0	28.7	10	90.1	63.1	70	139.2	97.5	30	188.4	131.9	90	237.5	166.3
51	41.8	29.2	111	90.9	63.7	171	140.0	98.1	231	189.2	132.5	291	238.3	166.9
52	42.6	29.8	12	91.7	64.2	72	140.9	98.6	32	190.0	133.1	92	239.1	167.5
53	43.4	30.4	13	92.5	64.8	73	141.7	99.2	33	190.8	133.6	93	240.0	168.0
54	44.2	31.0	14	93.4	65.4	74	142.5	99.8	34	191.6	134.2	94	240.8	168.6
55	45.0	31.5	15	94.2	66.0	75	143.3	100.4	35	192.5	134.8	95	241.6	169.2
56	45.9	32.1	16	95.0	66.5	76	144.1	100.9	36	193.3	135.3	96	242.4	169.8
57	46.7	32.7	17	95.8	67.1	77	145.0	101.5	37	194.1	135.9	97	243.2	170.3
58	47.5	33.3	18	96.6	67.7	78	145.8	102.1	38	194.9	136.5	98	244.1	170.9
59	48.3	33.8	19	97.5	68.2	79	146.6	102.7	39	195.7	137.1	99	244.9	171.5
60	49.1	34.4	20	98.3	68.8	80	147.4	103.2	40	196.6	137.6	300	245.7	172.1
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	49.3	35.9	121	97.9	71.1	81	146.4	106.4	241	195.0	141.7
2	01.6	01.2	62	50.2	36.4	22	98.7	71.7	82	147.2	107.0	42	195.8	142.2
3	02.4	01.8	63	51.0	37.0	23	99.5	72.3	83	148.0	107.6	43	196.6	142.8
4	03.2	02.4	64	51.8	37.6	24	100.3	72.9	84	148.9	108.2	44	197.4	143.4
5	04.0	02.9	65	52.6	38.2	25	101.1	73.5	85	149.7	108.7	45	198.2	144.0
6	04.9	03.5	66	53.4	38.8	26	101.9	74.1	86	150.5	109.3	46	199.0	144.6
7	05.7	04.1	67	54.2	39.4	27	102.7	74.7	87	151.3	109.9	47	199.8	145.2
8	06.5	04.7	68	55.0	40.0	28	103.6	75.2	88	152.1	110.5	48	200.6	145.8
9	07.3	05.3	69	55.8	40.6	29	104.4	75.8	89	152.9	111.1	49	201.4	146.4
10	08.1	05.9	70	56.6	41.1	30	105.2	76.4	90	153.7	111.7	50	202.2	146.9
11	08.9	06.5	71	57.4	41.7	131	106.0	77.0	191	154.5	112.3	251	203.1	147.5
12	09.7	07.1	72	58.2	42.3	32	106.8	77.6	92	155.3	112.9	52	203.9	148.1
13	10.5	07.6	73	59.1	42.9	33	107.6	78.2	93	156.1	113.4	53	204.7	148.7
14	11.3	08.2	74	59.9	43.5	34	108.4	78.8	94	156.9	114.0	54	205.5	149.3
15	12.1	08.8	75	60.7	44.1	35	109.2	79.4	95	157.8	114.6	55	206.3	149.9
16	12.9	09.4	76	61.5	44.7	36	110.0	79.9	96	158.6	115.2	56	207.1	150.5
17	13.8	10.0	77	62.3	45.3	37	110.8	80.5	97	159.4	115.8	57	207.9	151.1
18	14.6	10.6	78	63.1	45.8	38	111.6	81.1	98	160.2	116.4	58	208.7	151.7
19	15.4	11.2	79	63.9	46.4	39	112.5	81.7	99	161.0	117.0	59	209.5	152.2
20	16.2	11.8	80	64.7	47.0	40	113.3	82.3	200	161.8	117.6	60	210.3	152.8
21	17.0	12.3	81	65.5	47.6	141	114.1	82.9	201	162.6	118.1	261	211.1	153.4
22	17.8	12.9	82	66.3	48.2	42	114.9	83.5	02	163.4	118.7	62	212.0	154.0
23	18.6	13.5	83	67.1	48.8	43	115.7	84.1	03	164.2	119.3	63	212.8	154.6
24	19.4	14.1	84	68.0	49.4	44	116.5	84.6	04	165.0	119.9	64	213.6	155.2
25	20.2	14.7	85	68.8	50.0	45	117.3	85.2	05	165.8	120.5	65	214.4	155.8
26	21.0	15.3	86	69.6	50.6	46	118.1	85.8	06	166.7	121.1	66	215.2	156.4
27	21.8	15.9	87	70.4	51.1	47	118.9	86.4	07	167.5	121.7	67	216.0	156.9
28	22.7	16.5	88	71.2	51.7	48	119.7	87.0	08	168.3	122.3	68	216.8	157.5
29	23.5	17.0	89	72.0	52.3	49	120.5	87.6	09	169.1	122.8	69	217.6	158.1
30	24.3	17.6	90	72.8	52.9	50	121.3	88.2	10	169.9	123.4	70	218.4	158.7
31	25.1	18.2	91	73.6	53.5	151	122.2	88.8	211	170.7	124.0	271	219.2	159.3
32	25.9	18.8	92	74.4	54.1	52	123.0	89.3	12	171.5	124.6	72	220.0	159.9
33	26.7	19.4	93	75.2	54.7	53	123.8	89.9	13	172.3	125.2	73	220.9	160.5
34	27.5	20.0	94	76.0	55.3	54	124.6	90.5	14	173.1	125.8	74	221.7	161.1
35	28.3	20.6	95	76.9	55.8	55	125.4	91.1	15	173.9	126.4	75	222.5	161.6
36	29.1	21.2	96	77.7	56.4	56	126.2	91.7	16	174.7	127.0	76	223.3	162.2
37	29.9	21.7	97	78.5	57.0	57	127.0	92.3	17	175.6	127.6	77	224.1	162.8
38	30.7	22.3	98	79.3	57.6	58	127.8	92.9	18	176.4	128.1	78	224.9	163.4
39	31.6	22.9	99	80.1	58.2	59	128.6	93.5	19	177.2	128.7	79	225.7	164.0
40	32.4	23.5	100	80.9	58.8	60	129.4	94.0	20	178.0	129.3	80	226.5	164.6
41	33.2	24.1	101	81.7	59.4	161	130.2	94.6	221	178.8	129.9	281	227.3	165.2
42	34.0	24.7	02	82.5	60.0	62	131.1	95.2	22	179.6	130.5	82	228.1	165.8
43	34.8	25.3	03	83.3	60.5	63	131.9	95.8	23	180.4	131.1	83	228.9	166.3
44	35.6	25.9	04	84.1	61.1	64	132.7	96.4	24	181.2	131.7	84	229.8	166.9
45	36.4	26.5	05	84.9	61.7	65	133.5	97.0	25	182.0	132.3	85	230.6	167.5
46	37.2	27.1	06	85.8	62.3	66	134.3	97.6	26	182.8	132.8	86	231.4	168.1
47	38.0	27.6	07	86.6	62.9	67	135.1	98.2	27	183.6	133.4	87	232.2	168.7
48	38.8	28.2	08	87.4	63.5	68	135.9	98.7	28	184.5	134.0	88	233.0	169.3
49	39.6	28.8	09	88.2	64.1	69	136.7	99.3	29	185.3	134.6	89	233.8	169.9
50	40.5	29.4	10	89.0	64.7	70	137.5	99.9	30	186.1	135.2	90	234.6	170.5
51	41.3	30.0	111	89.8	65.2	171	138.3	100.5	231	186.9	135.8	291	235.4	171.0
52	42.1	30.6	12	90.6	65.8	72	139.1	101.1	32	187.7	136.4	92	236.2	171.6
53	42.9	31.2	13	91.4	66.4	73	140.0	101.7	33	188.5	137.0	93	237.0	172.2
54	43.7	31.7	14	92.2	67.0	74	140.8	102.3	34	189.3	137.5	94	237.8	172.8
55	44.5	32.3	15	93.0	67.6	75	141.6	102.9	35	190.1	138.1	95	238.7	173.4
56	45.3	32.9	16	93.8	68.2	76	142.4	103.5	36	190.9	138.7	96	239.5	174.0
57	46.1	33.5	17	94.7	68.8	77	143.2	104.0	37	191.7	139.3	97	240.3	174.6
58	46.9	34.1	18	95.5	69.4	78	144.0	104.6	38	192.5	139.9	98	241.1	175.2
59	47.7	34.7	19	96.3	69.9	79	144.8	105.2	39	193.3	140.5	99	241.9	175.7
60	48.5	35.3	20	97.1	70.5	80	145.6	105.8	40	194.2	141.1	300	242.7	176.3
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

[For 54 Degrees

TABLE II. Difference of Latitude and Departure for 37 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	48.7	36.7	121	96.6	72.8	181	144.5	108.9	241	192.5	145.0
2	01.6	01.2	62	49.5	37.3	22	97.4	73.4	82	145.3	109.5	42	193.1	145.6
3	02.4	01.8	63	50.3	37.9	23	98.2	74.0	83	146.1	110.1	43	194.3	146.2
4	03.2	02.4	64	51.1	38.5	24	99.0	74.6	84	146.9	110.7	44	194.9	146.8
5	04.0	03.0	65	51.9	39.1	25	99.8	75.2	85	147.7	111.3	45	195.7	147.4
6	04.8	03.6	66	52.7	39.7	26	100.6	75.8	86	148.5	111.9	46	196.5	148.0
7	05.6	04.2	67	53.5	40.3	27	101.4	76.4	87	149.3	112.5	47	197.3	148.6
8	06.4	04.8	68	54.3	40.9	28	102.2	77.0	88	150.1	113.1	48	198.1	149.2
9	07.2	05.4	69	55.1	41.5	29	103.0	77.6	89	150.9	113.7	49	198.9	149.8
10	08.0	06.0	70	55.9	42.1	30	103.8	78.2	90	151.7	114.3	50	199.7	150.4
11	08.8	06.6	71	56.7	42.7	131	104.6	78.8	191	152.5	114.9	251	200.4	151.0
12	09.6	07.2	72	57.5	43.3	32	105.4	79.4	92	153.3	115.5	52	201.2	151.6
13	10.4	07.8	73	58.3	43.9	33	106.2	80.0	93	154.1	116.1	53	202.0	152.2
14	11.2	08.4	74	59.1	44.5	34	107.0	80.6	94	154.9	116.7	54	202.8	152.9
15	12.0	09.0	75	59.9	45.1	35	107.8	81.2	95	155.7	117.3	55	203.6	153.5
16	12.8	09.6	76	60.7	45.7	36	108.6	81.8	96	156.5	117.9	56	204.4	154.1
17	13.6	10.2	77	61.5	46.3	37	109.4	82.4	97	157.3	118.6	57	205.2	154.7
18	14.4	10.8	78	62.3	46.9	38	110.2	83.0	98	158.1	119.2	58	206.0	155.3
19	15.2	11.4	79	63.1	47.5	39	111.0	83.6	99	158.9	119.8	59	206.8	155.9
20	16.0	12.0	80	63.9	48.1	40	111.8	84.2	200	159.7	120.4	60	207.6	156.5
21	16.8	12.6	81	64.7	48.7	141	112.6	84.9	201	160.5	121.0	261	208.4	157.1
22	17.6	13.2	82	65.5	49.3	42	113.4	85.5	02	161.3	121.6	62	209.2	157.7
23	18.4	13.8	83	66.3	49.9	43	114.2	86.1	03	162.1	122.2	63	210.0	158.3
24	19.2	14.4	84	67.1	50.6	44	115.0	86.7	04	162.9	122.8	64	210.8	158.9
25	20.0	15.0	85	67.9	51.2	45	115.8	87.3	05	163.7	123.4	65	211.6	159.5
26	20.8	15.6	86	68.7	51.8	46	116.6	87.9	06	164.5	124.0	66	212.4	160.1
27	21.6	16.2	87	69.5	52.4	47	117.4	88.5	07	165.3	124.6	67	213.2	160.7
28	22.4	16.9	88	70.3	53.0	48	118.2	89.1	08	166.1	125.2	68	214.0	161.3
29	23.2	17.5	89	71.1	53.6	49	119.0	89.7	09	166.9	125.8	69	214.8	161.9
30	24.0	18.1	90	71.9	54.2	50	119.8	90.3	10	167.7	126.4	70	215.6	162.5
31	24.8	18.7	91	72.7	54.8	151	120.6	90.9	211	168.5	127.0	271	216.4	163.1
32	25.6	19.3	92	73.5	55.4	52	121.4	91.5	12	169.3	127.6	72	217.2	163.7
33	26.4	19.9	93	74.3	56.0	53	122.2	92.1	13	170.1	128.2	73	218.0	164.3
34	27.2	20.5	94	75.1	56.6	54	123.0	92.7	14	170.9	128.8	74	218.8	164.9
35	28.0	21.1	95	75.9	57.2	55	123.8	93.3	15	171.7	129.4	75	219.6	165.5
36	28.7	21.7	96	76.7	57.8	56	124.6	93.9	16	172.5	130.0	76	220.4	166.1
37	29.5	22.3	97	77.5	58.4	57	125.4	94.5	17	173.3	130.6	77	221.2	166.7
38	30.3	22.9	98	78.3	59.0	58	126.2	95.1	18	174.1	131.2	78	222.0	167.3
39	31.1	23.5	99	79.1	59.6	59	127.0	95.7	19	174.9	131.8	79	222.8	167.9
40	31.9	24.1	100	79.9	60.2	60	127.8	96.3	20	175.7	132.4	80	223.6	168.5
41	32.7	24.7	101	80.7	60.8	161	128.6	96.9	221	176.5	133.0	281	224.4	169.1
42	33.5	25.3	02	81.5	61.4	62	129.4	97.5	22	177.3	133.6	82	225.2	169.7
43	34.3	25.9	03	82.3	62.0	63	130.2	98.1	23	178.1	134.2	83	226.0	170.3
44	35.1	26.5	04	83.1	62.6	64	131.0	98.7	24	178.9	134.8	84	226.8	170.9
45	35.9	27.1	05	83.9	63.2	65	131.8	99.3	25	179.7	135.4	85	227.6	171.5
46	36.7	27.7	06	84.7	63.8	66	132.6	99.9	26	180.5	136.0	86	228.4	172.1
47	37.5	28.3	07	85.5	64.4	67	133.4	100.5	27	181.3	136.6	87	229.2	172.7
48	38.3	28.9	08	86.2	65.0	68	134.2	101.1	28	182.1	137.2	88	230.0	173.3
49	39.1	29.5	09	87.0	65.6	69	135.0	101.7	29	182.9	137.8	89	230.8	173.9
50	39.9	30.1	10	87.8	66.2	70	135.8	102.3	30	183.7	138.4	90	231.6	174.5
51	40.7	30.7	111	88.6	66.8	171	136.6	102.9	231	184.5	139.0	291	232.4	175.1
52	41.5	31.3	12	89.4	67.4	72	137.4	103.5	32	185.3	139.6	92	233.2	175.7
53	42.3	31.9	13	90.2	68.0	73	138.2	104.1	33	186.1	140.2	93	234.0	176.3
54	43.1	32.5	14	91.0	68.6	74	139.0	104.7	34	186.9	140.8	94	234.8	176.9
55	43.9	33.1	15	91.8	69.2	75	139.8	105.3	35	187.7	141.4	95	235.6	177.5
56	44.7	33.7	16	92.6	69.8	76	140.6	105.9	36	188.5	142.0	96	236.4	178.1
57	45.5	34.3	17	93.4	70.4	77	141.4	106.5	37	189.3	142.6	97	237.2	178.7
58	46.3	34.9	18	94.2	71.0	78	142.2	107.1	38	190.1	143.2	98	238.0	179.3
59	47.1	35.5	19	95.0	71.6	79	142.9	107.7	39	190.9	143.8	99	238.8	179.9
60	47.9	36.1	20	95.8	72.2	80	143.7	108.3	40	191.7	144.4	300	239.6	180.5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

[For 53 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	48.1	37.6	121	95.3	74.5	181	142.6	111.4	241	189.9	148.4
2	01.6	01.2	62	48.9	38.2	22	96.1	75.1	82	143.4	112.1	42	190.7	149.0
3	02.4	01.8	63	49.6	38.8	23	96.9	75.7	83	144.2	112.7	43	191.5	149.6
4	03.2	02.5	64	50.4	39.4	24	97.7	76.3	84	145.0	113.3	44	192.2	150.2
5	03.9	03.1	65	51.2	40.0	25	98.5	77.0	85	145.8	113.9	45	193.0	150.8
6	04.7	03.7	66	52.0	40.6	26	99.3	77.6	86	146.5	114.5	46	193.8	151.5
7	05.5	04.3	67	52.8	41.3	27	100.1	78.2	87	147.3	115.1	47	194.6	152.1
8	06.3	04.9	68	53.6	41.9	28	100.9	78.8	88	148.1	115.8	48	195.4	152.7
9	07.1	05.5	69	54.4	42.5	29	101.6	79.4	89	148.9	116.4	49	196.2	153.3
10	07.9	06.2	70	55.2	43.1	30	102.4	80.0	90	149.7	117.0	50	197.0	153.9
11	08.7	06.8	71	55.9	43.7	131	103.2	80.7	191	150.5	117.6	251	197.8	154.5
12	09.5	07.4	72	56.7	44.3	32	104.0	81.3	92	151.3	118.2	52	198.5	155.2
13	10.2	08.0	73	57.5	44.9	33	104.8	81.9	93	152.1	118.8	53	199.3	155.8
14	11.0	08.6	74	58.3	45.6	34	105.6	82.5	94	152.9	119.4	54	200.1	156.4
15	11.8	09.2	75	59.1	46.2	35	106.4	83.1	95	153.6	120.1	55	200.9	157.0
16	12.6	09.9	76	59.9	46.8	36	107.1	83.7	96	154.4	120.7	56	201.7	157.6
17	13.4	10.5	77	60.7	47.4	37	107.9	84.4	97	155.2	121.3	57	202.5	158.2
18	14.2	11.1	78	61.5	48.0	38	108.7	85.0	98	156.0	121.9	58	203.3	158.9
19	15.0	11.7	79	62.2	48.6	39	109.5	85.6	99	156.8	122.5	59	204.1	159.5
20	15.8	12.3	80	63.0	49.3	40	110.3	86.2	200	157.6	123.1	60	204.9	160.1
21	16.5	12.9	81	63.8	49.9	141	111.1	86.8	201	158.4	123.8	261	205.6	160.7
22	17.3	13.5	82	64.6	50.5	42	111.9	87.4	02	159.2	124.4	62	206.4	161.3
23	18.1	14.2	83	65.4	51.1	43	112.7	88.0	03	159.9	125.0	63	207.2	161.9
24	18.9	14.8	84	66.2	51.7	44	113.5	88.7	04	160.7	125.6	64	208.0	162.5
25	19.7	15.4	85	67.0	52.3	45	114.2	89.3	05	161.5	126.2	65	208.8	163.2
26	20.5	16.0	86	67.8	53.0	46	115.0	89.9	06	162.3	126.8	66	209.6	163.8
27	21.3	16.6	87	68.5	53.6	47	115.8	90.5	07	163.1	127.4	67	210.4	164.4
28	22.1	17.2	88	69.3	54.2	48	116.6	91.1	08	163.9	128.1	68	211.2	165.0
29	22.9	17.9	89	70.1	54.8	49	117.4	91.7	09	164.7	128.7	69	211.9	165.6
30	23.6	18.5	90	70.9	55.4	50	118.2	92.4	10	165.5	129.3	70	212.7	166.2
31	24.4	19.1	91	71.7	56.0	151	119.0	93.0	211	166.2	129.9	271	213.5	166.9
32	25.2	19.7	92	72.5	56.6	52	119.8	93.6	12	167.0	130.5	72	214.3	167.5
33	26.0	20.3	93	73.3	57.3	53	120.5	94.2	13	167.8	131.1	73	215.1	168.1
34	26.8	20.9	94	74.1	57.9	54	121.3	94.8	14	168.6	131.8	74	215.9	168.7
35	27.6	21.5	95	74.9	58.5	55	122.1	95.4	15	169.4	132.4	75	216.7	169.3
36	28.4	22.2	96	75.6	59.1	56	122.9	96.0	16	170.2	133.0	76	217.5	169.9
37	29.2	22.8	97	76.4	59.7	57	123.7	96.7	17	171.0	133.6	77	218.2	170.5
38	29.9	23.4	98	77.2	60.3	58	124.5	97.3	18	171.8	134.2	78	219.0	171.2
39	30.7	24.0	99	78.0	61.0	59	125.3	97.9	19	172.5	134.8	79	219.8	171.8
40	31.5	24.6	100	78.8	61.6	60	126.1	98.5	20	173.3	135.5	80	220.6	172.4
41	32.3	25.2	101	79.6	62.2	161	126.9	99.1	221	174.1	136.1	281	221.4	173.0
42	33.1	25.9	02	80.4	62.8	62	127.6	99.7	22	174.9	136.7	82	222.2	173.6
43	33.9	26.5	03	81.2	63.4	63	128.4	100.4	23	175.7	137.3	83	223.0	174.2
44	34.7	27.1	04	81.9	64.0	64	129.2	101.0	24	176.5	137.9	84	223.8	174.9
45	35.5	27.7	05	82.7	64.6	65	130.0	101.6	25	177.3	138.5	85	224.5	175.5
46	36.2	28.3	06	83.5	65.3	66	130.8	102.2	26	178.1	139.1	86	225.3	176.1
47	37.0	28.9	07	84.3	65.9	67	131.6	102.8	27	178.9	139.8	87	226.1	176.7
48	37.8	29.6	08	85.1	66.5	68	132.4	103.4	28	179.6	140.4	88	226.9	177.3
49	38.6	30.2	09	85.9	67.1	69	133.2	104.1	29	180.4	141.0	89	227.7	177.9
50	39.4	30.8	10	86.7	67.7	70	133.9	104.7	30	181.2	141.6	90	228.5	178.6
51	40.2	31.4	111	87.5	68.3	71	134.7	105.3	231	182.0	142.2	291	229.2	179.2
52	41.0	32.0	12	88.2	69.0	72	135.5	105.9	32	182.8	142.8	92	230.1	179.8
53	41.8	32.6	13	89.0	69.6	73	136.3	106.5	33	183.6	143.5	93	230.9	180.4
54	42.6	33.2	14	89.8	70.2	74	137.1	107.1	34	184.4	144.1	94	231.6	181.0
55	43.3	33.9	15	90.6	70.8	75	137.9	107.7	35	185.2	144.7	95	232.4	181.6
56	44.1	34.5	16	91.4	71.4	76	138.7	108.4	36	185.9	145.3	96	233.2	182.2
57	44.9	35.1	17	92.2	72.0	77	139.5	109.0	37	186.7	145.9	97	234.0	182.9
58	45.7	35.7	18	93.0	72.7	78	140.2	109.6	38	187.5	146.5	98	234.8	183.5
59	46.5	36.3	19	93.8	73.3	79	141.0	110.2	39	188.3	147.2	99	235.6	184.1
60	47.3	36.9	20	94.5	73.9	80	141.8	110.8	40	189.1	147.8	300	236.4	184.7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep
1	00.8	00.6	61	47.4	38.4	121	94.0	76.1	181	140.7	113.9	241	187.3	151.7
2	01.6	01.3	62	48.2	39.0	22	94.8	76.8	82	141.4	114.5	42	188.1	152.3
3	02.3	01.9	63	49.0	39.6	23	95.6	77.4	83	142.2	115.2	43	188.8	152.9
4	03.1	02.5	64	49.7	40.3	24	96.4	78.0	84	143.0	115.8	44	189.6	153.6
5	03.9	03.1	65	50.5	40.9	25	97.1	78.7	85	143.8	116.4	45	190.4	154.2
6	04.7	03.8	66	51.3	41.5	26	97.9	79.3	86	144.5	117.1	46	191.2	154.8
7	05.4	04.4	67	52.1	42.2	27	98.7	79.9	87	145.3	117.7	47	191.9	155.4
8	06.2	05.0	68	52.8	42.8	28	99.5	80.6	88	146.1	118.3	48	192.7	156.1
9	07.0	05.7	69	53.6	43.4	29	100.2	81.2	89	146.9	118.9	49	193.5	156.7
10	07.8	06.3	70	54.4	44.1	30	101.0	81.8	90	147.6	119.6	50	194.3	157.3
11	08.5	06.9	71	55.2	44.7	131	101.8	82.4	191	148.4	120.2	251	195.1	158.0
12	09.3	07.6	72	56.0	45.3	32	102.6	83.1	92	149.2	120.8	52	195.8	158.6
13	10.1	08.2	73	56.7	45.9	33	103.4	83.7	93	150.0	121.5	53	196.6	159.2
14	10.9	08.8	74	57.5	46.6	34	104.1	84.3	94	150.8	122.1	54	197.4	159.8
15	11.7	09.4	75	58.3	47.2	35	104.9	85.0	95	151.5	122.7	55	198.2	160.5
16	12.4	10.1	76	59.1	47.8	36	105.7	85.6	96	152.3	123.3	56	198.9	161.1
17	13.2	10.7	77	59.8	48.5	37	106.5	86.2	97	153.1	124.0	57	199.7	161.7
18	14.0	11.3	78	60.6	49.1	38	107.2	86.8	98	153.9	124.6	58	200.5	162.4
19	14.8	12.0	79	61.4	49.7	39	108.0	87.5	99	154.6	125.2	59	201.3	163.0
20	15.5	12.6	80	62.2	50.3	40	108.8	88.1	200	155.4	125.9	60	202.0	163.6
21	16.3	13.2	81	62.9	51.0	141	109.6	88.7	201	156.2	126.5	261	202.8	164.2
22	17.1	13.8	82	63.7	51.6	42	110.3	89.4	02	157.0	127.1	62	203.6	164.9
23	17.9	14.5	83	64.5	52.2	43	111.1	90.0	03	157.8	127.7	63	204.4	165.5
24	18.7	15.1	84	65.3	52.9	44	111.9	90.6	04	158.5	128.4	64	205.2	166.1
25	19.4	15.7	85	66.1	53.5	45	112.7	91.2	05	159.3	129.0	65	205.9	166.8
26	20.2	16.4	86	66.8	54.1	46	113.5	91.9	06	160.1	129.6	66	206.7	167.4
27	21.0	17.0	87	67.6	54.7	47	114.2	92.5	07	160.9	130.3	67	207.5	168.0
28	21.8	17.6	88	68.4	55.4	48	115.0	93.1	08	161.6	130.9	68	208.3	168.7
29	22.5	18.2	89	69.2	56.0	49	115.8	93.8	09	162.4	131.5	69	209.0	169.3
30	23.3	18.9	90	69.9	56.6	50	116.6	94.4	10	163.2	132.2	70	209.8	169.9
31	24.1	19.5	91	70.7	57.3	151	117.3	95.0	211	164.0	132.8	271	210.6	170.5
32	24.9	20.1	92	71.5	57.9	52	118.1	95.7	12	164.7	133.4	72	211.4	171.2
33	25.6	20.8	93	72.3	58.5	53	118.9	96.3	13	165.5	134.0	73	212.1	171.8
34	26.4	21.4	94	73.0	59.2	54	119.7	96.9	14	166.3	134.7	74	212.9	172.4
35	27.2	22.0	95	73.8	59.8	55	120.5	97.5	15	167.1	135.3	75	213.7	173.1
36	28.0	22.7	96	74.6	60.4	56	121.2	98.2	16	167.9	135.9	76	214.5	173.7
37	28.8	23.3	97	75.4	61.0	57	122.0	98.8	17	168.6	136.6	77	215.3	174.3
38	29.5	23.9	98	76.2	61.7	58	122.8	99.4	18	169.4	137.2	78	216.0	174.8
39	30.3	24.5	99	76.9	62.3	59	123.6	100.1	19	170.2	137.8	79	216.8	175.9
40	31.1	25.2	100	77.7	62.9	60	124.3	100.7	20	171.0	138.4	80	217.6	176.[illegible]
41	31.9	25.8	101	78.5	63.6	161	125.1	101.3	221	171.7	139.1	281	218.4	176.8
42	32.6	26.4	02	79.3	64.2	62	125.9	101.9	22	172.5	139.7	82	219.1	177.5
43	33.4	27.1	03	80.0	64.8	63	126.7	102.6	23	173.3	140.3	83	219.9	178.1
44	34.2	27.7	04	80.8	65.4	64	127.4	103.2	24	174.1	141.0	84	220.7	178.7
45	35.0	28.3	05	81.6	66.1	65	128.2	103.8	25	174.8	141.6	85	221.5	179.4
46	35.7	28.9	06	82.4	66.7	66	129.0	104.5	26	175.6	142.2	86	222.3	180.0
47	36.5	29.6	07	83.1	67.3	67	129.8	105.1	27	176.4	142.9	87	223.0	180.6
48	37.3	30.2	08	83.9	68.0	68	130.6	105.7	28	177.2	143.5	88	223.8	181.2
49	38.1	30.8	09	84.7	68.6	69	131.3	106.4	29	178.0	144.1	89	224.6	181.9
50	38.9	31.5	10	85.5	69.2	70	132.1	107.0	30	178.7	144.7	90	225.4	182.5
51	39.6	32.1	111	86.3	69.9	171	132.9	107.6	231	179.5	145.4	291	226.1	183.1
52	40.4	32.7	12	87.0	70.5	72	133.7	108.2	32	180.3	146.0	92	226.9	183.8
53	41.2	33.4	13	87.8	71.1	73	134.4	108.9	33	181.1	146.6	93	227.7	184.4
54	42.0	34.0	14	88.6	71.7	74	135.2	109.5	34	181.8	147.3	94	228.5	185.0
55	42.7	34.6	15	89.4	72.4	75	136.0	110.1	35	182.6	147.9	95	229.2	185.6
56	43.5	35.2	16	90.1	73.0	76	136.8	110.8	36	183.4	148.5	96	230.0	186.3
57	44.3	35.9	17	90.9	73.6	77	137.5	111.4	37	184.2	149.1	97	230.8	186.9
58	45.1	36.5	18	91.7	74.3	78	138.3	112.0	38	185.0	149.8	98	231.6	187.5
59	45.8	37.1	19	92.5	74.9	79	139.1	112.6	39	185.7	150.4	99	232.4	188.2
60	46.6	37.8	20	93.3	75.5	80	139.9	113.3	40	186.5	151.0	300	233.1	188.8
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep	Lat.	Dist	Dep.	Lat

TABLE II. Difference of Latitude and Departure for 40 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	46.7	39.2	121	92.7	77.8	181	138.6	116.4	241	184.6	154.9
2	01.5	01.3	62	47.5	39.9	22	93.4	78.4	82	139.4	117.0	42	185.4	155.6
3	02.3	01.9	63	48.3	40.5	23	94.2	79.1	83	140.2	117.6	43	186.1	156.2
4	03.1	02.6	64	49.0	41.1	24	95.0	79.7	84	140.9	118.3	44	186.9	156.9
5	03.8	03.2	65	49.8	41.8	25	95.7	80.4	85	141.7	118.9	45	187.7	157.5
6	04.6	03.9	66	50.6	42.4	26	96.5	81.0	86	142.5	119.6	46	188.4	158.1
7	05.4	04.5	67	51.3	43.1	27	97.3	81.6	87	143.2	120.2	47	189.2	158.8
8	06.1	05.1	68	52.1	43.7	28	98.0	82.3	88	144 0	120.9	48	190.0	159.4
9	06.9	05.8	69	52.9	44.4	29	98.8	82.9	89	144.8	121.5	49	190.7	160.1
10	07.7	06.4	70	53.6	45.0	30	99.6	83.6	90	145.5	122.1	50	191.5	160.7
11	08.4	07.1	71	54.4	45.6	131	100.3	84.2	191	146.3	122.8	251	192.3	161.4
12	09.2	07.7	72	55.2	46.3	32	101.1	84.9	92	147.1	123.4	52	193.0	162.0
13	10.0	08.4	73	55.9	46.9	33	101.9	85.5	93	147.8	124.1	53	193.8	162.6
14	10.7	09.0	74	56.7	47.6	34	102.6	86.1	94	148.6	124.7	54	194.6	163.3
15	11.5	09.6	75	57.4	48.2	35	103.4	86.8	95	149.4	125.4	55	195.3	163.9
16	12.3	10.3	76	58.2	48.9	36	104.2	87.4	96	150.1	126.0	56	196.1	164.6
17	13.0	10.9	77	59.0	49.5	37	104.9	88.1	97	150.9	126.6	57	196.9	165.2
18	13.8	11.6	78	59.7	50.1	38	105.7	88.7	98	151.7	127.3	58	197.6	165.9
19	14.6	12.2	79	60.5	50.8	39	106.5	89.4	99	152.4	127.9	59	198.4	166.5
20	15.3	12.9	80	61.3	51.4	40	107.2	90.0	200	153.2	128.6	60	199.2	167.1
21	16.1	13.5	81	62.0	52.1	141	108.0	90.6	201	154.0	129.2	261	199.9	167.8
22	16.9	14.1	82	62.8	52.7	42	108.8	91.3	02	154.7	129.9	62	200.7	168.4
23	17.6	14.8	83	63.6	53.4	43	109.5	91.9	03	155.5	130.5	63	201.4	169.1
24	18.4	15.4	84	64.3	54.0	44	110.3	92.6	04	156.3	131.1	64	202.2	169.7
25	19.2	16.1	85	65.1	54.6	45	111.1	93.2	05	157.0	131.8	65	203.0	170.4
26	19.9	16.7	86	65.9	55.3	46	111.8	93.9	06	157.8	132.4	66	203.7	171.0
27	20.7	17.4	87	66.6	55.9	47	112.6	94.5	07	158.6	133.1	67	204.5	171.6
28	21.4	18.0	88	67.4	56.6	48	113.4	95.1	08	159.3	133.7	68	205.3	172.3
29	22.2	18.6	89	68.2	57.2	49	114.1	95.8	09	160.1	134.4	69	206.0	172.9
30	23.0	19.3	90	68.9	57.9	50	114.9	96.4	10	160.9	135.0	70	206.8	173.6
31	23.7	19.9	91	69.7	58.5	151	115.7	97.1	211	161.6	135.6	271	207.6	174.2
32	24.5	20.6	92	70.5	59.1	52	116.4	97.7	12	162.4	136.3	72	208.3	174.8
33	25.3	21.2	93	71.2	59.8	53	117.2	98.4	13	163.2	136.9	73	209.1	175.5
34	26.0	21.9	94	72.0	60.4	54	118.0	99.0	14	163.9	137.6	74	209.9	176.1
35	26.8	22.5	95	72.8	61.1	55	118.7	99.6	15	164.7	138.2	75	210.6	176.8
36	27.6	23.1	96	73.5	61.7	56	119.5	100.3	16	165.4	138.8	76	211.4	177.4
37	28.3	23.8	97	74.3	62.4	57	120.3	100.9	17	166.2	139.5	77	212.2	178.1
38	29.1	24.4	98	75 1	63.0	58	121.0	101.6	18	167.0	140.1	78	212.9	178.7
39	29.9	25.1	99	75.8	63.6	59	121.8	102.2	19	167.7	140.8	79	213.7	179.3
40	30.6	25.7	100	76.6	64.3	60	122.6	102.8	20	168.5	141.4	80	214.5	180.0
41	31.4	26.4	101	77.4	64.9	161	123.3	103.5	221	169.3	142.1	281	215.2	180.6
42	32.2	27.0	02	78.1	65.6	62	124.1	104.1	22	170.0	142.7	82	216.0	181.3
43	32.9	27.6	03	78.9	66.2	63	124.9	104.8	23	170.8	143.3	83	216.8	181.9
44	33.7	28.3	04	79.7	66.8	64	125.6	105.4	24	171.6	144.0	84	217.5	182.6
45	34.5	28.9	05	80.4	67.5	65	126.4	106.1	25	172.3	144.6	85	218.3	183.2
46	35.2	29.6	06	81.2	68.1	66	127.2	106.7	26	173.1	145.3	86	219.1	183.9
47	36.0	30.2	07	82.0	68.8	67	127.9	107.3	27	173.9	145.9	87	219.8	184.5
48	36.8	30.8	08	82.7	69.4	68	128.7	108.0	28	174.6	146.6	88	220.6	185.1
49	37.5	31.5	09	83.5	70.1	69	129.4	108.6	29	175.4	147.2	89	221.4	185.8
50	38.3	32.1	10	84.3	70.7	70	130.2	109.3	30	176.2	147.9	90	222.1	186.4
51	39.1	32.8	111	85.0	71.3	171	131.0	109.9	231	176.9	148.5	291	222.9	187.1
52	39.8	33.4	12	85.8	72.0	72	131.7	110.6	32	177.7	149.1	92	223.7	187.7
53	40.6	34.1	13	86.6	72.6	73	132.5	111.2	33	178.5	149.8	93	224.4	188.3
54	41.4	34.7	14	87.3	73.3	74	133.3	111.9	34	179.2	150.4	94	225.2	189.0
55	42.1	35.3	15	88.1	73.9	75	134.0	112.5	35	180.0	151.1	95	226.0	189.6
56	42.9	36.0	16	88.9	74.6	76	134.8	113.1	36	180.8	151.7	96	226.7	190.3
57	43.7	36.6	17	89.6	75.2	77	135.6	113.8	37	181.5	152.4	97	227.5	190.9
58	44.4	37.3	18	90.4	75.9	78	136.3	114.4	38	182.3	153.0	98	228.3	191.6
59	45.2	37.9	19	91.2	76.5	79	137.1	115.1	39	183.1	153.6	99	229.0	192.2
60	46.0	38.6	20	91.9	77.1	80	137.9	115.7	40	183.8	154.3	300	229.8	192.9
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.7	61	46.0	40.0	121	91.3	79.4	181	136.6	118.7	241	181.9	158.1
2	01.5	01.3	62	46.8	40.7	22	92.1	80.0	82	137.4	119.4	42	182.6	158.7
3	02.3	02.0	63	47.5	41.3	23	92.8	80.7	83	138.1	120.0	43	183.4	159.4
4	03.0	02.6	64	48.3	42.0	24	93.6	81.3	84	138.9	120.7	44	184.2	160.0
5	03.8	03.3	65	49.1	42.6	25	94.3	82.0	85	139.6	121.4	45	184.9	160.7
6	04.5	03.9	66	49.8	43.3	26	95.1	82.6	86	140.4	122.0	46	185.7	161.4
7	05.3	04.6	67	50.6	44.0	27	95.8	83.3	87	141.1	122.7	47	186.4	162.0
8	06.0	05.2	68	51.3	44.6	28	96.6	84.0	88	141.9	123.3	48	187.2	162.7
9	06.8	05.9	69	52.1	45.3	29	97.4	84.6	89	142.6	124.0	49	187.9	163.3
10	07.5	06.6	70	52.8	45.9	30	98.1	85.3	90	143.4	124.6	50	188.7	164.0
11	08.3	07.2	71	53.6	46.6	131	98.9	85.9	191	144.2	125.3	251	189.4	164.6
12	09.1	07.9	72	54.3	47.2	32	99.6	86.6	92	144.9	125.9	52	190.2	165.3
13	09.8	08.5	73	55.1	47.9	33	100.4	87.2	93	145.7	126.6	53	190.9	166.0
14	10.6	09.2	74	55.8	48.5	34	101.1	87.9	94	146.4	127.3	54	191.7	166.6
15	11.3	09.8	75	56.6	49.2	35	101.9	88.6	95	147.2	127.9	55	192.5	167.3
16	12.1	10.5	76	57.4	49.9	36	102.6	89.2	96	147.9	128.6	56	193.2	167.9
17	12.8	11.2	77	58.1	50.5	37	103.4	89.9	97	148.7	129.2	57	194.0	168.6
18	13.6	11.8	78	58.9	51.2	38	104.2	90.5	98	149.4	129.9	58	194.7	169.2
19	14.3	12.5	79	59.6	51.8	39	104.9	91.2	99	150.2	130.5	59	195.5	169.9
20	15.1	13.1	80	60.4	52.5	40	105.7	91.8	200	150.9	131.2	60	196.2	170.5
21	15.8	13.8	81	61.1	53.1	141	106.4	92.5	201	151.7	131.8	261	197.0	171.2
22	16.6	14.4	82	61.9	53.8	42	107.2	93.1	02	152.5	132.5	62	197.7	171.9
23	17.4	15.1	83	62.6	54.4	43	107.9	93.8	03	153.2	133.2	63	198.5	172.5
24	18.1	15.7	84	63.4	55.1	44	108.7	94.5	04	154.0	133.8	64	199.2	173.2
25	18.9	16.4	85	64.2	55.8	45	109.4	95.1	05	154.7	134.5	65	200.0	173.8
26	19.6	17.1	86	64.9	56.4	46	110.2	95.8	06	155.5	135.1	66	200.8	174.5
27	20.4	17.7	87	65.7	57.1	47	110.9	96.4	07	156.2	135.8	67	201.5	175.1
28	21.1	18.4	88	66.4	57.7	48	111.7	97.1	08	157.0	136.4	68	202.3	175.8
29	21.9	19.0	89	67.2	58.4	49	112.5	97.7	09	157.7	137.1	69	203.0	176.4
30	22.6	19.7	90	67.9	59.0	50	113.2	98.4	10	158.5	137.7	70	203.8	177.1
31	23.4	20.3	91	68.7	59.7	151	114.0	99.0	211	159.2	138.4	271	204.5	177.8
32	24.2	21.0	92	69.4	60.4	52	114.7	99.7	12	160.0	139.1	72	205.3	178.4
33	24.9	21.6	93	70.2	61.0	53	115.5	100.4	13	160.8	139.7	73	206.0	179.1
34	25.7	22.3	94	70.9	61.7	54	116.2	101.0	14	161.5	140.4	74	206.8	179.7
35	26.4	23.0	95	71.7	62.3	55	117.0	101.7	15	162.3	141.0	75	207.5	180.4
36	27.2	23.6	96	72.5	63.0	56	117.7	102.3	16	163.0	141.7	76	208.3	181.0
37	27.9	24.3	97	73.2	63.6	57	118.5	103.0	17	163 7	142.3	77	209.1	181.7
38	28.7	24.9	98	74.0	64.3	58	119.2	103.6	18	164.5	143.0	78	209.8	182.4
39	29.4	25.6	99	74.7	64.9	59	120.0	104.3	19	165.3	143.6	79	210.6	183.0
40	30.2	26.2	100	75.5	65.6	60	120.8	105.0	20	166.0	144.3	80	211.3	183.7
41	30.9	26.9	101	76.2	66.3	161	121.5	105.6	221	166.8	145.0	281	212.1	184.3
42	31.7	27.6	02	77.0	66.9	62	122.3	106.3	22	167.5	145.6	82	212.8	185.0
43	32.5	28.2	03	77.7	67.6	63	123.0	106.9	23	168.3	146.3	83	213.6	185.6
44	33.2	28.9	04	78.5	68.2	64	123.8	107.6	24	169.1	146.9	84	214.3	186.3
45	34.0	29.5	05	79.2	68.9	65	124.5	108.2	25	169.8	147.6	85	215.1	186.9
46	34.7	30.2	06	80.0	69.5	66	125.3	108.9	26	170.6	148.2	86	215.8	187.6
47	35.5	30.8	07	80.8	70.2	67	126.0	109.5	27	171.3	148.9	87	216.6	188.3
48	36.2	31.5	08	81.5	70.8	68	126.8	110.2	28	172.1	149.6	88	217.4	188.9
49	37.0	32.1	09	82.3	71.5	69	127.5	110.9	29	172.8	150.2	89	218.1	189.6
50	37.7	32.8	10	83.0	72.2	70	128.3	111.5	30	173.6	150.9	90	218.9	190.3
51	38.5	33.5	111	83.8	72.8	171	129.1	112.2	231	174.3	151.5	291	219.6	190.9
52	39.2	34.1	12	84.5	73.5	72	129.8	112.8	32	175.1	152.2	92	220.4	191.5
53	40.0	34.8	13	85.3	74.1	73	130.6	113.5	33	175.8	152.8	93	221.1	192.2
54	40.8	35.4	14	86.0	74.8	74	131.3	114.1	34	176.6	153.5	94	221.9	192.8
55	41.5	36.1	15	86.8	75.4	75	132.1	114.8	35	177.4	154.1	95	222.6	193.5
56	42.3	36.7	16	87.5	76.1	76	132.8	115.4	36	178.1	154.8	96	223.4	194.2
57	43.0	37.4	17	88.3	76.7	77	133.6	116.1	37	178.9	155.5	97	224.2	194.8
58	43.8	38.0	18	89.1	77.4	78	134.3	116.8	38	179.6	156.1	98	224.9	195.5
59	44.5	38.7	19	89.8	78.1	79	135.1	117.4	39	180.4	156.8	99	225.7	196.1
60	45.3	39.4	20	90.6	78.7	80	135.8	118.1	40	181.1	157.4	300	226.4	196.8
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0.7	0.7	61	45.3	40.8	121	89.9	80.9	181	134.5	121.1	241	179.0	161.2
2	1.5	1.3	62	46.1	41.5	22	90.6	81.6	82	135.2	121.8	42	179.8	161.9
3	2.2	2.0	63	46.8	42.1	23	91.4	82.3	83	135.9	122.4	43	180.5	162.6
4	3.0	2.7	64	47.5	42.8	24	92.1	83.0	84	136.7	123.1	44	181.3	163.2
5	3.7	3.3	65	48.3	43.5	25	92.9	83.6	85	137.4	123.8	45	182.0	163.9
6	4.5	4.0	66	49.0	44.2	26	93.6	84.3	86	138.2	124.4	46	182.7	164.6
7	5.2	4.7	67	49.8	44.8	27	94.3	85.0	87	138.9	125.1	47	183.5	165.2
8	5.9	5.4	68	50.5	45.5	28	95.1	85.6	88	139.7	125.8	48	184.2	165.9
9	6.7	6.0	69	51.3	46.2	29	95.8	86.3	89	140.4	126.4	49	185.0	166.6
10	7.4	6.7	70	52.0	46.8	30	96.6	87.0	90	141.1	127.1	50	185.7	167.2
11	8.2	7.4	71	52.7	47.5	131	97.3	87.6	191	141.9	127.8	251	186.5	167.9
12	8.9	8.0	72	53.5	48.2	32	98.1	88.3	92	142.6	128.4	52	187.2	168.6
13	9.7	8.7	73	54.2	48.8	33	98.8	89.0	93	143.4	129.1	53	187.9	169.3
14	10.4	9.4	74	55.0	49.5	34	99.5	89.6	94	144.2	129.8	54	188.7	169.9
15	11.1	10.0	75	55.7	50.2	35	100.3	90.3	95	144.9	130.5	55	189.4	170.6
16	11.9	10.7	76	56.5	50.8	36	101.0	91.0	96	145.6	131.1	56	190.2	171.3
17	12.6	11.4	77	57.2	51.5	37	101.8	91.7	97	146.3	131.8	57	190.9	171.9
18	13.4	12.0	78	57.9	52.2	38	102.5	92.3	98	147.1	132.5	58	191.7	172.6
19	14.1	12.7	79	58.7	52.9	39	103.3	93.0	99	147.8	133.1	59	192.4	173.3
20	14.9	13.4	80	59.4	53.5	40	104.0	93.7	200	148.6	133.8	60	193.1	173.9
21	15.6	14.1	81	60.2	54.2	141	104.7	94.3	201	149.3	134.5	261	193.9	174.6
22	16.3	14.7	82	60.9	54.9	42	105.5	95.0	02	150.1	135.1	62	194.6	175.3
23	17.1	15.4	83	61.7	55.5	43	106.2	95.7	03	150.8	135.8	63	195.4	175.9
24	17.8	16.1	84	62.4	56.2	44	107.0	96.3	04	151.5	136.5	64	196.1	176.6
25	18.6	16.7	85	63.1	56.9	45	107.7	97.0	05	152.3	137.1	65	196.9	177.3
26	19.3	17.4	86	63.9	57.5	46	108.5	97.7	06	153.0	137.8	66	197.6	177.9
27	20.1	18.1	87	64.7	58.2	47	109.2	98.3	07	153.8	138.5	67	198.3	178.6
28	20.8	18.7	88	65.4	58.9	48	109.9	99.0	08	154.5	139.1	68	199.1	179.3
29	21.5	19.4	89	66.1	59.5	49	110.7	99.7	09	155.3	139.8	69	199.8	180.0
30	22.3	20.1	90	66.9	60.2	50	111.4	100.4	10	156.0	140.5	70	200.6	180.6
31	23.0	20.7	91	67.6	60.9	151	112.2	101.0	211	156.7	141.2	271	201.3	181.3
32	23.8	21.4	92	68.3	61.5	52	112.9	101.7	12	157.5	141.8	72	202.1	182.0
33	24.5	22.1	93	69.1	62.2	53	113.7	102.4	13	158.2	142.5	73	202.8	182.6
34	25.3	22.7	94	69.8	62.9	54	114.4	103.0	14	159.0	143.2	74	203.5	183.3
35	26.0	23.4	95	70.6	63.6	55	115.1	103.7	15	159.7	143.8	75	204.3	184.0
36	26.7	24.1	96	71.3	64.2	56	115.9	104.4	16	160.5	144.5	76	205.0	184.6
37	27.5	24.8	97	72.1	64.9	57	116.6	105.0	17	161.2	145.2	77	205.8	185.3
38	28.2	25.4	98	72.8	65.6	58	117.4	105.7	18	161.9	145.8	78	206.5	186.0
39	29.0	26.1	99	73.5	66.2	59	118.1	106.4	19	162.7	146.5	79	207.3	186.6
40	29.7	26.8	100	74.3	66.9	60	118.9	107.1	20	163.4	147.2	80	208.0	187.3
41	30.5	27.4	101	75.0	67.6	161	119.6	107.7	221	164.2	147.8	281	208.7	188.0
42	31.2	28.1	02	75.8	68.2	62	120.3	108.4	22	164.9	148.5	82	209.5	188.7
43	32.0	28.8	03	76.5	68.9	63	121.1	109.0	23	165.7	149.2	83	210.2	189.3
44	32.7	29.4	04	77.3	69.6	64	121.8	109.7	24	166.4	149.9	84	211.0	190.0
45	33.4	30.1	05	78.0	70.2	65	122.6	110.4	25	167.2	150.5	85	211.7	190.7
46	34.2	30.8	06	78.8	70.9	66	123.3	111.0	26	167.9	151.2	86	212.5	191.3
47	34.9	31.4	07	79.5	71.6	67	124.1	111.7	27	168.6	151.9	87	213.2	192.0
48	35.7	32.1	08	80.3	72.3	68	124.8	112.4	28	169.4	152.5	88	213.9	192.7
49	36.4	32.8	09	81.0	72.9	69	125.5	113.1	29	170.1	153.2	89	214.7	193.3
50	37.1	33.5	10	81.7	73.6	70	126.3	113.7	30	170.9	153.9	90	215.4	194.0
51	37.9	34.1	111	82.5	74.3	171	127.0	114.4	231	171.6	154.5	291	216.2	194.7
52	38.6	34.8	12	83.2	74.9	72	127.8	115.1	32	172.3	155.2	92	216.9	195.3
53	39.4	35.5	13	83.9	75.6	73	128.5	115.7	33	173.1	155.9	93	217.7	196.0
54	40.1	36.1	14	84.7	76.3	74	129.3	116.4	34	173.8	156.5	94	218.4	196.7
55	40.9	36.8	15	85.5	76.9	75	130.0	117.1	35	174.6	157.2	95	219.1	197.4
56	41.6	37.5	16	86.2	77.6	76	130.7	117.7	36	175.3	157.9	96	219.9	198.0
57	42.4	38.1	17	86.9	78.3	77	131.5	118.4	37	176.1	158.5	97	220.6	198.7
58	43.1	38.8	18	87.7	78.9	78	132.2	119.1	38	176.8	159.2	98	221.4	199.4
59	43.8	39.5	19	88.4	79.6	79	133.0	119.7	39	177.5	159.9	99	222.1	200.1
60	44.6	40.1	20	89.2	80.2	80	133.7	120.4	40	178.3	160.6	300	222.9	200.8
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.7	00.7	61	44.6	41.6	121	88.5	82.5	181	132.4	123.4	241	176.3	164.3
2	01.5	01.4	62	45.3	42.3	22	89.2	83.2	82	133.1	124.1	42	177.0	165.0
3	02.2	02.0	63	46.1	43.0	23	90.0	83.9	83	133.8	124.8	43	177.7	165.7
4	02.9	02.7	64	46.8	43.6	24	90.7	84.6	84	134.6	125.5	44	178.4	166.4
5	03.7	03.4	65	47.5	44.3	25	91.4	85.2	85	135.3	126.2	45	179.2	167.1
6	04.4	04.1	66	48.3	45.0	26	92.1	85.9	86	136.0	126.8	46	179.9	167.7
7	05.1	04.8	67	49.0	45.7	27	92.9	86.6	87	136.8	127.5	47	180.6	168.4
8	05.9	05.5	68	49.7	46.4	28	93.6	87.3	88	137.5	128.2	48	181.4	169.1
9	06.6	06.2	69	50.5	47.1	29	94.3	88.0	89	138.2	128.9	49	182.1	169.8
10	07.3	06.8	70	51.2	47.7	30	95.1	88.6	90	139.0	129.5	50	182.8	170.5
11	08.0	07.5	71	51.9	48.4	131	95.8	89.3	191	139.7	130.2	251	183.6	171.2
12	08.8	08.2	72	52.7	49.1	32	96.5	90.0	92	140.4	130.9	52	184.3	171.8
13	09.5	08.9	73	53.4	49.8	33	97.3	90.7	93	141.1	131.6	53	185.0	172.5
14	10.2	09.5	74	54.1	50.5	34	98.0	91.4	94	141.9	132.3	54	185.8	173.2
15	11.0	10.2	75	54.9	51.2	35	98.7	92.1	95	142.6	133.0	55	186.5	173.9
16	11.7	10.9	76	55.6	51.8	36	99.5	92.7	96	143.3	133.6	56	187.2	174.5
17	12.4	11.6	77	56.3	52.5	37	100.2	93.4	97	144.1	134.3	57	187.9	175.2
18	13.2	12.3	78	57.0	53.2	38	100.9	94.1	98	144.8	135.0	58	188.7	175.9
19	13.9	13.0	79	57.8	53.9	39	101.7	94.8	99	145.5	135.7	59	189.4	176.6
20	14.6	13.6	80	58.5	54.5	40	102.4	95.5	200	146.3	136.4	60	190.1	177.3
21	15.4	14.3	81	59.2	55.2	141	103.1	96.2	201	147.0	137.1	261	190.9	178.0
22	16.1	15.0	82	60.0	55.9	42	103.9	96.8	02	147.7	137.7	62	191.6	178.6
23	16.8	15.7	83	60.7	56.6	43	104.6	97.5	03	148.5	138.4	63	192.3	179.3
24	17.6	16.4	84	61.4	57.3	44	105.3	98.2	04	149.2	139.1	64	193.1	180.0
25	18.3	17.1	85	62.2	58.0	45	106.0	98.9	05	149.9	139.8	65	193.8	180.7
26	19.0	17.7	86	62.9	58.6	46	106.8	99.5	06	150.7	140.5	66	194.5	181.4
27	19.7	18.4	87	63.6	59.3	47	107.5	100.2	07	151.4	141.2	67	195.3	182.1
28	20.5	19.1	88	64.4	60.0	48	108.2	100.9	08	152.1	141.8	68	196.0	182.7
29	21.2	19.8	89	65.1	60.7	49	109.0	101.6	09	152.9	142.5	69	196.7	183.4
30	21.9	20.5	90	65.8	61.4	50	109.7	102.3	10	153.6	143.2	70	197.5	184.1
31	22.7	21.2	91	66.5	62.1	151	110.4	103.0	211	154.3	143.9	271	198.2	184.8
32	23.4	21.8	92	67.3	62.7	52	111.2	103.6	12	155.0	144.5	72	198.9	185.5
33	24.1	22.5	93	68.0	63.4	53	111.9	104.3	13	155.8	145.2	73	199.7	186.2
34	24.9	23.2	94	68.7	64.1	54	112.6	105.0	14	156.5	145.9	74	200.4	186.8
35	25.6	23.9	95	69.5	64.8	55	113.4	105.7	15	157.2	146.6	75	201.1	187.2
36	26.3	24.5	96	70.2	65.5	56	114.1	106.4	16	158.0	147.3	76	201.9	188.5
37	27.1	25.2	97	70.9	66.2	57	114.8	107.1	17	158.7	148.0	77	202.6	188.9
38	27.8	25.9	98	71.7	66.8	58	115.6	107.7	18	159.4	148.6	78	203.3	189.5
39	28.5	26.6	99	72.4	67.5	59	116.3	108.4	19	160.2	149.5	79	204.0	190.2
40	29.3	27.3	100	73.1	68.2	60	117.0	109.1	20	160.9	150.0	80	204.8	190.9
41	30.0	28.0	101	73.9	68.9	161	117.7	109.8	221	161.6	150.7	281	205.5	191.6
42	30.7	28.6	02	74.6	69.5	62	118.5	110.5	22	162.4	151.4	82	206.2	192.3
43	31.4	29.3	03	75.3	70.2	63	119.2	111.2	23	163.1	152.1	83	207.0	193.0
44	32.2	30.0	04	76.1	70.9	64	119.9	111.8	24	163.8	152.7	84	207.7	193.6
45	32.9	30.7	05	76.8	71.6	65	120.7	112.5	25	164.6	153.4	85	208.4	194.3
46	33.6	31.4	06	77.5	72.3	66	121.4	113.2	26	165.3	154.1	86	209.2	195.0
47	34.4	32.1	07	78.3	73.0	67	122.1	113.9	27	166.0	154.8	87	209.9	195.7
48	35.1	32.7	08	79.0	73.6	68	122.9	114.5	28	166.7	155.5	88	210.6	196.4
49	35.8	33.4	09	79.7	74.3	69	123.6	115.2	29	167.5	156.2	89	211.4	197.1
50	36.6	34.1	10	80.4	75.0	70	124.3	115.9	30	168.2	156.8	90	212.1	197.7
51	37.3	34.8	111	81.2	75.7	171	125.1	116.6	231	168.9	157.5	291	212.8	198.4
52	38.0	35.5	12	81.9	76.4	72	125.8	117.3	32	169.7	158.2	92	213.6	199.1
53	38.8	36.2	13	82.6	77.1	73	126.5	118.0	33	170.4	158.9	93	214.3	199.8
54	39.5	36.8	14	83.4	77.7	74	127.3	118.6	34	171.1	159.5	94	215.0	200.5
55	40.2	37.5	15	84.1	78.4	75	128.0	119.3	35	171.9	160.2	95	215.7	201.2
56	41.0	38.2	16	84.8	79.1	76	128.7	120.0	36	172.6	160.9	96	216.5	201.8
57	41.7	38.9	17	85.6	79.8	77	129.4	120.7	37	173.3	161.6	97	217.2	202.5
58	42.4	39.5	18	86.3	80.5	78	130.2	121.4	38	174.1	162.3	98	218.0	203.2
59	43.1	40.2	19	87.0	81.2	79	130.9	122.1	39	174.8	163.0	99	218.7	203.9
60	43.9	40.9	20	87.8	81.8	80	131.6	122.8	40	175.5	163.6	300	219.4	204.6
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.7	00.7	61	43.9	42.4	121	87.0	84.0	181	130.2	125.7	241	173.4	167.4
2	01.4	01.4	62	44.6	43.1	22	87.8	84.7	82	130.9	126.4	42	174.1	168.1
3	02.2	02.1	63	45.3	43.8	23	88.5	85.4	83	131.6	127.1	43	174.8	168.8
4	02.9	02.8	64	46.0	44.5	24	89.2	86.1	84	132.4	127.8	44	175.5	169.5
5	03.6	03.5	65	46.8	45.1	25	89.9	86.8	85	133.1	128.5	45	176.2	170.2
6	04.3	04.2	66	47.5	45.8	26	90.6	87.5	86	133.8	129.2	46	176.9	170.9
7	05.0	04.9	67	48.2	46.5	27	91.4	88.2	87	134.5	129.9	47	177.7	171.6
8	05.8	05.6	68	48.9	47.2	28	92.1	88.9	88	135.2	130.6	48	178.4	172.3
9	06.5	06.3	69	49.6	47.9	29	92.8	89.6	89	135.9	131.3	49	179.1	173.0
10	07.2	06.9	70	50.4	48.6	30	93.5	90.3	90	136.7	132.0	50	179.8	173.6
11	07.9	07.6	71	51.1	49.3	131	94.2	91.0	191	137.4	132.7	251	180.5	174.3
12	08.6	08.3	72	51.8	50.0	32	94.9	91.7	92	138.1	133.4	52	181.3	175.0
13	09.4	09.0	73	52.5	50.7	33	95.7	92.4	93	138.8	134.1	53	182.0	175.7
14	10.1	09.7	74	53.2	51.4	34	96.4	93.1	94	139.5	134.8	54	182.7	176.4
15	10.8	10.4	75	53.9	52.1	35	97.1	93.8	95	140.3	135.4	55	183.4	177.1
16	11.5	11.1	76	54.7	52.8	36	97.8	94.5	96	141.0	136.1	56	184.1	177.8
17	12.2	11.8	77	55.4	53.5	37	98.5	95.2	97	141.7	136.8	57	184.9	178.5
18	12.9	12.5	78	56.1	54.2	38	99.3	95.9	98	142.4	137.5	58	185.6	179.2
19	13.7	13.2	79	56.8	54.9	39	100.0	96.5	99	143.1	138.2	59	186.3	179.9
20	14.4	13.9	80	57.5	55.6	40	100.7	97.2	200	143.0	138.9	60	187.0	180.6
21	15.1	14.6	81	58.3	56.3	141	101.4	97.9	201	144.6	139.6	261	187.7	181.3
22	15.8	15.3	82	59.0	57.0	42	102.1	98.6	02	145.3	140.3	62	188.4	182.0
23	16.5	16.0	83	59.7	57.7	43	102.9	99.3	03	146.0	141.0	63	189.2	182.7
24	17.3	16.7	84	60.4	58.3	44	103.6	100.0	04	146.7	141.7	64	189.9	183.4
25	18.0	17.4	85	61.1	59.0	45	104.3	100.7	05	147.5	142.4	65	190.6	184.1
26	18.7	18.1	86	61.9	59.7	46	105.0	101.4	06	148.2	143.1	66	191.3	184.8
27	19.4	18.8	87	62.6	60.4	47	105.7	102.1	07	148.9	143.8	67	192.1	185.5
28	20.1	19.4	88	63.3	61.1	48	106.5	102.8	08	149.6	144.5	68	192.8	186.1
29	20.9	20.1	89	64.0	61.8	49	107.2	103.5	09	150.3	145.2	69	193.5	186.8
30	21.6	20.8	90	64.7	62.5	50	107.9	104.2	10	151.1	145.9	70	194.2	187.5
31	22.3	21.5	91	65.5	63.2	151	108.6	104.9	211	151.8	146.6	271	194.9	188.1
32	23.0	22.2	92	66.2	63.9	52	109.3	105.6	12	152.5	147.3	72	195.6	188.9
33	23.7	22.9	93	66.9	64.6	53	110.1	106.3	13	153.2	147.9	73	196.4	189.6
34	24.5	23.6	94	67.6	65.3	54	110.8	107.0	14	153.9	148.6	74	197.1	190.3
35	25.2	24.3	95	68.3	66.0	55	111.5	107.7	15	154.6	149.3	75	197.8	191.0
36	25.9	25.0	96	69.1	66.7	56	112.2	108.4	16	155.4	150.0	76	198.5	191.7
37	26.6	25.7	97	69.8	67.4	57	112.9	109.1	17	156.1	150.7	77	199.2	192.4
38	27.3	26.4	98	70.5	68.1	58	113.7	109.7	18	156.8	151.4	78	200.0	193.1
39	28.1	27.1	99	71.2	68.8	59	114.4	110.4	19	157.5	152.1	79	200.7	193.8
40	28.8	27.8	100	71.9	69.5	60	115.1	111.1	20	158.2	152.8	80	201.4	194.5
41	29.5	28.5	101	72.6	70.2	161	115.8	111.8	221	159.0	153.5	281	202.1	195.2
42	30.2	29.2	02	73.4	70.8	62	116.5	112.5	22	159.7	154.2	82	202.8	195.9
43	30.9	29.9	03	74.1	71.5	63	117.2	113.2	23	160.4	154.9	83	203.6	196.6
44	31.6	30.6	04	74.8	72.2	64	118.0	113.9	24	161.1	155.6	84	204.3	197.3
45	32.4	31.3	05	75.5	72.9	65	118.7	114.6	25	161.8	156.3	85	205.0	198.0
46	33.1	32.0	06	76.2	73.6	66	119.4	115.3	26	162.6	157.0	86	205.7	198.7
47	33.8	32.6	07	77.0	74.3	67	120.1	116.0	27	163.3	157.7	87	206.4	199.3
48	34.5	33.3	08	77.7	75.0	68	120.8	116.7	28	164.0	158.4	88	207.2	200.0
49	35.2	34.0	09	78.4	75.7	69	121.6	117.4	29	164.7	159.1	89	207.9	200.7
50	36.0	34.7	10	79.1	76.4	70	122.3	118.1	30	165.4	159.8	90	208.6	201.4
51	36.7	35.4	111	79.8	77.1	171	123.0	118.8	231	166.2	160.4	291	209.3	202.1
52	37.4	36.1	12	80.6	77.8	72	123.7	119.5	32	166.9	161.1	92	210.0	202.8
53	38.1	36.8	13	81.3	78.5	73	124.4	120.2	33	167.6	161.8	93	210.8	203.5
54	38.8	37.5	14	82.0	79.2	74	125.2	120.9	34	168.3	162.5	94	211.5	204.2
55	39.6	38.2	15	82.7	79.9	75	125.9	121.6	35	169.0	163.2	95	212.2	204.9
56	40.3	38.9	16	83.4	80.6	76	126.6	122.2	36	169.8	163.9	96	212.9	205.6
57	41.0	39.6	17	84.2	81.3	77	127.3	122.9	37	170.5	164.6	97	213.6	206.3
58	41.7	40.3	18	84.0	82.0	78	128.0	123.6	38	171.2	165.3	98	214.4	207.0
59	42.4	41.0	19	85.6	82.7	79	128.8	124.3	39	171.9	166.0	99	215.1	207.7
60	43.2	41.7	20	86.3	83.4	80	129.5	125.0	40	172.6	166.7	300	215.8	208.4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

TABLE II. Difference of Latitude and Departure for 45 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.7	00.7	61	43.1	43.1	121	85.6	85.6	181	128.0	128.0	241	170.4	170.4
2	01.4	01.4	62	43.8	43.8	22	86.3	86.3	82	128.7	128.7	42	171.1	171.1
3	02.1	02.1	63	44.5	44.5	23	87.0	87.0	83	129.4	129.4	43	171.8	171.8
4	02.8	02.8	64	45.3	45.3	24	87.7	87.7	84	130.1	130.1	44	172.5	172.5
5	03.5	03.5	65	46.0	46.0	25	88.4	88.4	85	130.8	130.8	45	173.2	173.2
6	04.2	04.2	66	46.7	46.7	26	89.1	89.1	86	131.5	131.5	46	173.9	173.9
7	04.9	04.9	67	47.4	47.4	27	89.8	89.8	87	132.2	132.2	47	174.6	174.6
8	05.7	05.7	68	48.1	48.1	28	90.5	90.5	88	132.9	132.9	48	175.4	175.4
9	06.4	06.4	69	48.8	48.8	29	91.2	91.2	89	133.6	133.6	49	176.1	176.1
10	07.1	07.1	70	49.5	49.5	30	91.9	91.9	90	134.3	134.3	50	176.8	176.8
11	07.8	07.8	71	50.2	50.2	131	92.7	92.7	191	135.1	135.1	251	177.5	177.5
12	08.5	08.5	72	50.9	50.9	32	93.3	93.3	92	135.8	135.8	52	178.2	178.2
13	09.2	09.2	73	51.6	51.6	33	94.0	94.0	93	136.5	136.5	53	178.9	178.9
14	09.9	09.9	74	52.3	52.3	34	94.7	94.7	94	137.2	137.2	54	179.6	179.6
15	10.6	10.6	75	53.0	53.0	35	95.5	95.5	95	137.9	137.9	55	180.3	180.3
16	11.3	11.3	76	53.7	53.7	36	96.2	96.2	96	138.6	138.6	56	181.0	181.0
17	12.0	12.0	77	54.4	54.4	37	96.9	96.9	97	139.3	139.3	57	181.7	181.7
18	12.7	12.7	78	55.2	55.2	38	97.6	97.6	98	140.0	140.0	58	182.4	182.4
19	13.4	13.4	79	55.9	55.9	39	98.3	98.3	99	140.7	140.7	59	183.1	183.1
20	14.1	14.1	80	56.6	56.6	40	99.0	99.0	200	141.4	141.4	60	183.8	183.8
21	14.8	14.8	81	57.3	57.3	141	99.7	99.7	201	142.1	142.1	261	184.5	184.5
22	15.6	15.6	82	58.0	58.0	42	100.4	100.4	02	142.8	142.8	62	185.3	185.3
23	16.3	16.3	83	58.7	58.7	43	101.1	101.1	03	143.5	143.5	63	186.0	186.0
24	17.0	17.0	84	59.4	59.4	44	101.8	101.8	04	144.2	144.2	64	186.7	186.7
25	17.7	17.7	85	60.1	60.1	45	102.5	102.5	05	144.9	144.9	65	187.4	187.4
26	18.4	18.4	86	60.8	60.8	46	103.2	103.2	06	145.7	145.7	66	188.1	188.1
27	19.1	19.1	87	61.5	61.5	47	103.9	103.9	07	146.4	146.4	67	188.8	188.8
28	19.8	19.8	88	62.2	62.2	48	104.6	104.6	08	147.1	147.1	68	189.5	189.5
29	20.5	20.5	89	62.9	62.9	49	105.4	105.4	09	147.8	147.8	69	190.2	190.2
30	21.2	21.2	90	63.6	63.6	50	106.1	106.1	10	148.5	148.5	70	190.9	190.9
31	21.9	21.9	91	64.3	64.3	151	106.8	106.8	211	149.2	149.2	271	191.6	191.6
32	22.6	22.6	92	65.1	65.1	52	107.5	107.5	12	149.9	149.9	72	192.3	192.3
33	23.3	23.3	93	65.8	65.8	53	108.2	108.2	13	150.6	150.6	73	193.0	193.0
34	24.0	24.0	94	66.5	66.5	54	108.9	108.9	14	151.3	151.3	74	193.7	193.7
35	24.7	24.7	95	67.2	67.2	55	109.6	109.6	15	152.0	152.0	75	194.4	194.4
36	25.5	25.5	96	67.9	67.9	56	110.3	110.3	16	152.7	152.7	76	195.2	195.2
37	26.2	26.2	97	68.6	68.6	57	111.0	111.0	17	153.4	153.4	77	195.9	195.9
38	26.9	26.9	98	69.3	69.3	58	111.7	111.7	18	154.1	154.1	78	196.6	196.6
39	27.6	27.6	99	70.0	70.0	59	112.4	112.4	19	154.8	154.8	79	197.3	197.3
40	28.3	28.3	100	70.7	70.7	60	113.1	113.1	20	155.6	155.6	80	198.0	198.0
41	29.0	29.0	101	71.4	71.4	161	113.8	113.8	221	156.3	156.3	281	198.7	198.7
42	29.7	29.7	02	72.1	72.1	62	114.5	114.5	22	157.0	157.0	82	199.4	199.4
43	30.4	30.4	03	72.8	72.8	63	115.3	115.3	23	157.7	157.7	83	200.1	200.1
44	31.1	31.1	04	73.5	73.5	64	116.0	116.0	24	158.4	158.4	84	200.8	200.8
45	31.8	31.8	05	74.2	74.2	65	116.7	116.7	25	159.1	159.1	85	201.5	201.5
46	32.5	32.5	06	74.9	74.9	66	117.4	117.4	26	159.8	159.8	86	202.2	202.2
47	33.2	33.2	07	75.7	75.7	67	118.1	118.1	27	160.5	160.5	87	202.9	202.9
48	33.9	33.9	08	76.4	76.4	68	118.8	118.8	28	161.2	161.2	88	203.6	203.6
49	34.6	34.6	09	77.1	77.1	69	119.5	119.5	29	161.9	161.9	89	204.3	204.3
50	35.4	35.4	10	77.8	77.8	70	120.2	120.2	30	162.6	162.6	90	205.1	205.1
51	36.1	36.1	111	78.5	78.5	171	120.9	120.9	231	163.3	163.3	291	205.8	205.8
52	36.8	36.8	12	79.2	79.2	72	121.6	121.6	32	164.0	164.0	92	206.5	206.5
53	37.5	37.5	13	79.9	79.9	73	122.3	122.3	33	164.7	164.7	93	207.2	207.2
54	38.2	38.2	14	80.6	80.6	74	123.0	123.0	34	165.5	165.5	94	207.9	207.9
55	38.9	38.9	15	81.3	81.3	75	123.7	123.7	35	166.2	166.2	95	208.6	208.6
56	39.6	39.6	16	82.0	82.0	76	124.4	124.4	36	166.9	166.9	96	209.3	209.3
57	40.3	40.3	17	82.7	82.7	77	125.2	125.2	37	167.6	167.6	97	210.0	210.0
58	41.0	41.0	18	83.4	83.4	78	125.9	125.9	38	168.3	168.3	98	210.7	210.7
59	41.7	41.7	19	84.1	84.1	79	126.6	126.6	39	169.0	169.0	99	211.4	211.4
60	42.4	42.4	20	84.8	84.8	80	127.3	127.3	40	169.7	169.7	300	212.1	212.1
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

M.	0d.	1d.	2d.	3d.	4d.	5d.	6d.	7d.	8d.	9d.	10d.	11d.	12d.	13d.	M.
0	0	60	120	180	240	300	361	421	482	542	603	664	725	787	0
1	1	61	121	181	241	301	362	422	483	543	604	665	726	788	1
2	2	62	122	182	242	302	363	423	484	544	605	666	727	789	2
3	3	63	123	183	243	303	364	424	485	545	606	667	728	790	3
4	4	64	124	184	244	304	365	425	486	546	607	668	729	791	4
5	5	65	125	185	245	305	366	426	487	547	608	669	730	792	5
6	6	66	126	186	246	306	367	427	488	548	609	670	731	793	6
7	7	67	127	187	247	307	368	428	489	549	610	671	732	794	7
8	8	68	128	188	248	308	369	429	490	550	611	672	733	795	8
9	9	69	129	189	249	309	370	430	491	551	612	673	735	796	9
10	10	70	130	190	250	310	371	431	492	552	613	674	736	797	10
11	11	71	131	191	251	311	372	432	493	553	614	675	737	798	11
12	12	72	132	192	252	312	373	433	494	554	615	676	738	799	12
13	13	73	133	193	253	313	374	434	495	555	616	677	739	800	13
14	14	74	134	194	254	314	375	435	496	556	617	678	740	801	14
15	15	75	135	195	255	315	376	436	497	557	618	679	741	802	15
16	16	76	136	196	256	316	377	437	498	558	619	680	742	803	16
17	17	77	137	197	257	317	378	438	499	559	620	681	743	804	17
18	18	78	138	198	258	318	379	439	500	560	621	682	744	805	18
19	19	79	139	199	259	319	380	440	501	561	622	683	745	806	19
20	20	80	140	200	260	320	381	441	502	562	623	684	746	807	20
21	21	81	141	201	261	321	382	442	503	563	624	685	747	808	21
22	22	82	142	202	262	322	383	443	504	564	625	686	748	809	22
23	23	83	143	203	263	323	384	444	505	565	626	688	749	810	23
24	24	84	144	204	264	324	385	445	506	566	627	689	750	811	24
25	25	85	145	205	265	325	386	446	507	567	628	690	751	812	25
26	26	86	146	206	266	326	387	447	508	568	629	691	752	813	26
27	27	87	147	207	267	327	388	448	509	569	630	692	753	814	27
28	28	88	148	208	268	328	389	449	510	570	632	693	754	816	28
29	29	89	149	209	269	329	390	450	511	571	633	694	755	817	29
30	30	90	150	210	270	330	391	451	512	573	634	695	756	818	30
31	31	91	151	211	271	332	392	452	513	574	635	696	757	819	31
32	32	92	152	212	272	333	393	453	514	575	636	697	758	820	32
33	33	93	153	213	273	334	394	454	515	576	637	698	759	821	33
34	34	94	154	214	274	335	395	455	516	577	638	699	760	822	34
35	35	95	155	215	275	336	396	456	517	578	639	700	761	823	35
36	36	96	156	216	276	337	397	457	518	579	640	701	762	824	36
37	37	97	157	217	277	338	398	458	519	580	641	702	763	825	37
38	38	98	158	218	278	339	399	459	520	581	642	703	764	826	38
39	39	99	159	219	279	340	400	460	521	582	643	704	765	827	39
40	40	100	160	220	280	341	401	461	522	583	644	705	766	828	40
41	41	101	161	221	281	342	402	462	523	584	645	706	767	829	41
42	42	102	162	222	282	343	403	463	524	585	646	707	768	830	42
43	43	103	163	223	283	344	404	464	525	586	647	708	769	831	43
44	44	104	164	224	284	345	405	465	526	587	648	709	770	832	44
45	45	105	165	225	285	346	406	466	527	588	649	710	771	833	45
46	46	106	166	226	286	347	407	467	528	589	650	711	772	834	46
47	47	107	167	227	287	348	408	468	529	590	651	712	773	835	47
48	48	108	168	228	288	349	409	469	530	591	652	713	774	836	48
49	49	109	169	229	289	350	410	470	531	592	653	714	775	837	49
50	50	110	170	230	290	351	411	471	532	593	654	715	776	838	50
51	51	111	171	231	291	352	412	472	533	594	655	716	777	839	51
52	52	112	172	232	292	353	413	473	534	595	656	717	779	840	52
53	53	113	173	233	293	354	414	474	535	596	657	718	780	841	53
54	54	114	174	234	294	355	415	475	536	597	658	719	781	842	54
55	55	115	175	235	295	356	416	477	537	598	659	720	782	843	55
56	56	116	176	236	296	357	417	478	538	599	660	721	783	844	56
57	57	117	177	237	297	358	418	479	539	600	661	722	784	845	57
58	58	118	178	238	298	359	419	480	540	601	662	723	785	846	58
59	59	119	179	239	299	360	420	481	541	602	663	724	786	847	59

Table III. A Table of Meridional Parts.

M.	14d.	15d.	16d.	17d.	18d.	19d.	20d.	21d.	22d.	23d.	24d.	25d.	26d.	27d.	M.
0	848	910	973	1035	1098	1161	1225	1289	1354	1419	1484	1550	1616	1084	0
1	849	911	974	36	99	63	26	90	55	20	85	51	18	85	1
2	851	913	975	37	1100	64	27	91	56	21	86	52	19	86	2
3	852	914	976	38	01	65	28	92	57	22	87	53	20	87	3
4	853	915	977	39	02	66	29	93	58	23	88	54	21	88	4
5	854	916	978	41	03	67	30	94	59	24	90	56	22	89	5
6	855	917	979	42	05	68	32	96	60	25	91	57	23	90	6
7	856	918	980	43	06	69	33	97	61	26	92	58	24	91	7
8	857	919	981	44	07	70	34	98	62	27	93	59	25	93	8
9	858	920	982	45	08	71	35	99	63	28	94	60	26	94	9
10	859	921	983	1046	1199	1172	1236	1300	1364	1429	1495	1561	1628	1695	10
11	860	922	984	47	10	73	37	01	66	31	96	62	29	96	11
12	861	923	985	48	11	74	38	02	67	32	97	63	30	97	12
13	862	924	986	49	12	75	39	03	68	33	98	64	31	98	13
14	863	925	987	50	13	76	40	04	69	34	99	65	32	99	14
15	864	926	988	51	14	77	41	05	70	35	1500	67	33	1700	15
16	865	927	989	52	15	78	42	06	71	36	02	68	34	01	16
17	866	928	990	53	16	80	43	07	72	37	03	69	35	03	17
18	867	929	991	54	17	81	44	08	73	38	04	70	37	04	18
19	868	930	992	55	18	82	45	10	74	39	05	71	38	05	19
20	869	931	994	1056	1119	1183	1247	1311	1375	1440	1506	1572	1639	1706	20
21	870	932	995	57	20	84	48	12	76	41	07	73	40	07	21
22	871	933	996	58	21	85	49	13	77	43	08	74	41	08	22
23	872	934	997	59	22	86	50	14	79	44	09	75	42	09	23
24	873	935	998	60	23	87	51	15	80	45	10	77	43	10	24
25	874	956	999	61	25	88	52	16	81	46	11	78	44	12	25
26	875	937	1000	63	26	89	53	17	82	47	13	79	45	13	26
27	876	938	1001	64	27	90	54	18	83	48	14	80	47	14	27
28	877	939	1002	65	28	91	55	19	84	49	15	81	48	15	28
29	878	941	1003	66	29	92	56	20	85	50	16	82	49	16	29
30	879	942	1004	1067	1130	1193	1257	1321	1386	1451	1517	1583	1650	1717	30
31	880	943	05	68	31	94	58	22	87	52	18	84	51	18	31
32	881	944	06	69	32	95	59	24	88	53	19	85	52	20	32
33	883	945	07	70	33	96	60	25	89	55	20	86	53	21	33
34	884	946	08	71	34	97	61	26	90	56	21	88	54	22	34
35	885	947	09	72	35	99	62	27	92	57	22	89	56	23	35
36	886	948	10	73	36	1200	64	28	93	58	24	90	57	24	36
37	887	949	11	74	37	01	65	29	94	59	25	91	58	25	37
38	888	950	12	75	38	02	66	30	95	60	26	92	59	26	38
39	889	951	13	76	39	03	67	31	96	61	27	93	60	27	30
40	890	952	1014	1077	1140	1204	1268	1332	1397	1462	1528	1594	1661	1729	40
41	891	953	15	78	41	05	69	33	98	63	29	95	62	30	41
42	892	954	16	79	42	06	70	34	99	64	30	96	63	31	42
43	893	955	18	80	44	07	71	35	1400	65	31	98	64	32	43
44	894	956	19	81	45	08	72	36	01	67	32	99	66	33	44
45	895	957	20	82	46	09	73	38	02	68	33	1600	67	34	45
46	896	958	21	83	47	10	74	39	03	69	35	01	68	35	46
47	897	959	22	85	48	11	75	40	05	70	36	02	69	36	47
48	898	960	23	86	49	12	76	41	06	71	37	03	70	38	48
49	899	961	24	87	50	13	77	42	07	72	38	04	71	39	49
50	900	962	1025	1088	1151	1214	1278	1343	1408	1473	1539	1605	1672	1740	50
51	901	963	26	89	52	16	80	44	09	74	40	06	73	41	51
52	902	964	27	90	53	17	81	45	10	75	41	08	75	42	52
53	903	965	28	91	54	18	82	46	11	76	42	09	76	43	53
54	904	966	29	92	55	19	83	47	12	77	43	10	77	44	54
55	905	968	30	93	56	20	84	48	13	79	44	11	78	45	55
56	906	969	31	94	57	21	85	49	14	80	46	12	79	47	56
57	907	970	32	95	58	22	86	50	15	81	47	13	80	48	57
58	908	971	33	96	59	23	87	52	16	82	48	14	81	49	58
59	909	972	34	97	60	24	88	53	18	83	49	15	82	50	59

M.	28d.	29d.	30d.	31d.	32d.	33d.	34d.	35d.	36d.	37d.	38d.	39d.	40d.	41d.	M.
0	1751	1819	1888	1958	2028	2100	2171	2244	2318	2393	2468	2545	2623	2702	0
1	52	21	90	59	30	01	73	45	19	94	70	46	24	03	1
2	53	22	91	60	31	02	74	47	20	95	71	48	25	04	2
3	55	23	92	62	32	03	75	48	22	96	72	49	27	06	3
4	56	24	93	63	34	04	76	49	23	98	73	50	28	07	4
5	57	25	94	64	35	05	78	50	24	99	75	51	29	08	5
6	58	26	95	65	36	07	79	52	25	2400	76	53	31	10	6
7	59	27	96	66	37	08	80	53	27	01	77	54	32	11	7
8	60	29	98	67	38	09	81	54	28	03	78	55	33	12	8
9	61	30	99	69	39	10	82	55	29	04	80	57	34	14	9
10	1762	1831	1900	1970	2040	2111	2184	2256	2330	2405	2481	2558	2636	2715	10
11	64	32	01	71	41	13	85	58	32	06	82	59	37	16	11
12	65	33	02	72	43	14	86	59	33	08	84	60	38	18	12
13	66	34	03	73	44	15	87	60	34	09	85	62	40	19	13
14	67	35	05	74	45	16	88	61	35	10	86	63	41	20	14
15	68	37	06	76	46	17	90	63	37	11	87	64	42	22	15
16	69	38	07	77	47	19	91	64	38	13	89	66	44	23	16
17	70	39	08	78	48	20	92	65	39	14	90	67	45	24	17
18	72	40	09	79	50	21	93	66	40	15	91	68	46	26	18
19	73	41	10	80	51	22	94	68	42	16	92	69	48	27	19
20	1774	1842	1911	1981	2052	2123	2196	2269	2343	2418	2494	2571	2649	2728	20
21	75	43	13	83	53	25	97	70	44	19	95	72	50	29	21
22	76	45	14	84	54	26	98	71	45	20	96	73	51	31	22
23	77	46	15	85	56	27	99	72	46	21	98	75	53	32	23
24	78	47	16	86	57	28	2200	74	48	23	99	76	54	33	24
25	80	48	17	87	58	29	02	75	49	24	2500	77	55	35	25
26	81	49	18	88	59	31	03	76	50	25	01	78	57	36	26
27	82	50	20	90	60	32	04	77	51	27	03	80	58	37	27
28	83	52	21	91	61	33	05	79	53	28	04	81	59	39	28
29	84	53	22	92	63	34	07	80	54	29	05	82	61	40	29
30	1785	1854	1923	1993	2064	2135	2208	2281	2355	2430	2506	2584	2662	2742	30
31	86	55	24	94	65	37	09	82	56	32	08	85	63	43	31
32	87	56	25	95	66	38	10	83	58	33	09	86	65	44	32
33	89	57	27	97	67	39	11	85	59	34	10	88	66	46	33
34	90	58	28	98	69	40	13	86	60	35	12	89	67	47	34
35	91	60	29	99	70	41	14	87	61	37	13	90	69	48	35
36	92	61	30	2000	71	43	15	88	63	38	14	91	70	50	36
37	93	62	31	01	72	44	16	90	64	39	15	93	71	51	37
38	94	63	32	02	73	45	17	91	65	40	17	94	73	52	38
39	96	64	34	04	75	46	19	92	66	42	18	95	74	54	39
40	1797	1765	1935	2005	2076	2147	2220	2293	2368	2443	2519	2597	2675	2755	40
41	98	66	36	06	77	49	21	95	69	44	21	98	76	56	41
42	99	68	37	07	78	50	22	96	70	45	22	99	78	58	42
43	1800	69	38	08	79	51	24	97	71	47	23	2601	79	59	43
44	01	70	39	10	80	52	25	98	73	48	24	02	80	60	44
45	02	71	41	11	82	53	26	99	74	49	26	03	82	62	45
46	03	72	42	12	83	55	27	2301	75	51	27	04	83	63	46
47	05	73	43	13	84	56	28	02	76	52	28	06	84	64	47
48	06	75	44	14	85	57	30	03	78	53	30	07	86	66	48
49	07	76	45	15	86	58	31	04	79	54	31	08	87	67	49
50	1808	1877	1946	2017	2088	2159	2232	2306	2380	2456	2532	2610	2688	2768	50
51	09	78	48	18	89	61	33	07	81	57	33	11	90	70	51
52	10	79	49	19	90	62	35	08	83	58	35	12	91	71	52
53	11	80	50	20	91	63	36	09	84	59	36	14	92	72	53
54	13	81	51	21	92	64	37	11	85	61	37	15	94	74	54
55	14	83	52	22	94	65	38	12	86	62	38	16	95	75	55
56	15	84	53	24	95	67	39	13	88	63	40	17	96	76	56
57	16	85	55	25	96	68	41	14	89	64	41	19	98	78	57
58	17	86	56	26	97	69	42	16	90	66	42	20	99	79	58
59	18	87	57	27	98	70	43	17	91	67	44	21	2700	80	59

M.	42d.	43d.	44d.	45d.	46d.	47d.	48d.	49d.	50d.	51d.	52d.	53d.	54d.	55d.	M.
0	2782	2863	2946	3030	3116	3203	3292	3382	3474	3569	3665	3764	3865	3968	0
1	83	64	47	31	17	04	93	84	76	70	67	65	66	70	1
2	84	66	49	33	18	06	95	85	78	72	68	67	68	71	2
3	86	67	50	34	20	07	96	87	79	74	70	69	70	73	3
4	87	69	51	36	21	09	98	88	81	75	72	70	71	75	4
5	88	70	53	37	23	10	99	90	82	77	73	72	73	77	5
6	90	71	54	38	24	12	3301	91	84	78	75	74	75	78	6
7	91	73	56	40	26	13	02	93	85	80	77	75	77	80	7
8	92	74	57	41	27	14	03	94	87	82	78	77	78	82	8
9	94	75	58	43	29	16	05	96	88	83	80	79	80	84	9
10	2795	2877	2960	3044	3130	3217	3306	3397	3490	3585	3681	3780	3882	3985	10
11	97	78	61	46	31	19	08	99	92	86	83	82	83	87	11
12	98	80	63	47	33	20	09	3400	93	88	85	84	85	89	12
13	99	81	64	48	34	22	11	02	95	90	86	85	87	91	13
14	2801	82	65	50	36	23	12	03	96	91	88	87	89	92	14
15	02	84	67	51	37	25	14	05	98	93	90	89	90	94	15
16	03	85	68	53	39	26	16	07	99	94	91	90	92	96	16
17	05	86	70	54	40	28	17	08	3501	96	93	92	94	98	17
18	06	88	71	55	42	29	19	10	03	98	95	94	95	99	18
19	07	89	72	57	43	31	20	11	04	99	96	95	97	4001	19
20	2809	2891	2974	3058	3144	3232	3322	3413	3506	3601	3698	3798	3899	4003	20
21	10	92	75	60	46	34	23	14	07	02	99	99	3901	05	21
22	11	93	76	61	47	35	25	16	09	04	3701	3800	02	06	22
23	13	95	78	63	49	37	26	17	10	06	03	02	04	08	23
24	14	96	79	64	50	38	28	19	12	07	04	04	06	10	24
25	15	97	81	65	52	40	29	20	14	09	06	06	07	12	25
26	17	99	82	67	53	41	31	22	15	10	08	07	09	14	26
27	18	2900	83	68	55	42	32	23	17	12	09	09	11	15	27
28	20	01	85	70	56	44	34	25	18	14	11	11	13	17	28
29	21	03	86	71	57	45	35	27	20	15	13	12	14	19	29
30	2822	2904	2988	3073	3159	3247	3337	3428	3521	3617	3714	3814	3916	4021	30
31	24	06	89	74	60	48	38	30	23	18	16	16	18	22	31
32	25	07	91	75	62	50	40	31	25	20	17	17	19	24	32
33	26	09	92	77	63	51	41	33	26	22	19	19	21	26	33
34	28	10	93	78	65	53	43	34	28	23	21	21	23	28	34
35	29	11	95	80	66	54	44	36	29	25	22	22	25	29	35
36	30	13	96	81	68	56	46	37	31	26	24	24	26	31	36
37	32	14	98	83	69	57	47	39	32	28	26	26	28	33	37
38	33	15	99	84	71	59	49	40	34	30	27	27	30	35	38
39	34	17	3000	85	72	60	50	42	36	31	29	29	32	37	39
40	2836	2918	3002	3087	3173	3262	3352	3443	3537	3633	3731	3831	3933	4038	40
41	37	19	03	88	75	63	53	45	39	34	32	32	35	40	41
42	39	21	05	90	76	65	55	47	40	36	34	34	37	42	42
43	40	22	06	91	78	66	56	48	42	38	36	36	38	44	43
44	41	24	07	93	79	68	58	50	43	39	37	38	40	45	44
45	43	25	09	94	81	69	59	51	45	41	39	39	42	47	45
46	44	26	10	95	82	71	61	53	47	43	41	41	44	49	46
47	45	28	12	97	83	72	62	54	48	44	42	43	45	51	47
48	47	29	13	98	85	74	64	56	50	46	44	44	47	52	48
49	48	31	14	3100	87	75	65	57	51	47	46	46	49	54	49
50	2849	2932	3016	3101	3188	3277	3367	3459	3553	3649	3747	.84	.951	4056	50
51	51	33	17	03	90	78	68	60	55	51	49	49	52	58	51
52	52	35	19	04	91	80	70	62	56	52	50	51	54	60	52
53	54	36	20	06	92	81	71	64	58	54	52	53	56	61	53
54	55	37	21	07	94	83	73	65	59	55	54	55	58	63	54
55	56	39	23	08	95	84	74	67	61	57	55	56	59	65	55
56	58	40	24	10	97	86	76	68	62	59	57	58	61	67	56
57	59	42	26	11	98	87	78	70	64	60	59	60	63	69	57
58	60	43	27	13	3200	89	79	71	6	62	60	61	64	70	58
59	62	44	28	14	01	90	81	73	66	64	62	63	66	72	59

M.	56d.	57d.	58d.	59d.	60d.	61d.	62d.	63d.	64d.	65d.	66d.	67d.	68d.	69d.	M.
0	4074	4183	4294	4409	4527	4649	4775	4905	5039	5179	5324	5474	5631	5795	0
1	76	84	96	11	29	51	77	07	42	81	26	77	33	97	1
2	78	86	98	13	31	53	79	09	44	84	28	79	36	5800	2
3	79	88	4300	15	33	55	81	12	46	86	31	82	39	03	3
4	81	90	02	17	35	57	84	14	49	88	33	84	41	06	4
5	83	92	04	19	37	60	86	16	51	91	36	87	44	09	5
6	85	94	06	21	39	62	88	18	53	93	38	89	47	11	6
7	86	95	08	23	41	64	90	20	55	95	41	92	50	14	7
8	88	97	09	25	43	66	92	23	58	98	43	95	52	17	8
9	90	99	11	27	45	68	94	25	60	5200	46	97	55	20	9
10	4092	4201	4313	4429	4547	4670	4796	4927	5062	5203	5348	5500	5658	5823	10
11	94	03	15	31	49	72	98	29	65	05	51	02	60	25	11
12	95	05	17	33	51	74	4801	31	67	07	53	05	63	28	12
13	97	07	19	34	53	76	03	34	69	10	56	07	66	31	13
14	99	08	21	36	55	78	05	36	71	12	58	10	68	34	14
15	4101	10	23	38	57	80	07	38	74	14	61	13	71	37	15
16	03	12	25	40	59	82	09	40	76	17	63	15	74	39	16
17	04	14	27	42	61	84	11	43	78	19	66	18	76	42	17
18	06	16	28	44	64	87	14	45	81	22	68	20	79	45	18
19	08	18	30	46	66	89	16	47	83	24	71	23	82	48	19
20	4110	4220	4332	4448	4568	4691	4818	4949	5085	5226	5373	5526	5685	5851	20
21	12	21	34	50	70	93	20	51	88	29	76	28	87	54	21
22	13	23	36	52	72	95	22	54	90	31	78	31	90	56	22
23	15	25	38	54	74	97	24	56	92	34	80	33	93	59	23
24	17	27	40	56	76	99	26	58	95	36	83	36	95	62	24
25	19	29	42	58	78	4701	29	60	97	38	85	39	98	65	25
26	21	31	44	60	80	03	31	63	99	41	88	41	5701	68	26
27	22	32	46	62	82	05	33	65	5102	43	90	44	04	71	27
28	24	34	47	64	84	07	35	67	04	46	93	46	06	74	28
29	26	36	49	66	86	10	37	69	06	48	95	49	09	76	29
30	4128	4235	4351	4468	4588	4712	4839	4972	5108	5250	5398	5552	5712	5879	30
31	30	40	53	70	90	14	42	73	11	53	5401	54	15	82	31
32	32	42	55	72	92	16	44	76	13	55	03	57	17	85	32
33	33	44	57	74	94	18	46	78	15	58	06	59	20	88	33
34	35	46	59	76	96	20	48	81	18	60	08	62	23	91	34
35	37	47	61	78	98	22	50	83	20	63	11	65	25	94	35
36	39	49	63	80	4600	24	52	85	22	65	13	67	28	96	36
37	41	51	65	82	02	26	55	87	25	67	16	70	31	99	37
38	42	53	67	84	04	28	57	90	27	70	18	73	34	5902	38
39	44	55	69	86	06	31	59	92	30	72	21	75	36	05	39
40	4146	4257	4370	4488	4608	4733	4861	4994	5132	5275	5423	5578	5739	5908	40
41	48	59	72	90	10	35	63	96	34	77	26	80	42	11	41
42	50	60	74	92	12	37	65	99	36	80	28	83	45	14	42
43	52	62	76	94	14	39	68	5001	39	82	31	86	47	17	43
44	53	64	78	95	16	41	70	03	41	84	33	88	50	19	44
45	55	66	80	97	18	43	72	05	43	87	36	91	53	22	45
46	57	68	82	99	20	45	74	08	46	89	38	94	56	25	46
47	59	70	84	4501	23	47	76	10	48	92	41	96	58	28	47
48	61	72	86	03	25	50	79	12	51	94	43	99	61	31	48
49	62	74	88	05	27	52	81	14	53	97	46	5602	64	34	49
50	4164	4275	4390	4507	4629	4754	4883	5017	5155	5299	5448	5604	5767	5937	50
51	66	77	92	09	31	56	85	19	58	5301	51	07	70	40	51
52	68	79	94	11	33	58	87	21	60	04	54	10	72	43	52
53	70	81	96	13	35	60	90	23	62	06	56	12	75	46	53
54	72	83	98	15	37	62	92	26	65	09	59	15	78	48	54
55	73	85	99	17	39	64	94	28	67	11	61	17	81	51	55
56	75	87	4401	19	41	66	96	30	69	14	64	20	83	54	56
57	77	89	03	21	43	69	98	33	72	16	66	23	86	57	57
58	79	91	05	23	45	71	4901	35	74	19	69	25	89	60	58
59	81	93	07	25	47	73	03	37	76	21	71	28	92	63	59

M.	70d.	71d.	72d.	73d.	74d.	75d.	76d.	77d.	78d.	79d.	80d.	81d.	82d.	83d.	M
0	5966	6146	6335	6534	6746	6970	7210	7467	7745	8046	8375	8739	9145	9606	0
1	69	49	38	38	49	74	14	72	49	51	81	45	53	14	1
2	72	52	41	41	53	78	18	76	54	56	87	52	60	22	2
3	75	55	45	45	57	82	22	81	59	61	93	58	67	31	3
4	78	58	48	48	60	86	27	85	64	67	98	65	74	39	4
5	81	61	51	52	64	90	31	90	69	72	8404	71	82	47	5
6	84	64	54	55	68	94	35	94	74	77	10	78	89	55	6
7	86	67	58	58	71	97	39	98	78	83	16	84	96	64	7
8	89	70	61	62	75	7001	43	7503	83	88	22	91	9203	72	8
9	92	73	64	65	79	05	47	07	88	93	27	97	11	81	9
10	995	6177	6367	6569	6782	7009	7252	7512	7793	8099	8433	8804	2 18	9689	10
11	98	80	71	72	86	13	56	16	98	8104	39	10	25	97	11
12	6001	83	74	76	90	17	60	21	7803	09	45	17	33	9706	12
13	04	86	77	79	93	21	64	25	08	15	51	23	40	14	13
14	07	89	80	83	97	25	68	30	13	20	57	30	48	23	14
15	10	92	84	86	6801	29	73	35	17	25	63	36	55	31	15
16	13	95	87	90	04	33	77	39	22	31	69	43	62	40	16
17	16	98	90	93	08	37	81	44	27	36	74	49	70	48	17
18	19	6201	94	96	12	41	85	48	32	41	80	56	77	57	18
19	22	05	97	6600	15	45	89	53	37	47	86	63	85	65	19
20	6025	6208	6400	6603	6819	7049	7294	7557	7842	8152	8492	8869	9292	9774	20
21	28	11	03	07	23	52	98	62	47	58	98	76	9300	83	21
22	31	14	07	10	26	56	7302	66	52	63	8504	83	07	91	22
23	34	17	10	14	30	60	06	71	57	68	10	89	15	9800	23
24	37	20	13	17	34	64	11	76	62	74	16	96	22	09	24
25	40	23	17	21	38	68	15	80	67	79	22	8903	30	17	25
26	43	26	20	24	41	72	19	85	72	85	28	09	38	26	26
27	46	30	23	28	45	76	23	89	77	90	34	16	45	35	27
28	49	33	27	31	49	80	28	94	82	96	40	23	53	44	28
29	52	36	30	35	53	84	32	98	87	8201	46	30	60	52	29
30	6055	6239	6433	6639	6856	7088	7336	7603	7892	8207	8552	8936	9368	9861	30
31	58	42	37	42	60	92	40	08	97	12	58	43	76	70	31
32	61	45	40	46	64	96	45	12	7902	18	64	50	83	79	32
33	64	49	43	49	68	7100	49	17	07	23	71	57	91	88	33
34	67	52	47	53	71	04	53	22	12	29	77	63	99	97	34
35	70	55	50	56	75	08	58	26	17	34	83	70	9407	9906	35
36	73	58	53	60	79	12	62	31	22	40	89	77	14	15	36
37	76	61	57	63	83	16	66	36	27	45	95	84	22	24	37
38	79	64	60	67	86	20	71	40	32	51	8601	91	30	33	38
39	82	68	63	70	90	24	75	45	37	56	07	98	38	4[illegible]	39
40	6085	6271	6467	6674	6894	7128	7379	7650	7942	8262	8614	9005	9445	9951	40
41	88	74	70	77	98	32	84	54	48	67	20	12	53	60	41
42	91	77	73	81	6901	36	88	59	53	73	26	18	61	69	42
43	94	80	77	85	05	40	92	64	58	79	32	25	69	78	43
44	97	82	80	88	09	45	97	68	63	84	38	32	77	87	44
45	6100	87	83	92	13	49	7401	73	68	90	44	39	85	9996	45
46	03	90	87	95	17	53	06	78	73	95	51	46	93	10005	46
47	06	93	90	99	20	57	10	83	78	8301	57	53	9501	10015	47
48	09	96	94	6702	24	61	14	87	83	07	63	60	09	10024	48
49	12	99	97	06	28	65	19	92	89	12	69	67	17	10033	49
50	6115	6303	6500	6710	6932	7169	7423	7697	7994	8318	8676	9074	9525	10043	50
51	18	06	04	13	36	73	27	7702	99	24	82	81	33	10052	51
52	21	09	07	17	40	77	32	06	8004	29	89	88	41	10061	52
53	24	12	11	20	43	81	36	11	09	35	95	96	49	10071	53
54	27	15	14	24	47	85	41	16	14	41	8701	9103	57	10080	54
55	30	19	17	28	51	89	45	21	20	47	07	10	65	10089	55
56	33	22	21	31	55	94	49	25	25	52	14	17	73	10099	56
57	36	25	24	35	59	98	54	30	30	58	20	24	81	10108	57
58	40	28	28	38	63	7202	58	35	35	64	26	31	89	10118	58
59	43	32	31	42	66	06	63	40	40	69	33	38	98	10127	59

The Latitudes, Longitudes, and Times of High Water, of the Coasts of England and France, bounding the English Channel.

Note. In the following Tables, all Places marked thus * are determined by Celestial Observations; Places not so marked, are from the best Charts, compared and corrected by these.

English Coast.	Lat. D.M.	Long. D.M.	H.W. H.M.
S. Foreland lights	51 12 N	1 30 E	
*Dover ——	51 8	1 24	11 ½
Dungeness —	50 52	1 5	10 ½
Hastings —	50 53	0 47	10 ¾
Beachy Head —	50 44	0 26	10 ¾
Shoreham —	50 47	0 11 W	9 ¾
Arundel —	50 46	0 26	9 ¾
Selsey Bill —	50 43	0 41	9 ½
Owers, S.E. Part	50 36	0 36	9 ½
* Portsmouth Town —	50 47	1 0	11 ½
Isle of Wight.			
* Bembridge Ledge or Point	50 40	0 59	11 ¾
*Dunnose —	50 33	1 10	9
* Saint Catherine's Point —	50 30	1 14	9
*Needles Lights	50 41	1 24	9 ½
Pool Harbour —	50 42	2 5	9
St. Alban's Head	50 37	2 8	7 ¼
*Weymouth —	50 37	2 30	6 ¼
Portland Lights	50 31	2 31	7 ¼
Exmouth Bar —	50 37	3 18	6 ½
Torbay, Berry Head ——	50 22	3 22	6 ¼
Dartmouth —	50 18	3 33	6 ¼
*Start Point —	50 9	3 40	6 ½
Praul ditto —	50 8	3 47	6
*Eddystone Light	50 8	4 18	5 ½
Hand Deeps —	50 11	4 22	5 ½
Ram Head —	50 18	4 15	5 ½
*Plymouth —	50 22	4 10	6 ¼
Fowey ——	50 17	4 47	5 ½
*Deadman's Pt.	50 12	4 54	5 ¼
*Falmouth —	50 8	5 5	5 ¼
Manacles Rocks	50 2	5 6	5
Black Head —	50 5	5 10	5
*Lizard Point —	49 57	5 14	5
Mount's Bay —	50 8	5 37	5
Runnel Stone —	50 2	5 48	5
Wolf Rock —	49 56	6 30	4 ¾
Land's End —	50 6	5 55	4 ½
*St. Agnes Light Scilly ——	49 55	6 42	4 ½
*St. Mary's, ditto	49 57	6 35	4 ½
French Coast.			
*Calais ——	50 58	1 57 E	
Cape Griz Nez —	50 53	1 40	3 ¼
Bologne —	50 44	1 44	3 ¼
Etaples ——	50 31	1 47	3 ½

French Coast.	Lat. D.M.	Long. D.M.	H.W. H.M.
St. Vallery —	49 52 N	0 47 E	
*Dieppe —	49 55	1 10	11
Fecamp ——	49 50	0 30	11
*Havre de Grace	49 29	0 12	9
Mouth of Seine	49 27	0 10 W	9
*Caen ——	49 11	0 16	11
Cape Barfleur Ls.	49 44	1 7	10 ½
Cherbourgh —	49 38	1 32	7 ¾
Cape St. Germain's —	49 46	1 52	9
Alderney I. W. Point ——	49 48	2 12	9
Caskets Lights	49 48	2 25	10
Guernsey I. W. Point ——	49 32	2 36	
Sark I. N. Point	48 28	2 16	
Jersey I. N.W. Pt.	49 16	2 17	6 ½
*Coutance —	49 3	1 21	6
*Granville —	48 50	1 31	6
*Avranches —	48 41	1 17	6 ½
*St. Maloe —	48 39	1 56	6 ½
Cape Frehel —	48 48	2 22	
St. Brieux —	48 32	2 48	
De Braha I. —	48 52	2 52	7 ½
Roche Blanche —	48 59	3 52	7 ½
*St. Anthony's Lights —	48 40	4 24	6
*Ushant, W. Pt.	48 29	4 58	4 ½

The Current in the Mid. Channel in N. E. about 1 H. 30 M. after High Water; and it runs off Dungeness 4 H. to 4 and an half Hours; in the Downs 4 Hours; and East in the King's Channel, 3 Hours after High Water.

The following Table shews the Time of High Water at the principal Headlands, &c. in the Channel, on Full and Change Days, and the Time the Current runs after High Water.

The Current runs after H. W.

High Water.	H.M.	H M	And the Time the Current has done running H.M.
At the Lizard, at	5 0	3 0	8 0
Off the Eddistone	5 30	3 0	8 30
Off the Start —	6 10	2 30	8 30
Off Portland —	7 15	3 0	10 15
Off I. of Wight	8 14	3 15	11 30
Off Arundel and Shoreham —	9 15	1 15	10 30
Off Beachy —	9 45	1 15	11
Off Dungeness —	10 30	4 0	12 30

Note. H. W. stands for High Water; R. for River; I. for Island; P. for Point; and C. for Cape.—The Longitude is reckoned from the Meridian of London.

Note. The Variation in the English, and St. George's Channels, is 25° 30', and on the East Coast of England, 24° West, and about the Orkneys and Shetland Islands about 2 Points, on the Western Coast of Ireland 2½ Points West, and is found to vary between 11 and 12 Minutes Westerly every Year, or a Degree in 5½ Years; therefore, by adding a Degree for every 5½ Years to the Variation here given for 1791, you will have the Variation nearly for any succeeding Year.

From the North Foreland to Duncan's Bay Head.

	Lat. D. M.	Long. D. M.	H. W. H. M.
*North Foreland	51 25 N.	1 32 E.	11 3/4
Kentiſh Knock	51 43	1 45	11 1/2
Long Sand Head	51 48	1 45	11 1/2
Galloper N P. —	51 58	2 0	12
Ditto South P. —	51 48	1 59	12
Shipwaſh N. P. —	52 9	1 43	12
Ditto South P. —	52 2	1 39	12
Gabbard ——	52 5	1 45	12
Orfordneſs —	52 13	1 40	10 1/2
Alboro' knaps, South P. —	52 15	1 49	9 3/4
Southwold —	52 28	1 37	9
Leoſtaff Lights —	52 38	1 49	9
*Yarmouth —	52 45	1 45	8 1/4
Winterton Neſs Lights —	52 54	1 40	8 1/4
Smiths Knowl—	52 57	2 20	
Hasborough Sand, S. P. —	52 58	1 48	7 1/2
Ditto, North P.	53 10	1 32	7 1/2
Cromer Lights—	53 6	1 16	9
Lemon and Ower, North P. —	53 27	1 43	
Ditto, South P.	53 18	1 45	
Cromer Bank —	53 27	1 30	
Dudgeon Lights	53 27	1 0	7 1/2
Outer Dowings	53 42	1 0	
Inner Dowſings	53 24	0 50	5 1/2
Lynn Deeps —	53 0	0 27	6
Spurn Lights —	53 41	0 22	5 1/4
* Flamborough Head ——	54 10	0 7	4 1/4
Filey Brig —	54 17	0 5 W	4 1/2
Scarborough —	54 21	0 13	4 1/2
Robin Hood's Bay ——	54 30	0 22	3 3/4
Whitby——	54 34	0 27	3 1/4
River Tee's Mouth, Stockton —	54 41	0 59	3 1/2
River Tee's Mouth, Newcaſtle ——	55 2	1 9	3 1/4
Coquet Iſland —	55 22	1 21	2 1/4
Staples Iſlands—	55 39	1 30	2 1/2
Holy Iſland —	55 42	1 38	2 1/2
Berwick —	55 47	1 49	2 1/4
St. Abb's Head—	55 57	1 58	2 1/4
Dunbar ——	55 59	2 23	1 1/4
May I. Lights —	56 11	2 27	4 1/4
*Edinburgh —	55 58	3 6	4 1/4
Fife Neſs —	56 15	2 29	4 1/4
Mouth of Tay—	57 27	2 24	3 1/2
C. Rock, off ditto	56 29	2 0	3 1/2
Red Head —	56 38	2 28	12
Montroſe —	56 44	2 28	12
New Aberdeen	57 7	1 51	12 3/4
Peter Head —	57 34	1 25	12
Buchan Neſs —	57 31	1 24	12
Kinnaird's Head	57 39	1 38	12
Banff ——	57 38	2 12	11 1
Fort St. George	57 33	3 43	11 1/4
Inver Neſs —	57 28	3 45	11 1/4

	Lat. D. M.	Long. D. M.	H. W. H. M.
Cromartie —	57 42 N.	3 37 W	11 1/4
Tarbet Neſs —	57 52	3 24	11 1/4
Caithneſs —	58 1	3 16	11
Noſe Head —	58 27	2 56	11
Duncanſby Head	58 43	2 57	8 3/4

The Orkney Iſlands.

Pentland Skerries ——	58 45 N.	2 52 W	11 1/2
Stromo ——	58 45	2 59	11 1/2
South Ronaldſha, South P.	58 47	2 52	11 1/2
Copinſha —	58 54	2 37	11 1/2
Lambs Head, on Stronſal I. —	59 4	2 29	11
North Ronaldſha, North P.	59 23	2 22	10 1/2
Mould Head, on Patra Weſtra Iſland——	59 21	2 52	9
Noup Head, on Weſtra I.	59 18	3 2	9
Marwick Head, on Pomona I.	59 6	3 16	10
Hoy Head, on Hoy Wells I.	58 55	3 18	10
Slue Skerry —	59 3	3 24	10
Fair Iſland —	59 30	1 38	4

The Shetland Iſlands.

Sumbug Head, South Point—	59 47 N	1 29 W	4
Roſe or Hangliff	60 9	0 58	4
Braſſa Sound, Larwick —	61 11	1 1	4
Out Skerries —	60 25	0 18	4
Walſey Iſle —	60 25	0 46	4
Unſet, N. E. P.	60 47	0 15	4
Foul Iſland —	60 25	1 50	3

Ferro Iſlands.

The Munk Rock appears like a Ship under Sail	61 18 N.	6 47 W	3
Fulae I. N. E. part of Ferro	62 12	6 27	4
Eaſt Point of Mygenes Iſl. N. W. part of Ferro ——	62 3	7 32	4

From Duncan's Bay Head to the Land's End.

Duncanſby Head	58 43 N.	2 58 W.	11 1/2
Dunnet Head —	58 44	3 18	11 1/2
Farout Head —	58 36	5 0	11 1/2
Cape Wrath, or Barre Head —	58 33	5 13	7

	Lat. D.M.	Long. D.M.	H.W. H.M.
A Rock seen at ½ Ebb —	58 45 N	5 21 W	7
Rona Island —	58 55	6 2	7
Rockal ———	57 28	10 32	
St. Kilda ——	57 51	8 56	
Butt of the Lewis	58 22	6 24	5 [illegible]
Gallen Head —	58 9	7 8	4 [illegible]
Flannan I. —	58 13	7 36	4 [illegible]
Hiskere I. —	57 32	7 52	5
Na Monich I. —	57 22	7 56	5 [illegible]
Barra Head —	56 33	7 41	5 [illegible]
Rocks very dangerous —	57 46	7 4	5 [illegible]
Cana Islands —	56 58	6 52	5 [illegible]
Hysker Islands -	56 51	6 58	5 [illegible]
Rum I. West P.	56 59	6 41	5 [illegible]
Tircey I. S. P.—	56 16	7 3	5
Colt I. North P.	55 59	6 36	5
Bomishly Rocks	55 9	7 5	5 [illegible]
Skerryvore —	56 4	7 9	5 [illegible]
Ila I S. W. P.	55 37	6 47	10 [illegible]
Ditto, South P.	55 31	6 30	10 [illegible]
Rachland Isl. E. Part —	55 17	6 17	9 ¾
Mull of Cantire Light-House	55 18	6 0	11
I. of Arran, S.E. Part ———	55 28	5 27	11
Conway I. Entrance of Clyde	55 47	5 17	11
Ellis I. ———	55 16	5 24	11 [illegible]
Irvin ———	55 36	5 0	11 [illegible]
Air ———	55 26	4 57	11 [illegible]
Loch Ryan —	55 3	5 21	11 [illegible]
Port Patrick Lts	54 48	5 20	11
Mull of Galloway ———	54 37	5 8	11
Great Star I. —	54 40	4 57	11
Burrow Head —	54 41	4 39	11
Solway Firth —	54 47	4 30	11 ½
St. Bee's Head Light———	54 30	3 50	11 [illegible]
Whitehaven —	54 52	3 47	11 ½
Selker Rock —	54 16	3 39	11
Lancaster —	54 3	3 3	11 [illegible]
Liverpool —	53 27	3 12	11 [illegible]
Great Orms Hd.	53 20	4 3	10 [illegible]
Skerries Light—	53 25	4 50	9 [illegible]
Holyhead —	53 19	4 52	9 [illegible]
Brachy Pool Hd.	52 47	4 57	7 [illegible]
Bardsey I. —	52 45	5 0	7 [illegible]
Barmouth —	52 48	4 12	8
Cardigan Harbour ———	52 12	4 47	7 ½
Strumble Head	52 0	5 10	7
St. David's Head	51 55	5 20	6
Ramsey I. —	51 48	5 22	6
Small's Light-House —	51 48	5 36	9
St. Ann's ditto, Milford Haven	51 44	5 10	5 [illegible]
Worms Head —	51 35	4 22	5 [illegible]
Caldy I. —	51 43	4 42	5 [illegible]
Lundy I. Entrance of Bristol Channel —	51 15	5 44	5· 5

	Lat. D. M.	Long. D. M.	H.W. H.M.
Mort P. S. Entrance of Bristol Channel—	51 15 N	4 15 W	5 [illegible]
Hartland P. —	51 4	4 38	5 [illegible]
Padstow —	50 42	4 55	5 [illegible]
Towan Head —	50 30	5 7	5 [illegible]
St. Ives Bay —	50 17	5 34	4 [illegible]
Cape Cornwall—	50 10	5 55	4 [illegible]
The Seven Stones	50 6	6 23	4 [illegible]
The Wolf Rock	49 57	6 2	4 [illegible]
The Land's End	50 6	5 55	4 [illegible]

Ireland.

Cape Clear —	51 15N	9 50W	3
Fainet Rock —	51 13	9 55	3
Crookhaven —	51 19	10 5	3
Mizen-Head —	51 18	10 13	3 [illegible]
Sheep's Head —	51 24	10 15	3 [illegible]
Bantry-Bay —	51 26	10 10	3
Grelagh Rocks	51 22	10 41	3
Dursey I. W. P.	51 26	10 45	3
Bull Rock —	51 27	10 45	3
Cow ditto —	51 27	10 48	3
Coa's Head —	51 32	10 32	3
Kenmare Bay —	51 35	10 50	3 [illegible]
Lamb's Head —	51 38	10 37	3 [illegible]
Hog I. ———	51 37	10 44	3 [illegible]
Hog's Head —	51 41	10 48	3 [illegible]
Bolus Head —	51 41	10 55	3 [illegible]
Skelling's Rocks	51 40	11 10	3 [illegible]
Lemon Rock —	51 42	11 2	3 [illegible]
Bray Head —	51 47	10 49	3 [illegible]
Dangle Bay —	51 55	11 0	3 [illegible]
Foze Rock —	51 54	11 14	3 [illegible]
Fretter's I. —	51 56	11 22	3 [illegible]
Tiragh Rocks —	51 57	11 24	3 [illegible]
Great Blasket —	51 57	11 9	3 [illegible]
Enis Tuscan —	52 0	11 23	3 [illegible]
Dunmore Head -	51 59	10 55	3 [illegible]
Dunorling Head	52 5	10 57	3 [illegible]
Brandon Head—	52 9	10 46	3 [illegible]
The Seven Hogs Rocks —	52 11	10 37	3 [illegible]
Kerry Head, S. Entrance of Shannon River	52 15	10 32	3 [illegible]
Loop Head, N. Entrance ditto—	52 23	10 33	3 [illegible]
North Arran, or Killancy —	53 6	10 17	4
Galway Bay —	53 9	9 59	4
Sline Head —	53 23	10 49	4
Ennis Shark I.	53 34	10 52	4
Ennis Turk I. —	53 40	10 42	4
Clare Island —	53 45	10 36	4 [illegible]
Achill Head —	53 56	10 49	4 [illegible]
Black Rock —	54 2	10 53	5
Urris Head —	54 18	10 37	5
Broad Haven —	54 15	10 29	5
Stag Rocks, off Broad Haven	54 21	10 24	5

	Lat. D. M.	Long. D.M.	H.W. H.M.
Down Patrick Head	54 18N	9 58W	5
Sligo Bay	54 15	9 18	5 ¼
Ennis Murray I.	54 24	9 18	5
Donegal Bay	54 30	9 6	5 ½
Tillen Head	54 38	9 25	5 ½
Arranmore	54 58	9 8	5 ½
Tory Island	55 15	8 48	4 ½
Loch Swilly	55 15	8 8	5
Malin Head	55 23	7 58	4
Ennistrahul Rocks	55 24	7 46	4
Inishoan Head, Entrance of Londonderry	55 13	7 24	4
Bengore Head	55 14	6 52	4
Rachlin I. West Point	55 19	6 25	8
Fair Head	55 15	6 16	10 ½
The Maid's Rocks	54 55	5 46	10 ½
Belfast Loch	54 40	5 45	10 ½
Copeland Lights	54 41	5 33	10 ½
St. John's P.	54 12	5 49	11
Dundrum	54 13	6 0	11
Carlingford Loch	54 0	6 12	10 ½
Dundalk	53 57	6 27	10 ½
Drogheda Bar	53 45	6 22	11
St. Patrick s I.	53 36	6 10	11
Lambay Island	53 31	6 7	11
Dublin	53 22	6 22	11 ¾
Wicklow Lights	52 59	6 7	10
Wexford	52 22	6 30	8 ½
Tusker Rock	52 12	6 14	8 ½
Carnsore P.	52 11	6 23	8 ½
The Saltee Rocks	52 5	6 36	5 ½
Hook Lights, Waterford Harbour	52 3	7 3	4 ½
Dungarvon	51 59	7 36	5
Helwick Head	51 57	7 36	5
Youghall	51 50	7 53	5
Cork Harbour	51 41	8 23	4
Kinsale Harbour	51 34	8 42	4
Old Head of Kinsale	51 30	8 42	4
Seven Heads	51 27	8 52	4
Dundedy Head	51 25	9 8	4
The Stags, off Toe Head	51 19	9 23	4
Baltimore Harbour	51 20	9 40	4

The Isle of Man.

Calf of Man	54 1	5 3	10 ½
Douglas	54 7	4 42	
Ramsay Bay	54 17	4 38	10 ½
Point of Air	54 25	4 34	10 ½
Peel Hill	54 12	4 57	10 ½

From Ushant to Cape Spartel.

	Lat. D.M.	Long. D.M.	
*Ushant	48 29 N	5 0 W	4 ½
*Brest	48 23	4 25	3 ¼
Point Raz	48 2	4 40	
Point L'Abbe	47 48	4 11	
Isles de Glenan	47 44	4 0	
L'Orient	47 44	3 21	
Isle de Groa	47 36	3 28	
Quiberon	47 34	3 5	
*Belle Isle	47 17	3 1	2 ½
Houat Isle	47 20	2 57	
Dumet Isle	47 15	2 52	
*Nantes	47 13	1 25	
Nourmouster I.	47 2	2 10	
Dieu Isle	46 42	2 16	
*Roche Bon	46 14	2 21	4 ½
Ree Isle	46 15	1 28	3 ½
*Rochelle	46 9	1 4	3 ¾
*Rochfort	46 3	0 53	
Oleron Isle	46 3	1 19	
Cordovan Light-House	45 36	1 6	4 ½
*Bordeaux	44 50	0 30	3
C. Feret	44 43	1 10	
*Bayonne	43 29	1 24	3 ½
C. Machicaco	43 31	3 15	
Bilboa	43 15	3 1	3
C. de Lata	43 34	3 53	
C. Penas	43 48	5 48	3
*C. Ortegal	43 46	7 36	3
C. Prior	43 31	8 8	3
Ferrol	43 30	8 0	3
Corrunna	43 17	8 12	3
C. Belem	43 10	9 13	3
C Turiana	43 4	9 21	3
*C. Finisterre	42 52	9 14	3
Vigo Bay	42 14	8 34	3 ½
C. Fasilis	42 5	8 50	3
*Oporto	41 20	8 21	3
C. Mondego	40 5	8 46	3
C. Fileraon	39 24	9 10	3
The Burlings	39 20	9 31	3
*The Rock of			3
Lisbon	38 45	9 31	3
*Lisbon	38 42	9 7	3 ½
C. Epichel	38 21	9 15	3
St. Ubes	38 29	9 0	3
*C. St. Vincent	37 2	8 56	3
C. St. Mary	37 0	7 55	3
P. Avenida	37 6	6 53	3
*Cadiz	36 31	6 6	3 ½
C. Trafalgar	36 10	5 56	3
*Gibraltar	36 5	5 16	3
Ceuta	35 50	5 12	3 ½
*C. Spartel	35 48	5 48	3

The North Coast of the Mediterranean Sea, from Gibraltar to Constantinople.

	Lat. D.M.	Long. D M.
*Gibraltar	36 5 N.	5 16W.
Malaga	36 42	4 15
*Cape de Gatt	36 46	2 24
*Carthagena	37 37	1 2
*Cape Palios	37 34	0 58
Alicant	38 25	0 9
Cape St. Martin	38 47	0 5E.
Candia	39 1	0 10W.
Valentia	39 30	0 32
Cape Oropeso	40 0	0 7
River Ebro	40 44	0 30E.
*Barcelona	41 26	2 18
Cape Sebastian	41 48	3 15
Cape de Creux	42 18	3 23
Perpignan	42 30	2 57
Cette	43 24	3 46
Narbonne Road	43 0	2 55
Montpellier	43 37	3 49
Mountfort	43 39	5 0
*Marseilles	43 18	5 28
*Toulon	43 7	6 3
Cape Taillar	43 4	6 56
Cape de Oropes	43 29	7 21
Villa Franca	43 42	7 25
Cape de Mille	43 54	7 56
*Genoa	44 25	8 41
Point de Fino	44 16	9 0
*Leghorn	43 27	10 27
Cape M. Nero	43 18	10 0
Vada	43 15	10 35
Piombino	43 0	10 33
Point Ercore	42 29	11 1
*Civita Vecchia	42 5	11 52
*Rome	41 54	12 35
Cape Dazzia	41 38	12 35
*Naples	40 51	14 20
Cape de Polonalo	40 3	15 28
Policastro	41 17	15 53
Cape Batican	38 47	15 35
Cape Grose	38 17	16 16
Cape Spartevento	38 0	16 57
Cape Collonia	39 0	18 8
Tarentino	40 14	18 2
Galipoli	39 56	18 36
Cape St. Mary, the Entrance to the Gulf of Venice	39 40	19 14
Brinici	40 38	18 45
Barry	41 4	17 18
Manfredonia	41 40	16 10
Cape Vestio	41 43	15 34
Pescara	43 12	14 30
*Ancona	43 38	13 37
Cornago	44 25	12 0
*Venice	45 26	12 10
Trieste	46 0	13 34
Rovigno	45 11	13 48

	Lat. D.M.	Long. D.M.
St. Maria	45 23 N.	14 25 E.
Pescera	44 42	15 40
Cape Sesto	43 45	16 25
Rosaro	42 48	17 40
Patero	42 23	19 15
Dorazo	41 40	18 45
La Vallona	40 55	20 8
Cape Liqueta	40 42	19 50
Pageni	39 19	21 28
Larta	38 55	22 3
Cape de Larta	38 40	21 44
Lepanto	38 15	22 54
Cape Gallo	36 40	21 49
Cape Mantapan	36 35	22 37
Cape St. Angelo	36 37	23 44
Cape Mala	37 34	24 13
Corinth	38 10	23 35
*Athens	38 4	23 58
Negropont	38 28	24 10
Cape Doro	38 0	25 0
Cape St. George	39 10	23 44
*Salonica or Salonique	40 41	23 14
Cape Ballourri	39 43	23 55
Cape Pellice	39 57	24 25
Cape Monte Santo	40 10	24 57
Adrianople	40 44	27 5
Galipoli	40 25	27 11
*Constantinople	41 1	29 0

The South Coast of the Mediterranean Sea.

	Lat. D.M.	Long. D.M.
Ceuta	35 50 N.	5 14W.
C. Tetuan	35 28	5 14
C. Negril	35 25	4 24
*C. 3 Forcas	35 38	2 45
C. Fegalle	36 46	1 2
*C. Falcon	36 6	0 44
C. Ferrat	36 4	0 3E.
C. Tennis	36 35	1 12
*Algiers	36 49	2 19
C. Matifor	36 52	3 3
*C. Carbon	36 53	4 15
C. Tenes	37 4	5 44
C. Fyel	36 58	6 37
C. Ferro	37 4	7 33
Bona	36 45	7 53
Tabarca	37 8	8 55
C. Serra	37 25	9 35
C. Blanc	37 30	9 35
Tunis	36 45	10 10
C. Bon	37 9	11 8
Susa	35 44	10 50
C. Paul	35 5	11 15
Cape de Zoara	33 30	11 24
*Tripoli	32 54	13 11
Magra	32 29	15 0
C Mensurato	32 24	15 39
C Lorat	31 0	16 30
C. Sudico	31 43	17 37
Stantores	30 17	18 40

	Lat. D.M.	Long. D.M.
C. Linconta	30 57 N.	18 10 E.
C. Sarabion	31 28	19 1
Zeara	31 12	19 0
C. Bengaza	32 28	20 2
C. Razat	33 7	22 26
Derne	32 59	22 21
C. Razatin	32 45	22 57
C. Luco	32 15	25 25
C. Soliman	31 40	25 45
P. Ramitan	31 25	26 27
C. Lagofego	31 13	27 19
C. Capopero	31 3	28 49
C. Rofe	31 0	29 40
*Alexandria	31 11	30 22
C. Brule	31 44	31 34
Damiata	31 36	32 1
Ezreita	31 20	32 47
C. Gallo	31 34	33 55
Jaffa	32 5	35 10
M. Carmel	32 50	35 16
C. Vardo	34 18	35 57
Tripoly	36 46	36 24
Tortofa	35 20	36 25
C. Saudin	36 0	36 0
C. Canzin	36 24	35 47
*Alexandretta, or Scanderoon	36 35	36 26
Aleppo	35 45	37 26
C. Crico	36 35	34 20
P. Cavelero	36 33	33 17
C. Dranmont	36 23	32 7
Satalia	36 58	30 35
C. Biane	36 20	30 21
C. Seven Capes	36 31	28 54
C. Biabe	36 44	28 10
C. Crio	36 45	27 34
C. Petrera	37 10	27 30
C. St. Mary	37 45	27 20
C. Blanc	38 16	26 32
*Smyrna	38 28	27 26
C. Baba	39 24	26 20
C. Janefari	39 53	26 32
C. Capitani	40 13	28 0
Proffias	40 35	29 4

Islands within the Straits.

*Alboran	36 1 N.	2 48 W.
Zaffarine Islands	35 23	2 8
Formentara, W. Point	38 41	0 49 E.
Ditto, E. ditto	38 39	1 10
Ivica, S. ditto	38 48	0 51
Ditto, N. E. ditto	39 10	1 11
Salina	38 50	0 40
Carbera, S. Point	39 10	2 23
Majorca, S. Point	39 18	2 30
Ditto, N. ditto	40 45	2 40
Ditto, W. ditto	39 40	1 51
Ditto, E. ditto	39 42	3 2
Minorca, S. ditto	39 43	3 50

	Lat. D.M.	Long. D.M.
*Minorca, St. Philip's Fort	39 51 N.	3 5½ E.
Ditto, N. ditto Point	40 16	3 21
Sardinia, S. W. Point	39 4	8 18
Ditto, S. E. ditto	39 0	9 54
Ditto, N ditto	41 15	8 55
Ditto, N. W. ditto	40 57	8 2
Senera, N. Point	41 13	8 6
St. Pelean	39 0	8 5
Tovo	38 40	8 29
Galite	37 50	8 55
Elba	42 48	9 50
Planofo	42 34	9 45
Capraia	43 10	9 35
Gorgona	43 24	9 21
Ponza	42 32	9 55
Lufterca	38 53	13 35
Strombolo	38 57	15 52
Leuaze	38 12	12 20
Marelimo	38 0	12 11
Faugnana	37 56	12 29
Sicily, W. Point	38 11	12 40
Ditto, S. ditto	36 45	15 36
Messina, in ditto	38 15	15 59
Pantelaria	36 54	12 0
Linofa	35 55	12 38
Piduffa	35 40	12 49
Malta, N. Point	36 0	14 22
Ditto, S. ditto	35 39	14 35
*The Harbour in Malta	36 0	14 34
Gozo, N. Point	36 12	14 50
Corfu, S. E. Point	39 31	20 50
Fano, Entrance of the Gulph of Venice	40 8	21 6
Pelegofa	42 14	16 30
Piani	42 9	16 13
Tremilli	42 10	15 50
Liffa	42 47	16 27
Pomo	43 2	15 55
Longa, S. E. Part	43 53	15 52
Scio, S. Point	38 14	26 32
Cerigo, S. Point	36 22	23 21
Cerigotte	35 55	24 43
Milo	36 41	25 6
Mitelene, W. Point	39 15	27 12
Goze (Candia)	35 2	24 5
S. W. Point (Candia)	35 17	23 56
Cape Spada (Candia)	35 45	24 18
S. E. Point (Candia)	35 21	23 55
N. E. Point (Candia)	35 35	27 6
Rhodes, S. E. Point	33 27	28 45
Cyprus, W. Point	35 0	31 55
E. Point	35 40	35 0
S. Point	34 30	33 16

The Coast of Africa from Cape Spartel to Cape Verd.

*Cape Spartel	35 48 N.	5 47 W.
*Larash	35 11	6 8
*New Salé	32 35	6 38
*Mazagan	33 13	8 11

	Lat. D. M.	Long. D. M.
*Cape Blanco	33 5 N	8 20 W
*Cape Cantin	32 35	9 0
*Saffia Bay	32 20	8 40
*Mogadore Iſland	31 27	9 25
*Cape Geer	30 28	9 47
Santa Cruz	30 29	9 34
Cape Nun	28 40	11 10
*Cape Bajador	26 29	14 20
*Cape das Barbas	22 15	16 34
*Cape Blanco	20 41	16 52
Arguin	20 22	16 22
Cape Miric	19 15	16 16
Portendic	18 6	16 58
Senegal Bar	15 51	16 9
*Cape Verd	14 46	17 47

The Weſtern Iſles.

*Corvo	39 42 N	31 0 W
*Flores	39 34	29 54
*Fayal, the Town	38 32	28 37
*Pico	38 29.	28 20
Tercera	38 54	28 15
St. George	38 39	27 55
Gracioſa	39 2	28 4
*St. Michael, E. Point	37 47	25 48
Ditto, W. Point	37 50	26 48
*St. Mary	37 0	25 6

The Madeiras.

*Porto Santo	32 50 N	10 20 W
Rock E. of ditto under water	33 30	16 2
Madeira, Eaſt P.	32 50	16 46
Ditto, Weſt P.	32 30	17 26
*Funchal	32 38	17 5
The Salvages Iſlands	30 8½	16 4

The Canaries.

*Lanzarote, North P.	29 25 N	13 26 W
*Ditto, South P.	28 51	13 41
Forteventura, Weſt P.	28 4	14 26
Ditto, Eaſt P.	28 40	13 40
*Canaria, N. E. P.	28 13	15 33
*Ditto, South P.	27 42	15 54
*The Peak of Teneriffe	28 13	16 26
*Ditto, North P.	28 39	16 0
*Orotavia in ditto	28 23	16 30
Santa Cruz in ditto	28 27	16 18
Palma, North P.	28 36	27 32
Tazicote in ditto	28 6	17 3
Ditto, South P.	28 18	27 37
Gomera, at the Port	28 6	17 4
*Ferro, the Town	27 47	17 40
*Ditto, Eaſt P.	27 50	17 37
Ditto, Weſt P.	27 56	17 52

Cape Verd Iſlands.

	Lat. D. M.	Long. D. M.
St. Anthony	17 9 N	24 48 W
St. Vincent	16 50	24 36
St. Lucia	16 44	24 31
St. Nicholas	16 32	24 16
*Sal	16 38	22 50
*Bonaviſta	16 6	22 41
*Mayo	13 10	23 0
St. Jago, North P.	14 54	23 27
Ditto, South P.	14 17	23 25
Brava	14 50	24 39
*Fogo	14 57	24 22

From Cape Verd to the Cape of Good Hope.

*Cape de Verde	14 46 N	17 47 W
*Goree Iſle	14 36	17 37
Cape Naze	14 24	17 18
Cape St. Mary, Entrance to the River Gambia	13 17	16 56
Cape Roxo	12 23	17 10
Cape Vergue	14 56	9 52
Delos Iſles	9 29	14 7
*Cape Sierra Leon	8 29	13 42
*Cape Ann	7 7	13 18
*Cape Mount	6 46	11 42
*Cape Mezurado	6 13	11 17
Cape Baxos	5 28	10 7
Seſtos River	5 27	10 7
Cape Formoſa	5 8	9 39
*Cape Palmas	4 26	8 15
St. Andrew's River	5 2	6 45
Cape Laho	5 7	5 44
*Cape Appollonia	4 59	3 4
*Axim	4 52	2 36
*Cape Three Points	4 40	2 38
*Dix Cove	4 48	2 32
*Sakondee	5 0	1 51
*Elmina	5 2	1 34
*Cape Horſe Caſtle	5 4	1 20
*Devil's Hill	5 18	0 44 E.
*Anamaboe Fort	5 10	1 7
*Acra	5 30	0 16
*Tibberacoe	5 53	1 23
River Volta	5 53	1 25
Cape St. Paul	6 0	2 0
Whidah	6 13	2 45
Formoſa River	6 0	4 25
Cape Formoſa	4 30	5 22
New Callabar River	4 30	6 50
Cameron River	3 20	9 22
Cape St. John	1 5	9 20
Gabon River	0 0	9 23
C. de Lopas Gonſalvez	0 47 S	9 5
Seſto River	2 0	9 45
Alvary Bay	3 27	10 40

	Lat. D. M.	Long. D. M.
Congo River	4 17S.	12 54E.
Ambris River	8 55	13 13
Cape Ledo	9 50	12 3
St. Philip de Benguela	13 10	12 41
*Cape Negro, appears like Black Hommocks	16 27	12 44
Lies from	16 5	12 44
*Tiger's Island	16 30	12 0
Cape Frio	18 40	12 42
*Elizabeth's Bay	26 12	15 30
Cape Rostro de Pedro	22 26	13 22
*Angra Pequena	26 45	15 40
Cape das Voltas	29 0	10 45
*Walwick Bay, N. W. Point	23 0	14 0
Cape Descada	32 20	15 24
*St. Helen's Bay, C. St. Martin's	32 45	17 45
*Saldanah Bay	33 8	18 0
*Cape of Good Hope	34 29	18 29

Islands between Cape Verd, the Cape of Good Hope, and Cape Horn.

St. Paul's	0 54N.	26 40W
*Ferdinand Noronha	3 56S.	32 32
St. Matthew	1 33	7 30
Fernand de Po, N. P.	3 23N.	8 50E.
*Princes I.	1 44	7 35
*St. Thomas, Man of War's Bay	0 27	7 0
*Ditto, South P.	0 5	6 50
*Annabona	1 33S.	5 42
*Trinidad	20 15	30 30W
*Ascension	7 56	14 16
*St. Helena, James Town	15 55	5 46
Saxemburgh	30 41	19 15
*Tristan da Cunha	37 10	13 20
Diego Alvarez	39 20	11 2
*Gough's Island	40 3	2 30
Falkland I. N. E. P.	51 50	63 30
Ditto, S. W. Point	51 0	66 5
*Island of Georgia	54 30	37 30

From the Cape of Good Hope to Canton.

*Cape of Good Hope	34 29 S.	18 29E.
False Cape	34 16	18 50
Cape Aguilias	34 44	20 15
*False Bay	34 10	18 39
Bay St. Braze	34 28	21 59
Cape Talhado	33 27	24 7
*Algoa Bay	33 30	26 35
Cape Delgado, Muscle-Bay	33 38	24 10

	Lat. D.M.	Long. D.M.
*First P. of Natal	32 11S.	28 51E.
*Middle P. of Natal	30 45	30 20
Port Natal	29 50	30 57
Smoaky Cape	27 7	32 15
Cape St. Mary, Entrance of Delagoa Bay	25 51	33 16
Cape Coriantes	23 37	36 35
Cape St. Sebastian	21 35	36 25
Sofala	20 15	35 32
Angoxa	16 11	39 27
Judda	21 29	39 26
*Mozenbique	14 56	40 29
Cape Delgado	10 6	41 15
Giuloa	8 41	39 40
Mombas	3 34	41 30
Melinda	2 45	41 47
*Magadosha	2 20N.	46 25
Cape Bassas	4 50	49 2
*Cape Orfui	10 27	51 38
*Cape Guardafui	11 47	51 35
*Cape Babelmandel, Entrance of the Red Sea	12 38	43 47
*Cape Fartaih	15 29	52 5
*Cape Aden	12 45	45 17
Cape Morebet	17 16	54 19
*Socotra I. East P.	12 18	54 23
Ditto, West. P.	12 45	53 2
*Cape Pedro	17 54	55 27
*Moka in the Red Sea	13 17	43 17
Cape Isoclette	19 4	57 18
Great Mazeira I.	20 15	58 31
Cape Rofelgate	22 36	59 54
Muscat	23 30	58 16
Cape Jask	25 57	57 15
C. Museldon, Entrance to the Gulf of Persia	26 17	56 17
Cape Birdistan	28 0	51 8
Gambaroon	27 18	56 6
Cape Monze	25 0	66 18
*Bassora	30 31	47 32
*Point Gigat	23 30	68 35
Diu Point	20 44	69 50
Cambaye	22 36	72 17
Surat	21 10	72 26
Cape St. John	20 6	72 34
*Bombay	18 57	72 43
Dabul	18 0	73 29
*Goa	15 31	73 55
Barcelore	13 53	75 2
Mangalore	13 0	75 35
Mount Dilly	12 5	75 35
*Cochin	9 53	76 27
*Cape Comorin	7 57	77 32
Dondra Head, South P. of Ceylon	5 47	81 2
*Trincomaley	8 35	81 27
Point Pedro	9 57	80 39
Point Calymere	10 13	79 54
*Negapatnam	10 32	79 53
*Pondicherry	11 42	79 59
*Fort St. David's	11 29	79 54
*Madras	13 5	80 35
Point Divy	16 2	81 29
*Masulipatnam	16 16	81 24
*Coringa Bay	16 58	82 30
*Point Gordewere	16 45	82 37

	Lat. D.M.	Long. D.M.
*Visagapatam —	17 46N.	83 35E.
*Ganjam —	19 25	85 7
*Jagernaut Pagoda	19 40	85 57
*Black Pagoda —	19 51	86 10
False Point —	20 17	86 51
*Point Palmiras	20 44	87 10
*Kadgiree —	21 48	88 56
*Ballasore —	21 21	87 21
*Ingelee —	21 50	88 11
*Calcutta —	22 34	88 33
*Chandernagor	22 51	88 35
*Islamabad —	22 20	91 52
Aracan River	27 17	93 0
Cheduba Isle —	18 45	90 37
*C. Negrais —	16 8	94 9
*Gulf of Martaban	15 37	96 30
*Tavay Point —	13 37	97 41
*Junkseylon —	8 15	98 2
*Malacca —	2 12	102 11
*C. Romania —	1 15	104 5
*Siam, in the Gulf of Siam —	14 18	100 55
*Cambaja Point	8 45	103 45
Avarella Point —	12 54	107 50
*Pulo Canton	15 15	107 15
C. Norj or Turon —	16 4	106 30
*Macao —	22 13	113 52
*Canton —	23 8	113 8

Iſlands lying between the Cape of Good Hope and Cape Cameron.

		Lat. D.M.	Long. D.M.
St. Paul's I. —		37 51S.	77 56E.
Amsterdam —		38 15	78 0
*South P. Cape St. Mary's		25 33	44 55
North P. C. Ambro or Natal		12 2	50 19
*St. Augustin's B.		23 35	43 30
C. St. Vincent	Madagascar	21 45	43 37
C. St. Andrew's		16 6	45 32
C. St. Sebastian		12 30	49 44
Bay Antongil		16 0	50 38
I. St. Mary		16 54	50 36
*Foul Point		17 41	49 59
*Fort Dauphin		25 0	47 5
Baffes de India		22 20	41 30
Europa Rocks —		21 30	40 17
Juan de Nova		17 15	43 7
Suffex Rocks —		21 29	42 25
Bazaruto Iflands —		21 16	36 30
English Bank —		17 30	39 27
Chefterfield Shoal —		16 17	44 0
*Mayotto I. —		12 47	45 30
*Mohilla I. —		12 30	43 55
*Johanna I. —		12 15	44 35
*Comoro —		11 32	43 30
Portuguefe Shoals —		12 33	46 55
John Martin's I. —		10 9	43 15

	Lat. D.M.	Long. D.M.
Aldabra Iflands —	9 40S	46 55E.
Affumption I. —	9 46	47 37
Cofmoledo I. —	9 46	43 38
St. Peter's I. —	9 34	50 47
Natal I. —	9 35	47 15
Sandy I. —	9 16	48 12
Zanzibar I. —	6 10	40 45
Amirante I. N. W. P.	5 30	53 45
S. E. P.	6 30	55 0
Mahe I. N. W. P. —	3 50N.	54 5
S. E. P. —	5 20S.	56 30
*Ifle Bourbon —	20 52	55 36
*Mauritius —	20 10	57 35
*Diego Rais or Rodrigue	19 40	63 10
*St. Brandon —	16 34	62 50
Nazareth Bank, S. W. Point —	16 45	60 0
N. E. Point	13 35	61 44
Sandy Ifland —	15 10	55 5
*South Roquepiz —	10 30	64 32
John de Nova —	10 15	53 30
Providence I. —	9 15	53 32
St. Francis Ifles —	7 10	56 30
Peros Banhos —	5 30	72 20
*Diego Garcia —	7 30	72 35
Candu Ifles —	6 0N.	76 35
Adu Ifles —	5 30	76 20
Maldive Ifles, S. E. P.	0 40S.	74 55
N. W. P.	7 15N.	73 40
Malique Iflands —	8 15	73 29
Laccative Ifles, S. E. P.	10 0	72 45
N. W. P.	12 36	72 25

Iſles Eaſt of Cape Comorin.

	Lat. D.M.	Long. D.M.
*Ceylon, S. Point —	5 47N.	81 2E.
* N. Point —	9 57	80 39
*Trincomaley in ditto	8 35	81 27
Bale of Cotton Rock —	5 28	86 15
Preparis I. —	14 50	93 35
Cocos I. North P. —	14 21	93 10
*Great Andaman I. North P. —	13 30	92 30
South P.	11 22	92 35
Little Andaman, S. P.	10 15	92 45
Nicobar *Iſles*, N. P. —	9 25	93 7
South P.	6 51	94 17
Seyers *I.* —	7 35	95 30
Hog *I.* —	2 30	95 45
Pooloo Nyas —	0 57	97 2
Po Mintaon —	0 25S.	97 45
Good Fortune *I.* S. P.	1 57	99 49
Engona —	5 20	101 54
Poggy or Naffau, S. P.	3 15	100 25
Trompeufe —	5 33	102 30
Prince's *I.* Straits of Sunda — *	6 24	104 48
*Chriftmas *I.* —	10 30	104 27

	Lat. D.M.	Long. D.M.
Coco I.	21 45S.	98 30E.
*Java Head, or W. P.	6 45	104 55
* East P.	8 37	104 37
*Batavia in ditto	6 10	106 57
*Bally Straits, South Entrance	8 45	114 47
*Bally I. South P.	8 56	115 23
Lombock Straits	9 10	115 57
Straits of Mass	9 0	116 50
Straits of Sapy	8 30	119 32
Sandal Wood *I.*	9 45	120 0
Rotto *I.*	11 15	123 7
Timor *I.* West. P.	10 15	123 43
*Pulo Runda	5 59	95 39
*Pulo Way	5 49	95 33
*Pulo Brasse	5 38	95 21
*Sumatra, West P.	5 25N.	95 32
*Archer, in ditto	5 22	95 40
*Bencolen, in ditto	3 49S	102 6
*East Point	5 53	104 7

Islands in the China Seas to the Eastward of Java.

*Banca, N. P.	1 33S.	116 0E.
S. P.	3 4	106 17
*Luccpara, South Entrance to the Straits of Banca	3 12	106 10
North Entrance	2 0	105 5
Billiton, S. E. Point	3 6	108 15
Bintang, East Entrance to the Straits or Sincapore	0 18S.	105 15
Spirit *I.*	0 7 N.	106 30
St. Julian's *I.*	0 45	106 38
Timelan *I.*	1 0	107 15
Victory *I.*	1 28	105 55
Wood *I.*	1 34	105 47
Saddle *I.*	2 17	105 44
Anambas *I.*	2 47	106 15
Natunas *I.*	4 5	108 10
*Pulo Tinoy *I.*	2 30	105 45
*Pulo Aroe *I.*	2 30	104 35
*Pulo Timon *I.* S. P.	2 49	104 17
*Pulo Brata	4 45	103 30
Pulo Lazen	7 17	102 30
Ridang *I.*	6 20	102 37
*Pulo Uby	8 30	103 45
*Pulo Way	10 0	102 34
Two Brothers	8 32	105 37
*Pulo Condore	8 41	105 55
*Pulo Sapata	9 57	107 55
Elephant	11 0	113 10
Pitt's *I.*	10 55	114 11
South Sea Castle *I.*	11 30	112 17
Paracel's *I.* North P.	16 30	108 45
South P.	11 37	108 47
Macclesfield Bank, N. Point	16 0	113 36
South Point	15 15	113 45

	Lat. D.M.	Long. D.M.
Scarborough Rocks	15 0N.	117 12E.
Hainan, North Point	20 2	110 15
South Point	18 12	109 20
*Formosa, South P.	27 47	120 52
Pratas Rocks	20 30	116 15
Triangles Rocks, N. P.	17 0	111 6
S. P.	16 0	111 32
*Borneo, S. W. Point	2 45S.	109 28
*S. E. Point	4 15	114 25
*W. Point	0 0	108 45
* E. Point	5 15 N.	118 50
*N. Point	7 0	116 45
*Balambangan, Entrance to the Sooloo Sea	7 17	117 38
Banguey	7 17	117 30
*Palawan, S. Point	8 28	117 30
N. Point	11 20	119 46
*Sooloo *I.* E. Point	5 57	121 21
Celibes, S. Point	5 46S.	120 30
N. Point	2 0N.	124 0
Luconia, N. Point	18 45	120 45
*Manilla, in Luconia	14 36	120 59

NOTE. In these Seas there are many thousand Islands, so that it would be of no Use to lay them down here. Recourse must be had to the best Charts.

New Holland.

S. W. Cape	43 42S.	146 5 E.
S. E Cape	43 46	147 5
*St. Maria's Isles	43 20	148 10
*St. Patrick's Head	41 44	148 20
*Cape Howe	37 24	149 54
*Cape Dromedary	36 21	150 4
*Botany Bay	34 0	151 20
*Port Jackson	33 47	151 21
*Cape Hawke	32 13	152 28
*Smoky Cape	30 49	153 7
*Cape Danger	28 7	152 28
*Cape Morton	26 57	153 22
*Sandy Cape	24 45	153 2
*Keppel Bay	23 30	150 40
*Cumberland *I.*	20 30	148 45
*Cape Cleveland	19 10	148 5
*Cape Flattery	14 52	145 10
*Cape Conway	20 44	148 30
*Cape York	10 44	141 37
Van Diemen's Bay	10 30	130 15

New Guinea.

*Cape False	8 40S.	136 30E.
East Point	6 20	148 0
*Louisiade Isles, E. P.	10 35	154 0
West Point	8 30	148 30
*New Britain, East P.	4 53	153 9
West Point	6 0	148 20
*New Ireland, East. P.	5 0	152 30
West Point	2 20	148 20

Rocks and Shoals lying West of New Holland.

	Lat. D.M.	Long. D. M.
A Rock above Water	28 17S.	98 30E.
Cloates Islands	21 45	93 27
Tryal Rocks	20 40	104 30
Rosemary I.	20 30	110 45
Abrolhos Shoals	28 30	111 45
Kerguellen's Land	48 41	96 4

Islands in the Pacific Ocean, lying between New Holland and Cape Horn.

Formosa, South P.	22 5N.	120 50 E.
North P.	25 15	122 13
*Tayoan in Formosa	22 40	120 20
Great Liquee, S. P.	25 15	128 30
North-P.	28 0	128 30
Xuno I. South P.	31 30	131 50
North P.	34 45	131 30
Niphon, South P.	33 30	135 0
North P.	41 0	142 0
Metoosmace	42 50	140 30
*Kamschatka, on the Main, South P.	51 0	156 30
Beering's I. South P.	54 0	161 30
Ladrone Isles, Northernmost	21 0	114 6
Southernmost	8 0	114 6
*Pescadore Isles	10 30	164 0
Huahine I.	16 44S.	151 0W.
St. Bartholemi	14 20N.	156 30
I. St. Pierre	11 0	178 45
Sandwich Isles	17 41S.	168 39 E.
Northernmost	22 0	159 30W.
*Owhyhee, South P.	20 0	155 30
*Queen Charlotte I.	19 18	138 4
*New Hebrides, Quiros C.	14 56	167 26E.
Northernmost	14 30	156 45
Southernmost	20 30	169 30
*Ballabea I.	20 7	164 28
*New Caledonia, Pudgona	20 18	164 47
*C. Colenet	20 30	165 2
*Charlotte's Foreland	22 15	167 20
North P.	20 0	158 30
*C. Coronation	22 5	167 14
*Friendly Isles, Northernmost	19 30	174 15W.
Southernmost	21 30	175 10
*Society Isles, N. W. End	17 30	152 0
*Otaheite, Oaitipcha Bay	17 46	149 8
*Hood's I.	9 26	138 46

New Zealand.	Lat. D.M.	Long. D.M.
*Dusky Bay	45 47S.	166 24E.
*Pallifer's C.	41 38	175 24
*C. Farewell	40 37	172 47
*Turnagain C.	40 26	178 3
*North C.	34 10	167 10
*South C.	47 20	167 30
*Sandwich Land, N. P.	57 30	27 30
*South ditto	60 0	27 27

From Calais to the Scaw.

*Calais	50 57N.	1 57E.
Gravelines	51 0	2 15
*Dunkirk	51 2	2 28
*Newport	51 8	2 51
*Ostend	51 14	3 2
Walcheren I. West. P.	51 32	3 26
Goree I.	51 53	3 58
Schowen I.	51 47	3 43
*North Gatt	52 1	4 9
*Rotterdam	51 56	4 34
*Amsterdam	52 23	4 51
Texel	53 10	4 52
Bremen	53 23	10 23
Elbe River, Entrance of	54 4	10 1
Hilige Land Light	54 11	9 37
Holmen	57 1	8 38
Robsnout	57 30	9 49
Scaw	57 42	10 43

From the Naze to Petersburg.

*Naze of Norway	47 59 N.	7 13E.
Fer Light	59 20	10 8
Christiana	59 50	10 20
Frederickstad	59 10	10 35
Paternosters	57 54	11 32
Marstraud Light	57 54	11 40
Wingo Beacon	57 38	11 42
Gothernburgh	57 42	11 45
Lessou I. East P.	57 20	11 9
West. P.	57 17	10 51
Trindelen Rock	57 28	11 15
Kummel Bank	57 27	11 21
Nidigen Light	57 18	12 1
Warberg	57 7	12 19
Falkenburgh	56 54	12 34
Halmstad	56 40	12 56
Halland's I. Wadero	56 26	12 36
Koll Light	56 19	12 33
Anholt Light	56 44	11 30
Hasselo I.	56 12	11 48
Hielm I.	56 10	10 54
Cronenburgh Light	56 3	12 42
*Elseneur	56 1	12 41
Huen I. North P.	55 55	12 44
*Landicrone	56 8	12 5
*Copenhagen	55 41	12 41

	Lat. D.M.	Long. D.M.
Saltholm, North P.	55 41 N.	12 51 E.
Falstrebo Light	55 21	12 53
Lubek	53 51	10 50
Dars Head	54 28	12 40
Barnholm I. N. E. P.	55 19	14 54
S. W. P.	54 57	15 17
*Dantzick	54 22	18 40
Oland, North P.	56 11	16 29
South P.	57 24	17 9
Gotland, North P.	56 55	18 16
South P.	57 55	19 37
Geltske I.	58 16	19 27
Memel	55 24	21 6
Swaferort Lights	57 55	22 1
Domes Ness Lights	57 48	22 30
Runoe Light	57 49	23 12
Riga	57 2	23 45
Dagerort Light	58 56	22 3
Hengo Light	59 49	23 2
*Stockholm	59 21	18 9
*St. Petersburgh	59 56	30 25

From the Naze to Archangel.

*The Naze	47 59 N.	7 13 E.
Jadder, or Walbert's Hd.	58 34	5 55
Lister Land	58 9	6 45
Rutt's I.	58 42	5 58
Great Wylingsoe Light-House	58 56	5 50
Stavanger	58 56	6 5
Utter's I.	59 24	5 20
*Bergen	60 12	5 50
Mes Sound	60 18	5 30
Sillewoog I.	60 36	5 21
Kate Note	61 25	5 42
*Drontheim, Var. 2 P. West	63 26	11 10
*Werro I. Var. 1½ P. West	67 43	9 7
*North Cape, Var. 1 P. West	71 10	26 10
Fisher's I. Var. 1 P. W.	70 27	33 25
Kildume I. Var. ¾ P. West	69 30	35 45
*River Kola, Entrance, 1 Var. ¼ P. West	69 25	35 35
Sweetnose, Var. ½ P. W.	69 14	36 30
Cross I. Var. ½ P. W.	66 32	40 33
Ponoy R. Var. ½ P. W.	66 53	39 46
*Archangel, Var. ¼ P. West	64 30	39 0
Catnose	65 27	38 30
C. Bars	66 30	41 50
C. Candinose	68 45	43 15
Weigate's Straits	69 30	62 2
Nova Zembla	78 0	70 0

The Coast of Iceland.

	Lat. D.M.	Long. D.M.
Reikianess C.	63 55 N.	22 40 W.
Westman's I.	63 2	21 4
Palrixfiord	65 36	24 4
*Straumness	65 40	24 26
North Cape	66 34	23 5
Grims I.	67 0	21 41
*Rikefiord	67 0	17 30
Long Nose	66 45	12 14
Balaness	66 2	12 16
Enchuison I.	65 0	10 0
Engelhoait	64 32	12 14
Wreeland I.	64 5	13 14
C. Hekla	63 22	16 49

The Coast of Greenland.

*John or Manen's I.	71 10 N.	9 44 W.
Gael Hamkes Bay	75 0	6 45
Bontokoe I.	73 27	9 30
Charn P.	70 5	22 17
Dangey I.	67 23	27 19
Herjolfs Ness	65 3	30 19
Whales I.	62 30	39 3
C. Discord	60 50	39 55
C. Prince Christian	59 55	41 30
*C. Farewell	59 33	42 38
C. Desolation	62 0	46 7

Davis's Straits.

C. Resolution	62 40 N.	46 38 W.
C. Comfort	62 45	47 30
Hope Harbour	63 55	47 50
Gilbert's Sound	64 15	47 53
Cooken Sound	64 50	47 58
K. Christian's River	65 7	47 8
Musketto Cove	64 55	52 51
Romel Fort	67 22	45 53
Disco I. S. W. Point	69 6	44 38
Waygate I.	70 40	44 8
James's I. C. Bedford	68 30	50 8
Cumberland I. S. P.	66 0	60 30
Bay of Good Fortune	64 20	61 29
C. Elizabeth	62 5	64 30
Resolution I. C. Warwick	61 4	64 30

Hudson's Bay.

Button's Isles	60 47 N.	65 16 W.
Lowe's Savage I.	61 48	66 20
Terra Nieva	62 4	68 0
Saddle Back I.	62 10	68 10
Great Bear I.	54 4	79 56

	Lat. D.M.	Long. D. M.
Ice Cove	62 0 N	69 0 W
Baker's Dozen	57 0	
Great Savage I.	62 25	70 0
North Bluff	62 26	71 10
God's Mercies	62 28	70 48
Salisbury I.	63 20	76 50
Nottingham, E. End	63 35	76 45
C. Charles, East End	62 50	74 15
West End	62 40	76 0
Burgeo Isles	47 36	57 36
C. Walsingham	62 40	78 0
C. Diggs	62 45	78 48
Mansfield, North End	62 40	78 0
South End	61 35	81 30
Sleepers I.	60 10	81 30
Great ditto	58 35	81 30
C. Pembroke	62 57	82 10
Large Swan's Nest	62 20	83 30
C. Southampton	62 10	86 10
Churchill River	58 47	94 7
Charlton I.	52 3	79 5
Port Nelson's Shoals	57 35	92 30
Hay River	77 10	93 0

From Hudson's Bay to Quebec.

Button's Islands	60 47 N.	65 16 W
Black Head	59 50	63 32
False Black Head	59 20	69 14
Cardinals I.	58 50	62 55
Steel P.	58 7	61 45
East I.	57 45	61 15
Sadel Islands	57 13	60 45
Inchanted Cape	59 40	60 50
St. Peter's Harbour	56 28	60 45
C. Harrison	54 54	56 45
Great Bay of Eskimaux	54 20	57 30
C. Charles	52 13	55 25
York Point	51 57	55 52
Red Bay	51 44	61 25
Black Bay	51 40	56 22
Red Cliffs	51 33	55 45
Forteau Bay	51 30	56 55
Grant Point	51 24	57 12
Esquimeaux Bay	51 28	57 45
Haha Bay	50 52	59 2
Great Mecatina P.	50 42	59 8
Little Mecatina Islands	50 28	59 27
Mount Joli	50 5	61 30
Esquimeaux Islands	50 12	63 0
Mingan I.	50 16	63 15
Grand Bay, St. John's	50 22	64 0
The Seven Island Bay	50 7	65 45
Trinity Bay	49 37	66 27
St. Nicholas's Bay	49 28	67 0
Laval Bay	48 55	68 0
Bay of Rocks	48 5	68 33

	Lat. D.M.	Long. D.M.
St. Paul's Bay	47 30 N	69 10 W
Quebec	46 55	69 46
Bell Isle, Var. 20° 30' West	51 55	55 25
Quirpon Harbour	51.40	55 34
St. Anthony's Cape	51 17	55 39
Hare Bay	51 15	55 56
Groais I.	50 55	55 40
Green I.	50 47	55 30
Hooping Harbour	50 46	56 13
White Bay	50 15	56 20
Horse Islands	56 21	56 46
C. St. John	56 10	55 33
Bay of Notre Dame	50 0	55 30
Twillingate Islands	50 3	54 35
Fogo I.	50 0	53 49
Gander Bay	49 40	54 10
Wa. ham Islands	49 54	53 25
C. Freels	49 34	52 55
Funk I.	50 1	52 12
Barrow Harbour	48 50	53 0
C. Bonavista	48 52	53 35
Trinity Bay	48 30	53 0
P. of Grates	48 22	52 30
C. St. Francis	47 54	52 25
*St. John's Harbour	47 32	52 20
C. Spear	47 30	52 15
Bay of Bulls	47 21	52 24
C. Broyle	47 7	52 30
C. Ballard	46 49	52 37
C. Race	46 42	52 44
C. Pine	46 40	53 15
St. Mary's Bay	46 50	53 30
C. St. Mary's	46 52	54 2
Bay of Placentia	47 0	54 30
Chapeau Rouge	46 52	55 17
St Peter's I.	46 36	36 6
Langley I.	46 42	36 15
Great Miquelon	46 55	56 16
Burnet	47 15	55 56
Fortune Bay	47 16	55 30
Penguin's Islands	47 24	57 0
Runney I.	47 32	57 25
Great Barrisuay	47 37	57 40
*Burges I.	47 32	57 37
C. Ray, Var. 20° West	47 37	59 10
God Roy I.	47 52	59 18
C. St. George, Var. 19° W.	48 30	59 8
South Head	49 7	58 21
Cape St. Gregory, Var. 22° 40' West	49 22	58 12
Bay St. Paul	49 50	57 50
Ingornachoix Bay	50 38	57 22
St. John's I.	50 50	57 18
Point Ferolle	57 3	57 6
Bay St. Barbe	51 15	56 48
C. Norman	51 40	55 57
Limits of the Great Bank of Newfoundland, North P.	50 15	49 45
South P.	41 0	52 0
Outer Bank	47 0	45 0

The Gulf of St. Lawrence.

	Lat. D. M.	Long. D. M.
St. Paul's I.	47 11 N	59 55 W
Bird Islands	47 55	60 36
Brion I.	47 52	60 55
Magdalen I. N. E. P.	47 41	60 55
S. W. P.	47 12	61 36
Entry I.	47 15	61 15
Deadman's I.	47 15	61 48
I. of Anticosta, E. P.	49 8	61 34
S. W. ditto	49 22	63 18
West ditto	49 48	64 18
North ditto	49 53	63 58
Ida Bik, in the R. St. Lawrence	48 32	67 50
Mount Camille	48 37	67 15
C. St. Ann	49 3	66 0
Magdalen R.	49 13	65 18
C. Rozire	48 47	63 56
C. Gaspe and Bay	48 41	63 53
Flat P.	45 34	63 53
I. Bonaventure	48 28	63 53
C. Despair	48 24	64 1
Miscou I. Entrance of Chaleur Bay	48 0	64 16
P. Escuminac	47 1	64 37
St. John's I. N. Cape	47 2	63 49
West Point	46 34	64 11
East ditto	46 27	61 48
Bear Cape	46 0	62 13
Hillborough Bay	46 6	62 55
C. St. George or St. Lewis	45 51	61 44
Gut of Cansor, North Entrance	45 42	61 22
Justan Corp I.	45 56	61 22
Port Hood	45 57	61 20
C. North, I. off Cape Breton	47 1	60 10
Port Dauphin, ditto	46 23	60 13
Spanish Bay, ditto	46 18	59 57
Flint I.	46 11	59 33
Scatari I.	46 2	59 27
C. Breton	45 57	59 39
Louisburg	45 54	59 49
C. Hinchinbroke	45 34	60 24
I. Madam	45 29	60 44
Gut of Cansor, South Entrance	46 28	60 46
Chedabucto Bay	46 23	60 46

From Cape Cansor in Nova-Scotia to Cape Florida.

	Lat. D. M.	Long. D. M.
Sable I. East Point	44 8 N	59 55 W
West ditto	44 4	60 30
C. Cansor, Var. 15° W.	45 16	60 50
Port Howe	45 13	61 0
Torbay	45 12	61 11
Sandwich Bay	45 8	61 31
Port Stephens	45 0	61 53
Hallifax Harbour	44 36	63 23
C. Sambro Light-house	44 30	63 27
Charlotte Bay, Var. 14° West	44 34	63 50
Port Jackson	44 13	64 22
Isle of Hope	43 53	64 39
Port Roseway	43 40	65 12
C. Sable, Var. 11° 15′ West	43 27	65 30
Seal Isles	43 27	65 55
C. Forchu	43 52	66 4
St. Mary's Cape, Var. 11° 45′ West	44 10	66 7
Breyer's I. Var. 11° 15′ West	44 19	66 20
Anapolis Royal	44 47	65 50
Hauto I.	45 19	64 4[illegible]
C. Chignecto, Entrance Bason of Mines	45 44	65 44
C. Spencer	45 17	65 50
Mocgone's I. Entrance of St. John's River	45 18	65 59
Entrance of St. Croix River	45 00	67 [illegible]
Island of Campo-Bello, (middle or West passage of Passamaquoddy Bay	44 50	67 4
Wolves'-Islands	44 48	66 50
E. end of Grand-Manan	44 40	66 50
Grand-Manan N. head	44 43	66 55
do. West end	44 30	67 4
do. S. W. Ledge of Seal-Rock	44 25	67 6
Quady-Head N. E. P.	44 43	67 5
Entrance of Machias River	44 35	66 56
Cross-Island off Machias Bay	44 31	67 23
Machias-Seal-Islands	44 27	66 52
Beal's Island S. Point	44 24	67 37

	Lat. D. M.	Long. D. M.
Little-Manan-Iſland	44 19 N	67 52W
Gouldſboro'-Harbour	44 20	67 56
Mount-Deſert-Rock	43 52	68 05
Cranbury-Iſland (near Mount-Deſert) -	44 14	68 12
Long-Iſland, South of Mount-Deſert or entrance of Blue-Hill-Bay - - - -	44 06	68 22
Iſle of Holt - - -	44 00	68 5
Caſtine (formerly Penobſcot) - - -	44 24	68 46
Matinicus-Iſland -	43 50	6[illegible] 56
Cape-Sable (S. point of Nova-Scotia) -	43 24	65 35
Wooden Ball Rock	43 45	68 55
Iſland of Manheigan	43 44	69 15
Pemmaquid-Point -	43 48	69 27
Townſend, or Booth-Bay entrance -	43 49	69 04
do. South point Rock	43 26	69 07
Bantum Ledges -	43 42	69 03
Kennebeck-River entrance - - -	43 43	69 42
Seguine Iſland - -	43 41	69 41
Cape-Small Point -	43 40	69 47
Caſhe's-Ledge, (ſhoaleſt part) - - -	43 04	69 06
Alden's-Ledge, off Cape-Elizabeth -	43 28	70 00
Brunſwick - - -	43 52	
Fort-Hill (Portland)	43 43	
Portland Light-Houſe	43 39	70 08
Cape-Elizabeth -	43 33	70 06
Saco River entrance -	43 23	70 17
Wood-Iſland off do.	43 27	70 15
Biddeford Town -	43 30	70 21
Agamenticus-Hill -	43 16	70 36
Cape-Porpoiſe - -	43 21	70 20
Wells Harbour - -	43 19	70 28
Bald-Head - - -	43 15	70 30
Cape-Neddock Nubble	43 10	70 31
York-River - -	43 07	70 33
Boon-Iſland - - -	43 06	70 26
Boon-Iſland-Ledge	43 04	70 22
Portſmouth Light-Houſe - - -	43 04	70 39
Portſmouth - - -	43 05	70 41
Iſle of Shoals - -	43 00	70 33
Newbury-port Lights on Plumb-Iſland	42 48	70 46
Ipſwich Entrance -	42 43	70 44

	Lat. D. M.	Long. D. M.
Squam (Pidgeon Hill)	42 40 N	70 36W
Sandy Cove (or Bay)	42 40	70 34
Cape Ann light-houſes on Thatcher's Iſland	42 38	70 33
Eaſt Point of Cape Ann Harbour - - -	42 35	70 39
Light-houſe on Baker's Iſland - - -	42 33	70 46
Beverly - - - -	42 33	70 50
Salem - - - -	42 32	70 50
Marblehead - - -	42 30	70 49
Nahant Point (N. E. Point of Boſton harbour) - - -	42 27	70 52
Boſton Light-Houſe -	42 21	70 53
Boſton - - - -	42 23	70 58
Cape-Cod - - -	42 05	70 14
Cape-Cod Light-houſe	42 05	70 14
Sandy Point or Malabar	41 34	70 00
Shoal of George's, E. end	41 45	68 22
do. of do. W. end	41 35	68 54
Nantucket Great round Shoal - - - -	41 25	69 55
Nantucket light-houſe	41 16	70 04
Sancoty-head or Nantucket-Iſland -	41 16	69 49
Tom-Nevers-head	41 14	70 00
Nantucket ſouth-ſhoal	40 44	69 55
Cape-Poge -	41 25	70 27
Squibnocket--Head (ſouthweſterly part of Martha's-Vineyard)	41 19	70 48
Gay-Head (Weſt end of the Vineyard)	41 22	70 53
Noman's-Land-Iſland	41 16	70 52
New-Bedford	41 41	70 57
Buzzard's Bay entrance	41 28	70 58
New-Port entrance	41 29	71 23
Rhode-Iſland Light-Houſe - -	41 28	71 30
Point-Judith	41 24	71 33
Block-Iſland (Middle)	41 10	71 40
Montock-Point, Eaſt End of Long-Iſland	41 04	72 01
New-London, or entrance of Thames-River - -	41 22	72 16
Norwich on do.	41 34	72 29
New-Haven entrance	41 18	72 57
New York light-houſe on Sandy-Point -	40 28	74 07
Pert -Amboy -	40 35	

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	Lat. D. M.	Long. D. M.
Little-Egg-Harbour	39 30 N	74 23 W
Great-Egg-Harbour	39 18	74 33
Cape-May -	38 57	74 55
Cape-James -	38 47	75 08
Light-house on Cape-Henlopen -	38 46	75 07
False-Cape -	38 27	75 08
Cape-Charles •	37 11	76 10
Cape-Henry -	36 58	76 17
Norfolk (Vir.) -	36 55	76 37
Petersburgh (Vir.)	37 14	77 54
York-Town (Vir.)	37 12	76 52
Richmond (Vir.)	37 30	77 50
Annapolis (Mar.)	39 00	
Alexandria (Vir.)	38 55	
Chincoteague-shoals, on Maryland-Shore	38 00	75 05
Baltimore - -	39 20	76 50
Roanoke Inlet -	35 47	76 08
Cape-Hatteras Shoals, South-West point	34 48	76 00
Cape-Hatteras -	35 08	76 7
Occacocke Inlet -	34 54	76 28
Newbern (N. C.)	35 14	
Beaufort (N. C.)	34 42	
Cape-Lookout -	34 22	77 06
Shoals off do. S. part	34 12	77 01
Gore-Sound (or entrance to Beaufort)	34 28	77 18
Bouge Inlet -	34 33	77 38
Bear do. -	34 32	77 42
New-River do. -	34 27	77 52
Top-sail do. -	34 18	78 04
Wilmington (N. C.)	34 11	78 21
Petersburgh (Geor.)	33 46	81 32
Cape-Fear -	33 50	78 25
S. end of do. Shoals	33 40	78 23
Fryingpan-Shoals off ditto.	33 30	78 17
George-Town -	33 14	79 07
Shoals off do. -	33 10	79 03
Cape-Roman -	33 03	79 24
Charleston light-house	32 44	80 02
North Eddisto Inlet	32 33	80 16
South Eddisto do.	32 30	80 24
Beaufort (S. C.) -	32 28	
Port-Royal -	32 05	80 52
Tybee-Light -	32	80 57
St. Catherine-Sound	31 37	81 18
St. Simon's Sound	31 01	81 48
Brunswick (Geor.)	31 10	
Amelia Sound (or entrance of St. Mary's river)	30 35	82 0

	Lat. D. M.	Long. D. M.
Talbert's Island (Geo.)	30 20 N	82 00 W
River St. John (Ent.)	30 09	81 55
St. Augustine	29 40	81 45
Augustine-Bay	29 41	81 49
Cape-Canaverel -	28 12	80 52
Shoals off do. -	28 15	80 47
Cooper's Hill (eastern-most part of East Florida) - -	26 42	80 23
Cape Florida -	25 44	80 34
Dry-Tortuga-Shoals	24 22	83 10
Cape-Sable -	25 00	81 37
Charlotte Harbour	26 43	82 55
Spiritu Santo Bay -	27 46	83 22
Bay of Apalache -	29 40	83 35
Cape-St. Blaze -	29 35	85 00
Pensacola-Bar -	30 20	86 42
Mobille-Point -	30 15	87 21
Mouth of the Mississippi River - -	29 00	88 37
I. of Bermudas, Saint George's Town -	32 45	63 30
N. W. Point	32 25	63 25
S. W. Point	32 11	63 40

NOTE. This Island is surrounded with dangerous Rocks at six or seven Miles distance, especially on the North Side.

Islands in the West-Indies.

Trinidada, N. E. P.	10 45 N	60 36 W
Tobago, N. E. ditto	11 29	59 57
S. W. ditto	11 5	60 49
Greneda, N. E. Pt.	12 14	61 49
S. W. ditto	11 57	62 19
Greneda Bank, Middle	11 55	62 45
Barbadoes, S. Point	13 7	59 45
E. ditto -	13 12	59 37
Bridge Town	13 9	59 51
N. W. Point	13 22	59 52
St. Vincent, N. Point	13 12	61 16
S. ditto -	13 4	61 15
St. Lucia, S. Point	13 30	61 0
N. ditto -	13 56	60 46
Martinico, S. E. Point	14 24	60 57
Dimond ditto	14 24	61 1
Port Royal	14 36	61 4
W. Point	14 25	61 14
N. E. ditto	14 58	61 0

	Lat. D. M.	Long. D. M.
Dominica, S. Point	15 15 N	61 20 W
N. ditto	15 29	61 25
Marigalante, N. E. P.	16 4	61 0
S. E. ditto	15 53	60 59
Guadaloupe, S. Point	15 54	61 43
N. ditto	16 30	61 42
Grandeterre, S. E. P.	16 15	61 4
N. ditto	16 41	61 25
Deseada, N. E. Point	16 24	60 56
S. W. ditto	16 18	61 3
Antigua, E. Point	17 3	61 45
Montserrat, N. E. P.	16 47	62 12
S. W. ditto	16 40	62 15
Redondo Island	17 3	62 20
Nevis	17 17	62 28
St. Christopher's, S. E. Point	17 16	62 31
N. W. ditto	17 26	62 42
St. Eustatia, the Town	17 29	63 4
Saba	17 39	63 8
Aves Island	15 33	63 35
Bermuda, S. E. Point	17 50	61 45
St. Bartholomew, E. P.	17 56	62 34
W. ditto	17 54	62 51
St. Martin's, E. Point	18 3	62 50
W. ditto	18 40	63 7
Anguilla, N. E. Point	18 22	62 46
S. W. ditto	18 9	63 5
Prickly Pear	18 20	63 10
Sambero	18 26	63 21
Anegado, E. Point	18 36	63 50
W. ditto	18 41	64 1
St. Croix, E. Point	17 36	63 40
W. ditto	17 44	64 25
Virgin Gordia, E. Point	18 18	63 40
The Fort	18 18	63 54
Tortola, E. Point	18 21	64 27
W. ditto	16 18	64 39
St. John's, S. Point	18 5	64 40
St. Thomas, E. ditto	18 25	64 41
The Town	18 22	64 46
Porto Rico, N. E. Pt.	18 39	65 39
S. E. ditto	18 10	65 38
N. W. ditto	18 41	67 46
S. W. ditto	18 11	67 45
La Mona I.	18 10	68 24
Hispaniola, or St. Domingo ——		
Cape Enganno	18 27	68 47
Soona I. E. Point	17 55	
* Altavila Rock, off ditto	17 23	71 35
Anacon Point	17 52	73 30
* Porto Prince	18 40	72 10

	Lat. D. M.	Long. D. M.
C. Tiberon	18 15 N	74 20 W
* Fort St. Louis	18 19	73 15
Navaza I.	18 18	74 55
C. Dona Maria	18 38	74 22
* Petit Grove	18 27	72 45
C. Nicolas	19 46	73 25
* The Mole	19 49	73 25
Tort das, E. Point	20 2	73 32
W. ditto	20 5	72 54
Monte Christo	19 56	71 39
* Old C. Francois	19 40	69 57
* C. Samana	19 15	69 10
C. Raphael	18 56	69 0
Island of Jamaica		
Morant P. E. end	17 58	75 37
* Port Royal	18 0	76 40
Portland Point	17 44	77 2
Carlisle Bay	17 50	77 15
Pedro Bluffs	17 52	77 35
Black River	18 5	77 40
Savannah la Mar	18 15	78 6
Negril Point	18 17	78 31
Montego Bay	18 40	77 52
St. Ann's Harbour	18 39	76 56
Portia Maria	18 32	76 35
Port Anthony	18 25	76 5
Islands and Shoals lying off Jamaica		
Morant Keys, E. P.	17 35	75 25
W. ditto	17 27	75 48
Pedro Shoals E. P.	17 20	77 1
Little Cayman, S. W. ditto	19 32	80 10
Great Cayman, S. W. ditto	19 11	81 8
N. ditto	19 18	
Swan I. S. W. ditto	17 12	83 30
Mesteriosa Shoal	18 0	83 50
A dry Bank	18 36	73 15
Pracel Shoal	18 50	84 20
Island of Cuba,		
C. Mayze	20 16	74 4
St. Jago	19 55	75 35
Cabo de Cruz	19 42	77 52
I. of Pines, S. W. Point	21 20	83 12
C. Corientes	21 46	84 57
Middle Cape	21 44	84 34
C. Antonio	21 49	85 15
Colorados Rocks, N. W. P.	22 30	85 14
Havannah	23 12	82 12
Matanzas	23 12	81 15

	Lat. D. M.	Long. D. M.
Iſlands & Shoals North of Cuba and Jamaica		
Eaſt Reef - -	20 12 N	68 43 W
North Reef, E. Point	20 18	69 10
W. ditto -	20 31	69 32
The Triangle -	20 40	69 48
Square Handkerchief, N. E. Point -	21 35	70 14
S. W. ditto	21 5	70 43
Grand Turk's I. N.E. ditto - -	21 42	70 49
TheGreatCaycos, S.P.	21 20	71 30
S. E. ditto	21 43	71 17
W. ditto -	21 40	72 24
Heneaga, N. E Point	21 35	72 59
W. ditto -	22 4	73 40
Little Heneaga, S. W. Point - -	21 42	72 56
N. ditto -	21 56	72 50
Hogſtye's, the Middle	21 44	73 50
Mayaguana, E. Point	22 44	72 33
N. Point -	22 51	72 53
S. W. ditto	22 45	72 55
French Keys, -	22 51	73 27
MiraperoosKeys, S. P.	22 14	74 18
Caſtle I. or South Key	22 20	74 0
North Key Crooked I.	23 14	74 2
Atwood'sKey, N. E. P	23 29	73 25
Key Verde, S. W. do.	22 12	75 10
The Brothers -	22 38	75 0
Long I. S. part -	22 48	74 34
N. ditto -	23 38	74 45
Rum Key -	23 54	74 15
Watland' I. S. Part	24 0	73 55
Little I. its Centre	24 4	74 30
Cat I. S. Part -	24 4	74 44
N. ditto -	24 39	75 12
Exuma, E. ditto -	23 54	75 10
Eleuthera, Powel's Pt. or S. Part -	24 45	76 10
Egg I, or W. Part	25 35	77 10
NewProvidence, W.P.	21 56	78 5
*Naſſau Town in ditto	25 4	77 45
W. P. of ditto	24 57	78 3
Andros I. S. Point	24 5	78 0
N. ditto -	25 15	78 30
Frozen Key -	25 22	78 0
The Hole in the Wall	26 10	77 40
Little Bank of Baham. N. W. Point -	27 45	79 44
Sandy Key	26 33	79 34
Great Iſaac -	26 0	79 47
Little ditto -	26 5	79 11
Cat Keys Harbour	25 10	79 56

	Lat. D. M.	Long. D. M.
Orange Key -	24 43 N	79 36 W
Double-Headed Shot Keys, W. Point	24 0	80 10
Key Sal -	23 31	80 3
Anguilla, E. Part	23 22	78 43

From Cape Florida to Cape Horn.

	Lat. D. M.	Long. D. M.
*C. Florida -	25 44 N	80 44 W
*Dry Tortugas Shoals, S. W. Point -	24 32	83 40
C. Sable - -	24 57	81 52
C. Roman - -	25 42	82 36
*Charlotte Harbour	26 43	82 24
*Spiritu Santo Bay	27 36	82 54
Bay of Apalache -	29 40	85 0
C. St. Bláze -	29 35	85 44
Penſacola Bar -	30 15	87 34
Mobile P.int -	30 11	88 35
*New Orleans -	29 58	89 53
Mouth of R. Miſſiſippi	29 13	89 27
Mouth of Rio Brava	26 7	90 49
New St. Ander -	23 46	90 27
C. Roxo -	21 57	99 42
*Vera Cruz -	19 12	97 24
Campeche -	19 41	92 54
Praceles Shoals, N. P.	23 50	88 54
*C. Catoche -	21 33	87 26
*Loggerhead Key	21 38	87 14
Falſe C. - -	21 28	87 14
Cozumel I. S. Point	20 3	87 34
North Triangles, S. P.	18 25	87 26
N. Point -	19 5	87 27
Key Bokel -	16 27	88 14
Glovers Reef, N. Part	16 52	87 47
S. ditto -	16 33	88 17
Utila, E. Point -	16 11	87 27
Rattan I. E. Point	16 25	86 30
Bonacca I. N. E. ditto	16 29	85 55
C. Honduras	16 1	86 9
C. Cameron	16 0	85 4
Black River	15 56	85 4
C. Dias Gracias	15 1	82 50
Triangles, S. Part	16 30	79 55
N. ditto	17 0	80 53
Sand Key, N. Part	16 30	78 20
St. Andrew's I.	12 32	80 50
Corn Iſlands, N. Part	12 10	82 2
St. John's Point	10 33	82 50
*Porto Bello	9 33	79 44
Gulf of Darien	8 40	76 40

TABLE IV.

	Lat. D. M.	Long. D. M.
*Carthagena	10 27 N	75 21 W
*St. Martha	11 27	73 59
C. de la Vala	12 10	71 53
Monjes Iſlands	12 23	71 21
C. Coquibacoa	12 5	71 21
Aruba I. E. Point	12 9	69 25
Curacoa I. N. Point	12 25	69 7
C. St. Roman	11 30	69 30
*Point Cabello	10 31	67 26
*Aves I. S. Part	11 54	67 13
Roca I	11 45	66 17
Orchilla I. S. Part	11 44	66 3
SaltTortuga, E. ditto	11 0	64 44
Blanca I. N. ditto	11 40	63 56
Margarita I. N. E. P.	11 10	63 13
N. W. ditto	11 3	63 46
C. Three Points	10 19	62 25
Oroonoco River	8 25	59 26
Eſſequebo River	6 30	58 30
Surinam River	5 52	55 2
*Cayenne	4 56	52 10
C. North	1 48	49 57
Mouth of R. Amazon	0 18	51 30
St. Louis de Maranhan	2 15 S.	46 34
C. Baxas	3 0	42 26
C. St. Reque	5 1	36 17
Pernambuca or Plende	8 0	35 0
C. St. Auguſtine	8 32	35 0
St. Franciſco River	11 0	36 15
St. Salvadore	12 46	38 38
Porto Seguro	16 36	39 30
Abrolhos Banks	18 0	38 30
Eſpiritu Santo	20 0	39 45
C. St. Thome	21 51	40 20
C. Frio	22 35	41 15
*Rio Janeiro	22 54	42 31
Grande I.	23 15	43 30
Santos	24 4	45 30
St. Catherine's I.	27 15	49 0
Porto St. Pedro	31 44	51 17
*C. St. Mary, North Entrance to R. Plate	34 45	54 10
C. St. Anthony, S. Entrance to ditto	36 31 S	58 27 W
Beunos Ayres in ditto River	34 35	58 25
C. La Matas	45 0	65 45
C. Blanco	47 20	64 36
Bay St. Julian	49 10	68 38
Straits of Magellan	52 35	67 45
C. Succeſs	55 1	65 21
Staten I.	54 40	64 30
C. Horn	55 58	67 20

The Weſt Coaſt of America, from Cape-Horn to Behring's Straits.

	Lat. D. M.	Long. D. M.
Cape Horn	55 58 S	67 20 W
Barnwell's I.	55 49	66 52
C. Diego	54 33	64 6
Juan Fernandez I.	29 54	71 22
Arica	18 29	71 5
Conception Bay	36 43	72 34
Lima	12 1	76 43
Gallapagos Iſles	23 30 N	85 0
Panama	8 48	80 15
Aquapulco	17 10	101 40
C. Corientes	22 20	107 0
California, S. Point	23 30	109 30
Nootka, or Saint George's Sound	49 36	126 42
Pr. William's Sound	61 5	147 15
Cook's River	59 0	152 0
C. Grevill	57 30	153 0
Alaſka, S. Point	54 45	163 10
Shallow-Water P.	63 0	162 45
C. Stephens	64 21	162 15
Norton Sound	64 15	162 0
C. Rodney	64 35	164 24
C. Prince of Wales	65 45	168 13

A TABLE

OF THE

SUN's DECLINATION,

For the Year 1799.

Days.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	south	south	south	North	North	North	North	North	North	south	south	south
1	23. 0	17. 1	7.28	4.39	15. 9	22. 6	23. 7	18. 0	8.14	3.16	14.32	21.52
2	22.54	16.43	7. 5	5. 2	15.27	22.14	23. 3	17.45	7.52	3.40	14.51	22. 1
3	22.49	16.26	6.42	5.25	15.45	22.21	22.58	17.29	7.30	4. 3	15.10	22.10
4	22.42	16. 8	6.19	5.48	16. 2	22.28	22.53	17.13	7. 8	4.26	15.28	22.18
5	22.36	15.50	5.56	6.11	16.19	22.35	22.48	16.57	6.45	4.49	15.47	22.26
6	22.28	15.31	5.33	6.33	16.36	22.41	22.42	16.41	6.23	5.12	16. 5	22.33
7	22.21	15.13	5.10	6.56	16.53	22.47	22.36	16.24	6.	5.36	16.23	22.40
8	22.13	14.54	4.46	7.18	17. 9	22.53	22.29	16. 7	5.38	5.59	16.40	22.46
9	22. 4	14.34	4.23	7.40	17.25	22.58	22.22	15.50	5.15	6.21	16.57	22.52
10	21.55	14.15	3.59	8. 3	17.41	23. 3	22.15	15.32	4.52	6.44	17.14	22.58
11	21.46	13.55	3.36	8.25	17.57	23. 7	22. 7	15.14	4.30	7. 7	17.31	23. 3
12	21.36	13.35	3.12	8.47	18.12	23.11	21.58	14.56	4. 7	7.30	17.47	23. 8
13	21.26	13.15	2.49	9. 8	18.27	23.15	21.50	14.38	3.44	7.52	18. 4	23.12
14	21.16	12.55	2.25	9.30	18.41	23.18	21.41	14.20	3.21	8.15	18.19	23.15
15	21. 5	12.34	2. 1	9.51	18.56	23.20	21.32	14. 1	2.57	8.37	18.35	23.19
16	20.53	12.13	1.38	10.13	19.10	23.23	21.22	13.42	2.34	8.59	18.50	23.21
17	20.41	11.52	1.14	10.34	19.23	23.24	21.12	13.23	2.11	9.21	19. 5	23.24
18	20.29	11.31	0.50	10.55	19.36	23.26	21. 1	13. 4	1.48	9.43	19.19	23.25
19	20.17	11.10	0.27	11.16	19.49	23.27	20.51	12.44	1.24	10. 5	19.33	23.27
20	20. 4	10.48	0. 3	11.36	20. 2	23.28	20.39	12.24	1. 1	10.26	19.47	23.27
21	19.50	10.27	0.21 N	11.57	20.14	23.28	20.28	12. 4	0.38	10.48	20.	23.28
22	19.37	10. 5	0.45	12.17	20.26	23.28	20.16	11.44	0.14	11. 9	20.13	23.28
23	19.23	9.43	1. 8	12.37	20.38	23.27	20. 4	11.24	0. 9 S.	11.30	20.26	23.27
24	19. 8	9.21	1.32	12.57	20.49	23.26	9.51	11. 3	0.33	11.51	20.38	23.26
25	18.53	8.58	1.55	13.16	21.	23.26	19.39	10.43	0.56	12.12	20.50	23.25
26	18.38	8.36	2.19	13.36	21.10	23.23	19.25	10.22	1.20	12.33	21. 1	23.23
27	18.23	8.14	2.42	13.55	21.21	23.21	19.12	10. 1	1.43	12.53	21.12	23.20
28	18. 7	7.51	3. 6	14.14	21.30	23.18	18.58	9 40	2. 6	13.13	21.23	23.17
29	17.51		3.29	14.33	21.40	23.15	18.44	9.18	2.30	13.33	21.33	23.14
30	17.34		3.52	14.51	21.49	23.11	18.30	8.57	2 53	13.53	21.43	23.10
31	17.18		4.16		21.58		18.15	8.35		14.12		23. 6

A TABLE

OF THE

SUN's DECLINATION,

For the Year 1800.

Days	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	south	south	south	North	North	North	North	North	North	south	south	south
1	23. 1	17. 5	7.34	4.33	15. 4	22. 4	23. 8	18. 4	8.19	3.11	14.27	21.50
2	22.56	16.48	7.11	4.56	15.23	22.12	23. 4	17.40	7.57	3.34	14.46	21.59
3	22.50	16.30	6.48	5.19	15.40	22.19	23.	17.53	7.35	3.57	15. 5	22. 8
4	22.44	16.12	6.25	5.42	15.58	22.27	22.55	17.17	7.13	4.21	15.24	22.16
5	22.37	15.54	6. 2	6. 5	16.15	22.34	22.49	17. 1	6.51	4.44	15.42	22.24
6	22.30	15.36	5.39	6.28	16.32	22.40	22.43	16.45	6.28	5. 7	16. 1	22.32
7	22.23	15.17	5.15	6.50	16.49	22.46	22.37	16.28	6. 6	5.30	16.18	22.39
8	22.15	14.58	4.52	7.13	17. 5	22.52	22.31	16.11	5.43	5.53	16.36	22.45
9	22. 6	14.39	4.29	7.35	17.22	22.57	22.24	15.54	5.21	6.16	16.53	22.51
10	21.58	14.20	4. 5	7.57	17.37	23. 2	22.16	15.36	4.58	6.39	17.10	22.57
11	21.48	14. 0	3.42	8.19	17.53	23. 6	22. 9	15.19	4.35	7. 2	17.27	23. 2
12	21.39	13.40	3.18	8.41	18. 8	23.10	22. 0	15. 1	4.12	7.24	17.44	23. 7
13	21.29	13.20	2.54	9. 3	18.23	23.14	21.52	14.43	3.49	7.47	18.	23.11
14	21.18	13. 0	2.31	9.25	18.38	23.17	21.43	14.24	3.26	8. 9	18.15	23.15
15	21. 7	12.39	2. 7	9.46	18.52	23.20	21.34	14. 6	3. 3	8.31	18.31	23.18
16	20.56	12.18	1.43	10. 8	19. 6	23.22	21.24	13.47	2.40	8.54	18.46	23.21
17	20.44	11.58	1.20	10.29	19.20	23.24	21.14	13.28	2.17	9.16	19. 1	23.23
18	20.32	11.36	0.56	10.50	19.33	23.26	21. 4	13. 8	1.53	9.38	19.16	23.25
19	20.20	11.15	0.32	11.11	19.40	23.27	20.53	12.49	1.30	9.59	19.30	23.26
20	20. 7	10.54	0. 9	11.31	19.59	23.28	20.42	12.29	1. 7	10.21	19.43	23.27
21	19.54	10.32	0.15 N	11.52	20.11	23.28	20.31	12. 9	0.43	10.43	19.57	23.28
22	19.40	10.10	0.39	12.12	20.23	23.28	20.19	11.49	0.20	11. 4	20.10	23.28
23	19.26	9.48	1. 2	12.32	20.35	23.27	20. 7	11.29	0. 3 S	11.25	20.23	23.27
24	19.12	9.26	1.26	12.52	20.46	23.26	19.55	11. 9	0.27	11.46	20.35	23.27
25	18.57	9. 4	1.49	13.12	20.57	23.25	19.42	10.48	0.50	12. 7	20.47	23.25
26	18.42	8.42	2.13	13.31	21. 8	23.23	19.29	10.27	1.14	12.28	20.59	23.24
27	18.27	8.19	2.37	13.50	21.18	23.21	19.15	10. 6	1.37	12.48	21.10	23.21
28	18.11	7.57	3. 0	14. 9	21.28	23.18	19. 2	9.45	2. 1	13. 8	21.20	23.18
29	17.55		3.23	14.28	21.38	23.16	18.48	9.24	2.24	13.28	21.31	23.15
30	17.39		3.47	14.46	21.47	23.12	18.33	9. 2	3.47	13.48	21.41	23.11
31	17.22		4.10		21.55		18.19	8.41		14. 8		23. 7

A TABLE

OF THE

SUN's DECLINATION,

For the Years 1801, 1805, 1809.

Each being the first after Leap Year.

Days.	Jan. south	Feb. south	March south	April North	May North	June North	July North	Aug. North	Sept. North	Oct. south	Nov. south	Dec. south
1	23. 2	17.10	7.40	4.27	15. 0	22. 2	23. 9	18. 8	8.25	3. 4	14.22	21.48
2	22.57	16.52	7.17	4.51	15.18	22.10	23. 5	17.53	8. 3	3.28	14.41	21.57
3	22.52	16.35	6.54	5.14	15.36	22.17	23. 1	17.37	7.41	3.51	15. 0	22. 6
4	22.45	16.17	6.31	5.36	15.53	22.25	22.56	17.21	7.19	4.14	15.19	22.14
5	22.39	15.59	6. 8	5.59	16.11	22.32	22.50	17. 5	6.57	4.37	15.37	22.22
6	22.32	15.41	5.44	6.22	16.28	22.38	22.45	16.49	6.34	5. 1	15.56	22.30
7	22.25	15.22	5.21	6.45	16.44	22.44	22.38	16.33	6.12	5.24	16.14	22.37
8	22.17	15. 3	4.58	7. 7	17. 1	22.50	22.32	16.16	5.49	5.47	16.31	22.43
9	22. 9	14.44	4.35	7.30	17.17	22.55	22.26	15.59	5.27	6.10	16.49	22.49
10	22. 0	14.24	4.11	7.52	17.33	23. 0	22.18	15.41	5. 4	6.33	17. 6	22.55
11	21.51	14. 5	3.48	8.14	17.49	23. 5	22.11	15.24	4.41	6.55	17.23	23. 0
12	21.41	13.45	3.24	8.36	18. 4	23. 9	22. 3	15. 6	4.18	7.18	17.39	23. 5
13	21.31	13.25	3. 0	8.58	18.19	23.13	21.54	14.48	3.55	7.41	17.56	23.10
14	21.21	13. 5	2.37	9.19	18.34	23.16	21.45	14.29	3.32	8. 3	18.11	23.14
15	21.10	12.45	2.13	9.41	18.48	23.19	21.30	14.11	3. 9	8.25	18.27	23.17
16	20.59	12.24	1.49	10. 2	19. 2	23.21	21.27	13.52	2.46	8.48	18.42	23.20
17	20.47	12. 3	1.26	10.23	19.16	23.23	21.17	13.33	2.23	9.10	18.57	23.22
18	20.35	11.42	1. 2	10.44	19.30	23.25	21. 7	13.14	2. 0	9.32	19.12	23.24
19	20.23	11.21	0.39	11. 5	19.42	23.27	20.56	12.54	1.36	9.54	19.26	23.26
20	20.10	10.59	0.15	11.26	19.56	23.27	20.45	12.34	1.13	10.15	19.40	23.27
21	19.57	10.38	0. 9 N	11.46	20. 8	23.28	20.34	12.15	0.50	10.37	19.53	23.28
22	19.44	10.16	0.32	12. 6	20.20	23.28	20.22	11.55	0.26	10.58	20. 6	23.28
23	19.30	9.54	0.56	12.27	20.32	23.27	20.10	11.34	0. 3 S.	11.19	20.19	23.27
24	19.15	9.32	1.20	12.47	20.43	23.27	19.58	11.14	0.21	11.40	20.33	23.27
25	19. 1	9.10	1.44	13. 6	20.54	23.25	19.45	10.54	0.44	12. 1	20.44	23.26
26	18.46	8.48	2. 7	13.26	21. 5	23.24	19.32	10.33	1. 7	12.22	20.55	23.24
27	18.31	8.25	2.31	13.45	21.15	23.22	19. 9	10.12	1.31	12.43	21. 7	23.22
28	18.15	8. 2	2.54	14. 5	21.25	23.19	19. 5	9.51	1.54	13. 3	21.18	23.19
29	17.59		3.17	14.23	21.35	23.16	18.51	9.29	2.18	13.23	21.28	23.16
30	17.43		3.41	14.41	21.44	23.13	18.37	9. 8	2.41	13.43	21.38	23.12
31	17.26		4. 4		21.53		18.23	8.47		14. 2		23. 8

A TABLE

OF THE

SUN's DECLINATION,

For the Years 1802, 1806, 1810,

Each being the second after Leap Year.

Days	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	south	south	south	north	north	north	north	north	north	south	south	south
1	23. 4	17.14	7.45	4.21	14.55	22.	23.10	18.11	8.30	2.59	14.17	21.45
2	22.58	16.57	7.23	4.44	15.14	22. 8	23. 6	17.56	8. 8	3.22	14.37	21.55
3	22.53	16.39	7. 0	5. 7	15.31	22.16	23. 2	17.41	7.46	3.46	14.56	22. 4
4	22.47	16.21	6.37	5.30	15.49	22.23	22.57	17.25	7.24	4. 9	15.14	22.12
5	22.41	16. 3	6.14	5.53	16. 6	22.30	22.52	17. 9	7. 2	4.32	15.33	22.20
6	22.34	15.45	5.51	6.16	16.24	22.37	22.46	16.53	6.40	4.55	15.51	22.28
7	22.27	15.27	5.27	6.39	16.40	22.43	22.41	16.37	6.17	5.18	16. 9	22.35
8	22.19	15. 8	5. 4	7. 1	16.57	22.49	22.34	16.20	5.55	5.41	16.27	22.42
9	22.11	14.49	4.40	7.24	17.13	22.54	22.27	16. 3	5.32	6. 4	16.45	22.48
10	22. 2	14.30	4.17	7.46	17.29	22.59	22.20	15.45	5. 9	6.27	17. 2	22.54
11	21.53	14.10	3.54	8. 8	17.45	23. 4	22.13	15.28	4.47	6.50	17.19	22.59
12	21.44	13.50	3.30	8.30	18. 1	23. 8	22. 5	15.10	4.24	7.13	17.35	23. 4
13	21.34	13.30	3. 6	8.52	18.16	23.12	21.57	14.52	4. 1	7.35	17.51	23. 8
14	21.24	13.10	2.43	9.14	18.30	23.15	21.48	14.34	3.38	7.58	18. 7	23.12
15	21.13	12.50	2.19	9.35	18.45	23.18	21.39	14.15	3.15	8.20	18.23	23.16
16	21. 2	12.29	1.55	9.57	18.59	23.21	21.29	13.56	2.52	8.43	18.38	23.19
17	20.50	12. 8	1.32	10.19	19.13	23.23	21.20	13.37	2.28	9. 4	18.53	23.22
18	20.38	11.47	1. 8	10.39	19.26	23.25	21. 9	13.18	2. 6	9.26	19. 8	23.24
19	20.26	11.26	0.44	11. 0	19.40	23.26	20.59	12.59	1.42	9.48	19.22	23.26
20	20.13	11. 5	0.21	11.21	19.52	23.27	20.48	12.39	1.18	10.10	19.36	23.27
21	20. 1	10.43	0. 3 N	11.41	20. 5	23.28	20.37	12.20	0.55	10.32	19.50	23.28
22	19.47	10.21	0.27	12. 2	20.17	23.28	20.25	12.	0.32	10.53	20. 3	23.28
23	19.33	10. 0	0.50	12.22	20.29	23.28	20.13	11.40	0. 9	11.15	20.16	23.28
24	19.19	9.37	1.14	12.42	20.41	23.27	20. 1	11.19	0.15 S	11.36	20.29	23.27
25	19. 5	9.16	1.37	13. 2	20.52	23.26	19.48	10.58	0.39	11.56	20.41	23.25
26	18.50	8.53	2. 1	13.21	21. 3	23.24	19.36	10.38	1. 2	12.17	20.53	23.24
27	18.35	8.31	2.25	13.40	21.13	23.22	19.22	10.17	1.25	12.38	21. 4	23.22
28	18.19	8. 8	2.48	13.59	21.23	23.20	19. 9	9.56	1.49	12.58	21.15	23.20
29	18. 3		3.11	14.18	21.33	23.17	18.55	9.34	2.12	13.18	21.26	23.17
30	17.47		3.35	14.37	21.42	23.14	18.41	9.13	2.36	13.38	21.36	23.13
31	17.30		3.58		21.51		18.26	8.52		13.58		23. 9

A TABLE

OF THE

SUN's DECLINATION,

For the Years 1803, 1807, 1811,

Each being the third after Leap Year.

Days.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	south	south	south	north	north	north	north	north	north	south	south	south
1	23. 5	17.18	7.51	4.16	14.51	21.58	23.11	18.15	8.35	2.53	14.12	21.43
2	23. 0	17. 1	7.28	4.39	15. 9	22. 6	23. 7	18. 0	8.14	3.16	14.32	21.52
3	22.54	16.43	7. 5	5. 2	15.27	22.16	23. 3	17.45	7.52	3.40	14.51	22. 1
4	22.49	16.26	6.42	5.25	15.45	22.21	22.58	17.29	7.30	4. 3	15.10	22.10
5	22.42	16. 8	6.19	5.48	16. 2	22.28	22.53	17.13	7. 8	4.26	15.28	22.18
6	22.36	15.50	5.56	6.11	16.19	22.35	22.48	16.57	6.45	4.49	15.47	22.26
7	22.28	15.31	5.33	6.33	16.36	22.41	22.42	16.41	6.23	5.12	16. 5	22.33
8	22.21	15.13	5.10	6.56	16.53	22.47	22.36	16.24	6.	5.36	16.23	22.40
9	22.13	14.54	4.46	7.18	17. 9	22.53	22.29	16. 7	5.38	5.59	16.40	22.46
10	22. 4	14.34	4.23	7.40	17.25	22.58	22.22	15.50	5.15	6.21	16.57	22.52
11	21.55	14.15	3.59	8. 3	17.41	23. 3	22.15	15.32	4.52	6.44	17.14	22.58
12	21.46	13.55	3.36	8.25	17.57	23. 7	22. 7	15.14	4.30	7. 7	17.31	23. 3
13	21.36	13.35	3.12	8.47	18.12	23.11	21.58	14.56	4. 7	7.30	17.47	23. 8
14	21.26	13.15	2.49	9. 8	18.27	23.15	21.50	14.38	3.44	7.52	18. 4	23.12
15	21.16	12.55	2.25	9.30	18.41	23.18	21.41	14.20	3.21	8.15	18.19	23.15
16	21. 5	12.34	2. 1	9.51	18.56	23.20	21.32	14. 1	2.57	8.37	18.35	23.19
17	20.53	12.13	1.38	10.13	19.10	23.23	21.22	13.42	2.34	8.59	18.50	23.21
18	20.41	11.52	1.14	10.34	19.23	23.24	21.12	13.23	2.11	9.21	19. 5	23.24
19	20.29	11.31	0.50	10.55	19.36	23.26	21. 1	13. 4	1.48	9.43	19.19	23.25
20	20.17	11.10	0.27	11.16	19.49	23.27	20.51	12.44	1.24	10. 5	19.33	23.27
21	20. 4	10.48	0. 3	11.36	20. 2	23.28	20.39	12.24	1. 1	10.26	19.47	23.27
22	19.50	10.27	0.21 N	11.57	20.14	23.28	20.28	12. 4	0.38	10.48	20. 0	23.28
23	19.37	10. 5	0.45	12.17	20.26	23.28	20.16	11.44	0.14	11. 9	20.13	23.28
24	19.23	9.43	1. 8	12.37	20.38	23.27	20. 4	11.24	0. 9 S	11.30	20.26	23.27
25	19. 8	9.21	1.32	12.57	20.49	23.26	19.51	11. 3	0.33	11.51	20.38	23.26
26	18.53	8.58	1.55	13.16	21. 0	23.26	19.39	10.43	0.56	12.12	20.50	23.25
27	18.38	8.36	2.19	13.36	21.10	23.23	19.25	10.22	1.20	12.33	21. 1	23.23
28	18.23	8.14	2.42	13.55	21.21	23.21	19.12	10. 1	1.43	12.53	21.12	23.20
29	18. 7		3. 6	14.14	21.30	23.18	18.58	9.40	2. 6	13.13	21.23	23.17
30	17.51		3.29	14.33	21.40	23.15	18.44	9.18	2.30	13.33	21.33	23.14
31	17.34		2.52		21. 9		18.30	8.57		13.53		23.10

A TABLE

OF THE

SUN's DECLINATION,

For the Years 1804, 1808, 1812.

Each being Leap Year.

Days	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	south	south	south	North	North	North	North	North	North	south	south	south
1	23. 6	17.22	7.34	4.33	15. 4	22. 4	23. 8	18. 4	8.19	3.11	14.27	21.50
2	23. 1	17. 5	7.11	4.56	15.23	22.12	23. 4	17.48	7.57	3.34	14.46	21.59
3	22.56	16.48	6.48	5.19	15.40	22.19	23. 0	17.33	7.35	3.57	15. 5	22. 8
4	22.50	16.30	6.25	5.42	15.58	22.27	22.55	17.17	7.13	4.21	15.24	22.16
5	22.44	16.12	6. 2	6. 5	16.15	22.34	22.49	17. 1	6.51	4.44	15.42	22.24
6	22.37	15.54	5.39	6.28	16.32	22.40	22.43	16.45	6.28	5. 7	16. 1	22.32
7	22.30	15.36	5.15	6.50	16.49	22.46	22.37	16.28	6. 6	5.30	16.18	22.39
8	22.23	15.17	4.52	7.13	17. 5	22.52	22.31	16.11	5.43	5.53	16.36	22.45
9	22.15	14.58	4.29	7.35	17.22	22.57	22.24	15.54	5.21	6.16	16.53	22.51
10	22. 6	14.39	4. 5	7.57	17.37	23. 2	22.16	15.36	4.58	6.39	17.10	22.57
11	21.58	14.20	3.42	8.19	17.53	23. 6	22. 9	15.19	4.35	7. 2	17.27	23. 2
12	21.48	14. 0	3.18	8.41	18. 8	23.10	22. 0	15. 1	4.12	7.24	17.44	23. 7
13	21.39	13.40	2.54	9. 3	18.23	23.14	21.52	14.43	3.49	7.47	18. 0	23.11
14	21.29	13.20	2.31	9.25	18.38	23.17	21.43	14.24	3.26	8. 9	18.15	23.15
15	21.18	13. 0	2.17	9.46	18.52	23.20	21.34	14. 6	3. 3	8.31	18.31	23.18
16	21. 7	12.39	1.43	10. 8	19. 6	23.22	21.24	13.47	2.40	8.54	18.46	23.21
17	20.56	12.18	1.20	10.29	19.20	23.24	21.14	13.28	2.17	9.16	19. 1	23.23
18	20.44	11.58	0.56	10.50	19.33	23.26	21. 4	13. 8	1.53	9.38	19.16	23.25
19	20.32	11.36	0.32	11.11	19.46	23.27	20.53	12.49	1.30	9.59	19.30	23.26
20	20.20	11.15	0.19	11.31	19.59	23.28	20.42	12.29	1. 7	10.21	19.43	23.27
21	20. 7	10.54	0.15 N	11.52	20.11	23.28	20.31	12. 9	0.43	10.43	19.57	23.28
22	19.54	10.32	0.39	12.12	20.23	23.28	20.19	11.49	0.20	11. 4	20.10	23.28
23	19.40	10.10	1. 2	12.32	20.35	23.27	20. 7	11.29	0. 3 S	11.25	20.23	23.27
24	19.26	9.48	1.26	12.52	20.46	23.26	19.55	11. 9	0.27	11.46	20.35	23.27
25	19.12	9.26	1.49	13.12	20.57	23.25	19.42	10.48	0.50	12. 7	20.47	23.25
26	18.57	9. 4	2.13	13.31	21. 8	23.23	19.29	10.27	1.14	12.28	20.59	23.24
27	18.42	8.42	2.37	13.50	21.18	23.21	19.15	10. 6	1.37	12.48	21.10	23.21
28	18.27	8.19	3.	14. 9	21.28	23.18	19. 2	9.45	2. 1	13. 8	21.20	23.18
29	18.11	7.57	3.23	14.28	21.38	23.16	18.48	9.24	2.24	13.28	21.31	23.15
30	17.55		3.47	14.46	21.47	23.12	18.33	9. 2	2.47	13.48	21.41	23.11
31	17.39		4.10		21.55		18.19	8.41		14. 8		23. 7

TABLE VI.

A Table of the Variation of the Sun's Declination to every 10 Degrees of Longitude.

	Degrees of Longitude from the Meridian of London.																	
Daily var.	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
in	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
2	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1
3	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
4	0	0	0	0	1	1	1	1	1	1	1	1	1	2	2	2	2	2
5	0	0	0	0	1	1	1	1	1	1	1	2	2	2	2	2	2	2
6	0	0	0	0	1	1	1	1	1	2	2	2	2	2	2	2	3	3
7	0	0	0	1	1	1	1	2	2	2	2	2	3	3	3	3	3	3
8	0	0	1	1	1	1	1	2	2	2	2	3	3	3	3	3	4	4
9	0	0	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4
10	0	1	1	1	1	2	2	2	3	3	3	3	4	4	4	5	5	5
11	0	1	1	1	2	2	2	3	3	3	3	4	4	4	5	5	5	5
12	0	1	1	1	2	2	2	3	3	3	4	4	4	5	5	5	6	6
13	0	1	1	1	2	2	2	3	3	4	4	4	5	5	5	6	6	6
14	0	1	1	2	2	2	3	3	3	4	4	5	5	5	6	6	7	7
15	0	1	1	2	2	3	3	3	4	4	5	5	5	6	6	7	7	7
16	0	1	1	2	2	3	3	4	4	5	5	5	6	5	7	7	8	8
17	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	7	8	8
18	1	1	2	2	3	3	4	4	5	5	6	6	7	7	7	8	9	9
19	1	1	2	2	3	3	4	4	5	5	6	6	7	7	7	8	9	9
20	1	1	2	2	3	3	4	4	5	6	6	7	7	8	8	9	9	10
21	1	1	2	2	3	4	4	5	5	6	6	7	8	8	[illegible]	9	10	10
22	1	1	2	2	3	4	4	5	6	6	7	7	8	9	9	10	10	11
23	1	1	2	3	3	4	4	5	6	6	7	8	8	9	10	10	11	11
24	1	1	2	3	3	4	5	5	6	7	7	8	9	9	10	11	11	12

To find the SUN's DECLINATION by the foregoing TABLES.

EACH Page of the foregoing Tables contains the Sun's Declination for the Years that it is marked with at the Top, and is divided into thirteen Columns; the first of which to the Left Hand shews the Day of the month, and the other Twelve the Months of the Year, so that if it be required to find the Sun's Declination for any Day; suppose, for Example, on the 21st of August, 1800; First, I look for that Table that has 1800 at the top of it, and then right against the 21st Day of the Month, and under August, I find 12.9, which shews the Sun's Declination to be 12 Degrees 9 Minutes North; according to the Title at the Top of the Column.

The Sun's Declination in these Tables being calculated for the Meridian of London, if you should be considerably to the Eastward or to the Westward of London, it will cause some Alteration in it; to correct which, the

Table of the Variation of the Sun's Declination is to be used as follows:

First, Look out the Declination for the given Day of the Month, and for the Day following it, and subtract the Lesser from the Greater, the Remainder is the Daily Variation.

Second, Observe whether the Declination be increasing or decreasing, which you may know thus; If the Declination for the Day following the given Day be greatest, then it is increasing, but if it be least, it is decreasing.

Third, Look for the Daily Variation in the first Column of the Table, and see what Number stands right against it; and under the given Degrees of Longitude; which Number is to be used as follows:

If the Difference of Longitude be Easterly, and the Declination increasing, it must be subtracted from the Declination found in the Tables for the given Day; but if the Declination be decreasing, it must be added.

If the Difference of Longitude be Westerly, and the Declination increasing, it must be added; but if the Declination be decreasing, it must be subtracted; the Sum in one Case, and the Remainder in the other, will be the Sun's Declination at Noon in the Longitude required.

TABLE VII. A TABLE OF AMPLITUDES.

Lat.	DECLINATION IN DEGREES. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	23.29	Lat.
	D M	D M	D M	D M	D M	D M	D M	D M	D M	D M	D M	D M	D M	D M	D M	D M	D M	D M	D M	D M	D M	D M	D M	D M	
1	1. 0	2. 0	3. 0	4. 0	5. 0	6. 0	7. 0	8. 0	9. 0	10. 0	11. 0	12. 0	13. 0	14. 0	15. 0	16. 0	17. 0	18. 0	19. 0	20. 0	21. 0	22. 0	23. 0	23.29	1
2	1. 0	2. 0	3. 0	4. 0	5. 0	6. 0	7. 0	8. 0	9. 0	10. 0	11. 0	12. 0	13. 0	14. 0	15. 0	16. 1	17. 1	18. 1	19. 1	20. 1	21. 1	22. 1	23. 1	23.30	2
3	1. 0	2. 0	3. 0	4. 0	5. 0	6. 0	7. 1	8. 1	9. 1	10. 1	11. 1	12. 1	13. 1	14. 1	15. 1	16. 1	17. 1	18. 1	19. 1	20. 2	21. 2	22. 2	23. 2	23.31	3
4	1. 0	2. 0	3. 0	4. 0	5. 0	6. 1	7. 1	8. 1	9. 1	10. 1	11. 2	12. 1	13. 2	14. 2	15. 2	16. 2	17. 2	18. 2	19. 3	20. 3	21. 3	22. 3	23. 3	23.33	4
5	1. 0	2. 0	3. 0	4. 1	5. 1	6. 1	7. 2	8. 2	9. 2	10. 2	11. 3	12. 3	13. 3	14. 3	15. 4	16. 4	17. 4	18. 4	19. 4	20. 5	21. 5	22. 5	23. 5	23.35	5
6	1. 0	2. 0	3. 1	4. 1	5. 1	6. 2	7. 2	8. 2	9. 3	10. 2	11. 3	12. 4	13. 4	14. 4	15. 5	16. 5	17. 5	18. 6	19. 6	20. 7	21. 7	22. 7	23. 8	23.38	6
7	1. 0	2. 1	3. 1	4. 2	5. 2	6. 2	7. 3	8. 3	9. 4	10. 4	11. 5	12. 5	13. 6	14. 6	15. 7	16. 7	17. 8	18. 8	19. 9	20. 9	21.10	22.10	23.11	23.40	7
8	1. 0	2. 1	3. 1	4. 2	5. 3	6. 3	7. 4	8. 4	9. 5	10. 5	11. 6	12. 7	13. 8	14. 8	15.10	16.10	17.10	18.11	19.11	20.12	21.13	22.13	23.14	23.44	8
9	1. 0	2. 1	3. 2	4. 3	5. 3	6. 4	7. 5	8. 6	9. 7	10. 7	11. 8	12. 9	13.10	14.10	15.11	16.12	17.13	18.14	19.15	20.16	21.17	22.17	23.18	23.49	9
10	1. 1	2. 2	3. 3	4. 4	5. 5	6. 6	7. 7	8. 8	9. 9	10.10	11.11	12.12	13.13	14.14	15.15	16.16	17.17	18.18	19.19	20.20	21.21	22.22	23.23	23.54	10
11	1. 1	2. 2	3. 3	4. 4	5. 5	6. 6	7. 7	8. 9	9.10	10.11	11.11	12.13	13.15	14.16	15.17	16.18	17.20	18.21	19.22	20.24	21.25	22.26	23.28	23.58	11
12	1. 1	2. 3	3. 4	4. 5	5. 7	6. 8	7. 9	8.11	9.12	10.13	11.15	12.16	13.18	14.19	15.21	16.22	17.23	18.25	19.26	20.28	21.29	22.31	23.33	24. 3	12
13	1. 2	2. 3	3. 5	4. 6	5. 8	6.10	7.11	8.12	9.14	10.15	11.17	12.19	13.21	14.22	15.24	16.26	17.28	18.30	19.31	20.33	21.35	22.37	23.38	24. 8	13
14	1. 2	2. 3	3. 5	4. 7	5. 9	6.11	7.13	8.15	9.17	10.18	11.20	12.22	13.24	14.26	15.28	16.30	17.32	18.34	19.36	20.38	21.41	22.43	23.45	24.15	14
15	1. 2	2. 4	3. 6	4. 8	5.11	6.13	7.15	8.17	9.19	10.21	11.23	12.25	13.28	14.30	15.33	16.35	17.37	18.40	19.42	20.44	21.46	22.49	23.51	24.22	15
16	1. 2	2. 5	3. 7	4.10	5.12	6.15	7.17	8.19	9.22	10.24	11.27	12.29	13.32	14.34	15.37	16.40	17.42	18.45	19.48	20.51	21.53	22.56	23.59	24.29	16
17	1. 2	2. 5	3. 8	4.11	5.13	6.16	7.19	8.22	9.25	10.27	11.30	12.33	13.36	14.39	15.42	16.45	17.48	18.51	19.54	20.57	22. 0	23. 4	24. 7	24.38	17
18	1. 3	2. 6	3. 9	4.12	5.15	6.19	7.22	8.25	9.28	10.30	11.34	12.38	13.41	14.44	15.46	16.51	17.54	18.57	20. 1	21. 5	22. 8	23.12	24.15	24.46	18
19	1. 3	2. 7	3.10	4.13	5.17	6.21	7.24	8.28	9.31	10.34	11.38	12.42	13.47	14.50	15.53	16.57	18. 1	19. 5	20. 8	21.12	22.16	23.20	24.24	24.56	19
20	1. 4	2. 8	3.12	4.15	5.19	6.23	7.27	8.31	9.35	10.38	11.43	12.47	13.51	14.55	16. 0	17. 4	18. 8	19.12	20.16	21.20	22.25	23.29	24.34	25. 5	20
21	1. 4	2. 8	3.13	4.17	5.21	6.26	7.30	8.34	9.39	10.43	11.48	12.52	13.57	15. 1	16. 5	17.10	18.15	19.20	20.24	21.29	22.34	23.39	24.44	25.16	21
22	1. 4	2. 9	3.14	4.19	5.23	6.28	7.33	8.38	9.43	10.47	11.53	12.58	14. 3	15. 8	16.13	17.18	18.23	19.28	20.33	21.39	22.44	23.50	24.55	25.27	22
23	1. 5	2.10	3.15	4.21	5.26	6.31	7.36	8.42	9.47	10.52	11.58	13. 3	14. 9	15.14	16.19	17.25	18.31	19.37	20.43	21.49	22.55	24. 1	25. 7	25.39	23
24	1. 5	2.11	3.17	4.23	5.28	6.34	7.40	8.45	9.51	10.57	12. 3	13. 9	14.17	15.21	16.27	17.34	18.40	19.46	20.52	21.59	23. 6	24.12	25.19	25.51	24
25	1. 6	2.12	3.18	4.25	5.31	6.37	7.43	8.50	9.56	11. 2	12. 9	13.16	14.23	15.29	16.35	17.42	18.49	19.56	21. 3	22.10	23.18	24.24	25.32	26. 5	25
26	1. 7	2.13	3.20	4.27	5.33	6.41	7.48	8.54	10. 1	11. 8	12.15	13.23	14.30	15.37	16.44	17.51	18.59	20. 6	21.14	22.22	23.30	24.38	25.46	26.16	26
27	1. 7	2.14	3.22	4.29	5.36	6.44	7.51	8.59	10. 6	11.14	12.22	13.30	14.38	15.45	16.53	18. 1	19. 9	20.17	21.26	22.34	23.43	24.51	26. 0	26.34	27
28	1. 8	2.16	3.24	4.32	5.40	6.48	7.56	9. 4	10.12	11.20	12.29	13.37	14.46	15.54	17. 3	18.11	19.20	20.29	21.38	22.48	23.57	25. 6	26.16	26.4[illegible]	28
29	1. 8	2.17	3.25	4.34	5.43	6.52	8. 0	9. 9	10.18	11.27	12.36	13.45	14.54	16. 3	17.12	18.22	19.31	20.41	21.51	23. 1	24.11	25.22	26.32	27. [illegible]	29
30	1. 9	2.18	3.28	4.37	5.46	6.56	8. 5	9.15	10.24	11.33	12.42	13.53	15. 3	16.13	17.23	18.33	19.43	20.54	22. 5	23.16	24.27	25.38	26.49	27.23	30
31	1.10	2.20	3.30	4.40	5.50	7. 0	8.10	9.21	10.31	11.41	12.52	14. 2	15.13	16.23	17.34	18.45	19.56	21. 8	22.19	23.31	24.43	25.55	27. 7	27.4[illegible]	31
32	1.10	2.21	3.32	4.43	5.54	7. 5	8.16	9.27	10.38	11.49	13. 0	14.11	15.23	16.34	17.46	18.58	20.10	21.22	22.34	23.47	25. 0	26.13	27.26	28. 1	32
33	1.11	2.23	3.35	4.45	5.58	7. 9	8.22	9.33	10.45	11.57	13. 9	14.21	15.33	16.45	17.58	19.11	20.24	21.37	22.50	24. 4	25.18	26.32	27.40	28.23	33

TABLE VII. A TABLE OF AMPLITUDES.

DECLINATION IN DEGREES.

Lat.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	23.29	Lat.
	D M	D M	D M	D M	D M	D M	D M	D M	D M	D M	D M	D M	D M	D M	D M	D M	D M	D M	D M	D M	D M	D M	D M	D M	
34	1.12	2.25	3.37	4.50	6. 2	7.15	8.27	9.39	10.52	12. 5	13.18	14.31	15.44	16.57	18.11	19.25	20.39	21.53	23. 7	24.21	25.36	26.51	28. 7	28.44	34
35	1.13	2.27	3.40	4.53	6. 6	7.20	8.33	9.47	11. 0	12.14	13.28	14.42	15.55	17.11	18.25	19.40	20.55	22.10	23.25	24.40	25.56	27.13	28.29	29. 7	35
36	1.14	2.28	3.43	4.57	6.11	7.25	8.39	9.54	11. 9	12.23	13.38	14.53	16. 9	17.24	18.39	19.55	21.11	22.27	23.43	25. 0	26.18	27.35	28.53	29.30	36
37	1.15	2.30	3.45	5. 0	6.15	7.31	8.46	10. 2	11.17	12.33	13.49	15. 5	16.21	17.38	18.54	20.11	21.28	22.46	24. 3	25.21	26.39	27.58	29.17	29.56	37
38	1.16	2.32	3.48	5. 5	6.21	7.37	8.54	10.11	11.27	12.44	14. 1	15.18	16.35	17.53	19.10	20.28	21.46	23. 5	24.24	25.43	27. 3	28.23	29.43	30.23	38
39	1.17	2.34	3.51	5. 8	6.26	7.43	9. 1	10.19	11.37	12.54	14.12	15.31	16.49	18. 8	19.27	20.46	22. 6	23.26	24.46	26. 6	27.27	28.49	30.11	30.51	39
40	1.18	2.36	3.55	5.13	6.32	7.50	9. 9	10.28	11.47	13. 6	14.25	15.45	17. 5	18.24	19.44	21. 5	22.26	23.47	25. 9	26.31	27.53	29.16	30.40	31.22	40
41	1.19	2.39	3.58	5.18	6.38	7.57	9.17	10.37	11.57	13.18	14.39	16. 0	17.21	18.42	20. 4	21.26	22.48	24.10	25.33	26.56	28.21	29.46	31.11	31.53	41
42	1.21	2.41	4. 2	5.23	6.44	8. 5	9.26	10.47	12. 9	13.31	14.53	16.15	17.37	19. 0	20.23	21.46	23.10	24.34	25.58	27.24	28.50	30.16	31.43	32.26	42
43	1.22	2.44	4. 6	5.28	6.51	8.13	9.35	10.58	12.21	13.44	15. 7	16.31	17.55	19.19	20.43	22. 8	23.34	24.59	26.25	27.53	29.20	30.48	32.16	33. 0	43
44	1.23	2.47	4.10	5.34	6.58	8.21	9.45	11. 9	12.34	13.58	15.23	16.48	18.13	19.39	21. 5	22.32	23.59	25.26	26.54	28.23	29.53	31.22	32.51	33.37	44
45	1.25	2.50	4.15	5.40	7. 5	8.30	9.56	11.21	12.47	14.13	15.38	17. 6	18.33	20.00	21.28	22.56	24.25	25.54	27.25	28.56	30.27	31.58	33.30	34.16	45
46	1.26	2.53	4.19	5.46	7.12	8.39	10. 6	11.34	13. 1	14.28	15.56	17.25	18.54	20.23	21.52	23.23	24.53	26.25	27.58	29.31	31. 3	32.37	34.12	35. 0	46
47	1.28	2.56	4.24	5.52	7.20	8.49	10.18	11.47	13.16	14.44	16.15	17.45	19.16	20.47	22.18	23.50	25.23	26.57	28.32	30. 7	31.42	33.18	34.56	35.46	47
48	1.29	2.59	4.29	5.59	7.29	8.59	10.30	12. 0	13.31	15. 2	16.34	18. 6	19.39	21.12	22.45	24.40	25.55	27.31	29. 7	30.45	32.23	34. 3	35.43	36.35	48
49	1.31	3. 3	4.34	6. 6	7.38	9.10	10.42	12.14	13.47	15.21	16.54	18.28	20. 3	21.38	23.14	24.51	26.28	28. 6	29.45	31.25	33. 6	34.48	36.33	37.26	49
50	1.33	3. 6	4.40	6.14	7.48	9.21	10.55	12.29	14. 5	15.40	17.16	18.52	20.29	22. 6	23.45	25.24	27. 3	28.43	30.25	32. 8	33.52	35.37	37.26	38.20	50
51	1.35	3.10	4.46	6.22	7.58	9.33	11. 9	12.46	14.24	16. 1	17.39	19.18	20.57	22.37	24.18	25.59	27.41	29.24	31. 8	32.54	34.41	36.30	38.23	39.19	51
52	1.37	3.15	4.52	6.30	8. 8	9.46	11.24	13. 3	14.43	16.23	18. 6	19.44	21.26	23. 8	24.52	26.36	28.21	30. 7	31.55	33.44	35.34	37.27	39.24	40.23	52
53	1.40	3.20	4.59	6.39	8.19	10. 0	11.40	13.21	15. 3	16.46	18.29	20.12	21.57	23.42	25.28	27.16	29. 4	30.53	32.45	34.38	36.33	38.29	40.29	41.29	53
54	1.42	3.24	5. 5	6.49	8.31	10.15	11.57	13.41	15.26	17.11	18.57	20.43	22.30	24.18	26. 7	27.58	29.50	31.42	33.38	35.35	37.32	39.36	41.43	42.40	54
55	1.45	3.29	5.14	6.59	8.44	10.30	12.15	14. 2	15.49	17.37	19.26	21.14	23. 5	24.56	26.49	28.43	30.39	32.35	34.35	36.36	38.39	40.47	42.56	44. 0	55
56	1.47	3.34	5.22	7.10	8.57	10.47	12.35	14.24	16.14	18. 5	19.56	21.49	23.43	25.37	27.34	29.32	31.31	33.33	35.36	37.42	39.51	42. 4	44.19	45.27	56
57	1.50	3.40	5.31	7.22	9.11	11. 4	12.56	14.48	16.42	18.33	20.29	22.25	24.23	26.21	28.22	30.24	32.27	34.34	36.46	38.53	41. 9	43.27	45.50	47. 2	57
58	1.53	3.46	5.40	7.34	9.26	11.22	13.18	15.14	17.10	19. 7	21. 4	23. 4	25. 0	27. 9	29.14	31.21	33.28	35.40	37.54	40.12	42.34	44.59	47.30	48.46	58
59	1.56	3.53	5.50	7.47	9.43	11.42	13.41	15.41	17.41	19.41	21.43	23.47	25.54	28. 1	30.12	32.22	34.12	36.53	39.13	41.37	44. 5	46.40	49.21	50.51	59
60	2. 0	4. 0	6. 0	8. 1	10. 2	12. 4	14. 6	16.10	18.14	20.18	22.26	24.34	26.46	28.55	31. 9	33.27	35.47	38. 9	40.36	43.10	45.48	48.31	51.24	52.51	60
61	2. 3	4. 8	6.12	8.17	10.21	12.27	14.34	16.40	18.49	20.57	23.10	25.23	27.39	29.56	32.16	34.39	37. 5	39.36	42.11	44.52	47.40	50.35	53.42	55.17	61
62	2. 7	4.15	6.24	8.32	10.41	12.52	15. 2	17.14	19.28	21.42	23.59	26.17	28.37	31. 1	33.27	35.57	38.31	41.10	43.54	46.46	49.46	52.56	56.20	58. 4	62
63	2.12	4.24	6.37	8.50	11. 4	13.19	15.34	17.51	20. 9	22. 7	24.51	27.15	29.42	32.12	34.45	37.23	40. 5	42.54	45.49	48.53	52. 7	55.36	59.24	61.22	63
64	2.17	4.33	6.51	9. 9	11.28	13.47	16. 8	18.30	20.54	23.18	25.48	28.19	30.52	33.30	36.11	38.57	41.49	44.49	47.57	51.17	54.50	58.43	63. 2	65.22	64
65	2.27	4.44	[illegible]	9.30	11.54	14.19	16.45	19.13	21.43	24.13	26.50	29.28	32. 9	34.55	37.46	40.42	43.46	46.54	50.43	54. 2	57.59	62.26	67.36	70.33	65
66	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	66

A TABLE shewing the Time of the Sun, Moon, and Stars' Setting, when they have North Declination, or the Time of their Rising, when they have South Declination.

TABLE VIII.

Lat.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	23.28	Lat.
	DEGREES OF DECLINATION.																									
	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	H M	H M	H M	H M	H M	H M	H M	H M	H M	H M	H M	
1°	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.02	6.02	6.02	6.02	1°
2	6.00	6.00	6.00	6.00	6.00	6.00	6.01	6.01	6.01	6.01	6.01	6.01	6.02	6.02	6.02	6.02	6.02	6.02	6.03	6.03	6.03	6.03	6.03	6.03	6.04	2
3	6.00	6.00	6.00	6.00	6.01	6.01	6.01	6.01	6.02	6.02	6.02	6.02	6.02	6.03	6.03	6.03	6.03	6.04	6.04	6.04	6.04	6.05	6.05	6.05	6.05	3
4	6.00	6.00	6.00	6.01	6.01	6.01	6.02	6.02	6.02	6.03	6.03	6.03	6.03	6.04	6.04	6.04	6.05	6.05	6.05	6.05	6.06	6.06	6.06	6.07	6.07	4
5	6.00	6.00	6.01	6.01	6.01	6.02	6.02	6.02	6.03	6.03	6.04	6.04	6.04	6.05	6.05	6.05	6.06	6.06	6.07	6.07	6.07	6.08	6.08	6.09	6.09	5
6	6.00	6.00	6.01	6.01	6.02	6.02	6.03	6.03	6.03	6.04	6.04	6.05	6.05	6.06	6.06	6.06	6.0[illegible]	6.07	6.08	6.08	6.09	6.09	6.10	6.10	6.11	6
7	6.00	6.00	6.01	6.01	6.02	6.02	6.03	6.03	6.04	6.04	6.05	6.05	6.06	6.06	6.07	6.08	6.08	6.09	6.09	6.10	6.10	6.11	6.11	6.12	6.12	7
8	6.00	6.00	6.01	6.02	6.02	6.03	6.03	6.04	6.04	6.05	6.06	6.06	6.07	6.07	6.08	6.09	6.09	6.10	6.10	6.11	6.12	6.12	6.13	6.14	6.14	8
9	6.00	6.01	6.01	6.02	6.02	6.03	6.04	6.04	6.05	6.06	6.06	6.07	6.08	6.08	6.09	6.10	6.10	6.11	6.12	6.13	6.14	6.14	6.15	6.15	6.16	9
10	6.00	6.01	60.1	6.02	6.03	6.04	6.04	6.05	6.06	6.06	6.07	6.08	6.09	6.09	6.10	6.11	6.12	6.12	6.13	6.14	6.15	6.16	6.16	6.17	6.17	10
11	6.00	6.01	60.2	6.02	6.03	6.04	6.05	6.05	6.06	6.07	6.08	6.09	6.09	6.10	6.11	6.12	6.13	6.14	6.14	6.15	6.16	6.17	6.18	6.19	6.19	11
12	6.00	6.01	60.2	6.03	6.04	6.04	6.05	6.06	6.07	6.08	6.09	6.09	6.10	6.11	6.12	6.13	6.14	6.15	6.16	6.17	6.18	6.19	6.20	6.21	6.21	12
13	6.00	6.01	60.2	6.03	6.04	6.05	6.06	6.06	6.07	6.08	6.09	6.10	6.11	6.12	6.13	6.14	6.15	6.16	6.17	6.18	6.19	6.20	6.21	6.22	6.23	13
14	6.00	6.01	60.2	6.03	6.04	6.05	6.06	6.07	6.08	6.09	6.10	6.11	6.12	6.13	6.14	6.15	6.16	6.17	6.19	6.20	6.21	6.22	6.23	6.24	6.25	14
15	6.00	6.01	60.2	6.03	6.04	6.05	6.06	6.07	6.09	6.10	6.11	6.12	6.13	6.14	6.15	6.16	6.18	6.19	6.20	6.21	6.22	6.24	6.25	6.26	6.27	15
16	6.00	6.01	6.02	6.03	6.05	6.06	6.07	6.08	6.09	6.10	6.12	6.13	6.14	6.15	6.16	6.18	6.19	6.20	6.21	6.23	6.24	6.25	6.27	6.28	6.29	31
17	6.00	6.01	6.02	6.04	6.05	6.06	6.07	6.09	6.10	6.12	6.12	6.13	6.15	6.16	6.17	6.19	6.20	6.21	6.23	6.24	6.25	6.27	6.28	6.30	6.31	32
18	6.00	6.01	6.02	6.04	6.05	6.06	6.08	6.09	6.10	6.13	6.13	6.14	6.16	6.17	6.19	6.20	6.21	6.22	6.24	6.26	6.27	6.29	6.30	6.32	6.33	33
19	6.00	6.01	6.03	6.04	6.05	6.07	6.08	6.10	6.11	6.13	6.14	6.15	6.17	6.18	6.20	6.21	9.23	6.24	6.26	6.27	6.28	6.30	6.31	6.33	6.34	34
20	6.00	6.01	6.03	6.04	6.06	6.07	6.09	6.10	6.12	6.14	6.15	6.16	6.18	6.19	6.21	6.22	6.24	6.25	6.27	6.29	6.30	6.32	6.33	6.35	6.36	35
21	6.00	6.01	6.03	6.05	6.06	6.08	6.09	6.11	6.12	6.14	6.16	6.17	6.19	6.20	6.22	6.24	6.25	6.27	6.29	6.30	6.32	6.34	6.35	6.37	6.38	36
22	6.00	6.02	6.03	6.05	6.06	6.08	6.10	6.11	6.13	6.15	6.16	6.18	6.20	6.21	6.23	6.25	6.27	6.28	6.30	6.32	6.34	6.36	6.37	6.39	6.40	37
23	6.00	6.02	6.03	6.05	6.07	6.09	6.10	6.12	6.14	6.15	6.17	6.19	6.21	6.23	6.24	6.26	6.28	6.30	6.32	6.34	6.36	6.37	6.39	6.41	6.42	38
24	6.00	6.02	6.03	6.05	6.07	6.09	6.11	6.13	6.14	6.16	6.18	6.20	6.22	6.24	6.25	6.27	6.29	6.31	6.33	6.35	6.37	6.39	6.41	6.43	6.44	39
25	6.00	6.02	6.04	6.06	6.07	6.09	6.11	6.13	6.15	6.17	6.19	6.21	6.23	6.25	6.27	6.29	6.31	6.33	6.35	6.37	6.39	6.41	6.43	6.46	6.47	40
26	6.00	6.02	6.04	6.06	6.08	6.10	6.12	6.14	6.16	6.18	6.20	6.22	6.24	6.26	6.28	6.30	9.32	6.34	6.36	6.39	6.41	6.43	6.45	6.48	6.49	41
27	6.00	6.02	6.04	6.06	6.08	6.10	6.12	6.14	6.16	6.19	6.21	6.23	6.25	6.27	6.29	6.31	6.34	6.36	6.38	6.40	6.43	6.45	6.48	6.50	6.51	42
28	6.00	6.02	6.04	6.06	6.09	6.11	6.14	6.15	6.17	6.19	6.22	6.24	6.26	6.28	6.30	6.33	6.35	6.37	6.40	6.42	6.45	6.47	6.50	6.52	6.5[illegible]	43
29	6.00	6.02	6.04	6.07	6.09	6.11	6.13	6.16	6.18	6.20	6.23	6.2[illegible]	6.27	6.29	6.3[illegible]	6.34	6.37	6.39	6.41	6.44	6.47	6.49	6.52	6.54	6.55	44
30	6.00	6.02	6.05	6.07	6.09	6.12	6.14	6.16	6.19	6.21	6.2[illegible]	6.26	6.28	6.31	6.3[illegible]	6.36	6.38	6.41	6.43	6.46	6.48	6.51	6.54	6.57	6.58	45

A TABLE shewing the time of the Sun, Moon, and Stars' setting, when the latitude and declination are of the same name, and the time of their rising, when the latitudes and declinations are of different names.

TABLE VIII.

DEGREES OF DECLINATION.

Lat.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	23.29	Lat.
	HM	HM	HM	HM	HM	HM	HM	HM	HM	HM	HM	HM	HM	HM	HM	HM	HM	HM	HM	HM	HM	HM	HM	HM	H M	
31°	6.00	6.02	6.05	6.07	6.10	6.12	6.15	6.17	6.19	6.22	6.24	6.27	6.29	6.32	6.34	6.37	6.40	6.42	6.45	6.48	6.51	6.53	6.56	6.59	7.01	31
32	6.00	6.02	6.05	6.08	6.10	6.13	6.15	6.18	6.20	6.23	6.25	6.28	6.31	6.33	6.36	6.39	6.41	6.44	6.47	6.50	6.53	6.56	6.58	7.01	7.03	32
33	6.00	6.03	6.05	6.08	6.10	6.13	6.16	6.18	6.21	6.24	6.26	6.29	6.32	6.34	6.37	6.40	6.43	6.46	6.49	6.52	6.55	6.58	7.01	7.04	7.06	33
34	6.00	6.03	6.05	6.08	6.11	6.14	6.16	6.19	6.22	6.25	6.27	6.30	6.33	6.36	6.39	6.42	6.45	6.48	6.51	6.54	6.57	7.00	7.03	7.06	7.08	34
35	6.00	6.03	6.06	6.08	6.11	6.14	6.17	6.20	6.23	6.25	6.28	6.31	6.34	6.37	6.40	6.43	6.46	6.49	6.53	6.56	6.59	7.02	7.06	7.09	7.11	35
36	6.00	6.03	6.06	6.09	6.12	6.15	6.18	6.20	6.23	6.26	6.29	6.32	6.36	6.39	6.42	6.45	6.48	6.52	6.55	6.58	7.01	7.05	7.08	7.12	7.14	36
37	6.00	6.03	6.06	6.09	6.12	6.15	6.18	6.21	6.24	6.27	6.31	6.34	6.37	6.40	6.43	6.47	6.50	6.53	6.57	7.00	7.04	7.07	7.11	7.15	7.17	37
38	6.00	6.03	6.06	6.09	6.13	6.16	6.19	6.22	6.25	6.28	6.32	6.35	6.38	6.42	6.45	6.48	6.52	6.55	6.59	7.02	7.06	7.10	7.14	7.17	7.19	38
39	6.00	6.03	6.06	6.10	6.13	6.16	6.20	6.23	6.26	6.29	6.33	6.36	6.40	6.43	6.47	6.50	6.54	6.57	7.01	7.05	7.09	7.12	7.16	7.20	7.22	39
40	6.00	6.03	6.07	6.10	6.13	6.17	6.20	6.24	6.27	6.31	6.34	6.38	6.41	6.45	6.48	6.52	6.56	7.00	7.03	7.07	7.11	7.15	7.19	7.23	7.25	40
41	6.00	6.03	6.07	6.10	6.14	6.17	6.21	6.25	6.28	6.32	6.35	6.39	6.43	6.46	6.50	6.54	6.58	7.02	7.06	7.10	7.14	7.18	7.22	7.27	7.29	41
42	6.00	6.04	6.07	6.11	6.14	6.18	6.22	6.25	6.29	6.33	6.37	6.40	6.44	6.48	6.52	6.56	7.00	7.04	7.08	7.12	7.17	7.21	7.25	7.30	7.32	42
43	6.00	6.04	6.07	6.11	6.15	6.19	6.22	6.26	6.30	6.34	6.38	6.42	6.46	6.50	6.54	6.58	7.02	7.06	7.11	7.15	7.19	7.24	7.28	7.33	7.36	43
44	6.00	6.04	6.08	6.12	6.15	6.19	6.23	6.27	6.31	6.35	6.39	6.43	6.47	6.52	6.56	7.00	7.04	7.09	7.13	7.18	7.22	7.27	7.31	7.36	7.39	44
45	6.00	6.04	6.08	6.12	6.16	6.20	6.24	6.28	6.32	6.36	6.41	6.45	6.49	6.53	6.58	7.02	7.07	7.11	7.16	7.21	7.25	7.30	7.35	7.40	7.43	45
46	6.00	6.04	6.08	6.12	6.17	6.21	6.25	6.29	6.33	6.38	6.42	6.46	6.51	6.55	7.00	7.04	7.09	7.14	7.19	7.24	7.29	7.34	7.39	7.44	7.47	46
47	6.00	6.04	6.09	6.13	6.17	6.22	6.26	6.30	6.35	6.39	6.43	6.48	6.53	6.57	7.02	7.07	7.12	7.17	7.22	7.27	7.32	7.37	7.43	7.48	7.51	47
48	6.00	6.04	6.09	6.13	6.18	6.22	6.27	6.31	6.36	6.41	6.45	6.50	6.55	6.59	7.04	7.09	7.14	7.19	7.25	7.30	7.35	7.41	7.47	7.53	7.56	48
49	6.00	6.05	6.09	6.14	6.18	6.23	6.28	6.32	6.37	6.42	6.47	6.52	6.57	7.02	7.07	7.12	7.17	7.22	7.28	7.33	7.39	7.45	7.51	7.57	8.00	49
50	6.00	6.05	6.10	6.14	6.19	6.24	6.29	6.34	6.39	6.44	6.49	6.54	6.59	7.04	7.09	7.14	7.20	7.25	7.31	7.37	7.43	7.49	7.55	8.02	8.05	50
51	6.00	6.05	6.10	6.15	6.20	6.25	6.30	6.35	6.40	6.45	6.50	6.56	7.01	7.06	7.12	7.17	7.23	7.29	7.35	7.41	7.47	7.53	8.00	8.06	8.10	51
52	6.00	6.05	5.10	6.15	6.21	6.26	6.31	6.36	6.41	6.47	6.52	6.58	7.03	7.09	7.14	7.20	7.26	7.32	7.38	7.45	7.51	7.58	8.05	8.12	8.16	52
53	6.00	6.05	6.11	6.16	6.22	6.27	9.32	6.38	6.43	6.49	6.54	7.00	7.06	7.11	7.17	7.23	7.29	7.36	7.42	7.49	7.56	8.03	8.10	8.17	8.21	53
54	6.00	6.06	6.11	6.17	6.22	6.28	6.33	6.39	6.45	6.50	6.56	7.02	7.08	7.14	7.20	7.27	7.33	7.40	7.46	7.53	8.00	8.08	8.15	8.23	8.27	54
55	6.00	6.06	6.11	6.17	6.23	6.29	6.35	6.40	6.46	6.52	6.58	7.04	7.11	7.17	7.23	7.30	7.37	7.44	7.51	7.58	8.05	8.13	8.21	8.29	8.33	55
56	6.00	6.06	6.12	6.18	6.24	6.30	6.36	6.42	6.48	6.54	7.00	7.07	7.13	7.20	7.27	7.34	7.41	7.48	7.55	8.03	8.10	8.19	8.27	8.36	8.40	56
57	6.00	6.06	6.12	6.19	6.25	5.31	6.37	6.44	6.50	6.56	7.03	7.10	7.16	7.23	7.30	7.38	7.45	7.52	8.00	8.08	8.16	8.25	8.34	8.43	8.48	57
58	6.00	6.06	6.13	6.19	6.26	6.32	6.39	6.45	6.52	6.58	7.06	7.13	7.20	7.27	7.34	7.42	7.49	7.57	8.05	8.14	8.22	8.32	8.41	8.51	8.56	58
59	6.00	6.07	6.13	6.20	6.27	6.33	6.40	6.47	6.54	7.01	7.08	7.16	7.23	7.30	7.38	7.46	7.54	8.03	8.11	8.20	8.29	8.39	8.40	9.00	9.05	59
60	6.00	6.07	6.14	6.21	6.28	6.35	6.42	6.49	6.56	[illegible]	7.11	7.19	7.26	7.34	7.42	7.51	7.59	8.08	8.17	8.26	8.36	8.47	[illegible]	9.09	9.16	60

To find the Time of the Sun's Rising, Setting, and the Length of the Day and Night, by this Table.

First. Find the sun's declination at the top of the page (marked with the degrees of declination) and the latitudes in the right or left hand columns (marked lat.) and in the common angle of meeting is the time of sun setting, if the sun has north declination, but the time of sun rising, if the sun has south declination.

EXAMPLE I.

Let it be required to find the time of the sun's rising and setting, with the length of the day and night, in latitude 51° north, the 19th of July, 1800.

I first seek the sun's declination for the given day, and find it 20° 53′ north, which I here call 21°, then under the declination 21, and against the latitude 51°, stands 7 H. 53 M. the time the sun sets on the given day, in lat. 51 north, which being doubled, gives 15 H. 46 M. the length of the day; and if 7 H. 53 M. the time of the sun setting, be subtracted from 12 H. the remainder 4 H. 7 M. gives the time of the sun's rising, which being doubled, gives 8 H. 14 M. length of the night.

But, when the sun has 21° south declination in this latitude, the time of sun-setting becomes the time of sun-rising, and the length of the day will then become the length of the night.

Thus, the 26th of November, 1800, the sun's declination will be 20° 59′ south, or 21°, then the time of sun-rising is 7 H. 53 M. his setting 4 H. 7 M. and the length of the night 15 H. 46 M. and day 8 H. 14 M.

EXAMPLE II.

Let it be required to find the time of the sun's rising, setting, and length of the day and night, at Petersburg, the 21st of June, 1800.

Under 23° 28′ N. the declination that day, and against 60° N. the latitude of Petersburg,	12 0
Stands the sun's setting	9 16
The time of sun-rising	2 44
Sun-setting doubled is the length of day	18 32
Sun-rising doubled is the length of night	5 28

EXAMPLE III.

Required the time of the sun's rising and setting, and length of day at the Cape of Good Hope, in lat. 34° 29′ S. May 15th, 1800.

Under the declination 19° 6′ or 19° N. and against the lat. 34° S.	12 0
Stands the sun's rising	6 54
Time of sun's setting	5 6
	2
The length of the day	10 12
And 6 h. 54 m. doub. is length of night	13 48

When a greater degree of accuracy is required, proportional parts may be taken for degrees and minutes of latitude and declination.

To find the Rising and Setting of the Stars.

By this table the rising and setting of any star may be found, whose declination does not exceed 23° 30′ north or south, in the following manner:

If you are in north lat. and the star has north declination, look for the declination at the top, and the lat. in the right or left hand columns, in the angle of meeting, is half the time of the star's continuance above the horizon, in that lat. or the time it takes in ascending from the eastern side of the horizon to the meridian, and descending from the meridian to the western part of the horizon.

Therefore, if these hours and minutes be subtracted from the time of the star's coming to the meridian, the remainder will be the time of the star's rising, and if added, the sum will be the time of the star's setting.

EXAMPLE I.

Required when the star Arcturus rises and sets December 1, in latitude 51° N.

The time of the star's coming to the meridian, or southing in the morning	9 35
Then under star's declination 20° 15′ or 20° N. and against latitude 51 stands	7 47
Time of star's rising in the morning - - - - -	1 48
Added, gives the time of the star's setting - - -	17 22
	12
Star sets 22 minutes after 5 in the evening - - -	5 22

When the latitude is north, and the ſtar has ſouth declination, or the latitude ſouth and the ſtar has north declination, find the latitude in the ſide columns as before, againſt which, and under the degrees of declination, ſtands half the time the ſtar is under the horizon, which being ſubtracted from 12, the remainder will be half the time the ſtar will be above the horizon in that latitude.

Example. What time will the Dog Star, Sirius, riſe and ſet at London, January 25?

	12 0
Under the declination 16° 26′ S. and againſt latitude 51° 32′ or 52° ſtands	7 26
Half the time the ſtar is above the horizon - - -	4 34
The ſtar comes to the meridian in the evening, at - -	10 05
Which ſubtracted, ſhews that the ſtar riſes at 31 m. after 5 in the evening	5 31
Added, ſhews the time the ſtar ſets in the morning - -	2 39

In like manner may the riſing and ſetting of the planets be found when their declination does not exceed $23°\frac{1}{2}$, and the time of their paſſage over the meridian is known.

Suppoſe it was required to know the time of Jupiter's riſing and ſetting, Auguſt 2d, 1800, civil account, in latitude of 52° North.

In the Nautical Almanac for 1800, I find that Jupiter paſſes the meridian at 22 h. 35 m. or 10 h. 35 m. A. M. Auguſt 2, civil account, his declination being then about 22° N. Under the declination 22 and oppoſite the latitude 52 ſtands 8 h. 5 m. which is half the time that Jupiter is above the horizon; ſubtract it from 10 h. 35 m. and it leaves 2 h. 30 m. A. M. the time of Jupiter's riſing, and adding 8 h. 5 m. to 10 h. 35 m. A. M. gives 18 h. 40 m. or 6 h. 40 m. P. M. the time of Jupiter's ſetting.

Suppoſe it was required to find the time of the moon's riſing and ſetting, May 2d, 1800, in latitude of 52° South.

In the Nautical Almanac, page 6, I find that the moon paſſes the meridian at 6 h. 55 m. P. M. her declination being 19° N. Under the declination 19° and oppoſite the latitude 52 ſtands 7 h. 45 m. half the time of the moon's being below the horizon, which ſubtracted from 12 h. leaves 4 h. 15 m. half the time of the moon's being above the horizon, adding this number of 6 h. 55 m. gives 11 h. 10 m. P. M. the time of the moon's ſetting nearly; and ſubtracting 4h. 15m. from 6h. 55m. leaves 2h. 40m. P. M. the time of the moon's riſing.

Note. The time of the moon's paſſing the meridian taken from the Nautical Almanac ought to be corrected for the daily variation, when on any other meridian than that of Greenwich, which may be done by Table 1, page 218, or by ſaying, as 360 is to the longitude of the place, ſo is the daily variation of the moon's paſſing the meridian to the correction of the numbers marked in the Nautical Almanac, additive in weſt and ſubtractive in eaſt longitude. The declination ought alſo to be found for the moment of riſing and ſetting when great exactneſs is required.

It were to be wiſhed, that gentlemen belonging to the ſea would carry a celeſtial globe with them, upon which all the above may be found in an eaſy manner; for they would have nothing more to do but to ſet the globe north and ſouth, raiſe the pole as many degrees above the horizon as the latitude is; bring the ſun's place to the brazen meridian, and ſet the index to the upper 12; then turn the globe round, and note what ſtars come to the meridian, and the hour index will point to the time; when they come above the horizon, it will point to the time of their riſing, and when they deſcend below the horizon, it will point to their ſetting; for as each ſtar on the globe will point directly to one of the ſame name in the heavens, they may be viewed at any time of the night; or, if a planet, turn the globe until the index points to the time of their paſſage over the meridian, and make a mark on the globe with a pencil, under their declination, then turn the globe eaſt until the mark comes to the horizon, and the index will point to the time of their riſing; and turned weſterly till it come to the horizon, the index will point to the time of their ſetting.

TABLE IX.

THE REFRACTIONS OF THE HEAVENLY BODIES IN ALTITUDE.

App. Alt.	Refr.	App. Alt.	Refr.	App. Alt.	Ref.	App. Alt.	Ref.	Ap. Alt	Ref.	Ap. Alt.	Ref.
D.M.	M.S.	D.M.	M.S.	D.M.	MS.	D.M.	M.S	D.	M.S	D.	M.S.
0. 0	33. 0	2.30	16.24	6.30	7.51	12.20	4.16	30	1.38	60	0.33
0. 5	32.10	2.35	16. 4	6.40	7.40	12.40	4. 9	31	1.35	61	0.32
0.10	31.22	2.40	15.45	6.50	7.30	13. 0	4. 3	32	1.31	62	0.30
0.15	30.35	2.45	15.27	7. 0	7.20	13.20	3.57	33	1.28	63	0.29
0.20	29.50	2.50	15. 9	7.10	7.11	13.40	3.51	34	1.24	64	0.28
0.25	29. 6	2.55	14.52	7.20	7. 2	14. 0	3.45	35	1.21	65	0.26
0.30	28.22	3. 0	14.36	7.30	6.53	14.20	3.40	36	1.18	66	0.25
0.35	27.41	3. 5	14.20	7.40	6.45	14.40	3.35	37	1.16	67	0.24
0.40	27. 0	3.10	14. 4	7.50	6.37	15. 0	3.30	38	1.13	68	0.23
0.45	26.20	3.15	13.49	8. 0	6.29	15.30	3.24	39	1.10	69	0.22
0.50	25.42	3.20	13.34	8.10	6.22	16. 0	3.17	40	1. 8	70	0.21
0.55	25. 5	3.25	13.20	8.20	6.15	16.30	3.10	41	1. 5	71	0.19
1. 0	24.29	3.30	13. 6	8.30	6. 8	17. 0	3. 4	42	1. 3	72	0.18
1. 5	23.54	3.40	12.40	8.40	6. 1	17.30	2.59	43	1. 1	73	0.17
1.10	23.20	3.50	12.15	8.50	5.55	18. 0	2.54	44	0.59	74	0.16
1.15	22.47	4. 0	11.51	9. 0	5.48	18.30	2.49	45	0.57	75	0.15
1.20	22.15	4.10	11.29	9.10	5.42	19. 0	2.44	46	0.55	76	0.14
1.25	21.44	4.20	11. 8	9.20	5.36	19.30	2.39	47	0.53	77	0.13
1.30	21.15	4.30	10.48	9.30	5.31	20. 0	2.35	48	0.51	78	0.12
1.35	20.46	4.40	10.29	9.40	5.25	20.30	2.31	49	0.49	79	0.11
1.40	20.18	4.50	10.11	9.50	5.20	21. 0	2.27	50	0.48	80	0.10
1.45	19.51	5.00	9.54	10. 0	5.15	21.30	2.24	51	0.46	81	0. 9
1.50	19.25	5.10	9.38	10.15	5. 7	22. 0	2.20	52	0.44	82	0. 8
1.55	19. 0	5.20	9.23	10.30	5. 0	23. 0	2.14	53	0.43	83	0. 7
2. 0	18.35	5.30	9. 8	10.45	4.53	24. 0	2. 7	54	0.41	84	0. 6
2. 5	18.11	5.40	8.54	11. 0	4.47	25. 0	2. 2	55	0.40	85	0. 5
2.10	17.48	5.50	8.41	11.15	4.40	26. 0	1.56	56	0.38	86	0. 4
2.15	17.26	6. 0	8.28	11.30	4.24	27. 0	1.51	57	0.37	87	0. 3
2.20	17. 4	6.10	8.15	11.45	4.29	28. 0	1.47	58	0.35	88	0. 2
2.25	16.44	6.20	8. 3	12. 0	4.23	29. 0	1.42	59	0.34	89	0. 1

TABLE X. DEPRESSION OR DIP OF THE HORIZON OF THE SEA.

Height of Eye.	Dip of Horiz.	Height of Eye.	Dip of Horiz.	Height of Eye.	Dip of Horiz.	Height of Eye.	Dip of Horiz.
Feet.	M.S.	Feet.	M.S.	Feet.	M.S.	Feet.	M.S.
1	0.57	10	3. 1	19	4.10	35	5.39
2	1.21	11	3.10	20	4.16	40	6. 2
3	1.39	12	3.18	21	4.22	45	6.24
4	1.55	13	3.26	22	4.28	50	6.44
5	2. 8	14	3.34	23	4.34	60	7.23
6	2.20	15	3.42	24	4.40	70	7.59
7	2.31	16	3.49	26	4.52	80	8.32
8	2.42	17	3.56	28	5. 3	90	9. 3
9	2.52	18	4. 3	30	5.14	100	9.33

TABLE XI.

The Sun's Parallax in Altitude.

Sun's Altitude.	Sun's Parallax.
D.	S.
0	9
10	9
20	8
30	8
40	7
50	6
55	5
60	4
65	4
70	3
75	2
80	2
85	1
90	0

TABLE XII. Augmentation of the Moon's Semidiameter.

Moon's Altitude.	Augmentation.
D.	S.
0	0
5	1
10	3
15	4
20	6
25	7
30	8
35	9
40	10
45	11
50	12
55	13
60	14
70	15
80 &c.	16

TABLE XIII.

Dip of the Sea at different Distances from the Observer.

Distance of the land in sea miles.	Height of the Eye above the Sea in Feet.							
	5	10	15	20	25	30	35	40
	Dip.	Dip.	Dip.	Dip.	Dip.	Dip.	Dip.	Dip.
	M.	M.	M.	M.	M.	M.	M.	M.
$\frac{1}{4}$	11	22	34	45	56	68	79	90
$\frac{1}{2}$	6	11	17	22	28	34	39	45
$\frac{3}{4}$	4	8	12	15	19	23	27	30
1	4	6	9	12	15	17	20	23
$1\frac{1}{4}$	3	5	7	9	12	14	16	19
$1\frac{1}{2}$	3	4	6	8	10	12	14	15
2	2	3	5	6	8	10	11	12
$2\frac{1}{2}$	2	3	5	6	7	8	9	10
3	2	3	4	5	6	7	8	8
$3\frac{1}{2}$	2	3	4	5	6	6	7	7
4	2	3	4	4	5	6	7	7
5	2	3	4	4	5	5	6	6
6	2	3	4	4	5	5	6	6

NOTE TO TABLE XIV.—When the sun is near the Equinox (about the 21st of March and 21st of September) the rule for applying the corrections of Tab. 14, is sometimes faulty; thus, if it was required to find the declination for March 21, 1799, in longitude of 105 E. the declination for March 21, 1799, is 0.21 N. by Tab. 14, the correction is 7′ additive (as it falls between March 19 and March 22), which would make the declination 0.28 N. Now this correction ought to be subtracted, which would make the true declination 0.14 N. To avoid this error observe the following directions:—Find the correction from Tab. 14, as usual, and if on the noon of that day at Greenwich the sun has really crossed the equinoctial line, apply the corrections in the same manner as you would 8 or 10 days afterwards; but if the sun has not passed the equinox apply the correction as you would 8 or 10 days previous thereto. Thus in the preceding example the sun had really passed the equinox, now examining the table, 8 or 10 days after March 21, it will be found that the correction for east longitude is subtractive, so that subtracting the correction 7′ from 0° 21′ the remainder is the true declination.

When the correction is subtractive, and greater than the declination taken from the table, then the difference between the two numbers is to be taken and the declination will be of a different name from that taken from the table.

TAB. XIV. For reducing the SUN's DECLIN. as given in the N. A. for Noon at GREENWICH to any other Time under that Merid. or to Noon under any other Merid. See page 222.

Add aft. N. Sub. bef. N.	Sub. aft. N. Add bef. N.	H. M 0.20	H. M 0.40	H. M 1. 0	H. M 1.20	H. M 1.40	H. M 2. 0	H. M 2.20	H. M 2.40	Sub. aft. N. Add bef N.	Add aft. N. Sub. bef. N.
Add in W. Sub. in E.	Sub. in W. Add in E.	5 deg.	10 deg.	15 deg.	20 deg.	25 deg.	30 deg.	35 deg.	40 deg.	Sub. in W Add in E.	Add in W. Sub. in E.
Days.	Days.	M.S.	M.S.	M.S.	M.S.	M.S.	M.S.	M.S.	M.S.	Days.	Days.
Decemb. 21	Decem. 21	0. 0	0. 0	0. 0	0. 0	0. 0	0. 0	0. 0	0. 0	21 June	21 June
20	22	0. 0	0. 1	0. 1	0. 1	0. 2	0. 2	0. 2	0. 3	22	20
19	23	0. 0	0. 1	0. 2	0. 2	0. 3	0. 4	0. 5	0. 6	23	19
18	24	0. 1	0. 2	0. 3	0. 4	0. 6	0. 7	0. 8	0. 9	24	18
17	25	0. 1	0. 3	0. 4	0. 6	0. 7	0. 9	0.11	0.12	25	17
16	26	0. 2	0. 4	0. 5	0. 7	0. 9	0.11	0.13	0.15	26	16
15	27	0. 2	0. 5	0. 6	0. 8	0.11	0.13	0.15	0.18	27	15
14	28	0. 3	0. 6	0. 7	0.10	0.12	0.15	0.18	0.21	28	14
13	29	0. 3	0. 7	0. 9	0.12	0.15	0.18	0.21	0.24	29	13
12	30	0. 3	0. 7	0.10	0.13	0.17	0.20	0.23	0.27	30 June	12
11	Dec. 31	0. 4	0. 8	0.11	0.15	0.19	0.22	0.26	0.30	1 July	11
10	Jan. 1	0. 4	0. 8	0.12	0.16	0.20	0.24	0.28	0.32	2	10
9	2	0. 4	0. 8	0.13	0.17	0.21	0.26	0.30	0.35	3	9
8	3	0. 5	0. 9	0.14	0.19	0.24	0.29	0.33	0.38	4	8
7	4	0. 5	0.10	0.15	0.21	0.26	0.31	0.36	0.41	5	7
6	5	0. 5	0.11	0.16	0.22	0.28	0.33	0.38	0.44	6	6
5	6	0. 6	0.12	0.17	0.24	0.30	0.35	0.41	0.47	7	5
4	7	0. 6	0.12	0.18	0.25	0.31	0.37	0.43	0.49	8	4
3	8	0. 6	0.13	0.19	0.26	0.33	0.39	0.45	0.52	9	3
2	9	0. 7	0.14	0.20	0.27	0.34	0.41	0.48	0.55	10	2
Decemb. 1	10	0. 7	0.14	0.21	0.29	0.36	0.43	0.50	0.57	11	1 June
Novem. 30	11	0. 7	0.15	0.22	0.30	0.37	0.45	0.52	1. 0	12	31 May
29	12	0. 8	0.16	0.23	0.31	0.39	0.47	0.55	1. 3	13	30
28	13	0. 8	0.16	0.24	0.33	0.41	0.49	0.57	1. 6	14	29
27	14	0. 8	0.17	0.25	0.34	0.42	0.51	0.59	1. 8	15	28
26	15	0. 9	0.18	0.26	0.35	0.44	0.53	1. 2	1.11	16	27
25	16	0. 9	0.18	0.27	0.37	0.46	0.55	1. 4	1.13	17	26
24	17	0. 9	0.19	0.28	0.38	0.47	0.57	1. 6	1.16	18	25
23	18	0.10	0.20	0.29	0.39	0.49	0.58	1. 9	1.19	19	24
22	19	0.10	0.20	0.30	0.40	0.50	1. 0	1.10	1.20	20	23
21	20	0.10	0.21	0.31	0.41	0.51	1. 2	1.12	1.22	21	22
20	21	0.11	0.22	0.32	0.43	0.53	1. 4	1.14	1.25	22	21
19	22	0.11	0.22	0.33	0.44	0.55	1. 6	1.17	1.28	23	20
18	23	0.11	0.23	0.34	0.45	0.56	1. 7	1.19	1.30	24	19
17	24	0.12	0.23	0.34	0.46	0.57	1. 9	1.21	1.32	25	18
16	25	0.12	0.24	0.35	0.47	0.59	1.11	1.23	1.35	26	17
15	26	0.12	0.24	0.36	0.48	1. 0	1.12	1.24	1.36	27	16
14	27	0.12	0.25	0.37	0.49	1. 2	1.14	1.26	1.39	28	15
13	28	0.13	0.26	0.38	0.51	1. 4	1.16	1.28	1.41	29	14
11	Jan. 30	0.13	0.26	0.39	0.53	1. 6	1.19	1.32	1.45	31 July	12
9	Feb. 1	0.13	0.27	0.41	0.55	1. 9	1.22	1.36	1.50	2 August	10
7	3	0.14	0.28	0.42	0.57	1.11	1.25	1.39	1.53	4	8
5	5	0.14	0.29	0.43	0.58	1.13	1.27	1.42	1.56	6	6
3	7	0.15	0.30	0.45	1. 0	1.15	1.30	1.44	1.59	8	4
Nov. 1	9	0.15	0.31	0.46	1. 2	1.17	1.32	1.47	2. 3	10	2 May
October 30	11	0.16	0.32	0.47	1. 3	1.19	1.35	1.50	2. 6	12	30 April
28	13	0.16	0.32	0.48	1. 5	1.21	1.37	1.53	2. 9	14	28
26	15	0.16	0.33	0.49	1. 6	1.22	1.39	1.56	2.12	16	26
24	17	0.17	0.34	0.50	1. 7	1.24	1.41	1.58	2.15	18	24
21	20	0.17	0.34	0.52	1. 9	1.27	1.44	2. 1	2.19	21	21
18	23	0.17	0.35	0.53	1.11	1.29	1.46	2. 4	2.22	24	18
15	Feb. 26	0.18	0.36	0.54	1.13	1.31	1.49	2. 7	2.25	27	15
12	March 1	0.18	0.37	0.55	1.14	1.32	1.51	2. 9	2.28	30 August	12
9	4	0.19	0.38	0.56	1.15	1.34	1.53	2.12	2.30	2 Sept.	9
6	7	0.19	0.38	0.57	1.16	1.35	1.54	2.13	2.32	5	6
October 3	10	0.19	0.38	0.57	1.17	1.36	1.55	2.14	2.34	8	3 April
Septem. 30	13	0.19	0.39	0.58	1.17	1.37	1.56	2.15	2.35	11	31 March
27	16	0.19	0.39	0.58	1.18	1.38	1.57	2.16	2.36	14	28
24	19	0.20	0.39	0.58	1.18	1.38	1.57	2.16	2.36	17	25
21	22	0.20	0.40	0.59	1.19	1.39	1.58	2.17	2.36	20	22

TAB. XIV. For reducing the SUN'S DECLIN. as given in the N. A. for Noon at GREENWICH to any other Time under that Meridian, or to Noon under any other Meridian.

Add aft. N. Sub. bef. N.	Sub. aft. N. Add bef. N.	H. M. 3. 0	H. M. 3.20	H. M. 3.40	H. M. 4. 0	H. M. 4.20	H. M. 4.40	H. M. 5. 0	Sub. aft. N. Add bef. N.	Add aft. N. Sub. bef. N.
Add in W. Sub. in E.	Sub. in W. Add in E.	45 deg.	50 deg.	55 deg.	60 deg.	65 deg.	70 deg.	75 deg.	Sub. in W. Add in E.	Add in W. Sub. in E.
Days.	Days.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	Days.	Days.
Dec. 21	Dec. 21	0. 0	0. 0	0. 0	0. 0	0. 0	0. 0	0. 0	21 June	21 June
20	22	0. 3	0. 3	0. 4	0. 4	0. 4	0. 5	0. 5	22	20
19	23	0. 6	0. 7	0. 8	0. 9	0. 9	0.10	0.11	23	19
18	24	0.10	0.11	0.12	0.13	0.14	0.15	0.16	24	18
17	25	0.13	0.15	0.16	0.18	0.19	0.20	0.22	25	17
16	26	0.16	0.18	0.20	0.22	0.24	0.26	0.27	26	16
15	27	0.20	0.22	0.24	0.26	0.29	0.31	0.33	27	15
14	28	0.23	0.25	0.28	0.31	0.34	0.36	0.38	28	14
13	29	0.26	0.29	0.32	0.35	0.38	0.41	0.44	29	13
12	30	0.30	0.33	0.36	0.40	0.43	0.46	0.50	30 June	12
11	Dec. 31	0.33	0.37	0.40	0.44	0.48	0.51	0.55	1 July	11
10	Jan. 1	0.36	0.40	0.44	0.48	0.53	0.57	1. 1	2	10
9	2	0.39	0.44	0.48	0.53	0.57	1. 2	1. 6	3	9
8	3	0.43	0.48	0.53	0.57	1. 2	1. 7	1.11	4	8
7	4	0.46	0.51	0.56	1. 1	1. 7	1.12	1.17	5	7
6	5	0.49	0.55	1. 0	1. 6	1.11	1.17	1.22	6	6
5	6	0.52	0.58	1. 4	1.10	1.16	1.22	1.27	7	5
4	7	0.55	1. 1	1. 7	1.14	1.20	1.26	1.32	8	4
3	8	0.58	1. 5	1.11	1.18	1.24	1.31	1.37	9	3
2	9	1. 1	1. 8	1.15	1.22	1.29	1.36	1.43	10	2
Dec. 1	10	1. 4	1.12	1.19	1.26	1.33	1.41	1.48	11	1 June
Nov. 30	11	1. 7	1.15	1.23	1.30	1.37	1.45	1.52	12	31 May
29	12	1.10	1.18	1.26	1.34	1.42	1.50	1.57	13	30
28	13	1.13	1.22	1.30	1.38	1.46	1.54	2. 2	14	29
27	14	1.16	1.25	1.34	1.42	1.50	1.58	2. 7	15	28
26	15	1.19	1.28	1.37	1.46	1.55	2. 3	2.12	16	27
25	16	1.22	1.31	1.40	1.49	1.59	2. 8	2.17	17	26
24	17	1.25	1.35	1.44	1.53	2. 3	2.12	2.21	18	25
23	18	1.28	1.38	1.47	1.57	2. 7	2.16	2.26	19	24
22	19	1.30	1.41	1.51	2. 1	2.11	2.21	2.31	20	23
21	20	1.33	1.44	1.54	2. 4	2.15	2.25	2.35	21	22
20	21	1.36	1.47	1.57	2. 8	2.19	2.29	2.40	22	21
19	22	1.39	1.50	2. 0	2.11	2.22	2.33	2.44	23	20
18	23	1.41	1.53	2. 4	2.15	2.26	2.37	2.48	24	19
17	24	1.43	1.55	2. 7	2.18	2.30	2.41	2.52	25	18
16	25	1.46	1.58	2.10	2.21	2.33	2.45	2.56	26	17
15	26	1.48	2. 1	2.13	2.25	2.37	2.49	3. 1	27	16
14	27	1.51	2. 4	2.16	2.28	2.40	2.52	3. 5	28	15
13	28	1.54	2. 7	2.19	2.31	2.44	2.56	3. 9	29	14
11	Jan. 30	1.58	2.11	2.24	2.37	2.51	3. 4	3.17	31 July	12
9	Feb. 1	2. 3	2.17	2.30	2.43	2.57	3.11	3.24	2 Aug.	10
7	3	2. 7	2.21	2.35	2.49	3. 3	3.17	3.32	4	8
5	5	2.11	2.25	2.40	2.54	3. 9	3.23	3.38	6	6
3	7	2.14	2.29	2.44	2.59	3.14	3.29	3.44	8	4
Nov. 1	9	2.18	2.33	2.49	3. 4	3.19	3.35	3.50	10	2 May
Oct. 30	11	2.22	2.38	2.53	3. 9	3.25	3.41	3.56	12	30 April
28	13	2.25	2.41	2.58	3.14	3.30	3.46	4. 3	14	28
26	15	2.29	2.45	3. 2	3.18	3.35	3.51	4. 8	16	26
24	17	2.32	2.49	3. 5	3.22	3.39	3.56	4.13	18	24
21	20	2.36	2.53	3.11	3.28	3.45	4. 3	4.20	21	21
18	23	2.40	2.58	3.15	3.33	3.51	4. 8	4.26	24	18
15	Feb. 26	2.43	3. 1	3.20	3.38	3.56	4.14	4.32	27	15
12	March 1	2.46	3. 5	3.23	3.42	4. 1	4.19	4.38	30 Aug.	12
9	4	2.49	3. 8	3.26	3.45	4. 4	4.23	4.41	2 Sept.	9
6	7	2.51	3.10	3.29	3.48	4. 7	4.26	4.45	5	6
Oct. 3	10	2.53	3.13	3.32	3.51	4.10	4.29	4.49	8	3 April
Sept. 30	13	2.55	3.14	3.33	3.53	4.13	4.32	4.51	11	31 March
27	16	2.56	3.15	3.34	3.54	4.14	4.33	4.52	14	28
24	19	2.56	3.15	3.35	3.55	4.15	4.33	4.52	17	25
21	22	2.56	3.15	3.35	3.55	4.15	4.34	4.53	20	22

TAB. XIV. For reducing the SUN's DECLIN. as given in the N. A. for Noon at GREENWICH to any other Time under that Meridian or to Noon under any other Meridian.

Add aft. N. Sub. bef. N.		Sub. aft. N. Add bef. N.		H. M 5.20	H. M 5.40	H. M 6. 0	H. M 6.20	H. M 6.40	H. M 7. 0	H. M 7.20	Sub. aft. N. Add bef. N.		Add aft. N. Sub. bef. N.	
Add in W. Sub. in E.		Sub. in W. Add in E.		80 deg.	85 deg.	90 deg.	95 deg.	100 deg.	105 deg.	110 deg.	Sub. in W. Add in E.		Add in W. Sub. in E.	
Days.		Days.		M.S.	M.S.	M.S.	M.S.	M.S.	M.S.	M.S.	Days.		Days.	
Dec.	21	Dec.	21	0. 0	0. 0	0. 0	0. 0	0. 0	0. 0	0. 0	21	June	21	June
	20		22	0. 5	0. 6	0. 6	0. 7	0. 8	0. 8	0. 8	22		20	
	19		23	0.11	0.12	0.13	0.14	0.15	0.15	0.16	23		19	
	18		24	0.17	0.19	0.20	0.21	0.22	0.23	0.24	24		18	
	17		25	0.23	0.25	0.26	0.28	0.29	0.31	0.32	25		17	
	16		26	0.29	0.31	0.33	0.35	0.37	0.38	0.40	26		16	
	15		27	0.35	0.38	0.40	0.42	0.44	0.46	0.49	27		15	
	14		28	0.41	0.43	0.46	0.49	0.51	0.54	0.57	28		14	
	13		29	0.47	0.50	0.53	0.56	0.59	1. 2	1. 5	29		13	
	12		30	0.53	0.56	0.59	1. 3	1. 6	1. 9	1.12	30	June	12	
	11	Dec.	31	0.59	1. 2	1. 6	1.10	1.13	1.17	1.21	1	July	11	
	10	Jan.	1	1. 5	1. 9	1.13	1.17	1.21	1.25	1.29	2		10	
	9		2	1.11	1.15	1.19	1.24	1.28	1.32	1.37	3		9	
	8		3	1.16	1.21	1.26	1.31	1.35	1.40	1.45	4		8	
	7		4	1.22	1.27	1.32	1.37	1.42	1.47	1.53	5		7	
	6		5	1.27	1.33	1.38	1.44	1.49	1.54	2. 0	6		6	
	5		6	1.33	1.39	1.45	1.51	1.57	2. 2	2. 8	7		5	
	4		7	1.39	1.45	1.51	1.57	2. 3	2. 9	2.10	8		4	
	3		8	1.44	1.50	1.57	2. 4	2.10	2.16	2.23	9		3	
	2		9	1.50	1.56	2. 3	2.10	2.17	2.23	2.30	10		2	
Dec.	1		10	1.55	2. 2	2. 9	2.16	2.23	2.30	2.38	11		1	June
Nov.	30		11	2. 0	2. 7	2.15	2.22	2.30	2.37	2.45	12		31	May
	29		12	2. 5	2.13	2.21	2.29	2.37	2.44	2.52	13		30	
	28		13	2.10	2.19	2.27	2.35	2.43	2.51	3. 0	14		29	
	27		14	2.16	2.25	2.33	2.42	2.50	2.58	3. 7	15		28	
	26		15	2.21	2.30	2.38	2.47	2.56	3. 5	3.13	16		27	
	25		16	2.26	2.35	2.44	2.53	3. 2	3.11	3.21	17		26	
	24		17	2.31	2.40	2.50	2.59	3. 9	3.18	3.28	18		25	
	23		18	2.36	2.46	2.55	3. 5	3.15	3.24	3.34	19		24	
	22		19	2.41	2.51	3. 1	3.11	3.21	3.31	3.41	20		23	
	21		20	2.46	2.56	3. 6	3.17	3.27	3.37	3.48	21		22	
	20		21	2.50	3. 2	3.12	3.23	3.33	3.44	3.55	22		21	
	19		22	2.55	3. 6	3.17	3.28	3.39	3.50	4. 1	23		20	
	18		23	3. 0	3.11	3.22	3.33	3.45	3.56	4. 7	24		19	
	17		24	3. 4	3.16	3.27	3.39	3.50	4. 1	4.13	25		18	
	16		25	3. 8	3.20	3.32	3.44	3.56	4. 7	4.19	26		17	
	15		26	3.13	3.25	3.37	3.49	4. 1	4.13	4.26	27		16	
	14		27	3.17	3.29	3.42	3.54	4. 6	4.19	4.31	28		15	
	13		28	3.22	3.34	3.47	4. 0	4.12	4.25	4.38	29		14	
	11	Jan.	30	3.30	3.43	3.56	4. 9	4.22	4.36	4.49	31	July	12	
	9	Feb.	1	3.38	3.51	4. 5	4.18	4.32	4.46	4.59	2	Aug.	10	
	7		3	3.46	4. 0	4.14	4.28	4.42	4.56	5.10	4		8	
	5		5	3.52	4. 6	4.21	4.36	4.50	5. 5	5.19	6		6	
	3		7	3.59	4.14	4.29	4.44	4.59	5.14	5.29	8		4	
Nov.	1		9	4. 5	4.21	4.36	4.52	5. 7	5.23	5.38	10		2	May
Oct.	30		11	4.12	4.28	4.44	5. 0	5.16	5.31	5.47	12		30	April
	28		13	4.19	4.35	4.51	5. 7	5.23	5.40	5.56	14		28	
	26		15	4.24	4.41	4.57	5.14	5.30	5.47	6. 3	16		26	
	24		17	4.30	4.47	5. 3	5.21	5.38	5.55	6.12	18		24	
	21		20	4.37	4.55	5.12	5.29	5.47	6. 4	6.21	21		21	
	18		23	4.44	5. 2	5.19	5.37	5.55	6.13	6.31	24		18	
	15	Feb.	26	4.50	5. 8	5.26	5.44	6. 2	6.20	6.38	27		15	
	12	March	1	4.56	5.15	5.33	5.52	6.10	6.29	6.47	30	Aug.	12	
	9		4	5. 0	5.19	5.38	5.57	6.16	6.34	6.53	2	Sept.	9	
	6		7	5. 4	5.20	5.42	6. 1	6.20	6.39	6.58	5		6	
Oct.	3		10	5. 8	5.27	5.46	6. 5	6.25	6.44	7. 3	8		3	April
Sept.	30		13	5.11	5.30	5.49	6. 8	6.28	6.47	7. 6	11		31	March
	27		16	5.12	5.31	5.51	6.11	6.31	6.50	7. 9	14		28	
	24		19	5.12	5.32	5.52	6.12	6.32	6.51	7.11	17		25	
	21		22	5.13	5.33	5.53	6.13	6.33	6.52	7.11	20		22	

A TABLE

OF THE

SUN's RIGHT ASCENSION,

Days	Jan	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Days
	South	South	South	North	North	North	North	North	North	South	South	South	
	H. M.	. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	
1	18 48	21 0	22 49	0 43	2 34	4 36	6 41	8 46	10 42	12 30	14 26	16 30	1
2	18 52	21 4	22 53	0 46	2 38	4 41	6 45	8 49	10 45	12 33	14 30	16 34	2
3	18 57	21 8	22 57	0 50	2 41	4 45	6 49	8 53	10 49	12 37	14 34	16 39	3
4	19 1	21 12	23 1	0 53	2 45	4 49	6 57	8 57	10 52	12 41	14 38	16 43	4
5	19 6	21 16	23 4	0 57	2 49	4 53	6 57	9 1	10 56	12 44	14 42	16 47	5
6	19 10	21 20	23 8	1 1	2 53	4 56	7 1	9 5	11 0	12 48	14 46	16 52	6
7	19 14	21 24	23 11	1 4	2 57	5 1	7 5	9 9	11 3	12 52	14 50	16 56	7
8	19 19	21 28	23 15	1 8	3 1	5 5	7 10	9 12	11 7	12 55	14 54	17 0	8
9	19 23	21 32	23 19	1 12	3 5	5 9	7 14	9 16	11 11	12 59	14 58	17 5	9
10	19 27	21 36	23 22	1 15	3 8	5 13	7 18	9 20	11 14	13 3	15 2	17 9	10
11	19 32	21 40	23 26	1 19	3 12	5 18	7 22	9 24	11 18	13 6	15 6	17 14	11
12	19 36	21 44	23 30	1 23	3 16	5 22	7 26	9 28	11 21	13 10	15 10	17 18	12
13	19 40	21 48	23 33	1 26	3 20	5 26	7 30	9 31	11 25	13 14	15 14	17 23	13
14	19 45	21 52	23 37	1 30	3 24	5 30	7 34	9 35	11 28	13 17	15 18	17 27	14
15	19 49	21 56	23 41	1 34	3 28	5 34	7 38	9 39	11 32	13 21	15 22	17 31	15
16	19 53	22 0	23 44	1 37	3 32	5 38	7 42	9 43	11 36	13 25	15 26	17 36	16
17	19 58	22 4	23 48	1 41	3 36	5 43	7 46	9 40	11 39	13 29	15 31	17 40	17
18	20 2	22 7	23 52	1 45	3 40	5 47	7 50	9 50	11 43	13 32	15 35	17 45	18
19	20 6	22 11	23 55	1 49	3 44	5 51	7 54	9 54	11 46	13 36	15 39	17 49	19
20	20 10	22 15	23 59	1 52	3 48	5 55	7 58	9 58	11 50	13 40	15 43	17 54	20
21	20 14	22 19	0 3	1 56	3 52	5 59	8 2	10 1	11 54	13 44	15 47	17 58	21
22	20 19	22 23	0 6	2 0	3 56	6 3	8 6	10 5	11 57	13 47	15 52	18 2	22
23	20 23	22 26	0 10	2 3	4 0	6 7	8 10	10 9	12 1	13 51	15 56	18 7	23
24	20 27	22 30	0 13	2 7	4 4	6 12	8 14	10 12	12 4	13 55	16 0	18 11	24
25	20 31	22 34	0 17	2 11	4 8	6 16	8 18	10 16	12 8	13 59	16 4	18 16	25
26	20 35	22 38	0 21	2 15	4 12	6 20	8 22	10 20	12 12	14 3	16 9	18 20	26
27	20 40	22 42	0 24	2 19	4 16	6 24	8 26	10 23	12 15	14 7	16 13	18 25	27
28	20 44	22 45	0 28	2 22	4 20	6 28	8 30	10 27	12 19	14 10	16 17	18 29	28
29	20 48		0 32	2 26	4 24	6 32	8 34	10 31	12 22	14 14	16 21	18 34	29
30	20 52		0 35	2 30	4 28	6 37	8 38	10 34	12 26	14 18	16 26	18 38	30
31	20 56		0 39		4 32		8 42	10 38		14 22		18 42	31

This table is sufficiently exact for finding when any star comes to the meridian, in order to obtain the latitude; but in all calculations for determining the longitude by celestial observations, the sun's right ascension and declination must be taken out of the Nautical Almanac, as they are there calculated to a greater degree of accuracy.

TABLE XVI.

TABLE of the Right Aſcenſion and Declination of ſome of the principal fixed Stars, adapted to the Year 1800. with their Annual Variation.

Names of the Stars.	Mag.	Right Aſcenſion. H.	M.	S.	Annu. Varia. S. T.	Declination. °	'	"	Annual Varia. S. T.
Shedar, in the breaſt of Caſſiopeia - - -	3	0	29	4	+3.31	55	26	25 N	19.91+
Abruccabar, pole ſtar, tail of the Little Bear	2	0	51	4	10.05	88	14	32	19.69+
Mirach, in the girdle of Andromeda - -	2	0	58	55	3.30	34	33	25	19.45+
Almaach, in the foot of Andromeda - -	2	1	51	42	3.62	41	21	49	17.80+
Menkar in the jaw of the Whale - - -	2	2	51	51	3.13	3	17	51	14.80+
Algol, in the head of Meduſa - - - -	2	2	55	11	3.85	40	10	30	14.63+
Algenib, the bright ſtar in Perſeus - -	2	3	10	7	4.20	49	8	18	13.72+
Pleiades, the bright ſtar in Taurus - -	3	3	35	38	3.55	23	28	38	12.00+
Hyades, in Taurus - - - - - -	3	4	8	36	3.39	15	8	2	9.60+
Aldebaran, the Bull's ſouth eye - - -	1	4	24	28	3.43	16	5	52	8.32+
Capella, in the Goat - - - - - - -	1	5	1	58	4.40	45	46	33	5.30+
Bellatrix, in the weſt ſhoulder of Orion -	2	5	14	25	3.22	6	9	24	4.15+
Betelgueſe, in the eaſt ſhoulder of Orion -	1	5	44	21	3.25	7	21	27	1.58+
Caſtor, the bright ſtar in the head of Gemini	2	7	21	51	3.88	32	18	53	6.78−
Procyon, the bright ſtar in the Little Dog	1	7	28	52	3.20	5	44	28	7.40−
*Pollux, in the head of Gemini - - -	2	7	32	7	3.75	28	29	55	7.70−
Acubens, in the claw of Cancer - - -	3	8	47	32	3.24	12	37	25	13.30−
Regulus, in the Lion's heart - - - -	1	9	57	44	3.24	12	57	3	17.16−
Dubhe, upper Pointer in the Great Bear -	2	10	51	18	3.88	62	49	44	19.09−
Alioth, the firſt in the tail of the Great Bear	2	12	45	17	2.69	57	2	51	19.69−
Benetnach, laſt in the tail of the Great Bear	2	13	39	41	2.41	50	18	58	18.24−
Arcturus, in Bootes - - - - - - -	1	14	6	36	2.82	20	14	56	17.16−
Mirach, in the thigh of Bootes - - -	3	14	46	21	2.63	27	55	24	15.67−
Alphacca, the bright ſtar in the Crown -	2	15	26	14	2.54	27	23	49	12.60−
Raſ. Algethi, in the head of Hercules -	2	17	25	38	2.74	14	37	42	4.87−
Raſ. Alhague, in the head of Ophiucus -	2	17	5	33	2.75	12	43	5	3.15−
Rastaben, in the head of the Dragon - -	2	17	51	58	1.37	51	30	56	0.78−
Vega, the bright ſtar in the Harp - -	1	18	30	9	2.02	38	36	4	2.52+
Atair, the bright ſtar in the Eagle - -	2	19	41	0	2.90	8	20	41	8.40+
Deneb, in the tail of the Swan - - -	2	20	37	37	2.05	44	34	16	12.44+
Aldermain, in the ſhoulder of Cepheus -	3	21	13	48	1.44	61	44	31	14.95+
Scheat, in the thigh of Pegaſus - - -	2	22	54	6	2.88	26	59	25	19.18+
Marcab, in the wing of Pegaſus - - -	2	22	54	49	2.98	14	7	54 S.	19.20+
Achernar, in the river Eridanus - - -	1	1	30	16	2.25	58	17	53	18.56−
Rigel, in the foot of Orion - - - -	1	5	4	56	2.89	8	27	12	4.94−
Canopus, the bright ſtar in Argo - - -	1	6	19	21	1.34	52	35	29	1.60+
Sirius, the bright ſtar in the Great Dog -	1	6	30	22	2.69	16	26	10	3.10+
Alphard, in the heart of the female Hydra	2	9	17	46	2.96	7	47	54	15.13+
*Virgin's Spike, in the ſheaf of Virgo -	1	13	14	41	3.15	10	6	44	19.00+
Zubeneſch, in the ſouth ſcale of Libra -	2	14	39	51	3.31	15	12	5	15.50+
Zubenelg, in the north ſcale of Libra -	2	15	6	15	3.22	8	38	9	13.93+
Antares, in the heart of Scorpio - - -	1	16	17	11	3.66	25	58	31	8.90+
Fomalhaut, bright ſtar in the Southern Fiſh	1	22	46	33	3.33	30	40	36	18.97−
The foot of the Croſs - - - - - - -	1	12	15	37	3.22	61	59	10	20.01+
The bright ſtar in the Oars - - - -	1	9	10	59	0.75	68	53	45	14.79+
The bright ſtar in Centaur - - - -	1	14	26	29	4.41	60	1	2	16.26+

If the places of theſe ſtars are wanted for any time before the beginning of the year 1800 multiply the annual variation, both in right aſcenſion and declination, by the number of years before 1800 and ſubtract the product from the right aſcenſion ſtanding in the table; but the product of the annual variation in declination muſt be added to, or ſubtracted from, the declination, according as the ſign + or — follow it; but for any years after 1800 the variation in right aſcenſion muſt be added to the right aſcenſion in the table, and the variation in declination muſt be either added to, or ſubtracted from it, according as their ſigns are, to fit the declination to any ſucceeding year.--The annual variation is ſet down for ſeconds, and decimals of a ſecond.

TAB. XIV. For reducing the SUN'S DECLIN. as given in the N. A. for Noon at GREENWICH to any other Time under that Meridian, or to Noon under any other Meridian.

Add aft. N. Sub. bef. N.	Sub. aft. N. Add bef. N.	H. M. 7.40	H. M. 8. 0	H. M. 8.20	H. M. 8.40	H. M. 9. 0	H. M. 9.20	H. M. 9.40	Sub. aft. N. Add bef. N.	Add aft. N. Sub. bef. N.
Add in W. Sub. in E.	Sub. in W. Add in E.	115 deg.	120 deg.	125 deg.	130 deg.	135 deg.	140 deg.	145 deg.	Sub. in W. Add in E.	Add in W. Sub. in E.
Days.	Days.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	Days.	Days.
Dec. 21	Dec. 21	0. 0	0. 0	0. 0	0. 0	0. 0	0. 0	0. 0	21 June	21 June
20	22	0. 9	0. 9	0. 9	0.10	0.10	0.10	0.10	22	20
19	23	0.17	0.18	0.18	0.19	0.19	0.20	0.21	23	19
18	24	0.25	0.26	0.27	0.28	0.29	0.30	0.31	24	18
17	25	0.34	0.35	0.36	0.38	0.39	0.41	0.43	25	17
16	26	0.42	0.44	0.46	0.48	0.49	0.51	0.53	26	16
15	27	0.51	0.53	0.55	0.57	0.59	1. 1	1. 3	27	15
14	28	0.59	1. 2	1. 5	1. 7	1. 9	1.12	1.14	28	14
13	29	1. 8	1.11	1.14	1.17	1.19	1.22	1.25	29	13
12	30	1.16	1.19	1.23	1.26	1.29	1.32	1.35	30 June	12
11	Dec. 31	1.24	1.28	1.32	1.35	1.39	1.43	1.46	1 July	11
10	Jan. 1	1.33	1.37	1.41	1.45	1.49	1.53	1.57	2	10
9	2	1.42	1.46	1.51	1.55	1.59	2. 3	2. 7	3	9
8	3	1.49	1.54	1.59	2. 4	2. 9	2.13	2.18	4	8
7	4	1.58	2. 3	2. 8	2.13	2.19	2.23	2.28	5	7
6	5	2. 5	2.11	2.16	2.22	2.28	2.33	2.39	6	6
5	6	2.14	2.20	2.26	2.32	2.38	2.43	2.49	7	5
4	7	2.22	2.28	2.34	2.41	2.47	2.53	2.59	8	4
3	8	2.29	2.36	2.43	2.49	2.56	3. 3	3. 9	9	3
2	9	2.37	2.44	2.51	2.58	3. 5	3.12	3.19	10	2
Dec. 1	10	2.45	2.52	2.59	3. 6	3.14	3.21	3.28	11	1 June
Nov. 30	11	2.52	3. 0	3. 7	3.15	3.23	3.30	3.38	12	31 May
29	12	3. 0	3. 8	3.16	3.24	3.32	3.39	3.47	13	30
28	13	3. 8	3.16	3.24	3.32	3.40	3.49	3.57	14	29
27	14	3.15	3.24	3.32	3.41	3.49	3.58	4. 6	15	28
26	15	3.22	3.31	3.40	3.49	3.58	4. 7	4.16	16	27
25	16	3.30	3.39	3.48	3.57	4. 7	4.16	4.25	17	26
24	17	3.37	3.46	3.56	4. 6	4.16	4.24	4.34	18	25
23	18	3.44	3.54	4. 4	4.14	4.24	4.33	4.43	19	24
22	19	3.51	4. 1	4.11	4.21	4.31	4.41	4.51	20	23
21	20	3.58	4. 8	4.19	4.29	4.39	4.50	5. 0	21	22
20	21	4. 5	4.16	4.27	4.37	4.48	4.59	5. 9	22	21
19	22	4.12	4.23	4.34	4.45	4.56	5. 7	5.18	23	20
18	23	4.19	4.30	4.41	4.53	5. 4	5.15	5.26	24	19
17	24	4.25	4.36	4.48	5. 0	5.12	5.23	5.34	25	18
16	25	4.31	4.43	4.55	5. 7	5.19	5.30	5.42	26	17
15	26	4.38	4.50	5. 2	5.14	5.26	5.38	5.50	27	16
14	27	4.43	4.56	5. 8	5.21	5.33	5.46	5.58	28	15
13	28	4.50	5. 3	5.16	5.28	5.40	5.54	6. 6	29	14
11	Jan. 30	5. 2	5.15	5.28	5.41	5.54	6. 8	6.21	31 July	12
9	Feb. 1	5.13	5.27	5.40	5.54	6. 8	6.22	6.35	2 Aug.	10
7	3	5.24	5.38	5.52	6. 6	6.20	6.35	6.49	4	8
5	5	5.34	5.49	6. 4	6.18	6.33	6.47	7. 2	6	6
3	7	5.44	5.59	6.14	6.29	6.44	6.59	7.14	8	4
Nov. 1	9	5.53	6. 9	6.24	6.40	6.55	7.11	7.26	10	2 May
Oct. 30	11	6. 3	6.18	6.34	6.50	7. 6	7.21	7.37	12	30 April
28	13	6.12	6.28	6.44	7. 0	7.16	7.32	7.48	14	28
26	15	6.20	6.36	6.53	7.10	7.26	7.42	7.58	16	26
24	17	6.29	6.45	7. 2	7.19	7.36	7.52	8. 9	18	24
21	20	6.39	6.56	7.13	7.31	7.48	8. 5	8.22	21	21
18	23	6.48	7. 6	7.24	7.42	8. 0	8.17	8.34	24	18
15	Feb. 26	6.57	7.15	7.34	7.52	8.10	8.28	8.46	27	15
12	March 1	7. 6	7.24	7.42	8. 1	8.20	8.38	8.57	30 Aug.	12
9	4	7.12	7.31	7.50	8. 9	8.28	8.46	9. 6	2 Sept.	9
6	7	7.17	7.36	7.55	8.14	8.33	8.53	9.12	5	6
Oct. 3	10	7.23	7.42	8. 1	8.20	8.39	8.59	9.18	8	3 April
Sept. 30	13	7.26	7.45	8. 4	8.24	8.43	9. 3	9.22	11	31 March
27	16	7.29	7.48	8. 7	8.27	8.47	9. 6	9.25	14	28
24	19	7.30	7.50	8.10	8.29	8.49	9. 8	9.27	17	25
21	22	7.31	7.50	8.10	8.30	8.50	9. 9	9.28	20	22

TAB. XIV. For reducing the SUN's DECLIN. as given in the N. A. for Noon at GREENWICH to any other Time under that Meridian or to Noon under any other Meridian.

Add aft. N. Sub. bef. N.	Sub. aft. N Add bef. N.	H. M. 10.0	H. M. 10.20	H. M. 10.40	H. M. 11. 0	H. M. 11.20	H. M. 11.40	H. M. 12. 0	Sub. aft. N. Add bef. N.	Add aft. N. Sub. bef. N.
Add in W. Sub. in E.	Sub. in W. Add in E	150 deg.	155 deg.	160 deg.	165 deg.	170 deg.	175 deg.	180 deg.	Sub. in W Add in E.	Add in W. Sub. in E.
Days.	Days.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	Days.	Days.
Decemb. 21	Decem. 21	0. 0	0. 0	0. 0	0. 0	0. 0	0. 0	0. 0	21 June	21 June
20	22	0.11	0.11	0.12	0.12	0.12	0.13	0.13	22	20
19	23	0.22	0.23	0.24	0.24	0.25	0.26	0.26	23	19
18	24	0.33	0.34	0.35	0.36	0.37	0.38	0.39	24	18
17	25	0.44	0.46	0.47	0.48	0.50	0.51	0.53	25	17
16	26	0.55	0.57	0.58	1. 0	1. 2	1. 4	1. 6	26	16
15	27	1. 6	1. 8	1.11	1.13	1.15	1.17	1.19	27	15
14	28	1.17	1.20	1.23	1.25	1.27	1.30	1.32	28	14
13	29	1.28	1.31	1.34	1.37	1.40	1.43	1.46	29	13
12	30	1.39	1.42	1.45	1.49	1.52	1.55	1.59	30 June	12
11	Dec. 31	1.50	1.54	1.57	2. 1	2. 5	2. 8	2.12	1 July	11
10	Jan. 1	2. 1	2. 5	2. 9	2.13	2.17	2.21	2.25	2	10
9	2	2.12	2.16	2.20	2.25	2.30	2.34	2.38	3	9
8	3	2.23	2.27	2.32	2.37	2.42	2.47	2.51	4	8
7	4	2.34	2.39	2.44	2.49	2.54	2.59	3. 4	5	7
6	5	2.44	2.50	2.55	3. 0	3. 6	3.12	3.17	6	6
5	6	2.55	3. 1	3. 6	3.12	3.18	3.24	3.30	7	5
4	7	3. 5	3.11	3.17	3.23	3.29	3.36	3.42	8	4
3	8	3.15	3.21	3.28	3.34	3.41	3.48	3.54	9	3
2	9	3.25	3.32	3.38	3.45	3.52	3.59	4. 6	10	2
Decemb. 1	10	3.35	3.42	3.49	3.56	4. 4	4.11	4.18	11	1 June
Novem. 30	11	3.45	3.52	3.59	4. 7	4.15	4.22	4.30	12	31 May
29	12	3.55	4. 3	4.10	4.18	4.26	4.34	4.42	13	30
28	13	4. 5	4.13	4.21	4.29	4.38	4.46	4.54	14	29
27	14	4.15	4.23	4.31	4.40	4.49	4.57	5. 5	15	28
26	15	4.24	4.33	4.41	4.50	4.59	5. 8	5.17	16	27
25	16	4.34	4.43	4.52	5. 1	5.10	5.19	5.28	17	26
24	17	4.43	4.53	5. 2	5.11	5.21	5.30	5.40	18	25
23	18	4.52	5. 2	5.12	5.22	5.32	5.41	5.51	19	24
22	19	5. 1	5.12	5.22	5.32	5.42	5.52	6. 2	20	23
21	20	5.10	5.21	5.31	5.42	5.53	6. 3	6.13	21	22
20	21	5.20	5.31	5.41	5.52	6. 3	6.14	6.24	22	21
19	22	5.29	5.40	5.51	6. 2	6.13	6.24	6.34	23	20
18	23	5.37	5.49	6. 0	6.11	6.23	6.34	6.44	24	19
17	24	5.45	5.57	6. 9	6.20	6.32	6.43	6.54	25	18
16	25	5.54	6. 6	6.17	6.29	6.41	6.53	7. 4	26	17
15	26	6. 2	6.14	6.26	6.38	6.51	7. 3	7.14	27	16
14	27	6.10	6.22	6.34	6.47	7. 0	7.12	7.24	28	15
13	28	6.19	6.31	6.43	6.56	7. 9	7.22	7.34	29	14
11	Jan. 30	6.34	6.47	7. 0	7.13	7.26	7.40	7.53	31 July	12
9	Feb. 1	6.40	7. 3	7.16	7.30	7.43	7.57	8.11	2 August	10
7	3	[illegible]	7.17	7.31	7.45	7.59	8.13	8.28	4	8
5	5	[illegible]	7.31	7.45	8. 0	8.14	8.28	8.43	6	6
3	7	7.29	7.44	7.59	8.14	8.28	8.43	8.58	8	4
Nov. 1	9	7.41	7.56	8.12	8.27	8.42	8.58	9.13	10	2 May
October 30	11	7.53	8. 8	8.24	8.40	8.56	9.12	9.28	12	30 April
28	13	8. 4	8.20	8.39	8.55	9. 9	9.25	9.42	14	28
26	15	8.15	8.32	8.48	9. 5	9.21	9.38	9.54	16	26
24	17	8.27	8.43	9. 0	9.17	9.34	9.50	10. 7	18	24
21	20	8.45	[illegible]	9.14	9.32	9.49	10. 6	10.24	21	21
18	23	8.52	9.10	9.28	9.45	10. 3	10.21	10.39	24	18
15	Feb. 26	9. 4	9.22	9.40	9.58	10.16	10.34	10.53	27	15
12	March 1	9.15	9.33	9.51	10.10	10.29	10.47	11. 6	30 August	12
9	4	9.26	9.43	10. 1	10.20	10.39	10.58	11.16	2 Sept.	9
6	7	[illegible]	9.50	10. 0	10.28	10.47	11. 6	11.24	5	6
October 3	10	9.37	9.56	10.16	10.35	10.54	11.13	11.32	8	3 April
Septem. 30	13	9.41	10. 0	10.21	10.40	10.59	11.18	11.38	11	31 March
27	16	9.45	10. 4	10.24	10.44	11. 3	11.22	11.42	14	28
24	19	9.47	10. 6	10.26	10.46	11. 5	11.24	11.44	17	25
21	22	9.48	10. 7	10.27	10.47	11. 6	11.25	11.45	20	22

TABLE XVIII. For computing the Effects of Parallax on the Moon's Distance from the Sun or a Star.

Apparent Distance.
Add the Difference of the two Numbers taken out of this Table, if the Apparent Distance is less than 90°, and subtract it if above.

Par. in Alt. or Distance.	10°	11°	12°	13°	14°	15°	16°	17°	18°	19°	20°	21°	22	23°	24°	25°
M	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
5	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
8	3	3	2	2	2	2	2	2	2	2	1	1	1	1	1	1
10	5	5	4	4	4	3	3	3	3	2	2	2	2	2	2	2
11	6	5	5	4	4	4	4	3	3	3	3	3	3	3	2	2
12	7	6	6	5	5	4	4	4	4	3	3	3	3	3	3	3
13	8	8	7	6	6	5	5	5	5	4	4	4	3	3	3	3
14	10	9	8	7	7	6	6	6	6	5	5	4	4	4	4	4
15	11	10	9	8	8	7	7	6	6	6	5	5	5	4	4	4
16	13	11	10	9	9	8	8	7	7	6	6	6	6	5	5	5
17	14	13	12	11	10	9	9	8	8	7	7	6	6	6	5	5
18	16	14	13	12	11	10	10	9	9	8	8	7	7	6	6	6
19	18	16	15	14	13	12	11	10	10	9	8	8	8	7	7	7
20	20	18	16	15	14	13	12	11	11	10	9	9	9	8	8	7
21	22	20	18	17	15	14	13	12	12	11	10	10	10	9	9	8
22	24	22	20	18	17	16	15	14	13	12	12	11	11	10	10	9
23	26	24	22	20	18	17	16	15	14	14	13	12	11	11	10	10
24	29	26	24	22	20	19	18	17	16	15	14	13	12	11	11	10
25	31	28	26	24	22	21	19	18	17	16	15	14	13	12	12	11
26	34	31	28	26	24	22	21	19	18	17	16	15	14	13	13	12
27	36	33	30	28	26	24	22	21	19	18	17	16	15	15	14	13
28	39	35	32	30	28	26	24	22	21	20	19	18	17	16	15	14
29	42	38	34	32	30	28	25	24	22	21	20	19	18	17	16	15
30	45	41	37	34	32	29	27	25	24	22	21	20	19	18	17	16
31	48	44	39	37	34	31	29	27	25	24	23	22	21	19	18	18
32	51	46	42	39	36	33	31	29	27	25	24	23	22	21	20	19
33	54	49	44	41	38	35	33	31	29	27	25	24	23	22	21	20
34	57	52	47	44	41	38	35	33	31	29	27	25	24	23	22	21
35	60	55	50	46	43	40	37	35	33	31	29	27	25	24	23	23
36	64	58	53	49	45	42	40	37	35	33	31	29	27	26	25	24
37	67	61	56	52	48	45	42	39	37	35	32	31	29	28	26	25
38	71	65	59	55	51	47	44	41	39	36	34	32	31	29	28	27
39	75	68	62	58	53	50	46	43	41	38	36	34	32	31	29	28
40	79	72	66	61	56	52	49	46	43	40	38	36	34	32	31	30
41	83	76	69	64	59	55	51	48	45	42	40	38	36	34	33	32
42	87	80	73	67	62	58	54	50	47	44	42	40	38	36	35	33
43	91	84	76	70	64	60	56	53	49	47	44	42	39	38	36	35
44	96	88	80	73	67	63	59	55	52	49	46	43	41	39	38	36
45	100	92	83	77	70	66	61	58	54	51	48	46	43	41	40	38
46	105	96	87	80	74	69	64	60	57	54	51	48	45	43	42	40
47	109	100	91	84	77	72	67	63	59	56	53	49	47	45	43	42
48	114	104	95	87	80	75	70	65	61	58	55	52	50	47	45	43
49	119	109	99	91	83	78	73	69	64	61	57	55	52	49	46	45
50	124	113	103	95	87	81	76	71	67	63	60	57	54	51	48	46
51	129	117	107	98	91	85	79	74	69	66	62	59	56	53	50	49
52	134	121	111	102	95	89	83	77	72	68	65	61	58	55	53	51
53	139	126	115	106	98	92	86	80	74	71	67	64	60	58	55	53
54	144	131	120	110	102	95	89	83	77	73	70	66	63	60	57	54
55	149	136	124	114	106	99	92	86	80	76	72	69	65	62	59	57
56	155	141	129	119	110	103	96	89	83	79	75	71	68	65	62	59
57	160	146	133	123	114	107	99	93	86	82	77	74	70	67	64	61
58	166	151	138	127	118	110	103	96	90	85	80	76	73	69	66	63
59	172	156	143	133	123	115	106	100	93	88	83	79	75	72	68	65
60	178	162	148	137	128	119	110	103	97	91	86	82	78	74	70	67
61	184	167	153	141	131	122	113	107	100	94	89	85	80	76	72	69
62	190	173	158	145	135	125	117	110	103	97	92	87	83	79	75	72

Table XVIII. For computing the Effects of ParalIax on the Moon's Distance from the Sun or a Star.

Par. in Alt. or Distance.	Apparent Distance. Add the Difference of the two Numbers taken out of this Table, if the Apparent Distance is less than 90°, and subtract it if above.												
	26°	27°	28°	29°	30°	31°	32°	33°	34°	35°	36°	37°	38°
M	″	″	″	″	″	″	″	″	″	″	″	″	″
5	0	0	0	0	0	0	0	0	0	0	0	0	0
8	1	1	1	1	1	1	1	1	1	1	1	0	0
10	2	2	2	1	1	1	1	1	1	1	1	1	1
11	2	2	2	2	2	2	2	2	1	1	1	1	1
12	3	2	2	2	2	2	2	2	2	2	2	1	1
13	3	3	3	3	2	2	2	2	2	2	2	2	2
14	4	3	3	3	3	3	3	2	2	2	2	2	2
15	4	4	4	4	3	3	3	3	3	3	3	2	2
16	5	5	5	4	4	4	4	3	3	3	3	2	2
17	5	5	5	5	4	4	4	4	4	4	3	3	3
18	6	6	6	5	5	5	5	4	4	4	4	3	3
19	6	6	6	6	5	5	5	5	5	4	4	4	4
20	7	7	7	6	6	6	6	5	5	5	5	4	4
21	8	7	7	7	7	6	6	6	6	5	5	5	5
22	9	8	8	7	7	7	7	6	6	6	6	5	5
23	9	9	9	8	8	7	7	7	7	6	6	6	6
24	10	9	9	9	9	8	8	7	7	7	7	6	6
25	11	10	10	10	9	9	9	8	8	8	7	7	7
26	12	11	11	10	10	9	9	9	9	8	8	7	7
27	13	12	12	11	11	10	10	10	9	9	9	8	8
28	14	13	13	12	12	11	11	10	10	9	9	8	8
29	15	14	14	13	13	12	12	11	11	10	10	9	9
30	16	15	15	14	14	13	13	12	12	11	11	10	10
31	17	16	16	15	15	14	14	13	13	12	11	11	11
32	18	17	17	16	16	15	15	14	14	13	12	11	11
33	19	19	18	17	17	16	16	15	14	14	13	12	12
34	21	20	19	18	18	17	17	16	15	14	14	13	13
35	22	21	20	19	19	18	17	17	16	15	14	14	13
36	23	22	21	20	20	19	18	17	17	16	15	14	14
37	24	23	22	21	21	20	19	18	18	17	16	15	15
38	26	24	23	22	22	21	20	19	19	18	17	16	16
39	27	26	24	24	23	22	21	20	20	19	18	17	17
40	29	27	26	25	24	23	22	21	21	20	19	18	18
41	30	29	27	26	25	24	23	23	22	21	20	19	19
42	32	30	29	28	27	26	25	24	23	22	21	20	20
43	33	32	30	29	28	27	26	25	24	23	22	21	21
44	35	33	32	30	29	28	27	26	25	24	23	22	22
45	36	35	33	32	30	29	28	27	26	25	24	23	23
46	38	36	35	33	32	30	29	28	27	26	25	24	24
47	40	38	36	35	33	32	30	29	28	27	26	26	25
48	42	40	38	36	35	33	32	31	30	29	28	27	26
49	43	41	39	38	36	35	33	32	31	30	29	28	27
50	45	43	41	39	38	36	35	33	32	31	30	29	28
51	47	45	43	41	39	38	36	35	33	32	31	30	29
52	49	47	45	43	41	39	38	36	35	33	32	31	30
53	50	48	46	44	42	41	39	38	36	35	33	32	31
54	52	50	48	46	44	42	41	39	38	36	35	33	32
55	54	52	50	47	45	44	42	41	39	38	36	35	33
56	56	53	51	49	47	45	44	42	41	39	38	36	35
57	58	55	53	51	49	47	45	44	42	41	39	37	36
58	60	57	55	53	51	49	47	45	44	42	40	38	37
59	62	59	57	55	53	51	48	47	45	43	41	40	38
60	64	61	59	56	54	52	50	48	47	45	43	41	40
61	66	63	61	58	56	54	52	50	48	46	44	43	41
62	69	65	63	60	58	56	54	52	50	48	46	44	43

It is obvious, that by the sun's annual motion, he is perpetually changing his declination and right ascension, which is set down in the preceding table for the noon of every day at London; and may be reduced to any other time or meridian, as has been already shewn in finding the longitude.

By the precession of the equinoxes, the fixed stars are continually altering their longitudes, right ascensions, and declinations; the alteration in the longitude is about 50 seconds every year; the alteration in right ascension and declination of some of the principal fixed stars are set down in the preceding table for 1800, and their annual variation, which being applied to the right ascension and declination in the table, by addition or subtraction, gives the right ascension and declination for any succeeding years.

The right ascension of the sun, moon, or stars, is the number of degrees of the equinoctial that comes to the meridian with them, counted from the first point of Aries.

The use of the tables of the right ascension of the sun and stars is to find the time when any star culminates, or is upon the meridian on a given day.

RULE.

Look for the right ascension of the sun and star in the preceeding tables, and subtract the sun's right ascension from the star's; but if the sun's right ascension be greatest, add 24 hours to the star's right ascension, and then subtract the sun's from it, the remainder will be the time of the star's coming to the meridian.

When the sun's right ascension is least, the star comes to the meridian in the afternoon, but before noon when the sun is greatest.

EXAMPLE I.

At what time will the star Arcturus be on the meridian of London, Dec. 1?

	h.	m.
Arcturus's right ascension	14	6
	24	0
	38	6
Sun's right ascension	16	31
After midnight	21	35
	12	0
Morning	9	34

That is, the star Arcturus will be upon the meridian of London 35 minutes after nine o'clock in the morning.

EXAMPLE II.

At what time will the star Virgin's Spike be on the meridian of London, Sept. 1?

	h.	m.
Spica Virginis's right ascension	13	14
Sun's right ascension	10	42
The star culminates afternoon	2	32

So that the star Virgin's Spike comes to the meridian at London 32 minutes after two in the afternoon.

To find what Star will come upon the Meridian at any given Time.

RULE.

Add the time from noon to the right ascension of the sun, the sum will be the right ascension of the star required to be known; with which enter the table of the star's right ascension, and find what star's right ascension agrees with, or comes the nearest to it, and that is the star required.

EXAMPLE I.

I would know what star would be on the meridian of London about ten at night, January 25?

	H.	M.
Sun's right ascension January 25, at noon —	20	32
And for 10 hours more —	0	2
Given time 10 hours P. M.	10	0
	30	34
Sub.	24	0
Nearly answers to Sirius —	6	34

EXAMPLE II.

What star will be upon the meridian of London 20 minutes past four in the morning, May 10?

	H.	M.
Sun's right ascension May 9 at noon	3	5
And for 16 hours more —	0	3
Given time 16 hours, 30 minutes P. M. — —	16	30
Right ascension of mid. heaven	19	38

Answers nearly to Atair in the Eagle.

TABLE XVII. For finding the Distance of Terrestrial Objects at Sea.

Heigh. in Ft.	Dist. in Miles.	Height in Feet.	Dist. in Miles.	Height in Feet.	Dist. in Miles.	Height in Feet.	Dist. in Miles.	Height in Feet.	Dist. in Miles.
1	1.224	53	8.914	240	18.969	760	33.756	2250	58.083
2	1.732	56	9.163	245	19.165	780	34.197	2300	58.725
3	2.121	59	9.405	250	19.360	800	34.633	2350	59.360
4	2.449	62	9.641	255	19.553	820	35.063	2400	59.988
5	2.738	65	9.870	260	19.743	840	35.488	2450	60.609
6	2.999	68	10.097	265	19.932	860	35.908	2500	61.225
7	3.239	71	10.317	270	20.119	880	36.323	2550	61.834
8	3.463	74	10.533	275	20.305	900	36.734	2600	62.437
9	3.673	77	10.745	280	20.489	920	37.140	2650	63.035
10	3.872	80	10.952	285	20.671	940	37.546	2700	63.626
11	4.061	83	11.156	290	20.851	960	37.938	2750	64.213
12	4.242	86	11.355	295	21.030	980	38.332	2800	64.794
13	4.415	89	11.552	300	21.208	1000	38.721	2850	65.370
14	4.581	92	11.745	310	21.558	1030	39.297	2900	65.940
15	4.742	95	11.932	320	21.903	1060	39.886	2950	66.507
16	4.898	98	12.121	330	22.243	1090	40.426	3000	67.068
17	5.048	101	12.306	340	22.578	1120	40.978	3050	67.625
18	5.195	104	12.487	350	22.907	1150	41.524	3100	68.177
19	5.338	107	12.666	360	22.232	1180	42.062	3150	68.725
20	5.476	110	12.842	370	22.553	1210	42.593	3200	69.268
21	5.611	113	13.016	380	23.869	1240	43.118	3250	69.807
22	5.743	116	13.188	390	24.181	1270	43.636	3300	70.342
23	5.872	119	13.357	400	24.489	1300	44.149	3350	70.873
24	5.999	122	13.525	410	24.793	1330	44.659	3400	71.400
25	6.122	125	13.690	420	25.094	1360	45.156	3450	71.923
26	6.243	128	13.853	430	25.391	1390	45.651	3500	72.443
27	6.362	131	14.015	440	25.684	1420	46.140	3550	72.958
28	6.479	134	14.174	450	25.974	1450	46.629	3600	73.470
29	6.594	137	14.332	460	26.261	1480	47.106	3650	73.979
30	6.700	140	14.488	470	26.545	1510	47.581	3700	74.484
31	6.817	143	14.642	480	26.826	1540	48.052	3750	74.985
32	6.928	146	14.795	490	27.104	1570	48.517	3800	75.484
33	7.034	150	14.995	500	27.379	1600	48.979	3850	75.979
34	7.140	155	15.244	510	27.652	1630	49.436	3900	76.471
35	7.214	160	15.488	520	27.922	1660	49.889	3950	76.959
36	7.347	165	15.728	530	28.189	1690	50.339	4000	77.445
37	7.448	170	15.965	540	28.454	1720	50.782	4050	77.927
38	7.548	175	16.198	550	28.716	1750	51.223	4100	78.407
39	7.647	180	16.427	560	28.976	1780	51.661	4150	78.884
40	7.744	185	16.654	570	29.233	1810	52.094	4200	79.358
41	7.840	190	16.878	580	29.489	1840	52.524	4250	79.829
42	7.935	195	17.098	590	29.742	1870	52.951	4300	80.297
43	8.029	200	17.316	600	29.994	1900	53.374	4350	80.662
44	8.122	205	17.531	620	30.489	1930	53.793	4400	81.215
45	8.214	210	17.748	640	30.976	1960	54.219	4450	81.685
46	8.305	215	17.955	660	31.457	2000	54.761	4500	82.143
47	8.394	220	18.160	680	31.930	2050	55.441	4550	82.598
48	8.483	225	18.366	700	32.396	2100	56.113	4600	83.051
49	8.570	230	18.569	720	32.855	2150	56.777	4650	83.501
50	8.658	235	18.770	740	33.300	2200	57.434	4700	83.919

TABLE XVIII. For computing the Effects of Parallax on the Moon's Distance from the SUN or a STAR.

Par. in Alt. or Distance	Apparent Distance. Add the Difference of the two Numbers taken out of this Table, if the Apparent Distance is less than 90°, and subtract it if above.												
	39°	40°	41°	42°	43°	44°	45°	46°	47°	48°	49°	50°	51°
M	"	"	"	"	"	"	"	"	"	"	"	"	"
5	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0
10	1	1	1	1	1	1	1	1	1	1	1	0	0
11	1	1	1	1	1	1	1	1	1	1	1	0	0
12	1	1	1	1	1	1	1	1	1	1	1	0	0
13	2	2	2	2	2	1	1	1	1	1	1	1	1
14	2	2	2	2	2	2	2	1	1	1	1	1	1
15	2	2	2	2	2	2	2	2	2	1	1	1	1
16	2	2	2	2	2	2	2	2	2	2	2	2	1
17	3	3	3	3	3	3	2	2	2	2	2	2	2
18	3	3	3	3	3	3	3	3	3	2	2	2	2
19	4	3	3	3	3	3	3	3	3	3	3	3	3
20	4	4	4	4	3	3	3	3	3	3	3	3	3
21	5	4	4	4	4	4	4	4	4	3	3	3	3
22	5	5	5	5	4	4	4	4	4	3	3	3	3
23	5	5	5	5	5	5	4	4	4	4	4	3	3
24	6	6	6	6	5	5	5	5	5	4	4	4	4
25	7	6	6	6	6	6	5	5	5	5	5	4	4
26	7	7	7	7	6	6	6	6	6	5	5	5	5
27	8	7	7	7	7	6	6	6	6	5	5	5	5
28	8	8	8	8	7	7	7	7	7	6	6	6	6
29	9	9	9	8	8	7	7	7	7	6	6	6	6
30	9	9	9	9	8	8	8	8	7	7	6	6	6
31	10	10	10	9	9	8	8	8	8	7	7	7	6
32	10	10	10	10	9	9	9	9	8	8	7	7	6
33	11	10	10	10	10	10	9	9	8	8	7	7	7
34	12	11	11	11	10	10	10	10	9	9	8	8	7
35	13	12	12	11	11	11	10	10	9	9	8	8	8
36	13	13	13	12	11	11	11	11	10	10	9	9	9
37	14	13	13	12	12	11	11	11	10	10	10	10	10
38	15	14	14	13	13	12	12	12	12	11	11	11	11
39	16	15	15	14	14	13	13	13	13	12	12	11	11
40	17	16	16	15	15	14	14	14	13	13	12	12	12
41	18	17	17	16	15	15	14	14	14	13	13	12	12
42	19	18	18	17	16	15	15	15	14	14	13	13	13
43	20	18	18	17	16	16	15	15	14	14	13	13	13
44	20	19	19	18	17	16	16	16	15	14	13	13	13
45	21	20	20	19	18	17	17	16	15	14	14	13	13
46	22	21	20	19	19	18	18	17	16	15	14	14	14
47	23	22	22	21	20	20	19	18	17	16	15	15	15
48	24	23	23	22	22	21	20	19	18	17	16	16	16
49	26	24	24	24	23	22	21	20	19	18	17	17	17
50	27	26	26	25	24	23	22	21	20	19	18	18	18
51	28	27	26	25	24	23	22	22	21	20	19	18	18
52	29	28	27	26	25	24	23	22	21	20	19	19	18
53	30	29	28	27	26	25	24	23	22	21	20	19	19
54	31	30	29	28	27	26	25	24	23	22	21	20	19
55	32	31	30	29	28	27	26	25	24	23	22	21	20
56	33	32	31	30	29	28	27	26	25	24	23	22	21
57	35	33	32	31	30	29	28	27	26	25	24	23	22
58	36	35	33	32	31	30	29	28	27	26	25	24	23
59	37	36	34	33	32	31	30	29	28	27	26	25	24
60	38	37	35	34	33	32	31	30	29	28	27	26	25
61	40	38	36	35	34	33	32	31	30	29	28	27	26
62	41	40	38	36	35	34	33	32	31	30	29	28	27

Table XVIII. For computing the Effects of Parallax on the Moon's Distance from the Sun or a Star.

Apparent Distance.
Add the Difference of the two Numbers taken out of this Table, if the Apparent Distance is less than 90°, and subtract it if above.

Par. in Alt. or Distance	52°	53°	54°	55°	56°	57°	58°	59°	60° 120	65° 115	70° 110	75° 105	80° 100	85° 95	90° 90
M	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
14	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
15	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
16	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
17	2	2	2	1	1	1	1	1	1	1	0	0	0	0	0
18	2	2	2	2	2	2	2	2	2	1	1	0	0	0	0
19	3	2	2	2	2	2	2	2	2	1	1	0	0	0	0
20	3	2	2	2	2	2	2	2	2	1	1	1	0	0	0
21	3	3	3	2	2	2	2	2	2	1	1	1	0	0	0
22	3	3	3	3	3	3	2	2	2	2	1	1	0	0	0
23	3	3	3	3	3	3	3	3	2	2	1	1	0	0	0
24	4	3	3	3	3	3	3	3	3	2	1	1	1	0	0
25	4	4	4	3	3	3	3	3	3	2	1	1	1	0	0
26	5	4	4	4	4	4	3	3	3	3	2	1	1	0	0
27	5	5	5	4	4	4	4	4	3	3	2	1	1	0	0
28	6	5	5	5	5	5	4	4	4	3	2	2	1	0	0
29	6	5	5	5	5	5	4	4	4	3	2	2	1	0	0
30	6	5	5	5	5	5	4	4	4	4	3	2	1	0	0
31	6	5	5	5	5	5	5	5	4	4	3	2	1	0	0
32	6	5	5	5	5	5	5	5	5	4	3	2	1	0	0
33	6	6	6	5	5	5	5	5	5	4	3	2	1	0	0
34	7	6	6	6	6	6	5	5	5	4	4	2	1	0	0
35	8	7	7	6	6	6	6	6	5	4	4	2	1	0	0
36	8	8	7	7	7	7	6	6	6	5	4	3	2	1	0
37	9	9	8	8	8	7	7	7	6	5	4	3	2	1	0
38	10	10	9	9	9	8	8	7	7	5	4	3	2	1	0
39	11	10	10	9	9	9	8	8	7	5	4	3	2	1	0
40	11	11	10	10	9	9	8	8	8	6	5	3	2	1	0
41	12	12	11	10	10	10	9	9	8	6	5	3	2	1	0
42	12	12	11	11	10	10	9	9	9	7	5	4	2	1	0
43	12	12	11	11	10	10	9	9	9	7	5	4	2	1	0
44	12	12	11	11	11	10	10	9	9	7	6	4	2	1	0
45	13	12	12	11	11	11	10	10	9	7	6	4	2	1	0
46	13	13	12	12	12	11	11	10	10	8	7	5	3	1	0
47	14	14	13	12	12	12	11	11	10	8	7	5	3	1	0
48	15	14	13	13	12	12	12	11	11	9	7	5	3	2	0
49	16	15	14	14	14	13	13	12	11	9	7	5	3	2	0
50	17	16	15	15	14	13	13	12	12	10	8	6	4	2	0
51	17	16	16	15	15	14	14	13	12	10	8	6	4	2	0
52	17	17	16	16	15	15	14	14	13	10	8	6	4	2	0
53	18	18	17	16	16	15	14	14	13	10	8	6	4	2	0
54	19	18	17	17	16	16	15	15	14	11	9	7	4	2	0
55	19	18	18	17	17	16	16	15	14	11	9	7	4	2	0
56	20	19	18	18	17	16	16	15	15	12	9	7	5	2	0
57	21	20	19	19	19	18	17	16	15	12	9	7	5	2	0
58	22	21	20	20	19	18	17	16	16	13	10	7	5	2	0
59	23	22	21	21	20	19	18	17	17	13	10	7	5	2	0
60	24	23	22	22	21	20	19	18	18	14	11	8	5	3	0
61	25	24	23	23	22	21	20	19	18	15	11	8	5	3	0
62	26	25	24	23	22	21	20	19	19	16	12	9	6	3	0

TABLE XIX. For turning Degrees and Minutes into Time, and the contrary.

D	H M	D	H M	D	H M	D	H M	D	H M	D	H M
M	M S	M	M S	M	M S	M	M S	M	M S	M	M S
1	0. 4	61	4. 4	121	8. 4	181	12. 4	241	16. 4	301	20. 4
2	0. 8	62	4. 8	122	8. 8	182	12. 8	242	16. 8	302	20. 8
3	0.12	63	4.12	123	8.12	183	12.12	243	16.12	303	20.12
4	0.16	64	4.16	124	8.16	184	12.16	244	16.16	304	20.16
5	0.20	65	4.20	125	8.20	185	12.20	245	16.20	305	20.20
6	0.24	66	4.24	126	8.24	186	12.24	246	16.24	306	20.24
7	0.28	67	4.28	127	8.28	187	12.28	247	16.28	307	20.28
8	0.32	68	4.32	128	8.32	188	12.32	248	16.32	308	20.32
9	0.36	69	4.36	129	8.36	189	12.36	249	16.36	309	20.36
10	0.40	70	4.40	130	8.40	190	12.40	250	16.40	310	20.40
11	0.44	71	4.44	131	8.44	191	12.44	251	16.44	311	20.44
12	0.48	72	4.48	132	8.48	192	12.48	252	16.48	312	20.48
13	0.52	73	4.52	133	8.52	193	12.52	253	16.52	313	20.52
14	0.56	74	4.56	134	8.56	194	12.56	254	16.56	314	20.56
15	1. 0	75	5. 0	135	9. 0	195	13. 0	255	17. 0	315	21. 0
16	1. 4	76	5. 4	136	9. 4	196	13. 4	256	17. 4	316	21. 4
17	1. 8	77	5. 8	137	9. 8	197	13. 8	257	17. 8	317	21. 8
18	1.12	78	5.12	138	9.12	198	13.12	258	17.12	318	21.12
19	1.16	79	5.16	139	9.16	199	13.16	259	17.16	319	21.16
20	1.20	80	5.20	140	9.20	200	13.20	260	17.20	320	21.20
21	1.24	81	5.24	141	9.24	201	13.24	261	17.24	321	21.24
22	1.28	82	5.28	142	9.28	202	13.28	262	17.28	322	21.28
23	1.32	83	5.32	143	9.32	203	13.32	263	17.32	323	21.32
24	1.36	84	5.36	144	9.36	204	13.36	264	17.36	324	21.36
25	1.40	85	5.40	145	9.40	205	13.40	265	17.40	325	21.40
26	1.44	86	5.44	146	9.44	206	13.44	266	17.44	326	21.44
27	1.48	87	5.48	147	9.48	207	13.48	267	17.48	327	21.48
28	1.52	88	5.52	148	9.52	208	13.52	268	17.52	328	21.52
29	1.56	89	5.56	149	9.56	209	13.56	269	17.56	329	21.56
30	2. 0	90	6. 0	150	10. 0	210	14. 0	270	18. 0	330	22. 0
31	2. 4	91	6. 4	151	10. 4	211	14. 4	271	18. 4	331	22. 4
32	2. 8	92	6. 8	152	10. 8	212	14. 8	272	18. 8	332	22. 8
33	2.12	93	6.12	153	10.12	213	14.12	273	18.12	333	22.12
34	2.16	94	6.16	154	10.16	214	14.16	274	18.16	334	22.16
35	2.20	95	6.20	155	10.20	215	14.20	275	18.20	335	22.20
36	2.24	96	6.24	156	10.24	216	14.24	276	18.24	336	22.24
37	2.28	97	6.28	157	10.28	217	14.28	277	18.28	337	22.28
38	2.32	98	6.32	158	10.32	218	14.32	278	18.32	338	22.32
39	2.36	99	6.36	159	10.36	219	14.36	279	18.36	339	22.36
40	2.40	100	6.40	160	10.40	220	14.40	280	18.40	340	22.40
41	2.44	101	6.44	161	10.44	221	14.44	281	18.44	341	22.44
42	2.48	102	6.48	162	10.48	222	14.48	282	18.48	342	22.48
43	2.52	103	6.52	163	10.52	223	14.52	283	18.52	343	22.52
44	2.56	104	6.56	164	10.56	224	14.56	284	18.56	344	22.56
45	3. 0	105	7. 0	165	11. 0	225	15. 0	285	19. 0	345	23. 0
46	3. 4	106	7. 4	166	11. 4	226	15. 4	286	19. 4	346	23. 4
47	3. 8	107	7. 8	167	11. 8	227	15. 8	287	19. 8	347	23. 8
48	3.12	108	7.12	168	11.12	228	15.12	288	19.12	348	23.12
49	3.16	109	7.16	169	11.16	229	15.16	289	19.16	349	23.16
50	3.20	110	7.20	170	11.20	230	15.20	290	19.20	350	23.20
51	3.24	111	7.24	171	11.24	231	15.24	291	19.24	351	23.24
52	3.28	112	7.28	172	11.28	232	15.28	292	19.28	352	23.28
53	3.32	113	7.32	173	11.32	233	15.32	293	19.32	353	23.32
54	3.36	114	7.36	174	11.36	234	15.36	294	19.36	354	23.36
55	3.40	115	7.40	175	11.40	235	15.40	295	19.40	355	23.40
56	3.44	116	7.44	176	11.44	236	15.44	296	19.44	356	23.44
57	3.48	117	7.48	177	11.48	237	15.48	297	19.48	357	23.48
58	3.52	118	7.52	178	11.52	238	15.52	298	19.52	358	23.52
59	3.56	119	7.56	179	11.56	239	15.56	299	19.56	359	23.56
60	4. 0	120	8. 0	180	12. 0	240	16. 0	300	20. 0	360	24. 0

0 HOUR.

M.	S.	Log ½ ela Time.	Log Mid Time.	Logarith Rising.	M.	S.	Log ½ ela Time.	Log Mid Time.	Logarith Rising.
0	0				10	0	1.36032	3.94071	1.97854
	10	3.15853	2.16270	8.42230		10	1.35315	3.94788	1.99289
	20	2.83730	2.46373	9.02436		20	1.34609	3.95494	2.00699
	30	2.66121	2.63982	9.37654		30	1.33915	3.96188	2.02091
	40	2.53627	2.76476	9.62642		40	1.33231	3.96872	2.03458
	50	2.43936	2.86167	9.82024		50	1.32558	3.97545	2.04805
1	0	2.36018	2.94085	9.97860	11	0	1.31896	3.98207	2.06131
	10	2.29324	3.00779	0.11250		10	1.31243	3.98860	2.07437
	20	2.23525	3.06578	0.22848		20	1.30600	3.99503	2.08723
	30	2.18409	3.11694	0.33079		30	1.29967	4.00136	2.09991
	40	2.13834	3.16269	0.42230		40	1.29342	4.00761	2.11240
	50	2.09695	3.20408	0.50509		50	1.28727	4.01376	2.12472
2	0	2.05916	3.24187	0.58066	12	0	1.28120	4.01983	2.13687
	10	2.02440	3.27663	0.65019		10	1.27522	4.02581	2.14885
	20	1.99221	3.30882	0.71455		20	1.26931	4.03172	2.16066
	30	1.96225	3.33878	0.77448		30	1.26349	4.03754	2.17223
	40	1.93422	3.36681	0.83054		40	1.25774	4.04329	2.18382
	50	1.90790	3.39313	0.88319		50	1.25207	4.04896	2.19517
3	0	1.88307	3.41796	0.93284	13	0	1.24647	4.05456	2.20638
	10	1.85959	3.44144	0.97980		10	1.24095	4.06008	2.21744
	20	1.83732	3.46371	1.02435		20	1.23549	4.06554	2.22836
	30	1.81613	3.48490	1.06673		30	1.23010	4.07093	2.23915
	40	1.79593	3.50510	1.10714		40	1.22477	4.07626	2.24980
	50	1.77663	3.52440	1.14575		50	1.21952	4.08251	2.26033
4	0	1.75814	3.54289	1.18271	14	0	1.21432	4.08671	2.27073
	10	1.74042	3.56061	1.21817		10	1.20919	4.09184	2.28100
	20	1.72339	3.57764	1.25224		20	1.20412	4.09691	2.29116
	30	1.70700	3.59403	1.28502		30	1.19910	4.10193	2.30120
	40	1.69121	3.60982	1.31660		40	1.19415	4.10688	2.31112
	50	1.67597	3.62506	1.34708		50	1.18925	4.11178	2.32093
5	0	1.66125	3.63978	1.37653	15	0	1.18440	4.11663	2.33063
	10	1.64701	3.65402	1.40501		10	1.17961	4.12142	2.34023
	20	1.63322	3.66781	1.43258		20	1.17487	4.12616	2.34972
	30	1.61986	3.68117	1.45931		30	1.17018	4.13085	2.35910
	40	1.60690	3.69413	1.48524		40	1.16554	4.13549	2.36839
	50	1.59431	3.70672	1.51041		50	1.16096	4.14007	2.37758
6	0	1.58208	3.71895	1.53488	16	0	1.15642	4.14461	2.38667
	10	1.57018	3.73085	1.55868		10	1.15192	4.14911	2.39567
	20	1.55861	3.74242	1.58184		20	1.14748	4.15355	2.40457
	30	1.54733	3.75370	1.60420		30	1.14307	4.15796	2.41338
	40	1.53634	3.76469	1.62639		40	1.13872	4.16231	2.42211
	50	1.52561	3.77542	1.64784		50	1.13440	4.16663	2.43075
7	0	1.51515	3.78588	1.66877	17	0	1.13013	4.17090	2.43930
	10	1.50494	3.79609	1.68920		10	1.12590	4.17513	2.44777
	20	1.49496	3.80607	1.70917		20	1.12171	4.17932	2.45616
	30	1.48520	3.81583	1.72869		30	1.11757	4.18346	2.46447
	40	1.47566	3.82537	1.74778		40	1.11346	4.18757	2.47270
	50	1.46632	3.83471	1.76646		50	1.10939	4.19164	2.48085
8	0	1.45718	3.84385	1.78474	18	0	1.10536	4.19567	2.48893
	10	1.44823	3.85280	1.80265		10	1.10136	4.19967	2.49693
	20	1.43946	3.86157	1.82019		20	1.09740	4.20363	2.50486
	30	1.43086	3.87017	1.83739		30	1.09348	4.20755	2.51271
	40	1.42243	3.87860	1.85426		40	1.08960	4.21143	2.52050
	50	1.41417	3.88686	1.87080		50	1.08575	4.21528	2.52821
9	0	1.40605	3.89498	1.88703	19	0	1.08193	4.21910	2.53586
	10	1.39809	3.90294	1.90297		10	1.07814	4.22289	2.54344
	20	1.39027	3.91076	1.91862		20	1.07439	4.22664	2.55096
	30	1.38258	3.91845	1.93399		30	1.07067	4.23036	2.55841
	40	1.37503	3.92600	1.94909		40	1.06698	4.23405	2.56580
	50	1.36762	3.93341	1.96394		50	1.06333	4.23770	2.57312

0 HOUR.

M.	S.	Log ½ ela Time.	Log Mid Time.	Logarith Rising.
20	0	1.05970	4.24133	2.58039
	10	1.05610	4.24493	2.58759
	20	1.05254	4.24849	2.59473
	30	1.04901	4.25202	2.60182
	40	1.04550	4.25553	2.60885
	50	1.04202	4.25901	2.61582
21	0	1.03857	4.26246	2.62274
	10	1.03515	4.26588	2.62960
	20	1.03175	4.26928	2.63641
	30	1.02838	4.27265	2.64316
	40	1.02504	4.27599	2.64987
	50	1.02172	4.27931	2.65652
22	0	1.01843	4.28260	2.66312
	10	1.01516	4.28587	2.66967
	20	1.01192	4.28911	2.67617
	30	1.00870	4.29233	2.68262
	40	1.00550	4.29553	2.68903
	50	1.00233	4.29870	2.69538
23	0	0.99918	4.30185	2.70169
	10	0.99606	4.30497	2.70796
	20	0.99296	4.30807	2.71418
	30	0.98988	4.31115	2.72036
	40	0.98682	4.31421	2.72649
	50	0.98378	4.31725	2.73258
24	0	0.98077	4.32026	2.73863
	10	0.97777	4.32326	2.74464
	20	0.97480	4.32623	2.75060
	30	0.97184	4.32919	2.75652
	40	0.96891	4.33212	2.76241
	50	0.96600	4.33503	2.76825
25	0	0.96310	4.33793	2.77405
	10	0.96023	4.34080	2.77982
	20	0.95738	4.34365	2.78555
	30	0.95454	4.34649	2.79124
	40	0.95172	4.34931	2.79689
	50	0.94892	4.35211	2.80251
26	0	0.94614	4.35489	2.80809
	10	0.94338	4.35765	2.81363
	20	0.94063	4.36040	2.81914
	30	0.93790	4.36313	2.82461
	40	0.93519	4.36584	2.83005
	50	0.93250	4.36853	2.83546
27	0	0.92982	4.37121	2.84083
	10	0.92716	4.37387	2.84617
	20	0.92452	4.37651	2.85148
	30	0.92189	4.37914	2.85675
	40	0.91928	4.38175	2.86199
	50	0.91669	4.38434	2.86720
28	0	0.91411	4.38692	2.87238
	10	0.91154	4.38949	2.87753
	20	0.90899	4.39204	2.88265
	30	0.90646	4.39457	2.88773
	40	0.90394	4.39709	2.89279
	50	0.90143	4.39960	2.89782
29	0	0.89894	4.40209	2.90282
	10	0.89647	4.40456	2.90779
	20	0.89401	4.40702	2.91273
	30	0.89156	4.40947	2.91765
	40	0.88913	4.41190	2.92254
	50	0.88671	4.41432	2.92740
30	0	0.88430	4.41673	2.93223
	10	0.88191	4.41912	2.93703
	20	0.87953	4.42150	2.9418[illegible]
	30	0.87717	4.42386	2.94656
	40	0.87481	4.42622	2.95129
	50	0.87247	4.42856	2.95599
31	0	0.87015	4.43088	2.96067
	10	0.86783	4.43320	2.96532
	20	0.86553	4.43550	2.96994
	30	0.86324	4.43779	2.97454
	40	0.86096	4.44007	2.97912
	50	0.85870	4.44233	2.98367
32	0	0.85644	4.44459	2.98820
	10	0.85420	4.44683	2.99270
	20	0.85197	4.44906	2.99718
	30	0.84976	4.45127	3.00164
	40	0.84755	4.45348	3.00608
	50	0.84535	4.45568	3.01049
33	0	0.84317	4.45786	3.01486
	10	0.84100	4.46003	3.01925
	20	0.83884	4.46219	3.02360
	30	0.83669	4.46434	3.02792
	40	0.83455	4.46648	3.03222
	50	0.83242	4.46861	3.03650
34	0	0.83030	4.47073	3.04077
	10	0.82819	4.47284	3.04501
	20	0.82609	4.47494	3.04922
	30	0.82401	4.47702	3.05342
	40	0.82193	4.47910	3.05760
	50	0.81986	4.48117	3.06176
35	0	0.81780	4.48323	3.06590
	10	0.81576	4.48527	3.07001
	20	0.81372	4.48731	3.07411
	30	0.81169	4.48934	3.07819
	40	0.80967	4.49136	3.08225
	50	0.80767	4.49336	3.08630
36	0	0.80567	4.49536	3.09032
	10	0.80368	4.49735	3.09432
	20	0.80170	4.49933	3.09830
	30	0.79973	4.50130	3.10227
	40	0.79777	4.50326	3.10622
	50	0.79581	4.50522	3.11015
37	0	0.79387	4.50716	3.11406
	10	0.79193	4.50910	3.11796
	20	0.79001	4.51102	3.12184
	30	0.78809	4.51294	3.12570
	40	0.78618	4.51485	3.12954
	50	0.78428	4.51675	3.13337
38	0	0.78239	4.51864	3.13718
	10	0.78051	4.52054	3.14097
	20	0.77863	4.52240	3.14475
	30	0.77677	4.52426	3.14850
	40	0.77491	4.52612	3.15225
	50	0.77306	4.52797	3.15597
39	0	0.77122	4.52981	3.15969
	10	0.76938	4.53165	3.1633[illegible]
	20	0.76756	4.53347	3.16706
	30	0.76574	4.53529	3.17072
	40	0.76393	4.53710	3.17[illegible]
	50	0.76212	4.53891	3.178[illegible]

0 HOUR.

M.	S.	Log ½ ela Time.	Log Mid Time.	Logarith Rising	M.	S.	Log ½ ela Time.	Log Mid Time.	Logarith Rising.
40	0	0.76033	4.54070	3.18162	50	0	0.66466	4.63637	3.37482
	10	0.75854	4.54249	3.18522		10	0.66324	4.63779	3.37770
	20	0.75676	4.54427	3.18881		20	0.66182	4.63921	3.38057
	30	0.75499	4.54604	3.19238		30	0.66041	4.64062	3.38343
	40	0.75323	4.54780	3.19594		40	0.65900	4.64203	3.38628
	50	0.75147	4.54956	3.19948		50	0.65760	4.64343	3.38912
41	0	0.74972	4.55131	3.20301	51	0	0.65620	4.64483	3.39195
	10	0.74797	4.55306	3.20653		10	0.65481	4.64622	3.39477
	20	0.74624	4.55479	3.21003		20	0.65342	4.64761	3.39759
	30	0.74451	4.55652	3.21351		30	0.65204	4.64899	3.40039
	40	0.74279	4.55824	3.21698		40	0.65066	4.65037	3.40318
	50	0.74107	4.55996	3.22044		50	0.64928	4.65175	3.40597
42	0	0.73937	4.56166	3.22389	52	0	0.64791	4.65312	3.40875
	10	0.73767	4.56336	3.22732		10	0.64655	4.65448	3.41151
	20	0.73597	4.56506	3.23073		20	0.64519	4.65584	3.41427
	30	0.73429	4.56674	3.23414		30	0.64383	4.65720	3.41702
	40	0.73261	4.56842	3.23753		40	0.64248	4.65855	3.41976
	50	0.73093	4.57010	3.24090		50	0.64113	4.65990	3.42250
43	0	0.72926	4.57177	3.24427	53	0	0.63978	4.66125	3.42523
	10	0.72760	4.57343	3.24762		10	0.63844	4.66259	3.42794
	20	0.72595	4.57508	3.25095		20	0.63711	4.66392	3.43064
	30	0.72430	4.57673	3.25428		30	0.63578	4.66525	3.43334
	40	0.72266	4.57837	3.25759		40	0.63445	4.66658	3.43603
	50	0.72103	4.58000	3.26089		50	0.63313	4.66790	3.43871
44	0	0.71940	4.58163	3.26418	54	0	0.63181	4.66922	3.44138
	10	0.71778	4.58325	3.26745		10	0.63050	4.67053	3.44404
	20	0.71616	4.58487	3.27072		20	0.62919	4.67184	3.44670
	30	0.71455	4.58648	3.27396		30	0.62789	4.67314	3.44935
	40	0.71293	4.58808	3.27720		40	0.62659	4.67444	3.45199
	50	0.71135	4.58968	3.28042		50	0.62529	4.67574	3.45462
45	0	0.70976	4.59127	3.28363	55	0	0.62400	4.67703	3.45724
	10	0.70818	4.59285	3.28683		10	0.62271	4.67832	3.45986
	20	0.70660	4.59443	3.29002		20	0.62142	4.67961	3.46247
	30	0.70503	4.59600	3.29320		30	0.62014	4.68089	3.46507
	40	0.70346	4.59757	3.29637		40	0.61886	4.68217	3.46765
	50	0.70190	4.59913	3.29952		50	0.61759	4.68344	3.47024
46	0	0.70034	4.60069	3.30266	56	0	0.61632	4.68471	3.47282
	10	0.69879	4.60224	3.30579		10	0.61506	4.68597	3.47539
	20	0.69725	4.60378	3.30891		20	0.61380	4.68723	3.47795
	30	0.69571	4.60532	3.31202		30	0.61254	4.68849	3.48050
	40	0.69418	4.60685	3.31512		40	0.61129	4.68974	3.48305
	50	0.69265	4.60838	3.31820		50	0.61004	4.69099	3.48558
47	0	0.69113	4.60990	3.32128	57	0	0.60879	4.69224	3.48811
	10	0.68962	4.61141	3.32434		10	0.60755	4.69348	3.49064
	20	0.68811	4.61292	3.32739		20	0.60631	4.69472	3.49315
	30	0.68660	4.61443	3.33044		30	0.60508	4.69595	3.49566
	40	0.68510	4.61593	3.33347		40	0.60385	4.69718	3.49816
	50	0.68361	4.61742	3.33649		50	0.60262	4.69841	3.50066
48	0	0.68212	4.61891	3.33950	58	0	0.60140	4.69963	3.50314
	10	0.68064	4.62039	3.34250		10	0.60018	4.70085	3.50562
	20	0.67916	4.62187	3.34549		20	0.59896	4.70207	3.50809
	30	0.67769	4.62334	3.34847		30	0.59775	4.70328	3.51056
	40	0.67622	4.62481	3.35144		40	0.59654	4.70449	3.51301
	50	0.67476	4.62627	3.35439		50	0.59534	4.70569	3.51547
49	0	0.67330	4.62773	3.35734	59	0	0.59414	4.70689	3.51791
	10	0.67185	4.62918	3.36028		10	0.59294	4.70809	3.52035
	20	0.67040	4.63063	3.36321		20	0.59175	4.70928	3.52278
	30	0.66896	4.63207	3.36613		30	0.59056	4.71047	3.52520
	40	0.66752	4.63351	3.36903		40	0.58937	4.71166	3.52761
	50	0.66609	4.63494	3.37193		50	0.58818	4.71285	3.53002

TABLE XX. For finding the Latitude by two Altitudes of the Sun.

1 HOUR.

M.	S.	Log ½ ela Time.	Log Mid Time.	Logarith Rising.	M.	S.	Log ½ ela Time.	Log Mid Time.	Logarith Rising.
0	0	0.58700	4.71403	3.53243	10	0	0.52186	4.77917	3.66542
	10	0.58582	4.71521	3.53482		10	0.52086	4.78017	3.66747
	20	0.58465	4.71638	3.53721		20	0.51986	4.78117	3.66952
	30	0.58348	4.71755	3.53959		30	0.51886	4.78217	3.67156
	40	0.58231	4.71872	3.54197		40	0.51787	4.78316	3.67359
	50	0.58115	4.71988	3.54434		50	0.51688	4.78415	3.67562
1	0	0.57999	4.72104	3.54670	11	0	0.51589	4.78514	3.67765
	10	0.57883	4.72220	3.54905		10	0.51490	4.78613	3.67967
	20	0.57768	4.72335	3.55140		20	0.51392	4.78711	3.68168
	30	0.57653	4.72450	3.55375		30	0.51294	4.78809	3.68369
	40	0.57538	4.72565	3.55608		40	0.51196	4.78907	3.68570
	50	0.574[illegible]	4.72679	3.55841		50	0.51099	4.79004	3.68770
2	0	0.57310	4.72793	3.56074	12	0	0.51002	4.79101	3.68969
	10	0.57196	4.72907	3.56306		10	0.50905	4.79198	3.69169
	20	0.57083	4.73020	3.56537		20	0.50808	4.79295	3.69367
	30	0.56970	4.73133	3.56767		30	0.50711	4.79392	3.69566
	40	0.56857	4.73246	3.56997		40	0.50615	4.79488	3.69763
	50	0.56745	4.73358	3.57226		50	0.50519	4.79584	3.69961
3	0	0.56633	4.73470	3.57455	13	0	0.50423	4.79680	3.70158
	10	0.56521	4.73582	3.57683		10	0.50327	4.79776	3.70354
	20	0.56409	4.73694	3.57910		20	0.50232	4.79871	3.70550
	30	0.56298	4.73805	3.58137		30	0.50137	4.79966	3.70745
	40	0.56187	4.73916	3.58363		40	0.50042	4.80061	3.70940
	50	0.56076	4.74027	3.58589		50	0.49947	4.80156	3.71135
4	0	0.55966	4.74137	3.58814	14	0	0.49852	4.80251	3.71329
	10	0.55856	4.74247	3.59038		10	0.49758	4.80345	3.71523
	20	0.55746	4.74357	3.59262		20	0.49664	4.80439	3.71716
	30	0.55637	4.74466	3.59486		30	0.49570	4.80533	3.71909
	40	0.55528	4.74575	3.59708		40	0.49476	4.80627	3.72101
	50	0.55419	4.74684	3.59930		50	0.49383	4.80720	3.72293
5	0	0.55311	4.74792	3.60152	15	0	0.49290	4.80813	3.72485
	10	0.55203	4.74900	3.60373		10	0.49197	4.80906	3.72676
	20	0.55095	4.75008	3.60593		20	0.49104	4.80999	3.72867
	30	0.54987	4.75116	3.60813		30	0.49012	4.81091	3.73057
	40	0.54880	4.75223	3.61032		40	0.48920	4.81183	3.73247
	50	0.54773	4.75330	3.61251		50	0.48828	4.81275	3.73436
6	0	0.54666	4.75437	3.61469	16	0	0.48736	4.81367	3.73625
	10	0.54559	4.75544	3.61686		10	0.48644	4.81459	3.73813
	20	0.54453	4.75650	3.61903		20	0.48553	4.81550	3.74001
	30	0.54347	4.75756	3.62120		30	0.48462	4.81641	3.74189
	40	0.54241	4.75862	3.62336		40	0.48371	4.81732	3.74376
	50	0.54136	4.75967	3.62551		50	0.48280	4.81823	3.74563
7	0	0.54031	4.76072	3.62766	17	0	0.48189	4.81914	3.74750
	10	0.53926	4.76177	3.62980		10	0.48099	4.82004	3.74936
	20	0.53822	4.76281	3.63194		20	0.48009	4.82094	3.75121
	30	0.53718	4.76385	3.63407		30	0.47919	4.82184	3.75307
	40	0.53614	4.76489	3.63620		40	0.47829	4.82274	3.75491
	50	0.53510	4.76593	3.63832		50	0.47739	4.82364	3.75676
8	0	0.53406	4.76697	3.64043	18	0	0.47650	4.82453	3.75860
	10	0.53303	4.76800	3.64254		10	0.47561	4.82542	3.76043
	20	0.53200	4.76903	3.64465		20	0.47472	4.82631	3.76227
	30	0.53097	4.77006	3.64675		30	0.47383	4.82720	3.76409
	40	0.52995	4.77108	3.64885		40	0.47295	4.82808	3.76592
	50	0.52893	4.77210	3.65094		50	0.47207	4.82896	3.76774
9	0	0.52791	4.77312	3.65302	19	0	0.47119	4.82984	3.76955
	10	0.52690	4.77413	3.65510		10	0.47031	4.83072	3.77137
	20	0.52589	4.77514	3.65717		20	0.46943	4.83160	3.77318
	30	0.52488	4.77615	3.65924		30	0.46856	4.83247	3.77498
	40	0.52387	4.77716	3.66131		40	0.46769	4.83334	3.77678
	50	0.52286	4.77817	3.66337		50	0.46682	4.83421	3.77858

TABLE XX. For finding the Latitude by two Altitudes of the Sun.

1 HOUR.

M.	S.	Log ½ ela Time.	Log Mid Time.	Logarith Rising.	M.	S.	Log ½ ela Time.	Log Mid Time.	Logarith Rising.
20	0	0.46595	4.83508	3.78037	30	0	0.41716	4.88387	3.88150
	10	0.46508	4.83595	3.78216		10	0.41640	4.88463	3.88309
	20	0.46421	4.83682	3.78395		20	0.41564	4.88539	3.88467
	30	0.46335	4.83768	3.78573		30	0.41488	4.88615	3.88625
	40	0.46249	4.83854	3.78750		40	0.41412	4.88691	3.88783
	50	0.46163	4.83940	3.78928		50	0.41336	4.88767	3.88940
21	0	0.46077	4.84026	3.79105	31	0	0.41261	4.88842	3.89097
	10	0.45992	4.84111	3.79282		10	0.41186	4.88917	3.89254
	20	0.45907	4.84196	3.79458		20	0.41111	4.88992	3.89411
	30	0.45822	4.84281	3.79634		30	0.41036	4.89067	3.89567
	40	0.45737	4.84366	3.79809		40	0.40961	4.89142	3.89723
	50	0.45652	4.84451	3.79985		50	0.40886	4.89217	3.89879
22	0	0.45567	4.84536	3.80159	32	0	0.40812	4.89291	3.90034
	10	0.45483	4.84620	3.80334		10	0.40738	4.89365	3.90189
	20	0.45399	4.84704	3.80508		20	0.40664	4.89439	3.90344
	30	0.45315	4.84788	3.80682		30	0.40590	4.89513	3.90498
	40	0.45231	4.84872	3.80855		40	0.40516	4.89587	3.90653
	50	0.45147	4.84956	3.81028		50	0.40442	4.89661	3.90807
23	0	0.45064	4.85039	3.81201	33	0	0.40368	4.89735	3.90960
	10	0.44981	4.85122	3.81373		10	0.40295	4.89808	3.91114
	20	0.44898	4.85205	3.81545		20	0.40222	4.89881	3.91267
	30	0.44815	4.85288	3.81717		30	0.40149	4.89954	3.91420
	40	0.44732	4.85371	3.81888		40	0.40076	4.90027	3.91572
	50	0.44649	4.85454	3.82059		50	0.40003	4.90100	3.91724
24	0	0.44567	4.85536	3.82230	34	0	0.39930	4.90173	3.91876
	10	0.44485	4.85618	3.82400		10	0.39857	4.90246	3.92028
	20	0.44403	4.85700	3.82570		20	0.39785	4.90318	3.92179
	30	0.44321	4.85782	3.82739		30	0.39713	4.90390	3.92331
	40	0.44239	4.85864	3.82908		40	0.39641	4.90462	3.92482
	50	0.44158	4.85945	3.83077		50	0.39569	4.90534	3.92632
25	0	0.44077	4.86026	3.83246	35	0	0.39497	4.90606	3.92782
	10	0.43996	4.86107	3.83414		10	0.39425	4.90678	3.92932
	20	0.43915	4.86188	3.83582		20	0.39353	4.90750	3.93082
	30	0.43834	4.86269	3.83749		30	0.39282	4.90821	3.93232
	40	0.43753	4.86350	3.83917		40	0.39211	4.90892	3.93381
	50	0.43673	4.86430	3.84083		50	0.39140	4.90963	3.93530
26	0	0.43593	4.86510	3.84250	36	0	0.39069	4.91034	3.93679
	10	0.43513	4.86590	3.84416		10	0.38998	4.91105	3.93827
	20	0.43433	4.86670	3.84582		20	0.38927	4.91176	3.93975
	30	0.43353	4.86750	3.84748		30	0.38856	4.91247	3.94123
	40	0.43273	4.86830	3.84913		40	0.38786	4.91317	3.94271
	50	0.43193	4.86910	3.85078		50	0.38716	4.91387	3.94418
27	0	0.43114	4.86989	3.85242	37	0	0.38646	4.91457	3.94566
	10	0.43035	4.87068	3.85406		10	0.38576	4.91527	3.94712
	20	0.42956	4.87147	3.85570		20	0.38506	4.91597	3.94859
	30	0.42877	4.87226	3.85734		30	0.38436	4.91667	3.95005
	40	0.42799	4.87304	3.85897		40	0.38366	4.91737	3.95151
	50	0.42721	4.87382	3.86060		50	0.38296	4.91807	3.95297
28	0	0.42643	4.87460	3.86223	38	0	0.38227	4.91876	3.95443
	10	0.42565	4.87538	3.86385		10	0.38158	4.91945	3.95588
	20	0.42487	4.87616	3.86547		20	0.38089	4.92014	3.95733
	30	0.42409	4.87694	3.86709		30	0.38020	4.92083	3.95878
	40	0.42331	4.87772	3.86870		40	0.37951	4.92152	3.96023
	50	0.42253	4.87850	3.87031		50	0.37882	4.92221	3.96167
29	0	0.42176	4.87927	3.87192	39	0	0.37813	4.92290	3.96311
	10	0.42099	4.88004	3.87352		10	0.37745	4.92358	3.96455
	20	0.42022	4.88081	3.87513		20	0.37677	4.92426	3.96599
	30	0.41945	4.88158	3.87672		30	0.37609	4.92494	3.96742
	40	0.41868	4.88235	3.87832		40	0.37541	4.92562	3.96885
	50	0.41792	4.88311	3.87991		50	0.37473	4.92630	3.97028

I HOUR.

M.	S.	Log ½ ela Time.	Log Mid Time.	Logarith Rising.
40	0	0.37405	4.92698	3.97170
	10	0.37337	4.92766	3.97313
	20	0.37269	4.92834	3.97455
	30	0.37202	4.92901	3.97597
	40	0.37135	4.92968	3.97738
	50	0.37068	4.93035	3.97880
41	0	0.37001	4.93102	3.98021
	10	0.36934	4.93169	3.98162
	20	0.36867	4.93236	3.98302
	30	0.36800	4.93303	3.98443
	40	0.36734	4.93369	3.98583
	50	0.36668	4.93435	3.98723
42	0	0.36602	4.93501	3.98862
	10	0.36536	4.93567	3.99002
	20	0.36470	4.93633	3.99141
	30	0.36404	4.93699	3.99280
	40	0.36338	4.93765	3.99419
	50	0.36272	4.93831	3.99557
43	0	0.36206	4.93897	3.99696
	10	0.36141	4.93962	3.99834
	20	0.36076	4.94027	3.99972
	30	0.36011	4.94092	4.00109
	40	0.35946	4.94157	4.00247
	50	0.35881	4.94222	4.00384
44	0	0.35816	4.94287	4.00521
	10	0.35751	4.94352	4.00657
	20	0.35686	4.94417	4.00793
	30	0.35622	4.94481	4.00930
	40	0.35558	4.94545	4.01066
	50	0.35494	4.94609	4.01202
45	0	0.35430	4.94673	4.01337
	10	0.35366	4.94737	4.01473
	20	0.35302	4.94801	4.01608
	30	0.35238	4.94865	4.01743
	40	0.35174	4.94929	4.01877
	50	0.35110	4.94993	4.02012
46	0	0.35047	4.95056	4.02146
	10	0.34984	4.95119	4.02280
	20	0.34921	4.95182	4.02414
	30	0.34858	4.95245	4.02547
	40	0.34795	4.95308	4.02681
	50	0.34732	4.95371	4.02814
47	0	0.34669	4.95434	4.02947
	10	0.34606	4.95497	4.03080
	20	0.34544	4.95559	4.03212
	30	0.34482	4.95621	4.03344
	40	0.34420	4.95683	4.03477
	50	0.34358	4.95745	4.03608
48	0	0.34296	4.95807	4.03740
	10	0.34234	4.95869	4.03871
	20	0.34172	4.95931	4.04003
	30	0.34110	4.95993	4.04134
	40	0.34048	4.96055	4.04265
	50	0.33986	4.96117	4.04395
49	0	0.33925	4.96178	4.04526
	10	0.33864	4.96239	4.04656
	20	0.33803	4.96300	4.04786
	30	0.33742	4.96361	4.04916
	40	0.33681	4.96422	4.05045
	50	0.33620	4.96483	4.05175
50	0	0.33559	4.96544	4.05304
	10	0.33498	4.96605	4.05433
	20	0.33438	4.96665	4.05561
	30	0.33378	4.96725	4.05690
	40	0.33318	4.96785	4.05818
	50	0.33258	4.96845	4.05946
51	0	0.33197	4.96906	4.06074
	10	0.33137	4.96966	4.06202
	20	0.33077	4.97026	4.06330
	30	0.33017	4.97086	4.06457
	40	0.32958	4.97145	4.06584
	50	0.32899	4.97204	4.06711
52	0	0.32839	4.97264	4.06838
	10	0.32780	4.97323	4.06965
	20	0.32720	4.97383	4.07091
	30	0.32661	4.97442	4.07217
	40	0.32602	4.97501	4.07343
	50	0.32543	4.97560	4.07469
53	0	0.32485	4.97618	4.07595
	10	0.32426	4.97677	4.07720
	20	0.32367	4.97736	4.07845
	30	0.32309	4.97794	4.07970
	40	0.32250	4.97853	4.08095
	50	0.32192	4.97911	4.08220
54	0	0.32134	4.97969	4.08344
	10	0.32076	4.98027	4.08468
	20	0.32018	4.98085	4.08592
	30	0.31960	4.98143	4.08716
	40	0.31902	4.98201	4.08840
	50	0.31844	4.98259	4.08964
55	0	0.31787	4.98316	4.09087
	10	0.31729	4.98374	4.09210
	20	0.31672	4.98431	4.09333
	30	0.31614	4.98489	4.09456
	40	0.31557	4.98546	4.09578
	50	0.31500	4.98603	4.09701
56	0	0.31443	4.98660	4.09823
	10	0.31386	4.98717	4.09945
	20	0.31329	4.98774	4.10067
	30	0.31272	4.98831	4.10188
	40	0.31216	4.98887	4.10310
	50	0.31159	4.98944	4.10431
57	0	0.31103	4.99000	4.10552
	10	0.31046	4.99057	4.10673
	20	0.30990	4.99113	4.10794
	30	0.30934	4.99169	4.10915
	40	0.30878	4.99225	4.11035
	50	0.30822	4.99281	4.11155
58	0	0.30766	4.99337	4.11275
	10	0.30710	4.99393	4.11395
	20	0.30655	4.99448	4.11515
	30	0.30599	4.99504	4.11634
	40	0.30544	4.99559	4.11754
	50	0.30488	4.99615	4.11873
59	0	0.30433	4.99670	4.11992
	10	0.30378	4.99725	4.12111
	20	0.30323	4.99780	4.12229
	30	0.30268	4.99835	4.12348
	40	0.30213	4.99890	4.12466
	50	0.30158	4.99945	4.12584

2 HOURS.

M.	S.	Log ½ ela Time.	Log Mid Time.	Logarith Rising	M.	S.	Log ½ ela Time.	Log Mid Time.	Logarith Rising.
0	0	0.30103	5.00000	4.12702	10	0	0.26978	5.03125	4.19482
	10	0.30048	5.00055	4.12820		10	0.26929	5.03174	4.19590
	20	0.29994	5.00109	4.12938		20	0.26879	5.03224	4.19698
	30	0.29939	5.00164	4.13055		30	0.26830	5.03275	4.19806
	40	0.29885	5.00218	4.13172		40	0.26781	5.03322	4.19914
	50	0.29831	5.00272	4.13289		50	0.26731	5.03372	4.20021
1	0	0.29776	5.00327	4.13406	11	0	0.26682	5.03421	4.20129
	10	0.29722	5.00381	4.13523		10	0.26633	5.03470	4.20236
	20	0.29668	5.00435	4.13640		20	0.26584	5.03519	4.20344
	30	0.29614	5.00489	4.13756		30	0.26535	5.03568	4.20451
	40	0.29560	5.00543	4.13872		40	0.26486	5.03617	4.20558
	50	0.29507	5.00596	4.13988		50	0.26438	5.03665	4.20665
2	0	0.29453	5.00650	4.14104	12	0	0.26389	5.03714	4.20771
	10	0.29399	5.00704	4.14220		10	0.26340	5.03763	4.20878
	20	0.29346	5.00757	4.14336		20	0.26292	5.03811	4.20984
	30	0.29293	5.00810	4.14451		30	0.26244	5.03859	4.21091
	40	0.29239	5.00864	4.14566		40	0.26195	5.03908	4.21197
	50	0.29186	5.00917	4.14682		50	0.26147	5.03956	4.21303
3	0	0.29133	5.00970	4.14797	13	0	0.26099	5.04004	4.21409
	10	0.29080	5.01023	4.14911		10	0.26051	5.04052	4.21514
	20	0.29027	5.01076	4.15026		20	0.26003	5.04100	4.21620
	30	0.28974	5.01129	4.15140		30	0.25955	5.04148	4.21725
	40	0.28921	5.01182	4.15255		40	0.25907	5.04196	4.21831
	50	0.28869	5.01234	4.15369		50	0.25859	5.04244	4.21936
4	0	0.28816	5.01287	4.15483	14	0	0.25811	5.04292	4.22041
	10	0.28764	5.01339	4.15597		10	0.25763	5.04340	4.22146
	20	0.28711	5.01392	4.15710		20	0.25716	5.04387	4.22250
	30	0.28659	5.01444	4.15824		30	0.25668	5.04435	4.22355
	40	0.28607	5.01496	4.15937		40	0.25621	5.04482	4.22459
	50	0.28554	5.01549	4.16050		50	0.25573	5.04530	4.22564
5	0	0.28502	5.01601	4.16163	15	0	0.25526	5.04577	4.22668
	10	0.28450	5.01653	4.16276		10	0.25479	5.04624	4.22772
	20	0.28398	5.01705	4.16389		20	0.25432	5.04671	4.22876
	30	0.28346	5.01757	4.16501		30	0.25385	5.04718	4.22980
	40	0.28295	5.01808	4.16614		40	0.25338	5.04765	4.23083
	50	0.28243	5.01860	4.16726		50	0.25291	5.04812	4.23187
6	0	0.28191	5.01912	4.16838	16	0	0.25244	5.04859	4.23290
	10	0.28140	5.01963	4.16950		10	0.25197	5.04906	4.23393
	20	0.28089	5.02014	4.17062		20	0.25150	5.04953	4.23496
	30	0.28037	5.02066	4.17173		30	0.25104	5.04999	4.23599
	40	0.27986	5.02117	4.17285		40	0.25057	5.05046	4.23702
	50	0.27935	5.02168	4.17396		50	0.25011	5.05092	4.23805
7	0	0.27884	5.02219	4.17507	17	0	0.24964	5.05139	4.23907
	10	0.27833	5.02270	4.17618		10	0.24918	5.05185	4.24010
	20	0.27782	5.02321	4.17729		20	0.24872	5.05231	4.24112
	30	0.27731	5.02372	4.17839		30	0.24825	5.05278	4.24214
	40	0.27680	5.02423	4.17950		40	0.24779	5.05324	4.24316
	50	0.27630	5.02473	4.18060		50	0.24733	5.05370	4.24418
8	0	0.27579	5.02524	4.18171	18	0	0.24687	5.05416	4.24520
	10	0.27529	5.02574	4.18281		10	0.24641	5.05462	4.24622
	20	0.27478	5.02625	4.18391		20	0.24595	5.05508	4.24723
	30	0.27428	5.02675	4.18500		30	0.24550	5.05553	4.24825
	40	0.27378	5.02725	4.18610		40	0.24504	5.05599	4.24926
	50	0.27327	5.02776	4.18719		50	0.24458	5.05645	4.25027
9	0	0.27277	5.02826	4.18828	19	0	0.24413	5.05690	4.25128
	10	0.27227	5.02876	4.18938		10	0.24367	5.05736	4.25229
	20	0.27177	5.02926	4.19047		20	0.24322	5.05781	4.25330
	30	0.27127	5.02976	4.19156		30	0.24276	5.05827	4.25430
	40	0.27077	5.03026	4.19265		40	0.24231	5.05872	4.25531
	50	0.27028	5.03075	4.19373		50	0.24186	5.05917	4.25631

2 HOURS.

M.	S.	Log ½ ela Time.	Log Mid Time.	Logarith Rising.	M.	S.	Log ½ ela Time.	Log Mid Time.	Logarith Rising.
20	0	0.24141	5.05962	4.25731	30	0	0.21555	5.08548	4.31523
	10	0.24096	5.06007	4.25831		10	0.21514	5.08589	4.31616
	20	0.24051	5.06052	4.25931		20	0.21473	5.08630	4.31709
	30	0.24006	5.06097	4.26031		30	0.21432	5.08671	4.31801
	40	0.23961	5.06142	4.26131		40	0.21391	5.08712	4.31894
	50	0.23916	5.06187	4.26231		50	0.21350	5.08753	4.31987
21	0	0.23871	5.06232	4.26330	31	0	0.21309	5.08794	4.32079
	10	0.23827	5.06276	4.26429		10	0.21269	5.08834	4.32171
	20	0.23782	5.06321	4.26529		20	0.21228	5.08875	4.32264
	30	0.23738	5.06365	4.26628		30	0.21187	5.08916	4.32356
	40	0.23693	5.06410	4.26727		40	0.21147	5.08956	4.32448
	50	0.23649	5.06454	4.26826		50	0.21106	5.08997	4.32540
22	0	0.23605	5.06498	4.26924	32	0	0.21066	5.09037	4.32631
	10	0.23560	5.06543	4.27023		10	0.21025	5.09078	4.32723
	20	0.23516	5.06587	4.27121		20	0.20985	5.09118	4.32815
	30	0.23472	5.06631	4.27220		30	0.20945	5.09158	4.32906
	40	0.23428	5.06675	4.27318		40	0.20905	5.09198	4.32997
	50	0.23384	5.06719	4.27416		50	0.20864	5.09239	4.33089
23	0	0.23340	5.06763	4.27514	33	0	0.20824	5.09279	4.33180
	10	0.23296	5.06807	4.27612		10	0.20784	5.09319	4.33271
	20	0.23252	5.06851	4.27710		20	0.20744	5.09359	4.33362
	30	0.23209	5.46894	4.27807		30	0.20704	5.09399	4.33453
	40	0.23165	5.06938	4.27905		40	0.20665	5.09438	4.33543
	50	0.23122	5.06981	4.28002		50	0.20625	5.09478	4.33634
24	0	0.23078	5.07025	4.28099	34	0	0.20585	5.09518	4.33724
	10	0.23035	5.07068	4.28197		10	0.20545	5.09558	4.33815
	20	0.22991	5.07112	4.28294		20	0.20506	5.09597	4.33905
	30	0.22948	5.07155	4.28391		30	0.20466	5.09637	4.33995
	40	0.22905	5.07198	4.28487		40	0.20427	5.09676	4.34085
	50	0.22862	5.07241	4.28584		50	0.20387	5.09716	4.34175
25	0	0.22819	5.07284	4.28681	35	0	0.20348	5.09755	4.34265
	10	0.22775	5.07328	4.28777		10	0.20309	5.09794	4.34355
	20	0.22732	5.07371	4.28873		20	0.20269	5.09834	4.34444
	30	0.22690	5.07413	4.28969		30	0.20230	5.09873	4.34534
	40	0.22647	5.07456	4.29065		40	0.20191	5.09912	4.34623
	50	0.22604	5.07499	4.29162		50	0.20152	5.09951	4.24713
26	0	0.22561	5.07542	4.29257	36	0	0.20113	5.09990	4.34802
	10	0.22519	5.07584	4.29353		10	0.20074	5.10029	4.34891
	20	0.22476	5.07627	4.29449		20	0.20035	5.10068	4.34980
	30	0.22433	5.07670	4.29544		30	0.19996	5.10107	4.35069
	40	0.22391	5.07712	4.29639		40	0.19957	5.10146	4.35158
	50	0.22349	5.07754	4.29735		50	0.19919	5.10184	4.35247
27	0	0.22306	5.07797	4.29830	37	0	0.19880	5.10223	4.35335
	10	0.22264	5.07839	4.29925		10	0.19841	5.10262	4.35424
	20	0.22222	5.07881	4.30020		20	0.19803	5.10300	4.35512
	30	0.22180	5.07923	4.30115		30	0.19764	5.10339	4.35601
	40	0.22138	5.07965	4.30209		40	0.19726	5.10377	4.35689
	50	0.22096	5.08007	4.30304		50	0.19687	5.10416	4.35777
28	0	0.22054	5.08049	4.30398	38	0	0.19649	5.10454	4.35865
	10	0.22012	5.08091	4.30493		10	0.19611	5.10492	4.35953
	20	0.21970	5.08133	4.30587		20	0.19572	5.10531	4.36041
	30	0.21928	5.08175	4.30681		30	0.19534	5.10569	4.36128
	40	0.21887	5.08216	4.30775		40	0.19496	5.10607	4.36216
	50	0.21845	5.08258	4.30869		50	0.19458	5.10645	4.36303
29	0	0.21803	5.08300	4.30963	39	0	0.19420	5.10683	4.36391
	10	0.21762	5.08341	4.31056		10	0.19382	5.10721	4.36478
	20	0.21720	5.08383	4.31150		20	0.19344	5.10759	4.36565
	30	0.21679	5.08424	4.31243		30	0.19306	5.10797	4.36653
	40	0.21638	5.08465	4.31337		40	0.19269	5.10834	4.36740
	50	0.21596	5.08507	4.31430		50	0.19231	5.10872	4.36827

2 HOURS.

M.	S.	Log ½ ela Time.	Log Mid Time.	Logarith Rising.
40	0	0.19193	5.10910	4.36913
	10	0.19156	5.10947	4.37000
	20	0.19118	5.10985	4.37087
	30	0.19081	5.11022	4.37173
	40	0.19043	5.11060	4.37260
	50	0.19006	5.11097	4.37346
41	0	0.18968	5.11135	4.37432
	10	0.18931	5.11172	4.37518
	20	0.18894	5.11209	4.37604
	30	0.18857	5.11246	4.37690
	40	0.18820	5.11283	4.37776
	50	0.18783	5.11320	4.37862
42	0	0.18746	5.11357	4.37948
	10	0.18709	5.11394	4.38033
	20	0.18672	5.11431	4.38119
	30	0.18635	5.11468	4.38204
	40	0.18598	5.11505	4.38289
	50	0.18561	5.11542	4.38374
43	0	0.18525	5.11578	4.38459
	10	0.18488	5.11615	4.38544
	20	0.18451	5.11652	4.38629
	30	0.18415	5.11688	4.38714
	40	0.18378	5.11725	4.38799
	50	0.18342	5.11761	4.38884
44	0	0.18306	5.11797	4.38968
	10	0.18269	5.11834	4.39052
	20	0.18233	5.11870	4.39137
	30	0.18197	5.11906	4.39221
	40	0.18161	5.11942	4.39305
	50	0.18124	5.11979	4.39389
45	0	0.18089	5.12014	4.39473
	10	0.18053	5.12050	4.39557
	20	0.18017	5.12086	4.39641
	30	0.17981	5.12122	4.39725
	40	0.17945	5.12158	4.39808
	50	0.17909	5.12194	4.39892
46	0	0.17872	5.12229	4.39975
	10	0.17838	5.12265	4.40058
	20	0.17802	5.12301	4.40142
	30	0.17767	5.12336	4.40225
	40	0.17731	5.12372	4.40308
	50	0.17696	5.12407	4.40391
47	0	0.17660	5.12443	4.40474
	10	0.17625	5.12478	4.40556
	20	0.17590	5.12513	4.40639
	30	0.17554	5.12549	4.40722
	40	0.17519	5.12584	4.40804
	50	0.17484	5.12619	4.40886
48	0	0.17449	5.12654	4.40969
	10	0.17414	5.12689	4.41051
	20	0.17379	5.12724	4.41133
	30	0.17344	5.12759	4.41215
	40	0.17309	5.12794	4.41297
	50	0.17274	5.12829	4.41379
49	0	0.17239	5.12864	4.41461
	10	0.17205	5.12898	4.41542
	20	0.17170	5.12933	4.41624
	30	0.17135	5.12968	4.41706
	40	0.17101	5.13002	4.41787
	50	0.17066	5.13037	4.41868
50	0	0.17032	5.13071	4.41950
	10	0.16997	5.13106	4.42031
	20	0.16963	5.13140	4.42112
	30	0.16928	5.13175	4.42193
	40	0.16894	5.13209	4.42274
	50	0.16860	5.13243	4.42355
51	0	0.16826	5.13277	4.42435
	10	0.16792	5.13311	4.42516
	20	0.16758	5.13345	4.42597
	30	0.16724	5.13379	4.42677
	40	0.16690	5.13413	4.42758
	50	0.16656	5.13447	4.42838
52	0	0.16622	5.13481	4.42918
	10	0.16588	5.13515	4.42998
	20	0.16554	5.13549	4.43078
	30	0.16520	5.13583	4.43158
	40	0.16487	5.13616	4.43238
	50	0.16453	5.13650	4.43318
53	0	0.16419	5.13684	4.43398
	10	0.16386	5.13717	4.43477
	20	0.16352	5.13751	4.43557
	30	0.16319	5.13784	4.43636
	40	0.16285	5.13818	4.43716
	50	0.16252	5.13851	4.43795
54	0	0.16219	5.13884	4.43874
	10	0.16186	5.13917	4.43953
	20	0.16152	5.13951	4.44032
	30	0.16119	5.13984	4.44111
	40	0.16086	5.14017	4.44190
	50	0.16053	5.14050	4.44269
55	0	0.16020	5.14083	4.44348
	10	0.15987	5.14116	4.44426
	20	0.15954	5.14149	4.44505
	30	0.15921	5.14182	4.44583
	40	0.15888	5.14215	4.44662
	50	0.15856	5.14247	4.44740
56	0	0.15823	5.14280	4.44818
	10	0.15790	5.14313	4.44896
	20	0.15758	5.14345	4.44974
	30	0.15725	5.14378	4.45052
	40	0.15692	5.14411	4.45130
	50	0.15660	5.14443	4.45208
57	0	0.15628	5.14475	4.45286
	10	0.15595	5.14508	4.45363
	20	0.15563	5.14540	4.45441
	30	0.15530	5.14573	4.45518
	40	0.15498	5.14605	4.45596
	50	0.15466	5.14637	4.45673
58	0	0.15434	5.14669	4.45750
	10	0.15402	5.14701	4.45827
	20	0.15370	5.14733	4.45904
	30	0.15338	5.14765	4.45981
	40	0.15306	5.14797	4.46058
	50	0.15274	5.14829	4.46135
59	0	0.15242	5.14861	4.46212
	10	0.15210	5.14893	4.46289
	20	0.15178	5.14925	4.46365
	30	0.15146	5.14957	4.46442
	40	0.15115	5.14988	4.46518
	50	0.15083	5.15020	4.46595

3 HOURS.

M.	S.	Log ½ ela. Time.	Log Mid Time	Logarith Rising.	M.	S.	Log ½ ela. Time.	Log Mid Time.	Logarith Rising.
0	0	0.15051	5.15052	4.46671	10	0	0.13237	5.16866	4.51109
	10	0.15020	5.15083	4.46747		10	0.13208	5.16895	4.51181
	20	0.14988	5.15115	4.46823		20	0.13179	5.16924	4.51253
	30	0.14957	5.15146	4.46899		30	0.13150	5.16953	4.51325
	40	0.14926	5.15177	4.46975		40	0.13121	5.16982	4.51396
	50	0.14894	5.15209	4.47051		50	0.13093	5.17010	4.51467
1	0	0.14863	5.15240	4.47127	11	0	0.13064	5.17039	4.51539
	10	0.14832	5.1527.	4.47203		10	0.13035	5.17068	4.51610
	20	0.14800	5.15303	4.47278		20	0.13007	5.17096	4.51681
	30	0.14769	5.15334	4.47354		30	0.12978	5.17125	4.51753
	40	0.14738	5.15365	4.47430		40	0.12950	5.17153	4.51824
	50	0.14707	5.15396	4.47505		50	0.12921	5.17182	4.51895
2	0	0.14676	5.15427	4.47580	12	0	0.12893	5.17210	4.51966
	10	0.14645	5.15458	4.47656		10	0.12864	5.17239	4.52037
	20	0.14614	5.15489	4.47731		20	0.12836	5.17267	4.52107
	30	0.14583	5.15520	4.47806		30	0.12807	5.17296	4.52178
	40	0.14552	5.15551	4.47881		40	0.12779	5.17324	4.52249
	50	0.14521	5.15582	4.47956		50	0.12751	5.17352	4.52319
3	0	0.14490	5.15613	4.48031	13	0	0.12723	5.17380	4.52390
	10	0.14460	5.15643	4.48106		10	0.12695	5.17408	4.52461
	20	0.14429	5.15674	4.48180		20	0.12066	5.17437	4.52531
	30	0.14398	5.15705	4.48255		30	0.12638	5.17465	4.52601
	40	0.14368	5.15735	4.48330		40	0.12610	5.17493	4.52672
	50	0.14337	5.15766	4.48404		50	0.12582	5.17521	4.52742
4	0	0.14307	5.15796	4.48479	14	0	0.12554	5.17549	4.52812
	10	0.14276	5.15827	4.48553		10	0.12526	5.17577	4.52882
	20	0.14246	5.15857	4.48627		20	0.12499	5.17604	4.52952
	30	0.14215	5.15888	4.48701		30	0.12471	5.17632	4.53022
	40	0.14185	5.15918	4.48776		40	0.12443	5.17660	4.53092
	50	0.14155	5.15948	4.48850		50	0.12415	5.17688	4.53162
5	0	0.14124	5.15979	4.48924	15	0	0.12387	5.17716	4.53231
	10	0.14094	5.16009	4.48998		10	0.12360	5.17743	4.53301
	20	0.14064	5.16039	4.49071		20	0.12332	5.17771	4.53371
	30	0.14034	5.16069	4.49145		30	0.12305	5.17798	4.53440
	40	0.14004	5.16099	4.49219		40	0.12277	5.17826	4.53510
	50	0.13974	5.16129	4.49293		50	0.12249	5.17854	4.53579
6	0	0.13944	5.16159	4.49366	16	0	0.12222	5.17881	4.53648
	10	0.13914	5.16189	4.49440		10	0.12195	5.17908	4.53718
	20	0.13884	5.16219	4.49513		20	0.12167	5.17936	4.53787
	30	0.13854	5.16249	4.49586		30	0.12140	5.17963	4.53856
	40	0.13824	5.16279	4.49659		40	0.12113	5.17990	4.53925
	50	0.13794	5.16309	4.49733		50	0.12085	5.18018	4.53994
7	0	0.13765	5.16338	4.49806	17	0	0.12058	5.18045	4.54063
	10	0.13735	5.16368	4.49879		10	0.12031	5.18072	4.54132
	20	0.13705	5.16398	4.49952		20	0.12004	5.18099	4.54201
	30	0.13676	5.16427	4.50025		30	0.11977	5.18126	4.54269
	40	0.13646	5.16457	4.50098		40	0.11949	5.18154	4.54338
	50	0.13617	5.16486	4.50170		50	0.11922	5.18181	4.54407
8	0	0.13587	5.16516	4.50243	18	0	0.11895	5.18208	4.54475
	10	0.13558	5.16545	4.50316		10	0.11868	5.18235	4.54544
	20	0.13528	5.16575	4.50388		20	0.11842	5.18261	4.54612
	30	0.13499	5.16604	4.50461		30	0.11815	5.18288	4.54680
	40	0.13470	5.16633	4.50533		40	0.11788	5.18315	4.54749
	50	0.13441	5.16662	4.50605		50	0.11761	5.18342	4.54817
9	0	0.13411	5.16692	4.50677	19	0	0.11734	5.18369	4.54885
	10	0.13382	5.16721	4.50750		10	0.11706	5.18395	4.54953
	20	0.13353	5.16750	4.50822		20	0.11681	5.18422	4.55021
	30	0.13324	5.16779	4.50894		30	0.11654	5.18449	4.55089
	40	0.13295	5.16808	4.50966		40	0.11628	5.18475	4.55157
	50	0.13266	5.16837	4.51038		50	0.11601	5.18502	4.55225

Table XX. For finding the Latitude by two Altitudes of the Sun.

3 HOURS.

M.	S.	Log ½ ela. Time.	Log Mid Time.	Logarith Rising.	M.	S.	Log ½ ela. Time.	Log Mid Time.	Logarith Rising.
20	0	0.11575	5.18528	4.55293	30	0	0.10053	5.20050	4.59244
	10	0.11548	5.18555	4.55360		10	0.10029	5.20074	4.59308
	20	0.11522	5.18581	4.55428		20	0.10005	5.20098	4.59372
	30	0.11495	5.18608	4.55496		30	0.09981	5.20122	4.59436
	40	0.11469	5.18634	4.55563		40	0.09957	5.20146	4.59500
	50	0.11443	5.18660	4.55630		50	0.09933	5.20170	4.59564
21	0	0.11416	5.18687	4.55698	31	0	0.09909	5.20194	4.59627
	10	0.11390	5.18713	4.55765		10	0.09885	5.20218	4.59691
	20	0.11364	5.18739	4.55832		20	0.09861	5.20242	4.59755
	30	0.11338	5.18765	4.55900		30	0.09837	5.20266	4.59818
	40	0.11312	5.18791	4.55967		40	0.09813	5.20290	4.59882
	50	0.11285	5.18818	4.56034		50	0.09789	5.20314	4.59945
22	0	0.11259	5.18844	4.56101	32	0	0.09705	5.20338	4.60008
	10	0.11233	5.18870	4.56168		10	0.09741	5.20362	4.60072
	20	0.11207	5.18896	4.56235		20	0.09718	5.20385	4.60135
	30	0.11181	5.18922	4.56301		30	0.09694	5.20409	4.60198
	40	0.11155	5.18948	4.56368		40	0.09670	5.20433	4.60261
	50	0.11130	5.18973	4.56435		50	0.09647	5.20456	4.60324
23	0	0.11104	5.18999	4.56501	33	0	0.09623	5.20480	4.60387
	10	0.11078	5.19025	4.56568		10	0.09599	5.20504	4.60450
	20	0.11052	5.19051	4.56634		20	0.09576	5.20527	4.60513
	30	0.11027	5.19076	4.56701		30	0.09552	5.20551	4.60576
	40	0.11001	5.19102	4.56767		40	0.09529	5.20574	4.60639
	50	0.10975	5.19128	4.56834		50	0.09506	5.20597	4.60701
24	0	0.10950	5.19153	4.56900	34	0	0.09482	5.20621	4.60764
	10	0.10924	5.19179	4.56966		10	0.09459	5.20644	4.60827
	20	0.10899	5.19204	4.57032		20	0.09435	5.20668	4.60890
	30	0.10873	5.19230	4.57098		30	0.09412	5.20691	4.60952
	40	0.10848	5.19255	4.57164		40	0.09389	5.20714	4.61015
	50	0.10822	5.19281	4.57230		50	0.09366	5.20737	4.61077
25	0	0.10797	5.19306	4.57296	35	0	0.09343	5.20760	4.61139
	10	0.10772	5.19331	4.57362		10	0.09319	5.20784	4.61202
	20	0.10746	5.19357	4.57428		20	0.09296	5.20807	4.61264
	30	0.10721	5.19382	4.57494		30	0.09273	5.20830	4.61326
	40	0.10696	5.19407	4.57559		40	0.09250	5.20853	4.61388
	50	0.10671	5.19432	4.57625		50	0.09227	5.20876	4.61450
26	0	0.10646	5.19457	4.57690	36	0	0.09204	5.20899	4.61512
	10	0.10620	5.19483	4.57756		10	0.09181	5.20922	4.61574
	20	0.10595	5.19508	4.57821		20	0.09158	5.20945	4.61636
	30	0.10570	5.19533	4.57886		30	0.09136	5.20967	4.61698
	40	0.10545	5.19558	4.57951		40	0.09113	5.20990	4.61760
	50	0.10520	5.19583	4.58017		50	0.09090	5.21013	4.61822
27	0	0.10495	5.19608	4.58082	37	0	0.09067	5.21036	4.61883
	10	0.10471	5.19632	4.58147		10	0.09044	5.21059	4.61945
	20	0.10446	5.19657	4.58212		20	0.09022	5.21081	4.62006
	30	0.10421	5.19682	4.58277		30	0.08999	5.21104	4.62068
	40	0.10396	5.19707	4.58342		40	0.08976	5.21127	4.62129
	50	0.10371	5.19732	4.58407		50	0.08954	5.21149	4.62191
28	0	0.10347	5.19756	4.58471	38	0	0.08931	5.21172	4.62252
	10	0.10322	5.19781	4.58536		10	0.08909	5.21194	4.62313
	20	0.10297	5.19806	4.58601		20	0.08886	5.21217	4.62375
	30	0.10272	5.19831	4.58665		30	0.08864	5.21239	4.62436
	40	0.10248	5.19855	4.58730		40	0.08842	5.21261	4.62497
	50	0.10224	5.19879	4.58794		50	0.08819	5.21284	4.62558
29	0	0.10199	5.19904	4.58859	39	0	0.08797	5.21306	4.62619
	10	0.10175	5.19928	4.58923		10	0.08774	5.21329	4.62680
	20	0.10151	5.19952	4.58988		20	0.08752	5.21351	4.62741
	30	0.10126	5.19977	4.59052		30	0.08730	5.21373	4.62802
	40	0.10102	5.20001	4.59116		40	0.08708	5.21395	4.62863
	50	0.10078	5.20025	4.59180		50	0.08686	5.21417	4.62923

TABLE XX. For finding the Latitude by two Altitudes of the Sun.

3 HOURS.

M.	S.	Log ½ ela Time.	Log Mid Time.	Logarith Rising.
40	0	0.08664	5.21439	4.62984
	10	0.08641	5.21462	4.63045
	20	0.08619	5.21484	4.63105
	30	0.08597	5.21506	4.63166
	40	0.08575	5.21528	4.63226
	50	0.08553	5.21550	4.63287
41	0	0.08531	5.21572	4.63347
	10	0.08510	5.21593	4.63407
	20	0.08488	5.21615	4.63468
	30	0.08466	5.11637	4.63528
	40	0.08444	5.21659	4.63588
	50	0.08422	5.21681	4.63648
42	0	0.08401	5.21702	4.63708
	10	0.08379	5.21724	4.63768
	20	0.08357	5.21746	4.63828
	30	0.08336	5.21767	4.63888
	40	0.08314	5.21789	4.63948
	50	0.08293	5.21810	4.64008
43	0	0.08271	5.21832	4.64068
	10	0.08250	5.21853	4.64127
	20	0.08228	5.21875	4.64187
	30	0.08207	5.21896	4.64246
	40	0.08185	5.21918	4.64306
	50	0.08164	5.21939	4.64365
44	0	0.08143	5.21960	4.64425
	10	0.08121	5.21982	4.64484
	20	0.08100	5.22003	4.64544
	30	0.08079	5.22024	4.64603
	40	0.08058	5.22045	4.64662
	50	0.08036	5.22067	4.64721
45	0	0.08015	5.22088	4.64780
	10	0.07994	5.22109	4.64839
	20	0.07973	5.22130	4.64898
	30	0.07952	5.22151	4.64957
	40	0.07931	5.22172	4.65016
	50	0.07910	5.22193	4.65075
46	0	0.07889	5.22214	4.65134
	10	0.07868	5.22235	4.65193
	20	0.07848	5.22255	4.65251
	30	0.07827	5.22276	4.65310
	40	0.07806	5.22297	4.65369
	50	0.07785	5.22318	4.65427
47	0	0.07765	5.22338	4.65486
	10	0.07744	5.22359	4.65544
	20	0.07723	5.22380	4.65602
	30	0.07703	5.22400	4.65661
	40	0.07682	5.22421	4.65719
	50	0.07661	5.22442	4.65777
48	0	0.07641	5.22462	4.65836
	10	0.07620	5.22483	4.65895
	20	0.07600	5.22503	4.65952
	30	0.07579	5.22524	4.66010
	40	0.07559	5.22544	4.66068
	50	0.07539	5.22564	4.66126
49	0	0.07518	5.22585	4.66184
	10	0.07498	5.22605	4.66241
	20	0.07478	5.22625	4.66299
	30	0.07458	5.22645	4.66357
	40	0.07437	5.22666	4.66415
	50	0.07417	5.22686	4.66472
50	0	0.07397	5.22706	4.66530
	10	0.07377	5.22726	4.66588
	20	0.07357	5.22746	4.66645
	30	0.07337	5.22766	4.66702
	40	0.07317	5.22786	4.66760
	50	0.07297	5.22806	4.66817
51	0	0.07277	5.22826	4.66874
	10	0.07257	5.22846	4.66932
	20	0.07237	5.22866	4.66989
	30	0.07217	5.22886	4.67046
	40	0.07197	5.22906	4.67103
	50	0.07178	5.22925	4.67160
52	0	0.07158	5.22945	4.67217
	10	0.07138	5.22965	4.67274
	20	0.07119	5.22984	4.67331
	30	0.07099	5.23004	4.67388
	40	0.07079	5.23024	4.67445
	50	0.07060	5.23043	4.67502
53	0	0.07040	5.23063	4.67558
	10	0.07021	5.23082	4.67615
	20	0.07001	5.23102	4.67671
	30	0.06982	5.23121	4.67728
	40	0.06962	5.23141	4.67785
	50	0.06943	5.23160	4.67841
54	0	0.06923	5.23180	4.67897
	10	0.06904	5.23199	4.67954
	20	0.06885	5.23218	4.68010
	30	0.06865	5.23238	4.68066
	40	0.06846	5.23257	4.68123
	50	0.06827	5.23276	4.68179
55	0	0.06808	5.23295	4.68235
	10	0.06789	5.23314	4.68291
	20	0.06770	5.23333	4.68347
	30	0.06751	5.23352	4.68403
	40	0.06731	5.23372	4.68459
	50	0.06712	5.23391	4.68515
56	0	0.06693	5.23410	4.68571
	10	0.06674	5.23429	4.68627
	20	0.06656	5.23447	4.68682
	30	0.06637	5.23466	4.68738
	40	0.06618	5.23485	4.68794
	50	0.06599	5.23504	4.68849
57	0	0.06580	5.23523	4.68905
	10	0.06561	5.23542	4.68960
	20	0.06543	5.23560	4.69016
	30	0.06524	5.23579	4.69071
	40	0.06505	5.23598	4.69127
	50	0.06487	5.23616	4.69182
58	0	0.06468	5.23635	4.69237
	10	0.06449	5.23654	4.69292
	20	0.06431	5.23672	4.69348
	30	0.06412	5.23691	4.69403
	40	0.06394	5.23709	4.69458
	50	0.06375	5.23728	4.69513
59	0	0.06357	5.23746	4.69568
	10	0.06338	5.23765	4.69623
	20	0.06320	5.23783	4.69678
	30	0.06302	5.23801	4.69733
	40	0.06283	5.23820	4.69787
	50	0.06265	5.23838	4.69842

4 HOURS.

M.	S.	Log ½ ela. Time.	Log Mid. Time.	Logarith Rising.	M.	S.	Log ½ ela. Time.	Log Mid. Time.	Logarith Rising.
0	0	0.06247	5.23856	4.69897	10	0	0.05207	5.24896	4.73098
	10	0.06229	5.23874	4.69952		10	0.05191	5.24912	4.73150
	20	0.06211	5.23892	4.70006		20	0.05174	5.24929	4.73202
	30	0.06192	5.23911	4.70061		30	0.05158	5.24945	4.73254
	40	0.06174	5.23929	4.70115		40	0.05142	5.24961	4.73306
	50	0.06156	5.23947	4.70170		50	0.05125	5.24978	4.73358
1	0	0.06138	5.23965	4.70224	11	0	0.05109	5.24994	4.73410
	10	0.06120	5.23983	4.70279		10	0.05093	5.25010	4.73462
	20	0.06102	5.24001	4.70333		20	0.05076	5.25027	4.73514
	30	0.06084	5.24019	4.70387		30	0.05060	5.25043	4.73565
	40	0.06066	5.24037	4.70442		40	0.05044	5.25059	4.73617
	50	0.06048	5.24055	4.70496		50	0.05028	5.25075	4.73668
2	0	0.06030	5.24073	4.70550	12	0	0.05012	5.25091	4.73720
	10	0.06012	5.24091	4.70604		10	0.04996	5.25107	4.73772
	20	0.05995	5.24108	4.70658		20	0.04980	5.25123	4.73823
	30	0.05977	5.24126	4.70712		30	0.04964	5.25139	4.73874
	40	0.05959	5.24144	4.70766		40	0.04948	5.25155	4.73926
	50	0.05941	5.24162	4.70820		50	0.04932	5.25171	4.73977
3	0	0.05924	5.24179	4.70874	13	0	0.04916	5.25187	4.74028
	10	0.05906	5.24197	4.70928		10	0.04900	5.25203	4.74080
	20	0.05888	5.24215	4.70982		20	0.04884	5.25219	4.74131
	30	0.05871	5.24232	4.71036		30	0.04868	5.25235	4.74182
	40	0.05853	5.24250	4.71089		40	0.04852	5.25251	4.74233
	50	0.05836	5.24267	4.71143		50	0.04837	5.25266	4.74284
4	0	0.05818	5.24285	4.71197	14	0	0.04821	5.25282	4.74335
	10	0.05801	5.24302	4.71250		10	0.04805	5.25298	4.74386
	20	0.05783	5.24320	4.71304		20	0.04789	5.25314	4.74437
	30	0.05766	5.24337	4.71357		30	0.04774	5.25329	4.74488
	40	0.05748	5.24355	4.71411		40	0.04758	5.25345	4.74539
	50	0.05731	5.24372	4.71464		50	0.04743	5.25360	4.74590
5	0	0.05714	5.24389	4.71518	15	0	0.04727	5.25376	4.74641
	10	0.05696	5.24407	4.71571		10	0.04711	5.25392	4.74692
	20	0.05679	5.24424	4.71624		20	0.04696	5.25407	4.74742
	30	0.05662	5.24441	4.71678		30	0.04680	5.25423	4.74793
	40	0.05645	5.24458	4.71731		40	0.04665	5.25438	4.74844
	50	0.05627	5.24476	4.71784		50	0.04649	5.25454	4.74894
6	0	0.05610	5.24493	4.71837	16	0	0.04634	5.25469	4.74945
	10	0.05593	5.24510	4.71890		10	0.04619	5.25484	4.74995
	20	0.05576	5.24527	4.71943		20	0.04603	5.25500	4.75046
	30	0.05559	5.24544	4.71996		30	0.04588	5.25515	4.75096
	40	0.05542	5.24561	4.72049		40	0.04573	5.25530	4.75147
	50	0.05525	5.24578	4.72102		50	0.04557	5.25546	4.75197
7	0	0.05508	5.24595	4.72155	17	0	0.04542	5.25561	4.75247
	10	0.05491	5.24612	4.72208		10	0.04527	5.25576	4.75298
	20	0.05474	5.24629	4.72260		20	0.04512	5.25591	4.75348
	30	0.05457	5.24646	4.72313		30	0.04496	5.25607	4.75398
	40	0.05440	5.24663	4.72366		40	0.04481	5.25622	4.75448
	50	0.05423	5.24680	4.72418		50	0.04466	5.25637	4.75498
8	0	0.05406	5.24697	4.72471	18	0	0.04451	5.25652	4.75549
	10	0.05389	5.24714	4.72523		10	0.04436	5.25667	4.75599
	20	0.05373	5.24730	4.72576		20	0.04421	5.25682	4.75649
	30	0.05356	5.24747	4.72628		30	0.04406	5.25697	4.75699
	40	0.05340	5.24763	4.72681		40	0.04391	5.25712	4.75748
	50	0.05323	5.24780	4.72733		50	0.04376	5.25727	4.75798
9	0	0.05306	5.24797	4.72785	19	0	0.04361	5.25742	4.75848
	10	0.05290	5.24813	4.72838		10	0.04346	5.25757	4.75898
	20	0.05273	5.24830	4.72890		20	0.04332	5.25771	4.75948
	30	0.05257	5.24846	4.72942		30	0.04317	5.25786	4.75997
	40	0.05240	5.24863	4.72994		40	0.04302	5.25801	4.76047
	50	0.05224	5.24879	4.73046		50	0.04287	5.25816	4.76097

4 HOURS.

M.	S.	Log ½ cla Time.	Log Mid Time.	Logarith Rising.	M.	S.	Log ½ cla Time.	Log Mid Time.	Logarith Rising.
20	0	0.04272	5.25831	4.76146	30	0	0.03438	5.26665	4.79051
	10	0.04258	5.25845	4.76196		10	0.03425	5.26678	4.79098
	20	0.04243	5.25860	4.76245		20	0.03412	5.26691	4.79145
	30	0.04228	5.25875	4.76295		30	0.03399	5.26704	4.79192
	40	0.04214	5.25889	4.76344		40	0.03386	5.26717	4.79240
	50	0.04199	5.25904	4.76394		50	0.03373	5.26730	4.79287
21	0	0.04185	5.25918	4.76443	31	0	0.03360	5.26743	4.79334
	10	0.04170	5.25933	4.76492		10	0.03348	5.26755	4.79381
	20	0.04155	5.25948	4.76542		20	0.03335	5.26768	4.79428
	30	0.04141	5.25962	4.76591		30	0.03322	5.26781	4.79475
	40	0.04127	5.25976	4.76640		40	0.03309	5.26794	4.79,22
	50	0.04112	5.25991	4.76689		50	0.03296	5.26807	4.79568
22	0	0.04098	5.26005	4.76738	32	0	0.03283	5.26820	4.79615
	10	0.04083	5.26020	4.76787		10	0.03271	5.26832	4.79662
	20	0.04069	5.26034	4.76836		20	0.03258	5.26845	4.79709
	30	0.04055	5.26048	4.76885		30	0.03245	5.26858	4.79756
	40	0.04040	5.26063	4.76934		40	0.03233	5.26870	4.79802
	50	0.04026	5.26077	4.76983		50	0.03220	5.26883	4.79849
23	0	0.04012	5.26091	4.77032	33	0	0.03207	5.26896	4.79896
	10	0.03998	5.26105	4.77081		10	0.03195	5.26908	4.79942
	20	0.03983	5.26120	4.77130		20	0.03182	5.26921	4.79989
	30	0.03969	5.26134	4.77179		30	0.03170	5.26933	4.80035
	40	0.03955	5.26148	4.77227		40	0.03157	5.26946	4.80082
	50	0.03941	5.26162	4.77276		50	0.03145	5.26958	4.80128
24	0	0.03927	5.26176	4.77325	34	0	0.03132	5.26971	4.80175
	10	0.03913	5.26190	4.77373		10	0.03120	5.26983	4.80221
	20	0.03899	5.26204	4.77422		20	0.03107	5.26996	4.80267
	30	0.03885	5.26218	4.77470		30	0.03095	5.27008	4.80314
	40	0.03871	5.26232	4.77519		40	0.03083	5.27020	4.80360
	50	0.03857	5.26246	4.77567		50	0.03070	5.27033	4.80406
25	0	0.03843	5.26260	4.77616	35	0	0.03058	5.27045	4.80452
	10	0.03829	5.26274	4.77664		10	0.03046	5.27057	4.80498
	20	0.03815	5.26288	4.77713		20	0.03034	5.27069	4.80544
	30	0.03802	5.26301	4.77761		30	0.03021	5.27082	4.80591
	40	0.03788	5.26315	4.77809		40	0.03009	5.27094	4.80637
	50	0.03774	5.26329	4.77857		50	0.02997	5.27106	4.80683
26	0	0.03760	5.26343	4.77906	36	0	0.02985	5.27118	4.80729
	10	0.03746	5.26357	4.77954		10	0.02973	5.27130	4.80775
	20	0.03733	5.26370	4.78002		20	0.02961	5.27142	4.80820
	30	0.03719	5.26384	4.78050		30	0.02949	5.27154	4.80866
	40	0.03706	5.26397	4.78098		40	0.02937	5.27166	4.80912
	50	0.03692	5.26411	4.78146		50	0.02925	5.27178	4.80958
27	0	0.03678	5.26425	4.78194	37	0	0.02913	5.27190	4.81004
	10	0.03665	5.26438	4.78242		10	0.02901	5.27202	4.81049
	20	0.03651	5.26452	4.78290		20	0.02889	5.27214	4.81095
	30	0.03638	5.26465	4.78338		30	0.02877	5.27226	4.81141
	40	0.03624	5.26479	4.78385		40	0.02865	5.27238	4.81186
	50	0.03611	5.26492	4.78433		50	0.02853	5.27250	4.81232
28	0	0.03597	5.26506	4.78481	38	0	0.02841	5.27262	4.81277
	10	0.03584	5.26519	4.78529		10	0.02829	5.27274	4.81323
	20	0.03571	5.26532	4.78576		20	0.02818	5.27285	4.81368
	30	0.03557	5.26546	4.78624		30	0.02806	5.27297	4.81414
	40	0.03544	5.26559	4.78671		40	0.02794	5.27309	4.81459
	50	0.03531	5.26572	4.78719		50	0.02783	5.27320	4.81505
29	0	0.03517	5.26586	4.78767	39	0	0.02771	5.27332	4.81550
	10	0.03504	5.26599	4.78814		10	0.02759	5.27344	4.81595
	20	0.03491	5.26612	4.78861		20	0.02748	5.27355	4.81641
	30	0.03478	5.26625	4.78908		30	0.02736	5.27367	4.81686
	40	0.03465	5.26638	4.78956		40	0.02724	5.27379	4.81731
	50	0.03452	5.26651	4.79003		50	0.02713	5.27390	4.81776

4 HOURS.

M.	S.	Log ½ ela Time.	Log Mid Time.	Logarith Rising.	M.	S.	Log ½ ela Time.	Log Mid Time.	Logarith Rising.
40	0	0.02701	5.27402	4.81821	50	0	0.02058	5.28045	4.84466
	10	0.02690	5.27413	4.81866		10	0.02048	5.28055	4.84509
	20	0.02678	5.27425	4.81911		20	0.02038	5.28065	4.84552
	30	0.02667	5.27436	4.81956		30	0.02028	5.28075	4.84595
	40	0.02656	5.27447	4.82001		40	0.02018	5.28085	4.84638
	50	0.02644	5.27459	4.82046		50	0.02009	5.28094	4.84681
41	0	0.02633	5.27470	4.82091	51	0	0.01999	5.28104	4.84724
	10	0.02622	5.27481	4.82136		10	0.01989	5.28114	4.84767
	20	0.02610	5.27493	4.82181		20	0.01979	5.28124	4.84810
	30	0.02599	5.27504	4.82226		30	0.01969	5.28134	4.84852
	40	0.02588	5.27515	4.82271		40	0.01960	5.28143	4.84895
	50	0.02577	5.27526	4.82315		50	0.01950	5.28153	4.84938
42	0	0.02565	5.27538	4.82360	52	0	0.01940	5.28163	4.84981
	10	0.02554	5.27549	4.82405		10	0.01931	5.28172	4.85023
	20	0.02543	5.27560	4.82449		20	0.01921	5.28182	4.85066
	30	0.02532	5.27571	4.82494		30	0.01912	5.28191	4.85108
	40	0.02521	5.27582	4.82538		40	0.01902	5.28201	4.85151
	50	0.02510	5.27593	4.82583		50	0.01892	5.28211	4.85194
43	0	0.02499	5.27604	4.82628	53	0	0.01883	5.28220	4.85236
	10	0.02488	5.27615	4.82672		10	0.01873	5.28230	4.85278
	20	0.02477	5.27626	4.82716		20	0.01864	5.28239	4.85321
	30	0.02466	5.27637	4.82761		30	0.01854	5.28249	4.85363
	40	0.02455	5.27648	4.82805		40	0.01845	5.28258	4.85406
	50	0.02444	5.27659	4.82850		50	0.01836	5.28267	4.85448
44	0	0.02433	5.27670	4.82894	54	0	0.01826	5.28277	4.85490
	10	0.02422	5.27681	4.82938		10	0.01817	5.28286	4.85533
	20	0.02411	5.27692	4.82982		20	0.01808	5.28295	4.85575
	30	0.02400	5.27703	4.83026		30	0.01798	5.28305	4.85617
	40	0.02390	5.27713	4.83071		40	0.01789	5.28314	4.85659
	50	0.02379	5.27724	4.83115		50	0.01780	5.28323	4.85701
45	0	0.02368	5.27735	4.83159	55	0	0.01771	5.28332	4.85744
	10	0.02357	5.27746	4.83203		10	0.01761	5.28342	4.85786
	20	0.02347	5.27756	4.83247		20	0.01752	5.28351	4.85828
	30	0.02336	5.27767	4.83291		30	0.01743	5.28360	4.85870
	40	0.02326	5.27777	4.83335		40	0.01734	5.28369	4.85912
	50	0.02315	5.27788	4.83379		50	0.01725	5.28378	4.85954
46	0	0.02304	5.27799	4.83423	56	0	0.01716	5.28387	4.85996
	10	0.02294	5.27809	4.83467		10	0.01707	5.28396	4.86037
	20	0.02283	5.27820	4.83510		20	0.01698	5.28405	4.86079
	30	0.02273	5.27830	4.83554		30	0.01689	5.28414	4.86121
	40	0.02262	5.27841	4.83598		40	0.01680	5.28423	4.86163
	50	0.02252	5.27851	4.83642		50	0.01671	5.28432	4.86205
47	0	0.02241	5.27862	4.83685	57	0	0.01662	5.28441	4.86246
	10	0.02231	5.27872	4.83729		10	0.01653	5.28450	4.86288
	20	0.02221	5.27882	4.83773		20	0.01644	5.28459	4.86330
	30	0.02210	5.27893	4.83816		30	0.01635	5.28468	4.86372
	40	0.02200	5.27903	4.83860		40	0.01626	5.28477	4.86413
	50	0.02190	5.27913	4.83903		50	0.01618	5.28485	4.86455
48	0	0.02179	5.27924	4.83947	58	0	0.01609	5.28494	4.86496
	10	0.02169	5.27934	4.83990		10	0.01600	5.28503	4.86538
	20	0.02159	5.27944	4.84034		20	0.01591	5.28512	4.86579
	30	0.02149	5.27954	4.84077		30	0.01583	5.28520	4.86621
	40	0.02139	5.27964	4.84120		40	0.01574	5.28529	4.86662
	50	0.02128	5.27975	4.84164		50	0.01565	5.28538	4.86704
49	0	0.02118	5.27985	4.84207	59	0	0.01557	5.28546	4.86745
	10	0.02108	5.27995	4.84250		10	0.01548	5.28555	4.86786
	20	0.02098	5.28005	4.84293		20	0.01540	5.28563	4.86828
	30	0.02088	5.28015	4.84337		30	0.01531	5.28572	4.86869
	40	0.02078	5.28025	4.84380		40	0.01523	5.28580	4.86910
	50	0.02068	5.28035	4.84423		50	0.01514	5.28589	4.86951

TABLE XX. For finding the Latitude by two Altitudes of the Sun.

5 HOURS.

M.	S.	Log ½ ela Time.	Log Mid Time.	Logarith Rising.	M.	S.	Log ½ ela Time.	Log Mid Time.	Logarith Rising.
0	0	0.01506	5.28597	4.86992	10	0	0.01042	5.29061	4.89407
	10	0.01497	5.28606	4.87034		10	0.01035	5.29068	4.89447
	20	0.01489	5.28614	4.87075		20	0.01028	5.29075	4.89486
	30	0.01480	5.28623	4.87116		30	0.01021	5.29082	4.89525
	40	0.01472	5.28631	4.87157		40	0.01014	5.29089	4.89564
	50	0.01464	5.28639	4.87198		50	0.01007	5.29096	4.89604
1	0	0.01455	5.28648	4.87239	11	0	0.01000	5.29103	4.89643
	10	0.01447	5.28656	4.87280		10	0.00993	5.29110	4.89682
	20	0.01439	5.28664	4.87321		20	0.00987	5.29116	4.89721
	30	0.01430	5.28673	4.82362		30	0.00980	5.29123	4.89760
	40	0.01422	5.28681	4.87402		40	0.00973	5.29130	4.89799
	50	0.01414	5.28689	4.87443		50	0.00966	5.29137	4.89838
2	0	0.01406	5.28697	4.87484	12	0	0.00960	5.29143	4.89877
	10	0.01398	5.28705	4.87525		10	0.00953	5.29150	4.89916
	20	0.01390	5.28713	4.87566		20	0.00946	5.29157	4.89955
	30	0.01381	5.28722	4.87606		30	0.00940	5.29163	4.89994
	40	0.01373	5.28730	4.87647		40	0.00933	5.29170	4.90033
	50	0.01365	5.28738	4.87688		50	0.00926	5.29177	4.90072
3	0	0.01357	5.28746	4.87728	13	0	0.00920	5.29183	4.90111
	10	0.01349	5.28754	4.87769		10	0.00913	5.29190	4.90149
	20	0.01341	5.28762	4.87809		20	0.00907	5.29196	4.90188
	30	0.01333	5.28770	4.87850		30	0.00900	5.29203	4.90227
	40	0.01325	5.28778	4.87890		40	0.00894	5.29209	4.90266
	50	0.01317	5.28786	4.87931		50	0.00887	5.29216	4.90305
4	0	0.01310	5.28793	4.87971	14	0	0.00881	5.29222	4.90345
	10	0.01302	5.28801	4.88012		10	0.00874	5.29229	4.90382
	20	0.01294	5.28809	4.88052		20	0.00868	5.29235	4.90421
	30	0.01286	5.28817	4.88093		30	0.00862	5.29241	4.90459
	40	0.01278	5.28825	4.88133		40	0.00855	5.29248	4.90498
	50	0.01270	5.28833	4.88173		50	0.00849	5.29254	4.90536
5	0	0.01263	5.28840	4.88213	15	0	0.00843	5.29260	4.90575
	10	0.01255	5.28848	4.88254		10	0.00836	5.29267	4.90613
	20	0.01247	5.28856	4.88294		20	0.00830	5.29273	4.90652
	30	0.01240	5.28863	4.88334		30	0.00824	5.29279	4.90690
	40	0.01232	5.28871	4.88374		40	0.00818	5.29285	4.90728
	50	0.01224	5.28879	4.88414		50	0.00811	5.29292	4.90767
6	0	0.01217	5.28886	4.88454	16	0	0.00805	5.29298	4.90805
	10	0.01209	5.28894	4.88494		10	0.00799	5.29304	4.90843
	20	0.01202	5.28901	4.88534		20	0.00793	5.29310	4.90882
	30	0.01194	5.28909	4.88574		30	0.00787	5.29316	4.90920
	40	0.01187	5.28916	4.88614		40	0.00781	5.29322	4.90958
	50	0.01179	5.28924	4.88654		50	0.00775	5.29328	4.90996
7	0	0.01172	5.28931	4.88694	17	0	0.00769	5.29334	4.91034
	10	0.01164	5.28939	4.88734		10	0.00763	5.29340	4.91073
	20	0.01157	5.28946	4.88774		20	0.00757	5.29346	4.91111
	30	0.01150	5.28953	4.88814		30	0.00751	5.29352	4.91149
	40	0.01142	5.28961	4.88853		40	0.00745	5.29358	4.91187
	50	0.01135	5.28968	4.88893		50	0.00739	5.29364	4.91225
8	0	0.01128	5.28975	4.88933	18	0	0.00733	5.29370	4.91263
	10	0.01120	5.28983	4.88973		10	0.00728	5.29375	4.91301
	20	0.01113	5.28990	4.89012		20	0.00722	5.29381	4.91339
	30	0.01106	5.28997	4.89052		30	0.00716	5.29387	4.91377
	40	0.01099	5.29004	4.89091		40	0.00710	5.29393	4.91415
	50	0.01091	5.29012	4.89131		50	0.00704	5.29399	4.91452
9	0	0.01084	5.29019	4.89171	19	0	0.00699	5.29404	4.91490
	10	0.01077	5.29026	4.89210		10	0.00693	5.29410	4.91528
	20	0.01070	5.29033	4.89250		20	0.00687	5.29416	4.91566
	30	0.01063	5.29040	4.89289		30	0.00682	5.29421	4.91603
	40	0.01056	5.29047	4.89328		40	0.00676	5.29427	4.91641
	50	0.01049	5.29054	4.89368		50	0.00670	5.29433	4.91679

TABLE XX. For finding the Latitude by two Altitudes of the Sun.

5 HOURS.

M.	S.	Log ½ elap. Time.	Log Mid. Time.	Logarith Rising.	M.	S.	Log ½ elap. Time.	Log Mid. Time.	Logarith Rising.
20	0	0.00665	5.29438	4.91716	30	0	0.00373	5.29730	4.93926
	10	0.00659	5.29444	4.91754		10	0.00369	5.29734	4.93962
	20	0.00654	5.29449	4.91792		20	0.00365	5.29738	4.93998
	30	0.00648	5.29455	4.91830		30	0.00361	5.29742	4.94034
	40	0.00643	5.29460	4.91867		40	0.00357	5.29746	4.94069
	50	0.00637	5.29466	4.91904		50	0.00353	5.29750	4.94105
21	0	0.00632	5.29471	4.91942	31	0	0.00349	5.29754	4.94141
	10	0.00626	5.29477	4.91979		10	0.00345	5.29758	4.94177
	20	0.00621	5.29482	4.92017		20	0.00341	5.29762	4.94213
	30	0.00616	5.29487	4.92054		30	0.00337	5.29766	4.94249
	40	0.00610	5.29493	4.92092		40	0.00333	5.29770	4.94284
	50	0.00605	5.29498	4.92129		50	0.00329	5.29774	4.94320
22	0	0.00600	5.29503	4.92166	32	0	0.00325	5.29778	4.94356
	10	0.00594	5.29509	4.92203		10	0.00321	5.29782	4.94392
	20	0.00589	5.29514	4.92241		20	0.00317	5.29786	4.94427
	30	0.00584	5.29519	4.92278		30	0.00313	5.29790	4.94463
	40	0.00579	5.29524	4.92315		40	0.00310	5.29793	4.94498
	50	0.00574	5.29529	4.92352		50	0.00306	5.29797	4.94534
23	0	0.00568	5.29535	4.92390	33	0	0.00302	5.29801	4.94570
	10	0.00563	5.29540	4.92427		10	0.00298	5.29805	4.94605
	20	0.00558	5.29545	4.92464		20	0.00295	5.29808	4.94641
	30	0.00553	5.29550	4.92501		30	0.00291	5.29812	4.94676
	40	0.0054	5.29555	4.92538		40	0.00287	5.29816	4.94712
	50	0.00543	5.29560	4.92575		50	0.00284	5.29819	4.94747
24	0	0.00538	5.29565	4.92612	34	0	0.00280	5.29823	4.94782
	10	0.00533	5.29570	4.92649		10	0.00276	5.29827	4.94818
	20	0.00528	5.29575	4.92686		20	0.00273	5.29830	4.94853
	30	0.00523	5.29580	4.92723		30	0.00269	5.29834	4.94888
	40	0.00518	5.29585	4.92760		40	0.00266	5.29837	4.94924
	50	0.00513	5.29590	4.92796		50	0.00262	5.29841	4.94959
25	0	0.00508	5.29595	4.92833	35	0	0.00259	5.29844	4.94994
	10	0.00504	5.29599	4.92870		10	0.00255	5.29848	4.95029
	20	0.00499	5.29604	4.92907		20	0.00252	5.29851	4.95065
	30	0.00494	5.29609	4.92944		30	0.00249	5.29854	4.95100
	40	0.00489	5.29614	4.92980		40	0.00245	5.29858	4.95135
	50	0.00484	5.29619	4.93017		50	0.00242	5.29861	4.95170
26	0	0.00480	5.29623	4.93054	36	0	0.00239	5.29864	4.95205
	10	0.00475	5.29628	4.93090		10	0.00235	5.29868	4.95240
	20	0.00470	5.29633	4.93127		20	0.00232	5.29871	4.95275
	30	0.00466	5.29637	4.93164		30	0.00229	5.29874	4.95310
	40	0.00461	5.29642	4.93200		40	0.00225	5.29878	4.95345
	50	0.00456	5.29647	4.93237		50	0.00222	5.29881	4.95380
27	0	0.00452	5.29651	4.93273	37	0	0.00219	5.29884	4.95415
	10	0.00447	5.29656	4.93310		10	0.00216	5.29887	4.95450
	20	0.00443	5.29660	4.93346		20	0.00213	5.29890	4.95485
	30	0.00438	5.29665	4.93383		30	0.00210	5.29893	4.95520
	40	0.00434	5.29669	4.93419		40	0.00207	5.29896	4.95555
	50	0.00429	5.29674	4.93455		50	0.00203	5.29900	4.95589
28	0	0.00425	5.29678	4.93492	38	0	0.00200	5.29903	4.95624
	10	0.00420	5.29683	4.93528		10	0.00197	5.29906	4.95659
	20	0.00416	5.29687	4.93564		20	0.00194	5.29909	4.95694
	30	0.00412	5.29691	4.93600		30	0.00191	5.29912	4.95728
	40	0.00407	5.29696	4.93637		40	0.00188	5.29915	4.95763
	50	0.00403	5.29700	4.93673		50	0.00185	5.29918	4.95798
29	0	0.00399	5.29704	4.93709	39	0	0.00183	5.29920	4.95832
	10	0.00394	5.29709	4.93745		10	0.00180	5.29923	4.95867
	20	0.00390	5.29713	4.93781		20	0.00177	5.29926	4.95902
	30	0.00386	5.29717	4.93817		30	0.00174	5.29929	4.95936
	40	0.00382	5.29721	4.93854		40	0.00171	5.29932	4.95971
	50	0.00377	5.29726	4.93890		50	0.00168	5.29935	4.96005

5 HOURS.

M.	S.	Log ½ elaps. Time.	Log Mid. Time.	Logarith Rising.	M.	S.	Log ½ elaps. Time.	Log Mid. Time.	Logarith Rising.
40	0	0.00166	5.29937	4.96040	50	0	0.00041	5.30062	4.98063
	10	0.00163	5.29940	4.96074		10	0.00040	5.30063	4.98096
	20	0.00160	5.29943	4.96109		20	0.00039	5.30064	4.98129
	30	0.00157	5.29946	4.96143		30	0.00037	5.30066	4.98162
	40	0.00155	5.29948	4.96177		40	0.00036	5.30067	4.98195
	50	0.00152	5.29951	4.96212		50	0.00035	5.30068	4.98228
41	0	0.00149	5.29954	4.96246	51	0	0.00033	5.30070	4.98261
	10	0.00147	5.29956	4.96280		10	0.00032	5.30071	4.98293
	20	0.00144	5.29959	4.96315		20	0.00031	5.30072	4.98326
	30	0.00142	5.29961	4.96349		30	0.00030	5.30073	4.98359
	40	0.00139	5.29964	4.96383		40	0.00029	5.30074	4.98392
	50	0.00137	5.29966	4.96417		50	0.00028	5.30075	4.98425
42	0	0.00134	5.29969	4.96451	52	0	0.00026	5.30077	4.98457
	10	0.00132	5.29971	4.96486		10	0.00025	5.30078	4.98490
	20	0.00129	5.29974	4.96520		20	0.00024	5.30079	4.98523
	30	0.00127	5.29976	4.96554		30	0.00023	5.30080	4.98555
	40	0.00124	5.29979	4.96588		40	0.00022	5.30081	4.98588
	50	0.00122	5.29981	4.96622		50	0.00021	5.30082	4.98620
43	0	0.00120	5.29983	4.96656	53	0	0.00020	5.30083	4.98653
	10	0.00117	5.29986	4.96690		10	0.00019	5.30084	4.98686
	20	0.00115	5.29988	4.96724		20	0.00018	5.30085	4.98718
	30	0.00113	5.29990	4.96758		30	0.00017	5.30086	4.98751
	40	0.00110	5.29993	4.96792		40	0.00017	5.30086	4.98783
	50	0.00108	5.29995	4.96826		50	0.00016	5.30087	4.98816
44	0	0.00106	5.29997	4.96860	54	0	0.00015	5.30088	4.98848
	10	0.00104	5.29999	4.96894		10	0.00014	5.30089	4.98880
	20	0.00102	5.30001	4.96927		20	0.00013	5.30090	4.98913
	30	0.00099	5.30004	4.96961		30	0.00013	5.30090	4.98945
	40	0.00097	5.30006	4.96995		40	0.00012	5.30091	4.98978
	50	0.00095	5.30008	4.97029		50	0.00011	5.30092	4.99010
45	0	0.00093	5.30010	4.97062	55	0	0.00010	5.30093	4.99042
	10	0.00091	5.30012	4.97096		10	0.00010	5.30093	4.99074
	20	0.00089	5.30014	4.97130		20	0.00009	5.30094	4.99107
	30	0.00087	5.30016	4.97163		30	0.00008	5.30095	4.99139
	40	0.00085	5.30018	4.97197		40	0.00008	5.30095	4.99171
	50	0.00083	5.30020	4.97231		50	0.00007	5.30096	4.99203
46	0	0.00081	5.30022	4.97264	56	0	0.00007	5.30096	4.99235
	10	0.00079	5.30024	4.97298		10	0.00006	5.30097	4.99207
	20	0.00077	5.30026	4.97331		20	0.00006	5.30097	4.99300
	30	0.00075	5.30028	4.97365		30	0.00005	5.30098	4.99332
	40	0.00074	5.30029	4.97398		40	0.00005	5.30098	4.99364
	50	0.00072	5.30031	4.97432		50	0.00004	5.30099	4.99396
47	0	0.00070	5.30033	4.97465	57	0	0.00004	5.30099	4.99438
	10	0.00068	5.30035	4.97499		10	0.00003	5.30100	4.99460
	20	0.00066	5.30037	4.97532		20	0.00003	5.30100	4.99492
	30	0.00065	5.30038	4.97565		30	0.00003	5.30100	4.99524
	40	0.00063	5.30040	4.97599		40	0.00002	5.30101	4.99556
	50	0.00061	5.30042	4.97632		50	0.00002	5.30101	4.99587
48	0	0.00060	5.30043	4.97665	58	0	0.00002	5.30101	4.99619
	10	0.00058	5.30045	4.97699		10	0.00001	5.30102	4.99651
	20	0.00056	5.30047	4.97732		20	0.00001	5.30102	4.99683
	30	0.00055	5.30048	4.97765		30	0.00001	5.30102	4.99715
	40	0.00053	5.30050	4.97798		40	0.00001	5.30102	4.99747
	50	0.00052	5.30051	4.97832		50	0.00001	5.30102	4.99778
49	0	0.00050	5.30053	4.97865	59	0	0.00000	5.30103	4.99810
	10	0.00049	5.30054	4.97898		10	0.00000	5.30103	4.99842
	20	0.00047	5.30056	4.97931		20	0.00000	5.30103	4.99873
	30	0.00046	5.30057	4.97964		30	0.00000	5.30103	4.99905
	40	0.00044	5.30059	4.97997		40	0.00000	5.30103	4.99937
	50	0.00043	5.30060	4.98030		50	0.00000	5.30103	4.99968

6 HOURS.

M.	S.	Logarith. Rising	M.	S.	Logarith. Rising.	M.	S.	Logarith Rising.	M.	S.	Logarith Rising.
0	0	5.00000	10	0	5.01853	20	0	5.03629	30	0	5.05327
	10	5.00031		10	5.01883		10	5.03658		10	5.05354
	20	5.00063		20	5.01913		20	5.03687		20	5.05382
	30	5.00094		30	5.01943		30	5.03715		30	5.05410
	40	5.00125		40	5.01973		40	5.03744		40	5.05437
	50	5.00156		50	5.02004		50	5.03773		50	5.05465
1	0	5.00188	11	0	5.02034	21	0	5.03801	31	0	5.05493
	10	5.00219		10	5.02064		10	5.03830		10	5.05520
	20	5.00250		20	5.02094		20	5.03859		20	5.05548
	30	5.00282		30	5.02125		30	5.03887		30	5.05576
	40	5.00313		40	5.02155		40	5.03916		40	5.05604
	50	5.00345		50	5.02185		50	5.03945		50	5.05631
2	0	5.00376	12	0	5.02215	22	0	5.04974	32	0	5.05659
	10	5.00407		10	5.02245		10	5.04002		10	5.05686
	20	5.00438		20	5.02275		20	5.04031		20	5.05713
	30	5.00469		30	5.02304		30	5.04060		30	5.05740
	40	5.00501		40	5.02334		40	5.04088		40	5.05768
	50	5.00532		50	5.02364		50	5.04117		50	5.05795
3	0	5.00563	13	0	5.02394	23	0	5.04146	33	0	5.05822
	10	5.00594		10	5.02423		10	5.04174		10	5.05849
	20	5.00626		20	5.02453		20	5.04203		20	5.05876
	30	5.00657		30	5.02483		30	5.04232		30	5.05904
	40	5.00689		40	5.02512		40	5.04261		40	5.05931
	50	5.00720		50	5.02542		50	5.04289		50	5.05958
4	0	5.00751	14	0	5.02572	24	0	5.04318	34	0	5.05985
	10	5.00782		10	5.02602		10	5.04346		10	5.06013
	20	5.00813		20	5.02631		20	5.04374		20	5.06040
	30	5.00844		30	5.02661		30	5.04402		30	5.06067
	40	5.00875		40	5.02691		40	5.04430		40	5.06094
	50	5.00905		50	5.02720		50	5.04459		50	5.06122
5	0	5.00936	15	0	5.02750	25	0	5.04487	35	0	5.06149
	10	5.00967		10	5.02780		10	5.04515		10	5.06176
	20	5.00998		20	5.02810		20	5.04543		20	5.06203
	30	5.01029		30	5.02839		30	5.04571		30	5.06230
	40	5.01059		40	5.02869		40	5.04600		40	5.06258
	50	5.01090		50	5.02899		50	5.04628		50	5.06285
6	0	5.01121	16	0	5.02928	26	0	5.04656	36	0	5.06312
	10	5.01152		10	5.02958		10	5.04684		10	5.06339
	20	5.01182		20	5.02987		20	5.04712		20	5.06365
	30	5.01213		30	5.03016		30	5.04740		30	5.06392
	40	5.01244		40	5.03045		40	5.04769		40	5.06419
	50	5.01275		50	5.03074		50	5.04797		50	5.06445
7	0	5.01305	17	0	5.03104	27	0	5.04825	37	0	5.06472
	10	5.01336		10	5.03133		10	5.04853		10	5.06499
	20	5.01367		20	5.03162		20	5.04881		20	5.06526
	30	5.01398		30	5.03191		30	5.04910		30	5.06553
	40	5.01429		40	5.03220		40	5.04938		40	5.06579
	50	5.01459		50	5.03250		50	5.04966		50	5.06605
8	0	5.01490	18	0	5.03279	28	0	5.04994	38	0	5.06632
	10	5.01520		10	5.03308		10	5.05022		10	5.06659
	20	5.01550		20	5.03337		20	5.05050		20	5.06686
	30	5.01580		30	5.03366		30	5.05077		30	5.06713
	40	5.01611		40	5.03396		40	5.05105		40	5.06740
	50	5.01641		50	5.03425		50	5.05133		50	5.06767
9	0	5.01671	19	0	5.03454	29	0	5.05160	39	0	5.06793
	10	5.01701		10	5.03483		10	5.05188		10	5.06820
	20	5.01732		20	5.03512		20	5.05216		20	5.06847
	30	5.01762		30	5.03542		30	5.05243		30	5.06873
	40	5.01792		40	5.03571		40	5.05271		40	5.06900
	50	5.01822		50	5.03600		50	5.05299		50	5.06927

TABLE XX. For finding the Latitude by two Altitudes of the Sun.

6 HOURS.						7 HOURS.					
M.	S.	Logarith Rising.	M.	S.	Logarith Rising.	M.	S.	Logarith Rising.	M.	S.	Logarit Rising.
40	0	5.06954	50	0	5.08508	0	0	5.09996	10	0	5.11417
	10	5.06980		10	5.08533		10	5.10020		10	5.11440
	20	5.07006		20	5.08558		20	5.10044		20	5.11463
	30	5.07033		30	5.08584		30	5.10068		30	5.11486
	40	5.07059		40	5.08609		40	5.10092		40	5.11509
	50	5.07085		50	5.08634		50	5.10116		50	5.11532
41	0	5.07111	51	0	5.08660	1	0	5.10140	11	0	5.11556
	10	5.07138		10	5.08685		10	5.10164		10	5.11579
	20	5.07164		20	5.08710		20	5.10188		20	5.11602
	30	5.07190		30	5.08736		30	5.10212		30	5.11625
	40	5.07217		40	5.08761		40	5.10236		40	5.11648
	50	5.07243		50	5.08787		50	5.10260		50	5.11671
42	0	5.07269	52	0	5.08812	2	0	5.10284	12	0	5.11694
	10	5.07295		10	5.08837		10	5.10308		10	5.11717
	20	5.07322		20	5.08862		20	5.10332		20	5.11740
	30	5.07348		30	5.08887		30	5.10356		30	5.11763
	40	5.07374		40	5.08911		40	5.10380		40	5.11785
	50	5.07400		50	5.08936		50	5.10404		50	5.11808
43	0	5.07427	53	0	5.08961	3	0	5.10429	13	0	5.11831
	10	5.07453		10	5.08986		10	5.10453		10	5.11854
	20	5.07479		20	5.09011		20	5.10477		20	5.11876
	30	5.07505		30	5.09036		30	5.10501		30	5.11899
	40	5.07532		40	5.09061		40	5.10525		40	5.11922
	50	5.07558		50	5.09086		50	5.10549		50	5.11945
44	0	5.07584	54	0	5.09111	4	0	5.10573	14	0	5.11967
	10	5.07610		10	5.09136		10	5.10596		10	5.11990
	20	5.07636		20	5.09160		20	5.10620		20	5.12013
	30	5.07662		30	5.09185		30	5.10643		30	5.12036
	40	5.07687		40	5.09210		40	5.10667		40	5.12058
	50	5.07713		50	5.09235		50	5.10691		50	5.12080
45	0	5.07739	55	0	5.09260	5	0	5.10714	15	0	5.12104
	10	5.07765		10	5.09285		10	5.10738		10	5.12126
	20	5.07791		20	5.09310		20	5.10761		20	5.12149
	30	5.07816		30	5.09335		30	5.10785		30	5.12172
	40	5.07842		40	5.09360		40	5.10809		40	5.12195
	50	5.07868		50	5.09385		50	5.10832		50	5.12217
46	0	5.07894	56	0	5.09409	6	0	5.10856	16	0	5.12240
	10	5.07920		10	5.09434		10	5.10879		10	5.12263
	20	5.07945		20	5.09458		20	5.10903		20	5.12285
	30	5.07971		30	5.09483		30	5.10926		30	5.12307
	40	5.07997		40	5.09507		40	5.10950		40	5.12329
	50	5.08023		50	5.09532		50	5.10974		50	5.12352
47	0	5.08049	57	0	5.09556	7	0	5.10997	17	0	5.12374
	10	5.08074		10	5.09581		10	5.11021		10	5.12396
	20	5.08100		20	5.09605		20	5.11044		20	5.12419
	30	5.08126		30	5.09629		30	5.11068		30	5.12441
	40	5.08152		40	5.09654		40	5.11092		40	5.12463
	50	5.08178		50	5.09678		50	5.11115		50	5.12486
48	0	5.08203	58	0	5.09703	8	0	5.11139	18	0	5.12508
	10	5.08229		10	5.09727		10	5.11162		10	5.12530
	20	5.08254		20	5.09752		20	5.11185		20	5.12553
	30	5.08280		30	5.09776		30	5.11208		30	5.12575
	40	5.08305		40	5.09801		40	5.11231		40	5.12597
	50	5.08330		50	5.09825		50	5.11255		50	5.12610
49	0	5.08356	59	0	5.09850	9	0	5.11278	19	0	5.12642
	10	5.08381		10	5.09874		10	5.11301		10	5.12664
	20	5.08406		20	5.09899		20	5.11324		20	5.12686
	30	5.08432		30	5.09923		30	5.11347		30	5.12709
	40	5.08457		40	5.09947		40	5.11370		40	5.12731
	50	5.08482		50	5.09972		50	5.11393		50	5.12753

7 HOURS.

M.	S.	Logarith Rising.	M.	S.	Logarith Rising.	M.	S.	Logarith Rising.	M.	S.	Logarith Rising.
20	0	5.12776	30	0	5.14071	40	0	5.15309	50	0	5.16486
	10	5.12798		10	5.14092		10	5.15329		10	5.16505
	20	5.12820		20	5.14113		20	5.15349		20	5.16525
	30	5.12841		30	5.14134		30	5.15369		30	5.16544
	40	5.12863		40	5.14155		40	5.15388		40	5.16563
	50	5.12885		50	5.14176		50	5.15408		50	5.16582
21	0	5.12907	31	0	5.14198	41	0	5.15428	51	0	5.16601
	10	5.12929		10	5.14219		10	5.15448		10	5.16620
	20	5.12951		20	5.14240		20	5.15468		20	5.16640
	30	5.12973		30	5.14261		30	5.15488		30	5.16659
	40	5.12995		40	5.14282		40	5.15508		40	5.16678
	50	5.13017		50	5.14303		50	5.15528		50	5.16697
22	0	5.13039	32	0	5.14324	42	0	5.15548	52	0	5.16716
	10	5.13061		10	5.14345		10	5.15568		10	5.16735
	20	5.13083		20	5.14366		20	5.15588		20	5.16754
	30	5.13104		30	5.14386		30	5.15608		30	5.16773
	40	5.13126		40	5.14407		40	5.15628		40	5.16791
	50	5.13148		50	5.14428		50	5.15648		50	5.16810
23	0	5.13170	33	0	5.14449	43	0	5.15667	53	0	5.16829
	10	5.13192		10	5.14469		10	5.15687		10	5.16848
	20	5.13214		20	5.14490		20	5.15707		20	5.16866
	30	5.13236		30	5.14511		30	5.15727		30	5.16885
	40	5.13258		40	5.14531		40	5.15747		40	5.16904
	50	5.13280		50	5.14552		50	5.15767		50	5.16923
24	0	5.13302	34	0	5.14573	44	0	5.15787	54	0	5.16942
	10	5.13323		10	5.14593		10	5.15807		10	5.16960
	20	5.13345		20	5.14614		20	5.15826		20	5.16979
	30	5.13366		30	5.14635		30	5.15846		30	5.16998
	40	5.13388		40	5.14656		40	5.15865		40	5.17017
	50	5.13409		50	5.14676		50	5.15885		50	5.17036
25	0	5.13431	35	0	5.14697	45	0	5.15904	55	0	5.17054
	10	5.13452		10	5.14718		10	5.15924		10	5.17073
	20	5.13474		20	5.14738		20	5.15943		20	5.17092
	30	5.13495		30	5.14759		30	5.15963		30	5.17111
	40	5.13517		40	5.14780		40	5.15983		40	5.17129
	50	5.13538		50	5.14800		50	5.16002		50	5.17148
26	0	5.13560	36	0	5.14821	46	0	5.16022	56	0	5.17167
	10	5.13581		10	5.14842		10	5.16041		10	5.17185
	20	5.13603		20	5.14862		20	5.16061		20	5.17204
	30	5.13624		30	5.14882		30	5.16080		30	5.17222
	40	5.13646		40	5.14902		40	5.16100		40	5.17241
	50	5.13667		50	5.14923		50	5.16119		50	5.17259
27	0	5.13689	37	0	5.14943	47	0	5.16139	57	0	5.17277
	10	5.13710		10	5.14963		10	5.16158		10	5.17296
	20	5.13732		20	5.14984		20	5.16178		20	5.17314
	30	5.13753		30	5.15004		30	5.16197		30	5.17333
	40	5.13775		40	5.15024		40	5.16217		40	5.17351
	50	5.13796		50	5.15045		50	5.16237		50	5.17369
28	0	5.13818	38	0	5.15065	48	0	5.16256	58	0	5.17388
	10	5.13839		10	5.15085		10	5.16275		10	5.17406
	20	5.13860		20	5.15106		20	5.16295		20	5.17425
	30	5.13881		30	5.15126		30	5.16314		30	5.17443
	40	5.13902		40	5.15146		40	5.16333		40	5.17462
	50	5.13923		50	5.15166		50	5.16352		50	5.17480
29	0	5.13944	39	0	5.15187	49	0	5.16371	59	0	5.17498
	10	5.13966		10	5.15207		10	5.16390		10	5.17517
	20	5.13987		20	5.15227		20	5.16410		20	5.17535
	30	5.14008		30	5.15248		30	5.16429		30	5.17554
	40	5.14029		40	5.15268		40	5.16448		40	5.17572
	50	5.14050		50	5.15288		50	5.16467		50	5.17590

8 HOURS.

M.	S.	Logarith Rising.	M.	S.	Logarith. Rising.	M.	S.	Logarith. Rising.
0	0	5.17609	10	0	5.18675	20	0	5.19689
	10	5.17627		10	5.18692		10	5.19705
	20	5.17645		20	5.18709		20	5.19721
	30	5.17663		30	5.18727		30	5.19738
	40	5.17681		40	5.18744		40	5.19754
	50	5.17699		50	5.18761		50	5.19770
1	0	5.17717	11	0	5.18779	21	0	5.19786
	10	5.17735		10	5.18796		10	5.19803
	20	5.17753		20	5.18813		20	5.19819
	30	5.17772		30	5.18831		30	5.19835
	40	5.17790		40	5.18848		40	5.19851
	50	5.17808		50	5.18865		50	5.19868
2	0	5.17826	12	0	5.18883	22	0	5.19884
	10	5.17844		10	5.18900		10	5.19900
	20	5.17862		20	5.18917		20	5.19917
	30	5.17880		30	5.18934		30	5.19933
	40	5.17898		40	5.18951		40	5.19949
	50	5.17916		50	5.18968		50	5.19965
3	0	5.17934	13	0	5.18985	23	0	5.19982
	10	5.17952		10	5.19002		10	5.19998
	20	5.17970		20	5.19019		20	5.20014
	30	5.17988		30	5.19035		30	5.20030
	40	5.18006		40	5.19052		40	5.20047
	50	5.18024		50	5.19069		50	5.20063
4	0	5.18042	14	0	5.19086	24	0	5.20079
	10	5.18060		10	5.19103		10	5.20095
	20	5.18078		20	5.19120		20	5.20111
	30	5.18095		30	5.19137		30	5.20127
	40	5.18113		40	5.19154		40	5.20143
	50	5.18131		50	5.19171		50	5.20159
5	0	5.18148	15	0	5.19188	25	0	5.20175
	10	5.18166		10	5.19205		10	5.20191
	20	5.18184		20	5.19222		20	5.20206
	30	5.18202		30	5.19239		30	5.20222
	40	5.18219		40	5.19256		40	5.20238
	50	5.18237		50	5.19273		50	5.20254
6	0	5.18255	16	0	5.19290	26	0	5.20270
	10	5.18272		10	5.19307		10	5.20286
	20	5.18290		20	5.19323		20	5.20302
	30	5.18308		30	5.19340		30	5.20318
	40	5.18325		40	5.19356		40	5.20334
	50	5.18343		50	5.19373		50	5.20350
7	0	5.18361	17	0	5.19390	27	0	5.20366
	10	5.18378		10	5.19406		10	5.20382
	20	5.18396		20	5.19423		20	5.20398
	30	5.18414		30	5.19440		30	5.20413
	40	5.18431		40	5.19456		40	5.20429
	50	5.18449		50	5.19473		50	5.20445
8	0	5.18467	18	0	5.19489	28	0	5.20461
	10	5.18484		10	5.19506		10	5.20477
	20	5.18501		20	5.19523		20	5.20492
	30	5.18519		30	5.19539		30	5.20508
	40	5.18536		40	5.19556		40	5.20523
	50	5.18553		50	5.19572		50	5.20539
9	0	5.18571	19	0	5.19589	29	0	5.20555
	10	5.18588		10	5.19606		10	5.20570
	20	5.18605		20	5.19622		20	5.20586
	30	5.18623		30	5.19639		30	5.20601
	40	5.18640		40	5.19656		40	5.20617
	50	5.18657		50	5.19672		50	5.20633

8 HOURS.								
M.	S.	Logarith. Rising.	M.	S.	Logarith. Rising.	M.	S.	Logarith. Rising.
30	0	5.20648	40	0	5.21558	50	0	5.22416
	10	5.20664		10	5.21573		10	5.22430
	20	5.20679		20	5.21587		20	5.22444
	30	5.20695		30	5.21602		30	5.22457
	40	5.20710		40	5.21616		40	5.22471
	50	5.20726		50	5.21631		50	5.22485
31	0	5.20742	41	0	5.21645	51	0	5.22499
	10	5.20757		10	5.21660		10	5.22513
	20	5.20773		20	5.21675		20	5.22527
	30	5.20788		30	5.21689		30	5.22541
	40	5.20804		40	5.21704		40	5.22555
	50	5.20819		50	5.21718		50	5.22569
32	0	5.20835	42	0	5.21733	52	0	5.22583
	10	5.20850		10	5.21747		10	5.22596
	20	5.20865		20	5.21762		20	5.22610
	30	5.20881		30	5.21777		30	5.22623
	40	5.20896		40	5.21791		40	5.22637
	50	5.20911		50	5.21806		50	5.22650
33	0	5.20926	43	0	5.21820	53	0	5.22664
	10	5.20943		10	5.21835		10	5.22678
	20	5.20957		20	5.21849		20	5.22691
	30	5.20972		30	5.21864		30	5.22705
	40	5.20987		40	5.21878		40	5.22718
	50	5.21002		50	5.21893		50	5.22732
34	0	5.21018	44	0	5.21908	54	0	5.22745
	10	5.21033		10	5.21922		10	5.22759
	20	5.21048		20	5.21936		20	5.22773
	30	5.21063		30	5.21950		30	5.22786
	40	5.21079		40	5.21964		40	5.22800
	50	5.21094		50	5.21979		50	5.22813
35	0	5.21109	45	0	5.21993	55	0	5.22827
	10	5.21124		10	5.22007		10	5.22840
	20	5.21140		20	5.22021		20	5.22854
	30	5.21155		30	5.22036		30	5.22868
	40	5.21170		40	5.22050		40	5.22881
	50	5.21185		50	5.22064		50	5.22895
36	0	5.21201	46	0	5.22078	56	0	5.22908
	10	5.21215		10	5.22092		10	5.22921
	20	5.21230		20	5.22107		20	5.22935
	30	5.21245		30	5.22121		30	5.22948
	40	5.21260		40	5.22135		40	5.22961
	50	5.21275		50	5.22149		50	5.22974
37	0	5.21290	47	0	5.22164	57	0	5.22988
	10	5.21305		10	5.22178		10	5.23001
	20	5.21320		20	5.22192		20	5.23014
	30	5.21335		30	5.22206		30	5.23027
	40	5.21350		40	5.22221		40	5.23040
	50	5.21364		50	5.22235		50	5.23054
38	0	5.21379	48	0	5.22249	58	0	5.23067
	10	5.21394		10	5.22263		10	5.23080
	20	5.21409		20	5.22277		20	5.23093
	30	5.21424		30	5.22291		30	5.23107
	40	5.21439		40	5.22305		40	5.23120
	50	5.21454		50	5.22318		50	5.23133
39	0	5.21469	49	0	5.22332	59	0	5.23146
	10	5.21484		10	5.22346		10	5.23160
	20	5.21499		20	5.22360		20	5.23173
	30	5.21513		30	5.22374		30	5.23186
	40	5.21528		40	5.22388		40	5.23199
	50	5.21543		50	5.22402		50	5.23213

Table XXI. For computing the Altitude and Time, when the Sun or Star, is more than 6 Hours distant from the Meridian.

6 hours.						7 hours.						8 hours.					
M	S.	Log. Rising.	M	S.	Log. Rising.	M	S.	Log. Rising.	M	S.	Log. Rising.	M	S.	Log. Rising.	M	S.	Log. Rising.
0	30	5.00094	30	30	5.05410	0	30	5.10068	30	30	5.14134	0	30	5.17663	30	30	5.20695
1	00	00188	31	00	05493	1	00	10140	31	00	14198	1	00	17717	31	00	20742
1	30	00282	31	30	05576	1	30	10212	31	30	14261	1	30	17772	31	30	20788
2	00	00376	32	00	05659	2	00	10284	32	00	14324	2	00	17826	32	00	20835
2	30	00469	32	30	05740	2	30	10356	32	30	14386	2	30	17880	32	30	20881
3	00	00563	33	00	05822	3	00	10429	33	00	14449	3	00	17934	33	00	20926
3	30	00657	33	30	05904	3	30	10501	33	30	14511	3	30	17988	33	30	20972
4	00	00751	34	00	05985	4	00	10573	34	00	14573	4	00	18042	34	00	21018
4	30	00844	34	30	06067	4	30	10643	34	30	14635	4	30	18095	34	30	21063
5	00	00936	35	00	06149	5	00	10714	35	00	14697	5	00	18148	35	00	21109
5	30	01028	35	30	06230	5	30	10785	35	30	14759	5	30	18202	35	30	21155
6	00	01121	36	00	06312	6	00	10856	36	00	14821	6	00	18255	36	00	21201
6	30	01213	36	30	06392	6	30	10926	36	30	14882	6	30	18308	36	30	21245
7	00	01305	37	00	06472	7	00	10997	37	00	14943	7	00	18361	37	00	21290
7	30	01398	37	30	06553	7	30	11068	37	30	15004	7	30	18414	37	30	21335
8	00	01490	38	00	06633	8	00	11139	38	00	15065	8	00	18467	38	00	21379
8	30	01580	38	30	06713	8	30	11208	38	30	15126	8	30	18519	38	30	21424
9	00	01671	39	00	06793	9	00	11278	39	00	15187	9	00	18571	39	00	21469
9	30	01762	39	30	06873	9	30	11347	39	30	15248	9	30	18623	39	30	21513
10	00	01853	40	00	06954	10	00	11417	40	00	15309	10	00	18675	40	00	21558
10	30	01943	40	30	07033	10	30	11486	40	30	15364	10	30	18727	40	30	21602
11	00	02034	41	00	07111	11	00	11556	41	00	15428	11	00	18779	41	00	21645
11	30	02125	41	30	07190	11	30	11625	41	30	15488	11	30	18831	41	30	21689
12	00	02215	42	00	07269	12	00	11694	42	00	15548	12	00	18883	42	00	21733
12	30	02304	42	30	07348	12	30	11763	42	30	15608	12	30	18934	42	30	21777
13	00	02394	43	00	07427	13	00	11831	43	00	15667	13	00	18985	43	00	21820
13	30	02483	43	30	07505	13	30	11899	43	30	15727	13	30	19035	43	30	21864
14	00	02572	44	00	07584	14	00	11967	44	00	15787	14	00	19086	44	00	21908
14	30	02661	44	30	07662	14	30	12036	44	30	15846	14	30	19137	44	30	21950
15	00	02750	45	00	07739	15	00	12104	45	00	15904	15	00	19188	45	00	21993
15	30	02839	45	30	07816	15	30	12172	45	30	15963	15	30	19239	45	30	22036
16	00	02928	46	00	07894	16	00	12240	46	00	16022	16	00	19290	46	00	22078
16	30	03016	46	30	07971	16	30	12307	46	30	16080	16	30	19340	46	30	22121
17	00	03104	47	00	08049	17	00	12374	47	00	16139	17	00	19390	47	00	22164
17	30	03191	47	30	08126	17	30	12441	47	30	16197	17	30	19440	47	30	22206
18	00	03279	48	00	08203	18	00	12508	48	00	16256	18	00	19489	48	00	22249
18	30	03366	48	30	08280	18	30	12575	48	30	16314	18	30	19539	48	30	22291
19	00	03454	49	00	08356	19	00	12642	49	00	16371	19	00	19589	49	00	22332
19	30	03542	49	30	08432	19	30	12709	49	30	16429	19	30	19639	49	30	22374
20	00	03629	50	00	08508	20	00	12776	50	00	16486	20	00	19689	50	00	22416
20	30	03715	50	30	08584	20	30	12841	50	30	16544	20	30	19738	50	30	22457
21	00	03801	51	00	08660	21	00	12907	51	00	16601	21	00	19786	51	00	22499
21	30	03887	51	30	08736	21	30	12973	51	30	16659	21	30	19835	51	30	22541
22	00	03974	52	00	08812	22	00	13039	52	00	16716	22	00	19884	52	00	22583
22	30	04060	52	30	08887	22	30	13104	52	30	16773	22	30	19933	52	30	22623
23	00	04146	53	00	08961	23	00	13170	53	00	16829	23	00	19982	53	00	22664
23	30	04232	53	30	09036	23	30	13236	53	30	16885	23	30	20030	53	30	22705
24	00	04318	54	00	09111	24	00	13302	54	00	16942	24	00	20079	54	00	22745
24	30	04402	54	30	09185	24	30	13366	54	30	16998	24	30	20127	54	30	22786
25	00	04487	55	00	09260	25	00	13431	55	00	17054	25	00	20175	55	00	22827
25	30	04571	55	30	09335	25	30	13495	55	30	17111	25	30	20222	55	30	22868
26	00	04656	56	00	09409	26	00	13560	56	00	17167	26	00	20270	56	00	22908
26	30	04740	56	30	09483	26	30	13624	56	30	17222	26	30	20318	56	30	22948
27	00	04825	57	00	09556	27	00	13689	57	00	17277	27	00	20366	57	00	22988
27	30	04910	57	30	09629	27	30	13753	57	30	17333	27	30	20413	57	30	23027
28	00	04994	58	00	09703	28	00	13818	58	00	17388	28	00	20461	58	00	23067
28	30	05077	58	30	09776	28	30	13881	58	30	17443	28	30	20508	58	30	23107
29	00	05160	59	00	09850	29	00	13944	59	00	17498	29	00	20555	59	00	23126
29	30	05243	59	30	09923	29	30	14008	59	30	17554	29	30	20601	59	30	23186
30	00	05327	60	00	09996	30	00	14071	60	00	17609	30	00	20648			

Table XXII. Of Natural Sines.

	0°		1°		2°		3°		4°		
M.	N. sine	N. cos.	N. sine	N. cos.	N. sine	N. cos.	N. sine	N. cos.	N. sine	N. cos.	M.
0	00000	100000	01745	99985	03490	99939	05234	99863	06976	99756	60
1	00029	100000	01774	99984	03519	99938	05263	99861	07005	99754	59
2	00058	100000	01803	99984	03548	99937	05292	99860	07034	99752	58
3	00087	100000	01832	99983	03577	99936	05321	99858	07063	99750	57
4	00116	100000	01862	99983	03606	99935	05350	99857	07092	99748	56
5	00145	100000	01891	99982	03635	99934	05379	99855	07121	99746	55
6	00175	100000	01920	99982	03664	99933	05408	99854	07150	99744	54
7	00204	100000	01949	99981	03693	99932	05437	99852	07179	99742	53
8	00233	100000	01978	99980	03723	99931	05466	99851	07208	99740	52
9	00262	100000	02007	99980	03752	99930	05495	99849	07237	99738	51
10	00291	100000	02036	99979	03781	99929	05524	99847	07266	99736	50
11	00320	99999	02065	99979	03810	99927	05553	99846	07295	99734	49
12	00349	99999	02094	99978	03839	99926	05582	99844	07324	99731	48
13	00378	99999	02123	99977	03868	99925	05611	99842	07353	99729	47
14	00407	99999	02152	99977	03897	99924	05640	99841	07382	99727	46
15	00436	99999	02181	99976	03926	99923	05669	99839	07411	99725	45
16	00465	99999	02211	99976	03955	99922	05698	99838	07440	99723	44
17	00495	99999	02240	99975	03984	99921	05727	99836	07469	99721	43
18	00524	99999	02269	99974	04013	99919	05756	99834	07498	99719	42
19	00553	99998	02298	99974	04042	99918	05785	99833	07527	99716	41
20	00582	99998	02327	99973	04071	99917	05814	99831	07556	99714	40
21	00611	99998	02356	99972	04100	99916	05844	99829	07585	99712	39
22	00640	99998	02385	99972	04129	99915	05873	99827	07614	99710	38
23	00669	99998	02414	99971	04159	99913	05902	99826	07643	99708	37
24	00698	99998	02443	99970	04188	99912	05931	99824	07672	99705	36
25	00727	99997	02472	99969	04217	99911	05960	99822	07701	99703	35
26	00756	99997	02501	99969	04246	99910	05989	99821	07730	99701	34
27	00785	99997	02530	99968	04275	99909	06018	99819	07759	99699	33
28	00814	99997	02560	99967	04304	99907	06047	99817	07788	99696	32
29	00844	99996	02589	99966	04333	99906	06076	99815	07817	99694	31
30	00873	99996	02618	99966	04362	99905	06105	99813	07846	99692	30
31	00902	99996	02647	99965	04391	99904	06134	99812	07875	99689	29
32	00931	99996	02676	99964	04420	99902	06163	99810	07904	99687	28
33	00960	99995	02705	99963	04449	99901	06192	99808	07933	99685	27
34	00989	99995	02734	99963	04478	99900	06221	99806	07962	99683	26
35	01018	99995	02763	99962	04507	99898	06250	99804	07991	99680	25
36	01047	99995	02792	99961	04536	99897	06279	99803	08020	99678	24
37	01076	99994	02821	99960	04565	99896	06308	99801	08049	99676	23
38	01105	99994	02850	99959	04594	99894	06337	99799	08078	99673	22
39	01134	99994	02879	99959	04623	99893	06366	99797	08107	99671	21
40	01164	99993	02908	99958	04653	99892	06395	99795	08136	99668	20
41	01193	99993	02938	99957	04682	99890	06424	99793	08165	99666	19
42	01222	99993	02967	99956	04711	99889	06453	99792	08194	99664	18
43	01251	99992	02996	99955	04740	99888	06482	99790	08223	99661	17
44	01280	99992	03025	99954	04769	99886	06511	99788	08252	99659	16
45	01309	99991	03054	99953	04798	99885	06540	99786	08281	99657	15
46	01338	99991	03083	99952	04827	99883	06569	99784	08310	99654	14
47	01367	99991	03112	99952	04856	99882	06598	99782	08339	99652	13
48	01396	99990	03141	99951	04885	99881	06627	99780	08368	99649	12
49	01425	99990	03170	99950	04914	99879	06656	99778	08397	99647	11
50	01454	99989	03199	99949	04943	99878	06685	99776	08426	99644	10
51	01483	99989	03228	99948	04972	99876	06714	99774	08455	99642	9
52	01513	99989	03257	99947	05001	99875	06743	99772	08484	99639	8
53	01542	99988	03286	99946	05030	99873	06773	99770	08513	99637	7
54	01571	99988	03316	99945	05059	99872	06802	99768	08542	99635	6
55	01600	99987	03345	99944	05088	99870	06831	99766	08571	99632	5
56	01629	99987	03374	99943	05117	99869	06860	99764	08600	99630	4
57	01658	99986	03403	99942	05146	99867	06889	99762	08629	99627	3
58	01687	99986	03432	99941	05175	99866	06918	99760	08658	99625	2
59	01716	99985	03461	99940	05205	99864	06947	99758	08687	99622	1
M.	N. cos.	N. sine	N. cos.	N. sine	N. cos.	N. sine	N. cos.	N. sine	N. cos.	N. sine	M.
	89°		88°		87°		86°		85°		

	5°		6°		7°		8°		9°		
M.	N. sine.	N. cos.	N. sine	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	M.
0	08716	99619	10453	99452	12187	99255	13917	99027	15643	98769	60
1	08745	99617	10482	99449	12216	99251	13946	99023	15672	98764	59
2	08774	99614	10511	99446	12245	99248	13975	99019	15701	98760	58
3	08803	99612	10540	99443	12274	99244	14004	99015	15730	98755	57
4	08831	99609	10569	99440	12302	99240	14033	99011	15758	98751	56
5	08860	99607	10597	99437	12331	99237	14061	99006	15787	98746	55
6	08889	99604	10626	99434	12360	99233	14090	99002	15816	98741	54
7	08918	99602	10655	99431	12389	99230	14119	98998	15845	98737	53
8	08947	99599	10684	99428	12418	99226	14148	98994	15873	98732	52
9	08976	99596	10713	99424	12447	99222	14177	98990	15902	98728	51
10	09005	99594	10742	99421	12476	99219	14205	98986	15931	98723	50
11	09034	99591	10771	99418	12504	99215	14234	98982	15959	98718	49
12	09063	99588	10800	99415	12533	99211	14263	98978	15988	98714	48
13	09092	99586	10829	99412	12562	99208	14292	98973	16017	98709	47
14	09121	99583	10858	99409	12591	99204	14320	98969	16046	98704	46
15	09150	99580	10887	99406	12620	99200	14349	98965	16074	98700	45
16	09179	99578	10916	99402	12649	99197	14378	98961	16103	98695	44
17	09208	99575	10945	99399	12678	99193	14407	98957	16132	98690	43
18	09237	99572	10973	99396	12706	99189	14436	98953	16161	98686	42
19	09266	99570	11002	99393	12735	99186	14464	98948	16189	98681	41
20	09295	99567	11031	99390	12764	99182	14493	98944	16218	98676	40
21	09324	99564	11060	99386	12793	99178	14522	98940	16246	98671	39
22	09353	99562	11089	99383	12822	99175	14551	98936	16275	98667	38
23	09382	99559	11118	99380	12851	99171	14580	98931	16304	98662	37
24	09411	99556	11147	99377	12880	99167	14608	98927	16333	98657	36
25	09440	99553	11176	99374	12908	99163	14637	98923	16361	98652	35
26	09469	99551	11205	99370	12937	99160	14666	98919	16390	98648	34
27	09498	99548	11234	99367	12966	99156	14695	98914	16419	98643	33
28	09527	99545	11263	99364	12995	99152	14723	98910	16447	98638	32
29	09556	99542	11291	99360	13024	99148	14752	98906	16476	98633	31
30	09585	99540	11320	99357	13053	99144	14781	98902	16505	98629	30
31	09614	99537	11349	99354	13081	99141	14810	98897	16533	98624	29
32	09642	99534	11378	99351	13110	99137	14838	98893	16562	98619	28
33	09671	99531	11407	99347	13139	99133	14867	98889	16591	98614	27
34	09700	99528	11436	99344	13168	99129	14896	98884	16620	98609	26
35	09729	99526	11465	99341	13197	99125	14925	98880	16648	98604	25
36	09758	99523	11494	99337	13226	99122	14954	98876	16677	98600	24
37	09787	99520	11523	99334	13254	99118	14982	98871	16706	98595	23
38	09816	99517	11552	99331	13283	99114	15011	98867	16734	98590	22
39	09845	99514	11580	99327	13312	99110	15040	98863	16763	98585	21
40	09874	99511	11609	99324	13341	99106	15069	98858	16792	98580	20
41	09903	99508	11638	99320	13370	99102	15097	98854	16820	98575	19
42	09932	99506	11667	99317	13399	99098	15126	98849	16849	98570	18
43	09961	99503	11696	99314	13427	99094	15155	98845	16878	98565	17
44	09990	99500	11725	99310	13456	99091	15184	98841	16906	98561	16
45	10019	99497	11754	99307	13485	99087	15212	98836	16935	98556	15
46	10048	99494	11783	99303	13514	99083	15241	98832	16964	98551	14
47	10077	99491	11812	99300	13543	99079	15270	98827	16992	98546	13
48	10106	99488	11840	99297	13572	99075	15299	98823	17021	98541	12
49	10135	99485	11869	99293	13600	99071	15327	98818	17050	98536	11
50	10164	99482	11898	99290	13629	99067	15356	98814	17078	98531	10
51	10192	99479	11927	99286	13658	99063	15385	98809	17107	98526	9
52	10221	99476	11956	99283	13687	99059	15414	98805	17136	98521	8
53	10250	99473	11985	99279	13716	99055	15442	98800	17164	98516	7
54	10279	99470	12014	99276	13744	99051	15471	98796	17193	98511	6
55	10308	99467	12043	99272	13773	99047	15500	98791	17222	98506	5
56	10337	99464	12071	99269	13802	99043	15529	98787	17250	98501	4
57	10366	99461	12100	99265	13831	99039	15557	98782	17279	98496	3
58	10395	99458	12129	99262	13860	99035	15586	98778	17308	98491	2
59	10424	99455	12158	99258	13889	99031	15615	98773	17336	98486	1
M.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	M.
	84°		83°		82°		81°		80°		

Table XXII. Of Natural Sines.

	10°		11°		12°		13°		14°		
M.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	M.
0	17365	98481	19081	98163	20791	97815	22495	97437	24192	97030	60
1	17393	98476	19109	98157	20820	97809	22523	97430	24220	97023	59
2	17422	98471	19138	98152	20848	97803	22552	97424	24249	97015	58
3	17451	98465	19167	98146	20877	97797	22580	97417	24277	97008	57
4	17479	98461	19195	98140	20905	97791	22608	97411	24305	97001	56
5	17508	98455	19224	98135	20933	97784	22637	97404	24333	96994	55
6	17537	98450	19252	98129	20962	97778	22665	97398	24362	96987	54
7	17565	98445	19281	98124	20990	97772	22693	97391	24390	96980	53
8	17594	98440	19309	98118	21019	97766	22722	97384	24418	96973	52
9	17623	98435	19338	98112	21047	97760	22750	97378	24446	96966	51
10	17651	98430	19366	98107	21076	97754	22778	97371	24474	96959	50
11	17680	98425	19395	98101	21104	97748	22807	97365	24503	96952	49
12	17708	98420	19423	98096	21132	97742	22835	97358	24531	96945	48
13	17737	98414	19452	98090	21161	97735	22863	97351	24559	96937	47
14	17766	98409	19481	98084	21189	97729	22892	97345	24587	96930	46
15	17794	98404	19509	98079	21218	97723	22920	97338	24615	96923	45
16	17823	98399	19538	98073	21246	97717	22948	97331	24644	96916	44
17	17852	98394	19566	98067	21275	97711	22977	97325	24672	96909	43
18	17880	98389	19595	98061	21303	97705	23005	97318	24700	96902	42
19	17909	98383	19623	98056	21331	97698	23033	97311	24728	96894	41
20	17937	98378	19652	98050	21360	97692	23062	97304	24756	96887	40
21	17966	98373	19680	98044	21388	97686	23090	97298	24784	96880	39
22	17995	98368	19709	98039	21417	97680	23118	97291	24813	96873	38
23	18023	98362	19737	98033	21445	97673	23146	97284	24841	96866	37
24	18052	98357	19766	98027	21474	97667	23175	97278	24869	96858	36
25	18081	98352	19794	98021	21502	97661	23203	97271	24897	96851	35
26	18109	98347	19823	98016	21530	97655	23231	97264	24925	96844	34
27	18138	98341	19851	98010	21559	97648	23260	97257	24953	96837	33
28	18165	98336	19880	98004	21587	97642	23288	97251	24982	96829	32
29	18195	98331	19908	97998	21616	97636	23316	97244	25010	96822	31
30	18224	98325	19937	97992	21644	97630	23345	97237	25038	96815	30
31	18252	98320	19965	97987	21672	97623	23373	97230	25066	96807	29
32	18281	98315	19994	97981	21701	97617	23401	97223	25094	96800	28
33	18309	98310	20022	97975	21729	97611	23429	97217	25122	96793	27
34	18338	98304	20051	97969	21758	97604	23458	97210	25151	96786	26
35	18367	98299	20079	97963	21786	97598	23486	97203	25179	96778	25
36	18395	98294	20108	97958	21814	97592	23514	97196	25207	96771	24
37	18424	98288	20136	97952	21843	97585	23542	97189	25235	96764	23
38	18452	98283	20165	97946	21871	97579	23571	97182	25263	96756	22
39	18481	98277	20193	97940	21899	97573	23599	97176	25291	96749	21
40	18509	98272	20222	97934	21928	97566	23627	97169	25320	96742	20
41	18538	98267	20250	97928	21956	97560	23656	97162	25348	96734	19
42	18567	98261	20279	97922	21985	97553	23684	97155	25376	96727	18
43	18595	98256	20307	97916	22013	97547	23712	97148	25404	96719	17
44	18624	98250	20336	97910	22041	97541	23740	97141	25432	96712	16
45	18652	98245	20364	97905	22070	97534	23769	97134	25460	96705	15
46	18681	98240	20393	97899	22098	97528	23797	97127	25488	96697	14
47	18710	98234	20421	97893	22126	97521	23825	97120	25516	96690	13
48	18738	98229	20450	97887	22155	97515	23853	97113	25545	96682	12
49	18767	98223	20478	97881	22183	97508	23882	97106	25573	96675	11
50	18795	98218	20507	97875	22212	97502	23910	97100	25601	96667	10
51	18824	98212	20535	97869	22240	97496	23938	97093	25629	96660	9
52	18852	98207	20563	97863	22268	97489	23966	97086	25657	96653	8
53	18881	98201	20592	97857	22297	97483	23995	97079	25685	96645	7
54	18910	98196	20620	97851	22325	97476	24023	97072	25713	96638	6
55	18938	98190	20649	97845	22353	97470	24051	97065	25741	96630	5
56	18967	98185	20677	97839	22382	97463	24079	97058	25769	96623	4
57	18995	98179	20706	97833	22410	97457	24108	97051	25798	96615	3
58	19024	98174	20734	97827	22438	97450	24136	97044	25826	96608	2
59	19052	98168	20763	97821	22467	97444	24164	97037	25854	96600	1
M.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	M.
	79°		78°		77°		76°		75°		

	15°		16°		17°		18°		19°		
M.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	M.
0	25882	96593	27564	96126	29237	95630	30902	95106	32557	94552	60
1	25910	96585	27592	96118	29265	95622	30929	95097	32584	94542	59
2	25938	96578	27620	96110	29293	95613	30957	95088	32612	94533	58
3	25966	96570	27648	96102	29321	95605	30985	95079	32639	94523	57
4	25994	96562	27676	96094	29348	95596	31012	95070	32667	94514	56
5	26022	96555	27704	96086	29376	95588	31040	95061	32694	94504	55
6	26050	96547	27731	96078	29404	95579	31068	95052	32722	94495	54
7	26079	96540	27759	96070	29432	95571	31095	95043	32749	94485	53
8	26107	96532	27787	96062	29460	95562	31123	95033	32777	94476	52
9	26135	96524	27815	96054	29487	95554	31151	95024	32804	94466	51
10	26163	96517	27843	96046	29515	95545	31178	95015	32832	94457	50
11	26191	96509	27871	96037	29543	95536	31206	95006	32859	94447	49
12	26219	96502	27899	96029	29571	95528	31233	94997	32887	94438	48
13	26247	96494	27927	96021	29599	95519	31261	94988	32914	94428	47
14	26275	96486	27955	96013	29626	95511	31289	94979	32942	94418	46
15	26303	96479	27983	96005	29654	95502	31316	94970	32969	94409	45
16	26331	96471	28011	95997	29682	95493	31344	94961	32997	94399	44
17	26359	96463	28039	95989	29710	95485	31372	94952	33024	94390	43
18	26387	96456	28067	95981	29737	95476	31399	94943	33051	94380	42
19	26415	96448	28095	95972	29765	95467	31427	94933	33079	94370	41
20	26443	96440	28123	95964	29793	95459	31454	94924	33106	94361	40
21	26471	96433	28150	95956	29821	95450	31482	94915	33134	94351	39
22	26500	96425	28178	95948	29849	95441	31510	94906	33161	94342	38
23	26528	96417	28206	95940	29876	95433	31537	94897	33189	94332	37
24	26556	96410	28234	95931	29904	95424	31565	94888	33216	94322	36
25	26584	96402	28262	95923	29932	95415	31593	94878	33244	94313	35
26	26612	96394	28290	95915	29960	95407	31620	94869	33271	94303	34
27	26640	96386	28318	95907	29987	95398	31648	94860	33298	94293	33
28	26668	96379	28346	95898	30015	95389	31675	94851	33326	94284	32
29	26696	96371	28374	95890	30043	95380	31703	94842	33353	94274	31
30	26724	96363	28402	95882	30071	95372	31730	94832	33381	94264	30
31	26752	96355	28429	95874	30098	95363	31758	94823	33408	94254	29
32	26780	96347	28457	95865	30126	95354	31786	94814	33436	94245	28
33	26808	96340	28485	95857	30154	95345	31813	94805	33463	94235	27
34	26836	96332	28513	95849	30182	95337	31841	94795	33490	94225	26
35	26864	96324	28541	95841	30209	95328	31868	94786	33518	94215	25
36	26892	96316	28569	95832	30237	95319	31896	94777	33545	94206	24
37	26920	96308	28597	95824	30265	95310	31923	94768	33573	94196	23
38	26948	96301	28625	95816	30292	95301	31951	94758	33600	94186	22
39	26976	96293	28652	95807	30320	95293	31979	94749	33627	94176	21
40	27004	96285	28680	95799	30348	95284	32006	94740	33655	94167	20
41	27032	96277	28708	95791	30376	95275	32034	94730	33682	94157	19
42	27060	96269	28736	95782	30403	95266	32061	94721	33710	94147	18
43	27088	96261	28764	95774	30431	95257	32089	94712	33737	94137	17
44	27116	96253	28792	95766	30459	95248	32116	94702	33764	94127	16
45	27144	96246	28820	95757	30486	95240	32144	94693	33792	94118	15
46	27172	96238	28847	95749	30514	95231	32171	94684	33819	94108	14
47	27200	96230	28875	95740	30542	95222	32199	94674	33846	94098	13
48	27228	96222	28903	95732	30570	95213	32227	94665	33874	94088	12
49	27256	96214	28931	95724	30597	95204	32254	94656	33901	94078	11
50	27284	96206	28959	95715	30625	95195	32282	94646	33929	94068	10
51	27312	96198	28987	95707	30653	95186	32309	94637	33956	94058	9
52	27340	96190	29015	95698	30680	95177	32337	94627	33983	94049	8
53	27368	96182	29042	95690	30708	95168	32364	94618	34011	94039	7
54	27396	96174	29070	95681	30736	95159	32392	94609	34038	94029	6
55	27424	96166	29098	95673	30763	95150	32419	94599	34065	94019	5
56	27452	96158	29126	95664	30791	95142	32447	94590	34093	94009	4
57	27480	96150	29154	95656	30819	95133	32474	94580	34120	93999	3
58	27508	96142	29182	95647	30846	95124	32502	94571	34147	93989	2
59	27536	96134	29209	95639	30874	95115	32529	94561	34175	93979	1
M.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	M.
	74°		73°		72°		71°		70°		

Table XXII. Of Natural Sines.

	20°		21°		22°		23°		24°		
M.	N. sine	N. cos.	N. sine	N. cos.	N. sine	N. cos.	N. sine	N. cos.	N. sine	N. cos.	M.
0	34202	93969	35837	93358	37461	92718	39073	92050	40674	91355	60
1	34229	93959	35864	93348	37488	92707	39100	92039	40700	91343	59
2	34257	93949	35891	93337	37515	92697	39127	92028	40727	91331	58
3	34284	93939	35918	93327	37542	92686	39153	92016	40753	91319	57
4	34311	93929	35945	93316	37569	92675	39180	92005	40780	91307	56
5	34339	93919	35973	93306	37595	92664	39207	91994	40806	91295	55
6	34366	93909	36000	93295	37622	92653	39234	91982	40833	91283	54
7	34393	93899	36027	93285	37649	92642	39260	91971	40860	91272	53
8	34421	93889	36054	93274	37676	92631	39287	91959	40886	91260	52
9	34448	93879	36081	93264	37703	92620	39314	91948	40913	91248	51
10	34475	93869	36108	93253	37730	92609	39341	91936	40939	91236	50
11	34503	93859	36135	93243	37757	92598	39367	91925	40966	91224	49
12	34530	93849	36162	93232	37784	92587	39394	91914	40992	91212	48
13	34557	93839	36190	93222	37811	92576	39421	91902	41019	91200	47
14	34584	93829	36217	93211	37838	92565	39448	91891	41045	91188	46
15	34612	93819	36244	93201	37865	92554	39474	91879	41072	91176	45
16	34639	93809	36271	93190	37892	92543	39501	91868	41098	91164	44
17	34666	93799	36298	93180	37919	92532	39528	91856	41125	91152	43
18	34694	93789	36325	93169	37946	92521	39555	91845	41151	91140	42
19	34721	93779	36352	93159	37973	92510	39581	91833	41178	91128	41
20	34748	93769	36379	93148	37999	92499	39608	91822	41204	91116	40
21	34775	93759	36406	93137	38026	92488	39635	91810	41231	91104	39
22	34803	93748	36434	93127	38053	92477	39661	91799	41257	91092	38
23	34830	93738	36461	93116	38080	92466	39688	91787	41284	91080	37
24	34857	93728	36488	93106	38107	92455	39715	91775	41310	91068	36
25	34884	93718	36515	93095	38134	92444	39741	91764	41337	91056	35
26	34912	93708	36542	93084	38161	92432	39768	91752	41363	91044	34
27	34939	93698	36569	93074	38188	92421	39795	91741	41390	91032	33
28	34966	93688	36596	93063	38215	92410	39822	91729	41416	91020	32
29	34993	93677	36623	93052	38241	92399	39848	91718	41443	91008	31
30	35021	93667	36650	93042	38268	92388	39875	91706	41469	90996	30
31	35048	93657	36677	93031	38295	92377	39902	91694	41496	90984	29
32	35075	93647	36704	93020	38322	92366	39928	91683	41522	90972	28
33	35102	93637	36731	93010	38349	92355	39955	91671	41549	90960	27
34	35130	93626	36758	92999	38376	92343	39982	91660	41575	90948	26
35	35157	93616	36785	92988	38403	92332	40008	91648	41602	90936	25
36	35184	93606	36812	92978	38430	92321	40035	91636	41628	90924	24
37	35211	93596	36839	92967	38456	92310	40062	91625	41655	90911	23
38	35239	93585	36867	92956	38483	92299	40088	91613	41681	90899	22
39	35266	93575	36894	92945	38510	92287	40115	91601	41707	90887	21
40	35293	93565	36921	92935	38537	92276	40141	91590	41734	90875	20
41	35320	93555	36948	92924	38564	92265	40168	91578	41760	90863	19
42	35347	93544	36975	92913	38591	92254	40195	91566	41787	90851	18
43	35375	93534	37002	92902	38617	92243	40221	91555	41813	90839	17
44	35402	93524	37029	92892	38644	92231	40248	91543	41840	90826	16
45	35429	93514	37056	92881	38671	92220	40275	91531	41866	90814	15
46	35456	93503	37083	92870	38698	92209	40301	91519	41892	90802	14
47	35484	93493	37110	92859	38725	92198	40328	91508	41919	90790	13
48	35511	93483	37137	92849	38752	92186	40355	91496	41945	90778	12
49	35538	93472	37164	92838	38778	92175	40381	91484	41972	90766	11
50	35565	93462	37191	92827	38805	92164	40408	91472	41998	90753	10
51	35592	93452	37218	92816	38832	92152	40434	91461	42024	90741	9
52	35619	93441	37245	92805	38859	92141	40461	91449	42051	90729	8
53	35647	93431	37272	92794	38886	92130	40488	91437	42077	90717	7
54	35674	93420	37299	92784	38912	92119	40514	91425	42104	90704	6
55	35701	93410	37326	92773	38939	92107	40541	91414	42130	90692	5
56	35728	93400	37353	92762	38966	92096	40567	91402	42156	90680	4
57	35755	93389	37380	92751	38993	92085	40594	91390	42183	90668	3
58	35782	93379	37407	92740	39020	92073	40621	91378	42209	90655	2
59	35810	93368	37434	92729	39046	92062	40647	91366	42235	90643	1
M.	N. cos.	N. sine	N. cos.	N. sine	N. cos.	N. sine	N. cos.	N. sine	N. cos.	N. sine	M.
	69°		68°		67°		66°		65°		

TABLE XXII. Of Natural Sines.

	25°		26°		27°		28°		29°		
M.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	M.
0	42262	90631	43837	89879	45399	89101	46947	88295	48481	87462	60
1	42288	90618	43863	89867	45425	89087	46973	88281	48506	87448	59
2	42315	90606	43889	89854	45451	89074	46999	88267	48532	87434	58
3	42341	90594	43916	89841	45477	89061	47024	88254	48557	87420	57
4	42367	90582	43942	89828	45503	89048	47050	88240	48583	87406	56
5	42394	90569	43968	89816	45529	89035	47076	88226	48608	87391	55
6	42420	90557	43994	89803	45554	89021	47101	88213	48634	87377	54
7	42446	90545	44020	89790	45580	89008	47127	88199	48659	87363	53
8	42473	90532	44046	89777	45606	88995	47153	88185	48684	87349	52
9	42499	90520	44072	89764	45632	88981	47178	88172	48710	87335	51
10	42525	90507	44098	89752	45658	88968	47204	88158	48735	87321	50
11	42552	90495	44124	89739	45684	88955	47229	88144	48761	87306	49
12	42578	90483	44151	89726	45710	88942	47255	88130	48786	87292	48
13	42604	90470	44177	89713	45736	88928	47281	88117	48811	87278	47
14	42631	90458	44203	89700	45762	88915	47306	88103	48837	87264	46
15	42657	90446	44229	89687	45787	88902	47332	88089	48862	87250	45
16	42683	90433	44255	89674	45813	88888	47358	88075	48888	87235	44
17	42709	90421	44281	89662	45839	88875	47383	88062	48913	87221	43
18	42736	90408	44307	89649	45865	88862	47409	88048	48938	87207	42
19	42762	90396	44333	89636	45891	88848	47434	88034	48964	87193	41
20	42788	90383	44359	89623	45917	88835	47460	88020	48989	87178	40
21	42815	90371	44385	89610	45942	88822	47486	88006	49014	87164	39
22	42841	90358	44411	89597	45968	88808	47511	87993	49040	87150	38
23	42867	90346	44437	89584	45994	88795	47537	87979	49065	87136	37
24	42894	90334	44464	89571	46020	88782	47562	87965	49090	87121	36
25	42920	90321	44490	89558	46046	88768	47588	87951	49116	87107	35
26	42946	90309	44516	89545	46072	88755	47614	87937	49141	87093	34
27	42972	90296	44542	89532	46097	88741	47639	87923	49166	87079	33
28	42999	90284	44568	89519	46123	88728	47665	87909	49192	87064	32
29	43025	90271	44594	89506	46149	88715	47690	87896	49217	87050	31
30	43051	90259	44620	89493	46175	88701	47716	87882	49242	87036	30
31	43077	90246	44646	89480	46201	88688	47741	87868	49268	87021	29
32	43104	90233	44672	89467	46226	88674	47767	87854	49293	87007	28
33	43130	90221	44698	89454	46252	88661	47793	87840	49318	86993	27
34	43156	90208	44724	89441	46278	88647	47818	87826	49344	86978	26
35	43182	90196	44750	89428	46304	88634	47844	87812	49369	86964	25
36	43209	90183	44776	89415	46330	88620	47869	87798	49394	86949	24
37	43235	90171	44802	89402	46355	88607	47895	87784	49419	86935	23
38	43261	90158	44828	89389	46381	88593	47920	87770	49445	86921	22
39	43287	90146	44854	89376	46407	88580	47946	87756	49470	86906	21
40	43313	90133	44880	89363	46433	88566	47971	87743	49495	86892	20
41	43340	90120	44906	89350	46458	88553	47997	87729	49521	86878	19
42	43366	90108	44932	89337	46484	88539	48022	87715	49546	86863	18
43	43392	90095	44958	89324	46510	88526	48048	87701	49571	86849	17
44	43418	90082	44984	89311	46536	88512	48073	87687	49596	86834	16
45	43445	90070	45010	89298	46561	88499	48099	87673	49622	86820	15
46	43471	90057	45036	89285	46587	88485	48124	87659	49647	86805	14
47	43497	90045	45062	89272	46613	88472	48150	87645	49672	86791	13
48	43523	90032	45088	89259	46639	88458	48175	87631	49697	86777	12
49	43549	90019	45114	89245	46664	88445	48201	87617	49723	86762	11
50	43575	90007	45140	89232	46690	88431	48226	87603	49748	86748	10
51	43602	89994	45166	89219	46716	88417	48252	87589	49773	86733	9
52	43628	89981	45192	89206	46742	88404	48277	87575	49798	86719	8
53	43654	89968	45218	89193	46767	88390	48303	87561	49824	86704	7
54	43680	89956	45243	89180	46793	88377	48328	87546	49849	86690	6
55	43706	89943	45269	89167	46819	88363	48354	87532	49874	86675	5
56	43733	89930	45295	89153	46844	88349	48379	87518	49899	86661	4
57	43759	89918	45321	89140	46870	88336	48405	87504	49924	86646	3
58	43785	89905	45347	89127	46896	88322	48430	87490	49950	86632	2
59	43811	89892	45373	89114	46921	88308	48456	87476	49975	86617	1
M.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	M.
	64°		63°		62°		61°		60°		

	30°		31°		32°		33°		34°		
M.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	M.
0	50000	86603	51504	85717	52992	84805	54464	83867	55919	82904	60
1	50025	86588	51529	85702	53017	84789	54488	83851	55943	82887	59
2	50050	86573	51554	85687	53041	84774	54513	83835	55968	82871	58
3	50076	86559	51579	85672	53066	84759	54537	83819	55992	82855	57
4	50101	86544	51604	85657	53091	84743	54561	83804	56016	82839	56
5	50126	86530	51628	85642	53115	84728	54586	83788	56040	82822	55
6	50151	86515	51653	85627	53140	84712	54610	83772	56064	82806	54
7	50176	86501	51678	85612	53164	84697	54635	83756	56088	82790	53
8	50201	86486	51703	85597	53189	84681	54659	83740	56112	82773	52
9	50227	86471	51728	85582	53214	84666	54683	83724	56136	82757	51
10	50252	86457	51753	85567	53238	84650	54708	83708	56160	82741	50
11	50277	86442	51778	85551	53263	84635	54732	83692	56184	82724	49
12	50302	86427	51803	85536	53288	84619	54756	83676	56208	82708	48
13	50327	86413	51828	85521	53312	84604	54781	83660	56232	82692	47
14	50352	86398	51852	85506	53337	84588	54805	83645	56256	82675	46
15	50377	86384	51877	85491	53361	84573	54829	83629	56280	82659	45
16	50403	86369	51902	85476	53386	84557	54854	83613	56305	82643	44
17	50428	86354	51927	85461	53411	84542	54878	83597	56329	82626	43
18	50453	86340	51952	85446	53435	84526	54902	83581	56353	82610	42
19	50478	86325	51977	85431	53460	84511	54927	83565	56377	82593	41
20	50503	86310	52002	85416	53484	84495	54951	83549	56401	82577	40
21	50528	86295	52026	85401	53509	84480	54975	83533	56425	82561	39
22	50553	86281	52051	85385	53534	84464	54999	83517	56449	82544	38
23	50578	86266	52076	85370	53558	84448	55024	83501	56473	82528	37
24	50603	86251	52101	85355	53583	84433	55048	83485	56497	82511	36
25	50628	86237	52126	85340	53607	84417	55072	83469	56521	82495	35
26	50654	86222	52151	85325	53632	84402	55097	83453	56545	82478	34
27	50679	86207	52175	85310	53656	84386	55121	83437	56569	82462	33
28	50704	86192	52200	85294	53681	84370	55145	83421	56593	82446	32
29	50729	86178	52225	85279	53705	84355	55169	83405	56617	82429	31
30	50754	86163	52250	85264	53730	84339	55194	83389	56641	82413	30
31	50779	86148	52275	85249	53754	84324	55218	83373	56665	82396	29
32	50804	86133	52299	85234	53779	84308	55242	83356	56689	82380	28
33	50829	86119	52324	85218	53804	84292	55266	83340	56713	82363	27
34	50854	86104	52349	85203	53828	84277	55291	83324	56736	82347	26
35	50879	86089	52374	85188	53853	84261	55315	83308	56760	82330	25
36	50904	86074	52399	85173	53877	84245	55339	83292	56784	82314	24
37	50929	86059	52423	85157	53902	84230	55363	83276	56808	82297	23
38	50954	86045	52448	85142	53926	84214	55388	83260	56832	82281	22
39	50979	86030	52473	85127	53951	84198	55412	83244	56856	82264	21
40	51004	86015	52498	85112	53975	84182	55436	83228	56880	82248	20
41	51029	86000	52522	85096	54000	84167	55460	83212	56904	82231	19
42	51054	85985	52547	85081	54024	84151	55484	83195	56928	82214	18
43	51079	85970	52572	85066	54049	84135	55509	83179	56952	82198	17
44	51104	85956	52597	85051	54073	84120	55533	83163	56976	82181	16
45	51129	85941	52621	85035	54097	84104	55557	83147	57000	82165	15
46	51154	85926	52646	85020	54122	84088	55581	83131	57024	82148	14
47	51179	85911	52671	85005	54146	84072	55605	83115	57047	82132	13
48	51204	85896	52696	84989	54171	84057	55630	83098	57071	82115	12
49	51229	85881	52720	84974	54195	84041	55654	83082	57095	82098	11
50	51254	85866	52745	84959	54220	84025	55678	83066	57119	82082	10
51	51279	85851	52770	84943	54244	84009	55702	83050	57143	82065	9
52	51304	85836	52794	84928	54269	83994	55726	83034	57167	82048	8
53	51329	85821	52819	84913	54293	83978	55750	83017	57191	82032	7
54	51354	85806	52844	84897	54317	83962	55775	83001	57215	82015	6
55	51379	85792	52869	84882	54342	83946	55799	82985	57238	81999	5
56	51404	85777	52893	84866	54366	83930	55823	82969	57262	81982	4
57	51429	85762	52918	84851	54391	83915	55847	82953	57286	81965	3
58	51454	85747	52943	84836	54415	83899	55871	82936	57310	81949	2
59	51479	85732	52967	84820	54440	83883	55895	82920	57334	81932	1
M.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	M.
	59°		58°		57°		56°		55°		

TABLE XXII. Of Natural Sines.

	35°		36°		37°		38°		39°		
M.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	M.
0	57358	81915	58779	80902	60181	79864	61566	78801	62932	77715	60
1	57381	81899	58802	80885	60205	79846	61589	78783	62955	77696	59
2	57405	81882	58826	80867	60228	79829	61612	78765	62977	77678	58
3	57429	81865	58849	80850	60251	79811	61635	78747	63000	77660	57
4	57453	81848	58873	80833	60274	79793	61658	78729	63022	77641	56
5	57477	81832	58896	80816	60298	79776	61681	78711	63045	77623	55
6	57501	81815	58920	80799	60321	79758	61704	78693	63068	77605	54
7	57524	81798	58943	80782	60344	79741	61726	78676	63090	77586	53
8	57548	81781	58967	80765	60367	79723	61749	78658	63113	77568	52
9	57572	81765	58990	80748	60390	79706	61772	78640	63135	77550	51
10	57596	81748	59014	80730	60414	79688	61795	78622	63158	77531	50
11	57619	81731	59037	80713	60437	79671	61818	78604	63180	77513	49
12	57643	81714	59061	80696	60460	79653	61841	78586	63203	77494	48
13	57667	81698	59084	80679	60483	79635	61864	78568	63225	77476	47
14	57691	81681	59107	80662	60506	79618	61887	78550	63248	77458	46
15	57715	81664	59131	80644	60529	79600	61909	78532	63271	77439	45
16	57738	81647	59154	80627	60553	79583	61932	78514	63293	77421	44
17	57762	81631	59178	80610	60576	79565	61955	78496	63316	77402	43
18	57786	81614	59201	80593	60599	79547	61978	78478	63338	77384	42
19	57809	81597	59225	80576	60622	79530	62001	78460	63361	77366	41
20	57833	81580	59248	80558	60645	79512	62024	78442	63383	77347	40
21	57857	81563	59272	80541	60668	79494	62046	78424	63406	77329	39
22	57881	81546	59295	80524	60691	79477	62069	78405	63428	77310	38
23	57904	81530	59318	80507	60714	79459	62092	78387	63451	77292	37
24	57928	81513	59342	80489	60738	79441	62115	78369	63473	77273	36
25	57952	81496	59365	80472	60761	79424	62138	78351	63496	77255	35
26	57976	81479	59389	80455	60784	79406	62160	78333	63518	77236	34
27	57999	81462	59412	80438	60807	79388	62183	78315	63540	77218	33
28	58023	81445	59435	80420	60830	79371	62206	78297	63563	77199	32
29	58047	81428	59459	80403	60853	79353	62229	78279	63585	77181	31
30	58070	81412	59482	80386	60876	79335	62251	78261	63608	77162	30
31	58094	81395	59506	80368	60899	79318	62274	78243	63630	77144	29
32	58118	81378	59529	80351	60922	79300	62297	78225	63653	77125	28
33	58141	81361	59552	80334	60945	79282	62320	78206	63675	77107	27
34	58165	81344	59576	80316	60968	79264	62342	78188	63698	77088	26
35	58189	81327	59599	80299	60991	79247	62365	78170	63720	77070	25
36	58212	81310	59622	80282	61015	79229	62388	78152	63742	77051	24
37	58236	81293	59646	80264	61038	79211	62411	78134	63765	77033	23
38	58260	81276	59669	80247	61061	79193	62433	78116	63787	77014	22
39	58283	81259	59693	80230	61084	79176	62456	78098	63810	76996	21
40	58307	81242	59716	80212	61107	79158	62479	78079	63832	76977	20
41	58330	81225	59739	80195	61130	79140	62502	78061	63854	76959	19
42	58354	81208	59763	80178	61153	79122	62524	78043	63877	76940	18
43	58378	81191	59786	80160	61176	79105	62547	78025	63899	76921	17
44	58401	81174	59809	80143	61199	79087	62570	78007	63922	76903	16
45	58425	81157	59832	80125	61222	79069	62592	77988	63944	76884	15
46	58449	81140	59856	80108	61245	79051	62615	77970	63966	76866	14
47	58472	81123	59879	80091	61268	79033	62638	77952	63989	76847	13
48	58496	81106	59902	80073	61291	79015	62660	77934	64011	76828	12
49	58519	81089	59926	80056	61314	78998	62683	77916	64033	76810	11
50	58543	81072	59949	80038	61337	78980	62706	77897	64056	76791	10
51	58567	81055	59972	80021	61360	78962	62728	77879	64078	76772	9
52	58590	81038	59995	80003	61383	78944	62751	77861	64100	76754	8
53	58614	81021	60019	79986	61406	78926	62774	77843	64123	76735	7
54	58637	81004	60042	79968	61429	78908	62796	77824	64145	76717	6
55	58661	80987	60065	79951	61451	78891	62819	77806	64167	76698	5
56	58684	80970	60089	79934	61474	78873	62842	77788	64190	76679	4
57	58708	80953	60112	79916	61497	78855	62864	77769	64212	76661	3
58	58731	80936	60135	79899	61520	78837	62887	77751	64234	76642	2
59	58755	80919	60158	79881	61543	78819	62909	77733	64256	76623	1
M.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	M.
	54°		53°		52°		51°		50°		

	40°		41°		42°		43°		44°		
M.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	M.
0	64279	76604	65606	75471	66913	74314	68200	73135	69466	71934	60
1	64301	76586	65628	75452	66935	74295	68221	73116	69487	71914	59
2	64323	76567	65650	75433	66956	74276	68242	73096	69508	71894	58
3	64346	76548	65672	75414	66978	74256	68264	73076	69529	71873	57
4	64368	76530	65694	75395	66999	74237	68285	73056	69549	71853	56
5	64390	76511	65716	75375	67021	74217	68306	73036	69570	71833	55
6	64412	76492	65738	75356	67043	74198	68327	73016	69591	71813	54
7	64435	76473	65759	75337	67064	74178	68349	72996	69612	71792	53
8	64457	76455	65781	75318	67086	74159	68370	72976	69633	71772	52
9	64479	76436	65803	75299	67107	74139	68391	72957	69654	71752	51
10	64501	76417	65825	75280	67129	74120	68412	72937	69675	71732	50
11	64524	76398	65847	75261	67151	74100	68433	72917	69696	71711	49
12	64546	76380	65869	75241	67172	74080	68455	72897	69717	71691	48
13	64568	76361	65891	75222	67194	74061	68476	72877	69737	71671	47
14	64590	76342	65913	75203	67215	74041	68497	72857	69758	71650	46
15	64612	76323	65935	75184	67237	74022	68518	72837	69779	71630	45
16	64635	76304	65956	75165	67258	74002	68539	72817	69800	71610	44
17	64657	76286	65978	75146	67280	73983	68561	72797	69821	71590	43
18	64679	76267	66000	75126	67301	73963	68582	72777	69842	71569	42
19	64701	76248	66022	75107	67323	73944	68603	72757	69862	71549	41
20	64723	76229	66044	75088	67344	73924	68624	72737	69883	71529	40
21	64746	76210	66066	75069	67366	73904	68645	72717	69904	71508	39
22	64768	76192	66088	75050	67387	73885	68666	72697	69925	71488	38
23	64790	76173	66109	75030	67409	73865	68688	72677	69946	71468	37
24	64812	76154	66131	75011	67430	73846	68709	72657	69966	71447	36
25	64834	76135	66153	74992	67452	73826	68730	72637	69987	71427	35
26	64856	76116	66175	74973	67473	73806	68751	72617	70008	71407	34
27	64878	76097	66197	74953	67495	73787	68772	72597	70029	71386	33
28	64901	76078	66218	74934	67516	73767	68793	72577	70049	71366	32
29	64923	76059	66240	74915	67538	73747	68814	72557	70070	71345	31
30	64945	76041	66262	74896	67559	73728	68835	72537	70091	71325	30
31	64967	76022	66284	74876	67580	73708	68857	72517	70112	71305	29
32	64989	76003	66306	74857	67602	73688	68878	72497	70132	71284	28
33	65011	75984	66327	74838	67623	73669	68899	72477	70153	71264	27
34	65033	75965	66349	74818	67645	73649	68920	72457	70174	71243	26
35	65055	75946	66371	74799	67666	73629	68941	72437	70195	71223	25
36	65077	75927	66393	74780	67688	73610	68962	72417	70215	71203	24
37	65099	75908	66414	74760	67709	73590	68983	72397	70236	71182	23
38	65122	75889	66436	74741	67730	73570	69004	72377	70257	71162	22
39	65144	75870	66458	74722	67752	73551	69025	72357	70277	71141	21
40	65166	75851	66480	74703	67773	73531	69046	72337	70298	71121	20
41	65188	75832	66501	74683	67795	73511	69067	72317	70319	71100	19
42	65210	75813	66523	74664	67816	73491	69088	72297	70339	71080	18
43	65232	75794	66545	74644	67837	73472	69109	72277	70360	71059	17
44	65254	75775	66566	74625	67859	73452	69130	72257	70381	71039	16
45	65276	75756	66588	74606	67880	73432	69151	72236	70401	71019	15
46	65298	75738	66610	74586	67901	73412	69172	72216	70422	70998	14
47	65320	75719	66632	74567	67923	73393	69193	72196	70443	70978	13
48	65342	75700	66653	74548	67944	73373	69214	72176	70463	70957	12
49	65364	75680	66675	74528	67965	73353	69235	72156	70484	70937	11
50	65386	75661	66697	74509	67987	73333	69256	72136	70505	70916	10
51	65408	75642	66718	74489	68008	73314	69277	72116	70525	70896	9
52	65430	75623	66740	74470	68029	73294	69298	72095	70546	70875	8
53	65452	75604	66762	74451	68051	73274	69319	72075	70567	70855	7
54	65474	75585	66783	74431	68072	73254	69340	72055	70587	70834	6
55	65496	75566	66805	74412	68093	73234	69361	72035	70608	70813	5
56	65518	75547	66827	74392	68115	73215	69382	72015	70628	70793	4
57	65540	75528	66848	74373	68136	73195	69403	71995	70649	70772	3
58	65562	75509	66870	74353	68157	73175	69424	71974	70670	70752	2
59	65584	75490	66891	74334	68179	73155	69445	71954	70690	70731	1
M.	N. cos.	N. sine	N. cos.	N. sine	N. cos.	N. sine.	N. cos.	N. sine.	N. cos.	N. sine.	M.
	49°		48°		47°		46°		45°		

Table XXIII. Proportional Logarithms.

S.	h ' 0° 0'	h ' 0° 1'	h ' 0° 2'	h ' 0° 3'	h ' 0° 4'	h ' 0° 5'	h ' 0° 6'	h ' 0° 7'	h ' 0° 8'
0		2.2553	1.9542	1.7782	1.6532	1.5563	1.4771	1.4102	1.3522
1	4.0334	2.2481	1.9506	1.7757	1.6514	1.5548	1.4759	1.4091	1.3513
2	3.7324	2.2410	1.9470	1.7733	1.6496	1.5534	1.4747	1.4081	1.3504
3	3.5563	2.2341	1.9435	1.7710	1.6478	1.5520	1.4735	1.4071	1.3495
4	3.4313	2.2272	1.9400	1.7686	1.6460	1.5505	1.4723	1.4060	1.3486
5	3.3344	2.2205	1.9365	1.7662	1.6442	1.5491	1.4711	1.4050	1.3477
6	3.2553	2.2139	1.9331	1.7639	1.6425	1.5477	1.4699	1.4040	1.3468
7	3.1883	2.2073	1.9296	1.7616	1.6407	1.5463	1.4687	1.4030	1.3459
8	3.1303	2.2009	1.9262	1.7592	1.6390	1.5449	1.4676	1.4020	1.3450
9	3.0792	2.1946	1.9228	1.7570	1.6372	1.5435	1.4664	1.4010	1.3441
10	3.0334	2.1883	1.9195	1.7546	1.6355	1.5420	1.4652	1.3999	1.3432
11	2.9920	2.1821	1.9161	1.7524	1.6337	1.5406	1.4640	1.3989	1.3423
12	2.9542	2.1761	1.9128	1.7501	1.6320	1.5393	1.4629	1.3979	1.3415
13	2.9195	2.1701	1.9096	1.7478	1.6303	1.5379	1.4617	1.3969	1.3406
14	2.8873	2.1642	1.9063	1.7456	1.6286	1.5365	1.4605	1.3959	1.3397
15	2.8573	2.1584	1.9031	1.7434	1.6269	1.5351	1.4594	1.3949	1.3388
16	2.8293	2.1526	1.8999	1.7411	1.6252	1.5337	1.4582	1.3939	1.3379
17	2.8030	2.1469	1.8967	1.7389	1.6235	1.5323	1.4571	1.3929	1.3370
18	2.7782	2.1413	1.8935	1.7368	1.6218	1.5310	1.4559	1.3919	1.3362
19	2.7546	2.1358	1.8904	1.7345	1.6201	1.5296	1.4548	1.3909	1.3353
20	2.7324	2.1303	1.8873	1.7324	1.6184	1.5283	1.4536	1.3899	1.3344
21	2.7112	2.1249	1.8842	1.7302	1.6168	1.5269	1.4525	1.3890	1.3336
22	2.6910	2.1196	1.8811	1.7281	1.6151	1.5255	1.4513	1.3880	1.3327
23	2.6717	2.1143	1.8781	1.7259	1.6134	1.5242	1.4502	1.3870	1.3318
24	2.6532	2.1091	1.8751	1.7238	1.6118	1.5229	1.4491	1.3860	1.3310
25	2.6355	2.1040	1.8720	1.7216	1.6102	1.5215	1.4479	1.3850	1.3301
26	2.6184	2.0989	1.8690	1.7195	1.6085	1.5202	1.4468	1.3841	1.3293
27	2.6021	2.0939	1.8661	1.7175	1.6069	1.5189	1.4457	1.3831	1.3284
28	2.5862	2.0889	1.8631	1.7153	1.6053	1.5175	1.4446	1.3821	1.3275
29	2.5710	2.0840	1.8602	1.7133	1.6037	1.5162	1.4435	1.3812	1.3267
30	2.5563	2.0792	1.8573	1.7112	1.6021	1.5149	1.4424	1.3802	1.3259
31	2.5420	2.0744	1.8544	1.7091	1.6004	1.5136	1.4412	1.3792	1.3250
32	2.5283	2.0696	1.8516	1.7071	1.5988	1.5123	1.4401	1.3783	1.3241
33	2.5149	2.0649	1.8487	1.7050	1.5973	1.5110	1.4390	1.3773	1.3233
34	2.5019	2.0603	1.8459	1.7030	1.5957	1.5097	1.4379	1.3763	1.3224
35	2.4893	2.0557	1.8431	1.7010	1.5941	1.5084	1.4368	1.3754	1.3216
36	2.4771	2.0512	1.8403	1.6990	1.5925	1.5071	1.4357	1.3745	1.3208
37	2.4652	2.0466	1.8375	1.6969	1.5909	1.5058	1.4346	1.3735	1.3199
38	2.4536	2.0422	1.8347	1.6949	1.5894	1.5045	1.4335	1.3725	1.3191
39	2.4424	2.0378	1.8320	1.6930	1.5878	1.5032	1.4325	1.3716	1.3183
40	2.4313	2.0334	1.8293	1.6910	1.5862	1.5019	1.4313	1.3706	1.3174
41	2.4206	2.0291	1.8266	1.6890	1.5847	1.5006	1.4303	1.3697	1.3166
42	2.4102	2.0248	1.8239	1.6871	1.5832	1.4994	1.4292	1.3688	1.3158
43	2.3999	2.0206	1.8212	1.6851	1.5816	1.4981	1.4281	1.3678	1.3149
44	2.3899	2.0164	1.8186	1.6832	1.5801	1.4968	1.4270	1.3669	1.3141
45	2.3802	2.0122	1.8159	1.6812	1.5786	1.4956	1.4260	1.3660	1.3133
46	2.3706	2.0081	1.8133	1.6793	1.5770	1.4943	1.4249	1.3650	1.3124
47	2.3613	2.0040	1.8107	1.6774	1.5755	1.4931	1.4238	1.3641	1.3116
48	2.3522	2.0000	1.8081	1.6755	1.5740	1.4918	1.4228	1.3632	1.3108
49	2.3432	1.9960	1.8055	1.6736	1.5725	1.4906	1.4217	1.3622	1.3099
50	2.3344	1.9920	1.8030	1.6717	1.5710	1.4893	1.4206	1.3613	1.3091
51	2.3259	1.9881	1.8004	1.6698	1.5695	1.4881	1.4196	1.3604	1.3083
52	2.3174	1.9842	1.7979	1.6679	1.5680	1.4869	1.4185	1.3595	1.3075
53	2.3091	1.9803	1.7954	1.6660	1.5665	1.4856	1.4175	1.3585	1.3067
54	2.3010	1.9765	1.7929	1.6642	1.5651	1.4844	1.4165	1.3576	1.3059
55	2.2930	1.9727	1.7904	1.6623	1.5636	1.4832	1.4154	1.3567	1.3050
56	2.2852	1.9689	1.7879	1.6605	1.5621	1.4820	1.4143	1.3558	1.3042
57	2.2775	1.9652	1.7855	1.6587	1.5607	1.4808	1.4133	1.3549	1.3034
58	2.2700	1.9615	1.7830	1.6568	1.5592	1.4795	1.4122	1.3540	1.3026
59	2.2626	1.9579	1.7805	1.6550	1.5577	1.4783	1.4112	1.3531	1.3018
60	2.2553	1.9542	1.7782	1.6532	1.5563	1.4771	1.4102	1.3522	1.3010

S.	h ′ 0° 9′	h ′ 0° 10′	h ′ 0° 11′	h ′ 0° 12′	h ′ 0° 13′	h ′ 0° 14′	h ′ 0° 15′	h ′ 0° 16′	h ′ 0° 17′
0	1.3010	1.2553	1.2139	1.1761	1.1413	1.1091	1.0792	1.0512	1.0248
1	1.3002	1.2545	1.2132	1.1755	1.1408	1.1086	1.0787	1.0507	1.0244
2	1.2994	1.2538	1.2125	1.1749	1.1402	1.1081	1.0782	1.0502	1.0240
3	1.2986	1.2531	1.2119	1.1743	1.1397	1.1076	1.0777	1.0498	1.0235
4	1.2978	1.2524	1.2112	1.1737	1.1391	1.1071	1.0772	1.0493	1.0231
5	1.2970	1.2517	1.2106	1.1731	1.1385	1.1066	1.0768	1.0489	1.0227
6	1.2962	1.2510	1.2099	1.1725	1.1380	1.1061	1.0763	1.0484	1.0223
7	1.2954	1.2502	1.2093	1.1719	1.1374	1.1055	1.0758	1.0480	1.0218
8	1.2946	1.2495	1.2086	1.1713	1.1369	1.1050	1.0753	1.0475	1.0214
9	1.2939	1.2488	1.2080	1.1707	1.1363	1.1045	1.0749	1.0471	1.0210
10	1.2931	1.2481	1.2073	1.1701	1.1358	1.1040	1.0744	1.0466	1.0206
11	1.2923	1.2474	1.2067	1.1695	1.1352	1.1035	1.0739	1.0462	1.0201
12	1.2915	1.2467	1.2061	1.1689	1.1347	1.1030	1.0734	1.0458	1.0197
13	1.2907	1.2459	1.2054	1.1683	1.1341	1.1025	1.0729	1.0453	1.0193
14	1.2899	1.2452	1.2047	1.1677	1.1336	1.1020	1.0725	1.0448	1.0189
15	1.2891	1.2445	1.2041	1.1671	1.1331	1.1015	1.0720	1.0444	1.0185
16	1.2883	1.2438	1.2035	1.1665	1.1325	1.1009	1.0715	1.0440	1.0180
17	1.2875	1.2431	1.2028	1.1659	1.1319	1.1004	1.0710	1.0435	1.0176
18	1.2868	1.2424	1.2022	1.1654	1.1314	1.0999	1.0706	1.0431	1.0172
19	1.2860	1.2417	1.2015	1.1648	1.1309	1.0994	1.0701	1.0426	1.0168
20	1.2852	1.2410	1.2009	1.1642	1.1303	1.0989	1.0696	1.0422	1.0164
21	1.2845	1.2403	1.2003	1.1636	1.1298	1.0984	1.0692	1.0418	1.0160
22	1.2837	1.2396	1.1996	1.1630	1.1292	1.0979	1.0687	1.0413	1.0155
23	1.2829	1.2389	1.1990	1.1624	1.1287	1.0974	1.0682	1.0408	1.0151
24	1.2821	1.2382	1.1984	1.1619	1.1282	1.0969	1.0678	1.0404	1.0147
25	1.2814	1.2375	1.1977	1.1613	1.1276	1.0964	1.0673	1.0400	1.0143
26	1.2806	1.2368	1.1971	1.1607	1.1271	1.0959	1.0668	1.0395	1.0139
27	1.2798	1.2362	1.1965	1.1601	1.1266	1.0954	1.0663	1.0391	1.0135
28	1.2791	1.2355	1.1958	1.1595	1.1260	1.0949	1.0659	1.0386	1.0130
29	1.2783	1.2348	1.1952	1.1589	1.1255	1.0944	1.0654	1.0382	1.0126
30	1.2775	1.2341	1.1946	1.1584	1.1249	1.0939	1.0649	1.0378	1.0122
31	1.2768	1.2334	1.1939	1.1578	1.1244	1.0934	1.0645	1.0373	1.0118
32	1.2760	1.2327	1.1933	1.1572	1.1238	1.0929	1.0640	1.0369	1.0114
33	1.2753	1.2320	1.1927	1.1566	1.1233	1.0924	1.0635	1.0365	1.0110
34	1.2745	1.2313	1.1920	1.1560	1.1228	1.0919	1.0631	1.0360	1.0106
35	1.2737	1.2306	1.1914	1.1555	1.1222	1.0914	1.0626	1.0356	1.0102
36	1.2730	1.2300	1.1908	1.1549	1.1217	1.0909	1.0621	1.0352	1.0098
37	1.2722	1.2293	1.1902	1.1543	1.1212	1.0904	1.0617	1.0347	1.0093
38	1.2715	1.2286	1.1895	1.1537	1.1206	1.0899	1.0612	1.0343	1.0089
39	1.2707	1.2279	1.1889	1.1532	1.1201	1.0894	1.0608	1.0339	1.0085
40	1.2700	1.2272	1.1883	1.1526	1.1196	1.0889	1.0603	1.0334	1.0081
41	1.2692	1.2265	1.1877	1.1520	1.1191	1.0884	1.0599	1.0330	1.0077
42	1.2685	1.2259	1.1871	1.1515	1.1186	1.0880	1.0594	1.0326	1.0073
43	1.2677	1.2252	1.1864	1.1509	1.1180	1.0875	1.0589	1.0321	1.0069
44	1.2670	1.2245	1.1858	1.1503	1.1175	1.0870	1.0584	1.0317	1.0065
45	1.2663	1.2239	1.1852	1.1498	1.1170	1.0865	1.0580	1.0313	1.0061
46	1.2655	1.2232	1.1846	1.1492	1.1164	1.0860	1.0575	1.0308	1.0057
47	1.2648	1.2225	1.1840	1.1486	1.1159	1.0855	1.0571	1.0304	1.0053
48	1.2640	1.2218	1.1834	1.1481	1.1154	1.0850	1.0566	1.0300	1.0049
49	1.2633	1.2212	1.1828	1.1475	1.1148	1.0845	1.0561	1.0295	1.0044
50	1.2626	1.2205	1.1822	1.1469	1.1143	1.0840	1.0557	1.0291	1.0040
51	1.2618	1.2198	1.1816	1.1464	1.1138	1.0835	1.0552	1.0287	1.0036
52	1.2611	1.2192	1.1809	1.1458	1.1133	1.0830	1.0548	1.0282	1.0032
53	1.2603	1.2185	1.1803	1.1452	1.1128	1.0826	1.0543	1.0278	1.0028
54	1.2596	1.2178	1.1797	1.1447	1.1123	1.0821	1.0539	1.0274	1.0024
55	1.2589	1.2172	1.1791	1.1441	1.1117	1.0816	1.0534	1.0269	1.0020
56	1.2582	1.2165	1.1785	1.1435	1.1112	1.0811	1.0530	1.0265	1.0016
57	1.2574	1.2159	1.1779	1.1430	1.1107	1.0806	1.0525	1.0261	1.0012
58	1.2567	1.2152	1.1773	1.1424	1.1102	1.0801	1.0521	1.0257	1.0008
59	1.2560	1.2145	1.1767	1.1419	1.1096	1.0796	1.0516	1.0252	1.0004
60	1.2553	1.2139	1.1761	1.1413	1.1091	1.0792	1.0512	1.0248	1.0000

S.	h ′ 0° 18′	h ′ 0° 19′	h ′ 0° 20′	h ′ 0° 21′	h ′ 0° 22′	h ′ 0° 23′	h ′ 0° 24′	h ′ 0° 25′	h ′ 0° 26′	h ′ 0° 27′	h ′ 0° 28′	h ′ 0° 29′
0	0000	9765	9542	9331	9128	8935	8751	8573	8403	8239	8081	7929
1	9996	9761	9539	9327	9125	8932	8748	8570	8400	8236	8078	7926
2	9992	9757	9535	9323	9122	8929	8745	8567	8397	8234	8076	7924
3	9988	9754	9532	9320	9119	8926	8742	8565	8395	8231	8073	7921
4	9984	9750	9528	9317	9115	8923	8739	8562	8392	8228	8071	7919
5	9980	9746	9524	9313	9112	8920	8736	8559	8389	8225	8068	7916
6	9976	9742	9521	9310	9109	8917	8733	8556	8386	8223	8066	7914
7	9972	9738	9517	9306	9105	8913	8730	8553	8383	8220	8063	7911
8	9968	9735	9513	9303	9102	8910	8727	8550	8381	8217	8060	7909
9	9964	9731	9510	9300	9099	8907	8724	8547	8378	8215	8058	7906
10	9960	9727	9506	9296	9096	8904	8721	8544	8375	8212	8055	7904
11	9956	9723	9503	9293	9092	8901	8718	8541	8372	8209	8053	7901
12	9952	9720	9499	9289	9089	8898	8715	8539	8370	8207	8050	7899
13	9948	9716	9495	9286	9086	8895	8712	8536	8367	8204	8047	7896
14	9944	9712	9492	9282	9082	8891	8709	8533	8364	8202	8045	7894
15	9940	9708	9488	9279	9079	8888	8706	8530	8361	8199	8043	7891
16	9936	9704	9485	9276	9076	8885	8703	8527	8358	8196	8040	7889
17	9932	9701	9481	9272	9073	8882	8700	8524	8356	8194	8037	7886
18	9928	9697	9478	9269	9070	8879	8697	8522	8353	8191	8035	7884
19	9924	9693	9474	9265	9066	8876	8694	8519	8350	8188	8032	7881
20	9920	9689	9470	9262	9063	8873	8691	8516	8347	8186	8030	7879
21	9916	9686	9467	9259	9060	8870	8688	8513	8345	8183	8027	7877
22	9912	9682	9463	9255	9056	8867	8685	8510	8342	8180	8024	7874
23	9908	9678	9460	9252	9053	8864	8682	8507	8339	8178	8022	7872
24	9905	9675	9456	9249	9050	8861	8679	8504	8337	8175	8020	7869
25	9901	9671	9453	9245	9047	8857	8676	8501	8334	8172	8017	7867
26	9897	9667	9449	9242	9044	8854	8673	8498	8331	8170	8014	7864
27	9893	9664	9446	9238	9041	8851	8670	8496	8328	8167	8012	7862
28	9889	9660	9442	9235	9037	8848	8667	8493	8326	8164	8009	7859
29	9885	9656	9439	9231	9034	8845	8664	8490	8323	8162	8007	7857
30	9881	9652	9435	9228	9031	8842	8661	8487	8320	8159	8004	7855
31	9877	9648	9431	9225	9027	8839	8658	8484	8317	8157	8002	7852
32	9873	9645	9428	9221	9024	8836	8655	8481	8315	8154	7999	7849
33	9869	9641	9425	9218	9021	8833	8652	8479	8312	8152	7997	7847
34	9865	9637	9421	9215	9018	8830	8649	8476	8309	8149	7994	7844
35	9861	9634	9417	9211	9015	8827	8646	8473	8306	8146	7991	7842
36	9858	9630	9414	9208	9012	8824	8643	8470	8304	8144	7989	7840
37	9854	9626	9410	9205	9008	8820	8640	8467	8301	8141	7986	7837
38	9850	9623	9407	9201	9005	8817	8637	8464	8298	8138	7984	7835
39	9846	9619	9404	9198	9002	8814	8635	8462	8296	8136	7981	7832
40	9842	9615	9400	9195	8999	8811	8632	8459	8293	8133	7979	7830
41	9838	9612	9396	9191	8995	8808	8629	8456	8290	8130	7976	7827
42	9834	9608	9393	9188	8992	8805	8626	8453	8288	8128	7974	7825
43	9830	9604	9389	9185	8989	8802	8623	8450	8285	8125	7971	7823
44	9826	9601	9386	9181	8986	8799	8620	8448	8282	8122	7969	7820
45	9823	9597	9383	9178	8983	8796	8617	8445	8279	8120	7966	7818
46	9819	9593	9379	9175	8980	8793	8614	8442	8277	8117	7964	7815
47	9815	9590	9375	9171	8976	8790	8611	8439	8274	8115	7961	7813
48	9811	9586	9372	9168	8973	8787	8608	8437	8271	8112	7959	7811
49	9807	9582	9368	9165	8970	8784	8605	8434	8268	8109	7956	7808
50	9803	9579	9365	9161	8967	8781	8602	8431	8266	8107	7954	7805
51	9800	9575	9362	9158	8964	8778	8599	8428	8263	8104	7951	7803
52	9796	9571	9358	9155	8960	8775	8596	8425	8260	8102	7949	7801
53	9792	9568	9355	9151	8957	8772	8593	8422	8258	8099	7946	7798
54	9788	9564	9351	9148	8954	8769	8591	8420	8255	8097	7944	7796
55	9784	9560	9348	9145	8951	8766	8588	8417	8252	8094	7941	7793
56	9780	9557	9344	9141	8948	8763	8585	8414	8250	8091	7939	7791
57	9777	9553	9341	9138	8945	8760	8582	8411	8247	8089	7930	7789
58	9773	9549	9337	9135	8942	8757	8579	8408	8244	8086	7934	7786
59	9769	9546	9334	9132	8938	8754	8576	8406	8242	8084	7931	7784
60	9765	9542	9331	9128	8935	8751	8573	8403	8239	8081	7929	7782

S.	h ' 0° 30'	h ' 0° 31'	h ' 0° 32'	h ' 0° 33'	h ' 0° 34'	h ' 0° 35'	h ' 0° 36'	h ' 0° 37'	h ' 0° 38'	h ' 0° 39'	h ' 0° 40'	h ' 0° 41'
0	7782	7639	7501	7368	7238	7112	6990	6871	6755	6642	6532	6425
1	7779	7637	7499	7365	7236	7110	6988	6869	6753	6640	6536	6423
2	7776	7634	7496	7363	7234	7108	6986	6867	6751	6638	6528	6421
3	7774	7632	7494	7361	7232	7106	6984	6865	6749	6637	6527	6420
4	7772	7630	7492	7359	7229	7104	6982	6863	6747	6635	6525	6418
5	7769	7627	7490	7356	7227	7102	6980	6861	6745	6633	6523	6416
6	7767	7625	7488	7354	7225	7100	6978	6859	6743	6631	6521	6414
7	7764	7623	7485	7352	7223	7097	6976	6857	6741	6629	6519	6412
8	7762	7620	7483	7350	7221	7095	6974	6855	6739	6627	6517	6411
9	7760	7618	7481	7348	7219	7093	6972	6853	6738	6625	6516	6409
10	7757	7616	7478	7345	7216	7091	6970	6851	6736	6623	6514	6407
11	7755	7613	7476	7343	7214	7089	6968	6849	6734	6621	6512	6405
12	7753	7611	7474	7341	7212	7087	6966	6847	6732	6620	6510	6404
13	7750	7609	7472	7339	7210	7085	6964	6845	6730	6618	6508	6402
14	7748	7606	7469	7337	7208	7083	6962	6843	6728	6616	6507	6400
15	7745	7604	7467	7335	7206	7081	6960	6841	6726	6614	6505	6398
16	7743	7602	7465	7332	7204	7079	6958	6839	6724	6612	6503	6397
17	7740	7599	7463	7330	7202	7077	6956	6837	6722	6610	6501	6395
18	7738	7597	7461	7328	7200	7075	6954	6836	6721	6609	6500	6393
19	7736	7595	7458	7326	7197	7073	6952	6834	6719	6607	6498	6391
20	7733	7592	7456	7324	7195	7071	6950	6832	6717	6605	6496	6390
21	7731	7590	7454	7322	7193	7069	6948	6830	6715	6603	6494	6388
22	7729	7588	7452	7319	7191	7067	6946	6828	6713	6601	6492	6386
23	7726	7586	7449	7317	7189	7065	6944	6826	6711	6599	6490	6384
24	7724	7583	7447	7315	7187	7063	6942	6824	6709	6598	6489	6383
25	7721	7581	7445	7313	7185	7061	6940	6822	6707	6596	6487	6381
26	7719	7579	7443	7311	7183	7059	6938	6820	6705	6594	6485	6379
27	7717	7577	7441	7309	7181	7057	6936	6818	6704	6592	6484	6377
28	7714	7574	7438	7306	7179	7054	6934	6816	6702	6590	6482	6376
29	7712	7572	7436	7304	7177	7052	6932	6814	6700	6588	6480	6374
30	7710	7570	7434	7302	7175	7050	6930	6812	6698	6587	6478	6372
31	7707	7567	7431	7300	7172	7048	6928	6810	6696	6585	6476	6370
32	7705	7565	7429	7298	7170	7046	6926	6808	6694	6583	6474	6369
33	7703	7563	7427	7296	7168	7044	6924	6807	6692	6581	6473	6367
34	7700	7560	7425	7293	7166	7042	6922	6805	6690	6579	6471	6365
35	7698	7558	7423	7291	7164	7040	6920	6803	6689	6577	6469	6363
36	7696	7556	7421	7289	7162	7038	6918	6801	6687	6576	6467	6362
37	7693	7553	7418	7287	7160	7036	6916	6799	6685	6574	6465	6360
38	7691	7551	7416	7285	7158	7034	6914	6797	6683	6572	6464	6358
39	7688	7549	7414	7283	7156	7032	6912	6795	6681	6570	6462	6357
40	7686	7546	7411	7281	7153	7030	6910	6793	6679	6568	6460	6355
41	7683	7544	7409	7278	7151	7028	6908	6791	6677	6566	6458	6353
42	7681	7542	7407	7276	7149	7026	6906	6789	6676	6565	6457	6351
43	7679	7540	7405	7274	7147	7024	6904	6787	6674	6563	6455	6349
44	7676	7537	7403	7272	7145	7022	6902	6785	6672	6561	6453	6348
45	7674	7535	7401	7270	7143	7020	6900	6784	6670	6559	6451	6346
46	7672	7533	7398	7268	7141	7018	6898	6782	6668	6557	6449	6344
47	7669	7531	7396	7266	7139	7016	6896	6780	6666	6556	6448	6342
48	7667	7529	7394	7264	7137	7014	6894	6778	6664	6554	6446	6341
49	7665	7526	7392	7261	7135	7012	6892	6776	6662	6552	6444	6339
50	7662	7524	7389	7259	7133	7010	6890	6774	6660	6550	6442	6337
51	7660	7522	7387	7257	7131	7008	6888	6772	6659	6548	6441	6336
52	7658	7519	7385	7255	7128	7006	6886	6770	6657	6546	6439	6334
53	7655	7517	7383	7253	7126	7004	6884	6768	6655	6545	6437	6332
54	7653	7515	7381	7251	7124	7002	6882	6766	6653	6543	6435	6331
55	7651	7512	7378	7248	7122	7000	6880	6764	6651	6541	6434	6329
56	7649	7510	7376	7246	7120	6998	6878	6762	6649	6539	6432	6327
57	7646	7508	7374	7244	7118	6996	6877	6761	6648	6538	6430	6325
58	7644	7505	7372	7242	7116	6994	6875	6759	6646	6536	6428	6323
59	7641	7503	7370	7240	7114	6992	6873	6757	6644	6534	6426	6322
60	7639	7501	7368	7238	7112	6990	6871	6755	6642	6532	6425	6320

S.	h ' 0° 42'	h ' 0° 43'	h ' 0° 44'	h ' 0° 45'	h ' 0° 46'	h ' 0° 47'	h ' 0° 48'	h ' 0° 49'	h ' 0° 50'	h ' 0° 51'	h ' 0° 52'	h ' 0° 53'
0	6320	6218	6118	6021	5925	5832	5740	5651	5563	5477	5393	5310
1	6318	6216	6116	6019	5923	5830	5739	5649	5561	5475	5391	5308
2	6317	6214	6115	6017	5922	5828	5737	5648	5560	5474	5390	5307
3	6315	6213	6113	6016	5920	5827	5736	5646	5559	5473	5389	5306
4	6313	6211	6111	6014	5919	5825	5734	5645	5557	5471	5387	5304
5	6311	6209	6110	6012	5917	5824	5733	5643	5556	5470	5386	5303
6	6310	6208	6108	6011	5916	5823	5731	5642	5554	5469	5384	5302
7	6308	6206	6106	6009	5914	5821	5730	5640	5553	5467	5383	5300
8	6306	6204	6105	6008	5912	5819	5728	5639	5551	5465	5381	5299
9	6305	6203	6103	6006	5911	5818	5727	5637	5550	5464	5380	5298
10	6303	6201	6102	6004	5909	5816	5725	5636	5548	5463	5379	5296
11	6301	6199	6100	6003	5908	5815	5724	5634	5547	5461	5377	5295
12	6300	6198	6099	6001	5906	5813	5722	5633	5546	5460	5376	5294
13	6298	6196	6097	6000	5905	5812	5721	5631	5544	5458	5374	5292
14	6296	6194	6095	5998	5903	5810	5719	5630	5543	5457	5373	5291
15	6294	6193	6094	5997	5902	5809	5718	5629	5541	5456	5372	5290
16	6293	6191	6092	5995	5900	5807	5716	5627	5540	5454	5370	5288
17	6291	6189	6090	5993	5898	5805	5715	5626	5538	5453	5369	5287
18	6289	6188	6089	5992	5897	5804	5713	5624	5537	5452	5368	5285
19	6287	6186	6087	5990	5895	5802	5712	5623	5535	5450	5366	5284
20	6286	6184	6085	5988	5894	5801	5710	5621	5534	5449	5365	5283
21	6284	6183	6084	5987	5892	5800	5709	5620	5533	5447	5364	5281
22	6282	6181	6082	5985	5890	5798	5707	5618	5531	5446	5362	5280
23	6281	6179	6080	5984	5889	5796	5706	5617	5530	5444	5361	5278
24	6279	6178	6079	5982	5888	5795	5704	5615	5528	5443	5359	5277
25	6277	6176	6077	5980	5886	5793	5703	5614	5527	5441	5358	5276
26	6275	6174	6075	5979	5884	5792	5701	5612	5525	5440	5356	5274
27	6274	6173	6074	5977	5883	5790	5700	5611	5524	5439	5355	5273
28	6272	6171	6072	5976	5881	5789	5698	5609	5522	5437	5354	5272
29	6270	6169	6071	5974	5880	5787	5697	5608	5521	5436	5352	5270
30	6269	6168	6069	5973	5878	5786	5695	5607	5520	5435	5351	5269
31	6267	6166	6067	5971	5876	5784	5694	5605	5518	5433	5350	5268
32	6265	6164	6066	5969	5875	5783	5693	5604	5517	5432	5348	5266
33	6264	6163	6064	5968	5874	5781	5691	5602	5516	5430	5347	5265
34	6262	6161	6062	5966	5872	5779	5689	5601	5514	5429	5345	5264
35	6260	6159	6061	5964	5870	5778	5688	5599	5512	5427	5344	5262
36	6259	6158	6059	5963	5869	5777	5686	5598	5511	5426	5343	5261
37	6257	6156	6058	5961	5867	5775	5685	5596	5510	5425	5341	5260
38	6255	6154	6056	5960	5866	5773	5683	5595	5508	5423	5340	5258
39	6254	6153	6055	5958	5864	5772	5682	5594	5507	5422	5339	5257
40	6252	6151	6053	5957	5863	5770	5680	5592	5505	5420	5337	5255
41	6250	6149	6051	5955	5861	5769	5679	5590	5504	5419	5336	5254
42	6248	6148	6050	5954	5860	5768	5677	5589	5503	5418	5335	5253
43	6247	6146	6048	5952	5858	5766	5676	5587	5501	5416	5333	5251
44	6245	6144	6046	5950	5856	5764	5674	5586	5500	5415	5332	5250
45	6243	6143	6045	5949	5855	5763	5673	5585	5498	5414	5331	5249
46	6241	6141	6043	5947	5853	5761	5671	5583	5497	5412	5329	5247
47	6240	6139	6041	5945	5852	5760	5670	5582	5495	5411	5328	5246
48	6238	6138	6040	5944	5850	5758	5669	5580	5494	5409	5326	5245
49	6236	6136	6038	5942	5849	5757	5667	5579	5492	5408	5325	5243
50	6235	6134	6037	5941	5847	5755	5665	5577	5491	5406	5323	5242
51	6233	6133	6035	5939	5846	5754	5664	5576	5490	5405	5322	5241
52	6231	6131	6033	5938	5844	5752	5662	5574	5488	5404	5321	5239
53	6230	6130	6032	5936	5842	5751	5661	5573	5487	5402	5319	5238
54	6228	6128	6030	5935	5841	5749	5660	5572	5486	5401	5318	5237
55	6226	6126	6028	5933	5839	5748	5658	5570	5484	5399	5317	5235
56	6225	6125	6027	5931	5838	5746	5656	5569	5482	5398	5315	5234
57	6223	6123	6025	5930	5836	5745	5655	5567	5481	5397	5314	5233
58	6221	6121	6024	5928	5835	5743	5654	5566	5480	5395	5312	5231
59	6220	6120	6022	5927	5833	5742	5652	5564	5478	5394	5311	5230
60	6218	6118	6021	5925	5832	5740	5651	5563	5477	5393	5310	5229

S.	h ' 0° 54'	h ' 0° 55'	h ' 0° 56'	h ' 0° 57'	h ' 0° 58'	h ' 0° 59'	h ' 1° 0'	h ' 1° 1'	h ' 1° 2'	h ' 1° 3'	h ' 1° 4'	h ' 1° 5'
0	5229	5149	5071	4994	4918	4844	4771	4699	4629	4559	4491	4424
1	5227	5148	5069	4992	4917	4843	4770	4698	4627	4558	4490	4422
2	5226	5146	5068	4991	4916	4842	4769	4697	4626	4557	4489	4421
3	5225	5145	5067	4990	4915	4841	4768	4696	4625	4556	4488	4420
4	5223	5144	5065	4989	4913	4839	4766	4694	4624	4555	4486	4419
5	5222	5142	5064	4987	4912	4838	4765	4693	4623	4553	4485	4418
6	5221	5141	5063	4986	4911	4837	4764	4692	4622	4552	4484	4417
7	5219	5140	5062	4985	4910	4835	4763	4691	4620	4551	4483	4416
8	5218	5138	5060	4984	4908	4834	4761	4690	4619	4550	4482	4415
9	5217	5137	5059	4983	4907	4833	4760	4689	4618	4549	4481	4414
10	5215	5135	5058	4981	4906	4832	4759	4687	4617	4548	4479	4412
11	5214	5134	5056	4980	4905	4831	4758	4686	4616	4547	4478	4411
12	5213	5133	5055	4979	4903	4830	4757	4685	4615	4546	4477	4410
13	5211	5132	5054	4977	4902	4828	4755	4684	4613	4544	4476	4409
14	5210	5130	5053	4976	4901	4827	4754	4683	4612	4543	4475	4408
15	5209	5129	5051	4975	4900	4826	4753	4682	4611	4542	4474	4407
16	5207	5128	5050	4973	4898	4824	4752	4680	4610	4541	4473	4406
17	5206	5127	5049	4972	4897	4823	4751	4679	4609	4540	4472	4405
18	5205	5125	5047	4971	4896	4822	4750	4678	4608	4539	4471	4404
19	5203	5124	5046	4970	4895	4821	4748	4677	4606	4537	4469	4402
20	5202	5123	5045	4968	4893	4820	4747	4676	4605	4536	4468	4401
21	5201	5122	5044	4967	4892	4819	4746	4675	4604	4535	4467	4400
22	5199	5120	5042	4966	4891	4817	4745	4673	4603	4534	4466	4399
23	5198	5119	5041	4965	4890	4816	4743	4672	4602	4533	4465	4398
24	5197	5118	5040	4964	4889	4815	4742	4671	4601	4532	4464	4397
25	5195	5116	5038	4963	4887	4813	4741	4670	4600	4530	4463	4396
26	5194	5115	5037	4961	4886	4812	4740	4669	4598	4529	4461	4395
27	5193	5114	5036	4960	4885	4811	4739	4668	4597	4528	4460	4394
28	5191	5112	5035	4958	4883	4810	4737	4666	4596	4527	4459	4392
29	5190	5111	5033	4957	4882	4809	4736	4665	4595	4526	4458	4391
30	5189	5110	5032	4956	4881	4808	4735	4664	4594	4525	4457	4390
31	5187	5108	5031	4955	4880	4806	4734	4663	4593	4524	4456	4389
32	5186	5107	5029	4953	4878	4805	4733	4661	4591	4523	4455	4388
33	5185	5106	5028	4952	4877	4804	4732	4660	4590	4522	4454	4387
34	5183	5104	5027	4951	4876	4802	4730	4659	4589	4520	4452	4386
35	5182	5103	5026	4950	4875	4801	4729	4658	4588	4519	4451	4385
36	5181	5102	5025	4949	4874	4800	4728	4657	4587	4518	4450	4384
37	5179	5100	5023	4947	4872	4799	4727	4656	4586	4517	4449	4382
38	5178	5099	5022	4946	4871	4798	4725	4654	4585	4516	4448	4381
39	5177	5097	5021	4945	4870	4797	4724	4653	4584	4515	4447	4380
40	5175	5096	5019	4943	4869	4795	4723	4652	4582	4513	4446	4379
41	5174	5095	5018	4942	4867	4794	4722	4651	4581	4512	4445	4378
42	5173	5094	5017	4941	4866	4793	4721	4650	4580	4511	4444	4377
43	5171	5093	5015	4940	4865	4792	4719	4648	4579	4510	4442	4376
44	5170	5091	5014	4938	4864	4790	4718	4647	4578	4509	4441	4375
45	5169	5090	5013	4937	4863	4789	4717	4646	4577	4508	4440	4374
46	[illegible]	5089	5012	4936	4861	4788	4716	4645	4575	4507	4439	4372
47	[illegible]	5087	5010	4934	4860	4787	4715	4644	4574	4506	4438	4371
48	[illegible]	5086	5009	4933	4859	4786	4714	4643	4573	4505	4437	4370
49	[illegible]	5085	5008	4932	4858	4784	4712	4641	4572	4503	4436	4369
50	[illegible]	5084	5006	4931	4856	4783	4711	4640	4571	4502	4435	4368
51	5161	5082	5005	4930	4855	4782	4710	4639	4570	4501	4434	4367
52	5159	5081	5004	4928	4854	4781	4709	4638	4568	4500	4432	4366
53	5158	5080	5003	4927	4853	4779	4708	4637	4567	4499	4431	4365
54	5157	5079	5002	4926	4852	4778	4707	4636	4566	4498	4430	4364
55	5155	5077	5000	4924	4850	4777	4705	4634	4565	4496	4429	4363
56	5154	5076	4999	4923	4849	4776	4704	4633	4564	4495	4428	4362
57	5153	5075	4998	4922	4848	4775	4703	4632	4563	4494	4427	4361
58	5152	5073	4997	4921	4846	4773	4702	4631	4561	4493	4426	4359
59	5150	5072	4995	4920	4845	4772	4700	4630	4560	4492	4425	4358
60	5149	5071	4994	4918	4844	4771	4699	4629	4559	4491	4424	4357

S.	h ' 1° 6'	h ' 1° 7'	h ' 1° 8'	h ' 1° 9'	h ' 1° 10'	h ' 1° 11'	h ' 1° 12'	h ' 1° 13'	h ' 1° 14'	h ' 1° 15'	h ' 1° 16'	h ' 1° 17'
0	4357	4292	4228	4164	4102	4040	3979	3919	3860	3802	3745	3688
1	4356	4291	4226	4163	4101	4039	3978	3918	3859	3801	3744	3687
2	4355	4290	4225	4162	4100	4038	3977	3917	3858	3800	3743	3686
3	4354	4289	4224	4161	4099	4037	3976	3917	3857	3799	3742	3685
4	4353	4287	4223	4160	4098	4036	3975	3916	3856	3798	3741	3684
5	4352	4286	4222	4159	4097	4035	3974	3915	3855	3797	3740	3683
6	4351	4285	4221	4158	4096	4034	3973	3914	3855	3796	3739	3682
7	4349	4284	4220	4157	4094	4033	3972	3913	3854	3795	3738	3681
8	4348	4283	4219	4156	4093	4032	3971	3912	3853	3794	3737	3680
9	4347	4282	4218	4155	4092	4031	3970	3911	3852	3793	3736	3679
10	4346	4281	4217	4154	4091	4030	3969	3910	3851	3792	3735	3678
11	4345	4280	4216	4153	4090	4029	3968	3909	3850	3791	3734	3677
12	4344	4279	4215	4152	4089	4028	3967	3908	3849	3791	3733	3676
13	4343	4278	4214	4151	4088	4027	3966	3907	3848	3790	3732	3676
14	4342	4277	4213	4150	4087	4026	3965	3906	3847	3789	3731	3675
15	4341	4276	4212	4149	4086	4025	3964	3905	3846	3788	3730	3674
16	4340	4275	4211	4147	4085	4024	3963	3904	3845	3787	3729	3673
17	4339	4274	4210	4146	4084	4023	3962	3903	3844	3786	3728	3672
18	4338	4273	4209	4145	4083	4022	3961	3902	3843	3785	3727	3671
19	4336	4271	4207	4144	4082	4021	3960	3901	3842	3784	3726	3670
20	4335	4270	4206	4143	4081	4020	3959	3900	3841	3783	3725	3669
21	4334	4269	4205	4142	4080	4019	3958	3899	3840	3782	3725	3668
22	4333	4268	4204	4141	4079	4018	3957	3898	3839	3781	3724	3667
23	4332	4267	4203	4140	4078	4017	3956	3897	3838	3780	3723	3666
24	4331	4266	4202	4139	4077	4016	3955	3896	3837	3779	3722	3665
25	4330	4265	4201	4138	4076	4015	3954	3895	3836	3778	3721	3664
26	4329	4264	4200	4137	4075	4014	3953	3894	3835	3777	3720	3663
27	4328	4263	4199	4136	4074	4013	3952	3893	3834	3776	3719	3663
28	4327	4262	4198	4135	4073	4012	3951	3892	3833	3775	3718	3662
29	4326	4261	4197	4134	4072	4011	3950	3891	3832	3774	3717	3661
30	4325	4260	4196	4133	4071	4010	3949	3890	3831	3773	3716	3660
31	4323	4258	4195	4132	4070	4009	3948	3889	3830	3772	3715	3659
32	4322	4257	4194	4131	4069	4008	3947	3888	3829	3771	3714	3658
33	4321	4256	4193	4130	4068	4007	3946	3887	3828	3770	3713	3657
34	4320	4255	4191	4129	4067	4006	3945	3886	3827	3769	3712	3656
35	4319	4254	4190	4128	4066	4005	3944	3885	3826	3768	3711	3655
36	4318	4253	4189	4127	4065	4004	3943	3884	3825	3768	3710	3654
37	4317	4252	4188	4126	4064	4003	3942	3883	3824	3767	3709	3653
38	4316	4251	4187	4125	4063	4002	3941	3882	3823	3766	3708	3652
39	4315	4250	4186	4124	4062	4001	3940	3881	3822	3765	3708	3651
40	4313	4249	4185	4122	4061	4000	3939	3880	3821	3764	3707	3650
41	4312	4248	4184	4121	4060	3999	3938	3879	3820	3763	3706	3649
42	4311	4247	4183	4120	4059	3998	3937	3878	3820	3762	3705	3649
43	4310	4246	4182	4119	4057	3997	3936	3877	3819	3761	3704	3648
44	4309	4245	4181	4118	4056	3996	3935	3876	3818	3760	3703	3647
45	4308	4244	4180	4117	4055	3995	3934	3875	3817	3759	3702	3646
46	4307	4242	4179	4116	4054	3993	3933	3874	3816	3758	3701	3645
47	4306	4241	4178	4115	4053	3992	3932	3873	3815	3757	3700	3644
48	4305	4240	4177	4114	4052	3991	3931	3872	3814	3756	3699	3643
49	4304	4239	4176	4113	4051	3990	3930	3871	3813	3755	3698	3642
50	4303	4238	4175	4112	4050	3989	3929	3870	3812	3754	3697	3641
51	4302	4237	4174	4111	4049	3988	3928	3869	3811	3753	3696	3640
52	4300	4236	4173	4110	4048	3987	3927	3868	3810	3752	3695	3639
53	4299	4235	4172	4109	4047	3986	3926	3867	3809	3751	3694	3638
54	4298	4234	4171	4108	4046	3985	3925	3866	3808	3750	3693	3637
55	4297	4233	4169	4107	4045	3984	3924	3865	3807	3749	3692	3636
56	4296	4232	4168	4106	4044	3983	3923	3864	3806	3748	3691	3635
57	4295	4231	4167	4105	4043	3982	3922	3863	3805	3747	3691	3635
58	4294	4230	4166	4104	4042	3981	3921	3862	3804	3746	3690	3634
59	4293	4229	4165	4103	4041	3980	3920	3861	3803	3745	3689	3633
60	4292	4228	4164	4102	4040	3979	3919	3860	3802	3745	3688	3632

S.	h ' 1° 18'	h ' 1° 19'	h ' 1° 20'	h ' 1° 21'	h ' 1° 22'	h ' 1° 23'	h ' 1° 24'	h ' 1° 25'	h ' 1° 26'	h ' 1° 27'	h ' 1° 28'	h ' 1° 29'
0	3632	3576	3522	3468	3415	3362	3310	3259	3208	3158	3108	3059
1	3631	3575	3521	3467	3414	3361	3309	3258	3207	3157	3107	3058
2	3630	3574	3520	3466	3413	3360	3308	3257	3206	3156	3106	3057
3	3629	3574	3519	3465	3412	3359	3307	3256	3205	3155	3105	3056
4	3628	3573	3518	3464	3411	3358	3306	3255	3204	3154	3105	3056
5	3627	3572	3517	3463	3410	3358	3306	3254	3203	3153	3104	3055
6	3626	3571	3516	3463	3409	3357	3305	3253	3203	3153	3103	3054
7	3625	3570	3515	3462	3408	3356	3304	3253	3202	3152	3102	3053
8	3624	3569	3514	3461	3407	3355	3303	3252	3201	3151	3101	3052
9	3623	3568	3514	3460	3407	3354	3302	3251	3200	3150	3101	3052
10	3622	3567	3513	3459	3406	3353	3301	3250	3199	3149	3100	3051
11	3621	3566	3512	3458	3405	3352	3300	3249	3198	3148	3099	3050
12	3621	3565	3511	3457	3404	3351	3300	3248	3198	3148	3098	3049
13	3620	3564	3510	3456	3403	3351	3299	3247	3197	3147	3097	3048
14	3619	3563	3509	3455	3402	3350	3298	3247	3196	3146	3096	3047
15	3618	3563	3508	3454	3401	3349	3297	3246	3195	3145	3096	3047
16	3617	3562	3507	3454	3400	3348	3296	3245	3194	3144	3095	3046
17	3616	3561	3506	3453	3400	3347	3295	3244	3193	3143	3094	3045
18	3615	3560	3506	3452	3399	3346	3294	3243	3193	3143	3093	3044
19	3614	3559	3505	3451	3398	3345	3294	3242	3192	3142	3092	3043
20	3613	3558	3504	3450	3397	3344	3293	3241	3191	3141	3091	3043
21	3612	3557	3503	3449	3396	3344	3292	3241	3190	3140	3091	3042
22	3611	3556	3502	3448	3395	3343	3291	3240	3189	3139	3090	3041
23	3610	3555	3501	3447	3394	3342	3290	3239	3188	3138	3089	3040
24	3610	3555	3500	3446	3393	3341	3289	3238	3188	3138	3088	3039
25	3609	3554	3499	3445	3393	3340	3288	3237	3187	3137	3087	3038
26	3608	3553	3498	3445	3392	3339	3287	3236	3186	3136	3086	3038
27	3607	3552	3497	3444	3391	3338	3287	3236	3185	3135	3086	3037
28	3606	3551	3496	3443	3390	3338	3286	3235	3184	3134	3085	3036
29	3605	3550	3496	3442	3389	3337	3285	3234	3183	3133	3084	3035
30	3604	3549	3495	3441	3388	3336	3284	3233	3183	3133	3083	3034
31	3603	3548	3494	3440	3387	3335	3283	3232	3182	3132	3082	3034
32	3602	3547	3493	3439	3386	3334	3282	3231	3181	3131	3082	3033
33	3601	3546	3492	3438	3385	3333	3282	3231	3180	3130	3081	3032
34	3600	3545	3491	3438	3385	3332	3281	3230	3179	3129	3080	3031
35	3599	3544	3490	3437	3384	3331	3280	3229	3178	3128	3079	3030
36	3598	3544	3489	3436	3383	3331	3279	3228	3178	3128	3078	3030
37	3597	3543	3488	3435	3382	3330	3278	3227	3177	3127	3078	3029
38	3596	3542	3487	3434	3381	3329	3277	3226	3176	3126	3077	3028
39	3596	3541	3487	3433	3380	3328	3276	3225	3175	3125	3076	3027
40	3595	3540	3486	3432	3379	3327	3276	3225	3174	3124	3075	3026
41	3594	3539	3485	3431	3378	3326	3275	3224	3173	3123	3074	3026
42	3593	3538	3484	3431	3378	3325	3274	3223	3173	3123	3073	3025
43	3592	3537	3483	3430	3377	3325	3273	3222	3172	3122	3073	3024
44	3591	3537	3482	3429	3376	3324	3272	3221	3171	3121	3072	3023
45	3590	3536	3481	3428	3375	3323	3271	3220	3170	3120	3071	3022
46	3589	3534	3480	3427	3374	3322	3270	3219	3169	3119	3070	3022
47	3588	3533	3479	3426	3373	3321	3270	3219	3168	3119	3069	3021
48	3587	3533	3479	3425	3372	3320	3269	3218	3168	3118	3069	3020
49	3586	3532	3478	3424	3371	3319	3268	3217	3167	3117	3068	3019
50	3585	3531	3477	3423	3371	3318	3267	3216	3166	3116	3067	3018
51	3584	3530	3476	3423	3370	3318	3266	3215	3165	3115	3066	3018
52	3584	3529	3475	3422	3369	3317	3265	3214	3164	3114	3065	3017
53	3583	3528	3474	3421	3368	3316	3264	3214	3163	3114	3064	3016
54	3582	3527	3473	3420	3367	3315	3264	3213	3163	3113	3064	3015
55	3581	3526	3472	3419	3366	3314	3263	3212	3162	3112	3063	3014
56	3580	3525	3471	3418	3365	3313	3262	3211	3161	3111	3062	3013
57	3579	3525	3471	3417	3365	3313	3261	3210	3160	3110	3061	3013
58	3578	3524	3470	3416	3364	3312	3260	3209	3159	3109	3060	3012
59	3577	3523	3469	3415	3363	3311	3259	3209	3158	3109	3060	3011
60	3576	3522	3468	3415	3362	3310	3259	3208	3158	3108	3059	3010

S.	h ' 1° 30'	h ' 1° 31'	h ' 1° 32'	h ' 1° 33'	h ' 1° 34'	h ' 1° 35'	h ' 1° 36'	h ' 1° 37'	h ' 1° 38'	h ' 1° 39'	h ' 1° 40'	h ' 1° 41'
0	3010	2962	2915	2868	2821	2775	2730	2685	2640	2596	2553	2510
1	3009	2961	2914	2867	2821	2775	2729	2684	2640	2596	2552	2509
2	3009	2961	2913	2866	2820	2774	2728	2683	2639	2595	2551	2508
3	3008	2960	2912	2866	2819	2773	2728	2683	2638	2594	2551	2507
4	3007	2959	2912	2865	2818	2772	2727	2682	2637	2593	2550	2507
5	3006	2958	2911	2864	2818	2772	2726	2681	2637	2593	2549	2506
6	3005	2958	2910	2863	2817	2771	2725	2681	2636	2592	2548	2505
7	3005	2957	2909	2862	2816	2770	2725	2680	2635	2591	2548	2504
8	3004	2956	2908	2862	2815	2769	2724	2679	2634	2590	2547	2504
9	3003	2955	2908	2861	2815	2769	2723	2678	2634	2590	2546	2503
10	3002	2954	2907	2860	2814	2768	2722	2678	2633	2589	2545	2502
11	3001	2954	2906	2859	2813	2767	2722	2677	2632	2588	2545	2502
12	3001	2953	2905	2859	2812	2766	2721	2676	2632	2588	2544	2501
13	3000	2952	2905	2858	2811	2766	2720	2675	2631	2587	2543	2500
14	2999	2951	2904	2857	2811	2765	2719	2675	2630	2586	2543	2499
15	2998	2950	2903	2856	2810	2764	2719	2674	2629	2585	2542	2499
16	2997	2950	2902	2855	2809	2763	2718	2673	2629	2585	2541	2498
17	2997	2949	2901	2855	2808	2762	2717	2672	2628	2584	2540	2497
18	2996	2948	2901	2854	2808	2762	2716	2672	2627	2583	2540	2497
19	2995	2947	2900	2853	2807	2761	2716	2671	2626	2582	2539	2496
20	2994	2946	2899	2852	2806	2760	2715	2670	2626	2582	2538	2495
21	2993	2946	2898	2852	2805	2760	2714	2669	2625	2581	2538	2494
22	2993	2945	2898	2851	2804	2759	2713	2669	2624	2580	2537	2494
23	2992	2944	2897	2850	2804	2758	2713	2668	2623	2580	2536	2493
24	2991	2943	2896	2849	2803	2757	2712	2667	2623	2579	2535	2492
25	2990	2942	2895	2848	2802	2756	2711	2666	2622	2578	2535	2492
26	2989	2942	2894	2848	2801	2756	2710	2666	2621	2577	2534	2491
27	2989	2941	2894	2847	2801	2755	2710	2665	2621	2577	2533	2490
28	2988	2940	2893	2846	2800	2754	2709	2664	2620	2576	2532	2489
29	2987	2939	2892	2845	2799	2753	2708	2663	2619	2575	2532	2489
30	2986	2939	2891	2845	2798	2753	2707	2663	2618	2574	2531	2488
31	2985	2938	2890	2844	2798	2752	2707	2662	2618	2574	2530	2487
32	2985	2937	2890	2843	2797	2751	2706	2661	2617	2573	2530	2487
33	2984	2936	2889	2842	2796	2750	2705	2660	2616	2572	2529	2486
34	2983	2935	2888	2841	2795	2750	2704	2660	2615	2572	2528	2485
35	2982	2934	2887	2841	2795	2749	2704	2659	2615	2571	2527	2484
36	2981	2934	2887	2840	2794	2748	2703	2658	2614	2570	2527	2484
37	2981	2933	2886	2839	2793	2747	2702	2657	2613	2569	2526	2483
38	2980	2932	2885	2838	2792	2747	2701	2657	2612	2569	2525	2482
39	2979	2931	2884	2838	2792	2746	2701	2656	2612	2568	2525	2482
40	2978	2931	2883	2837	2791	2745	2700	2655	2611	2567	2524	2481
41	2977	2930	2883	2836	2790	2744	2699	2654	2610	2566	2523	2480
42	2977	2929	2882	2835	2789	2744	2698	2654	2610	2566	2522	2480
43	2976	2928	2881	2834	2788	2743	2698	2653	2609	2565	2522	2479
44	2975	2927	2880	2834	2788	2742	2697	2652	2608	2564	2521	2478
45	2974	2927	2880	2833	2787	2741	2696	2652	2607	2564	2520	2477
46	2973	2926	2879	2832	2786	2741	2695	2651	2607	2563	2520	2477
47	2973	2925	2878	2831	2785	2740	2695	2650	2606	2562	2519	2476
48	2972	2924	2877	2831	2785	2739	2694	2649	2605	2561	2518	2475
49	2971	2923	2876	2830	2784	2738	2693	2649	2604	2561	2517	2474
50	2970	2923	2876	2829	2783	2737	2692	2648	2604	2560	2517	2474
51	2969	2922	2875	2828	2782	2737	2692	2647	2603	2559	2516	2473
52	2969	2921	2874	2828	2782	2736	2691	2646	2602	2558	2515	2472
53	2968	2920	2873	2827	2781	2735	2690	2646	2601	2558	2514	2472
54	2967	2920	2873	2826	2780	2735	2689	2645	2601	2557	2514	2471
55	2966	2919	2872	2825	2779	2734	2689	2644	2600	2556	2513	2470
56	2965	2918	2871	2824	2778	2733	2688	2643	2599	2556	2512	2470
57	2965	2917	2870	2824	2778	2732	2687	2643	2599	2555	2512	2469
58	2964	2916	2869	2823	2777	2731	2686	2642	2598	2554	2511	2468
59	2963	2916	2869	2822	2776	2731	2686	2641	2597	2553	2510	2467
60	2962	2915	2868	2821	2775	2730	2685	2640	2596	2553	2510	2467

S.	h ' 1° 42'	h ' 1° 43'	h ' 1° 44'	h ' 1° 45'	h ' 1° 46'	h ' 1° 47'	h ' 1° 48'	h ' 1° 49'	h ' 1° 50'	h ' 1° 51'	h ' 1° 52'	h ' 1° 53'
0	2467	2424	2382	2341	2300	2259	2218	2178	2139	2099	2061	2022
1	2466	2424	2382	2340	2299	2258	2218	2178	2138	2099	2060	2021
2	2465	2423	2381	2339	2298	2257	2217	2177	2137	2098	2059	2021
3	2465	2422	2380	2339	2298	2257	2216	2176	2137	2098	2059	2020
4	2464	2421	2380	2338	2297	2256	2216	2176	2136	2097	2058	2019
5	2463	2421	2379	2337	2296	2255	2215	2175	2135	2096	2057	2019
6	2462	2420	2378	2337	2296	2255	2214	2174	2135	2096	2057	2018
7	2462	2419	2378	2336	2295	2254	2214	2174	2134	2095	2056	2017
8	2461	2419	2377	2335	2294	2253	2213	2173	2133	2094	2055	2017
9	2460	2418	2376	2335	2294	2253	2212	2172	2133	2094	2055	2016
10	2460	2417	2375	2334	2293	2252	2212	2172	2132	2093	2054	2016
11	2459	2417	2375	2333	2292	2251	2211	2171	2132	2092	2053	2015
12	2458	2416	2374	2333	2291	2251	2210	2170	2131	2092	2053	2014
13	2457	2415	2373	2332	2291	2250	2210	2170	2130	2091	2052	2014
14	2457	2414	2373	2331	2290	2249	2209	2169	2130	2090	2051	2013
15	2456	2414	2372	2331	2289	2249	2208	2169	2129	2090	2051	2012
16	2455	2413	2371	2330	2289	2248	2208	2168	2128	2089	2050	2012
17	2455	2412	2371	2329	2288	2247	2207	2167	2128	2088	2050	2011
18	2454	2412	2370	2328	2287	2247	2206	2167	2127	2088	2049	2010
19	2453	2411	2369	2328	2287	2246	2206	2166	2126	2087	2048	2010
20	2452	2410	2368	2327	2286	2245	2205	2165	2126	2086	2048	2009
21	2452	2410	2368	2326	2285	2245	2204	2165	2125	2086	2047	2009
22	2451	2409	2367	2326	2285	2244	2204	2164	2124	2085	2046	2008
23	2450	2408	2366	2325	2284	2243	2203	2163	2124	2084	2046	2007
24	2450	2408	2366	2324	2283	2243	2202	2163	2123	2084	2045	2007
25	2449	2407	2365	2324	2283	2242	2202	2162	2122	2083	2044	2006
26	2448	2406	2364	2323	2282	2241	2201	2161	2122	2083	2044	2005
27	2448	2405	2364	2322	2281	2241	2200	2161	2121	2082	2043	2005
28	2447	2405	2363	2322	2281	2240	2200	2160	2120	2081	2042	2004
29	2446	2404	2362	2321	2280	2239	2199	2159	2120	2081	2042	2004
30	2445	2403	2362	2320	2279	2239	2198	2159	2119	2080	2041	2003
31	2445	2403	2361	2319	2279	2238	2198	2158	2118	2079	2041	2002
32	2444	2402	2360	2319	2278	2237	2197	2157	2118	2079	2040	2001
33	2443	2401	2359	2318	2277	2237	2196	2157	2117	2078	2039	2001
34	2443	2400	2359	2317	2276	2236	2196	2156	2116	2077	2039	2000
35	2442	2400	2358	2317	2276	2235	2195	2155	2116	2077	2038	2000
36	2441	2399	2357	2316	2275	2235	2194	2155	2115	2076	2037	1999
37	2440	2398	2357	2315	2274	2234	2194	2154	2114	2075	2037	1998
38	2440	2398	2356	2315	2274	2233	2193	2153	2114	2075	2036	1998
39	2439	2397	2355	2314	2273	2233	2192	2153	2113	2074	2035	1997
40	2438	2396	2355	2313	2272	2232	2192	2152	2113	2073	2035	1996
41	2438	2396	2354	2313	2272	2231	2191	2151	2112	2073	2034	1996
42	2437	2395	2353	2312	2271	2231	2190	2151	2111	2072	2034	1995
43	2436	2394	2353	2311	2270	2230	2190	2150	2111	2071	2033	1994
44	2436	2394	2352	2311	2270	2229	2189	2149	2110	2071	2032	1994
45	2435	2393	2351	2310	2269	2229	2188	2149	2109	2070	2032	1993
46	2434	2392	2350	2309	2268	2228	2188	2148	2109	2070	2031	1993
47	2433	2391	2350	2308	2268	2227	2187	2147	2108	2069	2030	1992
48	2433	2391	2349	2308	2267	2227	2186	2147	2107	2068	2030	1991
49	2432	2390	2348	2307	2266	2226	2186	2146	2107	2068	2029	1991
50	2431	2389	2348	2306	2266	2225	2185	2145	2106	2067	2028	1990
51	2431	2388	2347	2306	2265	2225	2184	2145	2105	2066	2028	1989
52	2430	2388	2346	2305	2264	2224	2184	2144	2105	2066	2027	1989
53	2429	2387	2346	2304	2264	2223	2183	2143	2104	2065	2026	1988
54	2428	2387	2345	2304	2263	2223	2182	2143	2103	2064	2026	1987
55	2428	2386	2344	2303	2262	2222	2182	2142	2103	2064	2025	1987
56	2427	2385	2344	2302	2262	2221	2181	2141	2102	2063	2024	1986
57	2426	2384	2343	2302	2261	2220	2180	2141	2101	2062	2024	1986
58	2426	2384	2342	2301	2260	2220	2180	2140	2101	2062	2023	1985
59	2425	2383	2342	2300	2260	2219	2179	2139	2100	2061	2023	1984
60	2424	2382	2341	2300	2259	2218	2178	2139	2099	2061	2022	1984

S.	h ' 1° 54'	h ' 1° 55'	h ' 1° 56'	h ' 1° 57'	h ' 1° 58'	h ' 1° 59'	h ' 2° 0'	h ' 2° 1'	h ' 2° 2'	h ' 2° 3'	h ' 2° 4'
0	1984	1946	1908	1871	1834	1797	1761	1725	1689	1654	1619
1	1983	1945	1907	1870	1833	1797	1760	1724	1688	1653	1618
2	1982	1944	1907	1870	1833	1796	1760	1724	1688	1652	1617
3	1982	1944	1906	1869	1832	1795	1759	1723	1687	1652	1617
4	1981	1943	1906	1868	1831	1795	1758	1722	1687	1651	1616
5	1980	1943	1905	1868	1831	1794	1758	1722	1686	1651	1616
6	1980	1942	1904	1867	1830	1794	1757	1721	1686	1650	1615
7	1979	1941	1904	1867	1830	1793	1757	1721	1685	1650	1614
8	1979	1941	1903	1866	1829	1792	1756	1720	1684	1649	1614
9	1978	1940	1903	1865	1828	1792	1755	1719	1684	1648	1613
10	1977	1939	1902	1865	1828	1791	1755	1719	1683	1648	1613
11	1977	1939	1901	1864	1827	1791	1754	1718	1683	1647	1612
12	1976	1938	1901	1863	1827	1790	1754	1718	1682	1647	1612
13	1975	1938	1900	1863	1826	1789	1753	1717	1681	1646	1611
14	1975	1937	1899	1862	1825	1789	1752	1716	1681	1645	1610
15	1974	1936	1899	1862	1825	1788	1752	1716	1680	1645	1610
16	1973	1936	1898	1861	1824	1787	1751	1715	1680	1644	1609
17	1973	1935	1898	1860	1823	1787	1751	1715	1679	1644	1609
18	1972	1934	1897	1860	1823	1786	1750	1714	1678	1643	1608
19	1972	1934	1896	1859	1822	1786	1749	1713	1678	1642	1607
20	1971	1933	1896	1858	1822	1785	1749	1713	1677	1642	1607
21	1970	1933	1895	1858	1821	1785	1748	1712	1677	1641	1606
22	1970	1932	1894	1857	1820	1784	1748	1712	1676	1641	1606
23	1969	1931	1894	1857	1820	1783	1747	1711	1675	1640	1605
24	1968	1931	1893	1856	1819	1783	1746	1711	1675	1640	1605
25	1968	1930	1893	1855	1819	1782	1746	1710	1674	1639	1604
26	1967	1929	1892	1855	1818	1781	1745	1709	1674	1638	1603
27	1967	1929	1891	1854	1817	1781	1745	1709	1673	1638	1603
28	1966	1928	1891	1854	1817	1780	1744	1708	1673	1637	1602
29	1965	1927	1890	1853	1816	1780	1743	1708	1672	1637	1602
30	1965	1927	1889	1852	1816	1779	1743	1707	1671	1636	1601
31	1964	1926	1889	1852	1815	1778	1742	1706	1671	1635	1600
32	1963	1926	1888	1851	1814	1778	1742	1706	1670	1635	1600
33	1963	1925	1888	1850	1814	1777	1741	1705	1670	1634	1599
34	1962	1924	1887	1850	1813	1777	1740	1705	1669	1634	1599
35	1961	1924	1886	1849	1812	1776	1740	1704	1668	1633	1598
36	1961	1923	1886	1849	1812	1775	1739	1703	1668	1633	1598
37	1960	1922	1885	1848	1811	1775	1739	1703	1667	1632	1597
38	1960	1922	1884	1847	1811	1774	1738	1702	1667	1631	1596
39	1959	1921	1884	1847	1810	1774	1737	1702	1666	1631	1596
40	1958	1921	1883	1846	1809	1773	1737	1701	1665	1630	1595
41	1958	1920	1883	1846	1809	1772	1736	1700	1665	1630	1595
42	1957	1919	1882	1845	1808	1772	1736	1700	1664	1629	1594
43	1956	1919	1881	1844	1808	1771	1735	1699	1664	1628	1593
44	1956	1918	1881	1844	1807	1771	1734	1699	1663	1628	1593
45	1955	1918	1880	1843	1806	1770	1734	1698	1663	1627	1592
46	1955	1917	1879	1842	1806	1769	1733	1697	1662	1627	1592
47	1954	1916	1879	1842	1805	1769	1733	1697	1661	1626	1591
48	1953	1916	1878	1841	1805	1768	1732	1696	1661	1626	1591
49	1953	1915	1878	1841	1804	1768	1731	1696	1660	1625	1590
50	1952	1914	1877	1840	1803	1767	1731	1695	1660	1624	1589
51	1951	1914	1876	1839	1803	1766	1730	1694	1659	1624	1589
52	1951	1913	1876	1839	1802	1766	1730	1694	1658	1623	1588
53	1950	1912	1875	1838	1801	1765	1729	1693	1658	1623	1588
54	1950	1912	1875	1838	1801	1765	1728	1693	1657	1622	1587
55	1949	1911	1874	1837	1800	1764	1728	1692	1657	1621	1586
56	1948	1911	1873	1836	1800	1763	1727	1691	1656	1621	1586
57	1948	1910	1873	1836	1799	1763	1727	1691	1655	1620	1585
58	1947	1909	1872	1835	1798	1762	1726	1690	1655	1620	1585
59	1946	1909	1871	1834	1798	1761	1725	1690	1654	1619	1584
60	1946	1908	1871	1834	1797	1761	1725	1689	1654	1619	1584

S.	h ' 2° 5'	h ' 2° 6'	h ' 2° 7'	h ' 2° 8'	h ' 2° 9'	h ' 2° 10'	h ' 2° 11'	h ' 2° 12'	h ' 2° 13'	h ' 2° 14'	h ' 2° 15'
0	1584	1549	1515	1481	1447	1413	1380	1347	1314	1282	1249
1	1583	1548	1514	1480	1446	1413	1379	1346	1314	1281	1249
2	1582	1548	1514	1479	1446	1412	1379	1346	1313	1281	1248
3	1582	1547	1513	1479	1445	1412	1378	1345	1313	1280	1248
4	1581	1547	1512	1478	1445	1411	1378	1345	1312	1279	1247
5	1581	1546	1512	1478	1444	1410	1377	1344	1311	1279	1247
6	1580	1546	1511	1477	1443	1410	1377	1344	1311	1278	1246
7	1580	1545	1511	1477	1443	1409	1376	1343	1310	1278	1246
8	1579	1544	1510	1476	1442	1409	1376	1343	1310	1277	1245
9	1578	1544	1510	1476	1442	1408	1375	1342	1309	1277	1245
10	1578	1543	1509	1475	1441	1408	1374	1341	1309	1276	1244
11	1577	1543	1508	1474	1441	1407	1374	1341	1308	1276	1243
12	1577	1542	1508	1474	1440	1407	1373	1340	1308	1275	1243
13	1576	1542	1507	1473	1440	1406	1373	1340	1307	1275	1242
14	1575	1541	1507	1473	1439	1405	1372	1339	1307	1274	1242
15	1575	1540	1506	1472	1438	1405	1372	1339	1306	1274	1241
16	1574	1540	1506	1472	1438	1404	1371	1338	1305	1273	1241
17	1574	1539	1505	1471	1437	1404	1371	1338	1305	1272	1240
18	1573	1539	1504	1470	1437	1403	1370	1337	1304	1272	1240
19	1573	1538	1504	1470	1436	1403	1369	1337	1304	1271	1239
20	1572	1538	1503	1469	1435	1402	1369	1336	1303	1271	1239
21	1571	1537	1503	1469	1435	1402	1368	1335	1303	1270	1238
22	1571	1536	1502	1468	1434	1401	1368	1335	1302	1270	1238
23	1570	1536	1502	1468	1434	1400	1367	1334	1302	1269	1237
24	1570	1535	1501	1467	1433	1400	1367	1334	1301	1269	1237
25	1569	1535	1500	1466	1433	1399	1366	1333	1301	1268	1236
26	1569	1534	1500	1466	1432	1399	1366	1333	1300	1268	1235
27	1568	1534	1499	1465	1432	1398	1365	1332	1300	1267	1235
28	1567	1533	1499	1465	1431	1398	1365	1332	1299	1267	1234
29	1567	1532	1498	1464	1431	1397	1364	1331	1298	1266	1234
30	1566	1532	1498	1464	1430	1397	1363	1331	1298	1266	1233
31	1566	1531	1497	1463	1429	1396	1363	1330	1297	1265	1233
32	1565	1531	1496	1463	1429	1395	1362	1329	1297	1264	1232
33	1565	1530	1496	1462	1428	1395	1362	1329	1296	1264	1232
34	1564	1529	1495	1461	1428	1394	1361	1328	1296	1263	1231
35	1563	1529	1495	1461	1427	1394	1361	1328	1295	1263	1231
36	1563	1528	1494	1460	1427	1393	1360	1327	1295	1262	1230
37	1562	1528	1494	1460	1426	1393	1360	1327	1294	1262	1230
38	1562	1527	1493	1459	1426	1392	1359	1326	1294	1261	1229
39	1561	1527	1493	1459	1425	1392	1359	1326	1293	1261	1229
40	1560	1526	1492	1458	1424	1391	1358	1325	1292	1260	1228
41	1560	1525	1491	1457	1424	1390	1357	1325	1292	1260	1227
42	1559	1525	1491	1457	1423	1390	1357	1324	1291	1259	1227
43	1559	1524	1490	1456	1423	1389	1356	1323	1291	1258	1226
44	1558	1524	1490	1456	1422	1389	1356	1323	1290	1258	1226
45	1558	1523	1489	1455	1422	1388	1355	1322	1290	1257	1225
46	1557	1523	1489	1455	1421	1388	1355	1322	1289	1257	1225
47	1556	1522	1488	1454	1420	1387	1354	1321	1289	1256	1224
48	1556	1522	1487	1454	1420	1387	1354	1321	1288	1256	1224
49	1555	1521	1487	1453	1419	1386	1353	1320	1288	1255	1223
50	1555	1520	1486	1452	1419	1386	1352	1320	1287	1255	1223
51	1554	1520	1486	1452	1418	1385	1352	1319	1287	1254	1222
52	1554	1519	1485	1451	1418	1384	1351	1319	1286	1254	1222
53	1553	1518	1485	1451	1417	1384	1351	1318	1285	1253	1221
54	1552	1518	1484	1450	1417	1383	1350	1317	1285	1253	1221
55	1552	1518	1483	1450	1416	1383	1350	1317	1284	1252	1220
56	1551	1517	1483	1449	1415	1382	1349	1316	1284	1251	1219
57	1551	1516	1482	1449	1415	1382	1349	1316	1283	1251	1219
58	1550	1516	1482	1448	1414	1381	1348	1315	1283	1250	1218
59	1550	1515	1481	1447	1414	1381	1347	1315	1282	1250	1218
60	1549	1515	1481	1447	1413	1380	1347	1314	1282	1249	1217

S.	h ′ 2° 16′	h ′ 2° 17′	h ′ 2° 18′	h ′ 2° 19′	h ′ 2° 20′	h ′ 2° 21′	h ′ 2° 22′	h ′ 2° 23′	h ′ 2° 24′	h ′ 2° 25′	h ′ 2° 26′
0	1217	1186	1154	1123	1091	1061	1030	0999	0969	0939	0909
1	1217	1185	1153	1122	1091	1060	1029	0999	0969	0939	0909
2	1216	1184	1153	1121	1090	1059	1029	0998	0968	0939	0909
3	1216	1184	1152	1121	1090	1059	1028	0998	0968	0938	0908
4	1215	1183	1152	1120	1089	1058	1028	0998	0968	0938	0908
5	1215	1183	1151	1120	1089	1058	1027	0997	0967	0937	0907
6	1214	1182	1151	1119	1088	1057	1027	0997	0967	0937	0907
7	1214	1182	1150	1119	1088	1057	1026	0996	0966	0936	0906
8	1213	1181	1150	1118	1087	1056	1026	0996	0966	0936	0906
9	1213	1181	1149	1118	1087	1056	1025	0995	0965	0935	0905
10	1212	1180	1149	1117	1086	1055	1025	0995	0965	0935	0905
11	1211	1180	1148	1117	1086	1055	1024	0994	0964	0934	0904
12	1211	1179	1148	1116	1085	1054	1024	0994	0964	0934	0904
13	1210	1179	1147	1116	1085	1054	1023	0993	0963	0933	0903
14	1210	1178	1147	1115	1084	1053	1023	0993	0963	0933	0903
15	1209	1178	1146	1115	1084	1053	1022	0992	0962	0932	0902
16	1209	1177	1146	1114	1083	1052	1022	0992	0962	0932	0902
17	1208	1177	1145	1114	1083	1052	1021	0991	0961	0931	0901
18	1208	1176	1145	1113	1082	1051	1021	0991	0961	0931	0901
19	1207	1175	1144	1113	1082	1051	1020	0990	0960	0930	0900
20	1207	1175	1143	1112	1081	1050	1020	0990	0960	0930	0900
21	1206	1174	1143	1112	1081	1050	1020	0989	0959	0929	0899
22	1206	1174	1142	1111	1080	1049	1019	0989	0959	0929	0899
23	1205	1173	1142	1111	1080	1049	1019	0988	0958	0928	0898
24	1205	1173	1141	1110	1079	1048	1018	0988	0958	0928	0898
25	1204	1172	1141	1110	1079	1048	1018	098[illegible]	0957	0927	0897
26	1203	1172	1140	1109	1078	1047	1017	0987	0957	0927	0897
27	1203	1171	1140	1109	1078	1047	1017	0986	0956	0926	0896
28	1202	1171	1139	1108	1077	1046	1016	098[illegible]	0956	0926	0896
29	1202	1170	1139	1107	1076	1046	1016	098[illegible]	0955	0925	0895
30	1201	1170	1138	1107	1076	1045	1015	098[illegible]	0955	0925	0895
31	1201	1169	1138	1106	1075	1045	1015	098[illegible]	0954	0924	0894
32	1200	1169	1137	1106	1075	1044	1014	0984	0954	0924	0894
33	1200	1168	1137	1105	1074	1044	1014	0983	0953	0923	0893
34	1199	1168	1136	1105	1074	1043	1013	0983	0953	0923	0893
35	1199	1167	1136	1104	1073	1043	1013	0982	0952	0922	0892
36	1198	1167	1135	1104	1073	1042	1012	0982	0952	0922	0892
37	1198	1166	1135	1103	1072	1042	1012	0981	0951	0921	0891
38	1197	1165	1134	1103	1072	1041	1011	0981	0951	0921	0891
39	1197	1165	1134	1102	1071	1041	1010	0980	0950	0920	0890
40	1196	1164	1133	1102	1071	1040	1010	0980	0950	0920	0890
41	1196	1164	1132	1101	1070	1039	1009	0979	0949	0919	0889
42	1195	1163	1132	1101	1070	1039	1009	0979	0949	0919	0889
43	1194	1163	1131	1100	1069	1038	1008	0978	0948	0918	0888
44	1194	1162	1131	1100	1069	1038	1008	0978	0948	0918	0888
45	1193	1162	1130	1099	1068	1037	1007	0977	0947	0917	0887
46	1193	1161	1130	1099	1068	1037	1007	0977	0947	0917	0887
47	1192	1161	1129	1098	1067	1036	1006	0976	0946	0916	0886
48	1192	1160	1129	1098	1067	1036	1006	0976	0946	0916	0886
49	1191	1160	1128	1097	1066	1035	1005	0975	0945	0915	0885
50	1191	1159	1128	1097	1066	1035	1005	0975	0945	0915	0885
51	1190	1159	1127	1096	1065	1034	1004	0974	0944	0914	0884
52	1190	1158	1127	1096	1065	1034	1004	0974	0944	0914	0884
53	1189	1158	1126	1095	1064	1033	1003	0973	0943	0913	0883
54	1189	1157	1126	1095	1064	1033	1003	0973	0943	0913	0883
55	1188	1157	1125	1094	1063	1032	1002	0972	0942	0912	0883
56	1188	1156	1125	1093	1063	1032	1002	0972	0942	0912	0882
57	1187	1156	1124	1093	1062	1031	1001	0971	0941	0911	0882
58	1187	1155	1124	1092	1062	1031	1001	0971	0941	0911	0881
59	1186	1154	1123	1092	1061	1030	1000	0970	0940	0910	0881
60	1186	1154	1123	1091	1061	1030	0999	0969	0939	0909	0880

S.	h ' 2° 27'	h ' 2° 28'	h ' 2° 29'	h ' 2° 30'	h ' 2° 31'	h ' 2° 32'	h ' 2° 33'	h ' 2° 34'	h ' 2° 35'	h ' 2° 36'	h ' 2° 37'
0	0880	0850	0821	0792	0763	0734	0706	0678	0649	0621	0594
1	0879	0850	0820	0791	0762	0734	0705	0677	0649	0621	0593
2	0879	0849	0820	0791	0762	0733	0705	0677	0648	0621	0592
3	0878	0849	0819	0790	0762	0733	0704	0676	0648	0620	0592
4	0878	0848	0819	0790	0761	0732	0704	0676	0648	0620	0592
5	0877	0848	0818	0789	0761	0732	0703	0675	0647	0619	0591
6	0877	0847	0818	0789	0760	0731	0703	0675	0647	0619	0591
7	0876	0847	0817	0788	0760	0731	0702	0674	0646	0618	0590
8	0876	0846	0817	0788	0759	0730	0702	0674	0646	0618	0590
9	0875	0846	0816	0787	0759	0730	0702	0673	0645	0617	0590
10	0875	0845	0816	0787	0758	0729	0701	0673	0645	0617	0589
11	0874	0845	0815	0787	0758	0729	0701	0672	0644	0616	0589
12	0874	0844	0815	0786	0757	0729	0700	0672	0644	0616	0588
13	0873	0844	0814	0786	0757	0728	0700	0671	0643	0615	0588
14	0873	0843	0814	0785	0756	0728	0699	0671	0643	0615	0587
15	0872	0843	0814	0785	0756	0727	0699	0670	0642	0615	0587
16	0872	0842	0813	0784	0755	0727	0698	0670	0642	0614	0586
17	0871	0842	0813	0784	0755	0726	0698	0669	0641	0614	0586
18	0871	0841	0812	0783	0754	0726	0697	0669	0641	0613	0585
19	0870	0841	0812	0783	0754	0725	0697	0669	0641	0613	0585
20	0870	0840	0811	0782	0753	0725	0696	0668	0640	0612	0584
21	0869	0840	0811	0782	0753	0724	0696	0668	0640	0612	0584
22	0869	0839	0810	0781	0752	0724	0695	0667	0639	0611	0584
23	0868	0839	0810	0781	0752	0723	0695	0667	0639	0611	0583
24	0868	0838	0809	0780	0751	0723	0694	0666	0638	0610	0583
25	0867	0838	0809	0780	0751	0722	0694	0666	0638	0610	0582
26	0867	0837	0808	0779	0750	0722	0693	0665	0637	0609	0582
27	0866	0837	0808	0779	0750	0721	0693	0665	0637	0609	0581
28	0866	0836	0807	0778	0750	0721	0693	0664	0636	0608	0581
29	0865	0836	0807	0778	0749	0720	0692	0664	0636	0608	0580
30	0865	0835	0806	0777	0749	0720	0692	0663	0635	0608	0580
31	0864	0835	0806	0777	0748	0720	0691	0663	0635	0607	0579
32	0864	0834	0805	0776	0748	0719	0691	0662	0634	0607	0579
33	0863	0834	0805	0776	0747	0719	0690	0662	0634	0606	0579
34	0863	0833	0804	0775	0747	0718	0690	0662	0634	0606	0578
35	0862	0833	0804	0775	0746	0718	0689	0661	0633	0605	0578
36	0862	0833	0803	0774	0746	0717	0689	0661	0633	0605	0577
37	0861	0832	0803	0774	0745	0717	0688	0660	0632	0604	0577
38	0851	0832	0802	0773	0745	0716	0688	0660	0632	0604	0576
39	0860	0831	0802	0773	0744	0716	0687	0659	0631	0603	0576
40	0860	0831	0801	0773	0744	0715	0687	0659	0631	0603	0575
41	0859	0830	0801	0772	0743	0715	0686	0658	0630	0602	0575
42	0859	0830	0801	0772	0743	0714	0686	0658	0630	0602	0574
43	0858	0829	0800	0771	0742	0714	0685	0657	0629	0602	0574
44	0858	0829	0800	0771	0742	0713	0685	0657	0629	0601	0573
45	0857	0828	0799	0770	0741	0713	0685	0656	0628	0601	0573
46	0857	0828	0799	0770	0741	0712	0684	0656	0628	0600	0573
47	0856	0827	0798	0769	0740	0712	0684	0655	0627	0600	0572
48	0856	0827	0798	0769	0740	0711	0683	0655	0627	0599	0572
49	0855	0826	0797	0768	0739	0711	0683	0655	0627	0599	0571
50	0855	0826	0797	0768	0739	0711	0682	0654	0626	0598	0571
51	0855	0825	0796	0767	0739	0710	0682	0654	0626	0598	0570
52	0854	0825	0796	0767	0738	0710	0681	0653	0625	0597	0570
53	0854	0824	0795	0766	0738	0709	0681	0653	0625	0597	0569
54	0853	0824	0795	0766	0737	0709	0680	0652	0624	0596	0569
55	0853	0823	0794	0765	0737	0708	0680	0652	0624	0596	0568
56	0852	0823	0794	0765	0736	0708	0679	0651	0623	0596	0568
57	0852	0822	0793	0764	0736	0707	0679	0651	0623	0595	0568
58	0851	0822	0793	0764	0735	0707	0678	0650	0622	0595	0567
59	0851	0821	0792	0763	0735	0706	0678	0650	0622	0594	0567
60	0850	0821	0792	0763	0734	0706	0678	0649	0621	0594	0566

TABLE XXIII. Proportional Logarithms.

S.	h ' 2° 38'	h ' 2° 39'	h ' 2° 40'	h ' 2° 41'	h ' 2° 42'	h ' 2° 43'	h ' 2° 44'	h ' 2° 45'	h ' 2° 46'	h ' 2° 47'	h ' 2° 48'
0	0566	0539	0512	0484	0458	0431	0404	0378	0352	0326	0300
1	0566	0538	0511	0484	0457	0430	0404	0377	0351	0325	0299
2	0565	0538	0511	0484	0457	0430	0403	0377	0351	0325	0299
3	0565	0537	0510	0483	0456	0430	0403	0377	0351	0325	0299
4	0564	0537	0510	0483	0456	0429	0402	0376	0350	0324	0298
5	0564	0536	0509	0482	0455	0429	0402	0376	0350	0324	0298
6	0563	0536	0509	0482	0455	0428	0402	0375	0349	0323	0297
7	0563	0536	0508	0481	0454	0428	0401	0375	0349	0323	0297
8	0562	0535	0508	0481	0454	0427	0401	0374	0349	0322	0297
9	0562	0535	0507	0480	0454	0427	0400	0374	0348	0322	0296
10	0562	0534	0507	0480	0453	0426	0400	0373	0348	0322	0296
11	0561	0534	0507	0479	0453	0426	0399	0373	0347	0321	0295
12	0561	0533	0506	0479	0452	0426	0399	0373	0347	0321	0295
13	0560	0533	0506	0479	0452	0425	0399	0372	0346	0320	0294
14	0560	0532	0505	0478	0451	0425	0398	0372	0346	0320	0294
15	0559	0532	0505	0478	0451	0424	0398	0371	0346	0319	0294
16	0559	0531	0504	0477	0450	0424	0397	0371	0345	0319	0293
17	0558	0531	0504	0477	0450	0423	0397	0370	0345	0319	0293
18	0558	0531	0503	0476	0450	0423	0396	0370	0344	0318	0292
19	0557	0530	0503	0476	0449	0422	0396	0370	0344	0318	0292
20	0557	0530	0502	0475	0449	0422	0395	0369	0343	0317	0291
21	0557	0529	0502	0475	0448	0422	0395	0369	0343	0317	0291
22	0556	0529	0502	0475	0448	0421	0395	0368	0342	0316	0291
23	0556	0528	0501	0474	0447	0421	0394	0368	0342	0316	0290
24	0555	0528	0501	0474	0447	0420	0394	0367	0342	0316	0290
25	0555	0527	0500	0473	0446	0420	0393	0367	0341	0315	0289
26	0554	0527	0500	0473	0446	0419	0393	0366	0341	0315	0289
27	0554	0526	0499	0472	0446	0419	0392	0366	0340	0314	0288
28	0553	0526	0499	0472	0445	0418	0392	0366	0340	0314	0288
29	0553	0526	0498	0471	0445	0418	0391	0365	0339	0313	0288
30	0552	0525	0498	0471	0444	0418	0391	0365	0339	0313	0287
31	0552	0525	0497	0471	0444	0417	0391	0364	0338	0312	0286
32	0551	0524	0497	0470	0443	0417	0390	0364	0338	0312	0286
33	0551	0524	0497	0470	0443	0416	0390	0363	0337	0311	0285
34	0551	0523	0496	0469	0442	0416	0389	0363	0337	0311	0285
35	0550	0523	0496	0469	0442	0415	0389	0363	0336	0310	0285
36	0550	0522	0495	0468	0442	0415	0388	0362	0336	0310	0284
37	0549	0522	0495	0468	0441	0414	0388	0362	0336	0310	0284
38	0549	0521	0494	0467	0441	0414	0388	0361	0335	0309	0283
39	0548	0521	0494	0467	0440	0414	0387	0361	0335	0309	0283
40	0548	0521	0493	0466	0440	0413	0387	0360	0334	0308	0282
41	0547	0520	0493	0466	0439	0413	0386	0360	0334	0308	0282
42	0547	0520	0493	0466	0439	0412	0386	0359	0333	0307	0282
43	0546	0519	0492	0465	0438	0412	0385	0359	0333	0307	0281
44	0546	0519	0492	0465	0438	0411	0385	0359	0332	0306	0281
45	0546	0518	0491	0464	0438	0411	0384	0358	0332	0306	0280
46	0545	0518	0491	0464	0437	0410	0384	0358	0332	0306	0280
47	0545	0517	0490	0463	0437	0410	0384	0357	0331	0305	0279
48	0544	0517	0490	0463	0436	0410	0383	0357	0331	0305	0279
49	0544	0516	0489	0462	0436	0409	0383	0356	0330	0304	0279
50	0543	0516	0489	0462	0435	0409	0382	0356	0330	0304	0278
51	0543	0516	0489	0462	0435	0408	0382	0356	0329	0304	0278
52	0542	0515	0488	0461	0434	0408	0381	0355	0329	0303	0277
53	0542	0515	0488	0461	0434	0407	0381	0355	0329	0303	0277
54	0541	0514	0487	0460	0434	0407	0381	0354	0328	0302	0276
55	0541	0514	0487	0460	0433	0406	0380	0354	0328	0302	0276
56	0541	0513	0486	0459	0433	0406	0380	0353	0327	0301	0276
57	0540	0513	0486	0459	0432	0406	0379	0353	0327	0301	0275
58	0540	0512	0485	0458	0432	0405	0379	0352	0326	0300	0275
59	0539	0512	0485	0458	0431	0405	0378	0352	0326	0300	0274
60	0539	0512	0484	0458	0431	0404	0378	0352	0326	0300	0274

S.	h ' 2° 49'	h ' 2° 50'	h ' 2° 51'	h ' 2° 52'	h ' 2° 53'	h ' 2° 54'	h ' 2° 55'	h ' 2° 56'	h ' 2° 57'	h ' 2° 58'	h ' 2° 59'
0	0274	0248	0223	0197	0172	0147	0122	0098	0073	0049	0024
1	0273	0248	0222	0197	0172	0147	0122	0097	0073	0048	0024
2	0273	0247	0222	0197	0171	0146	0121	0097	0072	0048	0023
3	0273	0247	0221	0196	0171	0146	0121	0096	0072	0047	0023
4	0272	0246	0221	0196	0171	0146	0121	0096	0071	0047	0023
5	0272	0246	0221	0195	0170	0145	0120	0096	0071	0046	0022
6	0271	0246	0220	0195	0170	0145	0120	0095	0071	0046	0022
7	0271	0245	0220	0194	0169	0144	0119	0095	0070	0046	0021
8	0270	0245	0219	0194	0169	0144	0119	0094	0070	0045	0021
9	0270	0244	0219	0194	0169	0143	0119	0094	0069	0045	0021
10	0270	0244	0218	0193	0168	0143	0118	0093	0069	0044	0020
11	0269	0244	0218	0193	0168	0143	0118	0093	0068	0044	0020
12	0269	0243	0218	0192	0167	0142	0117	0093	0068	0044	0019
13	0268	0243	0217	0192	0167	0142	0117	0092	0068	0043	0019
14	0268	0242	0217	0192	0166	0141	0117	0092	0067	0043	0018
15	0267	0242	0216	0191	0166	0141	0116	0091	0067	0042	0018
16	0267	0241	0216	0191	0166	0141	0116	0091	0066	0042	0018
17	0267	0241	0216	0190	0165	0140	0115	0091	0066	0042	0017
18	0266	0241	0215	0190	0165	0140	0115	0090	0066	0041	0017
19	0266	0240	0215	0189	0164	0139	0114	0090	0065	0041	0016
20	0265	0240	0214	0189	0164	0139	0114	0089	0065	0040	0016
21	0265	0239	0214	0189	0163	0139	0114	0089	0064	0040	0016
22	0264	0239	0213	0188	0163	0138	0113	0089	0064	0040	0015
23	0264	0238	0213	0188	0163	0138	0113	0088	0064	0039	0015
24	0264	0238	0213	0187	0162	0137	0112	0088	0063	0039	0015
25	0263	0238	0212	0187	0162	0137	0112	0087	0063	0038	0014
26	0263	0237	0212	0186	0161	0136	0112	0087	0062	0038	0014
27	0262	0237	0211	0186	0161	0136	0111	0087	0062	0038	0013
28	0262	0236	0211	0186	0161	0136	0111	0086	0062	0037	0013
29	0261	0236	0210	0185	0160	0135	0110	0086	0061	0037	0012
30	0261	0235	0210	0185	0160	0135	0110	0085	0061	0036	0012
31	0261	0235	0210	0184	0159	0134	0110	0085	0060	0036	0012
32	0260	0235	0209	0184	0159	0134	0109	0084	0060	0035	0011
33	0260	0234	0209	0184	0158	0134	0109	0084	0060	0035	0011
34	0259	0234	0208	0183	0158	0133	0108	0084	0059	0035	0010
35	0259	0233	0208	0183	0158	0133	0108	0083	0059	0034	0010
36	0258	0233	0208	0182	0157	0132	0107	0083	0058	0034	0010
37	0258	0232	0207	0182	0157	0132	0107	0082	0058	0033	0009
38	0258	0232	0207	0181	0156	0131	0107	0082	0057	0033	0009
39	0257	0232	0206	0181	0156	0131	0106	0082	0057	0033	0008
40	0257	0231	0206	0181	0156	0131	0106	0081	0057	0032	0008
41	0256	0231	0205	0180	0155	0130	0105	0081	0056	0032	0008
42	0256	0230	0205	0180	0155	0130	0105	0080	0056	0031	0007
43	0255	0230	0205	0179	0154	0129	0105	0080	0055	0031	0007
44	0255	0230	0204	0179	0154	0129	0104	0080	0055	0031	0006
45	0255	0229	0204	0179	0153	0129	0104	0079	0055	0030	0006
46	0254	0229	0203	0178	0153	0128	0103	0079	0054	0030	0006
47	0254	0228	0203	0178	0153	0128	0103	0078	0054	0029	0005
48	0253	0228	0202	0177	0152	0127	0103	0078	0053	0029	0005
49	0253	0227	0202	0177	0152	0127	0102	0077	0053	0029	0004
50	0252	0227	0202	0176	0151	0126	0102	0077	0053	0028	0004
51	0252	0227	0201	0176	0151	0126	0101	0077	0052	0028	0004
52	0252	0226	0201	0176	0151	0126	0101	0076	0052	0027	0003
53	0251	0226	0200	0175	0150	0125	0100	0076	0051	0027	0003
54	0251	0225	0200	0175	0150	0125	0100	0075	0051	0027	0002
55	0250	0225	0200	0174	0149	0124	0100	0075	0051	0026	0002
56	0250	0224	0199	0174	0149	0124	0099	0075	0050	0026	0002
57	0250	0224	0199	0174	0148	0124	0099	0074	0050	0025	0001
58	0249	0224	0198	0173	0148	0123	0098	0074	0049	0025	0001
59	0249	0223	0198	0173	0148	0123	0098	0073	0049	0025	0000
60	0248	0223	0197	0172	0147	0122	0098	0073	0049	0024	0000

Of Logarithmic Sines, Tangents, and Secants, to every Point and Quarter Point of the Compass.

Points	Sines.	Co-sines.	Tangent.	Co-tang.	Secant.	Co-secant	Points
0	0.00000	10.00000	0.00000	Infinite.	10.00000	Infinite.	8
0 ¼	8.69070	9.99947	8.69131	11.30867	10.00052	11.30921	7 ¾
0 ½	8.99130	9.99790	8.99340	11.00660	10.00210	11.00870	7 ½
0 ¾	9.16652	9.99527	9.17125	10.82875	10.00473	10.83348	7 ¼
1	9.29024	9.99157	9.29866	10.70134	10.00843	10.70976	7
1 ¼	9.38557	9.98679	9.39878	10.60122	10.01321	10.61443	6 ¾
1 ½	9.46282	9.98088	9.48194	10.51806	10.01912	10.53718	6 ½
1 ¾	9.52742	9.97385	9.55365	10.44635	10.02616	10.47288	6 ¼
2	9.58284	9.96562	9.61722	10.38278	10.03438	10.41716	6
2 ¼	9.63099	9.95616	9.67483	10.32517	10.04384	10.36901	5 ¾
2 ½	9.67339	9.94543	9.72796	10.27204	10.05457	10.32661	5 ½
2 ¾	9.71105	9.93335	9.77770	10.22230	10.06665	10.28895	5 ¼
3	9.74474	9.91985	9.82489	10.17511	10.08015	10.25526	5
3 ¼	9.77503	9.90483	9.87020	10.12980	10.09517	10.22497	4 ¾
3 ½	9.80236	9.88819	9.91417	10.08583	10.11181	10.19764	4 ½
3 ¾	9.82708	9.86979	9.95729	10.04270	10.13021	10.17292	4 ¼
4	9.84948	9.84948	10.00000	10.00000	10.15052	10.15052	4
	Co-sines	Sines.	Co-tang.	Tangents.	Co-secant	Secant.	

Logarithms of Numbers.

N° 1——100. Log. 1.00000——200000.

N.	Log.	N.	Log.	N.	Log.	N.	Log.	N.	Log.
1	0.00000	21	1.32222	41	1.61278	61	1.78533	81	1.90849
2	0.30103	22	1.34242	42	1.62325	62	1.79239	82	1.91381
3	0.47712	23	1.36173	43	1.63347	63	1.79934	83	1.91908
4	0.60206	24	1.38021	44	1.64345	64	1.80618	84	1.92428
5	0.69897	25	1.39794	45	1.65321	65	1.81291	85	1.92942
6	0.77815	26	1.41497	46	1.66276	66	1.81954	86	1.93450
7	0.84510	27	1.43136	47	1.67210	67	1.82607	87	1.93952
8	0.90309	28	1.44716	48	1.68124	68	1.83251	88	1.94448
9	0.95424	29	1.46240	49	1.69020	69	1.83885	89	1.94939
10	1.00000	30	1.47712	50	1.69897	70	1.84510	90	1.95424
11	1.04139	31	1.49136	51	1.70757	71	1.85126	91	1.95904
12	1.07918	32	1.50515	52	1.71600	72	1.85733	92	1.96379
13	1.11394	33	1.51851	53	1.72428	73	1.86332	93	1.96848
14	1.14613	34	1.53148	54	1.73239	74	1.86923	94	1.97313
15	1.17609	35	1.54407	55	1.74036	75	1.87506	95	1.97772
16	1.20412	36	1.55630	56	1.74819	76	1.88081	96	1.98227
17	1.23045	37	1.56820	57	1.75587	77	1.88649	97	1.98677
18	1.25527	38	1.57978	58	1.76343	78	1.89209	98	1.99123
19	1.27875	39	1.59106	59	1.77085	79	1.89763	99	1.99564
20	1.30103	40	1.60206	60	1.77815	80	1.90309	100	2.00000

N° 100——1600. Log. 00000——20412.

N°	0	1	2	3	4	5	6	7	8	9
100	00000	00043	00087	00130	00173	00217	00260	00303	00346	00389
101	00432	00475	00518	00561	00604	00647	00689	00732	00775	00817
102	00860	00903	00945	00988	01030	01072	01115	01157	01199	01242
103	01284	01326	01368	01410	01452	01494	01536	01578	01620	01662
104	01703	01745	01787	01828	01870	01912	01953	01995	02036	02078
105	02119	02160	02202	02243	02284	02325	02366	02407	02449	02490
106	02531	02572	02612	02653	02694	02735	02776	02816	02857	02898
107	02938	02979	03019	03060	03100	03141	03181	03222	03262	03302
108	03342	03383	03423	03463	03503	03543	03583	03623	03663	03703
109	03743	03782	03822	03862	03902	03941	03981	04021	04060	04100
110	04139	04179	04218	04258	04297	04336	04376	04415	04454	04493
111	04532	04571	04610	04650	04689	04727	04766	04805	04844	04883
112	04922	04961	04999	05038	05077	05115	05154	05192	05231	05269
113	05308	05346	05385	05423	05461	05500	05538	05576	05614	05652
114	05690	05729	05767	05805	05843	05881	05918	05956	05994	06032
115	06070	06108	06145	06183	06221	06258	06296	06333	06371	06408
116	06446	06483	06521	06558	06595	06633	06670	06707	06744	06781
117	06819	06856	06893	06930	06967	07004	07041	07078	07115	07151
118	07188	07225	07262	07298	07335	07372	07408	07445	07482	07518
119	07555	07591	07628	07664	07700	07737	07773	07809	07846	07882
120	07918	07954	07990	08027	08063	08099	08135	08171	08207	08243
121	08279	08314	08350	08386	08422	08458	08493	08529	08565	08600
122	08636	08672	08707	08743	08778	08814	08849	08884	08920	08955
123	08991	09026	09061	09096	09132	09167	09202	09237	09272	09307
124	09342	09377	09412	09447	09482	09517	09552	09587	09621	09656
125	09691	09726	09760	09795	09830	09864	09899	09934	09968	10003
126	10037	10072	10106	10140	10175	10209	10243	10278	10312	10346
127	10380	10415	10449	10483	10517	10551	10585	10619	10653	10687
128	10721	10755	10789	10823	10857	10890	10924	10958	10992	11025
129	11059	11093	11126	11160	11193	11227	11261	11294	11327	11361
130	11394	11428	11461	11494	11528	11561	11594	11628	11661	11694
131	11727	11760	11793	11826	11860	11893	11926	11959	11992	12024
132	12057	12090	12123	12156	12189	12222	12254	12287	12320	12352
133	12385	12418	12450	12483	12516	12548	12581	12613	12646	12678
134	12710	12743	12775	12808	12840	12872	12905	12937	12969	13001
135	13033	13066	13098	13130	13162	13194	13226	13258	13290	13322
136	13354	13386	13418	13450	13481	13513	13545	13577	13609	13640
137	13672	13704	13735	13767	13799	13830	13862	13893	13925	13956
138	13988	14019	14051	14082	14114	14145	14176	14208	14239	14270
139	14301	14333	14364	14395	14426	14457	14489	14520	14551	14582
140	14613	14644	14675	14706	14737	14768	14799	14829	14860	14891
141	14922	14953	14983	15014	15045	15076	15106	15137	15168	15198
142	15229	15259	15290	15320	15351	15381	15412	15442	15473	15503
143	15534	15564	15594	15625	15655	15685	15715	15746	15776	15806
144	15836	15866	15897	15927	15957	15987	16017	16047	16077	16107
145	16137	16167	16197	16227	16256	16286	16316	16346	16376	16406
146	16435	16465	16495	16524	16554	16584	16613	16643	16673	16702
147	16732	16761	16791	16820	16850	16879	16909	16938	16967	16997
148	17026	17056	17085	17114	17143	17173	17202	17231	17260	17289
149	17319	17348	17377	17406	17435	17464	17493	17522	17551	17580
150	17609	17638	17667	17696	17725	17754	17782	17811	17840	17869
151	17898	17926	17955	17984	18013	18041	18070	18099	18127	18156
152	18184	18213	18241	18270	18298	18327	18355	18384	18412	18441
153	18469	18498	18526	18554	18583	18611	18639	18667	18696	18724
154	18752	18780	18808	18837	18865	18893	18921	18949	18977	19005
155	19033	19061	19089	19117	19145	19173	19201	19229	19257	19285
156	19312	19340	19368	19396	19424	19451	19479	19507	19535	19562
157	19590	19618	19645	19673	19700	19728	19756	19783	19811	19838
158	19866	19893	19921	19948	19976	20003	20030	20058	20085	20112
159	20140	20167	20194	20222	20249	20276	20303	20330	20358	20385
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N° 1600——2200. Log. 20412——34242.

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161	20683	20710	20737	20763	20790	20817	20844	20871	20898	20925
162	20951	20978	21005	21032	21059	21085	21112	21139	21165	21192
163	21219	21245	21272	21299	21325	21352	21378	21405	21431	21458
164	21484	21511	21537	21564	21590	21617	21643	21669	21696	21722
165	21748	21775	21801	21827	21854	21880	21906	21932	21958	21985
166	22011	22037	22063	22089	22115	22141	22167	22194	22220	22246
167	22272	22298	22324	22350	22376	22401	22427	22453	22479	22505
168	22531	22557	22583	22608	22634	22660	22686	22712	22737	22763
169	22789	22814	22840	22866	22891	22917	22943	22968	22994	23019
170	23045	23070	23096	23121	23147	23172	23198	23223	23249	23274
171	23300	23325	23350	23376	23401	23426	23452	23477	23502	23528
172	23553	23578	23603	23629	23654	23679	23704	23729	23754	23779
173	23805	23830	23855	23880	23905	23930	23955	23980	24005	24030
174	24055	24080	24105	24130	24155	24180	24204	24229	24254	24279
175	24304	24329	24353	24378	24403	24428	24452	24477	24502	24527
176	24551	24576	24601	24625	24650	24674	34699	24724	24748	24773
177	24797	24822	24846	24871	24895	24920	24944	24969	24993	25018
178	25042	25066	25091	25115	25139	25164	25188	25212	25237	25261
179	25285	25310	25334	25358	25382	25406	25431	25455	25479	25503
180	25527	25551	25575	25600	25624	25648	25672	25696	25720	25744
181	25768	25792	25816	25840	25864	25888	25912	25935	25959	25983
182	26007	26031	26055	26079	26102	26126	26150	26174	26198	26221
183	26245	26269	26293	26316	26340	26364	26387	26411	26435	26458
184	26482	26505	26529	26553	26576	26600	26623	26647	26670	26694
185	26717	26741	26764	26788	26811	26834	26858	26881	26905	26928
186	26951	26975	26998	27021	27045	27068	27091	27114	27138	27161
187	27184	27207	27231	27254	27277	27300	27323	27346	27370	27393
188	27416	27439	27462	27485	27508	27531	27554	27577	27600	27623
189	27646	27669	27692	27715	27738	27761	27784	27807	27830	27852
190	27875	27898	27921	27944	27967	27989	28012	28035	28058	28081
191	28103	28126	28149	28171	28194	28217	28240	28262	28285	28307
192	28330	28353	28375	28398	28421	28443	28466	28488	28511	28533
193	28556	28578	28601	28623	28646	28668	28691	28713	28735	28758
194	28780	28803	28825	28847	28870	28892	28914	28937	28959	28981
195	29003	29026	29048	29070	29092	29115	29137	29159	29181	29203
196	29226	29248	29270	29292	29314	29336	29358	29380	29403	29425
197	29447	29469	29491	29513	29535	29557	29579	29601	29623	29645
198	29667	29688	29710	29732	29754	29776	29798	29820	29842	29863
199	29885	29907	29929	29951	29973	29994	30016	30038	30060	30081
200	30103	30125	30146	30168	30190	30211	30233	30255	30276	30298
201	30320	30341	30363	30384	30406	30428	30449	30471	30492	30514
202	30535	30557	30578	30600	30621	30643	30664	30685	30707	30728
203	30750	30771	30792	30814	30835	30856	30878	30899	30920	30942
204	30963	30984	31006	31027	31048	31069	31091	31112	31133	31154
205	31175	31197	31218	31239	31260	31281	31302	31323	31345	31366
206	31387	31408	31429	31450	31471	31492	31513	31534	31555	31576
207	31597	31618	31639	31660	31681	31702	31723	31744	31765	31785
208	31806	31827	31848	31869	31890	31911	31931	31952	31973	31994
209	32015	32035	32056	32077	32098	32118	32139	32160	32181	32201
210	32222	32243	32263	32284	32305	32325	32346	32366	32387	32408
211	32428	32449	32469	32490	32510	32531	32552	32572	32593	32613
212	32634	32654	32675	32695	32715	32736	32756	32777	32797	32818
213	32838	32858	32879	32899	32919	32940	32960	32980	33001	33021
214	33041	33062	33082	33102	33122	33143	33163	33183	33203	33224
215	33244	33264	33284	33304	33325	33345	33365	33385	33405	33425
216	33445	33465	33486	33506	33526	33546	33566	33586	33606	33626
217	33646	33666	33686	33706	33726	33746	33766	33786	33806	33826
218	33846	33866	33885	33905	33925	33945	33965	33985	34005	34025
219	34044	34064	34084	34104	34124	34143	34163	34183	34203	34223
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No. 2200——2800. Log. 34242——44716.

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221	34439	34459	34479	34498	34518	34537	34557	34577	34596	34616
222	34635	34655	34674	34694	34713	34733	34753	34772	34792	34811
223	34830	34850	34869	34889	34908	34928	34947	34967	34986	35005
224	35025	35044	35064	35083	35102	35122	35141	35160	35180	35199
225	35218	35238	35257	35276	35295	35315	35334	35353	35372	35392
226	35411	35430	35449	35468	35488	35507	35526	35545	35564	35583
227	35603	35622	35641	35660	35679	35698	35717	35736	35755	35774
228	35793	35813	35832	35851	35870	35889	35908	35927	35946	35965
229	35984	36003	36021	36040	36059	36078	36097	36116	36135	36154
230	36173	36192	36211	36229	36248	36267	36286	36305	36324	36342
231	36361	36380	36399	36418	36436	36455	36474	36493	36511	36530
232	36549	36568	36586	36605	36624	36642	36661	36680	36698	36717
233	36736	36754	36773	36791	36810	36829	36847	36866	36884	36903
234	36922	36940	36959	36977	36996	37014	37033	37051	37070	37088
235	37107	37125	37144	37162	37181	37199	37218	37236	37254	37273
236	37291	37310	37328	37346	37365	37383	37401	37420	37438	37457
237	37475	37493	37511	37530	37548	37566	37585	37603	37621	37639
238	37658	37676	37694	37712	37731	37749	37767	37785	37803	37822
239	37840	37858	37876	37894	37912	37931	37949	37967	37985	38003
240	38021	38039	38057	38075	38093	38112	38130	38148	38166	38184
241	38202	38220	38238	38256	38274	38292	38310	38328	38346	38364
242	38382	38399	38417	38435	38453	38471	38489	38507	38525	38543
243	38561	38578	38596	38614	38632	38650	38668	38686	38703	38721
244	38739	38757	38775	38792	38810	38828	38846	38863	38881	38899
245	38917	38934	38952	38970	38987	39005	39023	39041	39058	39076
246	39094	39111	39129	39146	39164	39182	39199	39217	39235	39252
247	39270	39287	39305	39322	39340	39358	39375	39393	39410	39428
248	39445	39463	39480	39498	39515	39533	39550	39568	39585	39602
249	39620	39637	39655	39672	39690	39707	39724	39742	39759	39777
250	39794	39811	39829	39846	39863	39881	39898	49915	39933	39950
251	39967	39985	40002	40019	40037	40054	40071	40088	40106	40123
252	40140	40157	40175	40192	40209	40226	40243	40261	40278	40295
253	40312	40329	40346	40364	40381	40398	40415	40432	40449	40466
254	40483	40500	40518	40535	40552	40569	40586	40603	40620	40637
255	40654	40671	40688	40705	40722	40739	40756	40773	40790	40807
256	40824	40841	40858	40875	40892	40909	40926	40943	40960	40976
257	40993	41010	41027	41044	41061	41078	41095	41111	41128	41145
258	41162	41179	41196	41212	41229	41246	41263	41280	41296	41313
259	41330	41347	41363	41380	41397	41414	41430	41447	41464	41481
260	41497	41514	41531	41547	41564	41581	41597	41614	41631	41647
261	41664	41681	41697	41714	41731	41747	41764	41780	41797	41814
262	41830	41847	41863	41880	41896	41913	41929	41946	41963	41979
263	41996	42012	42029	42045	42062	42078	42095	42111	42127	42144
264	42160	42177	42193	42210	42226	42243	42259	42275	42292	42308
365	42325	42341	42357	42374	42390	42406	42423	42439	42455	42472
266	42488	42504	42521	42537	42553	42570	42586	42602	42619	42635
267	42651	42667	42684	42700	42716	42732	42749	42765	42781	42797
268	42813	42830	42846	42862	42878	42894	42911	42927	42943	42959
269	42975	42991	43008	43024	43040	43056	43072	43088	43104	43120
270	43136	43152	43169	43185	43201	43217	43233	43249	43265	43281
271	43297	43313	43329	43345	43361	43377	43393	43409	43425	43441
272	43457	43473	43489	43505	43521	43537	43553	43569	43584	43600
273	43616	43632	43648	43664	43680	43696	43712	43727	43743	43759
274	43775	43791	43807	43823	43838	43854	43870	43886	43902	43917
275	43933	43919	43965	43981	43996	44012	44028	44044	44059	44075
276	44091	44107	44122	44138	44154	44170	44185	44201	44217	44232
277	44248	44264	44279	44295	44311	44326	44342	44358	44373	44389
278	44404	44420	44436	44451	44467	44483	44498	44514	44529	44545
279	44560	44576	44592	44607	44623	44638	44654	44669	44685	44700
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281	44871	44886	44902	44917	44932	44948	44963	44979	44994	45010
282	45025	45040	45056	45071	45086	45102	45117	45133	45148	45163
283	45179	45194	45209	45225	45240	45255	45271	45286	45301	45317
284	45332	45347	45362	45378	45393	45408	45423	45439	45454	45469
285	45484	45500	45515	45530	45545	45561	45576	45591	45606	45621
286	45637	45652	45667	45682	45697	45712	45728	45743	45758	45773
287	45788	45803	45818	45834	45849	45864	45879	45894	45909	45924
288	45939	45954	45969	45984	46000	46015	46030	46045	46060	46075
289	46090	46105	46120	46135	46150	46165	46180	46195	46210	46225
290	46240	46255	46270	46285	46300	46315	46330	46345	46359	46374
291	46389	46404	46419	46434	46449	46464	46479	46494	46509	46523
292	46538	46553	46568	46583	46598	46613	46027	46642	46657	46672
293	46687	46702	46716	46731	46746	46761	46776	46790	46805	46820
294	46835	46850	46864	46879	46894	46909	46923	46938	46953	46967
295	46982	46997	47012	47026	47041	47056	47070	47085	47100	47114
296	47129	47144	47159	47173	47188	47202	47217	47232	47246	47261
297	47276	47290	47305	47319	47334	47349	47363	47378	47392	47407
298	47422	47436	47451	47465	47480	47494	47509	47524	47538	47553
299	47567	47582	47596	47611	47625	47640	47654	47669	47683	47698
300	47712	47727	47741	47756	47770	47784	47799	47813	47828	47842
301	47857	47871	47885	47900	47914	47929	47943	47958	47972	47986
302	48001	48015	48029	48044	48058	48073	48087	48101	48116	48130
303	48144	48159	48173	48187	48202	48216	48230	48244	48259	48273
304	48287	48302	48316	48330	48344	48359	48373	48387	48401	48416
305	48430	48444	48458	48473	48487	48501	48515	48530	48544	48558
306	48572	48586	48601	48615	48629	48643	48657	48671	48686	48700
307	48714	48728	48742	48756	48770	48785	48799	48813	48827	48841
308	48855	48869	48883	48897	48911	48926	48940	48954	48968	48982
309	48996	49010	49024	49038	49052	49066	49080	49094	49108	49122
310	49136	49150	49164	49178	49192	49206	49220	49234	49248	49202
311	49276	49290	49304	49318	49332	49346	49360	49374	49388	49402
312	49415	49429	49443	49457	49471	49485	49499	49513	49527	49541
313	49554	49568	49582	49596	49610	49624	49638	49651	49665	49679
314	49693	49707	49721	49734	49748	49762	49776	49790	49803	49817
315	49831	49845	49859	49872	49886	49900	49914	49927	49941	49955
316	49969	49982	49996	50010	50024	50037	50051	50065	50079	50092
317	50106	50120	50133	50147	50161	50174	50188	50202	50215	50229
318	50243	50256	50270	50284	50297	50311	50325	50338	50352	50365
319	50379	50393	50406	50420	50433	50447	50461	50474	50488	50501
320	50515	50529	50542	50556	50569	50583	50596	50610	50623	50637
321	50651	50664	50678	50691	50705	50718	50732	50745	50759	50772
322	50786	50799	50813	50826	50840	50853	50866	50880	50893	50907
323	50920	50934	50947	50961	50974	50987	51001	51014	51028	51041
324	51055	51068	51081	51095	51108	51121	51135	51148	51162	51175
325	51188	51202	51215	51228	51242	51255	51268	51282	51295	51308
326	51322	51335	51348	51362	51375	51388	51402	51415	51428	51441
327	51455	51468	51481	51495	51508	51521	51534	51548	51561	51574
328	51587	51601	51614	51627	51640	51654	51667	51680	51693	51706
329	51720	51733	51746	51759	51772	51786	51799	51812	51825	51838
330	51851	51865	51878	51891	51904	51917	51930	51943	51957	51970
331	51983	51996	52009	52022	52035	52048	52061	52075	52088	52101
332	52114	52127	52140	52153	52166	52179	52192	52205	52218	52231
333	52244	52257	52270	52284	52297	52310	52323	52336	52349	52362
334	52375	52388	52401	52414	52427	52440	52453	52466	52479	52492
335	52504	52517	52530	52543	52556	52569	52582	52595	52608	52621
336	52634	52647	52660	52673	52686	52699	52711	52724	52737	52750
337	52763	52776	52789	52802	52815	52827	52840	52853	52966	52879
338	52892	52905	52917	52930	52943	52956	52969	52982	52994	53007
339	53020	53033	53046	53058	53071	53084	53097	53110	53122	53135
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N° 3400——4000. Log. 53148——60206.

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341	53275	53288	53301	53314	53326	53339	53352	53364	53377	53390
342	53403	53415	53428	53441	53453	53466	53479	53491	53504	53517
343	53529	53542	53555	53567	53580	53593	53605	53618	53631	53643
344	53656	53668	53681	53694	53706	53719	53732	53744	53757	53769
345	53782	53794	53807	53820	53832	53845	53857	53870	53882	53895
346	53908	53920	53933	53945	53958	53970	53983	53995	54008	54020
347	54033	54045	54058	54070	54083	54095	54108	54120	54133	54145
348	54158	54170	54183	54195	54208	54220	54233	54245	54258	54270
349	54283	54295	54307	54320	54332	54345	54357	54370	54382	54394
350	54407	54419	54432	54444	54456	54469	54481	54494	54506	54518
351	54531	54543	54555	54568	54580	54593	54605	54617	54630	54642
352	54654	54667	54679	54691	54704	54716	54728	54741	54753	54765
353	54777	54790	54802	54814	54827	54839	54851	54864	54876	54888
354	54900	54913	54925	54937	54949	54962	54974	54986	54998	55011
355	55023	55035	55047	55060	55072	55084	55096	55108	55121	55133
356	55145	55157	55169	55182	55194	55206	55218	55230	55242	55255
357	55267	55279	55291	55303	55315	55328	55340	55352	55364	55376
358	55388	55400	55412	55425	55437	55449	55461	55473	55485	55497
359	55509	55522	55534	55546	55558	55570	55582	55594	55606	55618
360	55630	55642	55654	55666	55678	55691	55703	55715	55727	55739
361	55751	55763	55775	55787	55799	55811	55823	55835	55847	55859
362	55871	55883	55895	55907	55919	55931	55943	55955	55967	55979
363	55991	56003	56015	56027	56038	56050	56062	56074	56086	56098
364	56110	56122	56134	56146	56158	56170	56182	56194	56205	56217
365	56229	56241	56253	56265	56277	56289	56301	56312	56324	56336
366	56348	56360	56372	56384	56396	56407	56419	56431	56443	56455
367	56467	56478	56490	56502	56514	56526	56538	56549	56561	56573
368	56585	56597	56608	56620	56632	56644	56656	56667	56679	56691
369	56703	56714	56726	56738	56750	56761	56773	56785	56797	56808
370	56820	56832	56844	56855	56867	56879	56891	56902	56914	56926
371	56937	56949	56961	56972	56984	56996	57008	57019	57031	57043
372	57054	57066	57078	57089	57101	57113	57124	57136	57148	57159
373	57171	57183	57194	57206	57217	57229	57241	57252	57264	57276
374	57287	57299	57310	57322	57334	57345	57357	57368	57380	57392
375	57403	57415	57426	57438	57449	57461	57473	57484	57496	57507
376	57519	57530	57542	57553	57565	57576	57588	57600	57611	57623
377	57634	57646	57657	57669	57680	57692	57703	57715	57726	57738
378	57749	57761	57772	57784	57795	57807	57818	57830	57841	57852
379	57864	57875	57887	57898	57910	57921	57933	57944	57955	57967
380	57978	57990	58001	58013	58024	58035	58047	58058	58070	58081
381	58092	58104	58115	58127	58138	58149	58161	58172	58184	58195
382	58206	58218	58229	58240	58252	58263	58274	58286	58297	58309
383	58320	58331	58343	58354	58365	58377	58388	58399	58410	58422
384	58433	58444	58456	58467	58478	58490	58501	58512	58524	58535
385	58546	58557	58569	58580	58591	58602	58614	58625	58636	58647
386	58659	58670	58681	58692	58704	58715	58726	58737	58749	58760
387	58771	58782	58794	58805	58816	58827	58838	58850	58861	58872
388	58883	58894	58906	58917	58928	58939	58950	58961	58973	58984
389	58995	59006	59017	59028	59040	59051	59062	59073	59084	59095
390	59106	59118	59129	59140	59151	59162	59173	59184	59195	59207
391	59218	59229	59240	59251	59262	59273	59284	59295	59306	59318
392	59329	59340	59351	59362	59373	59384	59395	59406	59417	59428
393	59439	59450	59461	59472	59483	59494	59506	59517	59528	59539
394	59550	59561	59572	59583	59594	59605	59616	59627	59638	59649
395	59660	59671	59682	59693	59704	59715	59726	59737	59748	59759
396	59770	59780	59791	59802	59813	59824	59835	59846	59857	59868
397	59879	59890	59901	59912	59923	59934	59945	59956	59966	59977
398	59988	59999	60010	60021	60032	60043	60054	60065	60076	60086
399	60097	60108	60119	60130	60141	60152	60163	60173	60184	60195
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Nº 4000——4600. Log. 60206——66276.

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400	60206	60217	60228	60239	60249	60260	60271	60282	60293	60304
401	60314	60325	60336	60347	60358	60369	60379	60390	60401	60412
402	60423	60433	60444	60455	60466	60477	60487	60498	60509	60520
403	60531	60541	60552	60563	60574	60584	60595	60606	60617	60627
404	60638	60649	60660	60670	60681	60692	60703	60713	60724	60735
405	60746	60756	60767	60778	60788	60799	60810	60821	60831	60842
406	60853	60863	60874	60885	60895	60906	60917	60927	60938	60949
407	60959	60970	60981	60991	61002	61013	61023	61034	61045	61055
408	61066	61077	61087	61098	61109	61119	61130	61140	61151	61162
409	61172	61183	61194	61204	61215	61225	61236	61247	61257	61268
410	61278	61289	61300	61310	61321	61331	61342	61352	61363	61374
411	61384	61395	61405	61416	61426	61437	61448	61458	61469	61479
412	61490	61500	61511	61521	61532	61542	61553	61563	61574	61584
413	61595	61606	61616	61627	61637	61648	61658	61669	61679	61690
414	61700	61711	61721	61731	61742	61752	61763	61773	61784	61794
415	61805	61815	61826	61836	61847	61857	61868	61878	61888	61899
416	61909	61920	61930	61941	61951	61962	61972	61982	61993	62003
417	62014	62024	62034	62045	62055	62066	62076	62086	62097	62107
418	62118	62128	62138	62149	62159	62170	62180	62190	62201	62211
419	62221	62232	62242	62252	62263	62273	62284	62294	62304	62315
420	62325	62335	62346	62356	62366	62377	62387	62397	62408	62418
421	62428	62439	62449	62459	62469	62480	62490	62500	62511	62521
422	62531	62542	62552	62562	62572	62583	62593	62603	62613	62624
423	62634	62644	62655	6266	62675	62685	62696	62706	62716	62726
424	62737	62747	62757	62767	62778	62788	62798	62808	62818	62829
425	62839	62849	62859	62870	62880	62890	62900	62910	62921	62931
426	62941	62951	62961	62972	62982	62992	63002	63012	63022	63033
427	63043	63053	63063	63073	63083	63094	63104	63114	63124	63134
428	63144	63155	63165	63175	63185	63195	63205	63215	63225	63236
429	63246	63256	63266	63276	63286	63296	63306	63317	63327	63337
430	63347	63357	63367	63377	63387	63397	63407	63417	63428	63438
431	63448	63458	63468	63478	63488	63498	63508	63518	63528	63538
432	63548	63558	63568	63579	63589	63599	63609	63619	63629	63639
433	63649	63659	63669	63679	63689	63699	63709	63719	63729	63739
434	63749	63759	63769	63779	63789	63799	63809	63819	63829	63839
435	63849	63859	63869	63879	63889	63899	63909	63919	63929	63939
436	63949	63959	63969	63979	63988	63998	64008	64018	64028	64038
437	64048	64058	64068	64078	64088	64098	64108	64118	64128	64137
438	64147	64157	64167	64177	64187	64197	64207	64217	64227	64237
439	64246	64256	64266	64276	64286	64296	64306	64316	64326	64335
440	64345	64355	64365	64375	64385	64395	64404	64414	64424	64434
441	64444	64454	64464	64473	64483	64493	64503	64513	64523	64532
442	64542	64552	64562	64572	64582	64591	64601	64611	64621	64631
443	64640	64650	64660	64670	64680	64689	64699	64709	64719	64729
444	64738	64748	64758	64768	64777	64787	64797	64807	64816	64826
445	64836	64846	64856	64865	64875	64885	64895	64904	64914	64924
446	64933	64943	64953	64963	64972	64982	64992	65002	65011	65021
447	65031	65040	65050	65060	65070	65079	65089	65099	65108	65118
448	65128	65137	65147	65157	65167	65176	65186	65196	65205	65215
449	65225	65234	65244	65254	65263	65273	65283	65292	65302	65312
450	65321	65331	65341	65350	65360	65369	65379	65389	65398	65408
451	65418	65427	65437	65447	65456	65466	65475	65485	65495	65504
452	65514	65523	65533	65543	65552	65562	65571	65581	65591	65600
453	65610	65619	65629	65639	65648	65658	65667	65677	65686	65696
454	65706	65715	65725	65734	65744	65753	65763	65772	65782	65792
455	65801	65811	65820	65830	65839	65849	65858	65868	65877	65887
456	65896	65906	65916	65925	65935	65944	65954	65963	65973	65982
457	65992	66001	66011	66020	66030	66039	66049	66058	66068	66077
458	66087	66096	66106	66115	66124	66134	66143	66153	66162	66172
459	66181	66191	66200	66210	66219	66229	66238	66247	66257	66266
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N° 4600 —— 5200. Log. 66276 —— 71600.

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460	66276	66285	66295	66304	66314	66323	66332	66342	66351	66361
461	66370	66380	66389	66398	66408	66417	66427	66436	66445	66455
462	66464	66474	66483	66492	66502	66511	66521	66530	66539	66549
463	66558	66567	66577	66586	66596	66605	66614	66624	66633	66642
464	66652	66661	66671	66680	66689	66699	66708	66717	66727	66736
465	66745	66755	66764	66773	66783	66792	66801	66811	66820	66829
466	66839	66848	66857	66867	66876	66885	66894	66904	66913	66922
467	66932	66941	66950	66960	66969	66978	66987	66997	67006	67015
468	67025	67034	67043	67052	67062	67071	67080	67089	67099	67108
469	67117	67127	67136	67145	67154	67164	67173	67182	67191	67201
470	67210	67219	67228	67237	67247	67256	67265	67274	67284	67293
471	67302	67311	67321	67330	67339	67348	67357	67367	67376	67385
472	67394	67403	67413	67422	67431	67440	67449	67459	67468	67477
473	67486	67495	67504	67514	67523	67532	67541	67550	67560	67569
474	67578	67587	67596	67605	67614	67624	67633	67642	67651	67660
475	67669	67679	67688	67697	67706	67715	67724	67733	67742	67752
476	67761	67770	67779	67788	67797	67806	67815	67825	67834	67843
477	67852	67861	67870	67879	67888	67897	67906	67916	67925	67934
478	67943	67952	67961	67970	67979	67988	67997	68006	68015	68024
479	68034	68043	68052	68061	68070	68079	68088	68097	68106	68115
480	68124	68133	68142	68151	68160	68169	68178	68187	68196	68205
481	68215	68224	68233	68242	68251	68260	68269	68278	68287	68296
482	68305	68314	68323	68332	68341	68350	68359	68368	68377	68386
483	68395	68404	68413	68422	68431	68440	68449	68458	68467	68476
484	68485	68494	68502	68511	68520	68529	68538	68547	68556	68565
485	68574	68583	68592	68601	68610	68619	68628	68637	68646	68655
486	68664	68673	68681	68690	68699	68708	68717	68726	68735	68744
487	68753	68762	68771	68780	68789	68797	68806	68815	68824	68833
488	68842	68851	68860	68869	68878	68886	68895	68904	68913	68922
489	68931	68940	68949	68958	68966	68975	68984	68993	69002	69011
490	69020	69028	69037	69046	69055	69064	69073	69082	69090	69099
491	69108	69117	69126	69135	69144	69152	69161	69170	69179	69188
492	69197	69205	69214	69223	69232	69241	69249	69258	69267	69276
493	69285	69294	69302	69311	69320	69329	69338	69346	69355	69364
494	69373	69381	69390	69399	69408	69417	69425	69434	69443	69452
495	69461	69469	69478	69487	69496	69504	69513	69522	69531	69539
496	69548	69557	69566	69574	69583	69592	69601	69609	69618	69627
497	69636	69644	69653	69662	69671	69679	69688	69697	69705	69714
498	69723	69732	69740	69749	69758	69767	69775	69784	69793	69801
499	69810	69819	69827	69836	69845	69854	69862	69871	69880	69888
500	69897	69906	69914	69923	69932	69940	69949	69958	69966	69975
501	69984	69992	70001	70010	70018	70027	70036	70044	70053	70062
502	70070	70079	70088	70096	70105	70114	70122	70131	70140	70148
503	70157	70165	70174	70183	70191	70200	70209	70217	70226	70234
504	70243	70252	70260	70269	70278	70286	70295	70303	70312	70321
505	70329	70338	70346	70355	70364	70372	70381	70389	70398	70406
506	70415	70424	70432	70441	70449	70458	70467	70475	70484	70492
507	70501	70509	70518	70526	70535	70544	70552	70561	70569	70578
508	70586	70595	70603	70612	70621	70629	70638	70646	70655	70663
509	70672	70680	70689	70697	70706	70714	70723	70731	70740	70749
510	70757	70766	70774	70783	70791	70800	70808	70817	70825	70834
511	70842	70851	70859	70868	70876	70885	70893	70902	70910	70919
512	70927	70935	70944	70952	70961	70969	70978	70986	70995	71003
513	71012	71020	71029	71037	71046	71054	71063	71071	71079	71088
514	71096	71105	71113	71122	71130	71139	71147	71155	71164	71172
515	71181	71189	71198	71206	71214	71223	71231	71240	71248	71257
516	71265	71273	71282	71290	71299	71307	71315	71324	71332	71341
517	71349	71357	71366	71374	71383	71391	71399	71408	71416	71425
518	71433	71441	71450	71458	71466	71475	71483	71492	71500	71508
519	71517	71525	71533	71542	71550	71559	71567	71575	71584	71592
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N° 5200——5800. Log. 71600——76343.

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521	71684	71692	71700	71709	71717	71725	71734	71742	71750	71759
522	71767	71775	71784	71792	71800	71809	71817	71825	71834	71842
523	71850	71858	71867	71875	71883	71892	71900	71908	71917	71925
524	71933	71941	71950	71958	71966	71975	71983	71991	71999	72008
525	72016	72024	72032	72041	72049	72057	72066	72074	72082	72090
526	72099	72107	72115	72123	72132	72140	72148	72156	72165	72173
527	72181	72189	72198	72206	72214	72222	72230	72239	72247	72255
528	72263	72272	72280	72288	72296	72304	72313	72321	72329	72337
529	72346	72354	72362	72370	72378	72387	72395	72403	72411	72419
530	72428	72436	72444	72452	72460	72469	72477	72485	72493	72501
531	72509	72518	72526	72534	72542	72550	72558	72567	72575	72583
532	72591	72599	72607	72616	72624	72632	72640	72648	72656	72665
533	72673	72681	72689	72697	72705	72713	72722	72730	72738	72746
534	72754	72762	72770	72779	72787	72795	72803	72811	72819	72827
535	72835	72843	72852	72860	72868	72876	72884	72892	72900	72908
536	72916	72925	72933	72941	72949	72957	72965	72973	72981	72989
537	72997	73006	73014	73022	73030	73038	73046	73054	73062	73070
538	73078	73086	73094	73102	73111	73119	73127	73135	73143	73151
539	73159	73167	73175	73183	73191	73199	73207	73215	73223	73231
540	73239	73247	73255	73263	73272	73280	73288	73296	73304	73312
541	73320	73328	73336	73344	73352	73360	73368	73376	73384	73392
542	73400	73408	73416	73424	73432	73440	73448	73456	73464	73472
543	73480	73488	73496	73504	73512	73520	73528	73536	73544	73552
544	73560	73568	73576	73584	73592	73600	73608	73616	73624	73632
545	73640	73648	73656	73664	73672	73679	73687	73695	73703	73711
546	73719	73727	73735	73743	73751	73759	73767	73775	73783	73791
547	73799	73807	73815	73823	73830	73838	73846	73854	73862	73870
548	73878	73886	73894	73902	73910	73918	73926	73933	73941	73949
549	73957	73965	73973	73981	73989	73997	74005	74013	74020	74028
550	74036	74044	74052	74060	74068	74076	74084	74092	74099	74107
551	74115	74123	74131	74139	74147	74155	74162	74170	74178	74186
552	74194	74202	74210	74218	74225	74233	74241	74249	74257	74265
553	74273	74280	74288	74296	74304	74312	74320	74327	74335	74343
554	74351	74359	74367	74374	74382	74390	74398	74406	74414	74421
555	74429	74437	74445	74453	74461	74468	74476	74484	74492	74500
556	74507	74515	74523	74531	74539	74547	74554	74562	74570	74578
557	74586	74593	74601	74609	74617	74624	74632	74640	74648	74656
558	74663	74671	74679	74687	74695	74702	74710	74718	74726	74733
559	74741	74749	74757	74764	74772	74780	74788	74796	74803	74811
560	74819	74827	74834	74842	74850	74858	74865	74873	74881	74889
561	74896	74904	74912	74920	74927	74935	74943	74950	74958	74966
562	74974	74981	74989	74997	75005	75012	75020	75028	75035	75043
563	75051	75059	75066	75074	75082	75089	75097	75105	75113	75120
564	75128	75136	75143	75151	75159	75166	75174	75182	75189	75197
565	75205	75213	75220	75228	75236	75243	75251	75259	75266	75274
566	75282	75289	75297	75305	75312	75320	75328	75335	75343	75351
567	75358	75366	75374	75381	75389	75397	75404	75412	75420	75427
568	75435	75442	75450	75458	75465	75473	75481	75488	75496	75504
569	75511	75519	75526	75534	75542	75549	75557	75565	75572	75580
570	75587	75595	75603	75610	75618	75626	75633	75641	75648	75656
571	75664	75671	75679	75686	75694	75702	75709	75717	75724	75732
572	75740	75747	75755	75762	75770	75778	75785	75793	75800	75808
573	75815	75823	75831	75838	75846	75853	75861	75868	75876	75884
574	75891	75899	75906	75914	75921	75929	75937	75944	75952	75959
575	75967	75974	75982	75989	75997	76005	76012	76020	76027	76035
576	76042	76050	76057	76065	76072	76080	76087	76095	76103	76110
577	76118	76125	76133	76140	76148	76155	76163	76170	76178	76185
578	76193	76200	76208	76215	76223	76230	76238	76245	76253	76260
579	76268	76275	76283	76290	76298	76305	76313	76320	76328	76335
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N° 5800 —— 6400. Log. 76343 —— 80618.

N°	0	1	2	3	4	5	6	7	8	9
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581	76418	76425	76433	76440	76447	76455	76462	76470	76477	76485
582	76492	76500	76507	76515	76522	76530	76537	76545	76552	76559
583	76567	76574	76582	76589	76597	76604	76612	76619	76626	76634
584	76641	76649	76656	76664	76671	76678	76686	76693	76701	76708
585	76716	76723	76730	76738	76745	76753	76760	76768	76775	76782
586	76790	76797	76805	76812	76819	76827	76834	76842	76849	76856
587	76864	76871	76879	76886	76893	76901	76908	76916	76923	76930
588	76938	76945	76953	76960	76967	76975	76982	76989	76997	77004
589	77012	77019	77026	77034	77041	77048	77056	77063	77070	77078
590	77085	77093	77100	77107	77115	77122	77129	77137	77144	77151
591	77159	77166	77173	77181	77188	77195	77203	77210	77217	77225
592	77232	77240	77247	77254	77262	77269	77276	77283	77291	77298
593	77305	77313	77320	77327	77335	77342	77349	77357	77364	77371
594	77379	77386	77393	77401	77408	77415	77422	77430	77437	77444
595	77452	77459	77466	77474	77481	77488	77495	77503	77510	77517
596	77525	77532	77539	77546	77554	77561	77568	77576	77583	77590
597	77597	77605	77612	77619	77627	77634	77641	77648	77656	77663
598	77670	77677	77685	77692	77699	77706	77714	77721	77728	77735
599	77743	77750	77757	77764	77772	77779	77786	77793	77801	77808
600	77815	77822	77830	77837	77844	77851	77859	77866	77873	77880
601	77887	77895	77902	77909	77916	77924	77931	77938	77945	77952
602	77960	77967	77974	77981	77988	77996	78003	78010	78017	78025
603	78032	78039	78046	78053	78061	78068	78075	78082	78089	78097
604	78104	78111	78118	78125	78132	78140	78147	78154	78161	78168
605	78176	78183	78190	78197	78204	78211	78219	78226	78233	78240
606	78247	78254	78262	78269	78276	78283	78290	78297	78305	78312
607	78319	78326	78333	78340	78347	78355	78362	78369	78376	78383
608	78390	78398	78405	78412	78419	78426	78433	78440	78447	78455
609	78462	78469	78476	78483	78490	78497	78504	78512	78519	78526
610	78533	78540	78547	78554	78561	78569	78576	78583	78590	78597
611	78604	78611	78618	78625	78633	78640	78647	78654	78661	78668
612	78675	78682	78689	78696	78704	78711	78718	78725	78732	78739
613	78746	78753	78760	78767	78774	78781	78789	78796	78803	78810
614	78817	78824	78831	78838	78845	78852	78859	78866	78873	78880
615	78888	78895	78902	78909	78916	78923	78930	78937	78944	78951
616	78958	78965	78972	78979	78986	78993	79000	79007	79014	79021
617	79029	79036	79043	79050	79057	79064	79071	79078	79085	79092
618	79099	79106	79113	79120	79127	79134	79141	79148	79155	79162
619	79169	79176	79183	79190	79197	79204	79211	79218	79225	79232
620	79239	79246	79253	79260	79267	79274	79281	79288	79295	79302
621	79309	79316	79323	79330	79337	79344	79351	79358	79365	79372
622	79379	79386	79393	79400	79407	79414	79421	79428	79435	79442
623	79449	79456	79463	79470	79477	79484	79491	79498	79505	79511
624	79518	79525	79532	79539	79546	79553	79560	79567	79574	79581
625	79588	79595	79602	79609	79616	79623	79630	79637	79644	79650
626	79657	79664	79671	79678	79685	79692	79699	79706	79713	79720
627	79727	79734	79741	79748	79754	79761	79768	79775	79782	79789
628	79796	79803	79810	79817	79824	79831	79837	79844	79851	79858
629	79865	79872	79879	79886	79893	79900	79906	79913	79920	79927
630	79934	79941	79948	79955	79962	79969	79975	79982	79989	79996
631	80003	80010	80017	80024	80030	80037	80044	80051	80058	80065
632	80072	80079	80085	80092	80099	80106	80113	80120	80127	80134
633	80140	80147	80154	80161	80168	80175	80182	80188	80195	80202
634	80209	80216	80223	80229	80236	80243	80250	80257	80264	80271
635	80277	80284	80291	80298	80305	80312	80318	80325	80332	80339
636	80346	80353	80359	80366	80373	80380	80387	80393	80400	80407
637	80414	80421	80428	80434	80441	80448	80455	80462	80468	80475
638	80482	80489	80496	80502	80509	80516	80523	80530	80536	80543
639	80550	80557	80564	80570	80577	80584	80591	80598	80604	80611
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No. 6400———7000. Log. 80618———84510.

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640	80618	80625	80632	80638	80645	80652	80659	80665	80672	80679
641	80686	80693	80699	80706	80713	80720	80726	80733	80740	80747
642	80754	80760	80767	80774	80781	80787	80794	80801	80808	80814
643	80821	80828	80835	80841	80848	80855	80862	80868	80875	80882
644	80889	80895	80902	80909	80916	80922	80929	80936	80943	80949
645	80956	80963	80969	80976	80983	80990	80996	81003	81010	81017
646	81023	81030	81037	81043	81050	81057	81064	81070	81077	81084
647	81090	81097	81104	81111	81117	81124	81131	81137	81144	81151
648	81158	81164	81171	81178	81184	81191	81198	81204	81211	81218
649	81224	81231	81238	81245	81251	81258	81265	81271	81278	81285
650	81291	81298	81305	81311	81318	81325	81331	81338	81345	81351
651	81358	81365	81371	81378	81385	81391	81398	81405	81411	81418
652	81425	81431	81438	81445	81451	81458	81465	81471	81478	81485
653	81491	81498	81505	81511	81518	81525	81531	81538	81544	81551
654	81558	81564	81571	81578	81584	81591	81598	81604	81611	81617
655	81624	81631	81637	81644	81651	81657	81664	81671	81677	81684
656	81690	81697	81704	81710	81717	81723	81730	81737	81743	81750
657	81757	81763	81770	81776	81783	81790	81796	81803	81809	81816
658	81823	81829	81836	81842	81849	81856	81862	81869	81875	81882
659	81889	81895	81902	81908	81915	81921	81928	81935	81941	81948
660	81954	81961	81968	81974	81981	81987	81994	82000	82007	82014
661	82020	82027	82033	82040	82046	82053	82060	82066	82073	82079
662	82086	82092	82099	82105	82112	82119	82125	82132	82138	82145
663	82151	82158	82164	82171	82178	82184	82191	82197	82204	82210
664	82217	82223	82230	82236	82243	82249	82256	82263	82269	82276
665	82282	82289	82295	82302	82308	82315	82321	82328	82334	82341
666	82347	82354	82360	82367	82373	82380	82387	82393	82400	82406
667	82413	82419	82426	82432	82439	82445	82452	82458	82465	82471
668	82478	82484	82491	82497	82504	82510	82517	82523	82530	82536
669	82543	82549	82556	82562	82569	82575	82582	82588	82595	82601
670	82607	82614	82620	82627	82633	82640	82646	82653	82659	82666
671	82672	82679	82685	82692	82698	82705	82711	82718	82724	82730
672	82737	82743	82750	82756	82763	82769	82776	82782	82789	82795
673	82802	82808	82814	82821	82827	82834	82840	82847	82853	82860
674	82866	82872	82879	82885	82892	82898	82905	82911	82918	82924
675	82930	82937	82943	82950	82956	82963	82969	82975	82982	82988
676	82995	83001	83008	83014	83020	83027	83033	83040	83046	83052
677	83059	83065	83072	83078	83085	83091	83097	83104	83110	83117
678	83123	83129	83136	83142	83149	83155	83161	83168	83174	83181
679	83187	83193	83200	83206	83213	83219	83225	83232	83238	83245
680	83251	83257	83264	83270	83276	83283	83289	83296	83302	83308
681	83315	83321	83327	83334	83340	83347	83353	83359	83366	83372
682	83378	83385	83391	83398	83404	83410	83417	83423	83429	83436
683	83442	83448	83455	83461	83467	83474	83480	83487	83493	83499
684	83506	83512	83518	83525	83531	83537	83544	83550	83556	83563
685	83569	83575	83582	83588	83594	83601	83607	83613	83620	83626
686	83632	83639	83645	83651	83658	83664	83670	83677	83683	83689
687	83696	83702	83708	83715	83721	83727	83734	83740	83746	83753
688	83759	83765	83771	83778	83784	83790	83797	83803	83809	83816
689	83822	83828	83835	83841	83847	83853	83860	83866	83872	83879
690	83885	83891	83897	83904	83910	83916	83923	83929	83935	83942
691	83948	83954	83960	83967	83973	83979	83985	83992	83998	84004
692	84011	84017	84023	84029	84036	84042	84048	84055	84061	84067
693	84073	84080	84086	84092	84098	84105	84111	84117	84123	84130
694	84136	84142	84148	84155	84161	84167	84173	84180	84186	84192
695	84198	84205	84211	84217	84223	84230	84236	84242	84248	84255
696	84261	84267	84273	84280	84286	84292	84298	84305	84311	84317
697	84323	84330	84336	84342	84348	84354	84361	84367	84373	84379
698	84386	84392	84398	84404	84410	84417	84423	84429	84435	84442
699	84448	84454	84460	84466	84473	84479	84485	84491	84497	84504
No.	0	1	2	3	4	5	6	7	8	9

N° 7000——7600. Log. 84510——88081.

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700	84510	84516	84522	84528	84535	84541	84547	84553	84559	84566
701	84572	84578	84584	84590	84597	84603	84609	84615	84621	84628
702	84634	84640	84646	84652	84658	84665	84671	84677	84683	84689
703	84696	84702	84708	84714	84720	84726	84733	84739	84745	84751
704	84757	84763	84770	84776	84782	84788	84794	84800	84807	84813
705	84819	84825	84831	84837	84844	84850	84856	84862	84868	84874
706	84880	84887	84893	84899	84905	84911	84917	84924	84930	84936
707	84942	84948	84954	84960	84967	84973	84979	84985	84991	84997
708	85003	85009	85016	85022	85028	85034	85040	85046	85052	85058
709	85065	85071	85077	85083	85089	85095	85101	85107	85114	85120
710	85126	85132	85138	85144	85150	85156	85163	85169	85175	85181
711	85187	85193	85199	85205	85211	85217	85224	85230	85236	85242
712	85248	85254	85260	85266	85272	85278	85285	85291	85297	85303
713	85309	85315	85321	85327	85333	85339	85345	85352	85358	85364
714	85370	85376	85382	85388	85394	85400	85406	85412	85418	85425
715	85431	85437	85443	85449	85455	85461	85467	85473	85479	85485
716	85491	85497	85503	85509	85516	85522	85528	85534	85540	85546
717	85552	85558	85564	85570	85576	85582	85588	85594	85600	85606
718	85612	85618	85625	85631	85637	85643	85649	85655	85661	85667
719	85673	85679	85685	85691	85697	85703	85709	85715	85721	85727
720	85733	85739	85745	85751	85757	85763	85769	85775	85781	85788
721	85794	85800	85806	85812	85818	85824	85830	85836	85842	85848
722	85854	85860	85866	85872	85878	85884	85890	85896	85902	85908
723	85914	85920	85926	85932	85938	85944	85950	85956	85962	85968
724	85974	85980	85986	85992	85998	86004	86010	86016	86022	86028
725	86034	86040	86046	86052	86058	86064	86070	86076	86082	86088
726	86094	86100	86106	86112	86118	86124	86130	86136	86141	86147
727	86153	86159	86165	86171	86177	86183	86189	86195	86201	86207
728	86213	86219	86225	86231	86237	86243	86249	86255	86261	86267
729	86273	86279	86285	86291	86297	86303	86308	86314	86320	86326
730	86332	86338	86344	86350	86356	86362	86368	86374	86380	86386
731	86392	86398	86404	86410	86415	86421	86427	86433	86439	86445
732	86451	86457	86463	86469	86475	86481	86487	86493	86499	86504
733	86510	86516	86522	86528	86534	86540	86546	86552	86558	86564
734	86570	86576	86581	86587	86593	86599	86605	86611	86617	86623
735	86629	86635	86641	86646	86652	86658	86664	86670	86676	86682
736	86688	86694	86700	86705	86711	86717	86723	86729	86735	86741
737	86747	86753	86759	86764	86770	86776	86782	86788	86794	86800
738	86806	86812	86817	86823	86829	86835	86841	86847	86853	86859
739	86864	86870	86876	86882	86888	86894	86900	86906	86911	86917
740	86923	86929	86935	86941	86947	86953	86958	86964	86970	86976
741	86982	86988	86994	86999	87005	87011	87017	87023	87029	87035
742	87040	87046	87052	87058	87064	87070	87075	87081	87087	87093
743	87099	87105	87111	87116	87122	87128	87134	87140	87146	87151
744	87157	87163	87169	87175	87181	87186	87192	87198	87204	87210
745	87216	87221	87227	87233	87239	87245	87251	87256	87262	87268
746	87274	87280	87286	87291	87297	87303	87309	87315	87320	87326
747	87332	87338	87344	87349	87355	87361	87367	87373	87379	87384
748	87390	87396	87402	87408	87413	87419	87425	87431	87437	87442
749	87448	87454	87460	87466	87471	87477	87483	87489	87495	87500
750	87506	87512	87518	87523	87529	87535	87541	87547	87552	87558
751	87564	87570	87576	87581	87587	87593	87599	87604	87610	87616
752	87622	87628	87633	87639	87645	87651	87656	87662	87668	87674
753	87679	87685	87691	87697	87703	87708	87714	87720	87726	87731
754	87737	87743	87749	87754	87760	87766	87772	87777	87783	87789
755	87795	87800	87806	87812	87818	87823	87829	87835	87841	87846
756	87852	87858	87864	87869	87875	87881	87887	87892	87898	87904
757	87910	87915	87921	87927	87933	87938	87944	87950	87955	87961
758	87967	87973	87978	87984	87990	87996	88001	88007	88013	88018
759	88024	88030	88036	88041	88047	88053	88058	88064	88070	88076
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No. 7600——8200. Log. 88081——91381.

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761	88138	88144	88150	88156	88161	88167	88173	88178	88184	88190
762	88195	88201	88207	88213	88218	88224	88230	88235	88241	88247
763	88252	88258	88264	88270	88275	88281	88287	88292	88298	88304
764	88309	88315	88321	88326	88332	88338	88343	88349	88355	88360
765	88366	88372	88377	88383	88389	88395	88400	88406	88412	88417
766	88423	88429	88434	88440	88446	88451	88457	88463	88468	88474
767	88480	88485	88491	88497	88502	88508	88513	88519	88525	88530
768	88536	88542	88547	88553	88559	88564	88570	88576	88581	88587
769	88593	88598	88604	88610	88615	88621	88627	88632	88638	88643
770	88649	88655	88660	88666	88672	88677	88683	88689	88694	88700
771	88705	88711	88717	88722	88728	88734	88739	88745	88750	88756
772	88762	88767	88773	88779	88784	88790	88795	88801	88807	88812
773	88818	88824	88829	88835	88840	88846	88852	88857	88863	88868
774	88874	88880	88885	88891	88897	88902	88908	88913	88919	88925
775	88930	88936	88941	88947	88953	88958	88964	88969	88975	88981
776	88986	88992	88997	89003	89009	89014	89020	89025	89031	89037
777	89042	89048	89053	89059	89064	89070	89076	89081	89087	89092
778	89098	89104	89109	89115	89120	89126	89131	89137	89143	89148
779	89154	89159	89165	89170	89176	89182	89187	89193	89198	89204
780	89209	89215	89221	89226	89232	89237	89243	89248	89254	89260
781	89265	89271	89276	89282	89287	89293	89298	89304	89310	89315
782	89321	89326	89332	89337	89343	89348	89354	89360	89365	89371
783	89376	89382	89387	89393	89398	89404	89409	89415	89421	89426
784	89432	89437	89443	89448	89454	89459	89465	89470	89476	89481
785	89487	89492	89498	89504	89509	89515	89520	89526	89531	89537
786	89542	89548	89553	89559	89564	89570	89575	89581	89586	89592
787	89597	89603	89609	89614	89620	89625	89631	89636	89642	89647
788	89653	89658	89664	89669	89675	89680	89686	89691	89697	89702
789	89708	89713	89719	89724	89730	89735	89741	89746	89752	89757
790	89763	89768	89774	89779	89785	89790	89796	89801	89807	89812
791	89818	89823	89829	89834	89840	89845	89851	89856	89862	89867
792	89873	89878	89883	89889	89894	89900	89905	89911	89916	89922
793	89927	89933	89938	89944	89949	89955	89960	89966	89971	89977
794	89982	89988	89993	89998	90004	90009	90015	90020	90026	90031
795	90037	90042	90048	90053	90059	90064	90069	90075	90080	90086
796	90091	90097	90102	90108	90113	90119	90124	90129	90135	90140
797	90146	90151	90157	90162	90168	90173	90179	90184	90189	90195
798	90200	90206	90211	90217	90222	90227	90233	90238	90244	90249
799	90255	90260	90266	90271	90276	90282	90287	90293	90298	90304
800	90309	90314	90320	90325	90331	90336	90342	90347	90352	90358
801	90363	90369	90374	90380	90385	90390	90396	90401	90407	90412
802	90417	90423	90428	90434	90439	90445	90450	90455	90461	90466
803	90472	90477	90482	90488	90493	90499	90504	90509	90515	90520
804	90526	90531	90536	90542	90547	90553	90558	90563	90569	90574
805	90580	90585	90590	90596	90601	90607	90612	90617	90623	90628
806	90634	90639	90644	90650	90655	90660	90666	90671	90677	90682
807	90687	90693	90698	90703	90709	90714	90720	90725	90730	90736
808	90741	90747	90752	90757	90763	90768	90773	90779	90784	90789
809	90795	90800	90806	90811	90816	90822	90827	90832	90838	90843
810	90849	90854	90859	90865	90870	90875	90881	90886	90891	90897
811	90902	90907	90913	90918	90924	90929	90934	90940	90945	90950
812	90956	90961	90966	90972	90977	90982	90988	90993	90998	91004
813	91009	91014	91020	91025	91030	91036	91041	91046	91052	91057
814	91062	91068	91073	91078	91084	91089	91094	91100	91105	91110
815	91116	91121	91126	91132	91137	91142	91148	91153	91158	91164
816	91169	91174	91180	91185	91190	91196	91201	91206	91212	91217
817	91222	91228	91233	91238	91243	91249	91254	91259	91265	91270
818	91275	91281	91286	91291	91297	91302	91307	91312	91318	91323
819	91328	91334	91339	91344	91350	91355	91360	91365	91371	91376
No.	0	1	2	3	4	5	6	7	8	9

N° 8200 —— 8800. Log. 91381 —— 94448.

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820	91381	91387	91392	91397	91403	91408	91413	91418	91424	91429
821	91434	91440	91445	91450	91455	91461	91466	91471	91477	91482
822	91487	91492	91498	91503	91508	91514	91519	91524	91529	91535
823	91540	91545	91551	91556	91561	91566	91572	91577	91582	91587
824	91593	91598	91603	91609	91614	91619	91624	91630	91635	91640
825	91645	91651	91656	91661	91666	91672	91677	91682	91687	91693
826	91698	91703	91709	91714	91719	91724	91730	91735	91740	91745
827	91751	91756	91761	91766	91772	91777	91782	91787	91793	91798
828	91803	91808	91814	91819	91824	91829	91834	91840	91845	91850
829	91855	91861	91866	91871	91876	91882	91887	91892	91897	91903
830	91908	91913	91918	91924	91929	91934	91939	91944	91950	91955
831	91960	91965	91971	91976	91981	91986	91991	91997	92002	92007
832	92012	92018	92023	92028	92033	92038	92044	92049	92054	92059
833	92065	92070	92075	92080	92085	92091	92096	92101	92106	92111
834	92117	92122	92127	92132	92137	92143	92148	92153	92158	92163
835	92169	92174	92179	92184	92189	92195	92200	92205	92210	92215
836	92221	92226	92231	92236	92241	92247	92252	92257	92262	92267
837	92273	92278	92283	92288	92293	92298	92304	92309	92314	92319
838	92324	92330	92335	92340	92345	92350	92355	92361	92366	92371
839	92376	92381	92387	92392	92397	92402	92407	92412	92418	92423
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841	92480	92485	92490	92495	92500	92505	92511	92516	92521	92526
842	92531	92536	92542	92547	92552	92557	92562	92567	92572	92578
843	92583	92588	92593	92598	92603	92609	92614	92619	92624	92629
844	92634	92639	92645	92650	92655	92660	92665	92670	92675	92681
845	92686	92691	92696	92701	92706	92711	92716	92722	92727	92732
846	92737	92742	92747	92752	92758	92763	92768	92773	92778	92783
847	92788	92793	92799	92804	92809	92814	92819	92824	92829	92834
848	92840	92845	92850	92855	92860	92865	92870	92875	92881	92886
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850	92942	92947	92952	92957	92962	92967	92973	92978	92983	92988
851	92993	92998	93003	93008	93013	93018	93024	93029	93034	93039
852	93044	93049	93054	93059	93064	93069	93075	93080	93085	93090
853	93095	93100	93105	93110	93115	93120	93125	93131	93136	93141
854	93146	93151	93156	93161	93166	93171	93176	93181	93186	93192
855	93197	93202	93207	93212	93217	93222	93227	93232	93237	93242
856	93247	93252	93258	93263	93268	93273	93278	93283	93288	93293
857	93298	93303	93308	93313	93318	93323	93328	93334	93339	93344
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859	93399	93404	93409	93414	93420	93425	93430	93435	93440	93445
860	93450	93455	93460	93465	93470	93475	93480	93485	93490	93495
861	93500	93505	93510	93515	93520	93526	93531	93536	93541	93546
862	93551	93556	93561	93566	93571	93576	93581	93586	93591	93596
863	93601	93606	93611	93616	93621	93626	93631	93636	93641	93646
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865	93702	93707	93712	93717	93722	93727	93732	93737	93742	93747
866	93752	93757	93762	93767	93772	93777	93782	93787	93792	93797
867	93802	93807	93812	93817	93822	93827	93832	93837	93842	93847
868	93852	93857	93862	93867	93872	93877	93882	93887	93892	93897
869	93902	93907	93912	93917	93922	93927	93932	93937	93942	93947
870	93952	93957	93962	93967	93972	93977	93982	93987	93992	93997
871	94002	94007	94012	94017	94022	94027	94032	94037	94042	94047
872	94052	94057	94062	94067	94072	94077	94082	94086	94091	94096
873	94101	94106	94111	94116	94121	94126	94131	94136	94141	94146
874	94151	94156	94161	94166	94171	94176	94181	94186	94191	94196
875	94201	94206	94211	94216	94221	94226	94231	94236	94240	94245
876	94250	94255	94260	94265	94270	94275	94280	94285	94290	94295
877	94300	94305	94310	94315	94320	94325	94330	94335	94340	94345
878	94349	94354	94359	94364	94369	94374	94379	94384	94389	94394
879	94399	94404	94409	94414	94419	94424	94429	94433	94438	94443
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881	94498	94503	94507	94512	94517	94522	94527	94532	94537	94542
882	94547	94552	94557	94562	94567	94571	94576	94581	94586	94591
883	94596	94601	94606	94611	94616	94621	94626	94630	94635	94640
884	94645	94650	94655	94660	94665	94670	94675	94680	94685	94689
885	94694	94699	94704	94709	94714	94719	94724	94729	94734	94738
886	94743	94748	94753	94758	94763	94768	94773	94778	94783	94787
887	94792	94797	94802	94807	94812	94817	94822	94827	94832	94836
888	94841	94846	94851	94856	94861	94866	94871	94876	94880	94885
889	94890	94895	94900	94905	94910	94915	94919	94924	94929	94934
890	94939	94944	94949	94954	94959	94963	94968	94973	94978	94983
891	94988	94993	94998	95002	95007	95012	95017	95022	95027	95032
892	95036	95041	95046	95051	95056	95061	95066	95071	95075	95080
893	95085	95090	95095	95100	95105	95109	95114	95119	95124	95129
894	95134	95139	95143	95148	95153	95158	95163	95168	95173	65177
895	95182	95187	95192	95197	95202	95207	95211	95216	95221	95226
896	95231	95236	95240	95245	95250	95255	95260	95265	95270	95274
897	95279	95284	95289	95294	95299	95303	95308	95313	95318	95323
898	95328	95332	95337	95342	95347	95352	95357	95361	95366	95371
899	95376	95381	95386	95390	95395	95400	95405	95410	95415	95419
900	95424	95429	95434	95439	95444	95448	95453	95458	95463	95468
901	95472	95477	95482	95487	95492	95497	95501	95506	95511	95516
902	95521	95525	95530	95535	95540	95545	95550	95554	95559	95564
903	95569	95574	95578	95583	95588	95593	95598	95602	95607	95612
904	95617	95622	95626	95631	95636	95641	95646	95650	95655	95660
905	95665	95670	95674	95679	95684	95689	95694	95698	95703	95708
906	95713	95718	95722	95727	95732	95737	95742	95746	95751	95756
907	95761	95766	95770	95775	95780	95785	95789	95794	95799	95804
908	95809	95813	95818	95823	95828	95832	95837	95842	95847	95852
909	95856	95861	95866	95871	95875	95880	95885	95890	95895	95899
910	95904	95909	95914	95918	95923	95928	95933	95938	95942	95947
911	95952	95957	95961	95966	95971	95976	95980	95985	95990	95995
912	95999	96004	96009	96014	96019	96023	96028	96033	96038	96042
913	96047	96052	96057	96061	96066	96071	96076	96080	96085	96090
914	96095	96099	96104	96109	96114	96118	96123	96128	96133	96137
915	96142	96147	96152	96156	96161	96166	96171	96175	96180	96185
916	96190	96194	96199	96204	96209	96213	96218	96223	96227	96232
917	96237	96242	96246	96251	96256	96261	96265	96270	96275	96280
918	96284	96289	96294	96298	96303	96308	96313	96317	96322	96327
919	96332	96336	96341	96346	96350	96355	96360	96365	96369	96374
920	96379	96384	96388	96393	96398	96402	96407	96412	96417	96421
921	96426	96431	96435	96440	96445	96450	96454	96459	96464	96468
922	96473	96478	96483	96487	96492	96497	96501	96506	96511	96515
923	96520	96525	96530	96534	96539	96544	96548	96553	96558	96562
924	96567	96572	96577	96581	96586	96591	96595	96600	96605	96609
925	96614	96619	96624	96628	96633	96638	96642	96647	96652	96656
926	96661	96666	96670	96675	96680	96685	96689	96694	96699	96703
927	96708	96713	96717	96722	96727	96731	96736	96741	96745	96750
928	96755	96759	96764	96769	96774	96778	96783	96788	96792	96797
929	96802	96806	96811	96816	96820	96825	96830	96834	96839	96844
930	96848	96853	96858	96862	96867	96872	96876	96881	96886	96890
931	96895	96900	96904	96909	96914	96918	96923	96928	96932	96937
932	96942	96946	96951	96956	96960	97965	96970	96974	96979	96984
933	96988	96993	96997	97002	97007	97011	97016	97021	97025	97030
934	97035	97039	97044	97049	97053	97058	97063	97067	97072	97077
935	97081	97086	97090	97095	97100	97104	97109	97114	97118	97123
936	97128	97132	97137	97142	97146	97151	97155	97160	97165	97169
937	97174	97179	97183	97188	97192	97197	97202	97206	97211	97216
938	97220	97225	97230	97234	97239	97243	97248	97253	97257	97262
939	97267	97271	97276	97280	97285	97290	97294	97299	97304	97308
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942	97405	97410	97414	97419	97424	97428	97433	97437	97442	97447
943	97451	97456	97460	97465	97470	97474	97479	97483	97488	97493
944	97497	97502	97506	97511	97516	97520	97525	97529	97534	97539
945	97543	97548	97552	97557	97562	97566	97571	97575	97580	97585
946	97589	97594	97598	97603	97607	97612	97617	97621	97626	97630
947	97635	97640	97644	97649	97653	97658	97663	97667	97672	97676
948	97681	97685	97690	97695	97699	97704	97708	97713	97717	97722
949	97727	97731	97736	97740	97745	97749	97754	97759	97763	97768
950	97772	97777	97782	97786	97791	97795	97800	97804	97809	97813
951	97818	97823	97827	97832	97836	97841	97845	97850	97855	97859
952	97864	97868	97873	97877	97882	97886	97891	97896	97900	97905
953	97909	97914	97918	97923	97928	97932	97937	97941	97946	97950
954	97955	97959	97964	97968	97973	97978	97982	97987	97991	97996
955	98000	98005	98009	98014	98019	98023	98028	98032	98037	98041
956	98046	98050	98055	98059	98064	98068	98073	98078	98082	98087
957	98091	98096	98100	98105	98109	98114	98118	98123	98127	98132
958	98137	98141	98146	98150	98155	98159	98164	98168	98173	98177
959	98182	98186	98191	98195	98200	98204	98209	98214	98218	98223
960	98227	98232	98236	98241	98245	98250	98254	98259	98263	98268
961	98272	98277	98281	98286	98290	98295	98299	98304	98308	98313
962	98318	98322	98327	98331	98336	98340	98345	98349	98354	98358
963	98363	98367	98372	98376	98381	98385	98390	98394	98399	98403
964	98408	98412	98417	98421	98426	98430	98435	98439	98444	98448
965	98453	98457	98462	98466	98471	98475	98480	98484	98489	98493
966	98498	98502	98507	98511	98516	98520	98525	98529	98534	98538
967	98543	98547	98552	98556	98561	98565	98570	98574	98579	98583
968	98588	98592	98597	98601	98605	98610	98614	98619	98623	98628
969	98632	98637	98641	98646	98650	98655	98659	98664	98668	98673
970	98677	98682	98686	98691	98695	98700	98704	98709	98713	98717
971	98722	98726	98731	98735	98740	98744	98749	98753	98758	98762
972	98767	98771	98776	98780	98784	98789	98793	98798	98802	98807
973	98811	98816	98820	98825	98829	98834	98838	98843	98847	98851
974	98856	98860	98865	98869	98874	98878	98883	98887	98892	98896
975	98900	98905	98909	98914	98918	98923	98927	98932	98936	98941
976	98945	98949	98954	98958	98963	98967	98972	98976	98981	98985
977	98989	98994	98998	99003	99007	99012	99016	99021	99025	99029
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982	99211	99216	99220	99224	99229	99233	99238	99242	99247	99251
983	99255	99260	99264	99269	99273	99277	99282	99286	99291	99295
984	99300	99304	99308	99313	99317	99322	99326	99330	99335	99339
985	99344	99348	99352	99357	99361	99366	99370	99374	99379	99383
986	99388	99392	99396	99401	99405	99410	99414	99419	99423	99427
987	99432	99436	99441	99445	99449	99454	99458	99463	99467	99471
988	99476	99480	99484	99489	99493	99498	99502	99506	99511	99515
989	99520	99524	99528	99533	99537	99542	99546	99550	99555	99559
990	99564	99568	99572	99577	99581	99585	99590	99594	99599	99603
991	99607	99612	99616	99621	99625	99629	99634	99638	99642	99647
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993	99695	99699	99704	99708	99712	99717	99721	99726	99730	99734
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998	99913	99917	99922	99926	99930	99935	99939	99944	99948	99952
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M	Hour A.M	Hour P.M	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	M.
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1	11 59 52	0 8	6.46373	00000	6.46372	13.53627	00000	13.53627	59
2	59 44	0 16	76476	00000	76476	23524	00000	23524	58
3	59 36	0 24	94085	00000	94085	05915	00000	05915	57
4	59 28	0 32	7.06579	00000	7.06579	12.93421	00000	12.93421	56
5	11 59 20	0 0 40	7.16270	10.00000	7.16270	12.83730	10.00000	12.83730	55
6	59 12	0 48	24188	00000	24188	75812	00000	75812	54
7	59 4	0 56	30882	00000	30882	69118	00000	69118	53
8	58 56	1 4	36681	00000	36682	63318	00000	63318	52
9	58 48	1 12	41797	00000	41797	58203	00000	58203	51
10	58 40	1 20	46373	00000	46373	53627	00000	53627	50
11	11 58 32	0 1 28	7.40512	10.00000	7.50512	12.49488	10.00000	12.49488	49
12	58 24	1 36	54291	00000	54291	45709	00000	45709	48
13	58 16	1 44	57767	00000	57767	42233	00000	42233	47
14	58 8	1 52	60985	00000	60986	39014	00000	39015	46
15	58 0	2 0	63982	00000	63982	36018	00000	36018	45
16	11 57 52	0 2 8	7.66784	10.00000	7.66785	12.33215	10.00000	12.33216	44
17	57 44	2 16	69417	9.99999	69418	30582	00000	30583	43
18	57 36	2 24	71900	99999	71900	28100	00001	28100	42
19	57 28	2 32	74248	99999	74248	25752	00001	25752	41
20	57 20	2 40	76475	99999	76476	23524	00001	23525	40
21	11 57 12	0 2 48	7.78594	9.99999	7.78595	12.21405	10.00001	12.21406	39
22	57 4	2 56	80615	99999	80615	19385	00001	19385	38
23	56 56	3 4	82545	99999	82546	17454	00001	17455	37
24	56 48	3 12	84393	99999	84394	15606	00001	15607	36
25	56 40	3 20	86166	99999	86167	13833	00001	13834	35
26	11 56 32	0 3 28	7.87870	9.99999	7.87871	12.12130	10.00001	12.12130	34
27	56 24	3 36	89509	99999	89510	10490	00001	10491	33
28	56 16	3 44	92088	99999	91089	08911	00001	08912	32
29	56 8	3 52	92612	99999	92613	07387	00002	07388	31
30	56 0	4 0	94084	99999	94086	05914	00002	05915	30
31	11 55 52	0 4 8	7.95508	9.99998	7.95510	12.04490	10.00002	12.04492	29
32	55 44	4 16	96887	99998	96889	03111	00002	03113	28
33	55 36	4 24	98223	99998	98225	01775	00002	01777	27
34	55 28	4 32	99520	99998	99522	00478	00002	00480	26
35	55 20	4 40	8.00779	99998	8.00781	11.99219	00002	11.99221	25
36	11 55 12	0 4 48	8.02002	9.99998	8.02004	11.97996	10.00002	11.97998	24
37	55 4	4 56	03192	99997	03194	96805	00002	96808	23
38	54 56	5 4	04350	99997	04353	95647	00003	95650	22
39	54 48	5 12	05478	99997	05481	94519	00003	94522	21
40	54 40	5 20	06578	99997	06581	93419	00003	93422	20
41	11 54 32	0 5 28	8.07650	9.99997	8.07653	11.92347	10.00003	11.92350	19
42	54 24	5 36	08696	99997	08700	91300	00003	91304	18
43	54 16	5 44	09718	99997	09722	90278	00003	90281	17
44	54 8	5 52	10717	99996	10720	89280	00004	89283	16
45	54 0	6 0	11693	99996	11696	88304	00004	88307	15
46	11 53 52	0 6 8	8.12647	9.99996	8.12651	11.87349	10.00004	11.87356	14
47	53 44	6 16	13581	99996	13585	86415	00004	86419	13
48	53 36	6 24	14495	99996	14500	85500	00004	85505	12
49	53 28	6 32	15391	99996	15395	84605	00005	84609	11
50	53 20	6 40	16268	99995	16273	83727	00005	83732	10
51	11 53 12	0 6 48	8.17128	9.99995	8.17132	11.82867	10.00005	11.82872	9
52	53 4	6 56	17971	99995	17976	82024	00005	82029	8
53	52 56	7 4	18798	99995	18804	81196	00005	81202	7
54	52 48	7 12	19610	99995	19616	80384	00005	80390	6
55	52 40	7 20	20407	99994	20413	79587	00006	79593	5
56	11 52 32	0 7 28	8.21189	9.99994	8.21195	11.78805	10.00006	11.78811	4
57	52 24	7 36	21958	99994	21964	78036	00006	78042	3
58	52 16	7 44	22713	99994	22719	77280	00006	77206	2
59	52 8	7 52	23456	99994	23462	76538	00006	76544	1
60	52 0	8 0	24186	99993	24192	75808	00006	75814	0
M	Hour P.M.	Hour A.M	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M.

M.	Hour A.M.	Hour P.M.	Sine.	Co-fine.	Tangent.	Co-tang.	Secant.	Co-fecant.	M.
0	11 52 0	0 8 0	8.24185	9.99993	8.24192	11.75808	10.00007	11.75814	60
1	51 52	8 8	24903	99993	24910	75090	00007	75097	59
2	51 44	8 16	25609	99993	25616	74384	00007	74391	58
3	51 36	8 24	26304	99993	26311	73688	00007	73696	57
4	51 28	8 32	26988	99992	26996	73004	00007	73012	56
5	11 51 20	0 8 40	8.27661	9.99992	8.27669	11.72331	10.00008	11.72339	55
6	51 12	8 48	28324	99992	28332	71668	00008	71676	54
7	51 4	8 56	28977	99992	28985	71014	00008	71023	53
8	50 56	9 4	29621	99991	29629	70371	00008	70379	52
9	50 48	9 12	30255	99991	30263	69737	00009	69745	51
10	11 50 40	0 9 20	8.30879	9.99991	8.30888	11.69112	10.00009	11.69121	50
11	50 32	9 28	31495	99991	31505	68495	00009	68505	49
12	50 24	9 36	32103	99990	32112	67888	00009	67897	48
13	50 16	9 44	32702	99990	32711	67289	00010	67298	47
14	50 8	9 52	33292	99990	33302	66697	00010	66708	46
15	11 50 0	0 10 0	8.33875	9.99989	8.33886	11.66114	10.00010	11.66125	45
16	49 52	10 8	34450	99989	34461	65539	00011	65510	44
17	49 44	10 16	35018	99989	35029	64971	00011	64982	43
18	49 36	10 24	35578	99989	35589	64410	00011	64422	42
19	49 28	10 32	36131	99989	36143	63857	00011	63868	41
20	11 49 20	0 10 40	8.36678	9.99988	8.36689	11.63310	10.00012	11.63322	40
21	49 12	10 48	37217	99988	37229	62771	00012	62783	39
22	49 4	10 56	37750	99988	37762	62238	00012	62250	38
23	48 56	11 4	38276	99987	38289	61711	00013	61724	37
24	48 48	11 12	38796	99987	38809	61191	00013	61204	36
25	11 48 40	0 11 20	8.39310	9.99987	8.39323	11.60677	10.00013	11.60690	35
26	48 32	11 28	39818	99986	39832	60168	00014	60182	34
27	48 24	11 36	40320	99986	40334	59666	00014	59680	33
28	48 16	11 44	40816	99986	40830	59170	00014	59184	32
29	48 8	11 52	41307	99985	41321	58679	00015	58693	31
30	11 48 0	0 12 0	8.41792	9.99985	8.41807	11.58193	10.00015	11.58208	30
31	47 52	12 8	42272	99985	42287	57713	00015	57728	29
32	47 44	12 16	42746	99984	42762	57238	00016	57254	28
33	47 36	12 24	43216	99984	43231	56768	00016	56784	27
34	47 28	12 32	43680	99984	43696	56304	00016	56320	26
35	11 47 20	0 12 40	8.44139	9.99983	8.44156	11.55844	10.00017	11.55861	25
36	47 12	12 48	44594	99983	44611	55389	00017	55406	24
37	47 4	12 56	45044	99983	45061	54939	00017	54956	23
38	46 56	13 4	45489	99982	45507	54493	00018	54510	22
39	46 48	13 12	45930	99982	45948	54052	00018	54070	21
40	11 46 40	0 13 20	8.46366	9.99982	8.46385	11.53615	10.00018	11.53633	20
41	46 32	13 28	46798	99981	46817	53183	00019	53201	19
42	46 24	13 36	47226	99981	47245	52755	00019	52774	18
43	46 16	13 44	47650	99980	47669	52331	00019	52350	17
44	46 8	13 52	48069	99980	48089	51911	00020	51931	16
45	11 46 0	0 14 0	8.48485	9.99980	8.48505	11.51495	10.00020	11.51515	15
46	45 52	14 8	48896	99979	48917	51083	00021	51104	14
47	45 44	14 16	49304	99979	49325	50675	00021	50696	13
48	45 36	14 24	49708	99979	49729	50271	00021	50292	12
49	45 28	14 32	50108	99978	50130	49870	00022	49892	11
50	11 45 20	0 14 40	8.50504	9.99978	8.50527	11.49473	10.00022	11.49495	10
51	45 12	14 48	50897	99977	50920	49080	00023	49103	9
52	45 4	14 56	51287	99977	51310	48690	00023	48713	8
53	44 56	15 4	51673	99976	51696	48304	00023	48328	7
54	44 48	15 12	52055	99976	52079	47921	00024	47945	6
55	11 44 40	0 15 20	8.52434	9.99976	8.52459	11.47541	10.00024	11.47566	5
56	44 32	15 28	52810	99975	52835	47165	00025	47190	4
57	44 24	15 36	53183	99975	53208	46792	00025	46817	3
58	44 16	15 44	53552	99974	53578	46422	00026	46448	2
59	44 8	15 52	53919	99974	53945	46055	00026	46081	1
60	44 0	16 0	54282	99973	54308	45692	00026	45718	0
M.	Hour P.M.	Hour A.M.	Co-Sine.	Sine.	Co-tang.	Tangent.	Co-fecant.	Secant.	M.

M.	Hour A.M	Hour P.M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant	M.
0	11 44 0	0 16 0	8.54282	9.99973	8.54309	11.45692	10.00026	11.45718	60
1	43 52	16 8	54642	99973	54669	45331	00027	45358	59
2	43 44	16 16	54999	99973	55027	44973	00027	45000	58
3	43 36	16 24	55354	99972	55382	44618	00028	44646	57
4	43 28	16 32	55705	99972	55734	44266	00028	44295	56
5	11 43 20	0 16 40	8.56054	9.99971	8.56083	11.43917	10.00029	11.43946	55
6	43 12	16 48	56400	99971	56429	43572	00029	43600	54
7	43 4	16 56	56743	99970	56773	43227	00030	43257	53
8	42 56	17 4	57084	99970	57114	42886	00030	42916	52
9	42 48	17 12	57421	99970	57452	42548	00030	42579	51
10	11 42 40	0 17 20	8.57757	9.99969	8.57788	11.42212	10.00031	11.42243	50
11	42 32	17 28	58089	99968	58121	41879	00031	41911	49
12	42 24	17 36	58419	99968	58451	41549	00032	41581	48
13	42 16	17 44	58747	99967	58779	41221	00032	41253	47
14	42 8	17 52	59072	99967	59105	40895	00033	40927	46
15	11 42 0	0 18 0	8.59395	9.99966	8.59428	11.40572	10.00033	11.40605	45
16	41 52	18 8	59715	99966	59749	40251	00034	40285	44
17	41 44	18 16	60033	99965	60068	39932	00034	39967	43
18	41 36	18 24	60349	99965	60384	39616	00035	36951	42
19	41 28	18 32	60662	99964	60698	39302	00035	39338	41
20	11 41 20	0 18 40	8.60973	9.99964	8.61009	11.38991	10.00036	11.39027	40
21	41 12	18 48	61282	99963	61319	38681	00036	38718	39
22	41 4	18 56	61589	99963	61626	38374	00037	38411	38
23	40 56	19 4	61894	99962	61931	38069	00038	38106	37
24	40 48	19 12	62196	99962	62234	37766	00038	37804	36
25	11 40 40	0 19 20	8.62496	9.99961	8.62535	11.37465	10.00039	11.37503	35
26	40 32	19 28	62795	99961	62834	37166	00039	37205	34
27	40 24	19 36	63091	99960	63131	36869	00040	36909	33
28	40 16	19 44	63385	99960	63426	36574	00040	36615	32
29	40 8	19 52	63678	99959	63718	36281	00041	36322	31
30	11 40 0	0 20 0	8.63968	9.99959	8.64009	11.35991	10.00041	11.36032	30
31	39 52	20 8	64256	99958	64298	35702	00042	35744	29
32	39 44	20 16	64543	99957	64585	35415	00042	35457	28
33	39 36	20 24	64827	99957	64870	35130	00043	35173	27
34	39 28	20 32	65110	99956	65154	34846	00044	34890	26
35	11 39 20	0 20 40	8.65391	9.99956	8.65435	11.34565	10.00044	11.34609	25
36	39 12	20 48	65670	99955	65715	34285	00045	34330	24
37	39 4	20 56	65947	99955	65993	34007	00045	34052	23
38	38 56	21 4	66223	99954	66269	33731	00046	33777	22
39	38 48	21 12	66497	99953	66543	33457	00046	33503	21
40	11 38 40	0 21 20	8.66769	9.99953	8.66816	11.33184	10.00047	11.33231	20
41	38 32	21 28	67039	99952	67087	32913	00048	32961	19
42	38 24	21 36	67308	99952	67356	32644	00048	32692	18
43	38 16	21 44	67575	99951	67624	32376	00049	32425	17
44	38 8	21 52	67840	99951	67890	32110	00049	32160	16
45	11 38 0	0 22 0	8.68104	9.99950	8.68154	11.31846	10.00050	11.31896	15
46	37 52	22 8	68365	99949	68417	31583	00051	31633	14
47	37 44	22 16	68627	99949	68678	31322	00051	31373	13
48	37 36	22 24	68886	99948	68938	31062	00052	31114	12
49	37 28	22 32	69144	99947	69196	30804	00052	30856	11
50	11 37 20	0 22 40	8.69400	9.99947	8.69453	11.30547	10.00053	11.30600	10
51	37 12	22 48	69654	99946	69708	30292	00054	30346	9
52	37 4	22 56	69907	99946	69962	30039	00054	30093	8
53	36 56	23 4	70159	99945	70214	29786	00055	29841	7
54	36 48	23 12	70409	99944	70465	29535	00056	29591	6
55	11 36 40	0 23 20	8.70658	9.99944	8.70714	11.29286	10.00056	11.29342	5
56	36 32	23 28	70905	99943	70962	29038	00057	29095	4
57	36 24	23 36	71151	99942	71208	28792	00058	28849	3
58	36 16	23 44	71395	99942	71453	28546	00058	28605	2
59	36 8	23 52	71638	99941	71697	28303	00059	28361	1
60	36 0	24 0	71880	99940	71940	28060	00059	28120	0
M.	Hour.P.M	Hour A.M	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M.

3 Degs. TABLE XXV. Of Artificial Sines, Tangents, & Secants. 176 Degs.

M.	Hour A.M.	Hour P.M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant	M.
0	11 36 0	0 24 0	8.71880	9.99940	8.71940	11.28060	10.00059	11.28120	60
1	35 52	24 8	72120	99940	72181	27819	00060	27880	59
2	35 44	24 16	72359	99939	72420	27580	00061	27640	58
3	35 36	24 24	72597	99938	72659	27341	00062	27403	57
4	35 28	24 32	72834	99938	72896	27104	00062	27166	56
5	11 35 20	0 24 40	8.73069	9.99937	8.73132	11.26868	10.00063	11.26931	55
6	35 12	24 48	73303	99936	73366	26634	00064	26697	54
7	35 4	24 56	73535	99936	73600	26400	00064	26465	53
8	34 56	25 4	73767	99935	73832	26168	00065	26233	52
9	34 48	25 12	73997	99934	74063	25937	00065	26003	51
10	11 34 40	0 25 20	8.74226	9.99934	8.74292	11.25708	10.00066	11.25774	50
11	34 32	25 28	74454	99933	74521	25479	00067	25546	49
12	34 24	25 36	74680	99932	74748	25252	00068	25320	48
13	34 16	25 44	74905	99931	74974	25026	00068	25094	47
14	34 8	25 52	75130	99931	75199	24801	00069	24870	46
15	11 34 0	0 26 0	8.75353	9.99930	8.75423	11.24577	10.00070	11.24647	45
16	33 52	26 8	75575	99929	75645	24355	00070	24425	44
17	33 44	26 16	75795	99929	75867	24133	00071	24204	43
18	33 36	26 24	76015	99928	76087	23913	00072	23985	42
19	33 28	26 32	76234	99927	76306	23693	00073	23766	41
20	11 33 20	0 26 40	8.76451	9.99926	8.76525	11.23475	10.00073	11.23549	40
21	33 12	26 48	76667	99926	76742	23258	00074	23332	39
22	33 4	26 56	76883	99925	76958	23042	00075	23117	38
23	32 56	27 4	77097	99924	77173	22827	00076	22903	37
24	32 48	27 12	77310	99923	77387	22613	00076	22690	36
25	11 32 40	0 27 20	8.77522	9.99923	8.77599	11.22400	10.00077	11.22478	35
26	32 32	27 28	77733	99922	77811	22189	00078	22267	34
27	32 24	27 36	77943	99921	78022	21978	00079	22057	33
28	32 16	27 44	78152	99920	78232	21768	00079	21848	32
29	32 8	27 52	78360	99920	78441	21559	00080	21639	31
30	11 32 0	0 28 0	8.78567	9.99919	8.78849	11.21351	10.00081	11.21432	30
31	31 52	28 8	78774	99918	78855	21145	00082	21226	29
32	31 44	28 16	78979	99917	79061	20939	00083	21021	28
33	31 36	28 24	79183	99917	79266	20734	00083	20817	27
34	31 28	28 32	79386	99916	79470	20530	00084	20614	26
35	11 31 20	0 28 40	8.79588	9.99915	8.79673	11.20327	10.00085	11.20412	25
36	31 12	28 48	79789	99914	79875	20125	00086	20211	24
37	31 4	28 56	79990	99913	80076	19924	00087	20010	23
38	30 56	29 4	80189	99913	80276	19723	00087	19811	22
39	30 48	29 12	80388	99912	80476	19523	00088	19612	21
40	11 30 40	0 29 20	8.80585	9.99911	8.80674	11.19326	10.00089	11.19415	20
41	30 32	29 28	80782	99910	80872	19128	00090	19218	19
42	30 24	29 36	80978	99909	81068	18932	00091	19022	18
43	30 16	29 44	81173	99909	81264	18736	00091	18827	17
44	30 8	29 52	81367	99908	81459	18541	00092	18633	16
45	11 30 0	0 30 0	8.81560	9.99907	8.81653	11.18347	10.00093	11.18440	15
46	29 52	30 8	81752	99906	81846	18154	00094	18243	14
47	29 44	30 16	81944	99905	82038	17962	00095	18056	13
48	29 36	30 24	82134	99904	82230	17770	00096	17866	12
49	29 28	30 32	82324	99904	82420	17579	00097	17676	11
50	11 29 20	0 30 40	8.82513	9.99903	8.82610	11.17390	10.00097	11.17487	10
51	29 12	30 48	82701	99902	82799	17201	00098	17299	9
52	29 4	30 56	82888	99901	82987	17013	00099	17112	8
53	28 56	31 4	83075	99900	83175	16825	00100	16925	7
54	28 48	31 12	83261	99899	83361	16639	00101	16739	6
55	11 28 40	0 31 20	8.83446	9.99898	8.83547	11.16453	10.00102	11.16554	5
56	28 32	31 28	83630	99898	83732	16268	00102	16370	4
57	28 24	31 36	83813	99897	83916	16084	00103	16187	3
58	28 16	31 44	83996	99896	84100	15900	00104	16004	2
59	28 8	31 52	84177	99895	84282	15717	00105	15823	1
60	28 0	32 0	84358	99894	84464	15536	00106	15642	0
M.	[illegible]	Hour A.M.	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M.

93 Degs. 86 Degs.

M.	Hour A.M.	Hour P.M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	M.
0	11 28 0	0 32 0	8.84358	9.99894	8.84464	11.15536	10.00106	11.15642	60
1	27 52	32 8	84539	99893	84646	15354	00107	15461	59
2	27 44	32 16	84718	99892	84826	15174	00108	15282	58
3	27 36	32 24	84897	99891	85006	14994	00109	15103	57
4	27 28	32 32	85075	99890	85185	14815	00109	14925	56
5	11 27 20	0 32 40	8.85252	9.99890	8.85363	11.14637	10.00110	11.14748	55
6	27 12	32 48	85429	99889	85540	14460	00111	14571	54
7	27 4	32 56	85605	99888	85717	14283	00112	14395	53
8	26 56	33 4	85780	99887	85893	14107	00113	14220	52
9	26 48	33 12	85955	99886	86069	13931	00114	14045	51
10	11 26 40	0 33 20	8.86128	9.99885	8.86243	11.13757	10.00115	11.13872	50
11	26 32	33 28	86301	99884	86417	13583	00116	13699	49
12	26 24	33 36	86474	99883	86591	13409	00117	13526	48
13	26 16	33 44	86645	99882	86763	13237	00118	13355	47
14	26 8	33 52	86816	99881	86935	13065	00119	13184	46
15	11 26 0	0 34 0	8.86987	9.99880	8.87106	11.12894	10.00120	11.13013	45
16	25 52	34 8	87156	99879	87277	12723	00121	12844	44
17	25 44	34 16	87325	99878	87447	12553	00121	12675	43
18	25 36	34 24	87494	99878	87616	12384	00122	12506	42
19	25 28	34 32	87661	99877	87785	12215	00123	12339	41
20	11 25 20	0 34 40	8.87829	9.99876	8.87953	11.12047	10.00124	11.12171	40
21	25 12	34 48	87995	99875	88120	11880	00125	12005	39
22	25 4	34 56	88161	99874	88287	11713	00126	11839	38
23	24 56	35 4	88326	99873	88453	11547	00127	11674	37
24	24 48	35 12	88490	99872	88618	11382	00128	11510	36
25	11 24 40	0 35 20	8.88654	9.99871	8.88783	11.11217	10.00129	11.11346	35
26	24 32	35 28	88817	99870	88948	11052	00130	11183	34
27	24 24	35 36	88980	99869	89111	10889	00131	11020	33
28	24 16	35 44	89142	99868	89274	10726	00132	10858	32
29	24 8	35 52	89304	99867	89437	10563	00133	10696	31
30	11 24 0	0 36 0	8.89464	9.99866	8.89598	11.10402	10.00134	11.10536	30
31	23 52	36 8	89624	99865	89760	10240	00135	10375	29
32	23 44	36 16	89784	99864	89920	10080	00136	10216	28
33	23 36	36 24	89943	99863	90080	09920	00137	10057	27
34	23 28	36 32	90102	99862	90240	09760	00138	09898	26
35	11 23 20	0 36 40	8.90260	9.99861	8.90399	11.09601	10.00139	11.09740	25
36	23 12	36 48	90417	99860	90557	09443	00140	09583	24
37	23 4	36 56	90574	99859	90715	09285	00141	09426	23
38	22 56	37 4	90730	99858	90872	09128	00142	09270	22
39	22 48	37 12	90885	99857	91029	08971	00143	09115	21
40	11 22 40	0 37 20	8.91040	9.99856	8.91185	11.08815	10.00144	11.08960	20
41	22 32	37 28	91195	99855	91340	08660	00145	08805	19
42	22 24	37 36	91349	99854	91495	08505	00146	08651	18
43	22 16	37 44	91502	99853	91650	08350	00147	08498	17
44	22 8	37 52	91655	99852	91803	08197	00148	08345	16
45	11 22 0	0 38 0	8.91807	9.99851	8.91957	11.08043	10.00149	11.08193	15
46	21 52	38 8	91959	99849	92110	07890	00150	08041	14
47	21 44	38 16	92110	99848	92262	07738	00152	07890	13
48	21 36	38 24	92261	99847	92414	07586	00153	07739	12
49	21 28	38 32	92411	99846	92565	07435	00154	07589	11
50	11 21 20	0 38 40	8.92561	9.99845	8.92716	11.07284	10.00155	11.07439	10
51	21 12	38 48	92710	99844	92866	07134	00156	07290	9
52	21 4	38 56	92859	99843	93016	06984	00157	07141	8
53	20 56	39 4	93007	99842	93165	06835	00158	06993	7
54	20 48	39 12	93154	99841	93313	06687	00159	06846	6
55	11 20 40	0 39 20	8.93301	9.99840	8.93462	11.06538	10.00160	11.06699	5
56	20 32	39 28	93448	99839	93609	06391	00161	06552	4
57	20 24	39 36	93594	99838	93756	06244	00162	06406	3
58	20 16	39 44	93740	99837	93903	06097	00163	06260	2
59	20 8	39 52	93885	99835	94049	05951	00164	06115	1
60	20 0	40 0	94030	99834	94195	05805	00166	05970	0
M.	Hour P.M.	Hour A.M.	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Hour A.M.	Hour P.M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	M.
0	11 20 0	0 40 0	8.94030	9.99834	8.94195	11.05805	10.00166	11.05970	60
1	19 52	40 8	94174	99833	94340	05660	00167	05826	59
2	19 44	40 16	94317	99832	94485	05515	00168	05683	58
3	19 36	40 24	94461	99831	94630	05370	00169	05539	57
4	19 28	40 32	94603	99830	94773	05227	00170	05397	56
5	11 19 20	0 40 40	8.94746	9.99829	8.94917	11.05083	10.00171	11.05254	55
6	19 12	40 48	94887	99828	95060	04940	00172	05113	54
7	19 4	40 56	95029	99827	95202	04798	00173	04971	53
8	18 56	41 4	95170	99825	95344	04656	00175	04830	52
9	18 48	41 12	95310	99824	95486	04514	00176	04690	51
10	11 18 40	0 41 20	8.95450	9.99823	8.95627	11.04373	10.00177	11.04550	50
11	18 32	41 28	95590	99822	95767	04233	00178	04411	49
12	18 24	41 36	95728	99821	95908	04092	00179	04272	48
13	18 16	41 44	95867	99820	96047	03953	00180	04133	47
14	18 8	41 52	96005	99819	96187	03813	00181	03995	46
15	11 18 0	0 42 0	8.96143	9.99817	8.96325	11.03675	10.00183	11.03857	45
16	17 52	42 8	96280	99816	96464	03536	00184	03720	44
17	17 44	42 16	96417	99815	96602	03398	00185	03583	43
18	17 36	42 24	96553	99814	96739	03261	00186	03447	42
19	17 28	42 32	96689	99813	96877	03123	00187	03311	41
20	11 17 20	0 42 40	8.96825	9.99812	8.97013	11.02987	10.00188	11.03175	40
21	17 12	42 48	96960	99810	97150	02850	00190	03040	39
22	17 4	42 56	97095	99809	97285	02715	00191	02905	38
23	16 56	43 4	97229	99808	97421	02579	00192	02771	37
24	16 48	43 12	97363	99807	97556	02444	00193	02637	36
25	11 16 40	0 43 20	8.97496	9.99806	8.97691	11.02309	10.00194	11.02504	35
26	16 32	43 28	97629	99804	97825	02175	00196	02371	34
27	16 24	43 36	97762	99803	97959	02041	00197	02238	33
28	16 16	43 44	97894	99802	98092	01908	00198	02106	32
29	16 8	43 52	98026	99801	98225	01775	00199	01974	31
30	11 16 0	0 44 0	8.98157	9.99800	8.98358	11.01642	10.00200	11.01843	30
31	15 52	44 8	98288	99798	98490	01510	00202	01712	29
32	15 44	44 16	98419	99797	98622	01378	00203	01581	28
33	15 36	44 24	98549	99796	98753	01247	00204	01451	27
34	15 28	44 32	98679	99795	98884	01116	00205	01321	26
35	11 15 20	0 44 40	8.98808	9.99793	8.99015	11.00985	10.00207	11.01192	25
36	15 12	44 48	98937	99792	99145	00855	00208	01063	24
37	15 4	44 56	99066	99791	99275	00725	00209	00934	23
38	14 56	45 4	99194	99790	99405	00595	00210	00806	22
39	14 48	45 12	99322	99788	99534	00466	00212	00678	21
40	11 14 40	0 45 20	8.99450	9.99787	8.99662	11.00338	10.00213	11.00550	20
41	14 32	45 28	99577	99786	99791	00209	00214	00423	19
42	14 24	45 36	99704	9978	99919	00081	00215	00296	18
43	14 16	45 44	99830	99784	9.00046	10.99954	00217	00170	17
44	14 8	45 52	99956	99782	00174	99826	00218	00044	16
45	11 14 0	0 46 0	9.00082	9.99781	9.00301	10.99699	10.00219	10.99918	15
46	13 52	46 8	00207	99780	00427	99573	00220	99793	14
47	13 44	46 16	00332	99779	00553	99447	00222	99668	13
48	13 36	46 24	00456	99777	00679	99321	00223	99544	12
49	13 28	46 32	00580	99776	00805	99195	00224	99419	11
50	11 13 20	0 46 40	9.00704	9.99774	9.00930	10.99070	10.00225	10.99296	10
51	13 12	46 48	00828	99773	01055	98945	00227	99172	9
52	13 4	46 56	00951	99772	01179	98821	00228	99049	8
53	12 56	47 4	01074	99771	01303	98697	00229	98926	7
54	12 48	47 12	01196	99769	01427	98573	00231	98804	6
55	11 12 40	0 47 20	9.01318	9.99768	9.01550	10.98450	10.00232	10.08682	5
56	12 32	47 28	01440	99767	01673	98327	00233	98560	4
57	12 24	47 36	01561	99765	01796	98204	00235	98439	3
58	12 16	47 44	01682	99764	01918	98082	00236	98318	2
59	12 8	47 52	01803	99763	02040	97960	00237	98197	1
60	12 0	48 0	01923	99761	02162	97838	00239	98077	0
M.	Hour P.M.	Hour A.M.	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Hour A.M.	Hour P.M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant	M.
0	11 12 0	0 48 0	9.01923	9.99761	9.02162	10.97838	10.00239	10.98077	60
1	11 52	48 8	02043	99760	02283	97717	00240	97957	59
2	11 44	48 16	02163	99759	02404	97596	00241	97837	58
3	11 36	48 24	02283	99757	02525	97475	00243	97717	57
4	11 28	48 32	02402	99756	02645	97355	00244	97598	56
5	11 11 20	0 48 40	9.02520	9.99755	9.02766	10.97234	10.00245	10.97480	55
6	11 12	48 48	02639	99753	02885	97115	00247	97361	54
7	11 4	48 56	02757	99752	03005	96995	00248	97243	53
8	10 56	49 4	02874	99751	03124	96876	00249	97126	52
9	10 48	49 12	02992	99749	03242	96758	00251	97008	51
10	11 10 40	0 49 20	9.03109	9.99748	9.03361	10.96639	10.00252	10.96891	50
11	10 32	49 28	03226	99747	03479	96521	00253	96774	49
12	10 24	49 36	03342	99745	03597	96403	00255	96658	48
13	10 16	49 44	03458	99744	03714	96286	00256	96542	47
14	10 8	49 52	03574	99742	03832	96168	00258	96426	46
15	11 10 0	0 50 0	9.03690	9.99741	9.03948	10.96052	10.00259	10.96310	45
16	9 52	50 8	03805	99740	04065	95935	00260	96195	44
17	9 44	50 16	03920	99738	04181	95819	00262	96080	43
18	9 36	50 24	04034	99737	04297	95703	00263	95966	42
19	9 28	50 32	04140	99735	04413	95587	00264	95851	41
20	11 9 20	0 50 40	9.04262	9.99734	9.04528	10.95472	10.00266	10.95738	40
21	9 12	50 48	04376	99733	04643	95357	00267	95624	39
22	9 4	50 56	04489	99731	04758	95242	00269	95510	38
23	8 56	51 4	04603	99730	04873	95127	00270	95397	37
24	8 48	51 12	04715	99728	04987	95013	00272	95285	36
25	11 8 40	0 51 20	9.04828	9.99727	9.05101	10.94899	10.00273	10.95172	35
26	8 32	51 28	04940	99726	05214	94786	00274	95060	34
27	8 24	51 36	05052	99724	05328	94672	00276	94948	33
28	8 16	51 44	05164	99723	05441	94559	00277	94836	32
29	8 8	51 52	05275	99721	05553	94447	00279	94725	31
30	11 8 0	0 52 0	9.05386	9.99720	9.05666	10.94334	10.00280	10.94614	30
31	7 52	52 8	05497	99718	05778	94222	00282	94503	29
32	7 44	52 16	05607	99717	05890	94110	00283	94393	28
33	7 36	52 24	05717	99716	06002	93998	00284	94283	27
34	7 28	52 32	05827	99714	06113	93887	00286	94173	26
35	11 7 20	0 52 40	9.05937	9.99713	9.06224	10.93776	10.00287	10.94063	25
36	7 12	52 48	06046	99711	06335	93665	00289	93954	24
37	7 4	52 56	06155	99710	06445	93555	00290	93845	23
38	6 56	53 4	06264	99708	06556	93444	00292	93736	22
39	6 48	53 12	06372	99707	06666	93334	00293	93628	21
40	11 6 40	0 53 20	9.06481	9.99705	9.06775	10.93225	10.00295	10.93519	20
41	6 32	53 28	06588	99704	06885	93115	00296	93411	19
42	6 24	53 36	06696	99702	06994	93006	00298	93304	18
43	6 16	53 44	06804	99701	07103	92897	00299	93196	17
44	6 8	53 52	06911	99699	07211	92789	00301	93089	16
45	11 6 0	0 54 0	9.07018	9.99698	9.07320	10.92680	10.00302	10.92982	15
46	5 52	54 8	07124	99696	07428	92572	00304	92876	14
47	5 44	54 16	07231	99695	07536	92464	00305	92769	13
48	5 36	54 24	07337	99693	07643	92357	00307	92663	12
49	5 28	54 32	07442	99692	07751	92249	00308	92558	11
50	11 5 20	0 54 40	9.07548	9.99690	9.07858	10.92142	10.00310	10.92452	10
51	5 12	54 48	07653	99689	07964	92036	00311	92347	9
52	5 4	54 56	07758	99687	08071	91929	00313	92242	8
53	4 56	55 4	07863	99686	08177	91823	00314	92137	7
54	4 48	55 12	07968	99684	08283	91717	00316	92032	6
55	11 4 40	0 55 20	9.08072	9.99683	9.08389	10.91611	10.00317	10.91928	5
56	4 32	55 28	08176	99681	08495	91505	00319	91824	4
57	4 24	55 36	08280	99680	08600	91400	00320	91720	3
58	4 16	55 44	08383	99678	08705	91295	00322	91617	2
59	4 8	55 52	08486	99677	08810	91190	00323	91514	1
60	4 0	56 0	08589	99675	08914	91086	00325	91411	0
M.	Hour P.M.	Hour A.M.	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M.

M.	Hour A.M.	Hour P.M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	M.
0	11 4 0	0 56 0	9.08589	9.99675	9.08914	10.91086	10.00325	10.91411	60
1	3 52	56 8	08692	99673	09019	90981	00326	91308	59
2	3 44	56 16	08795	99672	09123	90877	00328	91205	58
3	3 36	56 24	08897	99670	09227	90773	00330	91103	57
4	3 28	56 32	08999	99669	09330	90670	00331	91001	56
5	11 3 20	0 56 40	9.09101	9.99667	9.09434	10.90566	10.00333	10.90899	55
6	3 12	56 48	09202	99666	09537	90463	00334	90798	54
7	3 4	56 56	09304	99664	09640	90360	00336	90696	53
8	2 56	57 4	09405	99662	09742	90258	00337	90595	52
9	2 48	57 12	09506	99661	09845	90155	00339	90494	51
10	11 2 40	0 57 20	9.09606	9.99659	9.09947	10.90053	10.00341	10.90394	50
11	2 32	57 28	09706	99658	10049	89951	00342	90293	49
12	2 24	57 36	09807	99656	10150	89850	00344	90193	48
13	2 16	57 44	09906	99655	10252	89748	00345	90093	47
14	2 8	57 52	10006	99653	10353	89647	00347	89994	46
15	11 2 0	0 58 0	9.10106	9.99651	9.10454	10.89546	10.00349	10.89894	45
16	1 52	58 8	10205	99650	10555	89445	00350	89795	44
17	1 44	58 16	10304	99648	10656	89344	00352	89696	43
18	1 36	58 24	10402	99647	10756	89244	00353	89598	42
19	1 28	58 32	10501	99645	10856	89144	00355	89499	41
20	11 1 20	0 58 40	9.10599	9.99643	9.10956	10.89044	10.00357	10.89401	40
21	1 12	58 48	10697	99642	11056	88944	00358	89303	39
22	1 4	58 56	10795	99640	11155	88845	00360	89205	38
23	0 56	59 4	10893	99638	11254	88746	00362	89107	37
24	0 48	59 12	10990	99637	11353	88647	00363	89010	36
25	11 0 40	0 59 20	9.11087	9.99635	9.11452	10.88548	10.00365	10.88913	35
26	0 32	59 28	11184	99633	11551	88449	00367	88816	34
27	0 24	59 36	11281	99632	11649	88351	00368	88719	33
28	0 16	59 44	11377	99630	11747	88253	00370	88623	32
29	0 8	50 52	11474	99628	11845	88155	00371	88526	31
30	11 0 0	1 0 0	9.11570	9.99627	9.11943	10.88057	10.00373	10.88430	30
31	10 59 52	0 8	11666	99625	12040	87960	00375	88334	29
32	59 44	0 16	11761	99623	12138	87862	00376	88239	28
33	59 36	0 24	11857	99622	12235	87765	00378	88143	27
34	59 28	0 32	11952	99620	12332	87668	00380	88048	26
35	10 59 20	1 0 40	9.12047	9.99618	9.12428	10.87572	10.00382	10.87953	25
36	59 12	0 48	12142	99617	12525	87475	00383	87858	24
37	59 4	0 56	12236	99615	12621	87379	00385	87764	23
38	58 56	1 4	12331	99613	12717	87283	00387	87669	22
39	58 48	1 12	12425	99611	12813	87187	00388	87575	21
40	10 58 40	1 1 20	9.12519	9.99610	9.12909	10.87091	10.00390	10.87481	20
41	58 32	1 28	12612	99608	13004	86996	00392	87388	19
42	58 24	1 36	12706	99607	13099	86901	00393	87294	18
43	58 16	1 44	12799	99605	13194	86806	00395	87201	17
44	58 8	1 52	12892	99603	13289	86711	00397	87108	16
45	10 58 0	1 2 0	9.12985	9.99601	9.13384	10.86616	10.00399	10.87015	15
46	57 52	2 8	13078	99600	13478	86522	00400	86922	14
47	57 44	2 16	13171	99598	13573	86427	00402	86829	13
48	57 36	2 24	13263	99596	13667	86333	00404	86737	12
49	57 28	2 32	13355	99595	13761	86239	00405	86645	11
50	10 57 20	1 2 40	9.13447	9.99593	9.13854	10.86146	10.00407	10.86553	10
51	57 12	2 48	13539	99591	13948	86052	00409	86461	9
52	57 4	2 56	13630	99589	14041	85959	00411	86370	8
53	56 56	3 4	13722	99588	14134	85866	00412	86278	7
54	56 48	3 12	13813	99586	14227	85773	00414	86187	6
55	10 56 40	1 3 20	9.13904	9.99584	9.14320	10.85680	10.00416	10.86096	5
56	56 32	3 28	13994	99582	14412	85588	00418	86006	4
57	56 24	3 36	14085	99581	14504	85496	00419	85915	3
58	56 16	3 44	14175	99579	14597	85403	00421	85825	2
59	56 8	3 52	14266	99577	14688	85312	00423	85734	1
60	56 0	4 0	14356	99575	14780	85220	00425	85644	0
M.	Hour P.M.	Hour A.M.	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Hour A.M	Hour P.M	Sine.	Co-Sine.	Tangent.	Co-tang.	Secant.	Co-sec.	M.
0	10 56 0	1 4 0	9.14356	9.99575	9.14780	10.85220	10.00425	10.85644	60
1	55 52	4 8	14445	99573	14872	85128	00426	85555	59
2	55 44	4 16	14535	99572	14963	85037	00428	85465	58
3	55 36	4 24	14624	99570	15054	84946	00430	85376	57
4	55 28	4 32	14714	99568	15145	84855	00432	85286	56
5	10 55 20	1 4 40	9.14803	9.99566	9.15236	10.84764	10.00434	10.85197	55
6	55 12	4 48	14891	99565	15327	84673	00435	85109	54
7	55 4	4 56	14980	99563	15417	84583	00437	85020	53
8	54 56	5 4	15069	99561	15508	84492	00439	84931	52
9	54 48	5 12	15157	99559	15598	84402	00441	84843	51
10	10 54 40	1 5 20	9.15245	9.99557	9.15688	10.84312	10.00443	10.84755	50
11	54 32	5 28	15333	99555	15777	84223	00444	84667	49
12	54 24	5 36	15421	99554	15867	84133	00446	84579	48
13	54 16	5 44	15508	99552	15956	84044	00448	84492	47
14	54 8	5 52	15596	99550	16046	83954	00450	84404	46
15	10 54 0	1 6 0	9.15683	9.99548	9.16135	10.83865	10.00452	10.84317	45
16	53 52	6 8	15770	99546	16224	83776	00454	84230	44
17	53 44	6 16	15857	99545	16312	83688	00455	84143	43
18	53 36	6 24	15943	99543	16401	83599	00457	84056	42
19	53 28	6 32	16030	99541	16489	83511	00459	83970	41
20	10 53 20	1 6 40	9.16116	9.99539	9.16577	10.83423	10.00461	10.83884	40
21	53 12	6 48	16203	99537	16665	83335	00463	83797	39
22	53 4	6 56	16289	99535	16753	83247	00465	83711	38
23	52 56	7 4	16374	99533	16841	83159	00467	83626	37
24	52 48	7 12	16460	99532	16928	83072	00468	83540	36
25	10 52 40	1 7 20	9.16545	9.99530	9.17016	10.82984	10.00470	10.83455	35
26	52 32	7 28	16631	99528	17103	82897	00472	83369	34
27	52 24	7 36	16716	99526	17190	82810	00474	83284	33
28	52 16	7 44	16801	99524	17277	82723	00476	83199	32
29	52 8	7 52	16886	99522	17363	82637	00478	83114	31
30	10 52 0	1 8 0	9.16970	9.99520	9.17450	10.82550	10.00480	10.83030	30
31	51 52	8 8	17055	99518	17536	82464	00482	82945	29
32	51 44	8 16	17139	99517	17622	82378	00483	82861	28
33	51 36	8 24	17223	99515	17708	82292	00485	82777	27
34	51 28	8 32	17307	99513	17794	82206	00487	82693	26
35	10 51 20	1 8 40	9.17391	9.99511	9.17880	10.82120	10.00489	10.82609	25
36	51 12	8 48	17474	99509	17965	82035	00491	82526	24
37	51 4	8 56	17558	99507	18051	81949	00493	82442	23
38	50 56	9 4	17641	99505	18136	81864	00495	82359	22
39	50 48	9 12	17724	99503	18221	81779	00497	82276	21
40	10 50 40	1 9 20	9.17807	9.99501	9.18306	10.81694	10.00499	10.82193	20
41	50 32	9 28	17890	99499	18391	81609	00501	82110	19
42	50 24	9 36	17973	99497	18475	81525	00503	82027	18
43	50 16	9 44	18055	99495	18560	81440	00505	81945	17
44	50 8	9 52	18137	99493	18644	81356	00506	81863	16
45	10 50 0	1 10 0	9.18220	9.99492	9.18728	10.81272	10.00508	10.81780	15
46	49 52	10 8	18302	99490	18812	81188	00510	81698	14
47	49 44	10 16	18383	99488	18896	81104	00512	81617	13
48	49 36	10 24	18465	99486	18979	81021	00514	81535	12
49	49 28	10 32	18547	99484	19063	80937	00516	81453	11
50	10 49 20	1 10 40	9.18628	9.99482	9.19146	10.80854	10.00518	10.81372	10
51	49 12	10 48	18709	99480	19229	80771	00520	81291	9
52	49 4	10 56	18790	99478	19312	80688	00522	81210	8
53	48 56	11 4	18871	99476	19395	80605	00524	81129	7
54	48 48	11 12	18952	99474	19478	80522	00526	81048	6
55	10 48 40	1 11 20	9.19033	9.99472	9.19561	10.80439	10.00528	10.80967	5
56	48 32	11 28	19113	99470	19643	80357	00530	80887	4
57	48 24	11 36	19193	99468	19725	80275	00532	80807	3
58	48 16	11 44	19273	99466	19807	80193	00534	80727	2
59	48 8	11 52	19353	99464	19889	80111	00536	80647	1
60	48 0	12 0	19433	99462	19971	80029	00538	80567	0
M.	Hour P.M	Hour A.M	Co-Sine.	Sine.	Co-tang.	Tangent.	Co-sec.	Secant.	M.

M	Hour A.M.	Hour P.M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	M.
0	10 48 0	1 12 0	9.19433	9.99462	9.19971	10.80029	10.00538	10.80567	60
1	47 52	12 8	19513	99460	20053	79947	00540	80487	59
2	47 44	12 16	19592	99458	20134	79866	00542	80408	58
3	47 36	12 24	19672	99456	20216	79784	00544	80328	57
4	47 28	12 32	19751	99454	20297	79703	00546	80249	56
5	10 47 20	1 12 40	9.19830	9.99452	9.20378	10.79622	10.00548	10.80170	55
6	47 12	12 48	19909	99450	20459	79541	00550	80091	54
7	47 4	12 56	19988	99448	20540	79460	00552	80012	53
8	46 56	13 4	20067	99446	20621	79379	00554	79933	52
9	46 48	13 12	20145	99444	20701	79299	00556	29855	51
10	10 46 40	1 13 20	9.20223	9.99442	9.20782	10.79218	10.00558	10.79777	50
11	46 32	13 28	20302	99440	20862	79138	00560	79698	49
12	46 24	13 36	20380	99438	20942	79058	00562	79620	48
13	46 16	13 44	20458	99436	21022	78978	00564	79542	47
14	46 8	13 52	20535	99434	21102	78898	00566	79465	46
15	10 46 0	1 14 0	9.20613	9.99432	9.21182	10.78818	10.00568	10.79387	45
16	45 52	14 8	20691	99429	21261	78739	00571	79309	44
17	45 44	14 16	20768	99427	21341	78659	00573	79232	43
18	45 36	14 24	20845	99425	21420	78580	00575	79155	42
19	45 28	14 32	20922	99423	21499	78501	00577	79078	41
20	10 45 20	1 14 40	9.20999	9.99421	9.21578	10.78422	10.00579	10.79001	40
21	45 12	14 48	21076	99419	21657	78343	00581	78924	39
22	45 4	14 56	21153	99417	21736	78264	00583	78847	38
23	44 56	15 4	21229	99415	21814	78186	00585	78771	37
24	44 48	15 12	21305	99413	21893	78107	00587	78694	36
25	10 44 40	1 15 20	9.21382	9.99411	9.21971	10.78029	10.00589	10.78618	35
26	44 32	15 28	21458	99409	22049	77951	00591	78542	34
27	44 24	15 36	21534	99407	22127	77873	00593	78466	33
28	44 16	15 44	21610	99404	22205	77795	00596	78390	32
29	44 8	15 52	21685	99402	22283	77717	00598	78315	31
30	10 44 0	1 16 0	9.21761	9.99400	9.22361	10.77639	10.00600	10.78239	30
31	43 52	16 8	21836	99398	22438	77562	00602	78164	29
32	43 44	16 16	21912	99396	22516	77484	00604	78088	28
33	43 36	16 24	21987	99394	22593	77407	00606	78013	27
34	43 28	16 32	22062	99392	22670	77330	00608	77938	26
35	10 43 20	1 16 40	9.22137	9.99390	9.22747	10.77253	10.00610	10.77863	25
36	43 12	16 48	22211	99388	22824	77176	00612	77789	24
37	43 4	16 56	22286	99385	22901	77099	00615	77714	23
38	42 56	17 4	22361	99383	22977	77023	00617	77639	22
39	42 48	17 12	22435	99381	23054	76946	00619	77565	21
40	10 42 40	1 17 20	9.22509	9.99379	9.23130	10.76870	10.00621	10.77491	20
41	42 32	17 28	22583	99377	23206	76794	00623	77417	19
42	42 24	17 36	22657	99375	23283	76717	00625	77343	18
43	42 16	17 44	22731	99372	23359	76641	00628	77269	17
44	42 8	17 52	22805	99370	23435	76565	00630	77195	16
45	10 42 0	1 18 0	9.22878	9.99368	9.23510	10.76490	10.00632	10.77122	15
46	41 52	18 8	22952	99366	23586	76414	00634	77048	14
47	41 44	18 16	23025	99364	23661	76339	00636	76975	13
48	41 36	18 24	23098	99362	23737	76263	00638	76902	12
49	41 28	18 32	23171	99359	23812	76188	00641	76829	11
50	10 41 20	1 18 40	9.23244	9.99357	9.23887	10.76113	10.00643	10.76756	10
51	41 12	18 48	23317	99355	23962	76038	00645	76683	9
52	41 4	18 56	23390	99353	24037	75963	00647	76610	8
53	40 56	19 4	23462	99351	24112	75888	00649	76538	7
54	40 48	19 12	23535	99348	24186	75814	00652	76465	6
55	10 40 40	1 19 20	9.23607	9.99346	9.24261	10.75739	10.00654	10.76393	5
56	40 32	19 28	23679	99344	24335	75665	00656	76321	4
57	40 24	19 36	23751	99342	24410	75590	00658	76248	3
58	40 16	19 44	23823	99340	24484	75516	00660	76177	2
59	40 8	19 52	23895	99337	24558	75442	00665	76105	1
60	40 0	20 0	23967	99335	24632	75368	00665	76033	0
M	Hour A.M.	Hour P.M.	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

10 Deg. TABLE XXV. Of Artificial Sines, Tangents, & Secants. 160 Deg

M.	Hour A.M.	Hour P.M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	M.
0	10 40 0	1 20 0	9.23967	9.99335	9.24632	10.75368	10.00665	10.76033	60
1	39 52	20 8	24039	99333	24706	75294	00667	75961	59
2	39 44	20 16	24110	99331	24779	75221	00669	75890	58
3	39 36	20 24	24181	99328	24853	75147	00672	75819	57
4	39 28	20 32	24253	99326	24926	75074	00674	75747	56
5	10 39 20	1 20 40	9.24324	9.99324	9.25000	10.75000	10.00676	10.75676	55
6	39 12	20 48	24395	99322	25073	74927	00678	75605	54
7	39 4	20 56	24466	99319	25146	74854	00681	75534	53
8	38 56	21 4	24536	99317	25219	74781	00683	75464	52
9	38 48	21 12	24607	99315	25292	74708	00685	75393	51
10	10 38 40	1 21 20	9.24677	9.99313	9.25365	10.74635	10.00687	10.75323	50
11	38 32	21 28	24748	99310	25437	74563	00690	75252	49
12	38 24	21 36	24818	99308	25510	74490	00692	75182	48
13	38 16	21 44	24888	99306	25582	74418	00694	75114	47
14	38 8	21 52	24958	99304	25655	74345	00696	75042	46
15	10 38 0	1 22 0	9.25028	9.99301	9.25727	10.74273	10.00699	10.74972	45
16	37 52	22 8	25098	99299	25799	74201	00701	74902	44
17	37 44	22 16	25168	99297	25871	74129	00703	74832	43
18	37 36	22 24	25237	99294	25943	74057	00706	74763	42
19	37 28	22 32	25307	99292	26015	73985	00708	74693	41
20	20 37 20	1 22 40	9.25376	9.99290	9.26086	10.73914	10.00710	10.74624	40
21	37 12	22 48	25445	99288	26158	73842	00712	74555	39
22	37 4	22 56	25514	99285	26229	73771	00715	74486	38
23	36 56	23 4	25583	99283	26301	73699	00717	74417	37
24	36 48	23 12	25652	99281	26372	73628	00719	74348	36
25	10 36 40	1 23 20	9.25721	9.99278	9.26443	10.73557	10.00722	10.74279	35
26	36 32	23 28	25790	99276	26514	73486	00724	74210	34
27	36 24	23 36	25858	99274	26585	73415	00726	74142	33
28	36 16	23 44	25927	99271	26655	73345	00729	74073	32
29	36 8	23 52	25995	99269	26726	73274	00731	74005	31
30	10 36 0	10 24 0	9.26063	9.99267	9.26797	10.73203	10.00733	10.73937	30
31	35 52	24 8	26131	99264	26867	73133	00736	73869	29
32	35 44	24 16	26199	99262	26937	73063	00738	73801	28
33	35 36	24 24	26267	99260	27008	72992	00740	73733	27
34	35 28	24 32	26335	99257	27078	72922	00743	73665	26
35	20 35 20	10 24 40	9.26403	9.99255	9.27148	10.72852	10.00745	10.73597	25
36	35 12	24 48	26470	99252	27218	72782	00748	73530	24
37	35 4	24 56	26538	99250	27288	72712	00750	73462	23
38	34 56	25 4	26605	99248	27357	72643	00752	73395	22
39	34 48	25 12	26672	99245	27427	72573	00755	73328	21
40	10 34 40	10 25 20	9.26739	9.99243	9.27496	10.72504	10 00757	10.73261	20
41	34 32	25 28	26806	99241	27566	72434	00759	73194	19
42	34 24	25 36	26873	99238	27635	72365	00762	73127	18
43	34 16	25 44	26940	99236	27704	72296	00764	73060	17
44	34 8	25 52	27007	99233	27773	72227	00767	72993	16
45	10 34 0	10 26 0	9.27073	9.99231	9.27842	10.72158	10.00769	10.72927	15
46	33 52	26 8	27140	99229	27911	72089	00771	72860	14
47	33 44	26 16	27206	99226	27980	72020	00774	72794	13
48	33 36	26 24	27273	99224	28049	71951	00776	72727	12
49	33 28	26 32	27339	99221	28117	71883	00779	72661	11
50	10 33 20	10 26 40	9.27405	9.99219	9.28186	10.71814	10.00781	10.72595	10
51	33 12	26 48	27471	99217	28254	71746	00783	72529	9
52	33 4	26 56	27537	99214	28323	71677	00786	72463	8
53	32 56	27 4	27602	99212	28391	71609	00788	72398	7
54	32 48	27 12	27668	99209	28459	71541	00791	72332	6
55	10 32 40	10 27 20	9.27734	9.99207	28527	10.71473	10.00793	10.72266	5
56	32 32	27 28	27799	99204	28595	71405	00796	72201	4
57	32 24	27 36	27864	99202	28662	71338	00798	72136	3
58	32 16	27 44	27930	99200	28730	71270	00800	72070	2
59	32 8	27 52	27995	99197	28798	71202	00803	72005	1
60	32 0	28 0	28060	99195	28865	71135	00805	71940	0
M.	Hour P.M.	Hour A.M.	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

100 Deg. 79 Deg.

M.	Hour A.M.	Hour P.M.	Sine.	Co-Sine.	Tangent.	Co-tang.	Secant.	Co-secant.	M.
0	10 32 0	1 28 0	9.28060	9.99195	9.28865	10.71135	10.00805	10.71940	60
1	31 52	28 8	28125	99192	28933	71067	00808	71875	59
2	31 44	28 16	28190	99190	29000	71000	00810	71810	58
3	31 36	28 24	28254	99187	29067	70933	00813	71746	57
4	31 28	28 32	28319	99185	29134	70866	00815	71681	56
5	10 31 20	1 28 40	9.28384	9.99182	9.29201	10.70799	10.00818	10.71616	55
6	31 12	28 48	28448	99180	29268	70732	00820	71552	54
7	31 4	28 56	28512	99177	29335	70665	00823	71488	53
8	30 56	29 4	28577	99175	29402	70598	00825	71423	52
9	30 48	29 12	28641	99172	29468	70532	00828	71359	51
10	10 30 40	1 29 20	9.28705	9.99170	9.29535	10.70465	10.00830	10.71295	50
11	30 32	29 28	28769	99167	29601	70399	00833	71231	49
12	30 24	29 36	28833	99165	29668	70332	00835	71167	48
13	30 16	29 44	28896	99162	29734	70266	00838	71104	47
14	30 8	29 52	28960	99160	29800	70200	00840	71040	46
15	10 30 0	1 30 0	9.29024	9.99157	9.29866	10.70134	10.00843	10.70976	45
16	29 52	30 8	29087	99155	29932	70068	00845	70913	44
17	29 44	30 16	29150	99152	29998	70002	00848	70850	43
18	29 36	30 24	29214	99150	30064	69936	00850	70786	42
19	29 28	30 32	29277	99147	30130	69870	00853	70723	41
20	10 29 20	1 30 40	9.29340	9.99145	9.30195	10.69805	10.00855	10.70660	40
21	29 12	30 48	29403	99142	30261	69739	00858	70597	39
22	29 4	30 56	29466	99140	30326	69674	00860	70534	38
23	28 56	31 4	29529	99137	30391	69609	00863	70471	37
24	28 48	31 12	29591	99135	30457	69543	00865	70409	36
25	10 28 40	1 31 20	9.29654	9.99132	9.30522	10.69478	10.00868	10.70346	35
26	28 32	31 28	29716	99130	30587	69413	00870	70284	34
27	28 24	31 36	29779	99127	30652	69348	00873	70221	33
28	28 16	31 44	29841	99124	30717	69283	00876	70159	32
29	28 8	31 52	29903	99122	30782	69218	00878	70097	31
30	10 28 0	1 32 0	9.29966	9.99119	9.30846	10.69154	10.00881	10.70034	30
31	27 52	32 8	30028	99117	30911	69089	00883	69972	29
32	27 44	32 16	30090	99114	30975	69025	00886	69910	28
33	27 36	32 24	30151	99112	31040	68960	00888	69849	27
34	27 28	32 32	30213	99109	31104	68896	00891	69787	26
35	10 27 20	1 32 40	9.30275	9.99106	9.31168	10.68832	10.00894	10.69725	25
36	27 12	32 48	30336	99104	31233	68767	00896	69664	24
37	27 4	32 56	30398	99101	31297	68703	00899	69602	23
38	26 56	33 4	30459	99099	31361	68639	00901	69541	22
39	26 48	33 12	30521	99096	31425	68575	00904	69479	21
40	10 26 40	1 33 20	9.30582	9.99093	9.31489	10.68511	10.00907	10.69418	20
41	26 32	33 28	30643	99091	31552	68448	00909	69357	19
42	26 24	33 36	30704	99088	31616	68384	00912	69296	18
43	26 16	33 44	30765	99086	31679	68321	00914	69235	17
44	26 8	33 52	30826	99083	31743	68257	00917	69174	16
45	10 26 0	1 34 0	9.30887	9.99080	9.31806	10.68194	10.00920	10.69113	15
46	25 52	34 8	30947	99078	31870	68130	00922	69053	14
47	25 44	34 16	31008	99075	31933	68067	00925	68992	13
48	25 36	34 24	31068	99072	31996	68004	00928	98932	12
49	25 28	34 32	31129	99070	32059	67941	00930	68871	11
50	10 25 20	1 34 40	9.31189	9.99067	9.32122	10.67878	10.00933	10.68811	10
51	25 12	34 48	31249	99064	32185	67815	00936	68750	9
52	25 4	34 56	31310	99062	32248	67752	00938	68690	8
53	24 56	35 4	31370	99059	32311	67689	00941	68630	7
54	24 48	35 12	31430	99056	32373	67627	00944	68570	6
55	10 24 40	1 35 20	9.31490	9.99054	9.32436	10.67564	10.00946	10.68510	5
56	24 32	35 28	31549	99051	32498	67502	00949	68451	4
57	24 24	35 36	31609	99048	32561	67439	00952	68391	3
58	24 16	35 44	31669	99046	32623	67377	00954	68331	2
59	24 8	35 52	31728	99043	32685	67315	00957	68272	1
60	24 0	36 0	31788	99040	32747	67253	00960	68212	0
M.	Hour P.M.	Hour A.M.	Co-Sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Hour A.M.	Hour P.M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	M.
0	9 52 0	2 8 0	9.44034	9.98284	9.45750	10.54250	10.01716	10.55966	60
1	51 52	8 8	44078	98281	45797	54203	01719	55922	59
2	51 44	8 16	44122	98277	45845	54155	01723	55878	58
3	51 36	8 24	44166	98273	45892	54108	01727	55834	57
4	51 28	8 32	44210	98270	45940	54060	01730	55790	56
5	9 51 20	2 8 40	9.44253	9.98266	9.45987	10.54013	10.01734	10.55747	55
6	51 12	8 48	44297	98262	46035	53965	01738	55703	54
7	51 4	8 56	44341	98259	46082	53918	01741	55659	53
8	50 56	9 4	44385	98255	46130	53870	01745	55615	52
9	50 48	9 12	44428	98251	46177	53823	01749	55572	51
10	9 50 40	2 9 20	9.44472	9.98248	9.46224	10.53776	10.01752	10.55528	50
11	50 32	9 28	44515	98244	46271	53729	01756	55484	49
12	50 24	9 36	44559	98240	46319	53681	01760	55441	48
13	50 16	9 44	44602	98237	46366	53634	01763	55398	47
14	50 8	9 52	44646	98233	46413	53587	01767	55354	46
15	9 49 0	2 10 0	9.44689	9.98229	9.46460	10.53540	10.01771	10.55311	45
16	49 52	10 8	44733	98226	46507	53493	01774	55267	44
17	49 44	10 16	44776	98222	46554	53446	01778	55224	43
18	49 36	10 24	44819	98218	46601	53399	01782	55181	42
19	49 28	10 32	44862	98215	46648	53352	01785	55138	41
20	9 49 20	2 10 40	9.44905	9.98211	9.46694	10.53306	10.01789	10.55095	40
21	49 12	10 48	44948	98207	46741	53259	01793	55052	39
22	49 4	10 56	44991	98203	46788	53212	01796	55008	38
23	48 56	11 4	45035	98200	46835	53165	01800	54965	37
24	48 48	11 12	45077	98196	46881	53119	01804	54923	36
25	9 48 40	2 11 20	9.45120	9.98192	9.46928	10.53072	10.01808	10.54880	35
26	48 32	11 28	45163	98189	46975	53025	01811	54837	34
27	48 24	11 36	45206	98185	47021	52979	01815	54794	33
28	48 16	11 44	45249	98181	47068	52932	01819	54751	32
29	48 8	11 52	45292	98177	47114	52886	01823	54708	31
30	9 48 0	2 12 0	9.45334	9.98174	9.47160	10.52840	10.01826	10.54666	30
31	47 52	12 8	45377	98170	47207	52793	01830	54623	29
32	47 44	12 16	45419	98166	47253	52747	01834	54581	28
33	47 36	12 24	45462	98162	47299	52701	01838	54538	27
34	47 28	12 32	45504	98159	47346	52654	01841	54496	26
35	9 47 20	2 12 40	9.45547	9.98155	9.47392	10.52608	10.01845	10.54453	25
36	47 12	12 48	45589	98151	47438	52562	01849	54411	24
37	47 4	12 56	45632	98147	47484	52516	01853	54368	23
38	46 56	13 4	45674	98144	47530	52470	01856	54326	22
39	46 48	13 12	45716	98140	47576	52424	01860	54284	21
40	9 46 40	2 13 20	9.45758	9.98136	9.47622	10.52378	10.01864	10.54242	20
41	46 32	13 28	45801	98132	47668	52332	01868	54199	19
42	46 24	13 36	45843	98128	47714	52286	01871	54157	18
43	46 16	13 44	45885	98125	47760	52240	01875	54115	17
44	46 8	13 52	45927	98121	47806	52194	01879	54073	16
45	9 46 0	2 14 0	9.45969	9.98117	9.47852	10.52148	10.01883	10.54031	15
46	45 52	14 8	46011	98113	47897	52103	01887	53989	14
47	45 44	14 16	46053	98109	47943	52057	01890	53947	13
48	45 36	14 24	46095	98106	47989	52011	01894	53905	12
49	45 28	14 32	46136	98102	48035	51965	01898	53864	11
50	9 45 20	2 14 40	9.46178	9.98098	9.48080	10.51920	10.01902	10.53822	10
51	45 12	14 48	46220	98094	48120	51874	01906	53780	9
52	45 4	14 56	46262	98090	48171	51829	01910	53738	8
53	44 56	15 4	46303	98087	48217	51783	01913	53697	7
54	44 48	15 12	46345	98083	48262	51738	01917	53655	6
55	9 44 40	2 15 20	9.46386	9.98079	9.48307	10.51693	10.01921	10.53614	5
56	44 32	15 28	46428	98075	48353	51647	01925	53572	4
57	44 24	15 36	46469	98071	48398	51602	01929	53531	3
58	44 16	15 44	46511	98067	48443	51557	01933	53489	2
59	44 [illegible]	15 52	46552	98063	48489	51511	01937	53448	1
60	44 0	16 0	46594	98060	48534	51466	01940	53406	0
M.	Hour P.M.	Hour A.M.	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Hour A.M.	Hour P.M.	Sine.	Co-Sine.	Tangent.	Co-tang.	Secant.	Co-sec.	M.
0	9 44 0	2 16 0	9.46593	9.98060	9.48534	10.51466	10.01940	10.53406	60
1	43 52	16 8	46635	98056	48579	51421	01944	53365	59
2	43 44	16 16	46676	98052	48624	51376	01948	53324	58
3	43 36	16 24	46717	98048	48669	51331	01952	53283	57
4	43 28	16 32	46758	98044	48714	51286	01956	53242	56
5	9 43 20	2 16 40	9.46800	9.98040	9.48759	10.51241	10.01960	10.53200	55
6	43 12	16 48	46841	98036	48804	51196	01964	53159	54
7	43 4	16 56	46882	98032	48849	51151	01968	53118	53
8	42 56	17 4	46923	98029	48894	51106	01971	53077	52
9	42 48	17 12	46964	98025	48939	51061	01975	53036	51
10	9 42 40	2 17 20	9.47005	9.98021	9.48984	10.51016	10.01979	10.52995	50
11	42 32	17 28	47045	98017	49029	50971	01983	52955	49
12	42 24	17 36	47086	98013	49073	50927	01987	52914	48
13	42 16	17 44	47127	98009	49118	50882	01991	52873	47
14	42 8	17 52	47168	98005	49163	50837	01995	52832	46
15	9 42 0	2 18 0	9.47209	9.98001	9.49207	10.50793	10.01999	10.52791	45
16	41 52	18 8	47249	97997	49252	50748	02003	52751	44
17	41 44	18 16	47290	97993	49296	50704	02007	52710	43
18	41 36	18 24	47330	97989	49341	50659	02011	52670	42
19	41 28	18 32	47371	97986	49385	50615	02014	52629	41
20	9 41 20	2 18 40	9.47411	9.97982	9.49430	10.50570	10.02018	10.52589	40
21	41 12	18 48	47452	97978	49474	50526	02022	52548	39
22	41 4	18 56	47492	97974	49519	50481	02026	52508	38
23	40 56	19 4	47533	97970	49563	50437	02030	52467	37
24	40 48	19 12	47573	97966	49607	50393	02034	52427	36
25	9 40 40	2 19 20	9.47613	9.97962	9.49652	10.50348	10.02038	10.52387	35
26	40 32	19 28	47654	97958	49696	50304	02042	52346	34
27	40 24	19 36	47694	97954	49740	50260	02046	52306	33
28	40 16	19 44	47734	97950	49784	50216	02050	52266	32
29	40 8	19 52	47774	97946	49828	50172	02054	52226	31
30	9 40 0	2 20 0	9.47814	9.97942	9.49872	10.50128	10.02058	10.52186	30
31	39 52	20 8	47854	97938	49916	50084	02062	52146	29
32	39 44	20 16	47894	97934	49960	50040	02066	52106	28
33	39 36	20 24	47934	97930	50004	49996	02070	52066	27
34	39 28	20 32	47974	97926	50048	49952	02074	52026	26
35	9 39 20	2 20 40	9.48014	9.97922	9.50092	10.49908	10.02078	10.51986	25
36	39 12	20 48	48054	97918	50136	49864	02082	51946	24
37	39 4	20 56	48094	97914	50180	49820	02086	51906	23
38	38 56	21 4	48133	97910	50223	49777	02090	51867	22
39	38 48	21 12	48173	97906	50267	49733	02094	51827	21
40	9 38 40	2 21 20	9.48213	9.97902	9.50311	10.49689	10.02098	10.51787	20
41	38 32	21 28	48252	97898	50355	49645	02102	51748	19
42	38 24	21 36	48292	97894	50398	49602	02106	51708	18
43	38 16	21 44	48332	97890	50442	49558	02110	51668	17
44	38 8	21 52	48371	97886	50485	49515	02114	51629	16
45	9 38 0	2 22 0	9.48411	9.97882	9.50529	10.49471	10.02118	10.51589	15
46	37 52	22 8	48450	97878	50572	49428	02122	51550	14
47	37 44	22 16	48490	97874	50616	49384	02126	51510	13
48	37 36	22 24	48529	97870	50659	49341	02130	51471	12
49	37 28	22 32	48568	97866	50703	49297	02134	51432	11
50	9 37 20	2 22 40	9.48607	9.97861	9.50746	10.49254	10.02139	10.51393	10
51	37 12	22 48	48647	97857	50789	49211	02143	51353	9
52	37 4	22 56	48686	97853	50833	49167	02147	51314	8
53	36 56	23 4	48725	97849	50876	49124	02151	51275	7
54	36 48	23 12	48764	97845	50919	49081	02155	51236	6
55	9 36 40	2 23 20	9.48803	9.97841	9.50962	10.49038	10.02159	10.51197	5
56	36 32	23 28	48842	97837	51005	48995	02163	51158	4
57	36 24	23 36	48881	97833	51048	48952	02167	51119	3
58	36 16	23 44	48920	97829	51092	48908	02171	51080	2
59	36 8	23 52	48959	97825	51135	48865	02175	51041	1
60	36 0	24 0	48998	97821	51178	48822	02179	51002	0
M.	Hour P.M.	Hour A.M.	Co-Sine.	Sine.	Co-tang.	Tangent.	Co-sec.	Secant.	M.

M.	Hou: A.M	Hour P.M	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant	M.
0	9 36 0	2 24 0	9.48998	9.97821	9.51178	10.48822	10.02179	10.51002	60
1	35 52	24 8	49037	97817	51221	48779	02183	50963	59
2	35 44	24 16	49076	97812	51264	48736	02188	50924	58
3	35 36	24 24	49115	97808	51306	48694	02192	50885	57
4	35 28	24 32	49153	97804	51349	48651	02196	50847	56
5	9 35 20	2 24 40	9.49192	9.97800	9.51392	10.48608	10.02200	10.50808	55
6	35 12	24 48	49231	97796	51435	48565	02204	50769	54
7	35 4	24 56	49269	97792	51478	48522	02208	50731	53
8	34 56	25 4	49308	97788	51520	48480	02212	50692	52
9	34 48	25 12	49347	97784	51563	48437	02216	50653	51
10	9 34 40	2 25 20	9.49385	9.97779	9.51606	10.48394	10.02221	10.50615	50
11	34 32	25 28	49424	97775	51648	48352	02225	50576	49
12	34 24	25 36	49462	97771	51691	48309	02229	50538	48
13	34 16	25 44	49500	97767	51734	48266	02233	50500	47
14	34 8	25 52	49539	97763	51776	48224	02237	50461	46
15	9 34 0	2 26 0	9.49577	9.97759	9.51819	10.48181	10.02241	10.50423	45
16	33 52	26 8	49615	97754	51861	48139	02246	50385	44
17	33 44	26 16	49654	97750	51903	48097	02250	50346	43
18	33 36	26 24	49692	97746	51946	48054	02254	50308	42
19	33 28	26 32	49730	97742	51988	48012	02258	50270	41
20	9 33 20	2 26 40	9.49768	9.97738	9.52031	10.47969	10.02262	10.50232	40
21	33 12	26 48	49806	97733	52073	47927	02266	50194	39
22	33 4	26 56	49844	97729	52115	47885	02271	50156	38
23	32 56	27 4	49882	97725	52157	47843	02275	50118	37
24	32 48	27 12	49920	97721	52200	47800	02279	50080	36
25	9 32 40	2 27 20	9.49958	9.97717	9.52242	10.47758	10.02283	10.50042	35
26	32 32	27 28	49996	97713	52284	47716	02287	50004	34
27	32 24	27 36	50034	97708	52326	47674	02292	49966	33
28	32 16	27 44	50072	97704	52368	47632	02296	49928	32
29	32 8	27 52	50110	97700	52410	47590	02300	49890	31
30	9 32 0	2 28 0	9.50148	9.97696	9.52452	10.47548	10.02304	10.49852	30
31	31 52	28 8	50185	97691	52494	47506	02309	49815	29
32	31 44	28 16	50223	97687	52536	47464	02313	49777	28
33	31 36	28 24	50261	97683	52578	47422	02317	49739	27
34	31 28	28 32	50298	97679	52620	47380	02321	49702	26
35	9 31 20	2 28 40	9.50336	9.97674	9.52661	10.47339	10.02326	10.49664	25
36	31 12	28 48	50373	97670	52703	47297	02330	49626	24
37	31 4	28 56	50411	97666	52745	47255	02334	49589	23
38	30 56	29 4	50448	97662	52787	47213	02338	49551	22
39	30 48	29 12	50486	97657	52829	47171	02343	49514	21
40	9 30 40	2 29 20	9.50523	9.97653	9.52870	10.47130	10.02347	10.49477	20
41	30 32	29 28	50561	97649	52912	47088	02351	49439	19
42	30 24	29 36	50598	97645	52953	47047	02355	49402	18
43	30 16	29 44	50635	97640	52995	47005	02360	49365	17
44	30 8	29 52	50673	97636	53037	46963	02364	49327	16
45	9 30 0	2 30 0	9.50710	9.97632	9.53078	10.46922	10.02368	10.49290	15
46	29 52	30 8	50747	97627	53120	46880	02372	49253	14
47	29 44	30 16	50784	97623	53161	46839	02377	49216	13
48	29 36	30 24	50821	97619	53202	46798	02381	49179	12
49	29 28	30 32	50858	97615	53244	46756	02385	49142	11
50	9 29 20	2 30 40	9.50896	9.97610	9.53285	10.46715	10.02390	10.49104	10
51	29 12	30 48	50933	97606	53327	46673	02394	49067	9
52	29 4	30 56	50970	97602	53368	46632	02398	49030	8
53	28 56	31 4	51006	97597	53409	46591	02403	48993	7
54	28 48	31 12	51043	97593	53450	46550	02407	48957	6
55	9 28 40	2 31 20	9.51080	9.97589	9.53492	10.46508	10.02411	10.48920	5
56	28 32	31 28	51117	97584	53533	46467	02416	48883	4
57	28 24	31 36	51154	97580	53574	46426	02420	48846	3
58	28 16	31 44	51191	97576	53615	46385	02424	48809	2
59	28 8	31 52	51227	97571	53656	46344	02429	48773	1
60	28 0	32 0	51264	97567	53697	46303	02433	48736	0
M.	Hour P.M	Hour A.M	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M.

M.	Hour A.M.	Hour P.M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	M.
0	9 28 0	2 32 0	9.51264	9.97567	9.53697	10.46303	10.02433	10.48736	60
1	27 52	32 8	51301	97563	53738	46262	02437	48699	59
2	27 44	32 16	51337	97558	53779	46221	02442	48662	58
3	27 36	32 24	51374	97554	53820	46180	02446	48626	57
4	27 28	32 32	51411	97550	53861	46139	02450	48589	56
5	9 27 20	2 32 40	9.51447	9.97545	9.53902	10.46098	10.02455	10.48553	55
6	27 12	32 48	51484	97541	53943	46057	02459	48516	54
7	27 4	32 56	51520	97536	53984	46016	02464	48480	53
8	26 56	33 4	51557	97532	54025	45975	02468	48443	52
9	26 48	33 12	51593	97528	54065	45935	02472	48407	51
10	9 26 40	2 33 20	9.51629	9.97523	9.54106	10.45894	10.02477	10.48371	50
11	26 32	33 28	51666	97519	54147	45853	02481	48334	49
12	26 24	33 36	51702	97514	54187	45813	02485	48298	48
13	26 16	33 44	51738	97510	54228	45772	02490	48262	47
14	25 8	33 52	51774	97506	54269	45731	02494	48226	46
15	9 26 0	2 34 0	9.51811	9.97501	9.54309	10.45691	10.02499	10.48189	45
16	25 52	34 8	51847	9749	54350	45650	02503	48153	44
17	25 44	34 16	51883	97492	54390	45610	02508	48117	43
18	25 36	34 24	51919	97488	54431	45569	02512	48081	42
19	25 28	34 32	51955	97484	54471	45529	02516	48045	41
20	9 25 20	2 34 40	9.51991	9.97479	9.54512	10.45488	10.02521	10.48009	40
21	25 12	34 48	52027	97475	54552	45448	02525	47973	39
22	25 4	34 56	52063	97470	54593	45407	02530	47937	38
23	24 56	35 4	52099	97466	54633	45367	02534	47901	37
24	24 48	35 12	52135	97461	54673	45327	02539	47865	36
25	9 24 40	2 35 20	9.52171	9.97457	9.54714	10.45286	10.02543	10.47829	35
26	24 32	35 28	52207	97452	54754	45246	02547	47793	34
27	24 24	35 36	52242	97448	54794	45206	02552	47758	33
28	24 16	35 44	52278	97444	54835	45165	02556	47722	32
29	24 8	35 52	52314	97439	54875	45125	02561	47686	31
30	9 24 0	2 36 0	9.52350	9.97435	9.54915	10.45085	10.02565	10.47650	30
31	23 52	36 8	52385	97430	54955	45045	02570	47615	29
32	23 44	36 16	52421	97426	54995	45005	02574	47579	28
33	23 36	36 24	52456	97421	55035	44965	02579	47544	27
34	23 28	36 32	52492	97417	55075	44925	02583	47508	26
35	9 23 20	2 36 40	9.52527	9.97412	9.55115	10.44885	10.02588	10.47473	25
36	23 12	36 48	52563	97408	55155	44845	02592	47437	24
37	23 4	36 56	52598	97403	55195	44805	02597	47402	23
38	22 56	37 4	52634	97399	55235	44765	02601	47366	22
39	22 48	37 12	52669	97394	55275	44725	02606	47331	21
40	9 22 40	2 37 20	9.52705	9.97390	9.55315	10.44685	10.02610	10.47295	20
41	22 32	37 28	52740	97385	55355	44645	02615	47260	19
42	22 24	37 36	52775	97381	55395	44605	02619	47225	18
43	22 16	37 44	52810	97376	55434	44566	02624	47189	17
44	22 8	37 52	52846	97372	55474	44526	02628	47154	16
45	9 22 0	2 38 0	9.52881	9.97367	9.55514	10.44486	10.02633	10.47119	15
46	21 52	38 8	52916	97362	55554	44446	02637	47084	14
47	21 44	38 16	52951	97358	55593	44407	02642	47049	13
48	21 36	38 24	52986	97353	55633	44367	02647	47014	12
49	21 28	38 32	53021	97349	55673	44327	02651	46979	11
50	9 21 20	2 38 40	9.53056	9.97344	9.55712	10.44288	10.02656	10.46944	10
51	21 12	38 48	53091	97340	55752	44248	02660	46908	9
52	21 4	38 56	53125	97335	55791	44209	02665	46874	8
53	20 56	39 4	53161	97331	55831	44169	02669	46839	7
54	20 48	39 12	53196	97326	55870	44130	02674	46804	6
55	9 20 40	2 39 20	9.53231	9.97322	9.55910	10.44090	10.02678	10.46769	5
56	20 32	39 28	53266	97317	55949	44051	02683	46734	4
57	20 24	39 36	53301	97312	55989	44011	02688	46699	3
58	20 16	39 44	53336	97308	56028	43972	02692	46664	2
59	20 8	39 52	53370	97303	56067	43933	02697	46630	1
60	20 0	40 0	53405	97299	56107	43893	02701	46595	0
M.	Hour P.M.	Hour A.M.	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Hour A.M.	Hour P.M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	10 24 0	1 36 0	9.31788	9.99040	9.32747	10.67253	10.00960	10.68212	60
1	23 52	36 8	31847	99038	32810	67190	00962	68153	59
2	23 44	36 16	31907	99035	32872	67128	00965	68093	58
3	23 36	36 24	31966	99032	32933	67067	00968	68034	57
4	23 28	36 32	32025	99030	32995	67005	00970	67975	56
5	10 23 20	1 36 40	9.32084	9.99027	9.33057	10.66943	10.00973	10.67916	55
6	23 12	36 48	32143	99024	33119	66881	00976	67857	54
7	23 4	36 56	32202	99022	33180	66820	00978	67798	53
8	22 56	37 4	32261	99019	33242	66758	00981	67739	52
9	22 48	37 12	32319	99016	33303	66697	00984	67681	51
10	10 22 40	1 37 20	9.32378	9.99013	9.33365	10.66635	10.00987	10.67622	50
11	22 32	37 28	32437	99011	33426	66574	00989	67563	49
12	22 24	37 36	32495	99008	33487	66513	00992	67505	48
13	22 16	37 44	32553	99005	33548	66452	00995	67447	47
14	22 8	37 52	32612	99002	33609	66391	00998	67388	46
15	10 22 0	1 38 0	9.32670	9.99000	9.33670	10.66330	10.01000	10.67330	45
16	21 52	38 8	32728	98997	33731	66269	01003	67272	44
17	21 44	38 16	32786	98994	33792	66208	01006	67214	43
18	21 36	38 24	32844	98991	33853	66147	01009	67156	42
19	21 28	38 32	32902	98989	33913	66087	01011	67098	41
20	10 21 20	1 38 40	9.32960	9.98986	9.33974	10.66026	10.01014	10.67040	40
21	21 12	38 48	33018	98983	34034	65966	01017	66982	39
22	21 4	38 56	33075	98980	34095	65905	01020	66925	38
23	20 56	39 4	33133	98978	34155	65845	01022	66867	37
24	20 48	39 12	33190	98975	34215	65785	01025	66810	36
25	10 20 40	1 39 20	9.33248	9.98972	9.34276	10.65724	10.01028	10.66752	35
26	20 32	39 28	33305	98969	34336	65664	01031	66695	34
27	20 24	39 36	33362	98967	34396	65604	01033	66638	33
28	20 16	39 44	33420	98964	34456	65544	01036	66580	32
29	20 8	39 52	33477	98961	34516	65484	01039	66523	31
30	10 20 0	1 40 0	9.33534	9.98958	9.34576	10.65424	10.01042	10.66466	30
31	19 52	40 8	33591	98955	34635	65365	01045	66409	29
32	19 44	40 16	33647	98953	34695	65305	01047	66353	28
33	19 36	40 24	33704	98950	34755	65245	01050	66296	27
34	19 28	40 32	33761	98947	34814	65186	01053	66239	26
35	10 19 20	1 40 40	9.33818	9.98944	9.34874	10.65126	10.01056	10.66182	25
36	19 12	40 48	33874	98941	34933	65067	01059	66126	24
37	19 4	40 56	33931	98938	34992	65008	01062	66069	23
38	18 56	41 4	33987	98936	35051	64949	01064	66013	22
39	18 48	41 12	34043	98933	35111	64889	01067	65957	21
40	10 18 40	1 41 20	9.34100	9.98930	9.35170	10.64830	10.01070	10.65900	20
41	18 32	41 28	34156	98927	35229	64771	01073	65844	19
42	18 24	41 36	34212	98924	35288	64712	01076	65788	18
43	18 16	41 44	34268	98921	35347	64653	01079	65732	17
44	18 8	41 52	34324	98919	35405	64595	01081	65676	16
45	10 18 0	1 42 0	9.34380	9.98916	9.35464	10.64536	10.01084	10.65620	15
46	17 52	42 8	34435	98913	35523	64477	01087	65564	14
47	17 44	42 16	34491	98910	35581	64419	01090	65509	13
48	17 36	42 24	34547	98907	35640	64360	01093	65453	12
49	17 28	42 32	34602	98904	35698	64302	01096	65398	11
50	10 17 20	1 42 40	9.34658	9.98901	9.35757	10.64243	10.01099	10.65342	10
51	17 12	42 48	34713	98899	35815	64185	01102	65287	9
52	17 4	42 56	34769	98896	35873	64127	01104	65231	8
53	16 56	43 4	34824	98893	35931	64069	01107	65176	7
54	16 48	43 12	34879	98890	35989	64011	01110	65121	6
55	10 16 40	1 43 20	9.34934	9.98887	9.36047	10.63953	10.01113	10.65066	5
56	16 32	43 28	34989	98884	36105	63895	01116	65011	4
57	16 24	43 36	35044	98881	36163	63837	01119	64956	3
58	16 16	43 44	35099	98878	36221	63779	01122	64901	2
59	16 8	43 52	35154	98875	36279	63721	01125	64846	1
60	16 0	44 0	35209	98872	36336	63664	01128	64791	0
M.	Hour P.M.	Hour A.M.	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

12 Deg. TABLE XXV. Of Artificial Sines, Tangents, & Secants. 166 Degs.

M.	Hour A.M.	Hour P.M.	Sine.	Co-Sine.	Tangent.	Co-tang.	Secant.	Co-secant.	M.
0	10 15 0	1 44 0	9.35209	9.98872	9.36336	10.63664	10.01128	10.64791	60
1	15 52	44 8	35263	98869	36394	63606	01131	64737	59
2	15 44	44 16	35318	98867	36452	63548	01133	64682	58
3	15 36	44 24	35373	98864	36509	63491	01136	64627	57
4	15 28	44 32	35427	98861	36566	63434	01139	64573	56
5	10 15 20	1 44 40	9.35481	9.98858	9.36624	10.63376	10.01142	10.64519	55
6	15 12	44 48	35536	98855	36681	63319	01145	64464	54
7	15 4	44 56	35590	98852	36738	63262	01148	64410	53
8	14 56	45 4	35644	98849	36795	63205	01151	64356	52
9	14 48	45 12	35698	98846	36852	63148	01154	64302	51
10	10 14 40	1 45 20	9.35752	9.98843	9.36909	10.63091	10.01157	10.64248	50
11	14 32	45 28	35806	98840	36966	63034	01160	64194	49
12	14 24	45 36	35860	98837	37023	62977	01163	64140	48
13	14 16	45 44	35914	98834	37080	62920	01166	64086	47
14	14 8	45 52	35968	98831	37137	62863	01169	64032	46
15	10 14 0	1 46 0	9.36021	9.98828	9.37193	10.62807	10.01172	10.63978	45
16	13 52	46 8	36075	98825	37250	62750	01175	63925	44
17	13 44	46 16	36129	98822	37306	62694	01178	63871	43
18	13 36	46 24	36182	98819	37363	62637	01181	63818	42
19	13 28	46 32	36236	98816	37419	62581	01184	63764	41
20	10 13 20	1 46 40	9.36289	9.98813	9.37476	10.62524	10.01187	10.63711	40
21	13 12	46 48	36342	98810	37532	62468	01190	63658	39
22	13 4	46 56	36395	98807	37588	62412	01193	63605	38
23	12 56	47 4	36449	98804	37644	62356	01196	63551	37
24	12 48	47 12	36502	98801	37700	62300	01199	63498	36
25	10 12 40	1 47 20	9.36555	9.98798	9.37756	10.62244	10.01202	10.63445	35
26	12 32	47 28	36607	98795	37812	62188	01205	63392	34
27	12 24	47 36	36660	98792	37868	62132	01208	63340	33
28	12 16	47 44	36713	98789	37924	62076	01211	63287	32
29	12 8	47 52	36766	98786	37980	62020	01214	63234	31
30	10 12 0	1 48 0	9.36819	9.98783	9.38035	10.61965	10.01217	10.63181	30
31	11 52	48 8	36871	98780	38091	61909	01220	63129	29
32	11 44	48 16	36924	98777	38147	61853	01223	63076	28
33	11 36	48 24	36976	98774	38202	61798	01226	63024	27
34	11 28	48 32	37028	98771	38257	61743	01229	62972	26
35	10 11 20	1 48 40	9.37081	9.98768	9.38313	10.61687	10.01232	10.62919	25
36	11 12	48 48	37133	98765	38368	61632	01235	62867	24
37	11 4	48 56	37185	98762	38423	61577	01238	62815	23
38	10 56	49 4	37237	98759	38479	61521	01241	62763	22
39	10 48	49 12	37289	98756	38534	61466	01244	62711	21
40	10 10 40	1 49 20	9.37341	9.98753	9.38589	10.61411	10.01247	10.62659	20
41	10 32	49 28	37393	98749	38644	61356	01250	62607	19
42	10 24	49 36	37445	98746	38699	61301	01254	62555	18
43	10 16	49 44	37497	98743	38754	61246	01257	62503	17
44	10 8	49 52	37549	98740	38808	61192	01260	62451	16
45	10 10 0	1 50 0	9.37600	9.98737	9.38863	10.61137	10.01263	10.62400	15
46	9 52	50 8	37652	98734	38918	61082	01266	62348	14
47	9 44	50 16	37703	98731	38972	61028	01269	62297	13
48	9 36	50 24	37755	98728	39027	60973	01272	62245	12
49	9 28	50 32	37806	98725	39082	60918	01275	62194	11
50	10 9 20	1 50 40	9.37858	9.98722	9.39136	10.60864	10.01278	10.62142	10
51	9 12	50 48	37909	98719	39190	60810	01281	62091	9
52	9 4	50 56	37960	98715	39245	60755	01285	62040	8
53	8 56	51 4	38011	98712	39299	60701	01288	61989	7
54	8 48	51 12	38062	98709	39353	60647	01291	61938	6
55	10 8 40	1 51 20	9.38113	9.98706	9.39407	10.60593	10.01294	10.61887	5
56	8 32	51 28	38164	98703	39461	60539	01297	61836	4
57	8 24	51 36	38215	98700	39515	60485	01300	61785	3
58	8 16	51 44	38266	98697	39569	60431	01303	61734	2
59	8 8	51 52	38317	98694	39623	60377	01306	61683	1
60	8 0	52 0	38368	98690	39677	60323	01310	61632	0
M.	Hour P.M.	Hour A.M.	Co-Sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

103 Degs. 76 Degs.

M.	Hour A.M.	Hour P.M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	M.
0	10 8 0	1 52 0	9.38368	9.98690	9.39677	10.60323	10.01310	10.61632	60
1	7 52	52 8	38418	98687	39731	60269	01313	61582	59
2	7 44	52 16	38469	98684	39785	60215	01316	61531	58
3	7 36	52 24	38519	98681	39838	60162	01319	61481	57
4	7 28	52 32	38570	98678	39892	60108	01322	61430	56
5	10 7 20	1 52 40	9.38620	9.98675	9.39945	10.60055	10.01325	10.61380	55
6	7 12	52 48	38670	98671	39999	60001	01329	61330	54
7	7 4	52 56	38721	98668	40052	59948	01332	61279	53
8	6 56	53 4	38771	98665	40106	59894	01335	61229	52
9	6 48	53 12	38821	98662	40159	59841	01338	61179	51
10	10 6 40	1 53 20	9.38871	9.98659	9.40212	10.59788	10.01341	10.61129	50
11	6 32	53 28	38921	98655	40266	59734	01344	61079	49
12	6 24	53 36	38971	98652	40319	59681	01348	61029	48
13	6 16	53 44	39021	98649	40372	59628	01351	60979	47
14	6 8	53 52	39071	98646	40425	59575	01354	60929	46
15	10 6 0	1 54 0	9.39121	9.98643	9.40478	10.59522	10.01357	10.60879	45
16	5 52	54 8	39170	98640	40531	59469	01360	60830	44
17	5 44	54 16	39220	98636	40584	59416	01364	60780	43
18	5 36	54 24	39270	98633	40636	59364	01367	60730	42
19	5 28	54 32	39319	98630	40689	59311	01370	60681	41
20	10 5 20	1 54 40	9.39369	9.98627	9.40742	10.59258	10.01373	10.60631	40
21	5 12	54 48	39418	98623	40795	59205	01377	60582	39
22	5 4	54 56	39467	98620	40847	59153	01380	60533	38
23	4 56	55 4	39517	98617	40900	59100	01383	60483	37
24	4 48	55 12	39566	98614	40952	59048	01386	60434	36
25	10 4 40	1 55 20	9.39615	9.98610	9.41005	10.58995	10.01390	10.60385	35
26	4 32	55 28	39664	98607	41057	58943	01393	60336	34
27	4 24	55 36	39713	98604	41109	58891	01396	60287	33
28	4 16	55 44	39762	98601	41161	58839	01399	60238	32
29	4 8	55 52	39811	98597	41214	58786	01403	60189	31
30	10 4 0	1 56 0	9.39860	9.98594	9.41266	10.58734	10.01406	10.60140	30
31	3 52	56 8	39909	98591	41318	58682	01409	60091	29
32	3 44	56 16	39957	98588	41370	58630	01412	60042	28
33	3 36	56 24	40006	98584	41422	58578	01416	59994	27
34	3 28	56 32	40055	98581	41474	58526	01419	59945	26
35	10 3 20	1 56 40	9.40103	9.98578	9.41526	10.58474	10.01422	10.59897	25
36	3 12	56 48	40152	98574	41578	58422	01426	59848	24
37	3 4	56 56	40200	98571	41629	58371	01429	59800	23
38	2 56	57 4	40249	98568	41681	58319	01432	59751	22
39	2 48	57 12	40297	98565	41733	58267	01435	59703	21
40	10 2 40	1 57 20	9.40345	9.98561	9.41784	10.58216	10.01439	10.59654	20
41	2 32	57 28	40394	98558	41836	58164	01442	59606	19
42	2 24	57 36	40442	98555	41887	58113	01445	59558	18
43	2 16	57 44	40490	98551	41939	58061	01449	59510	17
44	2 8	57 52	40538	98548	41990	58010	01452	59462	16
45	10 2 0	1 58 0	9.40586	9.98545	9.42041	10.57959	10.01455	10.59414	15
46	1 52	58 8	40634	98541	42093	57907	01459	59366	14
47	1 44	58 16	40682	98538	42144	57856	01462	59318	13
48	1 36	58 24	40730	98535	42195	57805	01465	59270	12
49	1 28	58 32	40778	98531	42246	57754	01469	59222	11
50	10 1 20	1 58 40	9.40825	9.98528	9.42297	10.57703	10.01472	10.59175	10
51	1 12	58 48	40873	98525	42348	57652	01475	59127	9
52	1 4	58 56	40921	98521	42399	57601	01479	59079	8
53	0 56	59 4	40968	98518	42450	57550	01482	59032	7
54	0 48	59 12	41016	98515	42501	57499	01485	58984	6
55	10 0 40	1 59 20	9.41063	9.98511	9.42552	10.57448	10.01489	10.58937	5
56	0 32	59 28	41111	98508	42603	57397	01492	58889	4
57	0 24	59 36	41158	98504	42653	57347	01495	58842	3
58	0 16	59 44	41205	98501	42704	57296	01499	58795	2
59	0 8	59 52	41252	98498	42755	57245	01502	58748	1
60	0 0	2 0 0	41300	98494	42805	57195	01506	58700	0
M.	Hour P.M.	Hour A.M.	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Hour A.M.	Hour P.M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	M.
0	10 0 0	2 0 0	9.41300	9.98494	9.42805	10.57195	10.01506	10.58700	60
1	9 59 52	0 8	41347	98491	42856	57144	01509	58653	59
2	59 44	0 16	41394	98488	42906	57094	01512	58606	58
3	59 36	0 24	41441	98484	42957	57043	01516	58559	57
4	59 28	0 32	41488	98481	43007	56993	01519	58512	56
5	9 59 20	2 0 40	9.41535	9.98477	9.43057	10.56943	10.01523	10.58465	55
6	59 12	0 48	41582	98474	43108	56892	01526	58418	54
7	59 4	0 56	41628	98471	43158	56842	01529	58372	53
8	58 56	1 4	41675	98467	43208	56792	01533	58325	52
9	58 48	1 12	41722	98464	43258	56742	01536	58278	51
10	9 58 40	2 1 20	9.41768	9.98460	9.43308	10.56692	10.01540	10.58232	50
11	58 32	1 28	41815	98457	43358	56642	01543	58185	49
12	58 24	1 36	41861	98453	43408	56592	01547	58139	48
13	58 16	1 44	41908	98450	43458	56542	01550	58092	47
14	58 8	1 52	41954	98447	43508	56492	01553	58046	46
15	9 58 0	2 2 0	9.42001	9.98443	9.43558	10.56442	10.01557	10.57999	45
16	57 52	2 8	42047	98440	43607	56393	01560	57953	44
17	57 44	2 16	42093	98436	43657	56343	01564	57907	43
18	57 36	2 24	42139	98433	43707	56293	01567	57861	42
19	57 28	2 32	42186	98429	43756	56244	01571	57814	41
20	9 57 20	2 2 40	9.42232	9.98426	9.43806	10.56194	10.01574	10.57768	40
21	57 12	2 48	42278	98422	43855	56145	01578	57722	39
22	57 4	2 56	42324	98419	43905	56095	01581	57676	38
23	56 56	3 4	42370	98415	43954	56046	01585	57630	37
24	56 48	3 12	42416	98412	44004	55996	01588	57584	36
25	9 56 40	2 3 20	9.42461	9.98409	9.44053	10.55947	10.01591	10.57539	35
26	56 32	3 28	42507	98405	44102	55898	01595	57493	34
27	56 24	3 36	42553	98402	44151	55849	01598	57447	33
28	56 16	3 44	42599	98398	44201	55799	01602	57401	32
29	56 8	3 52	42644	98395	44250	55750	01605	57356	31
30	9 56 0	2 4 0	9.42690	9.98391	9.44299	10.55701	10.01609	10.57310	30
31	55 52	4 8	42735	98388	44348	55652	01612	57265	29
32	55 44	4 16	42781	98384	44397	55603	01616	57219	28
33	55 36	4 24	42826	98381	44446	55554	01619	57174	27
34	55 28	4 32	42872	98377	44495	55505	01623	57128	26
35	9 55 20	2 4 40	9.42917	9.98373	9.44544	10.55456	10.01627	10.57083	25
36	55 12	4 48	42962	98370	44592	55408	01630	57038	24
37	55 4	4 56	43007	98366	44641	55359	01634	56992	23
38	54 56	5 4	43053	98363	44690	55310	01637	56947	22
39	54 48	5 12	43098	98359	44738	55262	01641	56902	21
40	9 54 40	2 5 20	9.43143	9.98356	9.44787	10.55213	10.01644	10.56857	20
41	54 32	5 28	43188	98352	44836	55164	01648	56812	19
42	54 24	5 36	43233	98349	44884	55116	01651	56767	18
43	54 16	5 44	43278	98345	44933	55067	01655	56722	17
44	54 8	5 52	43323	98342	44981	55019	01658	56677	16
45	9 54 0	2 6 0	9.43367	9.98338	9.45029	10.54971	10.01662	10.56633	15
46	53 52	6 8	43412	98334	45078	54922	01666	56588	14
47	53 44	6 16	43457	98331	45126	54874	01669	56543	13
48	53 36	6 24	43502	98327	45174	54826	01673	56498	12
49	53 28	6 32	43546	98324	45222	54778	01676	56454	11
50	9 53 20	2 6 40	9.43591	9.98320	9.45271	10.54729	10.01680	10.56409	10
51	53 12	6 48	43635	98317	45319	54681	01683	56365	9
52	53 4	6 56	43680	98313	45367	54633	01687	56320	8
53	52 56	7 4	43724	98309	45415	54585	01691	56276	7
54	52 48	7 12	43769	98306	45463	54537	01694	56231	6
55	9 52 40	2 7 20	9.43813	9.98302	9.45511	10.54489	10.01698	10.56187	5
56	52 32	7 28	43857	98299	45559	54441	01701	56143	4
57	52 24	7 36	43901	98295	45606	54394	01705	56099	3
58	52 16	7 44	43946	98291	45654	54346	01709	56054	2
59	52 8	7 52	43990	98288	45702	54298	01712	56010	1
60	52 0	8 0	44034	98284	45750	54250	01716	55966	0
M.	Hour P.M.	Hour A.M.	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Hour A.M.	Hour P.M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	M.
0	9 20 0	2 40 0	9.53405	9.97299	9.56107	10.43893	10.02701	10.46595	60
1	19 52	40 8	53440	97294	56146	43854	02706	46560	59
2	19 44	40 16	53475	97289	56185	43815	02711	46525	58
3	19 36	40 24	53509	97285	56224	43776	02715	46491	57
4	19 28	40 32	53544	97280	56264	43736	02720	46456	56
5	9 19 20	2 40 40	9.53578	9.97275	9.56303	10.43697	10.02724	10.46422	55
6	19 12	40 48	53613	97271	56342	43658	02729	46387	54
7	19 4	40 56	53647	97266	56381	43619	02734	46353	53
8	18 56	41 4	53682	97262	56420	43580	02738	46318	52
9	18 48	41 12	53716	97257	56459	43541	02743	46284	51
10	9 18 40	2 41 20	9.53751	9.97252	9.56498	10.43502	10.02748	10.46249	50
11	18 32	41 28	53785	97248	56537	43463	02752	46215	49
12	18 24	41 36	53819	97243	56576	43424	02757	46181	48
13	18 16	41 44	53854	97238	56615	43385	02762	46146	47
14	18 8	41 52	53888	97234	56654	43346	02766	46112	46
15	9 18 0	2 42 0	9.53922	9.97229	9.56693	10.43307	10.02771	10.46078	45
16	17 52	42 8	53957	97224	56732	43268	02776	46043	44
17	17 44	42 16	53991	97220	56771	43229	02780	46009	43
18	17 36	42 24	54025	97215	56810	43190	02785	45975	42
19	17 28	42 32	54059	97210	56849	43151	02790	45941	41
20	9 17 20	2 42 40	9.54093	9.97206	9.56887	10.43113	10.02794	10.45907	40
21	17 12	42 48	54127	97201	56926	43074	02799	45873	39
22	17 4	42 56	54161	97196	56965	43035	02804	45839	38
23	16 56	43 4	54195	97192	57004	42996	02808	45805	37
24	16 48	43 12	54229	97187	57042	42958	02813	45771	36
25	9 16 40	2 43 20	9.54263	9.97182	9.57081	10.42919	10.02818	10.45737	35
26	16 32	43 28	54297	97178	57120	42880	02822	45703	34
27	16 24	43 36	54331	97173	57158	42842	02827	45669	33
28	16 16	43 44	54365	97168	57197	42803	02832	45635	32
29	16 8	43 52	54399	97163	57235	42765	02837	45601	31
30	9 16 0	2 44 0	9.54433	9.97159	9.57274	10.42726	10.02841	10.45567	30
31	15 52	44 8	54466	97154	57312	42688	02846	45534	29
32	15 44	44 16	54500	97149	57351	42649	02851	45500	28
33	15 36	44 24	54534	97145	57389	42611	02855	45466	27
34	15 28	44 32	54567	97140	57428	42572	02860	45433	26
35	9 15 20	2 44 40	9.54601	9.97135	9.57466	10.42534	10.02865	10.45399	25
36	15 12	44 48	54635	97130	57504	42496	02870	45365	24
37	15 4	44 56	54668	97126	57543	42457	02874	45332	23
38	14 56	45 4	54702	97121	57581	42419	02879	45298	22
39	14 48	45 12	54735	97116	57619	42381	02884	45265	21
40	9 14 40	2 45 20	9.54769	9.97111	9.57658	10.42342	10.02889	10.45231	20
41	14 32	45 28	54802	97106	57696	42304	02893	45198	19
42	14 24	45 36	54836	97102	57734	42266	02898	45164	18
43	14 16	45 44	54869	97097	57772	42228	02903	45131	17
44	14 8	45 52	54903	97092	57810	42190	02908	45097	16
45	9 14 0	2 46 0	9.54936	9.97087	9.57849	10.42151	10.02913	10.45064	15
46	13 52	46 8	54969	97083	57887	42113	02917	45031	14
47	13 44	46 16	55003	97078	57925	42075	02922	44997	13
48	13 36	46 24	55036	97073	57963	42037	02927	44964	12
49	13 28	46 32	55069	97068	58001	41999	02932	44931	11
50	9 13 20	2 46 40	9.55102	9.97063	9.58039	10.41961	10.02937	10.44898	10
51	13 12	46 48	55136	97059	58077	41923	02941	44864	9
52	13 4	46 56	55169	97054	58115	41885	02946	44831	8
53	12 56	47 4	55202	97049	58153	41847	02951	44798	7
54	12 48	47 12	55235	97044	58191	41809	02956	44765	6
55	9 12 40	2 47 20	9.55268	9.97039	9.58229	10.41771	10.02961	10.44732	5
56	12 32	47 28	55301	97034	58267	41733	02965	44699	4
57	12 24	47 36	55334	97030	58304	41696	02970	44666	3
58	12 16	47 44	55367	97025	58342	41658	02975	44633	2
59	12 8	47 52	55400	97020	58380	41620	02980	44600	1
60	12 0	48 0	55433	97015	58418	41582	02985	44567	0
M.	Hour P.M.	Hour A.M.	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M	Hour A.M.	Hour P.M.	Sine.	Co-Sine.	Tangent.	Co-tang.	Secant.	Co-sec.	M.
0	9 12 0	2 48 0	9.55433	9.97015	9.58418	10.41582	10.02985	10.44567	60
1	11 52	48 8	55466	97010	58455	41545	02990	44534	59
2	11 44	48 16	55499	97005	58493	41507	02995	44501	58
3	11 36	48 24	55531	97001	58531	41469	02999	44468	57
4	11 28	48 32	55564	96996	58569	41431	03004	44436	56
5	9 11 20	2 48 40	9.55597	9.96991	9.58606	10.41394	10.03009	10.44403	55
6	11 12	48 48	55630	96986	58644	41356	03014	44370	54
7	11 4	48 56	55663	96981	58681	41319	03019	44337	53
8	10 56	49 4	55695	96976	58719	41281	03024	44305	52
9	10 48	49 12	55728	96971	58757	41243	03029	44272	51
10	6 10 40	2 49 20	9.55761	9.96966	9.58794	10.41206	10.03034	10.44239	50
11	10 32	49 28	55793	96962	58832	41168	03038	44207	49
12	10 24	49 36	55826	96957	58869	41131	03043	44174	48
13	10 16	49 44	55858	96952	58907	41093	03048	44142	47
14	10 8	49 52	55891	96947	58944	41056	03053	44109	46
15	9 10 0	2 50 0	9.55923	9.96942	9.58981	10.41019	10.03058	10.44077	45
16	9 52	50 8	55956	96937	59019	40981	03063	44044	44
17	9 44	50 16	55988	96932	59056	40944	03068	44012	43
18	9 36	50 24	56021	96927	59094	40906	03073	43979	42
19	9 28	50 32	56053	96922	59131	40869	03078	43947	41
20	9 9 20	2 50 40	9.56085	9.96917	9.59168	10.40832	10.03083	10.43915	40
21	9 12	50 48	56118	96912	59205	40795	03088	43882	39
22	9 4	50 56	56150	96907	59243	40757	03093	43850	38
23	8 56	51 4	56182	96903	59280	40720	03097	43818	37
24	8 48	51 12	56215	96898	59317	40683	03102	43785	36
25	9 8 40	2 51 20	9.56247	9.96893	9.59354	10.40646	10.03107	10.43753	35
26	8 32	51 28	56279	96888	59391	40609	03112	43721	34
27	8 24	51 36	56311	96883	59429	40571	03117	43689	33
28	8 16	51 44	56343	96878	59466	40534	03122	43657	32
29	8 8	51 52	56375	96873	59503	40497	03127	43625	31
30	9 8 0	2 52 0	9.56408	9.96868	9.59540	10.40460	10.03132	10.43592	30
31	7 52	52 8	56440	96863	59577	40423	03137	43560	29
32	7 44	52 16	56472	96858	59614	40386	03142	43528	28
33	7 36	52 24	56504	96853	59651	40349	03147	43496	27
34	7 28	52 32	56536	96848	59688	40312	03152	43464	26
35	9 7 20	2 52 40	9.56568	9.96843	9.59725	10.40275	10.03157	10.43432	25
36	7 12	52 48	56599	96838	59762	40238	03162	43401	24
37	7 4	52 56	56631	96833	59799	40201	03167	43369	23
38	6 56	53 4	56663	96828	59835	40165	03172	43337	22
39	6 48	53 12	56695	96823	59872	40128	03177	43305	21
40	9 6 40	2 53 20	9.56727	9.96818	9.59909	10.40091	10.03182	10.43273	20
41	6 32	53 28	56759	96813	59946	40054	03187	43241	19
42	6 24	53 36	56790	96808	59983	40017	03192	43210	18
43	6 16	53 44	56822	96803	60019	39981	03197	43178	17
44	6 8	53 52	56854	96798	60056	39944	03202	43146	16
45	9 6 0	2 54 0	9.56886	9.96793	9.60093	10.39907	10.03207	10.43114	15
46	5 52	54 8	56917	96788	60130	39870	03212	43083	14
47	5 44	54 16	56949	96783	60166	39834	03217	43051	13
48	5 36	54 24	56980	96778	60203	39797	03222	43020	12
49	5 28	54 32	57012	96772	60240	39760	03228	42988	11
50	9 5 20	2 54 40	9.57044	9.96767	9.60276	10.39724	10.03233	10.42956	10
51	5 12	54 48	57075	96762	60313	39687	03238	42925	9
52	5 4	54 56	57107	96757	60349	39651	03243	42893	8
53	4 56	55 4	57138	96752	60386	39614	03248	42862	7
54	4 48	55 12	57169	96747	60422	39578	03253	42831	6
55	9 4 40	2 55 20	9.57201	9.96742	9.60459	10.39541	10.03258	10.42799	5
56	4 32	55 28	57232	96737	60495	39505	03263	42768	4
57	4 24	55 36	57264	96732	60532	39468	03268	42736	3
58	4 16	55 44	57295	96727	60568	39432	03273	42705	2
59	4 8	55 52	57326	96722	60605	39395	03278	42674	1
60	4 0	56 0	57357	96717	60641	39359	03283	42642	0
M.	Hour P.M.	Hour A.M.	Co-Sine.	Sine.	Co-tang.	Tangent.	Co-sec.	Secant.	M.

M.	Hour A.M.	Hour P.M.	Sine.	Co-Sine.	Tangent.	Co-tang.	Secant.	Co-secant	M.
0	9 4 0	2 56 0	9.57358	9.96717	9.60641	10.39359	10.03283	10.42642	60
1	3 52	56 8	57389	96711	60677	39323	03289	42611	59
2	3 44	56 16	57420	96706	60714	39286	03294	42580	58
3	3 36	56 24	57451	96701	60750	39250	03299	42549	57
4	3 28	56 32	57482	96696	60786	39214	03304	42518	56
5	9 3 20	2 56 40	9.57514	9.96691	9.60823	10.39177	10.03309	10.42486	55
6	3 12	56 48	57545	96686	60859	39141	03314	42455	54
7	3 4	56 56	57576	96681	60895	39105	03319	42424	53
8	2 56	57 4	57607	96676	60931	39069	03324	42393	52
9	2 48	57 12	57638	96670	60967	39033	03330	42362	51
10	9 2 40	2 57 20	9.57669	9.9666	9.61004	10.38996	10.03335	10.42331	50
11	2 32	57 28	57700	96660	61040	38960	03340	42300	49
12	2 24	57 36	57731	96655	61076	38924	03345	42269	48
13	2 16	57 44	57762	96650	61112	38888	03350	42238	47
14	2 8	57 52	57793	96645	61148	38852	03355	42207	46
15	9 2 0	2 58 0	9.57824	9.96640	9.61184	10.38816	10.03360	10.42176	45
16	1 52	58 8	57854	96634	61220	38780	03366	42145	44
17	1 44	58 16	57885	96629	61256	38744	03371	42115	43
18	1 36	58 24	57916	96624	61292	38708	03376	42084	42
19	1 28	58 32	57947	96619	61328	38672	03381	42053	41
20	9 1 20	2 58 40	9.57978	9.96614	9.61364	10.38636	10.03386	10.42022	40
21	1 12	58 48	58008	96608	61400	38600	03392	41992	39
22	1 4	58 56	58039	96603	61436	38564	03397	41961	38
23	0 56	59 4	58070	96598	61472	38528	03402	41930	37
24	0 48	59 12	58100	96593	61508	38492	03407	41899	36
25	9 0 40	2 59 20	9.58131	9.96588	9.61544	10.38456	10.03412	10.41869	35
26	0 32	59 28	58162	96582	61579	38421	03418	41838	34
27	0 24	59 36	58192	96577	61615	38385	03423	41808	33
28	0 16	59 44	58223	96572	61651	38349	03428	41777	32
29	0 8	59 52	58253	96567	61687	38313	03433	41747	31
30	9 0 0	3 0 0	9.58284	9.96562	9.61722	10.38278	10.03438	10.41716	30
31	8 59 52	0 8	58314	96556	61758	38242	03444	41686	29
32	59 44	0 16	58345	96551	61794	38206	03449	41655	28
33	59 36	0 24	58375	96546	61830	38170	03454	41625	27
34	59 28	0 32	58406	9654	61865	38135	03459	41594	26
35	8 59 20	3 0 40	9.58436	9.9653	9.61901	10.38099	10.03465	10.41564	25
36	59 12	0 48	58467	96530	61936	38064	03470	41533	24
37	59 4	0 56	58497	96525	61972	38028	93475	41503	23
38	58 56	1 4	58527	96520	62008	37992	03480	41473	22
39	58 48	1 12	58557	96514	62043	37957	03486	41443	21
40	8 58 40	3 1 20	9.58588	9.96509	9.62079	10.37921	10.03491	10.41412	20
41	58 32	1 28	58618	96504	62114	37886	03496	41382	19
42	58 24	1 36	58648	96498	62150	37850	03502	41352	18
43	58 16	1 44	58678	96493	62185	37815	03507	41322	17
44	58 8	1 52	58708	96488	62221	37779	03512	41291	16
45	8 58 0	3 2 0	9.58739	9.96483	9.62256	10.37744	10.03517	10.41261	15
46	57 52	2 8	58769	96477	62292	37708	03523	41231	14
47	57 44	2 16	58799	96472	62327	37673	03528	41201	13
48	57 36	2 24	58829	96467	62362	37638	03533	41171	12
49	57 28	2 32	58859	96461	62398	37602	03539	41141	11
50	8 57 20	3 2 40	9.58889	9.96456	9.62433	10.37567	10.03544	10.41111	10
51	57 12	2 48	58919	96451	62468	37532	03549	41081	9
52	57 4	2 56	58949	96445	62504	37496	03555	41051	8
53	56 56	3 4	58979	96440	62539	37461	03560	41021	7
54	56 48	3 12	59009	96435	62574	37426	03565	40991	6
55	8 56 40	3 3 20	9.59039	9.96429	9.62609	10.37391	10.03571	10.40961	5
56	56 32	3 28	59069	96424	62645	37355	03576	40931	4
57	56 24	3 36	59098	96419	62680	37320	03581	40902	3
58	56 16	3 44	59128	96413	62715	37285	03587	40872	2
59	56 8	3 52	59158	96408	62750	37250	03592	40842	1
60	56 0	4 0	59188	96403	62785	37215	03597	40812	0
M.	Hour P.M.	Hour A.M.	Co-Sine	Sine.	Co-tang	Tangent.	Co-secant	Secant.	

M.	Hour A.M.	Hour P.M.	Sine.	Co-sine.	Tangent.	Co-tang	Secant.	Co-secant	M.
0	8 56 0	3 4 0	9.59188	9.96403	9.62785	10.37215	10.03597	10.40812	60
1	55 52	4 8	59218	96397	62820	37180	03603	40782	59
2	55 44	4 16	59247	96392	62855	37145	03608	40753	58
3	55 36	4 24	59277	96386	62890	37110	03613	40723	57
4	55 28	4 32	59307	96381	62926	37074	03619	40693	56
5	8 55 20	3 4 40	9.59336	9.96376	9.62961	10.37039	10.03624	10.40664	55
6	55 12	4 48	59366	96370	62996	37004	03630	40634	54
7	55 4	4 56	59396	96364	63031	36969	03635	40604	53
8	54 56	5 4	59425	96360	63066	36934	03640	40575	52
9	54 48	5 12	59455	96354	63101	36899	03646	40545	51
10	8 54 40	3 5 20	9.59484	9.96349	9.63135	10.36865	10.03651	10.40516	50
11	54 32	5 28	59514	96343	63170	36830	03657	40486	49
12	54 24	5 36	59543	96338	63205	36795	03662	40457	48
13	54 16	5 44	59573	96333	63240	36760	03667	40427	47
14	54 8	5 52	59602	96327	63275	36725	03673	40398	46
15	8 54 0	3 6 0	9.59632	9.96322	9.63310	10.36690	10.03678	10.40368	45
16	53 52	6 8	49661	96316	63345	36655	03684	40339	44
17	53 44	6 16	59690	96311	63379	36621	03689	40310	43
18	53 36	6 24	59720	96305	63414	36586	03695	40280	42
19	53 28	6 32	59749	96300	63449	36551	03700	40251	41
20	8 53 20	3 6 40	9.59778	9.96294	9.63484	10.36516	10.03706	10.40222	40
21	53 12	6 48	59808	96289	63519	36481	03711	40192	39
22	53 4	6 56	59837	96284	63553	36447	03716	40163	38
23	52 56	7 4	59866	96278	63588	36412	03722	40134	37
24	52 48	7 12	59805	96273	63623	36377	03727	40105	36
25	8 52 40	3 7 20	9.59924	9.96267	9.63657	10.36343	10.03733	10.40076	35
26	52 32	7 28	59954	96262	63692	36308	03738	40046	34
27	52 24	7 36	59983	96256	63726	36274	03744	40017	33
28	52 16	7 44	60012	96251	63761	36239	03749	39988	32
29	52 8	7 52	60041	96245	63796	36204	03755	39959	31
30	8 52 0	3 8 0	9.60070	9.96240	9.63830	10.36170	10.03760	10.39930	30
31	51 52	8 8	60099	96234	63865	36135	03766	39901	29
32	51 44	8 16	60128	96229	63899	36101	03771	39872	28
33	51 36	8 24	60157	96223	63934	36066	03777	39843	27
34	51 28	8 32	60186	96218	63968	36032	03782	39814	26
35	8 51 20	3 8 40	9.60215	9.96212	9.64003	10.35997	10.03788	10.39785	25
36	51 12	8 48	60244	96207	64037	35963	03793	39756	24
37	51 4	8 56	60273	96201	64072	35928	03799	39727	23
38	50 56	9 4	60302	96196	64106	35894	03804	39698	22
39	50 48	9 12	60331	96190	64140	35860	03810	39669	21
40	8 50 40	3 9 20	9.60359	9.96185	9.64175	10.35825	10.03815	10.39641	20
41	50 32	9 28	60388	96179	64209	35791	03821	39612	19
42	50 24	9 36	60417	96174	64243	35757	03826	39583	18
43	50 16	9 44	60446	96168	64278	35722	03832	39554	17
44	50 8	9 52	60474	96162	64312	35688	03838	39526	16
45	8 50 0	3 10 0	9.60503	9.96157	9.64346	10.35654	10.03843	10.39497	15
46	49 52	10 8	60532	96151	64381	35619	03849	39468	14
47	49 44	10 16	60561	96146	64415	35585	03854	39439	13
48	49 36	10 24	60589	96140	64449	35551	03860	39411	12
49	49 28	10 32	60618	96135	64483	35517	03865	39382	11
50	8 49 20	3 10 40	9.60646	9.96129	9.64517	10.35483	10.03871	10.39354	10
51	49 12	10 48	60675	96123	64552	35448	03877	39325	9
52	49 4	10 56	60704	96118	64586	35414	03882	39296	8
53	48 56	11 4	60732	96112	64620	35380	03888	39268	7
54	48 48	11 12	60761	96107	64654	35346	03893	39239	6
55	8 48 40	3 11 20	9.60789	9.96101	9.64688	10.35312	10.03899	10.39211	5
56	48 32	11 28	60818	96095	64722	35278	03905	39182	4
57	48 24	11 36	60846	96090	64756	35244	03910	39154	3
58	48 16	11 44	60874	96084	64790	35210	03916	39125	2
59	48 8	11 52	60903	96079	64824	35176	03921	39097	1
60	48 0	12 0	60931	96073	64858	35142	03927	39069	0
M.	Hour P.M.	Hour A.M.	Co-sine.	Sine.	Co-tang	Tangent.	Co-secant	Secant.	M.

M.	Hour A.M.	Hour P.M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant	M.
0	8 48 0	3 12 0	9.60931	9.96073	9.64858	10.35142	10.03927	10.39069	60
1	47 52	12 8	60960	96067	64892	35108	03933	39040	59
2	47 44	12 16	60988	96062	64926	35074	03938	39012	58
3	47 36	12 24	61016	96056	64960	35040	03944	38984	57
4	47 28	12 32	61045	96050	64994	35006	03950	38955	56
5	8 47 20	3 12 40	9.61073	9.96045	9.65028	10.34972	10.03955	10.38927	55
6	47 12	12 48	61101	96039	65062	34938	03961	38899	54
7	47 4	12 56	61129	96034	65096	34904	03966	38871	53
8	46 56	13 4	61158	96028	65130	34870	03972	38842	52
9	46 48	13 12	61186	96022	65164	34836	03978	38814	51
10	8 46 40	3 13 20	9.61214	9.96017	9.65197	10.34803	10.03983	10.38786	50
11	46 32	13 28	61242	96011	65231	34769	03989	38758	49
12	46 24	13 36	61270	96005	65265	34735	03995	38730	48
13	46 16	13 44	61298	95999	65299	34701	04000	38702	47
14	46 8	13 52	61326	95994	65333	34667	04006	38674	46
15	8 46 0	3 14 0	9.61354	9.95988	9.65366	10.34634	10.04012	10.38646	45
16	45 52	14 8	61382	95982	65400	34600	04018	38618	44
17	45 44	14 16	61411	95977	65434	34566	04023	38589	43
18	45 36	14 24	61438	95971	65467	34533	04029	38562	42
19	45 28	14 32	61466	95965	65501	34499	04035	38534	41
20	8 45 20	3 14 40	9.61494	9.95960	9.65535	10.34465	10.04040	10.38506	40
21	45 12	14 48	61522	95954	65568	34432	04046	38478	39
22	45 4	14 56	61550	95948	65602	34398	04052	38450	38
23	44 56	15 4	61578	95942	65636	34364	04058	38422	37
24	44 48	15 12	61606	95937	65669	34331	04063	38394	36
25	8 44 40	3 15 20	9.61634	9.95931	9.65703	10.34297	10.04069	10.38366	35
26	44 32	15 28	61662	95925	65736	34264	04075	38338	34
27	44 24	15 36	61689	95920	65770	34230	04080	38311	33
28	44 16	15 44	61717	95914	65803	34197	04086	38283	32
29	44 8	15 52	61745	95908	65837	34163	04092	38255	31
30	8 44 0	3 10 0	9.61773	9.95902	9.65870	10.34130	10.04098	10.38227	30
31	43 52	16 8	61800	95896	65904	34096	04103	38200	29
32	43 44	16 16	61828	95891	65937	34063	04109	38172	28
33	43 36	16 24	61856	95885	65971	34029	04115	38144	27
34	43 28	16 32	61883	95879	66004	33996	04121	38117	26
35	8 43 20	3 16 40	9.61911	9.95873	9.66038	10.33962	10.04127	10.38089	25
36	43 12	16 48	61939	95868	66071	33929	04132	38061	24
37	43 4	16 56	61966	95862	66104	33896	04138	38034	23
38	42 56	17 4	61994	95856	66138	33862	04144	38006	22
39	42 48	17 12	62021	95850	66171	33829	04150	37979	21
40	8 42 40	3 17 20	9.62049	9.95844	9.66204	10.33796	10.04156	10.37951	20
41	42 32	17 28	62076	95839	66238	33762	04161	37924	19
42	42 24	17 36	62104	95833	66271	33729	04167	37896	18
43	42 16	17 44	62131	95827	66304	33696	04173	37869	17
44	42 8	17 52	62159	95821	66337	33663	04179	37841	16
45	8 42 0	3 18 0	9.62186	9.95815	9.66371	10.33629	10.04185	10.37814	15
46	41 52	18 8	62214	95810	66404	33596	04190	37786	14
47	41 44	18 16	62241	95804	66437	33563	04196	37759	13
48	41 36	18 24	62268	95798	66470	33530	04202	37732	12
49	41 28	18 32	62296	95792	66503	33497	04208	37704	11
50	8 41 20	3 18 40	9.62323	9.95786	9.66537	10.33463	10.04214	10.37677	10
51	41 12	18 48	62350	95780	66570	33430	04220	37650	9
52	41 4	18 56	62377	95775	66603	33397	04225	37623	8
53	40 56	19 4	62405	95769	66636	33364	04231	37595	7
54	40 48	19 12	62432	95763	66669	33331	04237	37568	6
55	8 40 40	3 19 20	9.62459	9.95757	9.66702	10.33298	10.04243	10.37541	5
56	40 32	19 28	62486	95751	66735	33265	04249	37514	4
57	40 24	19 36	62513	95745	66768	33232	04255	37487	3
58	40 16	19 44	62541	95739	66801	33199	04261	37459	2
59	40 8	19 52	62568	95733	66834	33166	04267	37432	1
60	40 0	20 0	62595	95728	66867	33133	04272	37405	0
M.	Hour P.M.	Hour A.M.	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secan	Secant.	M.

M.	Hour A.M.	Hour P.M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	M.
0	8 40 0	3 20 0	9.62595	9.95728	9.66867	10.33133	10.04272	10.37405	60
1	39 52	20 8	62622	95722	66900	33100	04278	37378	59
2	39 44	20 16	62649	95716	66933	33067	04284	37351	58
3	39 36	20 24	62676	95710	66966	33034	04290	37324	57
4	39 28	20 32	62703	95704	66999	33001	04296	37297	56
5	8 39 20	3 20 40	9.62730	9.95698	9.67032	10.32968	10.04302	10.37270	55
6	39 12	20 48	62757	95692	67065	32935	04308	37243	54
7	39 4	20 56	62784	95686	67098	32902	04314	37216	53
8	38 56	21 4	62811	95680	67131	32869	04320	37189	52
9	38 48	21 12	62838	95674	67163	32837	04326	37162	51
10	8 38 40	3 21 20	9.62865	9.95668	9.67196	10.32804	10.04332	10.37135	50
11	38 32	21 28	62892	95662	67229	32771	04337	37108	49
12	38 24	21 36	62918	95657	67262	32738	04343	37082	48
13	38 16	21 44	62945	95651	67295	32705	04349	37055	47
14	38 8	21 52	62972	95645	67327	32673	04355	37028	46
15	8 38 0	3 22 0	9.62999	9.95639	9.67360	10.32640	10.04361	10.37001	45
16	37 52	22 8	63026	95633	67393	32607	04367	36974	44
17	37 44	22 16	63052	95627	67426	32574	04373	36948	43
18	37 36	22 24	63079	95621	67458	32542	04379	36921	42
19	37 28	22 32	63106	95615	67491	32509	04385	36894	41
20	8 37 20	3 22 40	9.63133	9.95609	9.67524	10.32476	10.04391	10.36867	40
21	37 12	22 48	63159	95603	67556	32444	04397	36841	39
22	37 4	22 56	63186	95597	67589	32411	04403	36814	38
23	36 56	23 4	63212	95591	67622	32378	04409	36787	37
24	36 48	23 12	63239	95585	67654	32346	04415	36761	36
25	8 36 40	3 23 20	9.63266	9.95579	9.67687	10.32313	10.04421	10.36734	35
26	36 32	23 28	63292	95573	67719	32281	04427	36708	34
27	36 24	23 36	63319	95567	67752	32248	04433	36681	33
28	36 16	23 44	63345	95561	67785	32215	04439	36655	32
29	36 8	23 52	63372	95555	67817	32183	04445	36628	31
30	8 36 0	3 24 0	9.63398	9.95549	9.67850	10.32150	10.04451	10.36602	30
31	35 52	24 8	63425	95543	67882	32118	04457	36575	29
32	35 44	24 16	63451	95537	67915	32085	04463	36549	28
33	35 36	24 24	63478	95531	67947	32053	04469	36522	27
34	35 28	24 32	63504	95525	67980	32020	04475	36496	26
35	8 35 20	3 24 40	9.63531	9.95519	9.68012	10.31988	10.04481	10.36469	25
36	35 12	24 48	63557	95513	68044	31956	04487	36443	24
37	35 4	24 56	63583	95507	68077	31923	04493	36417	23
38	34 56	25 4	63610	95500	68109	31891	04500	36390	22
39	34 48	25 12	63636	95494	68142	31858	04506	36364	21
40	8 34 40	3 25 20	9.63662	9.95488	9.68174	10.31826	10.04512	10.36338	20
41	34 32	25 28	63689	95482	68206	31794	04518	36311	19
42	34 24	25 36	63715	95476	68239	31761	04524	36285	18
43	34 16	25 44	63741	95470	68271	31729	04530	36259	17
44	34 8	25 52	63767	95464	68303	31697	04536	36233	16
45	8 34 0	3 26 0	9.63793	9.95458	9.68336	10.31664	10.04542	10.36206	15
46	33 52	26 8	63820	95452	68368	31632	04548	36180	14
47	33 44	26 16	63846	95446	68400	31600	04554	36154	13
48	33 36	26 24	63872	95440	68432	31568	04560	36128	12
49	33 28	26 32	63898	95434	68465	31535	04566	36102	11
50	8 33 20	3 26 40	9.63924	9.95427	9.68497	10.31503	10.04573	10.36076	10
51	33 12	26 48	63950	95421	68529	31471	04579	36050	9
52	33 4	26 56	63976	95415	68561	31439	04585	36024	8
53	32 56	27 4	64002	95409	68593	31407	04591	35998	7
54	32 48	27 12	64028	95403	68626	31374	04597	35972	6
55	8 32 40	3 27 20	9.64054	9.95397	9.68658	10.31342	10.04603	10.35946	5
56	32 32	27 28	64080	95391	68690	31310	04609	35920	4
57	32 24	27 36	64106	95384	68723	31278	04616	35894	3
58	32 16	27 44	64132	95378	68754	31246	04622	35868	2
59	32 8	27 52	64158	95372	68786	31214	04628	35842	1
60	32 0	28 0	64184	95366	68818	31182	04634	35816	0
M.	Hour P.M.	Hour A.M.	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Hour A.M.	Hour P.M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	M.
0	8 32 0	3 28 0	9.64184	9.95366	9.68818	10.31182	10.04634	10.35816	60
1	31 52	28 8	64210	95360	68850	31150	04640	35790	59
2	31 44	28 16	64236	95354	68882	31118	04646	35764	58
3	31 36	28 24	64262	95348	68914	31086	04652	35738	57
4	31 28	28 32	64288	95341	68946	31054	04659	35712	56
5	8 31 20	3 28 40	9.64313	9.95335	9.68978	10.31022	10.04665	10.35687	55
6	31 12	28 48	64339	95329	69010	30990	04671	35661	54
7	31 4	28 56	64365	95323	69042	30958	04677	35635	53
8	30 56	29 4	64391	95317	69074	30926	04683	35609	52
9	30 48	29 12	64417	95310	69106	30894	04690	35583	51
10	8 30 40	3 29 20	9.64442	9.95304	9.69138	10.30862	10.04696	10.35558	50
11	30 32	29 28	64468	95298	69170	30830	04702	35532	49
12	30 24	29 36	64494	95292	69202	30798	04708	35506	48
13	30 16	29 44	64519	95286	69234	30766	04714	35481	47
14	30 8	29 52	64545	95279	69266	30734	04721	35455	46
15	8 30 0	3 30 0	9.64571	9.95273	9.69298	10.30702	10.04727	10.35429	45
16	29 52	30 8	64596	95267	69329	30671	04733	35404	44
17	29 44	30 16	64622	95261	69361	30639	04739	35378	43
18	29 36	30 24	64647	95254	69393	30607	04746	35353	42
19	29 28	30 32	64673	95248	69425	30575	04752	35327	41
20	8 29 20	3 30 40	9.64698	9.95242	9.69457	10.30543	10.04758	10.35302	40
21	29 12	30 48	64724	95236	69488	30512	04764	35276	39
22	29 4	30 56	64749	95229	69520	30480	04771	35251	38
23	28 56	31 4	64775	95223	69552	30448	04777	35225	37
24	28 48	31 12	64800	95217	69584	30416	04783	35200	36
25	8 28 40	3 31 20	9.64826	9.95211	9.69615	10.30385	10.04789	10.35174	35
26	28 32	31 28	64851	95204	69647	30353	04796	35149	34
27	28 24	31 36	64877	95198	69679	30321	04802	35123	33
28	28 16	31 44	64902	95192	69710	30290	04808	35098	32
29	28 8	31 52	64927	95185	69742	30258	04815	35073	31
30	8 28 0	3 32 0	9.64953	9.95179	9.69774	10.20226	10.04821	10.35047	30
31	27 52	32 8	64978	95173	69805	30195	04827	35022	29
32	27 44	32 16	65003	95167	69837	30163	04833	34997	28
33	27 36	32 24	65029	95160	69868	30132	04840	34971	27
34	27 28	32 32	65054	95154	69900	30100	04846	34946	26
35	8 27 20	3 32 40	9.65079	9.95148	9.69932	10.30068	10.04852	10.34921	25
36	27 12	32 48	65104	95141	69963	30037	04859	34896	24
37	27 4	32 56	65130	95135	69995	30005	04865	34870	23
38	26 56	33 4	65155	95129	70026	29974	04871	34845	22
39	26 48	33 12	65180	95122	70058	29942	04878	34820	21
40	8 26 40	3 33 20	9.65205	9.95116	9.70089	10.29911	10.04884	10.34795	20
41	26 32	33 28	65230	95110	70121	29879	04890	34770	19
42	26 24	33 36	65255	95103	70152	29848	04897	34745	18
43	26 16	33 44	65281	95097	70184	29816	04903	34719	17
44	26 8	33 52	65306	95090	70215	29785	04910	34694	16
45	8 26 0	3 34 0	9.65331	9.95084	9.70247	10.29753	10.04916	10.34669	15
46	25 52	34 8	65356	95078	70278	29722	04922	34644	14
47	25 44	34 16	65381	95071	70309	29691	04929	34619	13
48	25 36	34 24	65406	65065	70341	29659	04935	34594	12
49	25 28	34 32	65431	95059	70372	29628	04941	34569	11
50	8 25 20	3 34 40	9.65456	9.95052	9.70404	10.29596	10.04948	10.34544	10
51	25 12	34 48	65481	95046	70435	29565	04954	34519	9
52	25 4	34 56	65506	95039	70466	29534	04961	34494	8
53	24 56	35 4	65531	95033	70498	29502	04967	34469	7
54	24 48	35 12	65556	95027	70529	29471	04973	34444	6
55	8 24 40	3 35 20	9.65580	9.95020	9.70560	10.29440	10.04980	10.34420	5
56	24 32	35 28	65605	95014	70592	29408	64986	34395	4
57	24 24	35 36	65630	95007	70623	29377	04993	34370	3
58	24 16	35 44	65655	95001	70654	29346	04999	34345	2
59	24 8	35 52	65680	94994	70685	29315	05005	34320	1
60	24 0	36 0	65705	94988	70717	29283	05012	34295	0
M.	Hour P.M.	Hour A.M.	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Hour A.M.	Hour P.M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	M.
0	8 24 0	3 36 0	9.65705	9.94988	9.70717	10.29283	10.05012	10.34295	60
1	23 52	36 8	65729	94982	70748	29252	05018	34271	59
2	23 44	36 16	65754	94975	70779	29221	05025	34246	58
3	23 36	36 24	65779	94969	70810	29190	05031	34221	57
4	23 28	36 32	65804	94962	70841	29159	05038	34196	56
5	8 23 20	3 36 40	9.65828	9.94956	9.70873	10.29127	10.05044	10.34172	55
6	23 12	36 48	65853	94949	70904	29096	05051	34147	54
7	23 4	36 56	65878	94943	70935	29065	05057	34122	53
8	22 56	37 4	65902	94936	70966	29034	05064	34098	52
9	22 48	37 12	65927	94930	70997	29003	05070	34073	51
10	8 22 40	3 37 20	9.65952	9.94923	9.71028	10.28972	10.05077	10.34048	50
11	22 32	37 28	65976	94917	71059	28941	05083	34024	49
12	22 24	37 36	66001	94910	71090	28910	05089	33999	48
13	22 16	37 44	66025	94904	71121	28879	05096	33975	47
14	22 8	37 52	66050	94898	71153	28847	05102	33950	46
15	8 22 0	3 38 0	9.66075	9.94891	9.71184	10.28816	10.05109	10.33925	45
16	21 52	38 8	66099	94884	71215	28785	05115	33901	44
17	21 44	38 16	66124	94878	71246	28754	05122	33876	43
18	21 36	38 24	66148	94871	71277	28723	05129	33852	42
19	21 28	38 32	66173	94865	71308	28692	05135	33827	41
20	8 21 20	3 38 40	9.66197	9.94858	9.71339	10.28661	10.05142	10.33803	40
21	21 12	38 48	66221	94852	71370	28630	05148	33779	39
22	21 4	38 56	66246	94845	71401	28599	05155	33754	38
23	20 56	39 4	66270	94839	71431	28569	05161	33730	37
24	20 48	39 12	66295	94832	71462	28538	05168	33705	36
25	8 20 40	3 39 20	9.66319	9.94826	9.71493	10.28507	10.05174	10.33681	35
26	20 32	39 28	66343	94819	71524	28476	05181	33657	34
27	20 24	39 36	66368	94813	71555	28445	05187	33632	33
28	20 16	39 44	66392	94806	71586	28414	05194	33608	32
29	20 8	39 52	66416	94799	71617	28383	05201	33584	31
30	8 20 0	3 40 0	9.66441	9.94793	9.71648	10.28352	10.05207	10.33559	30
31	19 52	40 8	66465	94786	71679	28321	05214	33535	29
32	19 44	40 16	66489	94780	71709	28291	05220	33511	28
33	19 36	40 24	66513	94773	71740	28260	05227	33487	27
34	19 28	40 32	66537	94767	71771	28229	05233	33463	26
35	8 19 20	3 40 40	9.66562	9.94760	9.71802	10.28198	10.05240	10.33438	25
36	19 12	40 48	66586	94753	71833	28167	05247	33414	24
37	19 4	40 56	66610	94747	71863	28137	05253	33390	23
38	18 56	41 4	66634	94740	71894	28106	05260	33366	22
39	18 48	41 12	66658	94734	71925	28075	05266	33342	21
40	8 18 40	3 41 20	9.66682	9.94727	9.71955	10.28045	10.05273	10.33318	20
41	18 32	41 28	66706	94720	71986	28014	05280	33294	19
42	18 24	41 36	66731	94714	72017	27983	05286	33269	18
43	18 16	41 44	66755	94707	72048	27952	05293	33345	17
44	18 8	41 52	66779	94700	72078	27922	05300	33221	16
45	8 18 0	3 42 0	9.66803	9.94694	9.72109	10.27891	10.05306	10.33197	15
46	17 52	42 8	66827	94687	72140	27860	05313	33173	14
47	17 44	42 16	66851	94680	72170	27830	05320	33149	13
48	17 36	42 24	66875	94674	72201	27799	05326	33125	12
49	17 28	42 32	66899	94667	72231	27769	05333	33101	11
50	8 17 20	3 42 40	9.66922	9.94660	9.72262	10.27738	10.05340	10.33078	10
51	17 12	42 48	66946	94654	72293	27707	05346	33054	9
52	17 4	42 56	66970	94647	72323	27677	05353	33030	8
53	16 56	43 4	66994	94640	72354	27646	05360	33006	7
54	16 48	43 12	67018	94634	72384	27616	05366	32982	6
55	8 16 40	3 43 20	9.67042	9.94627	9.72415	10.27585	10.05373	10.32958	5
56	16 32	43 28	67066	94620	72445	27555	05380	32934	4
57	16 24	43 36	67090	94614	72476	27524	05386	32910	3
58	15 16	43 44	67113	94607	72506	27494	05393	32887	2
59	15 8	43 52	67137	94600	72537	27463	05400	32863	1
60	15 0	44 0	67161	94593	72567	27433	05407	32839	0
M.	Hour P.M.	Hour A.M.	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Hour A.M	Hour P.M	Sine.	Co-sine.	Tangent.	Co-tang	Secant.	Co-secant	M.
0	8 16 0	3 44 0	9.67161	9.94593	9.72567	10.27433	10.05407	10.32839	60
1	15 52	44 8	67185	94587	72598	27402	05413	32815	59
2	15 44	44 16	67208	94580	72628	27372	05420	32792	58
3	15 36	44 24	67232	94573	72659	27341	05427	32768	57
4	15 28	44 32	67256	94567	72689	27311	05433	32744	56
5	8 15 20	3 44 40	9.67280	9.94560	9.72720	10.27280	10.05440	10.32720	55
6	15 12	44 48	67303	94553	72750	27250	05447	32697	54
7	15 4	44 56	67327	94546	72780	27220	05454	32673	53
8	14 56	45 4	67350	94540	72811	27189	05460	32650	52
9	14 48	45 12	67374	94533	72841	27159	05467	32626	51
10	8 14 40	3 45 20	9.67398	9.94526	9.72872	10.27128	10.05474	10.32602	50
11	14 32	45 28	67421	94519	72902	27098	05481	32579	49
12	14 24	45 36	67445	94513	72932	27068	05487	32555	48
13	14 16	45 44	67468	94506	72963	27037	05494	32532	47
14	14 8	45 52	67492	94499	72993	27007	05501	32508	46
15	8 14 0	3 46 0	9.67515	9.94492	9.73023	10.26977	10.05508	10.32485	45
16	13 52	46 8	67539	94485	73054	26946	05515	32461	44
17	13 44	46 16	67562	94479	73084	26916	05521	32438	43
18	13 36	46 24	67586	94472	73114	26886	05528	32414	42
19	13 28	46 32	67609	94465	73144	26856	05535	32391	41
20	8 13 20	3 46 40	9.67633	9.94458	9.73175	10.26825	10.05542	10.32367	40
21	13 12	46 48	67656	94451	73205	26795	05549	32344	39
22	13 4	46 56	67680	94445	73235	26765	05555	32320	38
23	12 56	47 4	67703	94438	73265	26735	05562	32297	37
24	12 48	47 12	67726	94431	73295	26705	05569	32274	36
25	8 12 40	3 47 20	9.67750	9.94424	9.73326	10.26674	10.05576	10.32250	35
26	12 32	47 28	67773	94417	73356	26644	05583	32227	34
27	12 24	47 36	67796	94410	73386	26614	05590	32204	33
28	12 16	47 44	67820	94404	73416	26584	05596	32180	32
29	12 8	47 52	67843	94397	73446	26554	05603	32157	31
30	8 12 0	3 48 0	9.67866	9.94390	9.73476	10.26524	10.05610	10.32134	30
31	11 52	48 8	67890	94383	73507	26493	05617	32110	29
32	11 44	48 16	67913	94376	73537	26463	05624	32087	28
33	11 36	48 24	67936	94369	73567	26433	05631	32064	27
34	11 28	48 32	67959	94362	73597	26403	05638	32041	26
35	8 11 20	3 48 40	9.67982	9.94355	9.73627	10.26373	10.05645	10.32018	25
36	11 12	48 48	68006	94349	73657	26343	05651	31994	24
37	11 4	48 56	68029	94342	73687	26313	05658	31971	23
38	10 56	49 4	68052	94335	73717	26283	05665	31948	22
39	10 48	49 12	68075	94328	73747	26253	05672	31925	21
40	8 10 40	3 49 20	9.68098	9.94321	9.73777	10.26223	10.05679	10.31902	20
41	10 32	49 28	68121	94314	73807	26193	05686	31879	19
42	10 24	49 36	68144	94307	73837	26163	05693	31856	18
43	10 16	49 44	68167	94300	73867	26133	05700	31833	17
44	10 8	49 52	68190	94293	73897	26103	05707	31810	16
45	8 10 0	3 50 0	9.68213	9.94286	9.73927	10.26073	10.05714	10.31787	15
46	9 52	50 8	68237	94279	73957	26043	05721	31763	14
47	9 44	50 16	68260	94273	73987	26013	05727	31740	13
48	9 36	50 24	68282	94266	74017	25983	05734	31717	12
49	9 28	50 32	68305	94259	74047	25953	05741	31695	11
50	8 9 20	3 50 40	9.68328	9.94252	9.74077	10.25923	10.05748	10.31672	10
51	9 12	50 48	68351	94245	74107	25893	05755	31649	9
52	9 4	50 56	68374	94238	74137	25863	05762	31626	8
53	8 56	51 4	68397	94231	74166	25834	05769	31603	7
54	8 48	51 12	68420	94224	74196	25804	05776	31580	6
55	8 8 40	3 51 20	9.68443	9.94217	9.74226	10.25774	10.05783	10.31557	5
56	8 32	51 28	68466	94210	74256	25744	05790	31534	4
57	8 24	51 36	68489	94203	74286	25714	05797	31511	3
58	8 16	51 44	68511	94196	74316	25684	05804	31488	2
59	8 8	51 52	68534	94189	74345	25655	05811	31466	1
60	8 0	52 0	68557	94182	74375	25625	05818	31443	0
M.	Hour P.M.	Hour A.M	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M.

M.	Hour A.M.	Hour P.M.	Sine.	Co-Sine.	Tangent.	Co-tang.	Secant.	Co-sec.	M.
0	8 8 0	3 52 0	9.68557	9.94182	9.74375	10.25625	10.05818	10.31443	60
1	7 52	52 8	68580	94175	74405	25595	05825	31420	59
2	7 44	52 16	68603	94168	74435	25565	05832	31397	58
3	7 36	52 24	68625	94161	74465	25535	05839	31375	57
4	7 28	52 32	68648	94154	74494	25506	05846	31352	56
5	8 7 20	3 52 40	9.68671	9.94147	9.74524	10.25476	10.05853	10.31329	55
6	7 12	52 48	68694	94140	74554	25446	05860	31306	54
7	7 4	52 56	68716	94133	74583	25417	05867	31284	53
8	6 56	53 4	68739	94126	74613	25387	05874	31261	52
9	6 48	53 12	68762	94119	74643	25357	05881	31238	51
10	8 6 40	3 53 20	9.68784	9.94112	9.74673	10.25327	10.05888	10.31216	50
11	6 32	53 28	68807	94105	74702	25298	05895	31193	49
12	6 24	53 36	68829	94098	74732	25268	05902	31171	48
13	6 16	53 44	68852	94090	74762	25238	05910	31148	47
14	6 8	53 52	68875	94083	74791	25209	05917	31125	46
15	8 6 0	3 54 0	9.68897	9.94076	9.74821	10.25179	10.05924	10.31103	45
16	5 52	54 8	68920	94069	74851	25149	05931	31080	44
17	5 44	54 16	68942	94062	74880	25120	05938	31058	43
18	5 36	54 24	68965	94055	74910	25090	05945	31035	42
19	5 28	54 32	68987	94048	74939	25061	05952	31013	41
20	8 5 20	3 54 40	9.69010	9.94041	9.74969	10.25031	10.05959	10.30990	40
21	5 12	54 48	69032	94034	74998	25002	05966	30968	39
22	5 4	54 56	69055	94027	75028	24972	05973	30945	38
23	4 56	55 4	69077	94020	75058	24942	05980	30923	37
24	4 48	55 12	69100	94012	75087	24913	05988	30900	36
25	8 4 40	3 55 20	9.69122	9.94005	9.75117	10.24883	10.05995	10.30878	35
26	4 32	55 28	69144	93998	75146	24854	06002	30856	34
27	4 24	55 36	69167	93991	75176	24824	06009	30833	33
28	4 16	55 44	69189	93984	75205	24795	06016	30811	32
29	4 8	55 52	69212	93977	75235	24765	06023	30788	31
30	8 4 0	3 56 0	9.69234	9.93970	9.75264	10.24736	10.06030	10.30766	30
31	3 52	56 8	69256	93963	75294	24706	06037	30744	29
32	3 44	56 16	69279	93955	75323	24677	06045	30721	28
33	3 36	56 24	69301	93948	75353	24647	06052	30699	27
34	3 28	56 32	69323	93941	75382	24618	06059	30677	26
35	8 3 20	3 56 40	9.69345	9.93934	9.75411	10.24589	10.06066	10.30655	25
36	3 12	56 48	69368	93927	75441	24559	06073	30632	24
37	3 4	56 56	69390	93919	75470	24530	06080	30610	23
38	2 56	57 4	69412	93912	75500	24500	06088	30588	22
39	2 48	57 12	69434	93905	75529	24471	06095	30566	21
40	8 2 40	3 57 20	9.69456	9.93898	9.75558	10.24442	10.06102	10.30544	20
41	2 32	57 28	69479	93891	75588	24412	06109	30521	19
42	2 24	57 36	69501	93884	75617	24383	06116	30499	18
43	2 16	57 44	69523	93876	75647	24353	06124	30477	17
44	2 8	57 52	69545	93869	75676	24324	06131	30455	16
45	8 2 0	3 58 0	9.69567	9.93862	9.75705	10.24295	10.06138	10.30433	15
46	1 52	58 8	69589	93855	75735	24265	06145	30411	14
47	1 44	58 16	69611	93847	75764	24236	06153	30389	13
48	1 36	58 24	69633	93840	75793	24207	06160	30367	12
49	1 28	58 32	69655	93833	75822	24178	06167	30345	11
50	8 1 20	3 58 40	9.69677	9.93826	9.75852	10.24148	10.06174	10.30323	10
51	1 12	58 48	69699	93819	75881	24119	06181	30301	9
52	1 4	58 56	69721	93811	75910	24090	06189	30279	8
53	0 56	59 4	69743	93804	75939	24061	06196	30257	7
54	0 48	59 12	69765	93797	75969	24031	06203	30235	6
55	8 0 40	3 59 20	9.69787	9.93789	9.75998	10.24002	10.06211	10.30213	5
56	0 32	59 28	69809	93782	76027	23973	06218	30191	4
57	0 24	59 36	69831	93775	76056	23944	06225	30169	3
58	0 16	59 44	69853	93768	76086	23914	06232	30147	2
59	0 8	59 52	69875	93760	76115	23885	06240	30125	1
60	0 0	4 0 0	69897	93753	76144	23856	06247	30103	0
M.	Hour P.M.	Hour A.M.	Co-Sine.	Sine.	Co-tang.	Tangent.	Co-sec.	Secant.	M.

M.	Hour A.M.	Hour P.M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	M.
0	8 0 0	4 0 0	9.69897	9.93753	9.76144	10.23856	10.06247	10.30103	60
1	7 59 52	0 8	69919	93746	76173	23827	06254	30081	59
2	59 44	0 16	69941	93738	76202	23798	06262	30059	58
3	59 36	0 24	69963	93731	76231	23769	06269	30037	57
4	59 28	0 32	69984	93724	76261	23739	06276	30016	56
5	7 59 20	4 0 40	9.70006	9.93717	9.76290	10.23710	10.06283	10.29994	55
6	59 12	0 48	70028	93709	76319	23681	06291	29972	54
7	59 4	0 56	70050	93702	76348	23652	06298	29950	53
8	58 56	1 4	70072	93695	76377	23623	06305	29928	52
9	58 48	1 12	70093	93687	76406	23594	06313	29907	51
10	7 58 40	4 1 20	9.70115	9.93680	9.76435	10.23565	10.06320	10.29885	50
11	58 32	1 28	70137	93673	76464	23536	06327	29863	49
12	58 24	1 36	70159	93665	76493	23507	06335	29841	48
13	58 16	1 44	70180	93658	76522	23478	06342	29820	47
14	58 8	1 52	70202	93650	76551	23449	06350	29798	46
15	7 58 0	4 2 0	9.70224	9.93643	9.76580	10.23420	10.06357	10.29776	45
16	57 52	2 8	70245	93636	76609	23391	06364	29755	44
17	57 44	2 16	70267	93628	76639	23361	06372	29733	43
18	57 36	2 24	70288	93621	76668	23332	06379	29712	42
19	57 28	2 32	70310	93614	76697	23303	06386	29690	41
20	7 57 20	4 2 40	9.70332	9.93606	9.76725	10.23275	10.06394	10.29668	40
21	57 12	2 48	70353	93599	76754	23246	06401	29647	39
22	57 4	2 56	70375	93591	76783	23217	06409	29625	38
23	56 56	3 4	70396	93584	76812	23188	06416	29604	37
24	56 48	3 12	70418	93577	76841	23159	06423	29582	36
25	7 56 40	4 3 20	9.70439	9.93569	9.76870	10.23130	10.06431	10.29561	35
26	56 32	3 28	70461	93562	76899	23101	06438	29539	34
27	56 24	3 36	70482	93554	76928	23072	06446	29518	33
28	56 16	3 44	70504	93547	76957	23043	06453	29496	32
29	56 8	3 52	70525	93539	76986	23014	06461	29475	31
30	7 56 0	4 4 0	9.70547	9.93532	9.77015	10.22985	10.06468	10.29453	30
31	55 52	4 8	70568	93525	77044	22956	06475	29432	29
32	55 44	4 16	70590	93517	77073	22927	06483	29410	28
33	55 36	4 24	70611	93510	77101	22899	06490	29389	27
34	55 28	4 32	70633	93502	77130	22870	06498	29367	26
35	7 55 20	4 4 40	9.70654	9.93495	9.77159	10.22841	10.06505	10.29346	25
36	55 12	4 48	70675	93487	77188	22812	06513	29325	24
37	55 4	4 56	70697	93480	77217	22783	06520	29303	23
38	54 56	5 4	70718	93472	77246	22754	06528	29282	22
39	54 48	5 12	70739	93465	77274	22726	06535	29261	21
40	7 54 40	4 5 20	9.70761	9.93457	9.77303	10.22697	10.06543	10.29239	20
41	54 32	5 28	70782	93450	77332	22668	06550	29218	19
42	54 24	5 36	70803	93442	77361	22639	06558	29197	18
43	54 16	5 44	70824	93435	77390	22610	06565	29176	17
44	54 8	5 52	70846	93427	77418	22582	06573	29154	16
45	7 54 0	4 6 0	9.70867	9.93420	9.77447	10.22553	10.06580	10.29133	15
46	53 52	6 8	70888	93412	77476	22524	06588	29112	14
47	53 44	6 16	70909	93405	77505	22495	06595	29091	13
48	53 36	6 24	70931	93397	77533	22467	06603	29069	12
49	53 28	6 32	70952	93390	77562	22438	06610	29048	11
50	7 53 20	4 6 40	9.70973	9.93382	9.77591	10.22409	10.06618	10.29027	10
51	53 12	6 48	70994	93375	77619	22381	06625	29006	9
52	53 4	6 56	71015	93367	77648	22352	06633	28985	8
53	52 56	7 4	71036	93360	77677	22323	06640	28964	7
54	52 48	7 12	71058	93352	77706	22294	06648	28942	6
55	7 52 40	4 7 20	9.71079	9.93344	9.77734	10.22266	10.06656	10.28921	5
56	52 32	7 28	71100	93337	77763	22237	06663	28900	4
57	52 24	7 36	71121	93329	77791	22209	06671	28879	3
58	52 16	7 44	71142	93322	77820	22180	06678	28858	2
59	52 8	7 52	71163	93314	77849	22151	06686	28837	1
60	52 0	8 0	71184	93307	77877	22123	06693	28816	0
M.	Hour P.M.	Hour A.M.	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Hour A.M.	Hour P.M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	M.
0	7 52 0	4 8 0	9.71184	9.93307	9.77877	10.22123	10.06693	10.28816	60
1	51 52	8 8	71205	93299	77906	22094	06701	28795	59
2	51 44	8 16	71226	93291	77935	22065	06709	28774	58
3	51 36	8 24	71247	93284	77963	22037	06716	28753	57
4	51 28	8 32	71268	93276	77992	22008	06724	28732	56
5	7 51 20	4 8 40	9.71289	9.93269	9.78020	10.21980	10.06731	10.28711	55
6	51 12	8 48	71310	93261	78049	21951	06739	28690	54
7	51 4	8 56	71331	93253	78077	21923	06747	28669	53
8	50 56	9 4	71352	93246	78106	21894	06754	28648	52
9	50 48	9 12	71373	93238	78135	21865	06762	28627	51
10	7 50 40	4 9 20	9.71393	9.93230	9.78163	10.21837	10.06770	10.28607	50
11	50 32	9 28	71414	93223	78192	21808	06777	28586	49
12	50 24	9 36	71435	93215	78220	21780	06785	28565	48
13	50 16	9 44	71456	93207	78249	21751	06793	28544	47
14	50 8	9 52	71477	93200	78277	21723	06800	28523	46
15	7 50 0	4 10 0	9.71498	9.93192	9.78306	10.21694	10.06808	10.28502	45
16	49 52	10 8	71519	93184	78334	21666	06816	28481	44
17	49 44	10 16	71539	93177	78363	21637	06823	28461	43
18	49 36	10 24	71560	93169	78391	21609	06831	28440	42
19	49 28	10 32	71581	93161	78419	21581	06839	28419	41
20	7 49 20	4 10 40	9.71602	9.93154	9.78448	10.21552	10.06846	10.28398	40
21	49 12	10 48	71622	93146	78476	21524	06854	28378	39
22	49 4	10 56	71643	93138	78505	21495	06862	28357	38
23	48 56	11 4	71664	93131	78533	21467	06869	28336	37
24	48 48	11 12	71685	93123	78562	21438	06877	28315	36
25	7 48 40	4 11 20	9.71705	9.93115	9.78590	10.21410	10.06885	10.28295	35
26	48 32	11 28	71726	93107	78618	21382	06892	28274	34
27	48 24	11 36	71747	93100	78647	21353	06900	28253	33
28	48 16	11 44	71767	93092	78675	21325	06908	28233	32
29	48 8	11 52	71788	93084	78704	21296	06916	28212	31
30	7 48 0	4 12 0	9.71809	9.93077	9.78732	10.21268	10.06923	10.28191	30
31	47 52	12 8	71829	93069	78760	21240	06931	28171	29
32	47 44	12 16	71850	93061	78789	21211	06939	28150	28
33	47 36	12 24	71870	93053	78817	21183	06947	28130	27
34	47 28	12 32	71891	93046	78845	21155	06954	28109	26
35	7 47 20	4 12 40	9.71911	9.93038	9.78874	10.21126	10.06962	10.28089	25
36	47 12	12 48	71932	93030	78902	21098	06970	28068	24
37	47 4	12 56	71952	93022	78930	21070	06978	28048	23
38	46 56	13 4	71973	93014	78959	21041	06986	28027	22
39	46 48	13 12	71993	93007	78987	21013	06993	28006	21
40	7 46 40	4 13 20	9.72014	9.92999	9.79015	10.20985	10.07001	10.27986	20
41	46 32	13 28	72034	92991	79043	20957	07009	27966	19
42	46 24	13 36	72055	92983	79072	20928	07017	27945	18
43	46 16	13 44	72075	92975	79100	20900	07024	27925	17
44	46 8	13 52	72096	92968	79128	20872	07032	27904	16
45	7 46 0	4 14 0	9.72116	9.92960	9.79156	10.20844	10.07040	10.27884	15
46	45 52	14 8	72137	92952	79185	20815	07048	27863	14
47	45 44	14 16	72157	92944	79213	20787	07056	27843	13
48	45 36	14 24	72177	92936	79241	20759	07064	27823	12
49	45 28	14 32	72198	92929	79269	20731	07071	27802	11
50	7 45 20	4 14 40	9.72218	9.92921	9.79297	10.20703	10.07079	10.27782	10
51	45 12	14 48	72238	92913	79326	20674	07087	27762	9
52	45 4	14 56	72259	92905	79354	20646	07095	27741	8
53	44 56	15 4	72279	92897	79382	20618	07103	27721	7
54	44 48	15 12	72299	92889	79410	20590	07111	27701	6
55	7 44 40	4 15 20	9.72320	9.92881	9.79438	10.20562	10.07119	10.27680	5
56	44 32	15 28	72340	92874	79466	20534	07126	27660	4
57	44 24	15 36	72360	92866	79495	20505	07134	27640	3
58	44 16	15 44	72381	92858	79523	20477	07142	27619	2
59	44 8	15 52	72401	92850	79551	20449	07150	27599	1
60	44 0	16 0	72421	92842	79579	20421	07158	27579	0
M.	Ho. P.M.	Hour A.M.	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

32 Degs. TABLE XXV. Of Artificial Sines, Tangents, & Secants. 147 Deg

M.	Hour A.M.	Hour P.M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	M.
0	7 44 0	4 16 0	9.72421	9.92842	9.79579	10.20421	10.07158	10.27579	60
1	43 52	16 8	72441	92834	79607	20393	07166	27559	59
2	43 44	16 16	72461	92826	79635	20365	07174	27539	58
3	43 36	16 24	72482	92818	79663	20337	07182	27519	57
4	43 28	16 32	72502	92810	79691	20309	07190	27498	56
5	7 43 20	4 16 40	9.72522	9.92803	9.79719	10.20281	10.07197	10.27478	55
6	43 12	16 48	72542	92795	79747	20253	07205	27458	54
7	43 4	16 56	72562	92787	79776	20224	07213	27438	53
8	42 56	17 4	72582	92779	79804	20196	07221	27418	52
9	42 48	17 12	72602	92771	79832	20168	07229	27398	51
10	7 42 40	4 17 20	9.72622	9.92763	9.79860	10.20140	10.07237	10.27378	50
11	42 32	17 28	72643	92755	79888	20112	07245	27357	49
12	42 24	17 36	72663	92747	79916	20084	07253	27337	48
13	42 16	17 44	72683	92739	79944	20056	07261	27317	47
14	42 8	17 52	72703	92731	79972	20028	07269	27297	46
15	7 42 0	4 18 0	9.72723	9.92723	9.80000	10.20000	10.07277	10.27277	45
16	41 52	18 8	72743	92715	80028	19972	07285	27257	44
17	41 44	18 16	72763	92707	80056	19944	07293	27237	43
18	41 36	18 24	72783	92699	80084	19916	07301	27217	42
19	41 28	18 32	72803	92691	80112	19888	07309	27197	41
20	7 41 20	4 18 40	9.72823	9.92683	9.80140	10.19860	10.07317	10.27177	40
21	41 12	18 48	72843	92675	80168	19832	07325	27157	39
22	41 4	18 56	72863	92667	80195	19805	07333	27137	38
23	40 56	19 4	72883	92659	80223	19777	07341	27117	37
24	40 48	19 12	72902	92651	80251	19749	07349	27098	36
25	7 40 40	4 19 20	9.72922	9.92643	9.80279	10.19721	10.07357	10.27078	35
26	40 32	19 28	72942	92635	80307	19693	07365	27058	34
27	40 24	19 36	72962	92627	80335	19665	07373	27038	33
28	40 16	19 44	72982	92619	80363	19637	07381	27018	32
29	40 8	19 52	73002	92611	80391	19609	07389	26998	31
30	7 40 0	4 20 0	9.73022	9.92603	9.80419	10.19581	10.07397	10.26978	30
31	39 52	20 8	73041	92595	80447	19553	07405	26959	29
32	39 44	20 16	73061	92587	80474	19526	07413	26939	28
33	39 36	20 24	73081	92579	80502	19498	07421	26919	27
34	39 28	20 32	73101	92571	80530	19470	07429	26899	26
35	7 39 20	4 20 40	9.73121	9.92563	9.80558	10.19442	10.07437	10.26879	25
36	39 12	20 48	73140	92556	80586	19414	07445	26860	24
37	39 4	20 56	73160	92546	80614	19386	07454	26840	23
38	38 56	21 4	73180	92538	80642	19358	07462	26820	22
39	38 48	21 12	73200	92530	80669	19331	07470	26800	21
40	7 38 40	4 21 20	9.73219	9.92522	9.80697	10.19303	10.07478	10.26781	20
41	38 32	21 28	73239	92514	80725	19275	07486	26761	19
42	38 24	21 36	73259	92506	80753	19247	07494	26741	18
43	38 16	21 44	73278	92498	80781	19219	07502	26722	17
44	38 8	21 52	73298	92490	80808	19192	07510	26702	16
45	7 38 0	4 22 0	9.73318	9.92482	9.80836	10.19164	10.07518	10.26682	15
46	37 52	22 8	73337	92473	80864	19136	07527	26663	14
47	37 44	22 16	73357	92465	80892	19108	07535	26643	13
48	37 36	22 24	73377	92457	80919	19081	07543	26623	12
49	37 28	22 32	73396	92449	80947	19053	07551	26604	11
50	7 37 20	4 22 40	9.73416	9.92441	9.80975	10.19025	10.07559	10.26584	10
51	37 12	22 48	73435	92433	81003	18997	07567	26565	9
52	37 4	22 56	73455	92425	81030	18970	07575	26545	8
53	36 56	23 4	73474	92416	81058	18942	07584	26526	7
54	36 48	23 12	73494	92408	81086	18914	07592	26506	6
55	7 36 40	4 23 20	9.73513	9.92400	9.81113	10.18887	10.07600	10.26487	5
56	36 32	23 28	73533	92392	81141	18859	07608	26467	4
57	36 24	23 36	73552	92384	81169	18831	07616	26448	3
58	36 16	23 44	73572	92376	81196	18804	07624	26428	2
59	36 8	23 52	73591	92367	81224	18776	07633	26409	1
60	36 0	24 0	73611	92359	81252	18748	07641	26389	0
M.	Hour P.M.	Hour A.M.	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

122 Degs. 57 Degs.

M.	Hour A.M.	Hour P.M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	M.
0	7 36 0	4 24 0	9.73611	9.92359	9.81252	10.18748	10.07641	10.26389	60
1	35 52	24 8	73630	92351	81279	18721	07649	26370	59
2	35 44	24 16	73650	92343	81307	18693	07657	26350	58
3	35 36	24 24	73669	92334	81335	18665	07665	26331	57
4	35 28	24 32	73689	92326	81362	18638	07674	26311	56
5	7 35 20	4 24 40	9.73708	9.92318	9.81390	10.18610	10.07682	10.26292	55
6	35 12	24 48	73727	92310	81418	18582	07690	26273	54
7	35 4	24 56	73747	92302	81445	18555	07698	26253	53
8	34 56	25 4	73766	92293	81473	18527	07707	26234	52
9	34 48	25 12	73785	92285	81500	18500	07715	26215	51
10	7 34 40	4 25 20	9.73805	9.92277	9.81528	10.18472	10.07723	10.26195	50
11	34 32	25 28	73824	92269	81556	18444	07731	26176	49
12	34 24	25 36	73843	92260	81583	18417	07740	26157	48
13	34 16	25 44	73863	92252	81611	18389	07748	26137	47
14	34 8	25 52	73882	92244	81638	18362	07756	26118	46
15	7 34 0	4 26 0	9.73901	9.92235	9.81666	10.18334	10.07765	10.26099	45
16	33 52	26 8	73921	92227	81693	18307	07773	26079	44
17	33 44	26 16	73940	92219	81721	18279	07781	26060	43
18	33 36	26 24	73959	92211	81748	18252	07789	26041	42
19	33 28	26 32	73978	92202	81776	18224	07798	26022	41
20	7 33 20	4 26 40	9.73997	9.92194	9.81803	10.18197	10.07806	10.26003	40
21	33 12	26 48	74017	92186	81831	18169	07814	25983	39
22	33 4	26 56	74036	92177	81858	18142	07823	25964	38
23	32 56	27 4	74055	92169	81886	18114	07831	25945	37
24	32 48	27 12	74074	92161	81913	18087	07839	25926	36
25	7 32 40	4 27 20	9.74093	9.92152	9.81941	10.18059	10.07848	10.25907	35
26	32 32	27 28	74112	92144	81968	18032	07856	25887	34
27	32 24	27 36	74132	92136	81996	18004	07864	25868	33
28	32 16	27 44	74151	92127	82023	17977	07873	25849	32
29	32 8	27 52	74170	92119	82051	17949	07881	25830	31
30	7 32 0	4 28 0	9.74189	9.92111	9.82078	10.17922	10.07889	10.25811	30
31	31 52	28 8	74208	92102	82106	17894	07898	25792	29
32	31 44	28 16	74227	92094	82133	17867	07906	25773	28
33	31 36	28 24	74246	92086	82161	17839	07914	25754	27
34	31 28	28 32	74265	92077	82188	17812	07923	25735	26
35	7 31 20	4 28 40	9.74284	9.92069	9.82215	10.17785	10.07931	10.25716	25
36	31 12	28 48	74303	92060	82243	17757	07940	25697	24
37	31 4	28 56	74322	92052	82270	17730	07948	25678	23
38	30 56	29 4	74341	92044	82298	17702	07956	25659	22
39	30 48	29 12	74360	92035	82325	17675	07965	25640	21
40	7 30 40	4 29 20	9.74379	9.92027	9.82352	10.17648	10.07973	10.25621	20
41	30 32	29 28	74398	92018	82380	17620	07982	25602	19
42	30 24	29 36	74417	92010	82407	17593	07990	25583	18
43	30 16	29 44	74436	92002	82435	17565	07998	25564	17
44	30 8	29 52	74455	91993	82462	17538	08007	25545	16
45	7 30 0	4 30 0	9.74474	9.91985	9.82489	10.17511	10.08015	10.25526	15
46	29 52	30 8	74493	91976	82517	17483	08024	25507	14
47	29 44	30 16	74512	91968	82544	17456	08032	25488	13
48	29 36	30 24	74531	91959	82571	17429	08041	25469	12
49	29 28	30 32	74549	91951	82599	17401	08049	25451	11
50	7 29 20	4 30 40	9.74568	9.91942	9.82626	10.17374	10.08058	10.25432	10
51	29 12	30 48	74587	91934	82653	17347	08066	25413	9
52	29 4	30 56	74606	91925	82681	17319	08075	25394	8
53	28 56	31 4	74625	91917	82708	17292	08083	25375	7
54	28 48	31 12	74644	91908	82735	17265	08092	25356	6
55	7 28 40	4 31 20	9.74662	9.91900	9.82762	10.17238	10.08100	10.25338	5
56	28 32	31 28	74681	91891	82790	17210	08109	25319	4
57	28 24	31 36	74700	91883	82817	17183	08117	25300	3
58	28 16	31 44	74719	91874	82844	17156	08126	25281	2
59	28 8	31 52	74737	91366	82871	17129	08134	25263	1
60	28 0	32 0	74756	91857	82899	17101	08143	25244	0
M.	Hour P.M.	Hour A.M.	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Hour A.M.	Hour P.M.	Sine.	Co-Sine.	Tangent.	Co-tang.	Secant.	Co-secant	M.
0	7 28 0	4 32 0	9.74756	9.91857	9.82899	10.17101	10.08143	10.25244	60
1	27 52	32 8	74775	91849	82926	17074	08151	25225	59
2	27 44	32 16	74794	91840	82953	17047	08160	25206	58
3	27 36	32 24	74812	91832	82980	17020	08168	25188	57
4	27 28	32 32	74831	91823	83008	16992	08177	25169	56
5	7 27 20	4 32 40	9.74850	9.91815	9.83035	10.16965	10.08185	10.25150	55
6	27 12	32 48	74868	91806	83062	16938	08194	25132	54
7	27 4	32 56	74887	91798	83089	16911	08202	25113	53
8	26 56	33 4	74906	91789	83117	16883	08211	25094	52
9	26 48	33 12	74924	91780	83144	16856	08219	25076	51
10	7 26 40	4 33 20	9.74943	9.91772	9.83171	10.16829	10.08228	10.25057	50
11	26 32	33 28	74961	91763	83198	16802	08237	25039	49
12	26 24	33 36	74980	91755	83225	16775	08245	25020	48
13	26 16	33 44	74999	91746	83252	16748	08254	25001	47
14	26 8	33 52	75017	91738	83280	16720	08262	24983	46
15	7 26 0	4 34 0	9.75036	9.91729	9.83307	10.16693	10.08271	10.24964	45
16	25 52	34 8	75054	91720	83334	16666	08280	24946	44
17	25 44	34 16	75073	91712	83361	16639	08288	24927	43
18	25 36	34 24	75091	91703	83388	16612	08297	24909	42
19	25 28	34 32	75110	91694	83415	16585	08305	24890	41
20	7 25 20	4 34 40	9.75128	9.91686	9.83442	10.16558	10.08314	10.24872	40
21	25 12	34 48	75147	91677	83470	16530	08323	24853	39
22	25 4	34 56	75165	91668	83497	16503	08331	24835	38
23	24 56	35 4	75184	91660	83524	16476	08340	24816	37
24	24 48	35 12	75202	91651	83551	16449	08349	24798	36
25	7 24 40	4 35 20	9.75221	9.91643	9.83578	10.16422	10.08357	10.24779	35
26	24 32	35 28	75239	91634	83605	16395	08366	24761	34
27	24 24	35 36	75258	91625	83632	16368	08375	24742	33
28	24 16	35 44	75276	91617	83659	16341	08383	24724	32
29	24 8	35 52	75294	91608	83686	16314	08392	24706	31
30	7 24 0	4 36 0	9.75313	9.91599	9.83713	10.16287	10.08401	10.24687	30
31	23 52	36 8	75331	91591	83740	16260	08409	24669	29
32	23 44	36 16	75349	91582	83768	16232	08418	24650	28
33	23 36	36 24	75368	91573	83795	16205	08427	24632	27
34	23 28	36 32	75386	91565	83822	16178	08435	24614	26
35	7 23 20	4 36 40	9.75405	9.91556	9.83849	10.16151	10.08444	10.24595	25
36	23 12	36 48	75423	91547	83876	16124	08453	24577	24
37	23 4	36 56	75441	91538	83903	16097	08462	24559	23
38	22 56	37 4	75459	91530	83930	16070	08470	24541	22
39	22 48	37 12	75478	91521	83957	16043	08479	24522	21
40	7 22 40	4 37 20	9.75496	9.91512	9.83984	10.16016	10.08488	10.24504	20
41	22 32	37 28	75514	91503	84011	15989	08496	24486	19
42	22 24	37 36	75533	91495	84038	15962	08505	24467	18
43	22 16	37 44	75551	91486	84065	15935	08514	24449	17
44	22 8	37 52	75569	91477	84092	15908	08523	24431	16
45	7 22 0	4 38 0	9.75587	9.91468	9.84119	10.15881	10.08531	10.24413	15
46	21 52	38 8	75605	91460	84146	15854	08540	24395	14
47	21 44	38 16	75624	91451	84173	15827	08549	24376	13
48	21 36	38 24	75642	91442	84200	15800	08558	24358	12
49	21 28	38 32	75660	91433	84227	15773	08567	24340	11
50	7 21 20	4 38 40	9.75678	9.91425	9.84254	10.15746	10.08575	10.24322	10
51	21 12	38 48	75696	91416	84280	15720	08584	24304	9
52	21 4	38 56	75714	91407	84307	15693	08593	24286	8
53	20 56	39 4	75732	91398	84334	15666	08602	24267	7
54	20 48	39 12	75751	91389	84361	15639	08611	24249	6
55	7 20 40	4 39 20	9.75769	9.91381	9.84388	10.15612	10.08619	10.24231	5
56	20 32	39 28	75787	91372	84415	15585	08628	24213	4
57	20 24	39 36	75805	91363	84442	15558	08637	24195	3
58	20 16	39 44	75823	91354	84469	15531	08646	24177	2
59	20 8	39 52	75841	91345	84496	15504	08655	24159	1
60	20 0	40 0	75859	91336	84523	15477	08664	24141	0
M.	Hour P.M.	Hour A.M.	Co-Sine.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M.

M.	Hour A.M.	Hour P.M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	M.
0	7 20 0	4 40 0	9.75859	9.91336	9.84523	10.15477	10.08664	10.24141	60
1	19 52	40 8	75877	91328	84550	15450	08672	24123	59
2	19 44	40 16	75895	91319	84576	15424	08681	24105	58
3	19 36	40 24	75913	91310	84603	15397	08690	24087	57
4	19 28	40 32	75931	91301	84630	15370	08699	24069	56
5	7 19 20	4 40 40	9.75949	9.91292	9.84657	10.15343	10.08708	10.24051	55
6	19 12	40 48	75967	91283	84684	15316	08717	24033	54
7	19 4	40 56	75985	91274	84711	15289	08726	24015	53
8	18 56	41 4	76003	91267	84738	15262	08734	23997	52
9	18 48	41 12	76021	91257	84764	15236	08743	23979	51
10	7 18 40	4 41 20	9.76039	9.91248	9.84791	10.15209	10.08752	10.23961	50
11	18 32	41 28	76057	91239	84818	15182	08761	23943	49
12	18 24	41 36	76075	91230	84845	15155	08770	23925	48
13	18 16	41 44	76093	91221	84872	15128	08779	23907	47
14	18 8	41 52	76111	91212	84899	15101	08788	23889	46
15	7 18 0	4 42 0	9.76129	9.91203	9.84925	10.15075	10.08797	10.23871	45
16	17 52	42 8	76146	91194	84952	15048	08806	23854	44
17	17 44	42 16	76164	91185	84979	15021	08815	23836	43
18	17 36	42 24	76182	91176	85006	14994	08824	23818	42
19	17 28	42 32	76200	91167	85033	14967	08833	23800	41
20	7 17 20	4 42 40	9.76218	9.91158	9.85059	10.14941	10.08842	10.23782	40
21	17 12	42 48	76236	91149	85086	14914	08851	23764	39
22	17 4	42 56	76253	91141	85113	14887	08859	23747	38
23	16 56	43 4	76271	91132	85140	14860	08868	23729	37
24	16 48	43 12	76289	91123	85166	14834	08877	23711	36
25	7 16 40	4 43 20	9.76307	9.91114	9.85193	10.14807	10.08886	10.23693	35
26	16 32	43 28	76324	91105	85220	14780	08895	23676	34
27	16 24	43 36	76342	91096	85247	14753	08904	23658	33
28	16 16	43 44	76360	91087	85273	14727	08913	23640	32
29	16 8	43 52	76378	91078	85300	14700	08922	23622	31
30	7 16 0	4 44 0	9.76395	9.91069	9.85327	10.14673	10.08931	10.23605	30
31	15 52	44 8	76413	91060	85354	14646	08940	23587	29
32	15 44	44 16	76431	91051	85380	14620	08949	23569	28
33	15 36	44 24	76448	91042	85407	14593	08958	23552	27
34	15 28	44 32	76466	91034	85434	14566	08967	23534	26
35	7 15 20	4 44 40	9.76484	9.91025	9.85460	10.14540	10.08975	10.23516	25
36	15 12	44 48	76501	91014	85487	14513	08986	23499	24
37	15 4	44 56	76519	91005	85514	14486	08995	23481	23
38	14 56	45 4	76537	90996	85540	14460	09004	23463	22
39	14 48	45 12	76554	90987	85567	14433	09013	23446	21
40	7 14 40	4 45 20	9.76572	9.90978	9.85594	10.14406	10.09022	10.23428	20
41	14 32	45 28	76590	90969	85620	14380	09031	23410	19
42	14 24	45 36	76607	90960	85647	14353	09040	23393	18
43	14 16	45 44	76625	90951	85674	14326	09049	23375	17
44	14 8	45 52	76642	90942	85700	14300	09058	23358	16
45	7 14 0	4 46 0	9.76660	9.90933	9.85727	10.14273	10.09067	10.23340	15
46	13 52	46 8	76677	90924	85754	14246	09076	23323	14
47	13 44	46 16	76695	90915	85780	14220	09085	23305	13
48	13 36	46 24	76712	90905	85807	14193	09094	23288	12
49	13 28	46 32	76730	90896	85834	14166	09104	23270	11
50	7 13 20	4 46 40	9.76747	9.90887	9.85860	10.14140	10.09113	10.23253	10
51	13 12	46 48	76765	90878	85887	14113	09122	23235	9
52	13 4	46 56	76782	90869	85913	14087	09131	23218	8
53	12 56	47 4	76800	90860	85940	14060	09140	23200	7
54	12 48	47 12	76817	90851	85967	14033	09149	23183	6
55	7 12 40	4 47 20	9.76835	9.90842	9.85993	10.14007	10.09158	10.23165	5
56	12 32	47 28	76852	90832	86020	13980	09168	23148	4
57	12 24	47 36	76870	90823	86046	13954	09177	23130	3
58	12 16	47 44	76887	90814	86073	13927	09186	23113	2
59	12 8	47 52	76904	90805	86100	13900	09195	23096	1
60	12 0	48 0	76922	90796	86126	13874	09204	23078	0
M.	Hour P.M.	Hour A.M.	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Hour A.M.	Hour P.M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	M.
0	7 12 0	4 48 0	9.76922	9.90796	9.86126	10.13874	10.09204	10.23078	60
1	11 52	48 8	76939	90787	86153	13847	09213	23061	59
2	11 44	48 16	76957	90777	86179	13821	09223	23043	58
3	11 36	48 24	76974	90768	86206	13794	09232	23026	57
4	11 28	48 32	76991	90759	86232	13768	09241	23009	56
5	7 11 20	4 48 40	9.77009	9.90750	9.86259	10.13741	10.09250	10.22991	55
6	11 12	48 48	77026	90741	86285	13715	09259	22974	54
7	11 4	48 56	77043	90731	86312	13688	09269	22957	53
8	10 56	49 4	77061	90722	86338	13662	09278	22939	52
9	10 48	49 12	77078	90713	86365	13635	09287	22922	51
10	7 10 40	4 49 20	9.77095	9.90704	9.86392	10.13608	10.09296	10.22905	50
11	10 32	49 28	77112	90694	86418	13582	09306	22888	49
12	10 24	49 36	77130	90685	86445	13555	09315	22870	48
13	10 16	49 44	77147	90676	86471	13529	09324	22853	47
14	10 8	49 52	77164	90667	86498	13502	09333	22836	46
15	7 10 0	4 50 0	9.77181	9.90657	9.86524	10.13476	10.09343	10.22819	45
16	9 52	50 8	77199	90648	86551	13449	09352	22801	44
17	9 44	50 16	77216	90639	86577	13423	09361	22784	43
18	9 36	50 24	77233	90630	86603	13397	09370	22767	42
19	9 28	50 32	77250	90620	86630	13370	09380	22750	41
20	7 9 20	4 50 40	9.77268	9.90611	9.86656	10.13344	10.09389	10.22732	40
21	9 12	50 48	77285	90602	86683	13317	09398	22715	39
22	9 4	50 56	77302	90592	86709	13291	09408	22698	38
23	8 56	51 4	77319	90583	86736	13264	09417	22681	37
24	8 48	51 12	77336	90574	86762	13238	09426	22664	36
25	7 8 40	4 51 20	9.77353	9.90565	9.86789	10.13211	10.09435	10.22647	35
26	8 32	51 28	77370	90555	86815	13185	09445	22630	34
27	8 24	51 36	77387	90546	86842	13158	09454	22613	33
28	8 16	51 44	77405	90537	86868	13132	09463	22595	32
29	8 8	51 52	77422	90527	86894	13106	09473	22578	31
30	7 8 0	4 52 0	9.77439	9.90518	9.86921	10.13079	10.09482	10.22561	30
31	7 52	52 8	77456	90509	86947	13053	09491	22544	29
32	7 44	52 16	77473	90499	86974	13026	09501	22527	28
33	7 36	52 24	77490	90490	87000	13000	09510	22510	27
34	7 28	52 32	77507	90480	87027	12973	09520	22493	26
35	7 7 20	4 52 40	9.77524	9.90471	9.87053	10.12947	09529	10.22476	25
36	7 12	52 48	77541	90462	87079	12921	09538	22459	24
37	7 4	52 56	77558	90453	87106	12894	09548	22442	23
38	6 56	53 4	77575	90443	87132	12868	09557	22425	22
39	6 48	53 12	77592	90434	87158	12842	09566	22408	21
40	7 6 40	4 53 20	9.77609	9.90424	9.87185	10.12815	10.09576	10.22391	20
41	6 32	53 28	77626	90415	87211	12789	09585	22374	19
42	6 24	53 36	77643	90405	87238	12762	09595	22357	18
43	6 16	53 44	77660	90396	87264	12736	09604	22340	17
44	6 8	53 52	77677	90386	87290	12710	09614	22323	16
45	7 6 0	4 54 0	9.77694	9.90377	9.87317	10.12683	10.09623	10.22306	15
46	5 52	54 8	77711	90368	87343	12657	09632	22289	14
47	5 44	54 16	77728	90358	87369	12631	09642	22272	13
48	5 36	54 24	77744	90349	87396	12604	09651	22256	12
49	5 28	54 32	77761	90339	87422	12578	09661	22239	11
50	7 5 20	4 54 40	9.77778	9.90330	9.87448	10.12552	10.09670	10.22222	10
51	5 12	54 48	77795	90320	87475	12525	09680	22205	9
52	5 4	54 56	77812	90311	87501	12499	09689	22188	8
53	4 56	55 4	77829	90301	87527	12473	09699	22171	7
54	4 48	55 12	77846	90293	87554	12446	09708	22154	6
55	7 4 40	4 55 20	9.77862	9.90282	9.87580	10.12420	10.09718	10.22138	5
56	4 32	55 28	77879	90273	87606	12394	09727	22121	4
57	4 24	55 36	77896	90263	87633	12367	09737	22104	3
58	4 16	55 44	77913	90254	87659	12341	09746	22087	2
59	4 8	55 52	77930	90244	87685	12315	09756	22070	1
60	4 0	56 0	77946	90235	87711	12289	09765	22054	0
M.	Hour P.M.	Hour A.M.	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Hour A.M.	Hour P.M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secan.	M.
0	7 4 0	4 56 0	9.77946	9.90235	9.87711	10.12289	10.09765	10.22054	60
1	3 52	56 8	77963	90225	87738	12262	09775	22037	59
2	3 44	56 16	77980	90216	87764	12236	09784	22020	58
3	3 36	56 24	77997	90206	87790	12210	09794	22003	57
4	3 28	56 32	78013	90197	87817	12183	09803	21987	56
5	7 3 20	4 56 40	9.78030	9.90187	9.87843	10.12157	10.09813	10.21970	55
6	3 12	56 48	78047	90178	87869	12131	09822	21953	54
7	3 4	56 56	78063	90168	87895	12105	09832	21937	53
8	2 56	57 4	78080	90159	87922	12078	09841	21920	52
9	2 48	57 12	78097	90149	87948	12052	09851	21903	51
10	7 2 40	4 57 20	9.78113	9.90139	9.87974	10.12026	10.09861	10.21887	50
11	2 32	57 28	78130	90130	88000	12000	09870	21870	49
12	2 24	57 36	78147	90120	88027	11973	09880	21853	48
13	2 16	57 44	78163	90111	88053	11947	09889	21837	47
14	2 8	57 52	78180	90101	88079	11921	09899	21820	46
15	7 2 0	4 58 0	9.78197	9.90091	9.88105	10.11895	10.09909	10.21803	45
16	1 52	58 8	78213	90082	88131	11869	09918	21787	44
17	1 44	58 16	78230	90072	88158	11842	09928	21770	43
18	1 36	58 24	78246	90063	88184	11816	09937	21754	42
19	1 28	58 32	78263	90053	88210	11790	09947	21737	41
20	7 1 20	4 58 40	9.78280	9.90043	9.88236	10.11764	10.09957	10.21720	40
21	1 12	58 48	78296	90034	88262	11738	09966	21704	39
22	1 4	58 56	78313	90024	88289	11711	09976	21687	38
23	0 56	59 4	78329	90014	88315	11685	09986	21671	37
24	0 48	59 12	78346	90005	88341	11659	09995	21654	36
25	7 0 40	4 59 20	9.78362	9.89995	9.88367	10.11633	10.10005	10.21638	35
26	0 32	59 28	78379	89985	88393	11607	10015	21621	34
27	0 24	59 36	78395	89976	88420	11580	10024	21605	33
28	0 16	59 44	78412	89966	88446	11554	10034	21588	32
29	0 8	59 52	78428	89956	88472	11528	10044	21572	31
30	7 0 0	5 0 0	9.78445	9.89947	9.88498	10.11502	10.10053	10.21555	30
31	6 59 52	0 8	78461	89937	88524	11476	10063	21539	29
32	59 44	0 16	78478	89927	88550	11450	10073	21522	28
33	59 36	0 24	78494	89917	88577	11423	10083	21506	27
34	59 28	0 32	78510	89908	88603	11397	10092	21490	26
35	6 59 20	5 0 40	9.78527	9.89898	9.88629	10.11371	10.10102	10.21473	25
36	59 12	0 48	78543	89888	88655	11345	10112	21457	24
37	59 4	0 56	78560	89879	88681	11319	10121	21440	23
38	58 56	1 4	78576	89869	88707	11293	10131	21424	22
39	58 48	1 12	78592	89859	88733	11267	10141	21408	21
40	6 58 40	5 1 20	9.78609	9.89849	9.88759	10.11241	10.10151	10.21391	20
41	58 32	1 28	78625	89840	88786	11214	10160	21375	19
42	58 24	1 36	78642	89830	88812	11188	10170	21358	18
43	58 16	1 44	78658	89820	88838	11162	10180	21342	17
44	58 8	1 52	78674	89810	88864	11136	10190	21326	16
45	6 58 0	5 2 0	9.78691	9.89801	9.88890	10.11110	10.10199	10.21309	15
46	57 52	2 8	78707	89791	88916	11084	10209	21293	14
47	57 44	2 16	78723	89781	88942	11058	10219	21277	13
48	57 36	2 24	78739	89771	88968	11032	10229	21261	12
49	57 28	2 32	78756	89761	88994	11006	10239	21244	11
50	6 57 20	5 2 40	9.78772	9.89752	9.89020	10.10980	10.10248	10.21228	10
51	57 12	2 48	78788	89742	89046	10954	10258	21212	9
52	57 4	2 56	78805	89732	89073	10927	10268	21195	8
53	56 56	3 4	78821	89722	89099	10901	10278	21179	7
54	56 48	3 12	78837	89712	89125	10875	10288	21163	6
55	6 56 40	5 3 20	9.78853	9.89702	9.89151	10.10849	10.10298	10.21147	5
56	56 32	3 28	78869	89693	89177	10823	10307	21131	4
57	56 24	3 36	78886	89683	89203	10797	10317	21114	3
58	56 16	3 44	78902	89673	89229	10771	10327	21098	2
59	56 8	3 52	78918	89663	89255	10745	10337	21082	1
60	56 0	4 0	78934	89653	89281	10719	10347	21066	0
M.	Hour P.M.	Hour A.M.	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Hour A.M.	Hour P.M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	M.
0	6 56 0	5 4 0	9.78934	9.89653	9.89281	10.10719	10.10347	10.21066	60
1	55 52	4 8	78950	89643	89307	10693	10357	21050	59
2	55 44	4 16	78967	89633	89333	10667	10367	21033	58
3	55 36	4 24	78983	89624	89359	10641	10376	21017	57
4	55 28	4 32	78999	89614	89385	10615	10386	21001	56
5	6 55 20	5 4 40	9.79015	9.89604	9.89411	10.10589	10.10396	10.20985	55
6	55 12	4 48	79031	89594	89437	10563	10406	20969	54
7	55 4	4 56	79047	89584	89463	10537	10416	20953	53
8	54 56	5 4	79063	89574	89489	10511	10426	20937	52
9	54 48	5 12	79079	89564	89515	10485	10436	20921	51
10	6 54 40	5 5 20	9.79095	9.89554	9.89541	10.10459	10.10446	10.20905	50
11	54 32	5 28	79111	89544	89567	10433	10456	20889	49
12	54 24	5 36	79128	89534	89593	10407	10466	20872	48
13	54 16	5 44	79144	89524	89619	10381	10476	20856	47
14	54 8	5 52	79160	89514	89645	10355	10486	20840	46
15	6 54 0	5 6 0	9.79176	9.89504	9.89671	10.10329	10.10496	10.20824	45
16	53 52	6 8	79192	89495	89697	10303	10505	20808	44
17	53 44	6 16	79208	89485	89723	10277	10515	20792	43
18	53 36	6 24	79224	89475	89749	10251	10525	20776	42
19	53 28	6 32	79240	89465	89775	10225	10535	20760	41
20	6 53 20	5 6 40	9.79256	9.89455	9.89801	10.10199	10.10545	10.20744	40
21	53 12	6 48	79272	89445	89827	10173	10555	20728	39
22	53 4	6 56	79288	89435	89853	10147	10565	20712	38
23	52 56	7 4	79304	89425	89879	10121	10575	20696	37
24	52 48	7 12	79319	89415	89905	10095	10585	20681	36
25	6 52 40	5 7 20	9.79335	9.89405	9.89931	10.10069	10.10595	10.20665	35
26	52 32	7 28	79351	89395	89957	10043	10605	20649	34
27	52 24	7 36	79367	89385	89983	10017	10615	20633	33
28	52 16	7 44	79383	89375	90009	09991	10625	20617	32
29	52 8	7 52	79399	89365	90035	09965	10636	20601	31
30	6 52 0	5 8 0	9.79415	9.89354	9.90061	10.09939	10.10646	10.20585	30
31	51 52	8 8	79431	89344	90086	09914	10656	20569	29
32	51 44	8 16	79447	89334	90112	09888	10666	20553	28
33	51 36	8 24	79463	89324	90138	09862	10676	20537	27
34	51 28	8 32	79478	89314	90164	09836	10686	20522	26
35	6 51 20	5 8 40	9.79494	9.89304	9.90190	10.09810	10.10696	10.20506	25
36	51 12	8 48	79510	89294	90216	09784	10706	20490	24
37	51 4	8 56	79526	89284	90242	09758	10716	20474	23
38	50 56	9 4	79542	89274	90268	09732	10726	20458	22
39	50 48	9 12	79558	89264	90294	09706	10736	20442	21
40	6 50 40	5 9 20	9.79573	9.89254	9.90320	10.09680	10.10746	10.20427	20
41	50 32	9 28	79589	89244	90346	09654	10756	20411	19
42	50 24	9 36	79605	89233	90371	09629	10767	20395	18
43	50 16	9 44	79621	89223	90397	09603	10777	20379	17
44	50 8	9 52	79636	89213	90423	09577	10787	20364	16
45	6 50 0	5 10 0	9.79652	9.89203	9.90449	10.09551	10.10797	10.20348	15
46	49 52	10 8	79668	89193	90475	09525	10807	20332	14
47	49 44	10 16	79684	89183	90501	09499	10817	20316	13
48	49 36	10 24	79699	89173	90527	09473	10827	20301	12
49	49 28	10 32	79715	89162	90553	09447	10838	20285	11
50	6 49 20	5 10 40	9.79731	9.89152	9.90578	10.09422	10.10848	10.20269	10
51	49 12	10 48	79746	89142	90604	09396	10858	20254	9
52	49 4	10 56	79762	89132	90630	09370	10868	20238	8
53	48 56	11 4	79778	89122	90656	09344	10878	20222	7
54	48 48	11 12	79793	89112	90682	09318	10888	20207	6
55	6 48 40	5 11 20	9.79809	9.89101	9.90708	10.09292	10.10899	10.20191	5
56	48 32	11 28	79825	89091	90734	09266	10909	20175	4
57	48 24	11 36	79840	89081	90759	09241	10919	20160	3
58	48 16	11 44	79856	89071	90785	09215	10929	20144	2
59	48 8	11 52	79872	89060	90811	09189	10940	20128	1
60	48 0	12 0	79887	89050	90837	09163	10950	20113	0
M.	Hour P.M.	Hour A.M.	Co-sine.	Sine.	Co-tang	Tangent.	Co-secant	Secant.	M.

M.	Hour A.M.	Hour P.M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant	M.
0	6 48 0	5 12 0	9.79887	9.89050	9.90837	10.09163	10.10950	10.20113	60
1	47 52	12 8	79903	89040	90863	09137	10960	20097	59
2	47 44	12 16	79918	89030	90889	09111	10970	20082	58
3	47 36	12 24	79934	89020	90914	09086	10980	20066	57
4	47 28	12 32	79950	89009	90940	09060	10991	20050	56
5	6 47 20	5 12 40	9.79965	9.88999	9.90966	10.09034	10.11001	10.20035	55
6	47 12	12 48	79981	88989	90992	09008	11011	20019	54
7	47 4	12 56	79996	88978	91018	08982	11022	20004	53
8	46 56	13 4	80012	88968	91043	08957	11032	19988	52
9	46 48	13 12	80027	88958	91069	08931	11042	19973	51
10	6 46 40	5 13 20	9.80043	9.88948	9.91095	10.08905	10.11052	10.19957	50
11	46 32	13 28	80058	88937	91121	08879	11063	19942	49
12	46 24	13 36	80074	88927	91147	08853	11073	19926	48
13	46 16	13 44	80089	88917	91172	08828	11083	19911	47
14	46 8	13 52	80105	88906	91198	08802	11094	19895	46
15	6 46 0	5 14 0	9.80120	9.88896	9.91224	10.08776	10.11104	10.19880	45
16	45 52	14 8	80136	88886	91250	08750	11114	19864	44
17	45 44	14 16	80151	88875	91276	08724	11125	19849	43
18	45 36	14 24	80166	88865	91301	08699	11135	19834	42
19	45 28	14 32	80182	88855	91327	08673	11145	19818	41
20	6 45 20	5 14 40	9.80197	9.88844	9.91353	10.08647	10.11156	10.19803	40
21	45 12	14 48	80213	88834	91379	08621	11166	19787	39
22	45 4	14 56	80228	88824	91404	08596	11176	19772	38
23	44 56	15 4	80244	88813	91430	08570	11187	19756	37
24	44 48	15 12	80259	88803	91456	08544	11197	19741	36
25	6 44 40	5 15 20	9.80274	9.88793	9.91482	10.08518	10.11207	10.19726	35
26	44 32	15 28	80290	88782	91507	08493	11218	19710	34
27	44 24	15 36	80305	88772	91533	08467	11228	19695	33
28	44 16	15 44	80320	88761	91559	08441	11239	19680	32
29	44 8	15 52	80336	88751	91585	08415	11249	19664	31
30	6 44 0	5 16 0	9.80351	9.88741	9.91610	10.08390	10.11259	10.19649	30
31	43 52	16 8	80366	88730	91636	08364	11270	19634	29
32	43 44	16 16	80382	88720	91662	08338	11280	19618	28
33	43 36	16 24	80397	88709	91688	08312	11291	19603	27
34	43 28	16 32	80412	88699	91713	08287	11301	19588	26
35	6 43 20	5 16 40	9.80428	9.88688	9.91739	10.08261	10.11312	10.19572	25
36	43 12	16 48	80443	88678	91765	08235	11322	19557	24
37	43 4	16 56	80458	88668	91791	08209	11332	19542	23
38	42 56	17 4	80473	88657	91816	08184	11343	19527	22
39	42 48	17 12	80489	88647	91842	08158	11353	19511	21
40	6 42 40	5 17 20	9.80504	9.88636	9.91868	10.08132	10.11364	10.19496	20
41	42 32	17 28	80519	88626	91893	08107	11374	19481	19
42	42 24	17 36	80534	88615	91919	08081	11385	19466	18
43	42 16	17 44	80550	88605	91945	08055	11395	19450	17
44	42 8	17 52	80565	88594	91971	08029	11406	19435	16
45	6 42 0	5 18 0	9.80580	9.88584	9.91996	10.08004	10.11416	10.19420	15
46	41 52	18 8	80595	88573	92022	07978	11427	19405	14
47	41 44	18 16	80610	88563	92048	07952	11437	19390	13
48	41 36	18 24	80625	88552	92073	07927	11448	19375	12
49	41 28	18 32	80641	88542	92099	07901	11458	19359	11
50	6 41 20	5 18 40	9.80656	9.88531	9.92125	10.07875	10.11469	10.19344	10
51	41 12	18 48	80671	88521	92150	07850	11479	19329	9
52	41 4	18 56	80686	88510	92176	07824	11490	19314	8
53	40 56	19 4	80701	88499	92202	07798	11501	19299	7
54	40 48	19 12	80716	88489	92227	07773	11511	19284	6
55	6 40 40	5 19 20	9.80731	9.88478	9.92253	10.07747	10.11522	10.19269	5
56	40 32	19 28	80746	88468	92279	07721	11532	19254	4
57	40 24	19 36	80762	88457	92304	07696	11543	19238	3
58	40 16	19 44	80777	88447	92330	07670	11553	19223	2
59	40 8	19 52	80792	88436	92356	07644	11564	19208	1
60	40 0	20 0	80807	88425	92381	07619	11575	19193	0
M.	Hour P.M.	Hour A.M.	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M.

M.	Hour A.M.	Hour P.M.	Sine.	Co-Sin	Tangent	Co-tang.	Secant	Co-secant	M.
0	6 40 0	5 20 0	9.80807	9.88425	9.92381	10.07619	10.11575	10.19193	60
1	39 52	20 8	80822	88415	92407	07593	11585	19178	59
2	39 44	20 16	80837	88404	92433	07567	11596	19163	58
3	39 36	20 24	80852	88394	92458	07542	11606	19148	57
4	39 28	20 32	80867	88383	92484	07516	11617	19133	56
5	6 39 20	5 20 40	9.80882	9.88372	9.92510	10.07490	10.11628	10.19118	55
6	39 12	20 48	80897	88362	92535	07465	11638	19103	54
7	39 4	20 56	80912	88351	92561	07439	11649	19088	53
8	38 56	21 4	80927	88340	92587	07413	11660	19073	52
9	38 48	21 12	80942	88330	92612	07388	11670	19058	51
10	6 38 40	5 21 20	9.80957	9.88319	9.92638	10.07362	10.11681	10.19043	50
11	38 32	21 28	80972	88308	92663	07337	11692	19028	49
12	38 24	21 36	80987	88298	92689	07311	11702	19013	48
13	38 16	21 44	81002	88287	92715	07285	11713	18998	47
14	38 8	21 52	81017	88276	92740	07260	11724	18983	46
15	6 38 0	5 22 0	9.81032	9.88266	9.92766	10.07234	10.11734	10.18968	45
16	37 52	22 8	81046	88255	92792	07208	11745	18953	44
17	37 44	22 16	81061	88244	92817	07183	11756	18939	43
18	37 36	22 24	81076	88234	92843	07157	11766	18924	42
19	37 28	22 32	81091	88223	92868	07132	11777	18909	41
20	6 37 20	5 22 40	9.81106	9.88212	9.92894	10.07106	10.11788	10.18894	40
21	37 12	22 48	81121	88201	92920	07080	11799	18879	39
22	37 4	22 56	81136	88191	92945	07055	11809	18864	38
23	36 56	23 4	81151	88180	92971	07029	11820	18849	37
24	36 48	23 12	81166	88169	92996	07004	11831	18834	36
25	6 36 40	5 23 20	9.81180	9.88158	9.93022	10.06978	10.11842	10.18820	35
26	36 32	23 28	81195	88148	93048	06952	11852	18805	34
27	36 24	23 36	81210	88137	93073	06927	11863	18790	33
28	36 16	23 44	81225	88126	93099	06901	11874	18775	32
29	36 8	23 52	81240	88115	93124	06876	11885	18760	31
30	6 36 0	5 24 0	9.81254	9.88105	9.93150	10.06850	10.11895	10.18746	30
31	35 52	24 8	81269	88094	93175	06825	11906	18731	29
32	35 44	24 16	81284	88083	93201	06799	11917	18716	28
33	35 36	24 24	81299	88072	93227	06773	11928	18701	27
34	35 28	24 32	81314	88061	93252	06748	11939	18686	26
35	6 35 20	5 24 40	9.81328	9.88050	9.93278	10.06722	10.11949	10.18672	25
36	35 12	24 48	81343	88040	93303	06697	11960	18657	24
37	35 4	24 56	81358	88029	93329	06671	11971	18642	23
38	34 56	25 4	81372	88018	93354	06646	11982	18628	22
39	34 48	25 12	81387	88007	93380	06620	11993	18613	21
40	6 34 40	5 25 20	9.81402	9.87996	9.93406	10.06594	10.12004	10.18598	20
41	34 32	25 28	81417	87985	93431	06569	12015	18583	19
42	34 24	25 36	81431	87975	93457	06543	12025	18569	18
43	34 16	25 44	81446	87964	93482	06518	12036	18554	17
44	34 8	25 52	81461	87953	93508	06492	12047	18539	16
45	6 34 0	5 26 0	9.81475	9.87942	9.93533	10.06467	10.12058	10.18525	15
46	33 52	26 8	81490	87931	93559	06441	12069	18510	14
47	33 44	26 16	81505	87920	93584	06416	12080	18495	13
48	33 36	26 24	81519	87909	93610	06390	12091	18481	12
49	33 28	26 32	81534	87898	93636	06364	12102	18466	11
50	6 33 20	5 26 40	9.81549	9.87887	9.93661	10.06339	10.12113	10.18451	10
51	33 12	26 48	81563	87877	93687	06313	12123	18437	9
52	33 4	26 56	81578	87866	93712	06288	12134	18422	8
53	32 56	27 4	81592	87855	93738	06262	12145	18408	7
54	32 48	27 12	81607	87844	93763	06237	12156	18393	6
55	6 32 40	5 27 20	9.81622	9.87833	9.93789	10.06211	10.12167	10.18378	5
56	32 32	27 28	81636	87822	93814	06186	12178	18364	4
57	32 24	27 36	81651	87811	93840	06160	12189	18349	3
58	32 16	27 44	81665	87800	93865	06135	12200	18335	2
59	32 8	27 52	81680	87789	93891	06109	12211	18320	1
60	32 0	28 0	81694	87778	93916	06084	12222	18306	0
M.	Hour P.M.	Hour A.M.	Co-Sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

M.	Hour A.M.	Hour P.M.	Sine.	Co-Sine.	Tangent.	Co-tang.	Secant.	Co-secant	M.
0	6 32 0	5 28 0	9.81694	9.87778	9.93916	10.06084	10.12222	10.18306	60
1	31 52	28 8	81709	87767	93942	06058	12233	18291	59
2	31 44	28 16	81723	87756	93967	06033	12244	18277	58
3	31 36	28 24	81738	87745	93993	06007	12255	18262	57
4	31 28	28 32	81752	87734	94018	05982	12266	18248	56
5	6 31 20	5 28 40	9.81767	9.87723	9.94044	10.05956	10.12277	10.18233	55
6	31 12	28 48	81781	87712	94069	05931	12288	18219	54
7	31 4	28 56	81796	87701	94095	05905	12299	18204	53
8	30 56	29 4	81810	87690	94120	05880	12310	18190	52
9	30 48	29 12	81825	87679	94146	05854	12321	18175	51
10	6 30 40	5 29 20	9.81839	9.87668	9.94171	10.05829	10.12332	10.18161	50
11	30 32	29 28	81854	87657	94197	05803	12343	18146	49
12	30 24	29 36	81868	87646	94222	05778	12354	18132	48
13	30 16	29 44	81882	87635	94248	05752	12365	18118	47
14	30 8	29 52	81897	87624	94273	05727	12376	18103	46
15	6 30 0	5 30 0	9.81911	9.87613	9.94299	10.05701	10.12387	10.18089	45
16	29 52	30 8	81926	87601	94324	05676	12399	18074	44
17	29 44	30 16	81940	87590	94350	05650	12410	18060	43
18	29 36	30 24	81954	87579	94375	05625	12421	18045	42
19	29 28	30 32	81969	87568	94401	05599	12432	18031	41
20	6 29 20	5 30 40	9.81983	9.87557	9.94426	10.05574	10.12443	10.18017	40
21	29 12	30 48	81998	87545	94452	05548	12454	18002	39
22	29 4	30 56	82012	87535	94477	05523	12465	17988	38
23	28 56	31 4	82026	87524	94503	05497	12476	17974	37
24	28 48	31 12	82041	87513	94528	05472	12487	17959	36
25	6 28 40	5 31 20	9.82055	9.87591	9.94554	10.05446	10.12499	10.17945	35
26	28 32	31 28	82069	87490	94579	05421	12510	17931	34
27	28 24	31 36	82084	87479	94604	05396	12521	17916	33
28	28 16	31 44	82098	87468	94630	05370	12532	17902	32
29	28 8	31 52	82112	87457	94655	05345	12543	17888	31
30	6 28 0	5 32 0	9.82126	9.87446	9.94681	10.05319	10.12554	10.17874	30
31	27 52	32 8	82141	87434	94706	05294	12566	17859	29
32	27 44	32 16	82155	87423	94732	05268	12577	17845	28
33	27 36	32 24	82169	87412	94757	05243	12588	17831	27
34	27 28	32 32	82184	87401	94783	05217	12599	17816	26
35	6 27 20	5 32 40	9.82198	9.87390	9.94808	10.05192	10.12610	10.17802	25
36	27 12	32 48	82212	87378	94834	05166	12622	17788	24
37	27 4	32 56	82226	87367	94859	05141	12633	17774	23
38	26 56	33 4	82240	87356	94884	05116	12644	17760	22
39	26 48	33 12	82255	87345	94910	05090	12655	17745	21
40	6 26 40	5 33 20	9.82269	9.87334	9.94935	10.05065	10.12666	10.17731	20
41	26 32	33 28	82283	87322	94961	05039	12678	17717	19
42	26 24	33 36	82297	87311	94986	05014	12689	17703	18
43	26 16	33 44	82311	87300	95012	04988	12700	17689	17
44	26 8	33 52	82326	87288	95037	04963	12712	17674	16
45	6 26 0	5 34 0	9.82340	9.87277	9.95062	10.04938	10.12723	10.17660	15
46	25 52	34 8	82354	87266	95088	04912	12734	17646	14
47	25 44	34 16	82368	87255	95113	04887	12745	17632	13
48	25 36	34 24	82382	87243	95139	04861	12757	17618	12
49	25 28	34 32	82396	87232	95164	04836	12768	17604	11
50	6 25 20	5 34 40	9.82410	9.87221	9.95190	10.04810	10.12779	10.17590	10
51	25 12	34 48	82424	87209	95215	04785	12791	17576	9
52	25 4	34 56	82439	87198	95240	04760	12802	17561	8
53	24 56	35 4	82453	87187	95266	04734	12813	17547	7
54	24 48	35 12	82467	87175	95291	04709	12825	17533	6
55	6 24 40	5 35 20	9.82481	9.87164	9.95317	10.04583	10.12836	10.17519	5
56	24 32	35 28	82495	87153	95342	04658	12847	17505	4
57	24 24	35 36	82509	87141	95368	04632	12859	17491	3
58	24 16	35 44	82523	87130	95393	04607	12870	17477	2
59	24 8	35 52	82537	87119	95418	04582	12881	17463	1
60	24 0	36 0	82551	87107	95444	04556	12893	17449	0
Min.	Hour A.M.	Hour P.M.	Co-Sine.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M.

M.	Hour A.M.	Hour P.M.	Sine.	Co-sine.	Tangent	Co-tang.	Secant.	Co-secant	M.
0	6 24 0	5 36 0	9.82551	9.87107	9.95444	10.04556	10.12893	10.17449	60
1	23 52	36 8	82565	87096	95469	04531	12904	17435	59
2	23 44	36 16	82579	87085	95495	04505	12915	17421	58
3	23 36	36 24	82593	87073	95520	04480	12927	17407	57
4	23 28	36 32	82607	87062	95545	04455	12938	17393	56
5	6 23 20	5 36 40	9.82621	9.87050	9.95571	10.04429	10.12950	10.17379	55
6	23 12	36 48	82635	87039	95596	04404	12961	17365	54
7	23 4	36 56	82649	87028	95622	04378	12972	17351	53
8	22 56	37 4	82663	87017	95647	04353	12983	17337	52
9	22 48	37 12	82677	87005	95672	04328	12995	17323	51
10	6 22 40	5 37 20	9.82691	9.86993	9.95698	10.04302	10.13007	10.17309	50
11	22 32	37 28	82705	86982	95723	04277	13018	17295	49
12	22 24	37 36	82719	86970	95748	04252	13030	17281	48
13	22 16	37 44	82733	86959	95774	04226	13041	17267	47
14	22 8	37 52	82747	86947	95799	04201	13053	17253	46
15	6 22 0	5 38 0	9.82761	9.86936	9.95825	10.04175	10.13064	10.17239	45
16	21 52	38 8	82775	86924	95850	04150	13076	17225	44
17	21 44	38 16	82788	86913	95875	04125	13087	17212	43
18	21 36	38 24	82802	86902	95901	04099	13098	17198	42
19	21 28	38 32	82816	86890	95926	04074	13110	17184	41
20	6 21 20	5 38 40	9.82830	9.86879	9.95952	10.04048	10.13121	10.17170	40
21	21 12	38 48	82844	86867	95977	04023	13133	17156	39
22	21 4	38 56	82858	86855	96002	03998	13145	17142	38
23	20 56	39 4	82872	86844	96028	03972	13156	17128	37
24	20 48	39 12	82885	86832	96053	03947	13168	17115	36
25	6 20 40	5 39 20	9.82899	9.86821	9.96078	10.03922	10.13179	10.17101	35
26	20 32	39 28	82913	86809	96104	03896	13191	17087	34
27	20 24	39 36	82927	86798	96129	03871	13202	17073	33
28	20 16	39 44	82941	86786	96155	03845	13214	17059	32
29	20 8	39 52	82955	86775	96180	03820	13225	17045	31
30	6 20 0	5 40 0	9.82968	9.86763	9.96205	10.03795	10.13237	10.17032	30
31	19 52	40 8	82982	86752	96231	03769	13248	17018	29
32	19 44	40 16	82996	86740	96256	03744	13260	17004	28
33	19 36	40 24	83010	86728	96281	03719	13272	16990	27
34	19 28	40 32	83023	86717	96307	03693	13283	16977	26
35	6 19 20	5 40 40	9.83037	9.86705	9.96332	10.03668	10.13295	10.16963	25
36	19 12	40 48	83051	86694	96357	03643	13306	16949	24
37	19 4	40 56	83065	86682	96383	03617	13318	16935	23
38	18 56	41 4	83078	86670	96408	03592	13330	16922	22
39	18 48	41 12	83092	86659	96433	03567	13341	16908	21
40	6 18 40	5 41 20	9.83106	9.86647	9.96459	10.03541	10.13353	10.16894	20
41	18 32	41 28	83119	86635	96484	03516	13365	16881	19
42	18 24	41 36	83133	86624	96510	03490	13376	16867	18
43	18 16	41 44	83147	86612	96535	03465	13388	16853	17
44	18 8	41 52	83161	86600	96560	03440	13400	16839	16
45	6 18 0	5 42 0	9.83174	9.86589	9.96586	10.03414	10.13411	10.16826	15
46	17 52	42 8	83188	86577	96611	03389	13423	16812	14
47	17 44	42 16	83202	86565	96636	03364	13435	16798	13
48	17 36	42 24	83215	86554	96662	03338	13446	16785	12
49	17 28	42 32	83229	86542	96687	03313	13458	16771	11
50	6 17 20	5 42 40	9.83242	9.86530	9.96712	10.03288	10.13470	10.16758	10
51	17 12	42 48	83256	86518	96738	03262	13482	16744	9
52	17 4	42 56	83270	86507	96763	03237	13493	16730	8
53	16 56	43 4	83283	86495	96788	03212	13505	16717	7
54	16 48	43 12	83297	86483	96814	03186	13517	16703	6
55	6 16 40	5 43 20	9.83310	9.86472	9.96839	10.03161	10.13528	10.16690	5
56	16 32	43 28	83324	86460	96864	03136	13540	16676	4
57	16 24	43 36	83338	86448	96890	03110	13552	16662	3
58	16 16	43 44	83351	86436	96915	03085	13564	16649	2
59	16 8	43 52	83365	86425	96940	03060	13575	16635	1
60	16 0	44 0	83378	86413	96966	03034	13587	16622	0
M.	Hour P.M.	Hour A.M.	Co-sine.	Sine.	Co-tang.	Tangent	Co-secant	Secant.	M.

M.	Hour A.M.	Hour P.M.	Sine.	Co-sine	Tangent	Co-tang	Secant.	Co-secant.	M.
0	6 16 0	5 44 0	9.83378	9.86413	9.96966	10.03034	10.13587	10.16622	60
1	15 52	44 8	83392	86401	96991	03009	13599	16608	59
2	15 44	44 16	83405	86389	97016	02984	13611	16595	58
3	15 36	44 24	83419	86377	97042	02958	13623	16581	57
4	15 28	44 32	83432	86366	97067	02933	13634	16568	56
5	6 15 20	5 44 40	9.83446	9.86354	9.97092	10.02908	10.13646	10.16554	55
6	15 12	44 48	83459	86342	97118	02882	13658	16541	54
7	15 4	44 56	83473	86330	97143	02857	13670	16527	53
8	14 56	45 4	83486	86318	97168	02832	13682	16514	52
9	14 48	45 12	83500	86306	97193	02807	13694	16500	51
10	6 14 40	5 45 20	9.83513	9.86295	9.97219	10.02781	10.13705	10.16487	50
11	14 32	45 28	83527	86283	97244	02756	13717	16473	49
12	14 24	45 36	83540	86271	97269	02731	13729	16460	48
13	14 16	45 44	83554	86259	97295	02705	13741	16446	47
14	14 8	45 52	83567	86247	97320	02680	13753	16433	46
15	6 14 0	5 46 0	9.83581	9.86235	9.97345	10.02655	10.13765	10.16419	45
16	13 52	46 8	83594	86223	97371	02629	13777	16406	44
17	13 44	46 16	83608	86211	97396	02604	13789	16392	43
18	13 36	46 24	83621	86200	97421	02579	13800	16379	42
19	13 28	46 32	83634	86188	97447	02553	13812	16366	41
20	6 13 20	5 46 40	9.83648	9.86176	9.97472	10.02528	10.13824	10.16352	40
21	13 12	46 48	83661	86164	97497	02503	13836	16339	39
22	13 4	46 56	83674	86152	97523	02477	13848	16326	38
23	12 56	47 4	83688	86140	97548	02452	13860	16312	37
24	12 48	47 12	83701	86128	97573	02427	13872	16299	36
25	6 12 40	5 47 20	9.83715	9.86116	9.97598	10.02402	10.13884	10.16285	35
26	12 32	47 28	83728	86104	97624	02376	13896	16272	34
27	12 24	47 36	83741	86092	97649	02351	13908	16259	33
28	12 16	47 44	83755	86080	97674	02326	13920	16245	32
29	12 8	47 52	83768	86068	97700	02300	13932	16232	31
30	6 12 0	5 48 0	9.83781	9.86056	9.97725	10.02275	10.13944	10.16219	30
31	11 52	48 8	83795	86044	97750	02250	13956	16205	29
32	11 44	48 16	83808	86032	97776	02224	13968	16192	28
33	11 36	48 24	83821	86020	97801	02199	13980	16179	27
34	11 28	48 32	83834	86008	97826	02174	13992	16166	26
35	6 11 20	5 48 40	9.83848	9.85996	9.97851	10.02149	10.14004	10.16152	25
36	11 12	48 48	83861	85984	97877	02123	14016	16139	24
37	11 4	48 56	83874	85972	97902	02098	14028	16126	23
38	10 56	49 4	83887	85960	97927	02073	14040	16113	22
39	10 48	49 12	83901	85948	97953	02047	14052	16099	21
40	6 10 40	5 49 20	9.83914	9.85936	9.97978	10.02022	10.14064	10.16086	20
41	10 32	49 28	83927	85924	98003	01997	14076	16073	19
42	10 24	49 36	83940	85912	98029	01971	14088	16060	18
43	10 16	49 44	83954	85900	98054	01946	14100	16046	17
44	10 8	49 52	83967	85888	98079	01921	14112	16033	16
45	6 10 0	5 50 0	9.83980	9.85876	9.98104	10.01896	10.14124	10.16020	15
46	9 52	50 8	83993	85864	98130	01870	14136	16007	14
47	9 44	50 16	84006	85851	98155	01845	14149	15994	13
48	9 36	50 24	84020	85839	98180	01820	14161	15980	12
49	9 28	50 32	84033	85827	98206	01794	14173	15967	11
50	6 9 20	5 50 40	9.84046	9.85815	9.98231	10.01769	10.14185	10.15954	10
51	9 12	50 48	84059	85803	98256	01744	14197	15941	9
52	9 4	50 56	84072	85791	98281	01719	14209	15928	8
53	8 56	51 4	84085	85779	98307	01693	14221	15915	7
54	8 48	51 12	84098	85766	98332	01668	14234	15902	6
55	6 8 40	5 51 20	9.84112	9.85754	9.98357	10.01643	10.14246	10.15888	5
56	8 32	51 28	84125	85742	98383	01617	14258	15875	4
57	8 24	51 36	84138	85730	98408	01592	14270	15862	3
58	8 16	51 44	84151	85718	98433	01567	14282	15849	2
59	8 8	51 52	84164	85706	98458	01542	14294	15836	1
60	8 0	52 0	84177	85693	98484	01516	14307	15823	0
M.	Hour P.M.	Hour A.M.	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secan.	Secant.	M.

M.	Hour A.M.	Hour P.M.	Sine.	Co-Sine.	Tangent.	Co-tang.	Secant.	Co-sec.	M.
0	6 8 0	5 52 0	9.84177	9.85693	9.98484	10.01516	10.14307	10.15823	60
1	7 52	52 8	84190	85681	98509	01491	14319	15810	59
2	7 44	52 16	84203	85669	98534	01466	14331	15797	58
3	7 36	52 24	84216	85657	98560	01440	14343	15784	57
4	7 28	52 32	84229	85645	98585	01415	14355	15771	56
5	6 7 20	5 52 40	9.84242	9.85632	9.98610	10.01390	10.14368	10.15758	55
6	7 12	52 48	84255	85620	98635	01365	14380	15745	54
7	7 4	52 56	84269	85608	98661	01339	14392	15731	53
8	6 56	53 4	84282	85596	98686	01314	14404	15718	52
9	6 48	53 12	84295	85583	98711	01289	14417	15705	51
10	6 6 40	5 53 20	9.84308	9.85571	9.98737	10.01263	10.14429	10.15692	50
11	6 32	53 28	84321	85559	98762	01238	14441	15679	49
12	6 24	53 36	84334	85546	98787	01213	14453	15666	48
13	6 16	53 44	84347	85534	98812	01188	14466	15653	47
14	6 8	53 52	84360	85522	98838	01162	14478	15640	46
15	6 6 0	5 54 0	9.84372	9.85510	9.98863	10.01137	10.14490	10.15627	45
16	5 52	54 8	84385	85497	98888	01112	14503	15615	44
17	5 44	54 16	84398	85485	98913	01087	14515	15602	43
18	5 36	54 24	84411	85473	98939	01061	14527	15589	42
19	5 28	54 32	84424	85460	98964	01036	14540	15576	41
20	6 5 20	5 54 40	9.84437	9.85448	9.98989	10.01011	10.14552	10.15563	40
21	5 12	54 48	84450	85436	99015	00985	14564	15550	39
22	5 4	54 56	84463	85423	99040	00960	14577	15537	38
23	4 56	55 4	84476	85411	99065	00935	14589	15524	37
24	4 48	55 12	84489	85399	99090	00910	14601	15511	36
25	6 4 40	5 55 20	9.84502	9.85386	9.99116	10.00884	10.14614	10.15498	35
26	4 32	55 28	84515	85374	99141	00859	14626	15485	34
27	4 24	55 36	84528	85361	99166	00834	14639	15472	33
28	4 16	55 44	84540	85349	99191	00809	14651	15460	32
29	4 8	55 52	84553	85337	99217	00783	14663	15447	31
30	6 4 0	5 56 0	9.84566	9.85324	9.99242	10.00758	10.14676	10.15434	30
31	3 52	56 8	84579	85312	99267	00733	14688	15421	29
32	3 44	56 16	84592	85299	99293	00707	14701	15408	28
33	3 36	56 24	84605	85287	99318	00682	14713	15395	27
34	3 28	56 32	84618	85274	99343	00657	14726	15382	26
35	6 3 20	5 56 40	9.84630	9.85262	9.99368	10.00632	10.14738	10.15370	25
36	3 12	56 48	84643	85250	99394	00606	14750	15357	24
37	3 4	56 56	84656	85237	99419	00581	14763	15344	23
38	2 56	57 4	84669	85225	99444	00556	14775	15331	22
39	2 48	57 12	84682	85212	99469	00531	14788	15318	21
40	6 2 40	5 57 20	9.84694	9.85200	9.99495	10.00505	10.14800	10.15306	20
41	2 32	57 28	84707	85187	99520	00480	14813	15293	19
42	2 24	57 36	84720	85175	99545	00455	14825	15280	18
43	2 16	57 44	84733	85162	99570	00430	14838	15267	17
44	2 8	57 52	84745	85150	99596	00404	14850	15255	16
45	6 2 0	5 58 0	9.84758	9.85137	9.99621	10.00379	10.14863	10.15242	15
46	1 52	58 8	84771	85125	99646	00354	14875	15229	14
47	1 44	58 16	84784	85112	99672	00328	14888	15216	13
48	1 36	58 24	84796	85100	99697	00303	14900	15204	12
49	1 28	58 32	84809	85087	99722	00278	14913	15191	11
50	6 1 20	5 58 40	9.84822	9.85074	9.99747	10.00253	10.14926	10.15178	10
51	1 12	58 48	84834	85062	99773	00227	14938	15165	9
52	1 4	58 56	84847	85049	99798	00202	14951	15153	8
53	0 56	59 4	84860	85037	99823	00177	14963	15140	7
54	0 48	59 12	84873	85024	99848	00152	14976	15127	6
55	6 0 40	5 59 20	9.84885	9.85012	9.99874	10.00126	10.14988	10.15115	5
56	0 32	59 28	84898	84999	99899	00101	15001	15102	4
57	0 24	59 36	84911	84986	99924	00076	15014	15089	3
58	0 16	59 44	84923	84974	99949	00051	15026	15077	2
59	0 8	59 52	84936	84961	99975	00025	15039	15064	1
60	0 0	6 0 0	84948	84948	10.00000	00000	15051	15051	0
M.	Hour P.M.	Hour A.M.	Co-Sine.	Sine.	Co-tang.	Tangent.	Co-sec.	Secant.	M.

OF MARINE INSURANCES.

INSURANCE is a contract by which the insurer undertakes, in consideration of a premium equivalent to the hazard run, to indemnify the person insured against certain perils or losses, or against some particular event. All insurances, whether against fire or on lives, fall within this general description; but the subject meant to be considered here is that of MARINE INSURANCES. From this definition it appears to be a contract of indemnity against those perils, to which ships and goods are exposed, in the course of their voyage from one place to another.

A complete system of this branch of law cannot be suddenly erected; but it is the boast of this age, that in it the great foundations of marine jurisprudence have been laid, by clearly developing the principles on which policies of insurance are founded, and by applying those principles to particular cases. In the following treatise we shall endeavour to render the law of it so clear as to be a guide to the merchant, owner, freighter, and man of business. To effect this we have divided the subject, and it will be discussed in the following order.

I. The Policy.	X. Fraud in Policies.
II. The Construction of the Policy.	XI. Sea-Worthiness.
III. Perils of the Sea.	XII. Illegal Voyages.
IV. Capture and Detention of Princes.	XIII. Re-Assurance and Double Insurance.
V. Barratry of the Master or Mariners.	XIV. Changing the Ship.
VI. Partial Losses and Adjustment.	XV. Deviation.
VII. General Average.	XVI. Non-compliance with Warranties.
VIII. Salvage.	XVII. Return of Premium.
IX. Abandonment.	XVIII. Bottomry and Respondentia.

I. THE POLICY.

The Policy is the instrument by which the contract of indemnity is effected between the insurer and insured; and it is signed only by the insurer, who is called the underwriter. Of policies there are two kinds, *valued* and *open*; and the only difference between them is this, that, in the former, goods or property insured are valued at prime cost, at the time of effecting the policy; in the latter, the value is not mentioned, but, in case of loss, must be proved.

Policies of assurance, when once they are underwritten, can, generally speaking, never be altered by any authority whatever; because it would be an opening to fraud, and would introduce uncertainty into a species of contract, of which certainty and precision are the most essential requisites. It must be observed, however, that cases frequently exist, in which a policy, *upon proper evidence*, may be altered: and, after signing, policies are frequently altered by *consent* of the parties.

An instance of the former kind of the alteration of the policy occurred before Lord Hardwicke. The insurance on the ship was five hundred pounds, and the policy stated, that the adventure was to commence immediately *from the departure of the ship from Fort St. George to London*. The plaintiff suggested that the owner had employed a Mr. Halhead to insure the ship with the defendants, to commence *from her arrival at Fort St. George*; that a label, agreeable to those instructions, with all the particulars of the agreement, had been entered in a book, and subscribed by Halhead, and two of the directors of the company; that by a *mistake* the policy was made out different from the label; that the ship being lost in the bay of Bengal, *after* her arrival at Fort St. George, but *before* her departure for England, the company refuse to pay; the plaintiff therefore prayed that the mistake might be rectified, and that the company might be ordered to pay five hundred pounds with interest.

His lordship was of opinion, that the label was a memorandum of the agreement, in which the material parts of the policy were inserted; that, although the policy was ambiguous, the label made it clear; and, as it was only *a mistake of the clerk*, it ought to be rectified according to the label. Motteux *v.* the Governor and Company of the London Assurance, 1 Atkyns, 545.

A policy of insurance is the property of the insured; and, if it be *wrongfully* withheld, either by his broker or any other person, he may recover it by an action of trover. Harding *v.* Carter and another: sittings at Guildhall, Easter vacation, 1781.

Policies of insurance are generally printed, leaving blanks for the insertion of names and all other requisites. It is therefore frequently necessary to insert written clauses, and these written clauses and conditions, thus inserted, are to be considered as part of the real contract; the court will look to them to find out the intention of the parties, and will consequently suffer such conditions to controul the printed words.

We will now proceed to consider, First, what things may be insured; Secondly, what the requisites of a policy are.

1st. What Things may be insured.

The most frequent subjects of marine insurance are ships, goods, merchandizes, the freight or hire of ships. But although insurances upon such property most frequently occur, yet there are cases which can hardly fall within any of those descriptions.

Thus bottomree and *respondentia* are a particular species of property which may be the subject of insurance. But then it must be particularly expressed in the policy to be *respondentia* interest; for, under a general insurance on *goods*, the party insured cannot recover money lent on *bottomree*. Such has been, and is at this day the established usage of merchants.

This was decided in an action upon a policy of insurance, "upon *goods and merchandizes* loaden, or to be loaden, &c." The evidence appeared to be, that, before the signing of the policy, the plaintiff had lent Capt. Tryon, *upon the goods* then loaden and to be loaden on-board the said ship, on account of the said Capt. Tryon, the sum of seven hundred and sixty-four pounds, at *respondentia*, for which a bond was executed in the usual form: that the ship at the time of the loss had goods and merchandizes on-board, the property of Capt. Tryon, of greater value than all the money he had borrowed: that the ship was afterwards burnt, and all the goods and merchandize were totally consumed and lost. Upon these facts, the question was, whether the plaintiff could recover. This case was twice argued at the bar; the court took time to consider it, and were unanimous in their determination.

Lord Mansfield, in delivering the judgment of the court, observed to this effect; I inclined to support this insurance, being convinced that it is fair, and that the doubt has arisen by a slip in omitting to specify (as it was intended to have been done) that this was a *respondentia* interest. The ground of supporting this insurance, if it could have been supported, was a clause of the 19 Geo. II. c. 37. § 5. which, as to the purpose of insurance, considers the borrower as having a right to insure only for the surplus value, over and above the money he has borrowed at *respondentia*. Yet we are all satisfied that this act of parliament never meant, or intended to make, any alteration in the manner of insurances, its view was to prevent gaming or wagering polices, where the insurer had no interest at all; and if the lender of money at *respondentia* were to be at liberty to insure for more than his whole interest, it would be a gaming policy; for it is obvious, that if he could insure all the goods, and insure his *respondentia* interest besides, this would amount to an insurance beyond his whole interest. In describing *respondentia* interest, the act gives the lender *alone* the right to make insurance on the money lent: so that the act left it on the practice. I have looked into the practice, and I find that bottomree and *respondentia* are a *particular species* of insurance in themselves, and have taken a particular denomination; I cannot find even a *dictum* in any writer, foreign or domestic, that the *respondentia* creditors may insure upon the *goods, as goods*. I find too, by talking with intelligent persons very conversant in the knowledge and practice of insurances, that they always do mention *respondentia* interest, whenever they mean to insure it. It might be greatly inconvenient to introduce a practice *contrary to general usage*, and there may be some opening to fraud if it be not specified. The ground of our resolution is, "That it is now established as the law and practice of merchants, that *respondentia* and bottomree must be specified and mentioned in the policy of insurance." Glover *v.* Black, 3, Burr. 1394.

But though this case is certainly good law, yet it has since been ruled, that money expended by the captain for the use of the ship, and for which *respondentia* interest was charged, may be recovered under an insurance on *goods*, *specie*, and *effects*, provided *the usage of the trade*, which in matters of insurance is always of great weight, sanctions it.

Thus, in an action upon a policy of insurance on *goods*, *specie* and *effects*, of the plaintiff, who was also the captain on-board the ship, the plaintiff claimed, under that insurance, money expended by him in the course of the voyage for the use of the ship, and for which he charged "*respondentia* interest."

Lord Mansfield said, as to whether the words "*goods*, *specie* and *effects*," extended to this interest, I should think not, if we were only to consider the words made use of. But here there is *an express usage*, which must govern our decision. A great many captains in the East-India service swear, that this kind of interest is always insured in this way, and here the person insured is the *captain*. Gregory *v.* Christie, K. B. Trinity Term, 24 Geo. III.

Insurances upon the wages of seamen are forbidden: a regulation founded in wisdom and sound policy; for, by this salutary law, the sailors are interested in the return of the ship; and they will, on that account, be prevented from deserting it when abroad, from leaving it unmanned, and will be more anxious for its preservation. This regulation, however, does not mean to prevent mariners from insuring those wages which they are intitled to receive abroad, or goods which they have purchased with those wages in order to bring them home; but, in such a case, they are to be considered in the same light with other men, It has long been a question how far insurances upon the ships or goods of enemies are politic; but, whether such a contract be founded in principles of sound policy or not, it is certainly not contrary to the law of England, as it is established at this day.

2dly. Of the Requisites of a Policy.

The essentials in a policy of insurance are, First, the name of the person for whom the insurance is made: Secondly, the names of the ship and master: Thirdly, whether they are ships, goods, or merchandizes, upon which the insurance is made: Fourthly, the name of the place where the goods are laden, and whether they are bound: Fifthly, the time when the risk begins, and when it ends: Sixthly, all the various perils and risks which the insurer takes upon himself: Seventhly, the consideration, or premium, paid for the risk or hazard run: Eighthly, the month, day, and year, on which the policy is executed: Ninthly, the stamps required by act of Congress.

First. Of the Name of the Person insured.

Every policy of assurance ought to contain the name or the usual stile and firm of dealing of one or more of the persons interested in such insurance; or instead thereof, the name or firm of the consignor or consignee of the goods and property to be insured; or the name or firm of the persons here who order or effect such policy.

Secondly. Of the Names of the Ship and Master.

It seems to be necessary, by the law and usage of merchants, to insert the names of the ship and master, in order to ascertain the bottom upon which the adventure is to be made, and the captain, by whose direction the ship is to be navigated. Sometimes, however, there are insurances generally, "upon any ship or ships," expected from a particular place: and, although it is more accurate to insert the name of the captain, it is not certain that the insurance would be void, if a different captain from that mentioned in the policy came into the ship; especially as the policy always contains the words—"or whosoever else shall go for master in the said ship."

Thirdly. Whether they are Ships, Goods, or Merchandizes, upon which the Insurance is made.

It is absolutely necessary that there should be a specification upon which of these the underwriter insures. But it is another question, whether, in policies upon goods, it be necessary to declare the particulars. The practice is very unsettled; in the opinion, however, of very respectable merchants, the particulars of goods should be specified, if possible, by their marks, numbers, and packages, and not under the general denomination of merchandize. When goods are coming from abroad, it is better to insure under general expressions, on account of the various casualties which may happen to obstruct the purchase of the commodities intended to be sent.

There are certain kinds of merchandize, which are of a perishable nature, on account of which, there is inserted a memorandum at the foot of the policy, by which it is declared, that, in insurances upon corn, fish, salt, fruit, flour, and seed, the underwriters will not be answerable for any partial loss, but only for general average, except the ship be stranded. That in insurances on sugar, tobacco, hemp, flax, hides, and skins, they consider themselves free from partial losses, not amounting *to five per cent.* and that on all other goods, as well as on the ship and freight, if the partial loss be under *three pounds per cent.* unless it arise from a general average, or the stranding of the ship, the underwriter considers himself discharged.

There are some kinds of property, which do not fall under the general denomination of *goods* in a policy; and for the loss of which the underwriters are not answerable, unless they are specifically named; such as *goods lashed on deck, the captain's clothes, and the ship's provisions.* A policy on *goods* means only such goods as are merchantable, and a part of the cargo; and, therefore, when goods like the present are meant to be insured, they are always insured by name; and the premium is greater. Ross *v.* Thwaite, Sitt. after Hilary, 16 Geo. III.

Fourthly. The Name of the Place at which the Goods are laden, and to which they are bound.

This has been always held to be neceſſary in policies, and muſt be ſo, on account of the evident uncertainty which would follow from a contrary practice, as the inſurer would never know what the riſk was which he had undertaken to inſure; and, therefore, if a ſhip be inſured from London to , a blank being left by the lader of the goods to prevent a ſurprize by an enemy, and if in her voyage ſhe happen to be caſt away, though there be private inſtructions for her port, yet the inſured muſt ſit down with his loſs, by reaſon of the uncertainty. Molloy, b. 2. c. 7. ſ. 14.

It is alſo cuſtomary to ſtate in the policy at what port or place the ſhip may touch and ſtay during the voyage, ſo that it ſhall not be conſidered as a *deviation* to go to any of thoſe places.

Fifthly. The Time when the Riſk commences, and when it ends.

The Engliſh policies expreſſly declare, that "the adventure ſhall begin upon the ſaid goods, and merchandize, *from the loading thereof on-board the ſaid ſhip*, and ſo ſhall continue until the ſaid ſhip, goods, and merchandizes, ſhall be arrived at L. and upon the ſaid ſhip until ſhe hath moored at anchor 24 hours in good ſafety; and *upon the goods till the ſame be there ſafely diſcharged and landed.*" From theſe words, it is obvious, that the inſurers are not anſwerable for any accident which may happen to the goods in lighters or boats going a-board, *previous* to the voyage; yet as the policy ſays, the riſk ſhall continue *till the goods are ſafely landed*, it ſeems the inſurer continues reſponſible for the riſk to be run in carrying the goods in boats to the ſhore. If there be a loſs, however, in theſe caſes, the accident muſt have happened, while the goods were in the boats or lighters belonging to the ſhip; but in a caſe where the owner of the goods brings down his own lighter, receives the goods out of the ſhip, and, before they reach land, an accident happens, whereby the goods are damaged, the inſurer is diſcharged, although the inſurance be upon goods to London, and *till the ſame be ſafely landed there.* Sparrow *v.* Carruthers, 2 Stra. 1236.

In the unloading of goods there ſhould be no unreaſonable delay, but this muſt always depend upon circumſtances.

The riſk on the body of a ſhip is generally to commence, "from *her beginning to load at* and ſo ſhall continue and endure *until the ſaid ſhip ſhall arrive at* and hath there been moored at anchor 24 hours in good ſafety." This mode of ſtating the commencement of the riſk muſt commonly be applied to inſurances on ſhips outward bound; for, when inſurance is made on the homeward riſk, the beginning of the adventure is ſometimes ſtated to be "immediately from and after her arrival at the port abroad;" at other times, "from the departure;" and, in ſhort, it is very variable, depending upon the inclination of the inſured.

Sixthly. Of the various Perils and Riſks againſt which the Underwriter inſures.

The words now uſed expreſſive of the inſurer's riſks are very extenſive, including "all perils of the ſeas, men of war, fire, enemies, pirates, rovers, thieves, jettiſons, letters of mart and counter-mart, ſurpriſals, takings at ſea, arreſts, reſtraints, and detainments, of all kings, princes, and people, of what nation, condition, or quality, ſoever; barratry of the maſter or mariners, and all other perils, loſſes, and misfortunes, that have or ſhall come to the hurt, detriment, or damage, of the ſaid goods and merchandizes, and ſhip, or any part thereof." In addition to theſe, however, it is frequently the practice, to inſure her *loſt or not loſt*, in which, if the ſhip ſhould be loſt, at the time of the inſurance, ſtill the underwriter, provided there be no fraud, is liable. This practice is peculiar to Engliſh and American policies, not being adopted by other nations.

Seventhly. The Conſideration or Premium for the Riſk or Hazard run.

This is always expreſſed to have been received at the time of underwriting; "we the aſſurers confeſſing ourſelves paid the conſideration due unto us for this aſſurance by the aſſured." This being ſubſcribed by the underwriter, it is proper to enquire whether, if the premium were not actually paid at the time, he could afterwards maintain an action for it againſt the *aſſured*, who might then produce his ſubſcription in evidence againſt himſelf. Queſtions, upon policies of aſſurance, ſtand moſt broadly upon the uſage of the place where the policy is effected, and this queſton would, no doubt, be determined by uſage. By the cuſtom of London, the underwriter credits the broker, and not the aſſured for the premium; and therefore the underwriter cannot demand it of the aſſured; but the broker as certainly could.

Eighthly. The Day, Month, and Year, on which the Policy is executed.

This insertion seems very necessary, because, by comparing the date of the policy with the date of facts which happened afterwards, or are material to be proved, it will frequently appear, whether there is any reason to suspect fraud or improper conduct on the part of the insured.

Ninthly. That it be duly stamped.

An Act of Congress passed July 6th, 1797, has imposed the following stamp-duties on policies of Insurance, if the ship or vessel, &c. insured, is going from one district to another in the United States, 25 cents. If going from the United States to any foreign port or place, when the sum insured is 500 dollars, or under, 25 cents; exceeding 500 dollars, 1 dollar.

By an Act of Congress passed Feb. 28, 1799, any policy of Insurance other than those above specified, must be stamped as follows, viz. when the sum insured is 500 dollars, or under, 25 cents; exceeding 500 dollars, 1 dollar.

II. THE CONSTRUCTION OF THE POLICY.

In the construction of policies two rules chiefly prevail, namely, to give effect to the intentions of the parties, and to the *usage of trade*, with respect to the particular voyages or risks to which the policy relates.

In a case so early as in the time of James the Second, a policy of insurance was construed to run until the ship had ended and was discharged of her voyage; for arrival at the port, to which she was bound, was not a discharge *till she was unloaded.*

But although this construction is right, where the policy is general from A. to B. yet if it contain the words usually inserted—"*and till the ship shall have moored at anchor twenty-four hours in good safety,*" the underwriter is not liable for any loss arising from seizure after she has been twenty-four hours in port; even if such seizure was in consequence of an act of barratry of the master *during the voyage.*—Lockyer and other *v.* Offley. 1 Term Rep. p. 252.

Upon an insurance from London to the East Indies, warranted to depart with convoy, the facts were, that the ship went from London to the Downs, and from thence with convoy, and was lost. It was adjudged, that the clause "warranted to depart with convoy," must be construed according to the usage among merchants, that is, from such place where convoys are to be had, *as the Downs.*—Lethulier's case. 2 Salk. 443.

The ship Success was insured "*at and from Legborn to the port of London, and till there moored twenty-four hours in good safety.*" She arrived the 8th of July at Fresh Wharf and moored, but was the same day served with an order to go back to the Hope to perform a fourteen days quarantine. The men upon this deserted her, and on the 12th of the month the captain applied to be excused going back, which petition was adjourned to the 28th, when the regency ordered her back; and on the 30th she went back, performed the quarantine, and then sent up for orders to air the goods; but before she returned the ship was burnt, on the 23d of August, and the question was, whether the insurer was liable.

Lord chief justice Lee ruled, that though the ship was so long at her moorings, yet she could not be said to be there in *good safety*, which must mean the *opportunity* of unloading and discharging.—Waples *v.* Eames. 2 Stra. 1243.

In an insurance upon *freight*, if an accident happens to the ship before any goods are put on board, which prevents her from sailing, the insured upon the policy cannot recover the freight which he would have earned if she had sailed.—Tongue *v.* Watts, 2 Stra. 1251.

But if the policy be a valued policy, and part of the cargo be on-board when such accident happens, the rest being ready to be shipped, the insured may recover to the whole amount.—Montgomery *v.* Egginton. 3 Term Rep. 362.

The words "at and from Bengal to England," mean the *first arrival* at Bengal; and, when such words are used in policies, *first arrival* is always implied and understood.—1 Atk. 548.

When a ship is insured *at and from a place* and it arrives at that place, as long as the ship is preparing for the voyage upon which it is insured, the insurer is liable: but, if all thoughts of the voyage be laid aside, and the ship lie there five, six, or seven years, with the *owner's* privity, the insurer is not liable—Chitty *v.* Selwin, 2 Atk. 350.

A ship was insured at and from Jamaica to London: she had also been insured from London to Jamaica generally, and was lost in coasting the island, after she had touched for some days at one port there, but before she had delivered all her outward-bound cargo at the other ports of the island. The question was, when the outward-bound risk commenced, and at what time the outward-bound risk determined. A special jury, after an examination of merchants as to the custom, decided, that the outward risk ended when the ship had moored in *any* port of the island, and did not *continue* till she came to the last port of delivery.—Camden *v.* Cowley. 1 Blackst. 417.

And this has been since confirmed by Lord Mansfield, who laid down this doctrine, that the outward risk *upon the ship* ended twenty-four hours after its arrival in the first port of the island to which it was destined: but that the outward policy *upon goods* continued till they were landed.—Barrass *v.* London Assurance. Sittings after Hilary, 1782.

An action was brought upon a policy of insurance "on goods, in a Dutch ship, from Malaga to Gibraltar, and at and from thence to England and Holland, both, or either: on goods, as hereunder agreed, beginning the adventure from the loading, and to continue till the ship and goods be arrived at England or Holland, and there safely landed. The agreement was, "that, upon the arrival of the ship at Gibraltar, the goods might be unloaded, and reshipped in one or more British ship or ships for England and Holland, and to return one *per cent.* if discharged in England." It appeared in evidence, that, when the ship came to Gibraltar, the goods were unloaded, and put into a *store ship*, (which it was proved was always considered as a warehouse,) and that there was then no British ship there. Two days after the goods were put into the store-ship, they were lost in a storm.

Lee, chief justice.—Policies are to be construed largely, for the benefit of trade, and for the insured. Now, it seems to be a strict construction, to confine this insurance only to the unloading and reshipping, and the accidents attending that act. The construction should be according to the course of trade in this place; and this appears to be the usual mode of unloading and reshipping in that place, viz. that, when there is no British ship there, then the goods are kept in store-ships. Where there is an insurance on goods on-board such a ship, that insurance extends to the carrying the goods to shore in a boat. So, if an insurance be of goods to such a city, and the goods are brought in safety to such a port, though distant from the city, that is a compliance with the policy, if that be the usual place to which the ships come. Therefore, as here is a liberty given of unloading and reshipping, it must be taken to be an insuring under such methods as are proper for unloading and reshipping. There is no neglect on the part of the insured, for the goods were brought into port the 19th, and were lost the 22d, of November. This manner of unloading and reshipping is to be considered as the necessary means of attaining that which was intended by the policy; and seems to be the same as if it had happened in the act of unshipping from one ship into another. And as this is the known course of the trade, it seems extraordinary, if it were not intended. This is not to be considered as a suspension of the policy; for, as the policy would extend to a loss, happening in the unloading and reshipping from one ship to another, so any means to attain that end come within the meaning of the policy. The plaintiff had a verdict.—Tiernay *v.* Etherington. 1 Bur. 348.

The decisions on this subject, notwithstanding the vast variety of their circumstances, are uniform in principle; and the judges always make a constant reference to the usage of trade.

At the same time, though the general rule be to refer to the usage of the trade, yet the parties contracting may, by their own agreement, prevent such a latitude of construction. In order to do this, it is not necessary that express words of exclusion should be inserted in the policy; but if, from the terms used, the court can collect, that such was the intention of the parties, that construction, which is most agreeable to their intention, will prevail.—Lavabre *v.* Wilson, Doug. 27.

When an insurance is made on one species of property, the damage suffered by loss of property, different from that named in the policy, cannot be recovered. Thus a man, who has insured a cargo of *goods*, cannot recover the *freight* which he has paid for the carriage of that cargo; nor can an owner, who insures the *ship merely*, demand satisfaction for the loss of merchandize, laden thereon, or ask from the insurers *extraordinary wages paid to the seamen, or the value of provisions consumed*, by reason of the detention of the *ship* at any port longer than was expected.—Fletcher and others *v.* Poole. Sittings after Easter, 1796.—Baillie *v.* Modigliani, Hilari-Term, 25 Geo. III.

On a policy on a *ship*, sailors' wages or provisions are never allowed in settling the damages; for, if a ship is detained, in consequence of any injury received in a storm, though the underwriter must make good that damage, yet the insured cannot come upon him for the amount of wages or provisions during the time she was so repairing.—Robertson *v.* Ewer, 3 Term Rep. 127.

But, on a policy on a ship and *furniture*, where the *provisions for the crew* were burnt, it was determined, that *provisions for the crew* are comprehended under *furniture*, and that the underwriter was of course answerable for their loss.—Brough *v.* Whitmore, 4 Term, Rep. 206.

In order to entitle the insured to recover, the loss must be a direct and immediate consequence of the peril insured, and not a remote one.

In an action on a policy of insurance on the ship Mary, a letter of marque, the words of the policy were, "at and from Liverpool to Antigua, *with liberty to cruise six weeks*, and to return to Ireland, or Falmouth, or Milford, with any prize or prizes." The ship having been taken, this action was brought, when a verdict was found for the plaintiffs.

The material parts of the evidence were, that the policy was made on the 9th of February, 1779, and there was no time fixed in it for the commencement or the duration of the voyage. The captain of the ship swore, that he sailed from Liverpool on the 28th of February; he was five days before he cleared the land; and he proceeded on his direct voyage till the 14th of March, chacing, however, at different times, from the 7th to the 14th, at which time he began his cruise, giving notice thereof to the crew, and ordering a minute of it to be entered in the log-book, which was done. From the 14th of March, he continued cruising about the same latitude till the 17th or 18th of April, when he discontinued the cruise, of which he also gave notice, intending to go to the Burlings, off Lisbon, in the course of his voyage. On the 23d he renewed the cruise, of which he gave notice, as before, and ordered a minute, to that purpose, to be entered in the log-book. From that time he continued cruising till the 28th of April, when he was taken by an American privateer. Many witnesses were examined, some of whom thought, that the liberty of cruising, given by the policy, meant six successive weeks; others conceived, that, if the separate times of cruising, when added together, should not exceed the space of six weeks, the terms of the insurance would be complied with; but none of them could prove any usage, as none of the witnesses ever knew a case exactly circumstanced like the present.

A motion was made for a new trial; upon which Lord Mansfield said, Here, the subject-matter, in my opinion, is decisive to shew, that the six weeks meant one *continued* period of time. A cruise is a well-known expression for a connected portion of time. There are frequently articles for a month's cruise, a six-week's cruise, &c. Such a liberty, as in this case, to a letter of marque, is an excuse for a deviation; for the true meaning is, "I will excuse a deviation for six weeks." If they had meant separate days, they would have said forty-two days.—The court ordered a new trial.

Insurance on a ship and cargo, from Liverpool to Oporto. The ship sailed, but was driven back by contrary winds; and, before she could sail again, an embargo was laid. The insured applied to the underwriters for leave to put guns on-board, and to take out a letter of marque. The underwriters consented to the guns, for her defence; but refused the letter of marque. Notwithstanding which, a general letter of marque was obtained, and put on-board. The ship sailed and was taken on her voyage out. The jury thought that the letter of marque was not intended to be used but in the voyage home. The court however determined that this vacated the policy.—Denison *v.* Modigliani, 5 Term, Rep. K. B. 580, Easter-Term, 1794.

Thus it appears, that the material rules to be adhered to, in the construction of policies, are the intention of the parties entering into the contract, and the usage of trade.

III. PERILS OF THE SEA.

It may, in general, be said, that every thing which happens to a ship, in the course of her voyage, by the immediate act of God, without the intervention of human agency, is a peril of the sea. Thus every accident happening by the violence of wind or waves, by thunder or lightning, by driving against rocks, by the stranding of the ship, or by any other violence which human prudence could not foresee, nor human strength resist, may be considered as a loss within the meaning of such a policy; and the insurer must answer for all damages sustained, in consequence of such accident.—1 Magens, 52, 76.

If a ship has been missing, and no intelligence received of her within a reasonable time after she sailed, it shall be presumed that she foundered at sea.—Newby *v.* Read, Sittings after Michaelmas, 3 Geo. III.

And, even in action on a policy, in which there was a warranty *against captures and seizures*, where it was insisted, for the defendant, that, as captures and seizures were excepted, it lay upon the plaintiff to prove, that the loss happened in the particular manner stated. Lord Chief Justice Lee said, it would be unreasonable to expect certain evidence of such a loss, where every body on-board is presumed to be drowned; and all that can be required is, the best proof the nature of the case admits of, which the plaintiff has given. The jury found a verdict for the plaintiff.—Green *v.* Brown, 2 Stra. 1190.

A practice prevails among inſurers, that a ſhip ſhall be deemed loſt, if not heard of in ſix months after her departure, (or after the time of the laſt intelligence from her,) for any part of Europe, and in twelve months, if for a greater diſtance. If, under this uſage, the inſurer ſhould pay the money, ſuppoſing the ſhip loſt, when it really is not, he may, as we ſhall ſee hereafter, recover it back in an action.

IV. CAPTURE AND DETENTION OF PRINCES.

A ſhip is to be conſidered as loſt by capture, though ſhe be never condemned at all, nor carried into any port or fleet of the enemy, and the inſurer muſt pay the value. If, after a condemnation, the owner recover or retake her, the inſurer can be in no other condition than if ſhe had been retaken or recovered before condemnation. The inſurer runs the riſk of the inſured, and undertakes to indemnify; he muſt therefore bear the *loſs actually* ſuſtained. So that if, after condemnation, the owner recovers the ſhip in her complete condition, but has paid ſalvage, or been at any expence in getting her back, the inſurer muſt pay the loſs ſo actually ſuſtained. No capture by the enemy can be ſo total a loſs as to leave no poſſibility of recovery.

Where a capture has been made, whether it be legal or not, the inſurers are liable for the charges of a compromiſe made, *boná fide*, to prevent the ſhip from being condemned as prize, or to avoid a greater expence.—Berens *v.* Rucker, 1 Blackſt. 313.

In caſes of capture, the underwriter is immediately reſponſible to the inſured. But, if the ſhip be recovered before a demand for indemnity, the inſurer is only liable for the amount of the loſs actually ſuſtained at the time of the demand: or, if the ſhip be reſtored at any time ſubſequent to the payment by the underwriter, he ſhall then ſtand in the place of the inſured, and receive all the benefits and advantages reſulting from ſuch reſtitution. All theſe regulations have their foundation in this great principle, that a policy of inſurance is nothing more than a contract of indemnity.

The underwriter is likewiſe anſwerable for all loſs or damage ariſing to the inſured, "*by the arreſts, reſtraints, and detainments, of all kings, princes, and people, of what nation, condition, or quality, whatſoever.*"

The only queſtion then is, what ſhall be conſidered as ſuch detention. Lord Manſfield has ſaid, that the inſured may abandon in caſe merely of an arreſt or embargo by a prince, not an enemy; and conſequently ſuch an arreſt is a loſs within the meaning of the word *detention.*—2 Burr. 696.

An embargo is an *arreſt* laid on ſhips or merchandize by public authority, or a prohibition of ſtate commonly iſſued to prevent foreign ſhips from putting to ſea in time of war, and ſometimes alſo to exclude them from entering our ports. Ships are frequently detained to ſerve a prince in an expedition, and for this end have their loading taken out, without any regard to the colours they bear, or the princes to whoſe ſubjects they belong. And this is an arreſt within the meaning of the policy.

In caſe of a detention by a foreign power, which in time of war may have ſeized a neutral veſſel at ſea, and carried it into port to be ſearched for enemy's property, all the charges conſequent thereon muſt be borne by the underwriter: and whatever coſts may ariſe from an improper detention muſt always fall upon them.—Salucci *v.* Johnſon, Hil. 25 Geo. III.

But, though an underwriter is liable for all damage ariſing to the owner of the ſhip or goods from the reſtraint or detention of princes, yet that rule is not extended to caſes where the inſured navigates againſt the laws of thoſe countries in the ports of which he may chance to be detained, or to caſes where there ſhall be a ſeizure for non-payment of cuſtoms.—2 Vern. 176.

If indeed any of thoſe acts were committed by the maſter of the ſhip, without the knowledge of the inſured, the underwriter would be liable, not for loſſes by *detention*, but for a loſs by the barratry of the maſter.

Since the caſe of Robertſon *v.* Ewer, mentioned before, there ſeems to be very little doubt, but that an underwriter is liable to pay damages ariſing by the detention or ſeizure of ſhips by the government of the country to which they belong; for an embargo had been laid by Lord Hood on all ſhipping at Barbadoes; and it was never doubted that the inſurer was liable for any loſs which might have been ſuſtained by ſuch detention, provided the loſs had happened to any of the property ſpecifically inſured. If the ſhip be detained by the order of the ſovereign before her departure for the voyage, but *after the riſk* commenced, the inſurer by our law is liable for the damage occaſioned by ſuch detention, as the words in the policy do in themſelves import no reſtriction to reſtraints and embargoes by foreign potentates only.

Although the words of this part of the policy are, "*arreſts, reſtraints, and detainments, of all kings, princes, and people, of what nation, condition, or quality whatſoever;*" yet the word *people* muſt be underſtood as applying to *thoſe people who are the ruling power of the country*, and not to any aſſemblage of people who arreſt the ſhip in a violent and riotous manner. Neſbitt *v.* Luſhington, 4 Term Rep. 783.

Before the inſured can recover againſt the underwriter in caſes of detention, he muſt firſt *abandon* to the inſurers his right, and whatever claims he may have to the goods inſured. This point will be treated of under the head of Abandonment.

V. BARRATRY OF THE MASTER OR MARINERS.

Barratry is committed when the maſter of the ſhip, or the mariners, cheat the owners, or inſurers, whether it be by running away with the ſhip, ſinking her, deſerting her, embezzling the cargo, or by carrying a ſhip a courſe different from their orders.—Poſtlethwaite's Dict. 1 vol. p. 136, 214. Theſe definitions are ſo very comprehenſive, that they ſeem to take in every caſe of barratry, known to the law of England. From a review of the deciſions on this ſubject, it appears, that any act of the maſter, or of the mariners, which is of a criminal nature, or which is groſſly negligent, tending to their own benefit, to the prejudice of the owners of the ſhip, *without their conſent or privity*, is barratry.

It is not neceſſary, in order to entitle the inſured to recover for barratry, that the loſs ſhould happen *in the act of barratry*: that is, it is immaterial, whether it take place *during* the *fraudulent* voyage, or *after* the ſhip has returned to the regular courſe; for the moment the ſhip is carried from its right track, with an evil intent, barratry is committed.—Cowp. Rep. 155.

But the loſs, in conſequence of the act of barratry, muſt happen *during the voyage inſured*, and within the time limited by the policy; for, if the captain be guilty of barratry by ſmuggling, and the ſhip afterwards arrive at the port of deſtination, and *be there moored at anchor twenty-four hours in good ſafety*, the underwriters are not liable, if, after this, ſhe ſhould be ſeized for that act of ſmuggling.—Lockyer *v.* Offley. 1 Term Rep. p. 252.

If the act of the captain be done with a view to the benefit of his owners, and not to advance his own private intereſt, no barratry is committed. To conſtitute barratry, it muſt be *without the knowledge or conſent of the owners*.

On a caſe ſtated for the opinion of the court, Lord Mansfield obſerved, It is ſomewhat extraordinary that the word *barratry* ſhould have crept into inſurances, and ſtill more, that it ſhould have continued in them ſo long; for the underwriter inſures the conduct of the captain, whom he does not appoint, and cannot diſmiſs, to the owner, who can do either. The point to be conſidered is, whether barratry, in the ſenſe in which it is uſed in our policies of inſurance, can be committed againſt any but the owners of the ſhip. It is clear beyond contradiction, that it cannot; for barratry is ſomething contrary to the duty of *maſter and mariners*, the very terms of which imply, that it muſt be in the relation in which they ſtand to the *owners of the ſhip*. The words uſed are *the maſters and mariners*, which are very particular. *An owner cannot commit barratry.* He may make himſelf liable by his *fraudulent conduct* to the owner of the goods, but not *as for barratry*. And, beſides, barratry cannot be committed againſt the owner, *with his conſent*: for, though the owner may become liable for a civil loſs by the miſbehaviour of the captain, if he conſents, yet that is not *barratry*. Barratry muſt partake of ſomething criminal, and muſt be committed *againſt the owner* by the *maſter* or *mariners*. In the caſe of Vallejo and Wheeler, the court took it for granted, that barratry could only be committed againſt the owner of the ſhip.

If the owner be alſo maſter of the ſhip, any act, which, in another maſter, would be conſtrued barratry, cannot be ſo in him.

If the parties inſert in the policy the words *in any lawful trade*, if the captain commit barratry by ſmuggling, the underwriters are anſwerable. For, otherwiſe the word *barratry* ſhould be ſtruck out of the policy; and moſt clearly the ſtipulation in the policy reſpecting the employment of the ſhip in a lawful trade, muſt mean, as was ſaid by Lord Kenyon, in delivering the unanimous opinion of the court, *the trade* on which ſhe is ſent by the owners. Havelock *v.* Hancil, 3 Term Rep. 277.

A very accurate definition of one ſpecies of *barratry* has been laid down, in the caſe of Roſs *v.* Hunter.

This was an inſurance on goods on-board the Live Oak, at and from Jamaica to New-Orleans. She ſailed on the voyage, inſured in May, 1783, and arrived, in June following, at the mouth of the river Miſſiſippi. When the captain had got thus far, he dropped anchor, and went in his boat up the river to New-Orleans; and, on his return, without carrying the ſhip to her port of deſtination, ſtood away for the Havannah; after his departure whence he was never afterwards heard of. A verdict was found for the plaintiff againſt the underwriter.

Mr. Juſtice Buller ſaid, in one ſenſe of the word, barratry is a *deviation* by the captain, *for fraudulent purpoſes of his own*. Then the queſtion in this caſe is, whether the captain did deviate *with a fraudulent view*. The jury have thought that he had a fraudulent intention, and therefore the verdict is right. 4 Term Rep. 35.

VI: PARTIAL LOSSES, AND ADJUSTMENT.

A total loss does not always mean that the property insured is irrecoverably lost or *gone*: but that, by some of the perils mentioned in the policy, it is in such a condition as to be of little use or value to the insured, and so much injured as to justify him in abandoning to the insurer, and in calling upon him to pay the whole amount of his insurance, as if a total loss had actually happened. But a total loss is so intimately blended with the doctrine of abandonment, that we shall refer what may be said on this subject till we come to the head of abandonment. Here it will be sufficient to remark, that, in case of a total loss, literally so called, the *prime cost* of the property insured, or the value mentioned in the policy, must be paid by the underwriter; at least as far as his proportion of the insurance extends. The insurer has nothing to do with the market; he has no concern in any profit or loss which may arise to the merchant from the sale of the goods. If they be totally lost, he must pay the value of the thing he insured at the *outset*; he has no concern in any subsequent value. So, if part of the cargo, capable of a several and distinct valuation at the outset, be totally lost, as, if there be one hundred hogsheads of sugar, and ten happen to be lost, the insurer must pay the prime-cost of those ten hogsheads, without any regard to the price for which the other ninety may be sold.

The word average, in *policies*, has two significations; it means "*a contribution to a general loss*;" and it also is used to signify "*a particular partial loss*." That which means "*a contribution to a general loss*" will be treated of in the next division.

Partial loss (the subject of our present inquiry) implies a damage, which the ship may have sustained, in the course of her voyage, from any of the perils mentioned in the policy; when applied to the cargo, it means the damage which goods may have received, without any fault of the master, by storm, capture, stranding, or shipwreck, although the whole, or the greater part thereof, may arrive in port. The partial losses fall upon the owners of the property so damaged, who must be indemnified by the underwriter.

The underwriters of London expressly declare, as appears from a memorandum at the foot of the policy, that they will not answer for partial losses, not amounting to 3 *per cent.* This clause was intended to prevent the underwriters from being continually harassed by trifling demands. But, at the same time that they provide against trifling claims for partial losses, they undertake to indemnify against losses, however inconsiderable, that arise from a general average.

When we speak of the underwriters being liable to pay, whether for total or partial losses, it must always be understood, that they are liable only in proportion to the sums which they have underwritten. Thus, if a man underwrite 100*l.* upon property valued at 500*l.* and a total loss happened, he shall be answerable for 100*l.* and no more, that being the amount of his subscription; if only a partial loss, amounting to 60*l.* or 70*l.* *per cent.* upon the whole value, he shall pay 60*l.* or 70*l.* being his proportion of the loss.

As to the question of how the proportion of damage is to be ascertained, the grand and leading case is that of Lewis and another *v.* Rucker, 2 Burr. 1167, from which, as it was so ably treated by Lord Mansfield, we think it necessary to give copious extracts.

A rule having been obtained by the plaintiffs, who were the insured, for the defendant (the insurer) to shew cause, why a verdict, obtained by him, should not be set aside, and a new trial had:

The court after hearing the matter fully debated, took time to advise, and their unanimous opinion was delivered, to the following effect, by

Lord Mansfield.—This was an action brought upon a policy, by the plaintiffs, for Mr. James Bordieu, upon the goods on-board a ship, called the Vrow Martha, at and from St. Thomas's Island to Hamburgh, from the loading at St. Thomas's Island till the ship should arrive and land the goods at Hamburgh. The goods, which consisted of sugars, coffee, and indigo, were valued; the clayed sugars at 30*l.* *per* hogshead; the Muscovado sugars at 20*l.* *per* hogshead; and the coffee and indigo were likewise respectively valued. The sugars were warranted free from average, (that is partial loss) under 5*l.* *per cent.* and all other goods free from average under 3*l.* *per cent.* unless general or the ship be stranded.

In the course of the voyage the sea-water got in; and, when the ship arrived at Hamburgh, it appeared that every hogshead of sugar was damaged. The damage the sugars had sustained made it necessary to sell them immediately, and they were accordingly sold; but the difference between the price which they brought, on account of the damage, and that which they might then have been sold for at Hamburgh, if they had been sound, was as 20*l.* 0*s.* 8*d.* *per* hogshead is to 23*l.* 7*s.* 8*d.* *per* hogshead: (that is, if sound, they would have been worth 23*l.* 7*s.* 8*d.* *per* hogshead: as damaged, they were only worth 20*l.* 0*s.* 8*d.* *per* hogshead.)

The defendant paid money into court, by the following rule of estimating the damage: *he paid the like proportion of the sum, at which the sugars were valued in the policy, as the* *price of the damaged sugars bore to sound sugars at Hamburgh, the port of delivery.* And the only question was, by what measure or rule the damage, upon all the circumstances of the case, ought to be estimated.

The special jury (amongst whom there were many sensible merchants) found the defendant's rule of estimation to be right, and gave their verdict for him.

And it is now the duty of the court to say, whether the jury have estimated the damage by a proper measure. This is the rule by which it was estimated.

The defendant takes the proportion of the difference between sound and damaged at the port of delivery, and pays that proportion upon the value of the goods specified in the policy; and has no regard to the price in money, which either the sound or the damaged goods bore in the port of delivery. He says, the proportion of the difference is equally the rule, whether the goods come to a rising or a falling market. For instance, suppose the value in the policy to be 30*l.* the goods are damaged but sell for 40*l.*—if they had been sound they would have sold for 50*l.* The difference then between the sound and damaged is a fifth, consequently the insurer must pay a fifth of the prime cost, or value in the policy, that is 6*l.* *e converso*, if they come to a losing market, and sell for 10*l.* being damaged, but would have sold for 20*l.* if sound, the difference is one-half: the insurer must pay half the prime cost, or of the value in the policy, that is 15*l.*

To this rule an objection has been made: that it is going by a different measure in the case of a partial, from that which governs in case of a total loss: for, upon a total loss, the prime cost, or value in the policy must be paid. The answer to which objection is, that the distinction is founded in the nature of the thing. Insurance is a contract of indemnity, against the perils of the voyage, to the amount of the value in the policy; and, therefore, if the thing be totally lost, the insurer must pay the whole value which he insured at the outset. But where a part of the commodity is spoiled, no measure can be taken from the prime cost to ascertain the quantity of the damage sustained. The only way is, to fix whether the thing be a third or fourth worse than the sound commodity; and then you pay a third or fourth of the prime cost, or value of the goods so damaged.

We are of opinion, that the rule by which the jury have gone is the right measure.

Wherever there is a specific description of casks, or goods, the rule of estimating the average is as above stated; but, in a subsequent case, the property, which consisted in various goods taken from an enemy, was valued at the sum insured, and part was lost by perils of the sea; consequently the same rule could not be adopted, on account of the nature of the thing insured. The only mode was to go into an account of the whole value of the goods, and take a proportion of that sum as the amount of the goods lost. Le Cras *v.* Hughes, East. Term. 22 Geo. III.

Some goods are in their nature perishable; and therefore the underwriters have, by express words inserted in their policy, declared that they will not be answerable for any partial loss happening to *corn, fish, salt, fruit, flour,* and *seed*, unless it arise by way of a general average, or in consequence of the ship being stranded. Upon this clause it is necessary to observe, that *corn* is a general term, and includes many particulars; peas and beans have been held to come within the meaning of the word. Mason *v.* Skurray, Sit. after Hilary, 1780.

But in a late trial at Guildhall, in the court of common-pleas, Mr. Justice Wilson was of opinion, that the term *salt* did not include *salt-petre.*—Journu *v.* Bourdieu, Sittings after Easter Term. 27 Geo. III.

It has likewise been determined, that there cannot be a total loss of corn, fish, salt, fruit, flour, or seed, but by the *absolute destruction* of the thing insured; for, while it specifically remains, though wholly unfit for use, and though the loss of it exceeds the sum to be paid for the freight of it, that this is not such a loss as is to be borne by the underwriters.—Wilson *v.* Smith, 3 Burr, 1550.—Mason *v.* Skurray, Sittings after Hilary Term, 1780.

When the quantity of damage sustained in the course of the voyage is known, and the amount which each underwriter of the policy is liable to pay, is settled, it is usual for the underwriter to endorse on the policy "*adjusted this loss at so much per cent.*" or some words to the same effect. This is called an adjustment.

After an adjustment has been signed by the underwriter, if he refuse to pay, the owner has no occasion to go into a proof of his loss, or any of the circumstances respecting it; but, if any fraud were used in obtaining the adjustment, that would be a ground for setting it aside.—Hog *v.* Gouldney, Sitt. after Trin. 1745. Beawes, Lex Merc. 310.—Thellusson *v.* Fletcher, Dougl. 301.

If any insurer pay money for a total loss, and in fact it be so at the time of adjustment; if it afterwards turn out to be only a partial loss, he shall not recover back the money so paid to the insured; for substantial justice is done, by putting him in place of the insured, and giving him all the advantages that may arise from the salvage.—Da Costa *v.* Frith, 4 Burr. 1966.

VII. GENERAL AVERAGE.

Whatever the master of a ship in distress does for the preservation of the whole, in cutting away masts or cables, or in throwing goods overboard to lighten his vessel, which is what is meant by jettison or jetson, is permitted to be brought into a general average: in which all who are concerned in ship, freight, and cargo, are to bear an equal or proportionable part of the loss of what was so sacrificed for the common welfare; and it must be made good by the insurers in such proportions as they have underwritten. 1 Magens, 55.

In order to make the act of throwing the goods overboard legal, the ship must be in distress, and the sacrificing a part must be necessary to preserve the rest.

If the ship ride out the storm, and arrive in safety at the port of destination, the captain must make regular protests, and must swear, in which some of the crew must join, that the goods were cast overboard for no other cause but for the safety of the ship and the rest of the cargo. Beawes, 148. Molloy, l. 2. c. 6. § 2.

There can be no contribution (which is another word used frequently for this species of *averages*) without the ejection of some goods, and the saving of others: but it is not always necessary for the purpose of contribution, that the ship should arrive at the port of destination.

If the jettison does not save the ship, but she perish in the storm, there shall be no contribution of such goods as may happen to be saved; because the object, for which the goods were thrown overboard, was not attained. But if the ship, being once preserved by such means, and continuing her course, should afterwards be lost, the property saved from the second accident shall contribute to the loss sustained by those whose goods were cast out upon the former occasion.—2 Magens, 98.

It is hardly necessary to state with minuteness the various accidents and charges that will entitle the party suffering to call upon the rest for a contribution; because, we may refer them all to this principle, that all losses sustained and expences incurred voluntarily and deliberately, with a view to prevent a *total loss* of the ship and cargo, ought to be equally borne by the ship and her remaining lading. Such, for instance, is the damage sustained in defending a ship against an enemy or pirate: such is the expence of curing and attendance upon the officers or mariners wounded in such defence: and such also is the sum which the master may have promised to pay for the ransom of his ship to any privateer or pirate, when taken. A master who has cut his mast, parted with his cable, or abandoned any other part of the ship and cargo, in a storm, in order to save the ship, is well entitled to this compensation: but if he should *lose* them by the storm, the loss falls only upon the ship and freight; because the tempest only was the occasion of this loss, without the deliberation of the master and crew; and was not done with a view to save the ship and lading. Upon the same principle it is established, that when a ship arrives at the mouth of a harbour, and the master, finding that his ship is too heavy laden to sail up, is obliged to put part of the cargo into hoys and barges; the owners of the ship and of the goods that remained are obliged to contribute if the lighters perished. But if the ship should be lost, and the lighters saved, the owners of the goods so preserved were not to contribute to the proprietors of the ship and cargo lost.—2 Magens, 96. 183.

The difference is this, the lightening of the ship was an act of deliberation for the general benefit: whereas the circumstance of the lighters being saved, and the ship lost, was accidental, no way proceeding from a regard for the whole.—1 Magens, 56.

It is not only the value of the goods thrown overboard that must be considered in a general average, but also the value of such as receive any damage by wet, &c. from the jettison of the rest.—Beawes, 148. Molloy, l. 2. c. 6. §. 8.

If a ship be taken by force, carried into some port, and the crew remain on-board to take care of and reclaim her, not only the charges of reclaiming shall be brought into a general average, but the wages and expence of the ship's company during her arrest, from the time of her capture and being disturbed in her voyage.—Beawes, 150.

But sailors wages and victuals, when they are under a necessity of performing quarantine, in which case the master would have been obliged to maintain and pay them, though his vessel had arrived only in ballast, do not come into general average, yet charges, occurring by an extraordinary quarantine, shall be brought into a general average.

Whether the extraordinary wages and victuals expended during the detention by a foreign prince not at war, ought to be brought into a general average, so as to charge the underwriter, has never been expressly determined, although it seems to be the general opinion that they should.

So, likewise, where a ship is obliged to go into port for the benefit of the whole concern, the charges of loading and unloading the cargo, and taking care of it, and the wages and provisions of *the workmen hired for the repairs*, become general average.—Da Costa *v.* Newnham, 2 Term Rep. 407.

By the antient laws of Rhodes, Oleron, and Wisbuy, the ship and all the remaining goods shall contribute to the loss sustained. The most valuable goods, though their weight should have been incapable of putting the ship in the least hazard, as diamonds or precious stones, must be valued at their just price in this contribution, because they could not have been saved to the owners but by the ejection of the other goods. Neither the persons of those in the ship, nor the ship-provisions, nor the respondentia-bonds, suffer any estimation; nor does wearing apparel in chests and boxes, nor do such jewels as belong to the person merely; but if the jewels are a part of the cargo, they must contribute.

Those who carry jewels by sea ought to communicate that circumstance to the master; because the care of them will be increased in proportion to their worth, to prevent their being thrown overboard promiscuously with other things; and hence their preservation will be a common benefit.—1 Magens, 63.

The wages of sailors are not to contribute to the general loss; a provision intended to make this description of men more easily consent to a jettison as they do not then risk their all, being still assured that their wages will be paid.—1 Magens, 71.

The way of fixing a right sum, by which the average ought to be computed, can only be by examining what the whole ship, freight, and cargo, if no jettison had been made, would have produced neat, if they all had belonged to one person, and been sold for ready money. And this is the sum whereon the contribution should be made, all the particular goods bearing their nett proportion.—1 Magens, 69.

Gold, silver, and jewels, contribute to a general average, according to their full value, and in the same manner as any other species of merchandize.—1 Magens, 62. and Peters *v.* Milligan, Sittings at Guildhall after Michaelmas, 1787.

The contribution is in general not made till the ship arrive at the place of delivery: but accidents may happen, which may cause a contribution before she reach her destined port. Thus, when a vessel has been obliged to make a jettison, or, by the damages suffered, soon after sailing, is obliged to return to her port of discharge; the necessary charges of her repairs, and the replacing the goods thrown overboard, may then be settled by a general average.—1 Magens, 60.

The following Examples of adjusted Averages are here subjoined, having received the Approbation of some experienced Merchants.

The Sea-horse, captain Dix, laden with hemp, flax, and iron, bound from Riga to London, ran on-shore, coming through the Grounds, at Elsineur: the captain hired a great number of men and several lighters to lighten the ship and get her afloat again; which was soon done; but he was obliged to pay 120l. for their assistance. This expence being incurred to preserve both ship and cargo, the average must consequently be general. When the ship arrived at London, the captain immediately made a protest and an average-bill: he then went to the merchant, to whom his goods were addressed, to have it signed, and to know the value of each man's property.

Average accruing to the Ship Sea-horse, from Riga to London, in 1782, for Assistance in getting off the Strand of Elsineur.

		l.	*s.*	*d.*
To sundry charges paid at the Sound for lighters and assistance in getting the ship off — — — —		120	0	0
Protest and Postages — — —		2	0	0
		122	0	0
Should the ship arrive at London, she will make 700l. freight		700	0	0
Wages, for all the people, 3 months and 10 days	£139 10 0	250	0	0
Victuals for ditto — —	110 10 0			
	Freight to contribute	450	0	0
Ship Sea-horse valued at — — —		4000	0	0
Freight valued at — — —		450	0	0
F. J. for value of hemp, as *per* invoice — —		6000	0	0
D. N. for value of flax — — —		1000	0	0
T. R. for value of iron — — —		350	0	0
		11800	0	0

If 11800*l.* loss give 122*l.* what will 100*l.* loss give?

Answer, 1*l.* 0*s.* 8*d.* *per cent.*

	l.	*s.*	*d.*
The ship must bear 4000*l.* at 1*l.* 0*s.* 8*d.* (which the insurers return)	41	7	2
Freight, 450*l.* at 1*l.* 0*s.* 8*d.* *per cent.* — —	4	13	0
F. J. pays the captain for 6000*l.* at the same rate —	62	0	6
D. N. pays the same for 1000*l.* — —	10	7	0
T. R. pays the same for 350*l.* — —	3	12	4
	122	0	0

The Mary, captain T. partly laden with goods, sailed in May, 1782, from London, bound to St. Petersburgh. She sailed the third of that month, and, after an agreeable passage, arrived at Elsineur on the 10th, whence she sailed the same day, with a fair wind, for St. Petersburgh: the next day a heavy gale of wind rose contrary, insomuch that it obliged the captain to bear away for Elsineur again: but night coming on, and the gale increasing, it being so dark that it was unsafe to continue running in such a dangerous place, thickly beset with many sands, and having a strong current, the captain judged it best to bring the ship to an anchor, which he accordingly did in 15 fathoms water. Before the ship had been at anchor half an hour, she began to drive; and, as she still kept driving, with both anchors ahead and the wind blowing stronger and stronger, they found it impossible to purchase their anchors: then the captain and ship's company judged it safest to cut the cables, in order to save their own lives and the ship and cargo, and take their chance in running for the Roads: luckily they got safe in; and, the weather abating, they brought up with a small anchor.

The Mary then wanted cables and anchors before she could proceed to St. Petersburgh; the master, therefore, went directly on-shore, bought them, and paid the following sums:

		l.	*s.*	*d.*
Protest — — —		0	10	0
Two new cables and buoy-ropes — —	£89 10 0			
One-third always deducted for new — —	29 16 8			
		59	13	4
Two anchors and two buoys — — —		37	15	0
Charges in getting them on-board, &c. — —		2	1	8
		100	0	0

As the cables were cut away for preservation of ship and cargo, it must be a general average, and both must contribute to pay the damages sustained. The captain made the following average-bill, on his arrival at Petersburgh, in order to recover the damages.

Average accrued to the Mary, for the Loss of her Anchors and Cables, in Prosecution of her Voyage from London to St. Petersburgh, 1782.

	l.	s.	d.
Ship Mary valued at — — —	800	0	0
Freight (after wages and victuals deducted) valued at —	50	0	0
O. P.'s value of goods — — —	700	0	0
V. R.'s value of goods — — —	225	0	0
T. T.'s value of goods — — —	25	0	0
	1800	0	0

If 1800*l.* loss give 100*l.* what will 100*l.* give?

Answer, 5*l.* 11*s.* 1*d.* *per cent.*

The ship must bear 800*l.* at 5*l.* 11*s.* 1*d.* *per cent.* — —	44	8	8
The freight must bear 50*l.* at the same — —	2	15	8
O. P. must pay the captain, at St. Petersburgh, for 700*l.* at the same	38	17	9
V. R. must pay, for 225*l.* at the same — —	12	10	0
T. T. must pay, for 25*l.* at the same — —	1	7	11
	100	0	0

Having received 52*l.* 15*s.* 8*d.* at Petersburgh, the captain sends his protest and average-bill to his owner, to receive of the underwriters their shares of the loss upon the ship and freight.

Captain T. of the Sea Adventure, bound from London to Virginia, in ballast, was riding at anchor in the Downs, with a large fleet of ships, in a gale of wind. She had not been at anchor long before she began to drive; and the captain, perceiving her to be in great danger of being on-shore, or else foul of the other vessels, judged it safest to cut his cables, as he must have been driven on-shore if he had not. After the gale was over, he went to Dover, bought new anchors and cables, and drew upon his owner for the amount of them, as follows:

	l.	s.	d.
Two anchors and buoys — — —	34	18	0
Rope-makers bill for new cables, &c. — —	54	2	0
Protest — — —	0	10	0
Charges in getting them on-board —	2	15	0
	92	5	0

The captain then sent the charges of reinstating the cables and anchors cut away, and of the protest, to his owner, that he might recover of the insurers the damage sustained.

State of the Sea-Adventure's Average.

		l.	s.	d.
Two anchors and two buoys — —		34	18	0
Rope-maker's bill — —	£54 2 0			
One-third always deducted for new —	18 0 8			
		36	1	4
Protest — —		0	10	0
Charges in getting the anchors, &c. on-board —		2	15	0
		74	4	4

Ship valued at 2000*l.*

If 2000*l.* loss give 74*l.* 4*s.* 4*d.* what will 100*l.* loss give?

Answer, 3*l.* 14*s.* 2$\frac{1}{2}$*d.* *per cent.*

Observe, if a ship had been riding in a gale of wind, and the cables had parted, that loss would have fallen upon the owners, for the underwriters are not liable to pay for wear and tear.

This may serve as a similar case for all ships in ballast that have cut away their masts, cables, &c. for preservation.

A loaded ship met with such exceeding bad weather, that the master and mariners found it impossible to save her without throwing part of her cargo overboard, which they are authorised to do for preservation. Being thus necessitated, they threw such goods overboard as lay nearest at hand, and lightened the ship of 10 casks of hardware and 30 hogsheads of sugar, which they judged sufficient to keep her from sinking. Soon after that, the ship arrived at her destined place, and then an average-bill was immediately made, in order to adjust the loss, and to pay the proprietors of those goods which were thrown overboard for the good of the whole.

Average accrued to the Ship ——— for Goods thrown overboard, for Preservation of the Ship, Freight, and Charge.

	l.	*s.*	*d.*
Ship valued at — — —	2000	0	0
Freight (wages and victuals deducted) — —	200	0	0
J. R.'s value of goods — — —	6000	0	0
J. P.'s value of goods — — —	300	0	0
R. F.'s value of goods — — —	1500	0	0
A. W. for 30 hogsheads of sugar — —	800	0	0
L. L. for 10 casks of hardware — — —	1200	0	0
	12000	0	0

If 12000*l.* loss give 2000*l.* what will 100*l.* loss give? *Ans.* 16*l.* 13*s.* 4*d.* *per cent.*

	l.	*s.*	*d.*
Mr. A. W.'s goods, thrown overboard, were valued at	800	0	0
Mr. L. L.'s ditto. — — —	1200	0	0
	2000	0	0

The ship must pay to A. W. and L. L. for 2000*l.* at 16*l.* 13*s.* 4*d.* *per cent.*	333	6	8
The freight, 200*l.* at 16*l.* 13*s.* 4*d.* *per cent.* — — —	33	6	8
J. R. for 6000*l.* at the same — — — —	1000	0	0
J. P. for 300*l.* at the same — — — — —	50	0	0
R. F. for 1500*l.* at the same — — — —	250	0	0
	1666	13	4

A. W. and L. L. receive, of the owners of the goods saved, and of the ship's owners or captain, 1666*l.* 13*s.* 4*d.* for their value of the goods thrown overboard; which they divide thus:

If 2000*l.* receive 1666*l.* 13*s.* 4*d.* what will 800*l.* receive? *Ans.* £.	666	13	4
Insurers pay for 800*l.* at 16*l.* 13*s.* 4*d.* *per cent.* — — —	133	6	8
	800	0	0

A. W. receives of the underwriters 16*l.* 13*s.* 4*d.* *per cent.* for the sum that he insured, and of the owners of what was saved 666*l.* 13*s.* 4*d.* which is equal to the loss he sustained by his property being thrown overboard.

	l.	*s.*	*d.*
L. L. receives, of the owners of the ship and goods preserved, — —	1000	0	0
And the insurers, for the 1200*l.* which he had insured, at 16*l.* 13*s.* 4*d.* *per cent.*	200	0	0
Value of L. L.'s property	1200	0	0

It is usual for the owners of goods preserved, and also for the owner of the ship, to pay their average to the sufferers on receipt of their goods and on delivery of the ship; their redress being upon the insurers, who must return the same.

The Mary, captain Thompſon, at Leghorn, bound to London, ſailed with a fair wind, which continued for ſome days, when ſhe was boarded by pirates, who forcibly took away ſix large guns, two cables, two anchors, much cabin-furniture, and one compaſs, leaving the ſhip without other damage. A violent ſtorm afterwards aroſe, which diſabled the ſhip ſo much, that the men, who laboured hard at the pumps, could ſcarcely keep her from ſinking. This continued ſo long, that the men, wearied out, gave themſelves up for loſt, and diſcontinued their labour. The captain ſupplied them with wine, and, to animate them, promiſed a gratuity of twenty guineas to each man if they brought the ſhip ſafe into port. This gave the men ſuch ſpirits, that, though they loſt all their maſts, they brought the ſhip ſafe to London under jury-maſts, &c.

Here was a *general* and a *particular* average. But although the gratuity given to the ſeamen was to preſerve both ſhip and cargo, and was admitted into a general average, it was done ſo only as a matter of favour, and not of right. What the pirates ſtole, and other damages done to the ſhip, muſt make a particular average.

The ſloop Chriſtians and Betſey, captain Watſon, on her paſſage from St. Ubes to Briſtol, met with a very heavy gale of wind, the ſea breaking over her, and the veſſel making much water; the captain determined on *cutting away* the jib, as he could not take it in; but, before that could be done, a ſea ſtruck the veſſel, and *broke the bowſprit*. The wreck of the bowſprit, jib, &c. broke the laſhing of the larboard anchor, and carried it and the cable overboard: in order to preſerve ſhip and cargo, he cut the whole of this wreck away. During the ſaid gale of wind, the maſts having loſt great part of their ſupport in the loſs of the bowſprit, he prevailed on one of his men, for a gratuity of five guineas, to go aloft, and cut away the top-ſail, top-gallant-ſail, yards, maſt, and rigging; and at laſt the veſſel reached her port of delivery.

Had the jib been *cut away*, it would have been general average; and it was only under the particular circumſtance of being carried away, while that was in contemplation, it was allowed as a particular average on the ſhip, as was likewiſe the bowſprit. The entangling with the anchor and cable, though a conſequence of the above, yet being *cut away*, came into general average, as did the topmaſt, &c. The gratuity to the ſeaman was not allowed, on the principle that a ſeaman is bound, by his duty and wages, to do *all* in his power for the good of the ſhip, and he can therefore earn no more.

General Average.	*l.*	*s.*	*d.*
Blocks for topmaſt rigging	2	12	3
Running rigging	10	7	2
Topſail yard	1	12	0
Topſail	8	5	3
Top-gallant-ſail	5	16	0
Cable	23	2	6
	51	15	2
One-third off	17	5	0
	34	10	2
Surveyors 3 guineas, proteſt 2*l.*	5	2	0
Anchor	9	5	0
Anchor ſtock	0	11	0
Poſtages	0	1	10
	£49	10	0

Ship	£500				
Cargo	352				
Nett freight	100				
	952	at 5*l.* 4*s.* *per cent.* is	49	10	0

N. B. No deduction is made from the value of an anchor.

Particular Average on the Ship.	*l.*	*s.*	*d.*
Blockmaker's bill — — — —	1	2	9
Ropemaker's account for stays, &c. — — —	6	8	6
Bowsprit, &c. — — — — —	6	13	0
Jib — — — — —	10	19	6
Carpenter's and smith's bill — — — —	5	10	7
Postages — — — —	0	0	7
	30	14	11
One-third — —	10	4	11
	£20	10	0
Ship £500 at 4*l.* 2*s.* *per cent.* is — — —	20	10	0

N. B. The above average comes but a little above 3 *per cent.* had it been below, the underwriters would not have allowed it.

VIII. SALVAGE.

Salvage is an allowance made for saving a ship, or goods, or both, from the dangers of the seas, fire, pirates, or enemies. This allowance is not precisely determined by our law; but our courts always give what is just and reasonable under all the circumstances of any particular case.

The wearing-apparel of the master and seamen is always excepted from the allowance of salvage.—Lex Mercatoria, 147.

The valuation of a ship, in order to ascertain the rate of salvage, may be determined by the policy of insurance, if there is no reason to suspect she is undervalued; and the same rule may be observed as to goods, where there are policies upon them. If that, however, should not be the case, the salvers may insist upon proof of the real value, which may be done by the merchant's invoices, and they must be paid for accordingly.—Lex Mercatoria, 147.

The insured may recover from the insurer the expences of salvage; yet he cannot receive a double satisfaction for the same loss. Thus, if the insurer should have paid to the insured the expences arising from salvage; and afterwards, on account of some particular circumstance, the loss should be repaired by some unexpected means, the insurer shall stand in the place of the insured and receive the sum thus paid to atone for the loss.—Randall *v.* Cockran, 1 Vez. 98.

IX. ABANDONMENT.

The insured, before he can demand a recompence from the underwriter for a *total loss*, must cede or *abandon* to him his right to all the property that may chance to be recovered from shipwreck, capture, or any other peril, stated in the policy.

The right to abandon must arise upon the object of the insured being so far defeated, that it is not worth his while to pursue it: such a loss as is equally inconvenient to him as if it had been total. For instance, if the voyage be absolutely lost, or not worth pursuing; if the salvage be very high, *suppose a half*; if farther expence be necessary; if the insurer will not engage at all events to bear that expence, though it should exceed the value, or fail of success; under these and many other like circumstances, the insured may disentangle himself, and abandon, notwithstanding there has been a recapture.—2 Bur. 1209.

There may be circumstances in which it would be unjust to suffer the insured to abandon; for a ship might be taken, and escape immediately, which would be no hindrance at all to the voyage; or she might be taken and instantly ransomed, which would amount only to a partial loss; in which cases, the insured shall not be allowed to demand a recompence for a total loss.—2 Burr. 697, 1213.

The right to abandon must depend upon the nature of the case at the time of the action brought, or at the time of the offer to abandon.—Burr. 1214.

The owner cannot abandon, unless, at *some* period or other of the voyage, there has been a total loss: and therefore, if neither the thing insured nor the voyage be lost, and the damage sustained shall be found, upon computation, not to amount to a moiety of the value, the owner shall not be allowed to abandon.—Term Rep. Easter Term, 26 Geo. III. p. 191.

These principles will be confirmed by the judgments in the following cases.

In Pringle v. Hartly, in Chancery, 1744. 3 Atk. 195. The defendant had insured the ship *Success* from London to Bermudas, and so to Carolina; the ship was taken by a Spanish privateer, and afterwards retaken by an English privateer, and carried into Boston, in New-England, where, no person appearing to give security, or to answer the moiety the recaptors were entitled to for salvage, she was condemned, and sold in the court of Admiralty there; the recaptors had their moiety, and the overplus-money remained in the hands of the officers of that court.

It was contended for the underwriter the insured ought not to recover more on the policy than a moiety of the loss, as the act of the 13 Geo. II. c. 4. § 18. gives the thing saved to the owner, and he is intitled to receive it from the officers of the Admiralty: and that the underwriter ought to be obliged to pay no more than the loss actually sustained, which cannot be ascertained till after the insured shall have received the part that might have come to him upon the salvage.

The insured was willing to relinquish his interest to the underwriter in the benefit of the salvage.

Upon this Lord Chancellor Hardwick said: I take it, when the insured is willing to relinquish his interest in the salvage, he ought to recover the whole money insured. It would be mischievous, if it were otherwise, for then, upon a recapture, a man would be in a worse situation than if the ship were totally lost.

Cazalet and others v. Barbe, 1 Term Rep. p. 187. This was an action on a policy of insurance upon the ship Friendship, from Wyburgh to Lynn, subscribed by the defendant for 100*l.* at two guineas *per cent.* The defendant pleaded a tender, and paid 48*l.* into court. The cause was tried at Guildhall, before Mr. Justice Buller, when a case was reserved for the opinion of the court, stating, that the *damages sustained by the ship, in the voyage insured, did not exceed 48l. per cent.* which sum the defendant had paid into court upon pleading in the action. That, when the ship arrived at the port of Lynn, she was not worth repairing. The question for the opinion of the court was, whether the plaintiffs had a right to abandon.

This case came on to be argued when Lord Mansfield was absent, and the three other judges were unanimous in opinion for the defendant.

Mr. Justice Buller said, "nothing can be better established than that the owner of a ship can only abandon in case of a total loss. But *there is no instance where the owner can abandon, unless, at some period or other of the voyage, there has been a total loss.* No such event has happened here; for the jury have expressly found, that the loss amounted only to 48*l.* *per cent.* Even allowing *total loss* to be a technical expression, yet the manner, in which the plaintiff's counsel has stated it, is rather too broad. It has been said, that the insurance must be taken to be on the ship as well as on the voyage; but the true way of considering it is this: *it is an insurance on the ship for the voyage.* If either the ship or the voyage be lost, that is a total loss; but here neither is lost."

Suppose a neutral ship is arrested and detained by a foreign prince by an embargo, the owner, immediately, upon hearing this accident, would have a right to abandon; because no man is bound to wait the event of an embargo. But if the same ship, that brings the account of the embargo, should also inform him, that the embargo was taken off, that the ship had only been detained two or three days, that very trifling or no damage had arisen, then it is impossible to say that the merchant may abandon; because, as we have seen, it is a principle of good sense, that a man cannot make his election, whether he will abandon or not, till he receive advice of the loss; and if, by the same conveyance, it appear that the peril is over, and the thing insured is in safety, he has lost his election entirely; because he has, and can have, no right to abandon when his property is safe.

It has been settled also, by a solemn decision of the Court of King's Bench, in Manning v. Newnham, Trin. 22 Geo. III. in what cases a loss should be deemed to be total, after an accident by perils of the sea. A policy was effected in London upon the ship Grace, her "*cargo* and *freight*, at and from Tortola to London, warranted to depart on or before the first of August, 1781. The ship valued at 2470*l.* the freight at 2250*l.* and the cargo at 12400*l.* At a premium of 25 guineas *per cent.* to return 10*l.* *per cent.* if she departed the West Indies with a convoy for England and arrives." At the head of the subscriptions is the following declaration, viz. *On ship, freight, and goods, warranted free of particular average.* This ship, with her cargo, was a Dutch prize taken by a privateer of Tortola, and was there condemned: during the whole of her stay at Tortola (four or five months) she was never unloaded. On the first of August the whole fleet of merchantmen got under way under the convoy of the Cyclops, &c. but not being able to get clear of the islands that day they cast anchor during the night, and the next day got clear of the islands. About 10 o'clock on the 2d of August, several squalls of wind arose, which occasioned the ship to strain and make water so fast, that the crew were obliged to work both pumps; and, on the third, the captain made a signal of distress: in consequence of which, she was obliged to return to Tortola, under protection of one of his majesty's ships. The captain made his protest, and a survey was had, by which the ship was declared unable to proceed with her cargo, and that she could not be repaired in any of the English islands in the West Indies; and that many of the sugars in the bilge and lower tier were washed out, and several of the casks broke and in bad order. The ship and the whole of the cargo were sold at Tortola accordingly. The assured claim a total loss of ship, cargo, and freight, which the jury thought right, and found accordingly. A motion was made for a new trial, which upon full consideration was refused.

Lord Mansfield, after stating the evidence, and that his prejudices at the trial were in favor of the underwriters, proceeded thus: But, notwithstanding this inclination of my opinion, upon full consideration we think the jury have done right. If by a peril insured the voyage is lost, it is a total loss; otherwise not. In this case the ship has irreparable hurt within the policy; this drives her back to Tortola, and there is no ship to be had there which could take the whole cargo on board. There were only two ships at Tortola, and both could not take in the cargo. To shew how completely the voyage was lost, that no ship could be got, the assured have not been able to send that part of the goods, which they purchased, forward to London. It is admitted there was a total loss on the freight, because the ship could not perform the voyage. The same argument applies to the ship and cargo. It is a contract of indemnity; and the insurance is that the ship shall come to London. Upon turning it in every view, we are of opinion that the voyage was totally lost, and that is the ground of our determination.

From what has been said in the preceding part of this subject, it appears, that the insured has a right to call upon the underwriter for a total loss, and of course to abandon, as *soon as he hears* of such a calamity having happened, his claim to an indemnity not being at all suspended by the chance of a future recovery of part of the property lost: because, by the abandonment, that chance devolves upon the underwriter; by which means the intention of the contracting parties is fully answered, and complete justice is done.

In a very modern decision it has been held, by the Court of King's Bench, that, as soon as the insured receive accounts of such a loss as entitles them to abandon, they must, in the first instance, make their election whether they will abandon or not; and, if they abandon, they must give the underwriters notice in a reasonable time, otherwise they waive their right to abandon, and can never afterwards recover for a total loss. Mitchell *v.* Edie, 1 Term, Rep. 608.

But if the insured, hearing that his ship is much disabled and has put into port to repair, express his desire to the underwriters to abandon, and be dissuaded from it by them, and they order the repairs to be made; they are liable to the owner for all the subsequent damage occasioned by that refusal, though it should amount to the whole sum insured. Da Costa *v.* Newnham, 2 Term, Rep. 407.

X. FRAUD IN POLICIES.

The insurers and insured are equally bound to disclose circumstances that are within their knowledge; and therefore if the insurer, at the time he underwrites, can be proved to have known that the ship was safe arrived, the contract will be equally void as if the insured had concealed from him some accident which had befallen the ship.

It is necessary to consider this in three divisions. *1st. The allegation of any circumstances, as facts, to the underwriter, which the person insured knows to be false:—2dly. The suppression of any circumstances which the insured knows to exist; and which, if known to the underwriter, might prevent him from undertaking the risk at all, or, if he did, might entitle him to demand a larger premium: and, lastly, a misrepresentation.* Of each of these in order.

In a case before Lord Chief-Justice Holt, in the reign of William and Mary, that learned judge held, that, if the goods were insured as the goods of an Hamburgher, who was an ally, and the goods were, in fact, the goods of a Frenchman, who was an enemy, it was a fraud, and that the insurance was not good.—Skinner, 327.

A *false assertion* in a policy will vitiate the contract; even though the loss happen in a mode not affected by that falsity.—3 Burr. 1419.

The second species of fraud, which affects insurances, is the concealment of circumstances, known only to one of the parties entering into the contract. The facts, upon which the risk is to be computed, lie, for the most part, within the knowledge of the insured only. The underwriter must therefore rely upon him for all necessary information; and must trust to him, that he will conceal nothing, so as to make him form a wrong estimate. If a mistake happen without any fraudulent intention, still the contract is annulled, because the risk is not the same which the underwriter intended.

One, having a doubtful account of his ship, that was at sea, namely, that a ship, describ like his, was taken, insured her, without giving any notice to the insurers of what he h heard, either as to the hazard or the circumstances, which might induce him to believe that his ship was in great danger, if not actually lost.

Lord-Chancellor Macclesfield.—The insured has not dealt fairly with the insurers in this case; he ought to have disclosed to them what intelligence he had of the ship's being in danger, and which might induce him, at least, to fear that it was not lost, though he had no certain account of it. For, if this circumstance had been discovered, it is impossible to think that the insurers would have insured the ship at so small a premium as they have done, but either would not have insured at all, or would have insisted on a larger premium, so that the concealment of this intelligence is a fraud. Whereupon the policy was decreed to be delivered up with costs, but the premium to be paid back, and allowed out of the costs.—Da Costa *v.* Scandret, 2 Peere Williams, 170.

In another case it appeared, that, on the 25th of August, 1740, the defendant underwrote a policy from Carolina to Holland. It came out in evidence, that the agent for the plaintiff had, on the 23d of August, (two days before the policy was effected,) received a leter from Cowes, dated the 21st of August, wherein it is said: "On the 12th of this month, I was in company with the ship Davy, (the ship in question,) at twelve at night lost sight of her all at once; the captain spoke to me the day before that he was leaky; and the next day we had a hard gale." The ship however, continued her voyage till the 19th of August, when she was taken by the Spaniards; and there was no pretence of any knowledge of the actual loss at the time of the insurance, but it was made in consequence of a letter received that day from the plaintiff abroad, dated the 27th of June before.

Lord Chief-Justice Lee declared, that as these are contracts upon chance, each party ought to know all the circumstances. And he thought it not material, that the loss was not such an one as the letter imported; for those things are to be considered in the situation of them at the time of the contract, and not to be judged of by subsequent events. He therefore thought it a strong case for the defendant. The jury found accordingly.—Seamen *v.* Fonnereau, 2 Stra. 1183.

But although the rule is laid down thus generally, that one of the contracting parties is bound to conceal nothing from the other, yet it is by no means so general as not to admit of an exception. There are many matters as to which the insured may be innocently silent.

Our ideas on this topic, the argument of Lord Mansfield, in Carter *v.* Boehm, 3 Burr. 1905, will completely regulate. The facts of that case are not material; but we shall only give the reasoning of Lord Mansfield, upon the general doctrine of what is not necessary to be revealed.

His lordship said, insurance is a contract upon speculation. The special facts, upon which the risk is to be computed, lie most commonly in the knowledge of the insured only. The underwriter trusts to his statement, and proceeds upon confidence, that he does not keep back any circumstances within his knowledge, to mislead the underwriter into a belief that the circumstance does not exist, and to induce him to estimate the risk as if it did not exist. The keeping back such circumstances is a fraud; and therefore the policy is void. Although the suppression should happen through mistake, without any fraudulent intention; yet still the underwriter is deceived, and the policy is void: because the risk run is really different from the risk understood and intended to be run at the time of the agreement. The policy would equally be void against the underwriter, if he concealed any thing; as, if he insured a ship on her voyage, which he privately knew to be arrived: and an action would lie to recover the premium. The governing principle is applicable to all contracts and dealings. Good faith forbids either party, by concealing what he privately knows, to draw the other into a bargain, from his ignorance of that fact, and his believing the contrary. But either party may be innocently silent as to grounds open to both to exercise their judgments upon. There are many matters as to which the insured may be innocently silent; he needs not mention what the underwriter knows. An underwriter cannot insist that the policy is void, because the insured did not tell him what he actually knew, what way soever he came to the knowledge. The insured needs not mention what the underwriter ought to know; what he takes upon himself the knowledge of; or what he waives being informed of. The underwriter needs not be told what lessens the risk agreed, and understood to be run by the express terms of the policy. He needs not be told general topics of speculation: as, for instance, the underwriter is bound to know every cause which may occasion natural perils; as the difficulty of the voyage; the kind of season; the probability of lightning, hurricanes, and earthquakes. He is bound to know every cause which may occasion political perils: from the rupture of states; from war, and the various operations of war. He is bound to know the probability of safety, from the continuance and return of peace; from the imbecility of the enemy, through the weakness of their councils, or their want of strength. If an underwriter insure private ships of war, by sea, and on shore, from ports to ports, and from places to places, any where, he needs not be told the secret enterprises, upon which they are destined;

because he knows some expedition must be in view: and, from the nature of his contract, he waives the information, without being told. If he insure for three years, he needs not be told any circumstance to shew it may be over in two: or, if he insure a voyage with liberty of deviation, he needs not be told what tends to shew there will be no deviation. Men argue differently, from natural phænomena and political appearances; they have different capacities, different degrees of knowledge, and different intelligence. But the means of information and judging are open to both: each professes to act from his own skill & sagacity, & therefore neither needs to communicate to the other. The reason of the rule, which obliges the parties to disclose, is to prevent fraud, and encourage good faith; it is adapted to such facts as vary the nature of the contract, which one privately knows, and the other is ignorant of, and has no reason to suspect. The question, therefore, must always be, "Whether there was, under all the circumstances, at the time the policy was underwritten, a fair statement, or a concealment: fraudulent, if designed; or, though not designed, varying materially the object of the policy, and changing the risk understood to be run."

52. We come now to the third division, namely, to cases in which policies are void by *misrepresentation*. Before we proceed to state the cases under this head, it will be proper to distinguish between a warranty and a representation. A warranty or condition is that which makes a part of the written policy, and be most literally and strictly performed; and being a part of the agreement, nothing *tantamount* will do or answer the purpose. A representation is a state of the case, not a part of the written instrument, but collateral to it, and entirely independent of it; and it is sufficient, that a representation be *substantially* performed. Warranties will be noticed hereafter. If there be a misrepresentation, it will avoid the policy, as a fraud, but not as a part of the agreement. Even written instructions, if they are not inserted in the policy, are only to be considered as representations; and in order to make them valid and binding, as a warranty, it is absolutely necessary to make them a part of the instrument, by which the contract of indemnity is effected. If a representation be false in any material point, it will avoid the policy; and if the point be not material, the representation can hardly ever be fraudulent. A few of the decisions will elucidate these principles.

Pawson *v.* Watson, Cowper, 785.—Upon a rule to shew cause why a new trial should not be granted in this case, Lord Mansfield reported as follows. This was an action upon a policy of insurance. At the trial it appeared in evidence, that the first underwriter had the following instructions shewn to him: "Three thousand five hundred pounds upon the ship Julius Cæsar, for Hallifax, to touch at Plymouth, and any port in America; *she mounts twelve guns and twenty men*." These instructions were not asked for, nor communicated to the defendant; but the ship was only represented *generally to him as a ship of force*: and a thousand pounds had been done, before the defendant underwrote any thing upon her. The instructions were dated the 28th of June, 1776, and the ship sailed on the 23d of July, 1776; and was taken by an American privateer. That, at the time of her being taken, she had on board six four-pounders, four three-pounders, three one-pounder, six half-pounders, which are called swivels, and twenty-seven men and boys in all, for her crew; but, of them, sixteen only were *men*, (not 20, as the instructions mentioned,) and the rest boys. But the witness said, he considered her as being stronger with this force, than if she had 12 carriage-guns and twenty men: he also said (which is a material circumstance) that *there were neither men nor guns on board at the time of the insurance*. That he himself insured at the same premium, without regard or inquiry into the force of the ship. Other underwriters also insured at the same premium, without any other representation than that she was *a ship of force*. That to every four-pounder there should be five men and a boy. That, in merchant-ships, boys always go under the denomination of men. This was met by evidence on the part of the defendant, saying, that guns mean *carriage-guns*, not *swivels*; and men mean *able men*, exclusive of *boys*. The defence was, that these instructions were to be considered as a warranty, the same as if they had been inserted in the policy, though they were not proved to have been shewn to any but the first underwriter. If the court should be of opinion, that the instructions amounted to a warranty, then a new trial is to be had without costs; otherwise, the verdict, which was for the plaintiff, is to stand.

Lord Mansfield.—There is no distinction better known to those, who are at all conversant in the law of insurance, than that which exists between a *warranty* or condition, which makes a part of a written policy, and a representation of the state of the case. Where it is a part of the written policy, it must be performed. As, if there be a warranty of convoy, there must be a convoy; for in the case of convoy, it might be said, the party would not have insured without convoy. Therefore, if there be fraud in a representation, it will avoid the policy, on account of the fraud, but not on account of the non-compliance with any part of the agreement. So that there cannot be a clearer distinction, than that which exists between a warranty, which makes part of the written policy, and a collateral representation, which, if false in a point *of materiality*, makes the policy void: but, if *not* material, it can hardly ever be fraudulent. I have repeatedly, at Guildhall, cautioned and recommended it to the brokers, to enter all representations made by them in a book: that advice has been followed in London. The question then is, whether, in this policy, the person insuring has *warranted* that the ship should positively and literally have *twelve carriage-guns and twenty men*. That is, whether the instructions given in evidence are a part of the policy. The answer to this is, read your agreement; read your policy. There is no such thing to be found there. It is replied, yes, but in fact there is, for the instructions upon which this policy was made contain that express stipulation. The answer again is, there never were any instructions shewn to the defendant; nor were any asked for by him. What colour then has he to say that those instructions are any part of *his* agreement? It is said, he insured upon the credit of the first underwriter. A representation to the first underwriter has nothing to do with that, which is the agreement, or terms of the policy. The representation amounts to no more than this: I tell you what the force will be, because it is so much the better for you. There is no fraud in it, because it is a representation only of what, in the then state of the ship, they thought would be the truth. And, in real truth, the ship sailed with a larger force: for she had nine carriage-guns and six swivels. The underwriters, therefore, had the advantage by the difference. There was no stipulation about what the weight of metal would be. All the witnesses say, that she had more force than if she had twelve carriage-guns, in point of strength, of convenience, and for the purpose of resistance. The supercargo, in particular, says, "he insured the same ship, and the same voyage, for the same premium, without saying a syllable about the force." Why then it was a matter proper for the jury to say, whether the representation was false, or whether it was in fact an insurance as of a ship without force. They have determined, and I think very rightly, that it was an insurance without force, and therefore there can be no new trial.

His Lordship was afterwards asked, whether it was the opinion of the court, that, to make written instructions valid and binding as a warranty, they must be inserted in the policy. Lord Mansfield answered, that most undoubtedly that was the opinion of the court: if a man warrant that a ship should depart with twelve guns, and it depart with ten only, it is contrary to the condition of the policy.

If a representation be made to the underwriter of any circumstance which was false, this, if it be in a material point, shall vacate the policy and annul the contract, although it happens by mistake, and without any fraudulent intention or improper motive on the part of the insured. The principle on which, in such a case, the contract is held to be void, is, that the insurer is led into error, and computes his risk upon circumstances not founded in fact; by which means, the risk actually run is different from that intended to be run, at the time the contract is made. On this ground it is, that the contract is as much at an end as if there had been a wilful and false allegation, or an undue concealment of circumstances.

Macdowall *v.* Fraser, Doug. 247.—This was an action on a policy of insurance on the ship, "the Mary and Hannah, from New-York to Philadelphia." At the time when the insurance was made, which was in London, on the 30th of January, the broker represented the situation of the ship to the underwriter as follows: "The Mary and Hannah, a tight vessel, sailed with several armed ships, and was seen safe in the *Delaware on the 11th of December*, by a ship which arrived at New-York." In fact, the ship was lost on *the 9th of December*, by running against a *chevaux de frise*, placed across the river. The cause came on to be tried before Lord Mansfield at Guildhall. This was held to be a material misrepresentation as to the time when the ship was seen; and the representation and the day of the loss being proved, the jury found for the defendant.

In a subsequent case, Lord Mansfield and the rest of the court were clearly of opinion, that, if the broker at the time when the policy is effected, in representing to the underwriter the state of the ship, and the last intelligence concerning her does not disclose the whole, and what he *conceals* shall appear *material* to the jury, they ought to find for the underwriter, the contract in such case being void; although the concealment should have been *innocent*, the facts not mentioned having appeared *immaterial* to the broker, and having not been communicated merely on that account.—Skirley *v.* Wilkinson, Doug. Rep. 293.

In order to vitiate the contract, the thing concealed must be *material*, it must be *some fact*, and not merely a supposition or speculation of the insured; and the underwriter must take advantage of any misrepresentation the first opportunity, otherwise he will not be allowed to claim any benefit from it at a future period. If therefore the insured merely represent that he *expects* a thing to be done, the contract will not be void, although the event should turn out very different from his expectation.—Barber *v.* Fletcher, Doug. 292.

Wherever there has been an allegation of a falsehood, a concealment of circumstances, or a misrepresentation, it is immaterial, whether such allegation or concealment be the act of the person himself who is interested, or of his agent; for, in either case, the contract is founded in deception, and the policy is consequently void.—Fitzherbert *v.* Mather, 1 Term Rep. p. 12.

If the insured is supposed to be guilty of fraud, the proof of it falls upon the underwriter: Direct and positive proof is not necessary; but circumstantial evidence is all that can be expected; and, indeed, all that is necessary to substantiate such a charge.

XI. SEA-WORTHINESS.

Every ship insured must, at the time of the insurance, be able to perform the voyage, unless some external accident should happen; and if she have a latent defect, wholly unknown to the parties, that will vacate the contract; and the insurers are discharged. This doctrine is founded upon that general principle of insurance-law, that the insurers shall not be responsible for any loss arising from the insufficient or defective quality or condition of the thing insured.

But although the insured ought to know whether the ship was sea-worthy or not at the time she set out upon her voyage, yet he may not be able to know the condition she may be in after she is out a twelvemonth: and, therefore, whenever it can be made appear, that the decay, to which the loss is attributable, did not commence till a period subsequent to the insurance, as she was sea-worthy at the time, the underwriter would be liable. In a late case, Eden *v.* Parkinson, Doug. 708, the same principle was much relied upon. Lord Mansfield said, "By an implied warranty every ship insured must be tight, staunch, and strong; but it is sufficient if she be so at the time of her sailing. She may cease to be so in twenty-four hours after departure, and yet the underwriter will continue liable." Every case of this kind, it is true, must depend upon its own circumstances; but, when they are once ascertained, the rule of law is clear and decisive.

XII. ILLEGAL VOYAGES.

Whenever an insurance is made on a voyage expressly prohibited by the common, statute, or maritime, law of the country, the policy is of no effect.

Even if it be told to the underwriter, that the voyage is illicit, he shall not be bound: because the contract is null and void.—Bynk. Quæst. Jur. Pub. l. i. c. 21.

If a ship, though neutral, be insured on a voyage prohibited by an embargo, laid on in the time of war, by the prince of the country, in whose ports the ship happens to be, such an insurance also is void.

Though an insurance upon a smuggling voyage, prohibited by the revenue-laws of this country, would be void under the principle above-stated; yet the rule has never been supposed to extend to those cases where ships have traded, or intend to trade, contrary to the revenue-laws of *foreign* countries, because no country takes notice of the revenue-laws of another; in such cases, therefore, the policy is good and valid; and, if a loss happens, the underwriter will be answerable.—Planche *v.* Fletcher, Doug. 238.

We may conclude the present subject with this principle: that all insurances upon a voyage generally prohibited, such as to an enemy's garrison, or upon a voyage directly contrary to an express act of parliament, are absolutely null and void.

XIII. RE-ASSURANCE: AND DOUBLE INSURANCE.

Re-assurance may be said to be a contract, which the first insurer enters into, in order to relieve himself from those risks which he has incautiously undertaken, by throwing them upon other underwriters, who are called re-assurers.

The re-assurer is wholly unconnected with the original owner of the property insured; and as there is no obligation between them originally, so none is raised by the subsequent act of the first underwriter. The risks of the insurer form the object of the re-insurance, which is a new independent contract, not at all concerning the insured; who consequently can exercise no power or authority with respect to it.—Pothier, tit. Assurance, No. 96.

A *double insurance* is where the same man is to receive two sums instead of one, or the same sum twice over, for the same loss, by reason of his having made two insurances upon the same goods or the same ship. The first distinction between these two contracts is, that a re-assurance is a contract made by the first underwriter, his executor, or assigns, to secure himself or his estate: a double assurance is entered into by the insured. A re-assurance, except in the cases provided for by the statute, is absolutely void: a double insurance is not void: but still the insured shall recover only one satisfaction for his loss. Where a man has made a double insurance he may recover his loss against which of the underwriters he pleases, but he can recover for no more than the amount of his loss. It being thus settled, that the insured shall recover but one satisfaction, and that, in case of a double insurance, he may fix upon which of the underwriters he will for the payment of his loss, it is a principle of natural justice that the several insurers should all of them contribute, in their several proportions, to satisfy that loss, against which they have all insured.

In the year 1763, it was ruled, by Lord Mansfield, chief-justice, and agreed to be the course of practice, that, upon a double insurance, though the insured is not entitled to two satisfactions, yet, upon the first action, he may recover the whole sum insured, and may leave the defendant therein to recover a rateable satisfaction from the other insurers.—Newby *v.* Reed, Sit. in London in Easter Vacat. 1763. 1 Black. Rep. 416.

Thus also it was determined in a subsequent case at Guildhall.—Rogers *v.* Davis, Sittings in Mich. Vac. 17 Geo. III. before Lord Mansfield.

Although a man, by making a double insurance, should not be allowed to recover a double satisfaction for the same loss, yet various persons may insure various interests on the same thing, and each to the whole value, (as the master for wages, the owner for freight, one person for goods, another for bottomry,) and such a contract does not fall within the idea of a double insurance.—1 Burr. 496.

XIV. CHANGING THE SHIP.

Changing the ship, or, as it is commonly called, changing the bottom, will operate as a bar to the insured's recovering upon a policy of insurance against the underwriter. Except in some special cases of insurances upon *ship or ships*, it is essentially requisite, to render a policy of insurance effectual, that the name of the ship, on which the risk was to be run, should be inserted. That being done, it follows, that the insured shall neither substitute another ship for that mentioned in the policy before the voyage commences, nor during the course of the voyage remove the property insured to another ship; without the consent of the underwriter, or without being impelled by a case of *unavoidable necessity*.

And this doctrine, relative to changing the bottom of the ship, was alluded to by Lord Mansfield, when delivering the opinion of the court in the case of Pelly against the Royal-Exchange Assurance-Company. "One objection," said his lordship, "was formed by comparing this case to that of changing the ship or bottom, on board of which goods are insured: *which the insured have no right to do.*"

This is to be taken as a rule, subject to the exceptions of inevitable or urgent necessity; for, it has been held, that the owners of goods insured, by the act of shifting the goods from one ship to another, do not preclude themselves from recovering an average loss, arising from the capture of the second ship, if they act from necessity, and for the benefit of all concerned.—Plantamour *v.* Staples, 1 Term E. 611, note (a).

XV. DEVIATION.

Deviation means a *voluntary departure*, without necessity or any reasonable cause, from the regular and usual course of the specific voyage insured. Whenever a deviation of this kind takes place, the voyage is determined; and the underwriters are discharged from any responsibility. It is necessary to insert, in every policy of insurance, the place of the ship's departure, and also of her destination. Hence it is a condition, on the part of the insured, that the ship shall pursue the most direct course, of which the nature of things will admit, to arrive at the destined port. If this be not done, if there be no special agreement to allow the ship to go to certain places out of the usual track, or if there be no just cause assigned for such a deviation, the underwriter is no longer bound by his contract. Nor is it at all material, whether the loss be or be not in actual consequence of the deviation; for the insurers are in no case answerable for a subsequent loss, in whatever place it happens, or to whatever cause it may be attributed. Neither does it make any difference, whether the insured was, or was not, consenting to the deviation.

The plaintiff was a shipper of goods in a vessel bound from Dartmouth to Liverpool. The ship sailed from Dartmouth, and put into Loo; a place *she must of necessity pass by* in the course of the insured voyage. But, as she had no liberty given her by the policy to go into Loo, and, although no accident befel her in going into or coming out of Loo, (for she was lost after she got out to sea again,) yet Mr. Justice Yates held that this was a deviation, and a verdict was accordingly found for the underwriters.—Fox *v.* Black, Exeter assizes, 1767, before Mr. Justice Yates.

It was also held, by Lord Chief-Justice Lee, that, if the master of a vessel put into a port not usual, or stay an unusual time, it is a deviation, and discharges the insurer.

These principles being once eftablifhed, it follows, as a neceffary confequence, that, however fhort the time of deviation may be, if only for a fingle night, or even for an hour, the underwriter is equally difcharged, as if there had been a deviation for weeks or months; for, the condition being once broken, no fubfequent act can ever make it good.

Wherever the deviation arifes from neceffity and a juft caufe, the underwriter ftill remains liable, although the courfe of the voyage is altered.—Rocus, n. 52.

The firft ground of neceffity, which juftifies a deviation, is that of going into port to repair. If a fhip is decayed, and goes to the *neareft place* to refit, it is no deviation; becaufe it is for the general intereft of all concerned, and confequently for that of the underwriters, that the fhip fhould be put in a proper condition, capable of performing the voyage.—Motteux and others *v.* the London Affurance-Company, 1 Atk. 545; and Gilbert *v.* Readfhaw, Sitt. in Lond. Hil. Vac. 1781.

The next excufe for leaving the direct courfe is *ftrefs of weather.* Upon this point the rule is this; that, wherever a fhip, in order to efcape a ftorm, goes out of the direct courfe; or when, in the due courfe of the voyage, fhe is driven out of it by ftrefs of weather, this is no deviation. It has alfo been held, that, if a ftorm drive a fhip out of the courfe of her voyage, and fhe do the beft fhe can to get to her port of deftination, fhe is not obliged to return back to the point from whence fhe was driven.—Harrington *v.* Halkeld, Sitt. in Lond. Mich. Vac. 1778.

If a fhip be driven out of her port of lading, by ftrefs of weather, into another, and then does the beft fhe can to get to her port of deftination, it fhall not be deemed a deviation, though fhe do not return to the port from whence fhe was driven.—Delaney *v.* Stoddart, 1 Term, Rep. p. 22.

A deviation may alfo be juftified, if done to avoid an enemy, or feek for convoy; becaufe it is in truth no deviation to go out of the courfe of a voyage, in order to avoid danger, or to obtain a protection againft it.—Bond *v.* Gonfales, 2 Salk. 445—Gordon *v.* Morley.—Campbell *v.* Bordieu, 2 Stra. 1265.

In the cafe of Bond againft Nutt, in which the material queftion was, whether a warranty had or had not been complied with; the point of deviation for the purpofe of procuring convoy alfo came under the confideration of the court. Upon that occafion, Lord Mansfield and the whole court held, that, if a fhip go to the *ufual place of rendezvous*, for the fake of joining convoy there ready, though fuch place be out of the direct courfe of the voyage, it is no deviation.—Cowp. Rep. 601.

And, in a more modern cafe, the only queftion was, whether there was a deviation or not. Lord Mansfield there directed the jury to find for the plaintiffs, if they believed that the captain fairly and *bona fide* acted according to the beft of his judgment; that he had no other view or motive but to come the fafeft way home, and to meet with convoy; for, that it was no deviation to go out of the way to avoid danger.—Enderby and another *v.* Fletcher, Sitt. in Lond. Trin. Vac. 1780.

If, by the ufage of any particular trade, it is cuftomary to ftop at certain places, lying out of the direct courfe from A to B, it is not a deviation to ftop there, becaufe it is a part of the voyage; but, in order to juftify the captain of a fhip in quitting the ftraight and direct line from the port of lading to that of delivery, there muft be a precife, clear, and eftablifhed ufage upon the fubject, not depending merely upon one or two loofe and vague inftances.

But, though an actual deviation from the voyage infured is thus fatal to the contract of infurance, yet a deviation, merely *intended*, but never carried into effect, is confidered as no deviation, and the infurer continues liable. Thus, in the cafe of an infurance from Carolina to Lifbon, and at and from thence to Briftol, it appeared, that the captain had taken in falt, which he was to deliver at Falmouth, before he went to Briftol; but the fhip was taken in the direct road to both, and before fhe came to the point where fhe would have turned off to Falmouth. Lord Chief-Juftice Lee held, that the infurer was liable; for, it is but an *intention to deviate*, and that was held not fufficient to difcharge the underwriters.—Fofter *v.* Wilmer, 2 Stra. 1249.

In the cafe of Carter *v.* the Royal-Exchange Affurance-Company, where the infurance was from Honduras to London, and a confignment to Amfterdam, a lofs happened before fhe came to the dividing point between the two voyages, for which the infurers were held liable to pay.—2 Stra. 1249.

If, however, it can be made appear, by evidence, that it never was intended or came within the contemplation of the parties to fail upon the voyage infured; if all the fhip's papers and documents be made out for a different place from that defcribed in the policy, the infurer is difcharged from all degree of refponfibility, even though the lofs fhould happen before the dividing point of the two voyages. This diftinction was very properly taken by the court of King's-bench, in Woolbridge *v.* Boydel, Dougl. 16.

In a ſtill later caſe, the ſame doctrine was advanced, namely, that if a ſhip be inſured from a day certain, from A. to B. and before the day, ſail on a different voyage from that inſured, the aſſured cannot recover; even though the ſhip afterwards fall into the courſe of the voyage inſured, and be loſt after the day on which the policy was to have attached.—Way *v.* Modigliani, 2 Term Rep. 50.

From the propoſition juſt eſtabliſhed, namely, that a mere *intention to deviate*, will not vacate the policy, it follows, as an immediate conſequence, that whatever damage is ſuſtained before *actual* deviation will fall upon the underwriters.

Thus it was held by Lord Chief-Juſtice Holt, who ſaid, that if a policy of inſurance be made to begin from the departure of the ſhip, from England, until, &c. and after the departure a damage happens, &c. and then the ſhip *deviates*; though the policy is diſcharged from the time of the deviation, yet for the damages ſuſtained before the deviation the inſurer ſhall make ſatisfaction to the inſured.—Green *v.* Young, 2 Ld. Raym. 840. 2 Salk. 444. S. C.

In caſes of deviation, the premium is not to be returned; becauſe, the riſk being commenced, the underwriter is entitled to retain it.

XVI. NON-COMPLIANCE WITH WARRANTIES.

A warranty in a policy of inſurance is a condition or contingency, that a certain thing ſhall be done, or happen; and, unleſs that is performed, there is no valid contract. It is perfectly immaterial for what view the warranty is introduced: but, being once inſerted, it becomes a binding condition on the inſured; and unleſs he can ſhew that he has *literally* fulfilled it, or that it was *literally* performed, the contract is the ſame as if it had never exiſted.—1 Term Rep. p. 345.

But as a warranty muſt be *ſtrictly* complied with in favour of the underwriter, and againſt the inſured, equal juſtice demands, that if a ſtrict and literal compliance with the warranty will ſupport the demand of the inſured, the deciſion ought to be in his favour; eſpecially when, by ſuch a deciſion, *all* the words in the policy will have their full operation.

In an action on a policy on goods, dated the 9th of December, 1784, *loſt or not loſt*, *warranted well this 9th day of December*, 1784; it appeared, that the warranty was at the foot of the policy; that the policy was underwritten between the hours of one and three in the afternoon of the 9th of December; that the ſhip was well at ſix o'clock in the morning, but was loſt at eight o'clock the ſame morning.

Upon a motion to ſet aſide a non-ſuit, which had been entered, Lord Kenyon, Chief-Juſtice, Aſhhurſt, Buller, and Groſe, Juſtices, were clearly of opinion, that the warranty was ſufficiently complied with, if the ſhip were well at any time that day: that the nature of a warranty goes to determine the queſtion: for, as it is a matter of indifference whether the thing warranted be or be not material, and yet muſt be literally complied with, ſtill, if it be complied with, that is enough: that there was good reaſon for inſerting theſe words, becauſe they protected the underwriter from loſſes before that day, to which he would otherwiſe have been liable, as the policy was on the goods from the lading; and thus too, the words *loſt or not loſt* have alſo their operation.—Blackhurſt *v.* Cockell, 3 Term Rep. 360.

In order to make written inſtructions valid and binding as a warranty, they muſt appear on the face of the policy itſelf: even though a written paper be *wrapt up in the policy*, when it is brought to the underwriters to ſubſcribe, and ſhewn to them at that time: or even though it be *wafered to the policy*, at the time of ſubſcribing; ſtill it is not in either caſe a *warranty*, or to be conſidered as part of the policy itſelf, but only as a *repreſentation*. Both theſe inſtances have occurred before Lord Mansfield, in Pawſon *v.* Barnevelt, Dougl. 12. and in Bize *v.* Fletcher, Dougl. 12.

It being thus ſettled, that a warranty muſt appear on the face of the inſtrument, it has likewiſe been determined, that a warranty, written in the margin of the policy, was to be conſidered equally binding, and ſubject to the ſame ſtrict rule of conſtruction, as if inſerted in the body of the policy itſelf.—Doug. 10 and 271.

The warranties which moſt frequently occur, and upon which the greateſt queſtions have ariſen, may be reduced to three claſſes: *warranty as to the time of ſailing*, *warranty as to convoy*; and *warranty as to neutrality*.

1ſt. *As to the time of ſailing.*—It has been held, that when a ſhip has been warranted to ſail on a particular day, though the ſhip be delayed for the beſt and wiſeſt reaſons, or even though ſhe be detained by force; the warranty has not been complied with, and the inſurer is diſcharged from his contract.—Hare *v.* Whitmore, Cowp. 784.

If the warranty be to ſail *after* a ſpecific day and the ſhip ſail before, the policy is equally avoided as in the former caſe; becauſe the terms of the warranty are as much departed from in the one caſe as in the other.—Vezian *v.* Grant, before Mr. Juſtice Buller, Guildhall, Eaſt. Vac. 1779.

But when a ship is warranted to sail on or before a particular day, if she sail from her port of loading, *with all her cargo and clearances on-board*, to the usual place of rendezvous at another part of the same island, merely for the sake of joining convoy, it is a compliance with the warranty, though she be afterwards detained there by an embargo beyond the day. The ground is, that when a ship leaves her port of loading, when she has a full and complete cargo on-board, and has no other object in view, but the safest mode of sailing to her port of delivery, her voyage must be said to commence from her departure from that port. If, indeed, her cargo was not complete, it would not have been a commencement of the voyage.—Bond *v.* Nutt, Cowp. 601.

The second species of warranty, which most frequently occurs in insurances, is that of *sailing under the protection of convoy*. Upon this subject, it is material to consider what is deemed *a convoy*. It has been settled, by the court of King's Bench, that it is not every *single man of war*, which chooses to take a merchant ship under its protection, that will constitute such a convoy as a warranty means; but it must be *a naval force under the command of a person appointed by the government of the country to which they belong*.—Hibbert *v.* Pigou, B. R. Easter, 23 Geo. III. 1783.

From that case of Hibbert and Pigou, we likewise collect this; that a convoy appointed by the admiral, commanding in chief upon a station abroad, is a convoy appointed by government.

Having seen what shall be deemed a convoy, let us proceed to consider what shall be a *departure* with convoy, within the meaning of a warranty *to depart with convoy*. The rule on this point is short and clear, that such a warranty implies, that the ship shall go with convoy from the usual place of rendezvous, at which the ships have been accustomed to assemble; as Spithead, or the Downs, for the port of London; and Bluefields, for all the ports in Jamaica. And from the particular port, to such usual place of convoy, the ship is protected by the policy.—Lethulier's case, 2 Salk. 443. and Gorden *v.* Morley, 2 Stra. 1265.

Although the words commonly used are, "to *depart* with convoy," or, "to sail with convoy;" yet, they extend to sailing with convoy throughout the whole of the voyage, as much as if those words were inserted. If, therefore, the convoy is to go only a part of the way, that is not a compliance with the warranty; and the insurer is discharged from his engagements.—Lilly *v.* Ewer, Dougl. 72.

But, although it has been thus settled, that a ship must depart with convoy for the whole of the voyage; yet an *unforeseen* separation is an accident to which the underwriter is liable. —Jefferey *v.* Legendra, 3 Lev. 320.

Even where the ship has, by tempestuous weather, been prevented from joining the convoy at all, at least, of receiving the orders of the commander of the ships of war, if she do every thing in her power to effect it, it shall be deemed a sailing with convoy, within the terms of the warranty.—Victoria *v.* Cleeve, 2 Stra. 1250.

The third species of warranty is that of *neutrality*; or, that the ship or goods insured are neutral property. If the ship and property are neutral at the time when the risk commences, this is a sufficient compliance with a warranty of neutral property: because it is impossible for the insured to be answerable for the consequences of a war breaking out during the voyage.—Eden and another *v.* Parkinson, Dougl. 705. And this doctrine has been since confirmed, in the case of Tyson *v.* Gurney, 3 Term Rep. 477.

XVII. RETURN OF PREMIUM.

The next object of our inquiry is, in what cases, and under what circumstances, there shall be *a return of premium*.

The principle upon which the whole of this doctrine depends, is simple and plain. The risk or peril is the consideration for which the premium is to be paid: if the risk be not run, the consideration for the premium fails; and equity implies a condition, that the insurer shall not receive the price of running a risk, if, in fact, he runs none.—3 Burr. 1240.

Accordingly, in an action brought by the plaintiff, for 5*l.* received by the defendant to the plaintiff's use, where it appeared in evidence, that one Barkdale had made a policy of insurance upon account, for 5*l.* premium, in the plaintiff's name, and that he had paid the same premium to the defendant, and that Barkdale had no goods then on-board, and so the policy was void. Lord Chief-Justice Holt said, the money is not only to be returned by the custom but the policy is made originally void, the party, for whose use it was made, having no goods on board; so that by this discovery, the money was received without any *reason*, *occasion*, or *consideration*, and, consequently it was received originally to the plaintiff's use.—And so judgment was given for the plaintiff.—Martin *v.* Sitwell, 1 Shower, 156.

Clauses are frequently inserted in policies of insurance, containing conditions on the performance or non-performance of which the premium is returnable.

By the law of England, it has been clearly settled, that, whether the cause of the risk not being run is attributable to the *fault, will, or pleasure*, of the insured, still the premium is to be returned.—Cowp. 668.

The French, in the famous ordinances of Lewis XIV. have inserted an article, declaring that, if the voyage is entirely broken up, before the departure of the ship, *even by the act of the insured*, the insurance shall be void, and the underwriter shall return the premium, reserving one half *per cent.* for his trouble. Accordingly, in England, it has always been the custom, when the policy is cancelled, to return the premium, deducting one half *per cent.*—Molloy, l. 2. c. 7. § 12.

In the English law there are two general rules established, which govern almost all cases. The first is, that, where the risk has not been run, whether that circumstance was owing to the fault, the pleasure, or will, of the insured, or to any other cause, the premium shall be returned. Another rule is, that, if the risk has *once* commenced, there shall be *no* apportionment or return of premium afterwards. Hence, in cases of deviation, though the underwriter is discharged from his engagement; yet, the risk being once commenced, he is entitled to retain the premium.

Where, however, from the nature of the agreement between the parties, or the nature of the voyage, the contract becomes divisible, "a part of the premium shall be retained for the risk run, and part shall be returned as the risk has never commenced."

The first time in which this doctrine was considered at any length was in a case which came before the Court of King's Bench, in the year 1761. It was an insurance upon a ship, at five guineas *per cent.* lost or not lost, *at and from London to Halifax, in Nova-Scotia, warranted to depart with convoy from Portsmouth*, for the voyage, that is to say, the Halifax or Louisburgh convoy. Before the ship arrived at Portsmouth the convoy was gone. Notice of this was immediately given by the insured to the underwriter; and at the same time he was also desired, either to make the long insurance or to return part of the premium. The jury found that the usual settled premium, from London to Portsmouth, was one and a half *per cent.* They also found, that it *is usual* for the underwriter, in such like cases, to return part of the premium; but the *quantum* is uncertain: (and the *quantum* must in its nature be uncertain, because it depends upon certain circumstances.) It was stated, that the plaintiff made an offer to the defendant of allowing him to retain one and a half *per cent.* for the risk he had run on such part of the voyage as was performed under the policy, viz. from London to Portsmouth.

Lord Mansfield.—I had not at the trial, nor have now, the least doubt about this question myself. These contracts are to be taken with great latitude: the strict letter of the contract is not so much regarded as the object and intention of it. Equity implies a condition, "that the insurer shall not receive the price of running a risk, if he runs none." This is a contract without any consideration, as to the voyage from Portsmouth to Halifax; for he intended to insure that part of the voyage as well as the former part of it, and has not. Consequently, the insured received no consideration for this proportion of his premium: and then this case is within the general principle of actions for money had and received to the plaintiff's use. I do not go upon the usage: for the usage found is only that, in like cases, it is usual to return a part of the premium, without ascertaining what part. If the risk is not run, though it is by the neglect, or even the fault of the party insuring, yet the insurer shall not retain the premium. It has been objected, that the voyage being *begun*, and part of the risk being already run, the premium cannot be apportioned. But I can see no force in the objection. This is not a contract so entire, that there can be no apportionment: for there are two parts in this contract: and the premium may be divided into two distinct parts, relative, as it were, to two distinct voyages. The practice shews, that it has been usual, in such like cases, to return a part of the premium, though the *quantum* be not ascertained. And, indeed, the *quantum* must vary as circumstances vary: so that it never can have been fixed with any precise exactness. But though the *quantum* has not been ascertained, yet the principle is agreeable to the general sense of mankind.—Stevenson *v.* Snow, 3 Burr. 1237.

Some years afterwards, the principle established in the foregoing case was attempted to be applied to one which it did not at all resemble. That was in an insurance for twelve months at 9*l. per cent* and, because the ship was captured within two months after the contract was made, a return of premium was demanded. But the contract in this case was entire; the premium was a gross sum stipulated and paid for twelve months; and the parties when they made the contract, had no intention or thought of a subsequent division, or apportionment, and therefore there could be no return of premium.—Tyrie *v.* Fletcher, Cowp. 666.

In a subsequent case, the Court of King's Bench adopted the same rule of decision, where the ship was insured for twelve months, and the risk ceased at the end of two. A distinction was attempted to be made, because, in this case, the whole premium, 18*l.* was acknowledged to be received from the insured *at the rate of fifteen shillings per month*: and this, it was insisted, evidently shewed the parties intended the risk to continue only from month to month. This objection was, however, over-ruled; the court being of opinion, that the case last mentioned decided this; and that the fifteen shillings per month was only a mode of computing the gross sum.—Loraine *v.* Thomlinson, Dougl. 564.

The two last cases, were insurances upon time; but it seems perfectly clear, that when the contract is entire, whether it be for a *specified time*, or *for a voyage*, there shall be no apportionment or return, if the risk has *once commenced*. And, therefore, where the premium is entire in a policy on a voyage, where there is no contingency at any period, out or home, upon the happening or not happening of which the risk is to end, nor any usage established upon such voyages, although there be several distinct ports, at which the ship is to stop, yet the voyage is one, and no part of the premium shall be recoverable.—Bermon *v.* Woodbridge, Dougl. 751.

The last case upon this subject was also an action for a return of the premium. The policy was "at and from Jamaica to London, warranted to depart with convoy for the voyage, and to sail on or before the 1st of August, upon goods on-board a ship called the Jamaica, at a premium of twelve guineas *per cent.*" The ship sailed from Jamaica to London on the 31st of July, 1782, but without any convoy for the voyage. At the trial, before Lord Mansfield, the jury found a verdict for the plaintiff, subject to the opinion of the court, upon a case, stating the facts already mentioned. In addition to which, they *expressly* find, "that it is the constant and invariable usage in an insurance, at and from Jamaica to London, warranted to depart with convoy, or to sail on or before the 1st of August, when the ship does not depart with convoy, or sails after the 1st of August, to return the premium, deducting one half *per cent.*"

Lord Mansfield.—An insurance being on goods warranted to depart with convoy, the ship sails without convoy; and an action is brought to recover the premium. The law is clear, that, if the risk be commenced, there shall be no return. Hence questions arise of distinct risks insured by one policy or instrument. My opinion has been to divide the risks. I am aware that there are great difficulties in the way of apportionments, and, therefore, the court has sometimes leaned against them. But where an express usage is found by the jury, the difficulty is cured. They offer to prove the same usage as to the West-Indies in general: but I stopt them, and confined the evidence to Jamaica. The court, therefore, decided for the plaintiff.—Long. *v.* Allen, Easter Term, 25 Geo. III.

From the tenor of all these cases, it should seem, as my Lord Mansfield said, that so many difficulties occur in apportioning the premium, that the courts are often obliged to decide against it, unless there be some usage upon the subject.

XVIII. BOTTOMRY AND RESPONDENTIA.

Bottomry is in the nature of a mortgage of a ship, when the owner of it borrows money to enable him to carry on the voyage, and pledges the keel, or *bottom* of the ship, as a security for the repayment: and it is understood, that, if the ship be lost, the lender also loses his whole money: but, if it return in safety, then he shall receive back his principal, and also the premium or interest stipulated to be paid, however it may exceed the usual or legal rate of interest. When the ship and tackle are brought home, they are liable, as well as the person of the borrower, for the money lent. But when the loan is not made upon the vessel, but upon the goods and merchandizes laden thereon, which, from their nature, must be sold or exchanged in the course of the voyage, then the borrower only is *personally* bound to answer the contract; who, therefore, in this case, is said to take up money at *respondentia*. In this consists the difference between *bottomry* and *respondentia*; that the one is a loan upon the ship, the other upon the goods: in the former, the ship and tackle are liable, as well as the person of the borrower; in the latter, for the most part, recourse must be had to the *person* only of the borrower. Another observation is, that in a loan upon bottomry, the lender runs no risk, though the *goods* should be lost; and, upon respondentia, the lender must be paid his principal and interest, though the ship perish, provided the goods are safe. In all other respects, the contract of bottomry and that of respondentia are upon the same footing.

These terms are also applied to another species of contract, which does not exactly fall within the description of either; namely, to a contract for the repayment of money, not upon the ship and goods only, but upon the mere hazard of the voyage itself; as if a man lend 1000*l.* to a merchant to be employed in a beneficial trade, with a condition to be repaid with extraordinary intereſt, in caſe a ſpecific voyage named in the condition ſhall be ſafely performed.

The contract of bottomry and reſpondentia ſeems to deduce its origin from the cuſtom of permitting the maſter of a ſhip, when in a foreign country, to hypothecate the ſhip, in order to raiſe money to refit. Such a permiſſion is abſolutely neceſſary, and is impliedly given him in the very act of conſtituting him maſter, by the marine law, which in this reſpect is reaſonable; for, if a ſhip happen to be at ſea, and ſpring a leak, or the voyage is likely to be defeated for want of neceſſaries, it is better that the maſter ſhould have it in his power to pledge the ſhip and goods, or either of them, than that the ſhip ſhould be loſt, or the voyage defeated. But he cannot do either for any debt of his own; but merely in caſes of *neceſſity*, and for *completing the voyage*. Although the maſter of the veſſel has this power while abroad, becauſe it is abſolutely neceſſary for the purpoſes of commerce and navigation: yet the very ſame authority, which gave that power in thoſe caſes, has denied it when he happens to be in the ſame place where the owners reſide. All the caſes which have been determined upon the ſubject, ſeem to require, that the ſhip ſhould be *abroad*, as well as in a *ſtate of neceſſity*, to juſtify the captain or maſter in taking money on bottomry. Molloy, in expreſs terms, declares, that a maſter has no power to take up money on bottomry in places where his owners dwell: otherwiſe, he and his eſtate muſt be liable thereto.—Molloy, l. 2. c. 11. § 11. If, indeed, the owners do not agree in ſending the ſhip to ſea, the majority ſhall carry it, and then money may be taken up by the maſter on bottomry for their proportion who refuſe, although they reſide on the ſpot, and it ſhall bind them all.

It is of the eſſence of a contract of bottomry, that the lender run the riſk of the voyage; and that both principal and intereſt be at hazard: for, if the riſk go only to the intereſt of premium, and not to the principal alſo, though a real and ſubſtantial riſk be inſerted, it is a contract againſt the ſtatute of uſury, and therefore void. This has been frequently ſo determined in our courts of law.

As the hazard to be run is the very baſis and foundation of this contract, it follows, that, if the riſk is not run, the lender cannot be entitled to the extraordinary premium; for that would be to open a door to means by which the ſtatute of uſury might be evaded. This was ſo decided in the court of chancery.

This caſe was upon a bottomry-bond, where the plaintiff was bound, in conſideration of 400*l*. as well to perform the voyage within ſix months, as at the ſix months end to pay 400*l*. and 40*l*. premium, in caſe the veſſel arrived ſafe, and was not loſt in the voyage. It happened that the plaintiff never went the voyage, whereby the bond became forfeited, and he now preferred his bill to be relieved. Upon the former hearing, as the ſhip lay all the time in the port of London, and there was no hazard of loſing the principal, the lord-keeper thought fit to decree, that the defendant ſhould loſe the premium of 40*l*. and be contented with his principal and *ordinary intereſt*. And now, upon a rehearing, he confirmed his former decree.—Deguilder *v.* Depeiſter, 1 Vern. 263.

It remains to be ſhewn what thoſe riſks are to which the lender undertakes to expoſe himſelf. Theſe are, for the moſt part, mentioned in the condition of the bond, and are nearly the ſame, againſt which the underwriter, in a policy of inſurance, undertakes to indemnify. Theſe accidents are, tempeſts, pirates, fire, capture, and every other misfortune, except ſuch as ariſe either from the defects of the thing itſelf, on which the loan is made, or from the miſconduct of the borrower.

Capture here does not mean a mere temporary taking, but it muſt be ſuch a capture as to occaſion a total loſs. And therefore, if a ſhip be taken and detained for a ſhort time, and yet arrive at the port of deſtination within the time limited, (if time be mentioned in the condition,) the bond is not forfeited, and the obligee may recover.—Joyce *v.* Williamſon, B.R. Mich. Term, 23 Geo. III.

A lender on bottomry, or at reſpondentia, is neither entitled to the benefit of ſalvage, nor liable to contribute in caſe of a general average.—Walpole *v.* Ewer, Sitt. after Trin. 1789.

It has been ſaid, that, if the accident happen by default of the borrower or of the captain, the lender is not liable, and has a right to demand the payment of the bond. If, therefore, the ſhip be loſt by a wilful deviation from the track of the voyage, the event has not happened upon which the borrower was to be diſcharged from his obligation.—Weſtern *v.* Wildy, Skin. 152.

OF BILLS OF EXCHANGE.

Of Foreign Bills.

A BILL of Exchange is a piece of paper, on which is written a ſhort order, given by a banker, &c. for paying to ſuch a perſon, or his order, a certain ſum of money.

In order to underſtand this ſubject, it will be neceſſary to explain the terms uſed in bills of exchange.

The *drawer* is the perſon who draws the bill of exchange.

The *drawee* is the perſon upon whom it is drawn; and he is ſo called *before* he accepts the ſame; but, after he has accepted, he is then called the *acceptor*.

An *indorſer*.—Every perſon, before he can pay away, or paſs, a bill of exchange, muſt write his name on the back of the bill; and he is therefore called an *indorſer*.

An *indorſee* is any perſon who is in poſſeſſion of a bill of exchange in conſequence of its having been indorſed to him.

The *payee* is the perſon in whoſe favour a bill is drawn; as, if A. draws upon B. directing him "*pay to C. or order*," C. is called the payee; and, before C. can paſs away the ſame, he muſt *indorſe* it.

If the drawee refuſe to accept or pay the bill, the payee muſt cauſe it to be proteſted.

A proteſt ſignifies, to the drawer, that the party upon whom he drew his bill was unwilling, not to be found, or inſolvent; and to let him (the drawer) have timely notice thereof; and alſo to enable the party to recover againſt the drawer, and alſo againſt the acceptor, as far as he can pay, if the bill be accepted.

A foreign bill muſt be proteſted on the laſt day of the three days of grace allowed; (after the time expreſſed upon the bill;) and, if not paid upon the laſt of the three days, the party ought immediately to proteſt the bill and return it: but, if the laſt of the three days be a great holiday, the day before is the day of payment.

Bills of exchange muſt be ſued for within ſix years after their becoming due.

If two or three bills are drawn for the ſame ſum, they ſhall carry a condition with them that only one ſhould be paid; and, in a declaration on one of them, it is not neceſſary to aver that the other bills were not paid.

If A. ſells goods to B. and B. is to give a bill in ſatisfaction, B. is ſo far diſcharged, that he cannot be ſued for the goods, though the bill be never paid; for the bill is payment; but he is liable to be ſued for the bill.

A note, or bill, is no abſolute payment, though agreed to be ſuch, if the giver of it knows the perſon upon whom it is drawn to be in a failing condition.

Of what ſhall be deemed a Bill of Exchange.

The cuſtom preſcribes the form of a bill, and raiſes a contract.

It is not requiſite to obſerve the ſame nicety in a bill of exchange as in deeds or wills.

A bill, payable out of a particular fund, is no bill of exchange.

Pray pay out of my growing ſubſiſtence—is no bill of exchange.

Bill, payable out of the fifth payment, as it ſhall become due, is not good.

Pray pay, J. S. or order, at my quarterly half-pay per advance, is a negociable bill.

Bill, payable to *me* or *my order*, is a good bill, if accepted.

Of the Acceptance.

The acceptance of a bill of exchange is ſuch an act, by the drawee, as will make him liable to pay the ſame. It is uſually made by ſigning his name or initials at the bottom of the bill, when it is preſented to him by the bearer.

A very ſmall matter will amount to an acceptance; and any words will be ſufficient for that purpoſe which ſhew the party's aſſent or agreement to the bill; as,

Writing the day of the month on the bill is ſufficient acceptance.

Leave your bill with me and call to-morrow, and it ſhall be accepted, is a ſufficient acceptance.

Leave your bill with me, I will look over my book and accounts between the drawer and me, and call to-morrow, and the bill ſhall be accepted, is not a ſufficient acceptance.

When the bill was returned for non-acceptance, the drawee ſaid, *that, if it came back again, he would pay it*; it was ruled to be a good acceptance.

Verbal acceptance is ſufficient; and an action lies againſt the acceptor thereon, as to the principal, but not for intereſt and coſts. But there muſt be a witneſs. Theſe words, "The two bills of exchange which you ſent me, I will pay, in caſe the owners of the queen Anne do not," are a ſufficient acceptance.

Acceptance, to pay when the goods are sold, is a good acceptance.

Acceptance, to pay half in money, half in bills, is good.

Acceptance, to pay, according to the tenor of the bill, after the day of payment is past, is good.

A bill may be accepted for part, and the sum accepted for is good against the acceptor.

Acceptance of a bill, drawn upon two partners, by one of them, binds both if it concerns the joint trade.

Acceptance of a servant usually transacting business for his master, is good: yet the servant should express such acceptance to be for his master, or he is liable himself.

Of the Protest.

A protest is absolutely necessary on a foreign bill, where it is refused acceptance or payment, in order to charge the drawer.

The payee must demand acceptance from the drawee before protest.

If a payee dies, there can be no protest before probate or administration.

If a bill, left for acceptance, be lost, the drawee must give a note for the payment thereof; otherwise it may be protested.

If a bill be lost, and no new one can be had, and the drawee does not insist on having the original, but refuses payment on another account, a protest made on a copy is sufficient.

A protest is good evidence of non-acceptance or non-payment, until the contrary is proved.

A protest on a foreign bill is necessary to recover, against the drawer, not only interest and costs, but also principal; and such protest must be made in due time, and timely notice given to the drawer. What is a *timely* notice must be determined by the customs of the merchants. Convenient notice must be given to the drawer of an inland bill; which notice, as to time, must also rest upon custom and the verdict of a jury.

But, in case of non-payment of either foreign or inland bills, the safest way is to give as early notice, to the person of whom it was received, as possible; that is, by the first post, or, rather, to send the bill to a correspondent, to tender it to the drawer or indorser. Where they refuse to accept the bill, it may be protested, before the day of payment, for better security but not for non-payment.

Of Indorsements.

Every man, who writes his name upon the back of a bill, becomes bound to the next holder for the amount thereof; it matters not whether he has received any value for the bill, or does it to serve a friend. The indorsement of his name implies him to have received the value of the bill, and the law will compel him to be answerable for the same to the holder thereof.

Of who shall pay the Money.

Every drawer, indorser, and acceptor, of a bill of exchange, is separately liable to the payment thereof.

On non-payment, the payee (the person to whom it is to be paid) may sue the acceptor and drawer; but he can have but one satisfaction, that is, he can only recover from them jointly the amount of the bill in his hands.

He, who accepts for the honour of the drawer, is liable to the payment, although he may have no effects. The acceptance is an undertaking for the payment, and the law will oblige him.

If a bill be indorsed to the drawer of it, he may maintain an action, as the indorsee, against the drawee, if the latter had effects of the drawer at the time of drawing the bill; otherwise not.

The holder of a bill must tender it before the three days grace are expired.

If the indorsee indulges the acceptor after the bill is due in course of payment, it is at his own risk; and, if the acceptor fails, he has no remedy against the drawer, or person who paid him the bill.

The last indorser of a bill of exchange may maintain an action against any of the former indorsers, and so any indorser may against all that precede him.

An indorser of a bill, who has paid it, must prove payment in an action against the acceptor.

The indorser of a foreign bill of exchange may be charged, without first resorting to the drawer.

If the indorsee receive a sum, in part, of the acceptor, he has no remedy against the drawer or any indorser for the remainder, but against the acceptor only.

A man cannot be sued in England, Scotland, or Ireland, on his acceptance of any bill of exchange abroad, after he has been discharged by the laws of that country.

It is not necessary to prove the hand of the drawer in an action against the acceptor, nor can the acceptor set up the forgery of the bill.

The assignee of the indorsee may sue, on a general indorsement, to the latter only.

The winner shall not recover, on a bill of exchange, for money won at play, against the acceptor, otherwise than in the case of an indorsee.

If A. draws a bill, payable to B. for the use of C. and B. indorses it to D. D. may bring an action for the money.

If a bill be assigned for a just debt, equity will not relieve, though the bill was at first given without consideration.

Bill upon B. payable to D. is accepted by B. and indorsed by C. to D. B. is discharged of any payment as to C.

Stamp-Duties on Bills of Exchange.

By the laws of the United States, bills of Exchange are subject to the following stamp-duties, viz. Inland bills, where the sum shall amount to

	20 dollars,	and not exceeding 100 dollars—	10 cents.
Above	100 dollars,	and not exceeding 500 dollars—	25 cents.
Above	500 dollars,	and not exceeding 1000 dollars—	50 cents.
Above	1000 dollars,		75 cents.

Foreign bills are chargeable with twenty cents on every bill, without respect to the number contained in each sett.

Stamp-Duties on Promissory Notes.

Where the sum amounts to	20 dolls. and not exceeding 100 dolls.—		10 cents.
Above	100 dolls. and not exceeding 500 dolls.—		25 cents.
Above	500 dolls. and not exceeding 1000 dolls.—		50 cents.
Above	1000 dolls.		75 cents.

Provided, that if any of these notes are payable at or within 60 days, they shall be liable to only two-fifths of the duty.

The following directions, to the several parties to a bill of exchange, may prevent the inconveniences to which they may be liable through inexperience.

The Drawer of Bills

Should be well satisfied that they will be accepted and duly honoured before he draws: to this end, it is requisite that he be assured of having effects in the hands of the person drawn upon, and also that he be a man of integrity and punctuality, who will not dishonour his paper but pay it regularly as it is due.

The Acceptor

Should be careful to accept no bill but what he has effects in his hand to answer:—To insist upon his correspondent advising of each bill, as soon as drawn, specifying the number, date, sum, time, and to whom payable; for, if he should accept or pay a forged draft, the loss will fall on himself:—To adjust and balance all accounts of this nature at least once in three months, and oftener if the drafts are large and continual.

The Bill-Holder

Should exchange no drafts for a stranger, where he is not convinced of the validity thereof from the *writing* of the drawer or acceptor: if not, offer to send the bill to one of the parties, and, when in cash, that he will account with him for the value.

See that the bill be drawn upon a proper stamp: and make the person, paying the bill to you, indorse his name on the back. Take a regular copy of the particulars of the bill in a book.

If the bill be not already accepted, present it for acceptance. If the person it is drawn upon will not accept, and also adds he will not pay it when due, you had best return it to the indorser or drawer immediately, taking a good bill or cash for the same.

But, if the drawee says he may pay it when due, wait till that day, present it for payment, and, if refused then, have it protested, and for the amount call upon the indorser. But as you have at present the indorser and drawer as your security, be cautious how you give up the bill to either for their single security, if doubtful.

When you remit a bill, indorse, on the back thereof, "Pay the contents to A. B. of C. or order. D. E." This will prevent the bill being negotiated, should it fall into bad hands.

If the bill be payable to bearer, write, upon the face thereof, "Sent by post, August, 1789, to A. B. of C. D. E." in red ink.—Indorse no bill until you pay it away.

OWNERS OF SHIPS.

IF goods are spoiled by default of a master of a ship employed by the owners, the owners are liable; but the action must be bro't against all the part-owners, who make but one master.

If several part-owners wish to send a ship on a voyage, but 2 or 3 other part-owners refuse their consent, the former may send her on the voyage, but they must enter into a recognizance in the admiralty for her return.

A part-owner of a ship sued the other owners for his share of the freight on finishing her voyage; but the other owners had fitted her out, in which the complainant would not join, whereupon the other owners complained in the admiralty; and, by order there, they gave security, if the ship perished in the voyage, to make good to the plaintiff his share, or to that effect; in such a case, by the law marine and course of the admiralty, the plaintiff was to have no share in the freight. It was referred to Sir Lionel Jenkins to certify the course of the admiralty, who certified accordingly, and that it was so in all places, for otherwise there would be no navigation: whereupon the plaintiff's bill was dismissed.

If the owner of a ship lets it to another, he is still liable for a loss of gold sent by that ship. The defendant, in an action of this kind, was sole owner of a ship, which he let to one Fletcher for a voyage, for a certain sum, and Fletcher was to have the benefit of carrying goods. The plaintiff sent a quantity of moidores, and had bills of lading signed by the captain: and, many of the moidores not being delivered according to consignment, an action was brought against the defendant, the owner of the ship, to make him liable as far as the ship and freight were worth, according to 7 Geo. II. c. 15.

For the defendant it was insisted, that, though the ship was his property, yet he was not so owner as to be liable to the plaintiff, and that Fletcher is for this purpose the owner. But, it appearing the defendant had covenanted for the condition of the ship, and the behaviour of the master, the chief-justice held he was liable to the plaintiff: and the freight he had in general from Fletcher was sufficient, though the identical freight for the gold belonged to the other; and Fletcher had only the use of the ship, but no ownership.

If a ship be repaired in the river Thames, and fitted out there with new rigging and apparel, the ship itself is not liable, but the owners. If she be repaired at sea, the ship is liable, and the master may hypothecate (or pawn) her for payment of the charges.

The repairer of a ship may sue either the master, who employs him, or the owners; but, if he undertakes it on a special promise from either, the other is discharged.

If the master of a ship buys provisions for her, and has money from the owners to pay for the provisions, but fails without paying the money, the owners are liable to pay, in proportion to their respective shares in the ship, the master being but a servant to the owners.

An action was brought by a ship-wright for repairing the defendant's ship in his dock. About three hours before the ships repairs were finished, a fire happened and she was burnt. Notwithstanding which, the court held that the owner was liable to pay for the repairs that had been done.

Lord Mansfield, in delivering the opinion of the court in the case of Farmer and another against Davis, where goods were ordered for a ship by the owner before the appointment of the captain, and some of which goods were delivered after his appointment, said, "Where a captain contracts for the use of a ship, the credit is given to him, in respect of his contract; it is given to the owners, because the contract is on their account; and the tradesman has likewise a specific lien on the ship itself. Therefore, in general, the tradesman, who gives that credit, debits both the captain and the owners. Now, what is this case? The captain made no contract personally: the owners contracted for their ship: the credit was given to them only; and there is not a shadow of colour to charge the captain for any part of these goods."

Wilkins and others, assignees of Brooke, a bankrupt, against Carmichael. The question in this case was, whether a captain, having paid for stores supplied, and repairs done, to a ship in England, and having wages due to him, has such a lien on the ship as to be entitled to keep her till he is paid.

Lord Mansfield said, notwithstanding the strongest inclination that the defendant (the captain) should have full satisfaction, we are not able to find ground on which we can give judgment in his favour. 1. He has set up a lien upon two sorts of claim, viz. wages and stores and repairs. As to wages, there was no particular contract, that the ship should be a pledge; there is no usage in trade to that purpose; nor any implication from the nature of the dealing: On the contrary, the law has always considered the captain as contracting personally with the owner; and the case of the captain has, in that respect, been distinguished from that of all other persons belonging to the ship: this rule of law may have its foundation in policy, and the benefit of navigation; for, as ships may be making profit and earning every day, it might be attended with great inconvenience, if, on the change of a captain for misbehaviour, or any other reason, he should be entitled to keep the ship till he is paid. As to stores and repairs, it is a strong answer to that claim, that, when the demand was made by the assignees, the captain had not paid the tradesmen's bills. But, if there was any lien originally, it was in the carpenter. The captain could not, by paying him, be in a better situation than he was, and he had parted with the possession, so that he had given up his lien, if he ever had one: the other creditors had none. If the defendant is liable to the tradesmen, it is by his own act. Work done for a ship in England, is supposed to be done on the personal credit of the employer; in foreign parts, the captain may hypothecate the ship. The defendant might have told the tradesmen, that he only acted as an agent, and that they must look to the owner for payment. Judgment for the plaintiff.

Rich, executor, versus Coe and another.—The plaintiffs, being ropemakers, supplied the ship Henry and Thomas with cables to the value of 5*l.* 8*s.* 3*d.* by the order of Thomas Harwood, the captain; and made Harwood, and the owners of the ship (the defendants) debtors, in the usual manner, without naming the owners, or knowing particularly who they were.—The ship Henry and Thomas had been let by the defendants to Harwood upon certain articles, in which it was mutually covenanted between them as follows. 1st, The owners covenanted with Harwood, that, on his performance of the covenant stipulated on his part, he should have the sole management of the ship, and employ her for his own sole benefit and advantage for the space of eleven years, if he should so long live, and the ship should not be lost. The covenants on the part of Harwood were (amongst others) to pay a yearly rent of 30*l.* per cent. at stated periods: that he would at all times, at his own cost and charge, repair, maintain, and keep, the vessel and her rigging, &c. in good and sufficient repair.—The plaintiffs had no notice of this contract at the time they furnished Harwood, the captain, with the goods. The question was, whether the defendants were liable to this debt?

Lord Mansfield, in delivering judgment, said, This case was reserved not with a view to the particular matter in dispute or the parties now before the court, but in consideration of a general anxiety in the owners of ships, employed in this trade, to know how far they are by law liable for the acts of their respective lessees. In that point of view, we have considered the cases very particularly; and, after the fullest deliberation, we think it impossible to say that the plaintiffs are not entitled to recover. Whoever supplies a ship with necessaries, has a treble security. 1. The person of the master. 2. The specific ship. 3. The personal security of the owners, *whether they know of the supply or not*.—1. The master is personally liable as making the contract. 2. The owners are liable in consequence of the master's act, because they choose him; they run the risk, and they say whom they will trust with the appointment and office of master. Suppose the owners in this case had delivered the value of the goods in question, in specie, to the master, with directions for him to pay it over to the creditors, and the master had embezzled the money: it would have been no concern of the creditors; for they trust specifically to the ship, and generally to the owners. In this case, the defendants are the owners; and there happens to be a private agreement between them and the master, by which he is to have the sole conduct and management of the ship, and to keep her in repair, &c. But how does that affect the creditors who, it is expressly stated, were total strangers to the transaction? and that is an answer to the observation, that the plaintiff must have known the real situation of the master, in this case, from the general usage and custom of the country in that respect. To be sure, if it appeared that a tradesman had notice of such a contract; and, in consequence of it, gave credit to the captain individually as the responsible person, particular circumstances of that sort might afford a ground to say, he meant to absolve the owner, and to look singly to the personal security of the master; but here it is stated, that the plaintiff had no notice whatever of the contract. The owners themselves are aware of their being liable at the time: they choose a master to whom they agree to let the ship, and trust for their security to the covenants which they oblige him to enter into: these covenants are, that he shall keep the ship in repair, and deliver her up, at the end of the term, in as good condition as when delivered to him. This is not all; for they indemnify themselves against the private debts of the master; and against his being taken in execution: for, if he does not perform all and every the covenants in the agreement, (except in case of the loss of the ship,) the consequence (beside their remedy against him upon the covenant) is that the contract and agreement is to be absolutely at an end, and they are to take possession of the ship.

Suppose the ship had been impounded in the admiralty-court, and that happened at the end of the term; or, suppose the captain had broken a covenant which had put an end to the agreement, the defendant could never have taken the ship out of the court, without paying the debt for which the ship was impounded. We are all of opinion, therefore, that, under these circumstances, there is no colour to say that the creditors should be stript of the general security they are, by law, entitled to against the owners.

MASTERS OF SHIPS.

NOTHING more materially concerns the master of a ship, than to know what degree of responsibility is attached to his situation, and what privileges it invests him with: and it is the design of this chapter to explain them.

Masters of ships are as responsible for goods, committed to their charge, as hoymen or carriers by land are: for the law makes no distinction between carriers by land and carriers by water: and for whatever losses, that arise from the neglect of persons employed under them, they are answerable: whatever cases, therefore, that are contained in this chapter, relative to carriers by land, must be understood to be equally applicable to carriers by water, or masters of ships.

In the case of Mors *v.* Sluce, it was adjudged that the master of a ship was liable for the goods of which the ship was robbed in the river: and the reasons given were, 1. Because he was an officer known: 2. Because he received his salary out of that which was paid for the freight. But the master may reimburse himself out of the mariners' wages for a loss happening by their neglect.

The law charges persons entrusted to carry goods (such as common carriers, hoymen, and masters of ships) to carry them against all events but acts of God, and of public enemies.

The plaintiff put goods on-board the defendant's hoy, who was a common carrier. Coming through bridge, by a sudden gust of wind, the hoy sunk, and the goods were spoiled.—The plaintiff insisted, that the defendant should be liable, it being his carelessness in going through at such a time; and offered some evidence, that, if the hoy had been in good order, it would not have sunk with the stroke it received; and thence inferred, the defendant was answerable for all accidents, which would not have happened to the goods in case they had been put in a better hoy. But the chief-justice held the defendant not answerable, the damage being occasioned by the act of God; for though the defendant ought not to have ventured to shoot the bridge if the general bent of the weather had been tempestuous, yet this, being only a sudden gust of wind, has entirely differed the case: and no carrier is obliged to have a new carriage for every journey; it is sufficient if he provides one which (without any extraordinary accident, such as this was,) will probably perform the journey.

In the case of Forward against Pittard, the plaintiff had delivered goods to the defendant, who was a common carrier; and which goods were afterwards destroyed by accident of fire. The question was, whether the defendant was answerable for them.

Lord Mansfield said, It appears from all the cases, for 100 years back, that there are events for which the carrier is liable independent of his contract. By the nature of his contract he is liable for all due care and diligence; and, for any negligence, he is suable on his contract. But there is a farther degree of responsibility, by the custom of the realm, that is, by the common law: a carrier is in the nature of an insurer. It is laid down that he is liable for every accident, except by the act of God or public enemies: now, what is the act of God? I consider it to be something in opposition to the act of man; for every thing is the act of God that happens by his permission; every thing by his knowledge. But, to prevent litigation, collusion, and the necessity of going into circumstances impossible to be unravelled; the law presumes *against* the carrier, unless he shews it was done by public enemies, or by such act as could not happen by the intervention of man, as storms, lightning, and tempests.

If an armed force come to rob the carrier of the goods, he is liable: and the reason is, for fear it may give room for collusion, that the master may contrive to be robbed on purpose, and share the spoil.

In this case, it does not appear but that the fire arose from the act of some man or other; it certainly did arise from some act of man; for it is expresly stated not to have happened by lightning. The carrier, therefore, is liable, inasmuch as he is liable for inevitable accident.—Judgment for the plaintiff.

What acceptance makes a carrier liable. Per King, C. J. If a box be delivered generally to a carrier, and he accepts it, he is answerable, though the party did not tell him there was money in it. But, if the carrier asks, and the other says no, or if he accepts it conditionally, providing there is no money in it; in either of these cases, I hold, the carrier is not liable; and so it was afterwards determined in the court of king's-bench, in the case of Gibson *v.* Poynton and another.

If goods are lost after the owner of them has taken them from the ship into a lighter, it is his own loss: but it is otherwise if the goods are sent from the ship by the ship's boat, which is considered as part of the ship and voyage. Yet, if the owner of any goods send his servant with them, the carrier or lighterman is not liable if they be lost.

If any passenger die on-board, the master is obliged to inventory his effects; and, if no claim be made to them within a year, the master becomes proprietor of the goods, but answerable for them to the deceased's legal representatives. Bedding and furniture become the master's and his mates'; but the cloathing must be brought to the mast-head, and there appraised and distributed among the crew.

If a captain die, leaving money on-board, and the mate, becoming captain, shall improve the money, he shall, on allowance for his care, account both for interest and profits.

OF FREIGHT, CHARTER-PARTY, AND DEMURRAGE.

FREIGHT is the sum agreed on for the hire of a ship or carriage of goods, and must be paid in preference to all other debts for the payment of which the goods stand engaged; but, as the goods are obliged to the ship for hire, so is the ship to the owner of the goods, in case of damage or waste through any defect of the vessel or sailors.

Charter-party is the same in the civil law with an indenture at the common law: it settles the agreement, as the bills of lading do the contents, of the cargo; and binds the master to deliver them well conditioned at the place of discharge, according to the agreement: and, for performance, the master obliges himself, ship, tackle, and furniture.

The taking a ship to freight is the hiring her of her master or owners, either in part or the whole, and either by the month, for an entire voyage, or by the ton: and the contract, reduced into writing, commonly called a charter-party, executed between the freighter and the person who lets the ship, must express the different particulars agreed on.

The master or owners generally covenant to provide a sufficiency of tackle and mariners, and to fit the ship in every respect for performing the voyage. The merchant, on his part, stipulates to comply with the payment promised for freight on delivery of his goods; and both oblige themselves in penalties for non-compliance.

If, by the time appointed in the charter-party, the ship is not ready to take in, or the merchant (after the days of demurrage commonly granted) not ready to load, the parties are at liberty, and the suffering one hath his remedy against the other, by action, to recompense the damage.

If part of the loading be on-board, and some intervening misfortune prevent the merchant from shipping the whole in time, the master is at liberty to contract with another, and shall have freight by way of damage for the time that those goods were on-board after that limited; for such agreements, being of a conditional nature, and preceding a failure as to a complete loading, will determine the same unless afterwards *affirmed by consent*; and, though it be no prudence for every merchant or master to depart from the contract on non-compliance of articles, yet it is the highest justice that ships and masters should remain free; for otherwise, by the bare lading of a cask or bale, they might be defeated of the opportunity of passage, or the season of the year.

So, on the other hand, if the vessel be not ready, the merchant may ship the remainder of his goods on-board another, and discharge the first, and recover damages against the master or owners for the rest; this being grounded on the like reason as the former.

Atkinson contracted with Buckle for the carriage of a hundred quarters of barley, and promised to deliver unto him the hundred quarters of barley on ship-board at Barton-Haven, in the county of York, to carry them for him, and for the carriage thereof did promise to pay him so much; and Buckle promised to carry the same for him, and accordingly brought his ship to the said haven, expecting there the delivery of the hundred quarters of barley; but Atkinson came not to deliver the same unto him; whereupon Buckle brought his action of the case upon the promise; and, upon *non assumpsit* pleaded, had a verdict and judgment, which was affirmed upon a writ of error.

If goods are fully laden on-board, and the ship hath *broken ground*, and the merchant, on after-consideration, determines again to unload them, and not prosecute the adventure, by the marine law the freight is due.

And, if the ship in her voyage becomes unable without the master's fault, or that the master or ship be arrested by any foreign prince or state in her voyage, the master may either *mend his ship or freight another*; but, if the merchant will not consent thereto, then the *freight* becomes due for so much as the ship hath *earned*; otherwise the master is liable for all damages that shall happen: and therefore, if that ship, to which the goods were translated, perish, the master shall answer; but, if both the ships perish, then he is discharged. But, in case of extreme necessity, as that the ship would be in a sinking condition, and an empty ship is passing by or at hand, he may translate the goods; but, if that ship sinks or perishes, he is there excused; but then it must be apparent that that ship seemed *probable* and *sufficient*.

If a master shall weigh anchor and sail after the time covenanted or agreed for his departure, if any damage happens at sea after that time, he shall refund and make good all such misfortune. Yet, if a *charter-party* be made, that the plaintiff shall sail from London to Lisbon with the first wind and opportunity, &c. in consideration of which the merchant did covenant to pay so much for freight, and the ship departs not with the first wind and opportunity, yet afterwards *breaks ground* and arrives at her port, the freight in this case has become due; and there is nothing can debar the ship of her freight but non-departure; for only that in law is material to avoid the payment of the freight; but to say the ship did not depart with the next wind is but a circumstance, which, in strictness of law, is not necessary to be denied.

If it be agreed, that the master shall sail from London to Leghorn in two months, and freight accordingly is agreed on, if he begins the voyage within two months, though he does not arrive at Leghorn within the time, yet the freight is become due.

The East-India company might, by charter-party, keep a ship they had freighted a long time in India, and did so keep her until she was unfit for service, and could not come home; they were obliged in Chancery to pay the damage, though by the charter-party it was payable at the return of the ship.

So, where no freight was to be paid for the cargo *outwards*, but freight for the cargo *homewards*, and the factor abroad had no goods to load her homewards, payment of the freight was decreed.

And, if a ship is freighted to go to any place to load, and on arrival there the factor cannot or will not put any thing on-board him, after the master has lain the days agreed on by charter-party, and made his regular protests, he shall be paid, empty or full.

If a ship is freighted from one port to another, and thence to a third, a fourth, and so home to the port whence she first sailed, (commonly called a *trading voyage*,) this is all but one and the same voyage, so as it be in conformity to the charter-party.

A contract is made, between a merchant and master of a ship, that, if he carries the merchant's goods to such a port, he will then pay him so much money for freight. In making the voyage, the ship is robbed by pirates, and part of her loading lost, and afterwards the remainder is brought to the port of discharge. Here the sum agreed on for freight is not due, the agreement not being performed on the part of the master; and this is a conditional contract. But it is otherwise by the civil law; for thereby the same is a danger of the seas, which, if not expressed in naval agreements, is naturally implied; and there was no default in the master or his mariners; and, had these goods, which the pirates carried away, been thrown over-board in stress of weather, it would not have worked a disability in the master to receive the sum agreed on; because, both by the common law and law marine, the act of God, or that of an enemy, shall not have an effect to work a wrong in actions private; and a pirate is esteemed an enemy in our law.

If a ship be freighted by the ton, and she is full laden according to the charter-party, the freight is to be paid for the whole; otherwise but for so many tons as the lading amounted to.

If freight be contracted for the lading certain cattle, or the like, from Dublin to West-Chester, and some of them happen to die before the ship's arrival, the whole freight is become due, as well for the dead as the living.

But, if the freight be contracted for the transporting them at so much *per* head, if death happens, there ariseth due no more freight than only for such as are living at the ship's arrival at her port of discharge, and not for the dead.

When cattle or slaves are sent on board, without any previous agreement about lading or transporting them, but generally, then freight shall be paid as well for the dead as the living; and, if freight be contracted for the transporting of women, and they happen in the voyage to be delivered of children, no freight becomes due for the infants.

A master of a ship is not bound to answer freight to the owners for passengers, where it appears they are not able to pay.

If goods are sent on-board ship, generally, the freight must be according to that commonly paid for the like accustomed voyages.

If a ship shall be freighted, and named to be of such a burthen, and, being freighted by the ton, shall be found less, there shall be no more paid than only by the ton for all the goods that were laden on-board.

And, if a ship be freighted for two hundred tons or thereabouts, the addition of *thereabouts* is commonly reduced to be within five tons, more or less, as the moiety of the number ten, whereof the whole is compounded.

If a ship be freighted by the great, and the burthen of it is not expressed, yet the sum certain is to be paid.

If a freighter, by loading prohibited or unlawful goods, occasion the ship's detention, or otherwise impedes her voyage, he shall pay the freight contracted and agreed for.

When a ship is freighted *out* and *in*, (or *out* and *home*,) there is no freight due till the whole voyage is performed; so that, if she be cast away coming home, the freight *outwards* as well as *inwards* becomes lost.

If a master lets out his ship, and afterwards secretly takes in other goods, unknown to the first freighter, by law marine he loses his freight; and, if it should so fall out that any of the freighter's goods should, for safety of the ship, be cast over-board, the rest shall not become subject to average, but the master shall make the damage good; though, if the goods are brought into the ship secretly and unknown to him, it is otherwise, and goods so brought in may be subject to what freight the master thinks fit.

When a ship puts into any port than that she was bound to by agreement, the master shall answer all damages that shall accrue thereby: but, if she was forced in by storm, enemies, or pirates, he must afterwards proceed to that he was obliged to by contract.

In construction of law, the lading of the ship is *tacitly* obliged for the freight, the same being, in point of payment, preferred before all other debts to which the goods so laden are liable, though such debts, as to time, were *precedent* to the freight; for the goods remain, as it were, bailed for the same, nor can they be *attached* in the master's hands, though it is commonly conceived otherwise.

As ships deserve wages like a labourer, the actions touching the same are, in the eye of the law, generally construed favourably for the ship and owners; and therefore, if four parts in five of them shall make up their accounts with the freighters, and receive their proportions, yet the fifth may sue singly, by himself, without joining with the rest, and this as well by the common law as the law marine.

If a ship in her voyage happens to be taken by an enemy, and afterwards is re-taken by another ship, in amity, and restitution is made, and she proceeds on her voyage, the contract is not determined, though the taking by the enemy divested the property out of the owners; yet, by the law of war, that possession was defeasible, and, being recovered in battle afterwards, the owners become re-invested; so the contract, by fiction of law, became as if she never had been taken, and so the entire freight becomes due.

It was covenanted, by a charter-party, that the ship should return by a certain time within the river Thames (the danger of the sea excepted) and afterwards, in the voyage, and within the time of the return, the ship was taken upon the sea by enemies unknown to the covenanter, and, being detained by them, could not return within the river Thames within the time mentioned by the covenant. *Resolved*, This impediment was within the exception; *for these words intend* as well any danger, upon the sea, by pirates or men of war, as dangers of the sea by shipwreck, tempest, or the like.

If freight be taken for a hundred tons of wine, and twenty of them leak out, so that there is not above eight inches from the bulge upwards, yet the freight becomes due; but, if they be under eight inches, some conceive it then to be in the election of the freighters to fling them up to the master for freight, but most think otherwise; for, if all had leaked out, if there was no fault found in the stowage, after proper survey, there is no reason the ship should lose her freight; for, the freight arises from the tonnage taken, and, if the leakage was occasioned through storm, the same perhaps, may come into an average. Masters should take care to make their regular protests after a storm, as they may suffer severely by omitting it.

If a ship, freighted by the great, be cast away, the freight is lost; but, if by the ton or parcels, and part thereof is saved from the wreck, *doubted* whether, *pro rata*, she ought not to be answered her freight.

If a ship by charter-party reciting to be of the burthen of 200 tons, is taken to freight for a sum certain, to be paid at her return, the sum certain is to be paid though the ship amounts not to that burthen.

In case a ship is freighted after the rate of 20l. for every month that she shall be out, to be paid after arrival at the port of London; the ship is cast away coming up from the Downs, but the lading is all preserved, in which case the freight is become due; for, the money arises so monthly by the contract, and the place mentioned is only to shew where payment is to be made; for the ship deserves wages like a mariner who serveth by the month; and though he dies in the voyage, yet his executors are to be answered *pro rata*. Beside, the freight becomes due by intendment on the delivery, or bringing up of the commodities to the port of London, and not of the ship.

If a man freights a ship out, and covenants, that the ship should sail out of the port to Cadiz with the first fair wind and opportunity, and the freighter covenants, that, for the freight of all the premises, he would pay unto the master 184*l.* if the master doth not shew that the ship arrived at the port of Cadiz, he cannot maintain an action against the freighter.

If the master enter into a *charter-party* for himself and owners, the master, in that case, may release the freighters without advising with the owners. But, if the owners let the ship out to freight, whereof J. J. is master, though the master covenant in the same *charter-party*, and subscribe, yet his release in that case will not bind the owners; but the owners' release, on the other hand, will include the master; and the reason is, for that the master is not made a proper party to the indenture.

If an indenture of *charter-party* be made between A. and B. owners of a ship, of the one part, and C. and D. merchants, of the other part; and A. only seals the deed of the one part, and C. and D. of the other part; but in the indenture it is mentioned, that A. and B. covenant with C. and D. and C. and D. covenant with A. and B. In this case, A. and B. may join in an action against C. and D. though that B. never seals the deed, for he is party to the dead, and C. and D. have sealed the other part of B. as well as to A.

If a factor freight a ship, by order and for account of another, out and home, and a *charter-party* is accordingly made and indented between him and the master, the factor is liable for the freight and performance of all the covenants. But if the ship be only freighted outwards, and loaded by the factor, the goods shipped are only liable for the freight, and no demands to be made on the freighters in virtue of the *charter-party*, but the person who receives the goods is to pay it, according to the tenor of the bill of lading.

If a ship is freighted out and home, and after having delivered her cargo at the place agreed on, there are no goods provided for her re-loading, the master must stay the days of demurrage agreed on by *charter-party*, and make his regular protest for his freighter's non-compliance, who will, in this case, be obliged to pay him, empty or full; tho', should the master not wait the time stipulated, or omit to make his protest, he will lose his freight; and, in case the master, on his finding no goods provided by his freighter, should determine to load some on his account, as salt, or the like, this will not prevent his recovering his freight; for, if the ship had been laden only with salt by the merchant, which (it may be) would not pay half the freight, yet the shipper, or proprietor, may at pleasure abandon the same to the master for his freight, and he can demand no more by the *charter-party*. But if the master take in such salt, on his own account, before the days of demurrage are expired, and that, by some condition with the freighter, he may claim freight, then this latter is to have the benefit of the salt in deduction of the said freight.

Form of a Charter-Party of Affreightment.

THIS charter-party, indented, made, &c. between A. B. of, &c. mariner, master and owner of the good ship, or vessel, called, &c. now riding at anchor at, &c. of the burthen of two hundred tons, or thereabouts, of the one part, and C. D. of, &c. merchant, of the other part, witnesseth, that the said A. B. for the consideration hereinafter mentioned, hath granted, and to freight letten, and by these presents doth grant and to freight let, unto the said C. D. his executors, administrators, and assigns, the whole tonnage of the hold, stern-sheets, and half-deck, of the said ship, or vessel, called, &c. from the port of London to, &c. in a voyage to be made by the said A. B. with the said ship, in manner herein after mentioned, (that is to say) to sail with the first fair wind and weather that shall happen after, &c. next, from the port of London, with the goods and merchandize of the said C. D. his factors, or assigns, on-board, to, &c. aforesaid (the danger of the sea excepted,) and there unlade and make discharge of the said goods and merchandizes; and also shall there take into and on-board the said ship again the goods and merchandizes of the said C. D. his factors, or assigns, and shall then return to the port of London with the said goods, in the space of, &c. limited for the end of the said voyage. In consideration whereof, the said C. D. for himself, his executors, and administrators, doth covenant, promise, and grant, to and with the said A. B. his executors, administrators, or assigns, by these presents, that the said C. D. his executors, administrators, factors, or assigns, shall and will well and truly pay, or cause to be paid, unto the said A. B. his executors, administrators, or assigns, for the freight of the said ship and goods, the sum of, &c. (or so much per ton,) within twenty-one days after the said ship arrived, and goods returned and discharged at the port of London aforesaid, for the end of the said voyage; and also shall and will pay for demurrage, (if any shall be by default of him, the said C. D. his factors, or assigns,) the sum of, &c. per day, daily, and every day, as the same shall grow due. And the said A. B. for himself, his executors, and administrators, doth covenant, promise, and grant, to and with the said C. D. his executors, administrators, and assigns, by these presents, that the said ship or vessel shall be ready at the port of London, to take in goods by the said C. D. on or before, &c. next coming. And the said C. D. for himself, his, &c. doth covenant and promise, within ten days after the said ship or vessel shall be thus ready, to have his goods put on-board the said ship, to proceed on in the said voyage; and also, on the arrival of the said ship at, &c. within, &c. days, to have his goods ready to put on-board the said ship, to return on the said voyage. And the said A. B. for himself, his executors, and administrators, doth farther covenant and grant, to and with the said C. D. his executors, administrators, and assigns, that the said ship or vessel now is, and at all times during the voyage shall be, to the best endeavours of him, the said A. B. his executors and administrators, and at his and their own proper costs and charges, in all things made and kept stiff, staunch, strong, well apparelled, furnished, and provided, as well with men and mariners sufficient and able to sail, guide, and govern, the said ship, as with all manner of rigging, boats, tackle, apparel, furniture, provision, and appurtenances, fitting and necessary for the said men and mariners, and for the said ship, during the voyage aforesaid. In witness, &c.

The following is the Form of a Charter-Party, whereby the Owners of one Moiety of a Ship let to Freight their Share to the Owners of the other Moiety.

THIS charter-party, indented, made, &c. between A. B. and C. D. of London, merchants, owners of one moiety, or half part, of the good ship, or vessel, called the Neptune, of the burthen of two hundred tons, with the like moiety of all the sails, masts, tackle, apparel, furniture, ordnance, and appurtenances, thereu to belonging, riding at anchor in the river of Thames, within the port of London, of which the said C. D. is master, of the one part, and E. F. and G. H. of London, merchants, owners of the other moiety and residue of the said ship, with the masts, sails, tackle, ordnance, furniture, and apparel, thereunto belonging, on the other part, WITNESSETH, that the said A. B. and C. D. have granted and letten to freight, and by these presents do grant and let to freight, all their said part and moiety of the said ship and premises, unto the said E. F. and G. H. for a voyage with her (by God's grace) to be made in the manner and form following:

That is to say, That the said A. B. and C. D. for them, their executors, administrators, and assigns, do hereby covenant and grant, to and with the said E. F. and G. H. for them, their, and either of their executors and administrators, by these presents, that the said ship (being already laden) shall, with the first good wind and weather after the date hereof, (God permitting,) sail directly from the said river of Thames to the port of Leghorn in Italy, (the perils and dangers of the seas excepted,) and there discharge such goods and merchandizes as shall be directed and appointed by the said E. F. and G. H. or one of them, their, or one of their, factors or assigns; and thence shall sail, and take her direct course, as wind and weather shall serve, with as much speed as may be, (the perils and dangers of the sea excepted,) to Venice, and there shall stay and abide the space of forty working days next after her first arrival there, to unlade all such goods and merchandizes as shall remain on-board for account of E. F. and G. H. after her delivery at Leghorn as aforesaid; and to re-lade such goods, wares, and merchandizes, as the said E. F. and G. H. or either of them, their, or either of their factors and assigns, shall think fit to charge and re-lade on-board, and into the said ship, that is to say, so much as the said ship can conveniently carry, over and above her victuals, tackle, ammunition, apparel, and furniture.

And the said ship with her said loading shall, with the first good wind and weather after the expiration of the said forty days, sail and proceed from the said city of Venice to London. And the said E. F. and G. H. for themselves and either of them, their and either of their, executors, and administrators, do covenant, promise, and grant, to and with the said

A. B. and C. D. and either of them, their and either of their executors, administrators, and assigns, by these presents, that they, the said E. F. and G. H. or one of them, or their or one of their executors, administrators, or assigns, shall and will well and truly pay, or cause to be paid, to the said A. B. and C. D. or one of them, their or one of their executors or administrators, within the said city of London, for every ton of such wares and merchandizes, as shall be laden or unladen in the said ship during the said voyage, the sum of, &c, [counting the tonnage according to custom, or if a certain sum is agreed on for the voyage out and home, or so much per month,] for the part and interest of the said A. B. and C. D. in the said ship, and for and in respect of, the freight and hire of their part of her: which said money is to be paid in manner and form following; that is to say, one third part thereof upon the right discharge of the said ship, and another third part thereof within the space of six weeks then next following, and the remaining third part thereof within the space of two months next ensuing after the end and determination of the said six weeks.

And the said A. B. and C. D. for them and either of them, their and either of their executors and administrators, do covenant and grant to and with the said E. F. and G. H. their executors and administrators, by these presents, that the said ship, for their part, shall be strong and staunch, and well and sufficiently tackled and apparelled with sails, sail-yards, anchors, cables, ropes, gun-shot, artillery, gun-powder, and all other instruments, tackle, and apparel, needful and necessary for such a ship and for such a voyage, together with an able master and sufficient number of mariners.

And, in the performance of all and every the covenants, grants, articles, and agreements, on the parts and behalfs of every of the said parties, truly to be holden, performed, and kept, in all things as is aforesaid, the said parties to these presents do bind themselves to one another: that is to say, the said A. B. and C. D. do, by these presents, bind themselves, and either of them, and their several executors and administrators, goods, and their part and interest in the said ship, with the furniture thereof, to the said E. F. and G. H. and to their executors and administrators; and the said E. F. and G. H. do, in like manner bind themselves, and either of them, their and either of their executors, administrators, and assigns, and all their goods and interest in the said ship, to the said A. B. and C. D. their executors and administrators, in the sum or penalty of one thousand pounds lawful money of Great-Britain, by the party or parties infringing the said covenants, or any of them, to the other party or parties truly observing, to be paid by the virtue of these presents.

If before the departure of the ship there should happen an embargo, occasioned by war, reprisals, or otherwise, with the country to which the ship is bound, so that she cannot proceed on her voyage, the *charter-party* shall be dissolved without damages or charges to either party, and the merchant shall pay the charges of unlading his goods; but if the restraint arises from a difference between the parties themselves, the *charter-party* shall still remain valid in all points.

If the ports be only shut, and the vessels stopped for a time the *charter-party* shall still be valid, and the master and merchant shall be reciprocally obliged to wait the opening of the ports, and the liberty of the ships, without any pretensions for damages on either side.

However, the merchant, at his own charges, may unload his goods during shutting up of the port, upon condition either to relade them, or indemnify the master.

The great variety of circumstances occasioned by different voyages naturally produce a correspondent diversity in charter-parties, all the different forms of which it would be impracticable and unnecessary to introduce here, as the preceding may be varied to suit any purpose.

A bill of lading is a writing wherein masters of ships acknowledge the receipt of goods on-board, and oblige themselves to deliver the same in good order and condition at the place where they are consigned to. There must always be three made out, and must be on stamped paper, otherwise they are invalid; of which one should be remitted, by the first post after signing, to the person the goods go to; another be sent him by the ship; and the third remain with the shipper: besides which, a fourth should be made out, on an unstamped paper, to be given to the master for his government.

The Form of a Bill of Lading.

W. B.
No. 1 a 10.

SHIPPED, in good order, by A. B. merchant, in and upon the good ship called whereof C. D. is master, now riding at anchor in the river Thames, and bound for Alicant in Spain, ten bales, containing fifty pieces of broad cloth, marked and numbered as *per* margin; and are to be delivered in the like good order and condition, at Alicant aforesaid, (the danger of the seas excepted) unto E. F. merchant, there, or to his assigns, he or they paying for the said goods *per* piece freight, with primage and average accustomed. In witness whereof, the master or purser of the said ship hath affirmed to three bills of lading of this tenor and date; the one of which bills being accomplished, the other two to stand void. And so God send the ship to her designed port in safety. Amen.

Dated at London,

If the goods are to be exported from one district to another district of the United States, not being in the same State, the bill of lading must have a four cent stamp. If from the United States to any foreign port or place, a ten cent stamp. And these duties are chargeable on every bill, without respect to the number contained in each sett.

The difference between a bill of lading and a charter-party is, that the first is required and given for a single article or more, laden on-board a ship that has sundry merchandize shipped for sundry accounts. Whereas a charter-party is a contract for the whole ship. Bills of lading ought to be signed by the master within twenty-four hours after the delivery of the goods on-board. But, upon delivery of the goods, the master, or other person officiating for the master in his absence, is to give a common receipt for them, which is to be delivered up, upon the master's signing the bill of lading.

Upon delivering the goods at the port of destination to the shipper's factor or assigns, giving up the bill of lading sent to the factors or assigns is a sufficient discharge, but the master may insist on a receipt.

Demurrage is an allowance made to the master of a ship by his freighters, for staying longer in a place than the time first appointed for his departure, and is generally inserted in the charter-party to be paid daily, as it becomes due; the days are always limited, so that, on the expiration thereof, and protests duly made, the master is at liberty to proceed, as is before-mentioned.

OF DISBURSEMENTS, AND OTHER ACCOUNTS.

THE method of book-keeping is the art of placing our accounts in ſuch an eaſy manner, that the whole, or any part, of the money received and advanced may, with the greateſt clearneſs, be attained in a very little time.

Whatever is paid upon a ſhip's account,	The ſhip muſt be Dr. for it.
Whatever is received upon a ſhip's account,	The ſhip muſt have credit for the ſame.

It is recommended to every captain to keep a ſmall memorandum-book, to ſet down the money as he lays it out, both for himſelf and his ſhip; likewiſe the money which he receives, leſt at any time it ſlip his memory and be forgotten: then theſe accounts can be eaſily entered into a larger book at leiſure. By this method he can eaſily tell whether any thing has been omitted or not, by adding up the money paid, and taking it from the money received; if what remains is equal to the caſh he has in hand, nothing has been forgotten; if they do not agree, then it is plain ſomething has been omitted.

Many loſſes have frequently fallen upon owners of ſhips, for want of proper care being taken by their captains in ſigning bills of lading. When there is the leaſt reaſon to ſuſpect the quantity is not right, or that there is any damage in the goods, always write,

(If hemp, flax, bars of iron, &c.)

Quantity and conditions unknown; and three bundles of hemp in diſpute; if on-board, to be delivered. *Thomas Smith.*

(If linen, yarn, bales, hardware, &c.)

Inſides and contents unknown to *Thomas Smith.*

(If tar, wines, brandy, turpentine, &c.)

Contents and conditions unknown; not to be accountable for leakage; and it is agreed that the freight ſhall be paid for the quantity ſhipped.
Thomas Smith.

The following accounts and examples will be ſufficient for any voyage whatſoever, to render a captain's accounts and tranſactions conciſe and pleaſant to himſelf, notwithſtanding they are limited to one voyage only; but if he go to many other ports, before he return home and ſettle his accounts, theſe are plain enough to give him a perfect idea how to ſettle them for ſuch voyages, how long ſoever they may happen to be, as, in this voyage, money is diſburſed and received at London, Elſineur, and St. Peterſburgh.

Dr. *Peter Saveall, Mate on-board the*

1795			l.	s.	d.
April 3	To cash paid him in London - - -		1	11	6
May 10	To cash at St. Petersburgh .	2 Rubles			
12	To ditto - -	1			
	To two pairs of slippers -	1			
14	To one piece of linen - -	4			
18	To cash - - - - -	3			
	Rubles	11 at 4s each	2	4	0
June 17	To two half-anchors of brandy - -		2	10	0
	To three pounds of tea - - -		1	0	0
July 17	To cash, at London - - - - -		0	2	0
	To one jacket - - - -		1	0	0
	To monthly pay to his wife, paid by the owner		2	0	0
31	To balance paid in full - - -		3	12	6
		£	14	0	0

Peter Wilkinson, Cook. Dr.

May 1	To cash, at St. Petersburgh - - - -	3	14	2
June 17	To brandy, at the Sound - - -	1	5	0
July 31	To balance paid in full - - - -	5	0	10
	£	10	0	0

John Smart, Seaman. Dr.

June 17	To three pounds of tea, at the Sound -	0	7	6
July 22	To cash, at London - - - - -	0	10	0
25	To balance paid in full - - - -	7	7	6
	£	8	5	0

Joseph Howell, Seaman. Dr.

July 25	To cash paid in full - - - -	8	5	0

Favourite Nancy, with Thomas Smith. Cr.

		l.	s.	d.
1795	Entered into pay the 1ſt of April.			
	By wages from the 1ſt of April to the 1ſt of Auguſt, 4 months, at 3*l.* 10*s.* per month	14	0	0
	Contra Creditor. By wages from the 1ſt of April to the 1ſt of Auguſt, 4 months, at 50*s.* per month -	10	0	0
	Contra Creditor. By wages from the fifth of April to the twenty-fifth of July, three months and twenty days, at 45*s.* per month - - -	8	5	0
	Contra Creditor. By wages from the fifth of April to the twenty-fifth of July, three months and twenty days, at 45*s.* per month - - -	8	5	0

Account of Disbursements for the Ship Favourite Nancy, on a Voyage to St. Petersburgh, and back. By Thomas Smith, Master.

1795	*Commenced April 1, 1795.*	*l.*	*s.*	*d.*
April 1	To the seamen's contract - - -	0	2	9
	To forty tons of ballast - - -	2	10	0
3	To men heaving-in ditto - - -	0	14	0
	To greens and oatmeal - - -	0	2	0
	To two handspikes - - -	0	2	0
4	To the sail-maker's bill - - -	18	14	0
	To the smith's bill - - -	3	19	4
	To mending a stove - - -	0	3	8
5	To the baker's bill - - -	4	0	0
	To the butcher's bill - - -	6	3	7
6	To butter and sugar for sea stock - -	0	17	11
	To a dozen bottles of porter - -	0	6	6
	To waterage and coffee-house expences -	0	4	1
	To watermen going down the Pool -	0	5	3
7	To fresh meat, at Gravesend - -	0	2	0
	To charges of clearing at ditto - -	1	0	0
	At Yarmouth.			
11	To greens - - - -	0	2	0
	To bread - - - -	0	1	8
	To two fowls - - - -	0	1	2
		39	11	11

	At Elsineur.			
April 24	To postage of a letter - - -	0	1	0
	To two half-anchors of brandy, for the ship's use	2	10	0
	To three pounds of tea, ditto - -	0	12	0
	To pilotage through the Grounds - -	1	0	0
June 16	To port-charges up and down - -	4	0	0
	To fresh meat - - - -	0	10	0
	To butter, sugar, &c. - - -	0	7	0
	To a shore-boat - - - -	0	10	0
	£	9	10	0

1795	*At St. Peterſburgh.*	*rubles.*	*cop.*
May 11	To drink-money to the pilot - -	1	0
12	To eighty-four pounds of beef - -	1	0
	To two large caſks of beer - -		50
	To a ſpare top-maſt - - -	5	50
15	To four bolts of ſail-cloth - -	21	20
20	To port-charges - - - -	28	0
	To harbour-maſter, &c. - - -	5	0
	To deals for dunnage - - -	14	0
	To mats ditto - - - -	5	0
	To commiſſion on the freight, paid the merchant	20	0
	To cooking on-ſhore - - -	5	0
	To expences - - - -	20	0
27	To the butcher's bill - - -	27	0
	To the baker's bill - - -	20	0
	To poſtage of letters - - -	2	0
	To pilotage out to ſea - - -	3	0
		188	20

	At London.	*l.*	*s.*	*d.*
July 16	To watermen coming up the pool - -	0	7	6
	To entering a proteſt - - -	0	5	0
	To reporting and light-money at the cuſtom-houſe	4	7	6
17	To heaving-up the chains - - -	0	5	0
	To mutton and beef - - -	1	4	4
28	To tranſporting ſhip - - -	0	7	0
	To workmen unloading - - -	0	10	0
	To the hoſpital-bills - - -	0	18	0
	To chain-dues - - - -	0	18	0
	To waterage and expences - -	0	6	9
	To greens and oatmeal - - -	0	2	0
	To ſurveyors clearing ſhip - -	0	7	6
	£	9	18	7

Dr. *Mr. Thomas Delight, Owner of the Favourite Nancy,*

1795		l.	s.	d.
April 11	To ſundry diſburſements, per account -	39	11	11
	To ditto at Elſineur - - - -	9	10	0
May 28	To ditto at Peterſburgh, 188 rubles 20 copecs,			
-	at 4*s.* per ruble - - - -	37	12	9
July 31	To diſburſements at London - -	9	18	7
Ditto	To the amount of the portage-bill -	66	16	8
	To a bill remitted from Peterſburgh, 650 rubles,			
	exchange at 4 ſhillings - -	130	0	0
		293	9	11

Dr. *Favourite Nancy, her Account current.*

1795		l.	s.	d.
April 2	To inſurance and other charges - -	39	5	0
	To commiſſion on the freight, at $2\frac{1}{2}$ per cent.			
	for being ſhip's huſband - -	9	12	6
11	To diſburſements at London, &c. - -	39	11	11
	To ditto at the Sound - - -	9	10	0
May 28	To ditto at Peterſburgh - - -	37	12	9
July 31	To ditto at London homewards - -	9	18	7
	To the portage-bill - - -	66	16	8
	To balance gained - - -	144	16	7
		357	4	0
1795				
July 31	To T. Delight, for his half gained -	72	8	$3\frac{1}{2}$
	To L. Dorſley, Eſq. for his quarter gained -	36	4	2
	To J. Woodbine, Eſq. for his eighth gained	18	2	1
	To Capt. Smith, for his eighth gained -	18	2	$0\frac{1}{2}$
		144	16	7

his Account current with Thomas Smith. Cr.

1795		l.	s.	d.
April 4	By caſh received before I failed - -	46	0	0
May 28	By freight received at St. Peterſburgh, 600 rubles, at 4*s.* per ruble - -	120	0	0
	By neat proceeds of the adventure, per account ſales, 250 rubles, at 4*s.* per ruble -	50	0	0
June 16	By freight to the Sound - -	1	4	0
Ditto	By my bill drawn upon him - -	20	0	0
July 19	By caſh received of him - -	10	0	0
20	By caſh ditto - - - -	27	15	6
	By monthly pay to Peter Saveall's wife -	2	0	0
Auguſt 1	By balance due to me - - -	16	10	5
		293	9	11
	Errors excepted.			
	London, Auguſt 1, 1795.			
	Tho. Smith.			

	Contra Creditor.			
1795				
May 25	By freight to St. Peterſburgh - -	120	0	0
	By freight to the Sound - -	1	4	0
July 31	By freight from St. Peterſburgh to London, viz.			
	100 tons of hemp, at 2*l.* per ton - -	200	0	0
	2 tons and 16 cwt. of flax, at 2*l.* per ton -	5	11	8
	800 deals, at 3*l.* per hundred - -	24	0	0
	Two-thirds of the port charges - -	6	8	4
		357	4	0
July 31	By balance, from above, gained - -	144	16	7
	London, Auguſt 2, 1795.			
	Errors excepted.			
	T. Delight.			

A TABLE

Of the Real and Imaginary Moneys of the World: wherein the Species of Money are specified, and the Computation of each Nation explained.

REMARK.

The Figures next after the denomination of each Foreign Piece show the *English* intrinsic Value thereof, and those at the right-hand of the English are the same Value in the *Money of the United States of America.*—This mark * is prefixed to every *imaginary money*, or, as it is called, *Money of Account*, as *pounds, shillings, &c.*—This mark = signifies *is, make,* or *equal to.*

NORTHERN PARTS OF EUROPE.

ENGLAND and SCOTLAND.

London, Bristol, Liverpool, Edingburgh, Glasgow, &c.

				£.	s.	d.		D. c. m.
1 Farthing	=		=	0	0	0$\frac{1}{4}$	=	0;00,4$\frac{17}{27}$
2 Farthings		1 Halfpenny		0	0	0$\frac{1}{2}$		0;00,9$\frac{7}{27}$
2 Halfpence		1 Penny		0	0	1		0;01,8$\frac{14}{27}$
4 Pence		1 Groat		0	0	4		0;07;4$\frac{2}{27}$
6 Pence		$\frac{1}{2}$ Shilling		0	0	6		0,11;1 $\frac{1}{9}$
12 Pence		1 Shilling		0	1	0		0;22,2 $\frac{2}{9}$
5 Shillings		1 Crown		0	5	0		1,11,1 $\frac{1}{9}$
20 Shillings		1 Pound		1	0	0		4,44;4 $\frac{4}{9}$
21 Shillings		*1 Guinea		1	1	0		4,66,6 $\frac{2}{3}$

Isle of Man, Castle-Town, Douglas, &c.

				£.	s.	d.		D. c. m.
*1 Farthing	=		=	0	0	0$\frac{3}{14}$	=	0;00,3$\frac{61}{63}$
2 Farthings		1 halfpenny		0	0	0 $\frac{3}{7}$		0;00,7$\frac{59}{63}$
2 Halfpence		1 penny		0	0	1		0;01,8$\frac{14}{27}$
7 Pence		$\frac{1}{2}$ shilling		0	0	6		0,11,1 $\frac{1}{9}$
12 Pence		* 1 shilling manks		0	0	10 $\frac{2}{7}$		0,19,0$\frac{12}{21}$
14 Pence		1 shilling		0	1	0		0,22,2 $\frac{2}{9}$
70 Pence		1 crown		0	5	0		1,11,1 $\frac{1}{9}$
20 Shillings		*1 pound		0	17	1 ^{5}		3,80,9$\frac{11}{21}$
24$\frac{1}{2}$ Shillings		1 guinea		1	1	0		4,66,6 $\frac{2}{3}$

IRELAND.

Dublin, Cork, Londonderry, &c.

				£.	s.	d.		D. c. m.
1 farthing	=		=	0	0	$0\frac{3}{13}$	=	$0,00,4\frac{31}{117}$
2 farthings		1 halfpenny		0	0	$0\frac{6}{13}$		$0,00,8\frac{64}{117}$
2 halfpence		*1 penny		0	0	$0\frac{12}{13}$		$0,01,7\frac{11}{117}$
$6\frac{1}{2}$ pence		$\frac{1}{2}$ shilling		0	0	6		$0,11,1\frac{1}{9}$
12 pence		*1 shilling Irish		0	0	$11\frac{1}{13}$		$0,20,5\frac{5}{54}$
13 pence		1 shilling		0	1	0		$0,22,2\frac{2}{9}$
65 pence		1 crown		0	5	0		$1,11,1\frac{1}{9}$
20 shillings		*1 pound Irish		0	18	$5\frac{1}{2}$		$4,10,1\frac{23}{27}$
$22\frac{3}{4}$ shillings		1 guinea		1	1	0		$4,66,6\frac{2}{3}$

FLANDERS AND BRABANT.

Ghent, Ostend, &c. Antwerp, Brussels, &c.

				£.	s.	d.		D. c. m.
1 penning*	=		=	0	0	$0\frac{9}{160}$	=	$0,00,1\frac{24}{25}$
4 penningens		1 urche		0	0	$0\frac{9}{40}$		$0.00,7\frac{21}{25}$
8 penningens		*1 grot		0	0	$0\frac{9}{20}$		$0,01,5\frac{17}{25}$
2 grotes		1 petard		0	0	$0\frac{9}{10}$		$0,03,1\frac{9}{25}$
6 petards		*1 sealin		0	0	$5\frac{2}{5}$		0,10.0
7 petards		1 sealin		0	0	$6\frac{3}{10}$		$0,11,6\frac{2}{3}$
40 grotes		*1 florin		0	1	6		$0:33\cdot3\frac{1}{3}$
$17\frac{1}{2}$ sealins		1 ducat		0	9	3		$2,05,5\frac{5}{9}$
210 grotes		*1 pound Flemish		0	9	0		2,00,0

HOLLAND AND ZEALAND.

Amsterdam, Rotterdam, &c. Middleburgh, Flushing, &c.

				£.	s.	d.		D. c. m.
1 penning*	=		=	0	0	$0\frac{21}{320}$	=	$0,00\ 1\frac{31}{72}$
8 penningens		*1 grot		0	0	$0\frac{21}{40}$		$0,00,9\frac{53}{72}$
2 grotes		1 stiver		0	0	$1\frac{1}{20}$		$0,01,9\frac{45}{72}$
6 stivers		1 sealin		0	0	$6\frac{3}{10}$		$0,11,6\frac{2}{3}$
20 stivers		1 guilder		0	1	9		$0,38.8\frac{8}{9}$
50 stivers		1 rix-dollar		0	4	$4\frac{1}{4}$		$0,96,7\frac{19}{27}$
60 stivers		1 dry guilder		0	5	3		$1,16,6\frac{2}{3}$
3 florins, 3 stivers		1 silver ducattoon		0	5	$7\frac{69}{143}$		1,25,1
105 stivers		1 ducat		0	9	3		$2,05,5\frac{5}{9}$
20 florins		1 gold ducat, or ducattoon		1	16	0		8.00.0
6 guilders		*1 pound Flemish		0	10	6		$2.33.3\frac{1}{3}$
15 florins		1 ducattoon or sovereign		1	7	0		6,00,0

GERMANY.

Hamburgh, Altena, Lubec, Bremen, &c.

				£.	s.	d.		D. c. m.
1 tryling	=		=	0	0	0 $\frac{3}{128}$	=	0,00,0 $\frac{125}{288}$
2 trylings		*1 fexling		0	0	0 $\frac{3}{64}$		0,00,0 $\frac{125}{144}$
2 fexlings		1 fening		0	0	0 $\frac{3}{32}$		0,00,1 $\frac{53}{72}$
12 fenings		1 shilling lub		0	0	1 $\frac{1}{8}$		0,02,0 $\frac{41}{54}$
16 shillings		*1 marc		0	1	6		0,33,3 $\frac{1}{3}$
2 marcs		1 flet dollar		0	3	0		0,66,6 $\frac{2}{3}$
3 marcs		1 rix dollar		0	4	6		1,00,0
4 marcs		1 silver ducattoon		0	6	0		1,33,3 $\frac{1}{3}$
6¼ marcs		1 ducat		0	9	4 $\frac{1}{2}$		2,08,3 $\frac{1}{3}$
120 shillings		*1 pound Flemish		0	11	6		2,55,5 $\frac{5}{9}$

Hanover, Lunenburgh, Zell, &c.

				£.	s.	d.		D. c. m.
1 fening*	=		=	0	0	0 $\frac{7}{45}$	=	0,00,2 $\frac{227}{575}$
3 fenings		1 dreyer		0	0	0 $\frac{7}{16}$		0,00,6 $\frac{691}{575}$
8 fenings		1 marien		0	0	1 $\frac{1}{6}$		0,02,1 $\frac{49}{81}$
12 fenings		1 grosh		0	0	1 $\frac{1}{4}$		0,02,3 $\frac{4}{27}$
8 groshen		½ gulden		0	1	2		0,25,9 $\frac{7}{27}$
16 groshen		1 gulden		0	2	4		0,51,8 $\frac{14}{27}$
24 groshen		*1 rix dollar		0	3	6		0,77,7 $\frac{7}{9}$
32 groshen		1 double gulden		0	4	8		1,03,7 $\frac{1}{27}$
4 guldens		1 ducat		0	9	2		2,03,7 $\frac{1}{27}$

Saxony and Holstein, Dresden, Leipsic, &c. Wismar, Keil, &c.

				£.	s.	d.		D. c. m.
1 heller*	=		=	0	0	0 $\frac{7}{96}$	=	0,00,0 $\frac{227}{1756}$
2 hellers		1 fening		0	0	0 $\frac{7}{45}$		0,00,2 $\frac{227}{875}$
6 hellers		1 dreyer		0	0	0 $\frac{7}{16}$		0,00,6 $\frac{691}{675}$
16 hellers		1 marien		0	0	1 $\frac{1}{6}$		0,02,1 $\frac{49}{81}$
12 fenings		1 grosh		0	0	1 $\frac{3}{4}$		0,03,2 $\frac{11}{27}$
16 groshen		1 gould		0	2	4		0,51,8 $\frac{14}{27}$
24 groshen		*1 rix dollar		0	3	6		0,77,7 $\frac{7}{9}$
32 groshen		1 specie dollar		0	4	8		1,03,7 $\frac{1}{27}$
4 goulds		1 ducat		0	9	4		2,07,4 $\frac{2}{27}$

Brandenburgh and Pomerania, Berlin, Stettin, Potzdam, &c.

				£.	s.	d.		D. c. m.
1 denier*	=		=	0	0	0 $\frac{7}{273}$	=	0,00,0 $\frac{359}{729}$
9 deniers		1 polcher		0	0	0 $\frac{7}{30}$		0,00,4 $\frac{26}{81}$
18 deniers		1 grosh		0	0	0 $\frac{7}{15}$		0,00,8 $\frac{52}{81}$
3 polchens		1 abrais		0	0	0 $\frac{7}{10}$		0,01,2 $\frac{26}{27}$
20 groshen		*1 mark		0	0	9 $\frac{1}{3}$		0,17,2 $\frac{69}{81}$
30 groshen		1 florin		0	1	2		0,25,9 $\frac{7}{27}$
90 groshen		*1 rix dollar		0	3	6		0,77,7 $\frac{7}{9}$
108 groshen		1 albertus		0	4	2		0,92,5 $\frac{25}{27}$
8 florins		1 ducat		0	9	4		2,07,4 $\frac{2}{7}$

Cologne, Mentz, Triers, Liege, Munich, Munster, Paderborn, &c.

				£.	s.	d.		D. c. m.
1 dute	=		=	0	0	$0\frac{7}{80}$	=	$0,00,1\frac{67}{108}$
3 dutes		1 cruitzer		0	0	$0\frac{21}{80}$		$0,00,4\frac{31}{36}$
2 cruitzers		1 albus		0	0	$0\frac{21}{40}$		$0,00,9\frac{13}{18}$
8 dutes		1 ſtiver		0	0	$0\frac{7}{10}$		$0,01,2\frac{26}{27}$
3 ſtivers		1 plapert		0	0	$2\frac{1}{10}$		$0,03,8\frac{24}{27}$
4 plaperts		1 copſtuck		0	0	$8\frac{2}{5}$		$0,15,5\frac{5}{9}$
40 ſtivers		1 guilder		0	2	4		$0,51,8\frac{14}{27}$
2 guilders		1 hard dollar		0	4	8		$1,03,7\frac{1}{27}$
4 guilders		1 ducat		0	9	3		$2,05,5\frac{5}{9}$

Bohemia, Sileſia, Hungary, Prague, Breſlav, Preſburgh.

				£.	s.	d.		D. c. m.
1 fening	=		=	0	0	$0\frac{7}{60}$	=	$0,00,2\frac{13}{81}$
2 fenings		1 dreyer		0	0	$0\frac{7}{30}$		$0,00,4\frac{26}{81}$
3 fenings		1 groſh		0	0	$0\frac{7}{20}$		$0,00,6\frac{13}{27}$
4 fenings		1 cruitzer		0	0	$0\frac{7}{15}$		$0,00,8\frac{52}{81}$
2 cruitzers		1 white groſh		0	0	$0\frac{14}{15}$		$0,01,7\frac{23}{81}$
60 cruitzers		1 gould		0	2	4		$0,51,8\frac{14}{27}$
90 cruitzers		*1 rix dollar		0	3	6		$0,77,7\frac{7}{9}$
2 goulds		1 hard dollar		0	4	8		$1,03,7\frac{1}{27}$
4 goulds		1 ducat		0	9	4		$2,07,4\frac{2}{27}$

Auſtria and Suabia. Vienna, Trieſte, Augsburgh, Blenheim, &c.

				£.	s.	d.		D. c. m.
1 fening	=		=	0	0	$0\frac{7}{60}$	=	$0,00,2\frac{13}{81}$
3 fenings		1 dreyer		0	0	$0\frac{7}{20}$		$0,00,6\frac{13}{27}$
4 fenings		1 cruitzer		0	0	$0\frac{7}{15}$		$0,00,8\frac{52}{81}$
14 fenings		1 groſh		0	0	$1\frac{19}{30}$		$0,02,7\frac{7}{8}$
4 cruitzers		1 batzen		0	0	$1\frac{13}{15}$		$0,03,3\frac{61}{108}$
15 batzen		1 gould		0	2	4		$0,51,8\frac{14}{27}$
90 cruitzers		*1 rix dollar		0	3	6		$0,77,7\frac{7}{9}$
30 batzen		1 ſpecie dollar		0	4	8		$1,03,7\frac{1}{27}$
60 batzen		1 ducat		0	9	4		$2,07,4\frac{2}{27}$

Franconia, Frankfort, Nuremburgh, Dettingen, &c.

				£.	s.	d.		D. c. m.
1 fening	=		=	0	0	$0\frac{7}{60}$	=	$0,00,2\frac{13}{81}$
4 fenings		1 cruitzer		0	0	$0\frac{7}{15}$		$0,00,8\frac{52}{81}$
3 cruitzers		1 keyſer groſh		0	0	$1\frac{2}{5}$		$0,02,5\frac{25}{27}$
4 cruitzers		1 batzen		0	0	$1\frac{13}{15}$		$0,03,4\frac{46}{81}$
15 cruitzers		1 ort gould		0	0	7		$0,12,9\frac{17}{27}$
60 cruitzers		1 gould		0	2	4		$0,51,8\frac{14}{27}$
90 cruitzers		*1 rix-dollar		0	3	6		$0,77,7\frac{7}{9}$
2 goulds		1 hard dollar		0	4	8		$1,03,7\frac{1}{27}$
240 cruitzers		1 ducat		0	9	4		$2,07,4\frac{2}{27}$

POLAND AND PRUSSIA.

Cracow, Warsaw, &c. Dantzic, Koningsberg, &c.

				£.	s.	d.		D. c. m.
1 shelon	=		=	0	0	$0\frac{7}{45}$	=	$0,00,2\frac{214}{243}$
3 shelons		1 grosh		0	0	$0\frac{7}{15}$		$0,00,8\frac{52}{81}$
5 groshen		1 coustic		0	0	$2\frac{1}{3}$		$0,04,3\frac{16}{81}$
3 coustics		1 tinse		0	0	7		$0,12,9\frac{17}{27}$
18 groshen		1 ort		0	0	$8\frac{2}{5}$		$0,15,5\frac{5}{9}$
30 groshen		1 florin		0	1	2		$0,25,9\frac{7}{27}$
90 groshen		*1 rix-dollar		0	3	6		$0,77,7\frac{7}{9}$
8 florins		1 ducat		0	9	2		$2,03,7\frac{1}{27}$
5 rix-dollars		1 Frederic d'or		0	17	0		$3,77,7\frac{21}{27}$

LIVONIA.

Riga, Revel, Narva, &c.

				£.	s.	d.		D. c. m.
1 blacken	=		=	0	0	$0\frac{7}{90}$	=	$0,00,1\frac{107}{243}$
6 blackens		1 grosh		0	0	$0\frac{7}{15}$		$0,00,8\frac{52}{81}$
9 blackens		1 vorden		0	0	$0\frac{7}{10}$		$0,01,2\frac{26}{27}$
2 groshen		1 whiten		0	0	$0\frac{14}{15}$		$0,01,7\frac{23}{81}$
6 groshen		1 marc		0	0	$2\frac{4}{5}$		$0,05,1\frac{23}{27}$
30 groshen		1 florin		0	1	2		$0,25,9\frac{7}{27}$
8 florins		1 ducat		0	9	4		$2,07,4\frac{2}{27}$
90 groshen		*1 rix-dollar		0	3	6		$0,77,7\frac{7}{9}$
108 groshen		1 albertus		0	4	2		$0,92,5\frac{25}{27}$
64 whitens		1 copper plate dollar		0	5	0		$1,11,1\frac{1}{9}$

DENMARK, ZELL, NORWAY.

Copenhagen, Sound, &c. Bergen, Drontheim, &c.

				£.	s.	d.		D. c. m.
1 skilling	=		=	0	0	$0\frac{9}{16}$	=	$0,01,0\frac{5}{12}$
6 skillings		1 druggen		0	0	$3\frac{3}{8}$		$0,06,2\frac{1}{2}$
16 skillings		*1 marc		0	0	9		$0,16,6\frac{2}{3}$
20 skillings		1 rix-marc		0	0	$11\frac{1}{4}$		$0,20,8\frac{1}{3}$
24 skillings		1 rix-ort		0	1	$1\frac{1}{2}$		0,25,0
4 marcs		1 crown		0	3	0		$0,66,6\frac{2}{3}$
6 marcs		1 rix-dollar		0	4	6		1,00,0
11 marcs		1 ducat		0	8	3		$1,83,3\frac{1}{3}$
14 marcs		1 hat ducat		0	10	6		$2,33,3\frac{1}{3}$

SWEDEN AND LAPLAND.

Stockholm, Upsal, &c. Thorn, &c.

				£.	s.	d.		D. c. m.
1 runstic	=		=	0	0	$0\frac{7}{36}$	=	$0,00,8\frac{11}{108}$
2 runstics		1 stiver		0	0	$0\frac{7}{18}$		$0,01,6\frac{11}{54}$
8 runstics		1 copper marc		0	0	$1\frac{5}{9}$		$0,02,8\frac{105}{243}$
3 copper marcs		1 silver marc		0	0	$4\frac{2}{3}$		$0,08,6\frac{74}{81}$
4 copper marcs		1 copper dollar		0	0	$6\frac{2}{9}$		$0,11;5\frac{55}{243}$
9 copper marcs		1 caroline		0	1	2		$0,25;9\frac{7}{27}$
3 copper dollars		1 silver dollar		0	1	$6\frac{2}{3}$		$0;34,5\frac{55}{81}$
3 silver dollars		1 rix dollar		0	4	8		$1;03,7\frac{1}{27}$
[illegible] rix-dollars		1 ducat		0	9	4		$2,07,4\frac{2}{27}$

RUSSIA AND MUSCOVY.

Petersburgh, Archangel, Moscow, &c.

				£.	s.	d.		D. c. m.
1 polusca	=		=	0	0	$0\frac{27}{200}$	=	$0,00;2\frac{1}{2}$
2 poluscas		1 denusca		0	0	$0\frac{27}{100}$		0,00;5
2 denuscas		1 copec		0	0	$0\frac{27}{50}$		0,01,0
3 copecs		1 altin		0	0	$1\frac{31}{50}$		0;03.0
10 copecs		1 grievener		0	0	$5\frac{2}{5}$		0,10;0
25 copecs		1 polpotin		0	1	$1\frac{1}{2}$		0,25;0
50 copecs		1 poltin		0	2	3		0,50,0
100 copecs		1 ruble		0	4	6		1;00;0
2 rubles		1 xervonitz		0	9	0		2;00,0

SOUTHERN PARTS OF EUROPE.

SWITZERLAND.

Basil, Zurich, Zug, &c.

				£.	s.	d.		D. c. m.
1 rap	=		=	0	0	$0\frac{1}{24}$	=	$0;00,0\frac{124}{162}$
3 rapen		1 fening		0	0	$0\frac{1}{8}$		$0;00;2\frac{51}{162}$
4 fenings		1 cruitzer		0	0	$0\frac{1}{2}$		$0;00,9\frac{7}{27}$
12 fenings		*1 sol		0	0	$1\frac{1}{2}$		$0;02,7\frac{21}{27}$
15 fenings		1 coarse batzen		0	0	$1\frac{7}{8}$		$0;03,4\frac{13}{18}$
18 fenings		1 good batzen		0	0	$2\frac{1}{4}$		$0;04;1\frac{2}{3}$
20 sols		*1 livre		0	2	6		$0;55;5\frac{5}{9}$
60 cruitzers		1 gulden		0	2	6		$0;55\cdot5\frac{5}{9}$
108 cruitzers		1 rix-dollar		0	4	6		1;00,0

St. Gall, Appenfel, &c.

				£.	s.	d.		D. c. m.
1 heller	=		=	0	0	0 $\frac{1}{16}$	=	0,00,1 $\frac{17}{163}$
2 hellers		1 fening		0	0	0 $\frac{1}{8}$		0,00,2 $\frac{34}{163}$
4 fenings		1 cruitzer		0	0	0 $\frac{1}{2}$		0,00,9 $\frac{7}{27}$
12 fenings		*1 sol		0	0	1 $\frac{1}{2}$		0,02,7 $\frac{21}{27}$
4 cruitzers		1 coarse batzen		0	0	1 $\frac{7}{8}$		0,03,4 $\frac{13}{18}$
5 cruitzers		1 good batzen		0	0	2 $\frac{1}{4}$		0,04,1 $\frac{2}{3}$
20 sols		*1 livre		0	2	6		0,55,5 $\frac{5}{9}$
60 cruitzers		1 gould		0	2	6		0,55,5 $\frac{5}{9}$
102 cruitzers		1 rix-dollar		0	4	3		0,94,4 $\frac{4}{9}$

Bern, Lucern, Neufchatel, &c.

				£.	s.	d.		D. c. m.
1 denier	=		=	0	0	0 $\frac{1}{16}$	=	0,00,1 $\frac{23}{27}$
4 deniers		1 cruitzer		0	0	0 $\frac{2}{5}$		0,00,7 $\frac{11}{27}$
3 cruitzers		*1 sol		0	0	1 $\frac{1}{5}$		0,02,2 $\frac{2}{9}$
4 cruitzers		1 plapert		0	0	1 $\frac{3}{5}$		0,02,9 $\frac{17}{27}$
5 cruitzers		1 gros		0	0	2		0,03,7 $\frac{1}{27}$
6 cruitzers		1 batzen		0	0	2 $\frac{2}{5}$		0,04,4 $\frac{4}{9}$
20 sols		*1 livre		0	2	0		0,44,4 $\frac{4}{9}$
75 cruitzers		1 gulden		0	2	6		0,55,5 $\frac{5}{9}$
135 cruitzers		1 crown		0	4	6		1,00,0

Geneva, Pekay, Bonne.

				£.	s.	d.		D. c. m.
1 denier	=		=	0	0	0 $\frac{1}{32}$	=	0,00,0 $\frac{125}{201}$
2 deniers		1 denier current		0	0	0 $\frac{1}{16}$		0,00,1 $\frac{49}{201}$
12 deniers		1 small sol		0	0	0 $\frac{3}{8}$		0,00,6 $\frac{17}{18}$
12 deniers current		1 sol current		0	0	0 $\frac{3}{4}$		0,01,3 $\frac{8}{9}$
12 small sols		*1 florin		0	0	4 $\frac{1}{2}$		0.08,3 $\frac{1}{3}$
20 sols current		*1 livre current		0	1	3		0,27,7 $\frac{7}{9}$
10 $\frac{1}{2}$ florins		1 pacaton		0	3	11 $\frac{1}{4}$		0,87,5
15 $\frac{3}{4}$ florins		1 croisade		0	5	10 $\frac{7}{8}$		1,31,2
24 florins		1 ducat		0	9	0		2,00,0

FRANCE AND NAVARRE.

Lisle, Cambray, Valenciennes, &c.

				£.	s.	d.		D. c. m.
1 denier	=		=	0	0	0 $\frac{1}{24}$	=	0,00,0 $\frac{125}{162}$
12 deniers		1 sol		0	0	0 $\frac{1}{2}$		0,00,9 $\frac{7}{27}$
15 deniers		1 petard		0	0	0 $\frac{5}{8}$		0,01,1 $\frac{31}{54}$
15 petards		*1 piette		0	0	9 $\frac{3}{8}$		0,17,3 $\frac{33}{54}$
20 sols		*1 livre Tournois		0	0	10		0,18,5 $\frac{5}{27}$
20 petards		*1 florin		0	1	0 $\frac{1}{2}$		0,23,1 $\frac{13}{27}$
60 sols		1 ecu of exchange		0	2	6		0,55,5 $\frac{5}{9}$
10 $\frac{1}{2}$ livres		1 ducat		0	9	3		2,05,5 $\frac{5}{9}$
24 livres		1 Louis d'or		1	0	0		4,44,5 $\frac{4}{9}$

District of Massachusetts District,

TO WIT—

(L.S.) BE it remembered that on the twenty-fourth day of May, in the 23d year of the Independence of the United States of America, EDMUND MARCH BLUNT, of the ſaid Diſtrict, has depoſited in this office the title of a Book, the right whereof he claims as Proprietor, in the words following, to wit;

"The New Practical Navigator, being an Epitome of Navigation, containing the different methods of working the Lunar obſervations, and all the requiſite tables uſed with the Nautical Almanac, in determining the latitude and longitude, and keeping a complete reckoning at ſea: Illuſtrated by proper rules and examples. The whole exemplified in a Journal kept from England to the Iſland of Teneriffe; alſo the ſubſtance of Information every Candidate for the American Navy ought to be acquainted with, previous to his being appointed: This, with the ſea terms, are particularly recommended to the attention of all young gentlemen deſigned for, or belonging to the ſea. The firſt American, from the thirteenth Engliſh edition of JOHN HAMILTON MOORE, improved by the introduction of ſeveral new tables, and by large additions to the former tables, and reviſed and corrected by a ſkilful Mathematician and Navigator. Illuſtrated with copper plates, to which are added, ſome general inſtructions and information to merchants, maſters of veſſels, and others concerned in navigation, relative to the mercantile and maritime laws and cuſtoms.

In conformity to the Act of the Congreſs of the United States, intitled, "An Act for the encouragement of learning by ſecuring the copies of Maps, Charts, and Books to the authors and proprietors of ſuch copies during the times therein mentioned."

N. GOODALE, Clerk of the Diſtrict of Maſſachuſetts Diſtrict.

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A CHART of GEORGE's BANK, including Cape-Cod, Nantucket, and the Shoals lying on their Coast, with Directions for Sailing over the same.—Surveyed by Capt. Paul Pinkham, of Nantucket.

The BRITISH CHANNEL, including that of Bristol and the south-west Coast of Ireland, as far as the River Shannon, constructed upon the true Principles of Mercator's Sailing, containing particular Chart of the Downs, Portsmouth, Dartmouth, Plymouth, and Falmouth, with a printed Book of Directions.

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A new and correct CHART of the NORTH SEA, on a large Scale, including a Plan of Helegoland, the whole of the Navigation from Dungeness to the Shetland Islands, and from Calais to the Scaw, with the Entrance of the Rivers Weser, Elbe, and Eyder, from Helegoland Light, with a printed Book of Directions.

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Dunkirk, St. Omen's, St. Quintin, &c.

				£.	s.	d.		D. c. m.
1 denier	=		=	0	0	$0\frac{1}{24}$	=	$0,00,0\frac{125}{162}$
12 deniers		1 sol		0	0	$0\frac{1}{2}$		$0,00,9\frac{7}{27}$
15 deniers		*1 petard		0	0	$0\frac{5}{8}$		$0,01,1\frac{31}{54}$
15 sols		*1 piette		0	0	$7\frac{1}{2}$		$0,13,8\frac{8}{9}$
20 sols		1 livre Tournois		0	0	10		$0,18,5\frac{5}{27}$
3 livres		1 ecu of exchange		0	2	6		$0,55,5\frac{5}{9}$
24 livres		1 Louis d'or		1	0	0		$4,44,4\frac{4}{9}$
24 livres		1 guinea		1	1	0		$4,66,6\frac{2}{3}$
$39\frac{3}{8}$ livres		1 moeda		1	7	0		6,00,0

Paris, Lyons, Marseilles, &c. Bourdeaux, Bayonne, &c.

				£.	s.	d.		D. c. m.
1 denier	=		=	0	0	$0\frac{1}{14}$	=	$0,00,1\frac{61}{189}$
3 deniers		1 liard		0	0	$0\frac{1}{8}$		$0,00,2\frac{17}{54}$
2 liards		1 dardene		0	0	$0\frac{1}{4}$		$0,00,4\frac{17}{27}$
12 deniers		1 sol		0	0	$0\frac{1}{2}$		$0,00,9\frac{7}{27}$
20 sols		*1 livre Tournois		0	0	10		$0,18,5\frac{5}{27}$
60 sols		1 ecu of exchange		0	2	6		$0,55,5\frac{5}{9}$
6 livres		1 ecu		0	5	0		$1,11,1\frac{1}{9}$
10 livres		*1 pistole		0	8	4		$1,85,1\frac{23}{27}$
24 livres		1 Louis d'or		1	0	0		$4,44,4\frac{4}{9}$

PORTUGAL.

Lisbon, Oporto, &c.

				£.	s.	d.		D. c. m.
1 re	=		=	0	0	$0\frac{27}{400}$	=	$0,00,1\frac{1}{4}$
10 rez		1 half vintin		0	0	$0\frac{27}{40}$		$0,01,2\frac{1}{2}$
20 rez		1 vintin		0	0	$1\frac{7}{20}$		0,02,5
5 vintins		1 testoon		0	0	$6\frac{3}{4}$		0,12,5
4 testoons		1 crusade of exchange		0	2	3		0,50,0
24 vintins		1 new crusade		0	2	$8\frac{2}{5}$		0,60,0
10 testoons		*1 milre		0	5	$7\frac{1}{2}$		1,25,0
48 testoons		1 moeda		1	7	0		6,00,0
64 testoons		1 Joanese		1	16	0		8,00,0

SPAIN AND CATALONIA.

Madrid, Cadiz, Seville, &c. New Plate.

				£.	s.	d.		D. c. m.
*1 maravedie	=		=	0	0	$0\frac{43}{272}$	=	$0,00,2\frac{1703}{1836}$
2 maravedies		1 quartil		0	0	$0\frac{43}{136}$		$0,00,5\frac{795}{918}$
34 maravedies		1 rial		0	0	$5\frac{3}{8}$		$0,09,9\frac{29}{54}$
2 rials		1 pistarine		0	0	$10\frac{3}{4}$		0,20,0
8 rials		*1 piastre of exchange		0	3	7		$0,79,6\frac{8}{27}$
10 rials		1 dollar		0	4	6		1,00,0
375 maravedies		*1 ducat of exchange		0	4	$11\frac{1}{2}$		$1,10,1\frac{23}{27}$
32 rials		*1 pistole of exchange		0	14	4		$3,18,1\frac{5}{27}$
36 rials		1 pistole		0	16	0		$2,55,5\frac{5}{9}$

Gibraltar, Malaga, Denia, &c. Velon.

			£.	s.	d.		D. c. m.
*1 maravedie	=		= 0	0	$0\frac{43}{272}$	=	$0,00,2\frac{1703}{1836}$
2 maravedies		1 ochavo	0	0	$0\frac{43}{136}$		$0,00,5\frac{785}{918}$
4 maravedies		1 quartil	0	0	$0\frac{43}{68}$		$0,01,1\frac{326}{459}$
34 maravedies		*1 rial Velon	0	0	$2\frac{7}{8}$		$0;05;3\frac{14}{27}$
15 rials		*1 piastre of exchange	0	3	7		$0;79,6\frac{8}{27}$
512 maravedies		1 piastre	0	3	7		$0;79,6\frac{8}{27}$
60 rials		1 pistole of exchange	0	14	4		$3,18,5\frac{5}{27}$
2048 maravedies		*1 pistole of exchange	0	14	4		$3,18,5\frac{5}{27}$
70 rials		1 pistole	0	16	9		$3,72,2\frac{2}{9}$

Barcelona, Saragossa, Valencia, &c. Old Plate.

			£.	s.	d.		D. c. m.
1 maravedie	=		= 0	0	$0\frac{27}{125}$	=	$0,00,2\frac{211}{432}$
10 maravedies		1 soldo	0	0	$3\frac{3}{8}$		$0,02,4\frac{191}{216}$
2 soldos		1 rial, old plate	0	0	$6\frac{3}{4}$		$0,04,9\frac{63}{108}$
20 soldos		*1 libra	0	5	$7\frac{1}{2}$		1,25,1
24 soldos		*1 ducat	0	6	9		1;50,0
16 soldos		*1 dollar	0	4	6		1,00,0
22 soldos		*1 ducat	0	6	$2\frac{1}{4}$		1;37;5
21 soldos		*1 ducat	0	5	$10\frac{7}{8}$		1;31,2
60 soldos		1 pistole	0	16	9		$3,72,2\frac{2}{9}$

ITALY.

Genoa, Novi, St. Remo, &c. Corsica, Bastia, &c.

			£.	s.	d.		D. c. m.
1 denari	=		= 0	0	$0\frac{43}{1200}$	=	$0,00,0\frac{211}{324}$
12 denari		1 soldi	0	0	$0\frac{43}{100}$		$0,00,7\frac{26}{27}$
4 soldi		1 chevalet	0	0	$1\frac{18}{25}$		$0,03,1\frac{23}{27}$
20 soldi		*1 lire	0	0	$8\frac{3}{5}$		$0,15;9\frac{7}{27}$
30 soldi		1 testoon	0	1	$0\frac{9}{10}$		$0;23;8\frac{24}{27}$
5 lires		1 croisade	0	3	7		$0;79,6\frac{8}{27}$
115 soldi		*1 pezzo of exchange	0	4	2		$0,92;5\frac{25}{27}$
6 testoons		1 genouine	0	6	$2\frac{2}{5}$		$1;37;7\frac{7}{9}$
20 lires		1. pistole	0	14	4		$3;18;5\frac{5}{27}$

Piedmont, Savoy, Sardinia, Turin, Chamberry, Cagliari.

			£.	s.	d.		D. c. m.
1 denari	=		= 0	0	$0\frac{1}{16}$	=	$0,00,1\frac{17}{108}$
3 denari		1 quatrini	0	0	$0\frac{3}{16}$		$0;00;3\frac{51}{108}$
12 denari		1 soldi	0	0	$0\frac{3}{4}$		$0;01,3\frac{8}{9}$
12 soldi		*1 florin	0	0	9		$0,16,6\frac{2}{3}$
20 soldi		*1 lire	0	1	3		$0,27,7\frac{7}{9}$
6 florins		1 scudi	0	4	6		1;00,0
7 florins		1 ducatoon	0	5	3		$1,16,6\frac{2}{3}$
13 lires		1 pistole	0	16	3		$3,61,1\frac{1}{9}$
16 lires		1 Louis d'or	1	0	0		$4;44,4\frac{4}{9}$

Milan, Modenia, Parma, Pavia, &c.

				£.	s.	d.		D. c. m.
1 denari	=		=	0	0	0$\frac{3}{82}$	=	0,00 0$\frac{250}{369}$
3 denari		1 quatrini		0	0	0$\frac{9}{82}$		0,00 2$\frac{4}{123}$
12 denari		1 soldi		0	0	0$\frac{18}{41}$		0,00,8$\frac{16}{123}$
20 soldi		*1 lire		0	0	8$\frac{32}{41}$		0,16.2$\frac{74}{123}$
115 soldi		1 scudi current		0	4	2$\frac{1}{8}$		0,92.8$\frac{13}{54}$
117 soldi		*1 scudi of exchange		0	4	3		0,94,4$\frac{4}{9}$
6 lires		1 Philip		0	4	4$\frac{1}{2}$		0,97,2$\frac{2}{9}$
22 lires		1 pistole		0	16	0		3,55,5$\frac{5}{9}$
23 lires		1 Spanish pistole		0	16	9		3,72,2$\frac{2}{9}$

Leghorn, Florence, &c.

				£.	s.	d.		D. c. m.
1 denari	=		=	0	0	0$\frac{5}{143}$	=	0.00,0$\frac{500}{783}$
4 denari		1 quatrini		0	0	0$\frac{5}{36}$		0,00,2$\frac{434}{783}$
12 denari		1 soldi		0	0	0$\frac{5}{12}$		0,00,7$\frac{510}{783}$
5 quatrini		1 craca		0	0	0$\frac{25}{36}$		0,01,2$\frac{603}{785}$
8 cracas		1 quilo		0	0	5$\frac{5}{9}$		0,10,2$\frac{214}{243}$
20 soldi		*1 lire		0	0	8$\frac{1}{3}$		0,15,4$\frac{26}{81}$
6 lires		1 piastre of exchange		0	4	2		0,92,5$\frac{25}{27}$
7$\frac{1}{2}$ lires		1 ducat		0	5	2$\frac{1}{2}$		1,15,7$\frac{11}{27}$
22 lires		1 pistole		0	15	6		3,44,4$\frac{4}{9}$

Rome, Civita-Vecchia, Ancona, &c.

				£.	s.	d.		D. c. m.
1 quatrini	=		=	0	0	0$\frac{3}{20}$	=	0,00,2$\frac{7}{9}$
5 quatrini		1 bayoc		0	0	0$\frac{3}{4}$		0,01.3$\frac{8}{9}$
8 bayocs		1 Julio		0	0	6		0,11,1$\frac{1}{9}$
10 bayocs		1 stamped Julio		0	0	7$\frac{1}{2}$		0,13,8$\frac{24}{27}$
24 bayocs		1 testoon		0	1	6		0,33,3$\frac{1}{3}$
10 Julios		1 crown current		0	5	0		1,11,1$\frac{1}{9}$
12 Julios		*1 crown stamped		0	6	0		1,33,3$\frac{1}{3}$
18 Julios		1 chequin		0	9	0		2,00,0
31 Julios		1 pistole		0	15	6		3,44,4$\frac{4}{9}$

Naples, Gaieta, Capua, &c.

				£.	s.	d.		D. c. m.
1 quatrini	=		=	0	0	0$\frac{2}{15}$	=	0,00,2$\frac{38}{81}$
3 quatrini		1 grain		0	0	0$\frac{2}{5}$		0,00.7$\frac{33}{81}$
10 grains		1 carlin		0	0	4		0,07.4$\frac{2}{27}$
40 quatrini		1 Paolo		0	0	5$\frac{1}{3}$		0,09.8$\frac{62}{81}$
20 grains		1 tarin		0	0	8		0,14,8$\frac{4}{27}$
40 grains		1 testoon		0	1	4		0,29.6$\frac{8}{27}$
100 grains		1 ducat of exchange		0	3	4		0,74.0$\frac{20}{27}$
23 tarins		1 pistole		0	15	4		2,40,7$\frac{11}{27}$
25 tarins		1 Spanish pistole		0	16	9		2,72,2$\frac{2}{9}$

Sicily and Malta. Palermo, Messina, &c.

			£.	s.	d.		D. c. m.
1 pichili	=		= 0	0	$0\frac{1}{39}$	=	$0,00,0\frac{500}{1053}$
6 pichili		1 grain	0	0	$0\frac{2}{13}$		$0,00,2\frac{208}{351}$
8 pichili		1 ponti	0	0	$0\frac{8}{39}$		$0,00,3\frac{841}{1053}$
10 grains		1 carlin	0	0	$1\frac{7}{13}$		$0,02,8\frac{172}{351}$
20 grains		1 tarin	0	0	$3\frac{1}{13}$		$0,05,6\frac{344}{351}$
6 tarins		1 florin of exchange	0	1	$6\frac{6}{13}$		$0,34,1\frac{302}{351}$
13 tarins		*1 ducat of exchange	0	3	4		$0,74,0\frac{20}{27}$
60 carlins		*1 ounce	0	7	$8\frac{4}{13}$		$1,70,9\frac{141}{351}$
2 ounces		1 pistole	0	15	4		$2,40,7\frac{11}{27}$

Bologna, Ravenna, &c.

			£.	s.	d.		D. c. m.
1 quatrini	=		= 0	0	$0\frac{1}{16}$	=	$0,00,1\frac{23}{27}$
6 quatrini		1 bayoc	0	0	$0\frac{3}{5}$		$0,01,1\frac{1}{9}$
10 bayocs		1 Julio	0	0	6		$0,11,1\frac{1}{9}$
20 bayocs		*1 lire	0	1	0		$0,22,2\frac{2}{9}$
3 Julios		1 testoon	0	1	6		$0,33,3\frac{1}{3}$
85 bayocs		1 scudi of exchange	0	4	3		$0,94,4\frac{4}{9}$
105 bayocs		1 ducatoon	0	5	3		$1,16,6\frac{2}{3}$
100 bayocs		1 crown	0	5	0		$1,11,1\frac{1}{9}$
31 Julios		1 pistole	0	15	6		$2,44,4\frac{4}{9}$

Venice, Bergham, &c.

			£.	s.	d.		D. c. m.
1 picoli	=		= 0	0	$0\frac{1}{36}$	=	$0,00,0\frac{125}{243}$
12 picoli		1 soldi	0	0	$0\frac{1}{3}$		$0,00,6\frac{52}{243}$
$6\frac{1}{2}$ soldi		*1 gross	0	0	$2\frac{1}{6}$		$0,01,0\frac{95}{243}$
18 soldi		1 Jule	0	0	6		$0,11,1\frac{1}{9}$
20 soldi		*1 lire	0	0	$6\frac{2}{3}$		$0,11,8\frac{14}{27}$
3 Jules		1 testoon	0	1	6		$0,33,3\frac{1}{3}$
124 soldi		1 ducat current	0	3	$5\frac{1}{3}$		$0,76,5\frac{35}{81}$
24 gross		*1 ducat of exchange	0	4	4		$0,92,5\frac{25}{27}$
17 livres		1 chequin	0	9	2		$2,03,7\frac{1}{27}$

TURKEY.

Morea, Candia, Cyprus, &c.

			£.	s.	d.		D. c. m.
1 manger	=		= 0	0	$0\frac{3}{20}$	=	$0,00,2\frac{7}{9}$
4 manger		*1 asper	0	0	$0\frac{3}{5}$		$0,01,1\frac{1}{9}$
3 aspers		1 parac	0	0	$1\frac{4}{5}$		$0,03,3\frac{1}{3}$
5 aspers		1 bestic	0	0	3		$0,05,5\frac{5}{9}$
10 aspers		1 oftic	0	0	6		$0,11,1\frac{1}{9}$
20 aspers		1 folota	0	1	0		$0,22,2\frac{2}{9}$
80 aspers		*1 piastre	0	4	0		$0,88,8\frac{8}{9}$
100 aspers		1 caragrough	0	5	0		$1,11,1\frac{1}{9}$
10 folotas		1 xeriff	0	10	0		$2,22,2\frac{2}{9}$

ASIA.

ARABIA.

Medina, Mecca, Mocha, &c.

			£.	s.	d.		D. c. m.
1 carret	=	=	0	0	0$\frac{1}{8}$	=	0,00,2$\frac{1}{54}$
5$\frac{1}{4}$ carrets		1 caveer	0	0	0$\frac{135}{200}$		0,01,2$\frac{1}{2}$
7 carrets		1 comashee	0	0	0$\frac{7}{8}$		0,01,6$\frac{11}{54}$
80 carrets		1 larin	0	0	10		0,18,5$\frac{5}{27}$
18 comashees		1 abyss	0	1	4$\frac{1}{5}$		0,30,0
60 comashees		*1 piastre	0	4	6		1,00,0
80 caveers		1 dollar	0	4	6		1,00,0
100 comashees		1 sequin	0	7	6		1,66,6$\frac{2}{3}$
80 larins		*1 tomond	3	7	6		15,00,0

PERSIA.

Isspahan, Ormus, Gombrun, &c.

			£.	s.	d.		D. c. m.
1 coz	=	=	0	0	0$\frac{2}{5}$	=	0,00,7$\frac{7}{27}$
4 coz		1 bisti	0	0	1$\frac{3}{5}$		0,02,9$\frac{1}{27}$
10 coz		1 shahee	0	0	4		0,07,4$\frac{2}{27}$
20 coz		1 mamooda	0	0	8		0,14,8$\frac{4}{27}$
25 coz		1 larin	0	0	10		0,18,5$\frac{5}{27}$
4 shahees		1 abashee	0	1	4		0,29,6$\frac{8}{27}$
5 abashees		1 Or	0	6	8		1,48,1$\frac{13}{27}$
12 abashees		1 bovello	0	16	0		3,55,5$\frac{5}{9}$
50 abashees		*1 tomond	3	6	8		14,81,4$\frac{22}{27}$

MOGUL.

Guzzurat, Surat, Cambay, &c.

			£.	s.	d.		D. c. m.
1 pecka	=	=	0	0	0$\frac{15}{64}$	=	0,00.4$\frac{49}{144}$
2 peckas		1 pice	0	0	0$\frac{15}{32}$		0,00,8$\frac{49}{72}$
4 pices		1 fanam	0	0	1$\frac{7}{8}$		0,03,4$\frac{13}{18}$
5 pices		1 viz	0	0	2$\frac{11}{32}$		0,04.3$\frac{187}{216}$
16 pices		1 ana	0	0	7$\frac{1}{2}$		0,13,8$\frac{8}{9}$
4 anas		1 rupee	0	2	6		0,55,5$\frac{5}{9}$
2 rupees		1 English crown	0	5	0		1,11,1$\frac{1}{9}$
14 anas		1 pagoda	0	8	9		1.94,4$\frac{4}{9}$
4 pagodas		1 gold rupee	1	15	0		7,77,7$\frac{7}{9}$

Malabar, Bombay, Dabul, &c.

			£.	s.	d.		D. c. m.
*1 budgrook	=	=	0	0	0$\frac{27}{800}$	=	0.00.0$\frac{5}{8}$
2 budgrooks		*1 re	0	0	0$\frac{27}{400}$		0.00 1$\frac{1}{4}$
5 rez		1 pice	0	0	0$\frac{27}{80}$		0,00.6$\frac{1}{4}$
16 pices		1 laree	0	0	5$\frac{2}{5}$		0,10.0
20 pices		1 quarter	0	0	6$\frac{3}{4}$		0,12.5
240 rez		1 xeraphim	0	1	4$\frac{1}{2}$		0,30.5$\frac{5}{9}$
4 quarters		1 rupee	0	2	3		0,50.0,
14 quarters		1 pagoda	0	8	0		1,77.7$\frac{7}{9}$
60 quarters		1 gold rupee	1	15	0		7,77,7$\frac{7}{9}$

Malabar, Goa, Visapour, &c.

				£.	s.	d.		D. c. m.
*1 re	=		=	0	0	$0\frac{27}{400}$	=	$0,00,1\frac{1}{4}$
2 rez		1 bazaraco		0	0	$0\frac{27}{100}$		$0,00,2\frac{1}{2}$
2 bazaracos		1 pecka		0	0	$0\frac{27}{100}$		0,00,5
20 rez		1 vintin		0	0	$1\frac{7}{20}$		0,02,5
4 vintins		1 laree		0	0	$5\frac{2}{5}$		0,10,0
3 larees		1 xeraphim		0	1	$4\frac{1}{5}$		0,30,0
42 vintins		1 tangu		0	4	6		1,00,0
4 tangus		1 paru		0	18	0		4,00,0
8 tangus		1 gold rupee		1	15	0		$7,77,7\frac{7}{9}$

Coromandel, Madras, Pondicherry, &c.

				£.	s.	d.		D. c. m.
1 cash	=		=	0	0	$0\frac{3}{50}$	=	$0,00,0\frac{26}{35}$
5 cash		1 viz		0	0	$0\frac{3}{10}$		$0,00,3\frac{17}{36}$
2 viz		1 pice		0	0	$0\frac{3}{8}$		$0,00,6\frac{17}{18}$
6 pices		1 pical		0	0	$2\frac{1}{4}$		$0,04,1\frac{2}{3}$
8 pices		1 fanam		0	0	3		$0,05,5\frac{5}{9}$
10 fanams		1 rupee		0	2	6		$0,55,5\frac{5}{9}$
2 rupees		1 English crown		0	5	0		$1,11,1\frac{1}{9}$
36 fanams		1 pagoda		0	8	9		$1,94,4\frac{4}{9}$
4 pagodas		1 gold rupee		1	15	0		$7,77,7\frac{7}{9}$

Bengal, Callicut, Fort-William, &c.

				£.	s.	d.		D. c. m.
1 pice	=		=	0	0	$0\frac{5}{32}$	=	$0,00,2\frac{61}{72}$
4 pices		1 fanam		0	0	$0\frac{5}{8}$		$0,01,1\frac{7}{18}$
6 pices		1 viz		0	0	$0\frac{15}{16}$		$0,01,7\frac{10}{13}$
12 pices		1 ana		0	0	$1\frac{7}{8}$		$0,03,5\frac{7}{13}$
10 anas		1 fiano		0	1	$6\frac{3}{4}$		$0,35,5\frac{5}{13}$
16 anas		1 rupee		0	2	6		$0,55,5\frac{5}{9}$
2 rupees		1 French ecu		0	5	0		$1,11,1\frac{1}{9}$
2 rupees		1 English crown		0	5	0		$1,11,1\frac{1}{9}$
56 anas		1 pagoda		0	8	9		$1,94,4\frac{4}{9}$

SIAM.

Pegu, Malacca, Cambodia, Sumatra, Java, Berneo, &c.

				£.	s.	d.		D. c. m.
1 cori	=		=	0	0	$0\frac{3}{400000}$	=	$0,00,0\frac{1}{720}$
800 cori		1 fettee		0	0	$0\frac{3}{50}$		$0,00,1\frac{1}{9}$
125 fettees		1 falteleer		0	0	$7\frac{1}{2}$		$0,13,8\frac{8}{9}$
250 fettees		1 fooco		0	1	3		$0,27,7\frac{7}{9}$
500 fettees		1 tutal		0	2	6		$0,55,5\frac{5}{9}$
1000 fettees		1 dollar		0	4	6		1,00,0
2 ticals		1 rial		0	5	0		$1,11,1\frac{1}{9}$
4 foocos		1 ecu		0	5	0		$1,11,1\frac{1}{9}$
8 falteleers		1 crown		0	5	0		$1,11,1\frac{1}{9}$

CHINA.

Pekin, Canton, &c.

				£.	s.	d.		D. c. m.
1 caxa	=		=	0	0	$0\frac{2}{25}$	=	$0,00,1\frac{13}{27}$
10 caxa		1 candareen		0	0	$0\frac{4}{5}$		$0,01,4\frac{22}{27}$
10 candareens		1 mace		0	0	8		$0,14,8\frac{4}{27}$
85 candareens		1 rupee		0	2	6		$0,55,5\frac{5}{9}$
2 rupees		1 dollar		0	4	6		1,00,0
70 candareens		1 rix-dollar		0	4	$4\frac{1}{2}$		$0,97,2\frac{2}{9}$
70 maces		1 ecu		0	5	0		$1,11,1\frac{1}{9}$
2 rupees		1 crown		0	5	0		$1,11,1\frac{1}{9}$
10 maces		*1 tale		0	6	8		$1,48,1\frac{13}{27}$

JAPAN.

Jeddo, Mecco, &c.

				£.	s.	d.		D. c. m.
1 piti	=		=	0	0	$0\frac{1}{5}$	=	$0,00,3\frac{19}{27}$
20 pitis		1 mace		0	0	4		$0,07,4\frac{2}{27}$
15 maces		1 ounce of silver		0	4	$10\frac{1}{3}$		$1,08,0\frac{20}{81}$
20 maces		1 tale		0	6	8		$1,48,1\frac{13}{27}$
30 maces		1 ingot		0	9	$8\frac{2}{3}$		$2,16,0\frac{40}{81}$
13 ounces silver		1 ounce of gold		3	3	0		$14,81,4\frac{22}{27}$
2 ounces gold		1 Japanese		6	6	0		$29,62,9\frac{17}{27}$
2 Japaneses		1 double		12	12	0		$59,25,9\frac{7}{27}$
21 ounces gold		*1 cattee		66	3	0		294,00,0

AFRICA.

EGYPT.

Old and New-Cairo, Alexandria, Sayde, &c.

				£.	s.	d.		D. c. m.
1 asper	=		=	0	0	$0\frac{5}{9}$	=	$0,01,0\frac{70}{243}$
3 aspers		1 medin		0	0	$1\frac{2}{3}$		$0,03,0\frac{210}{243}$
24 medins		1 Italian ducat		0	3	4		$0,74,0\frac{20}{27}$
80 aspers		*1 piastre		0	4	0		$0,88,8\frac{8}{9}$
30 medins		1 dollar		0	4	6		1,00,0
96 aspers		1 ecu		0	5	0		$1,11,1\frac{1}{9}$
32 medins		1 crown		0	5	0		$1,11,1\frac{1}{9}$
200 aspers		1 sultanin		0	10	0		$2,22,2\frac{2}{9}$
70 medins		*1 pargo dollar		0	10	6		$2,33,3\frac{1}{3}$

BARBARY.

Algiers, Tunis, Tripoly, Una, &c.

				£.	s.	d.		D. c. m.
1 asper	=		=	0	0	$0\frac{5}{9}$	=	$0,01,0\frac{70}{243}$
3 aspers		1 medin		0	0	$1\frac{2}{3}$		$0,03,0\frac{210}{243}$
10 aspers		1 rial, old plate		0	0	$6\frac{1}{4}$		$0,11,5\frac{20}{27}$
3 rials		1 double		0	1	$1\frac{1}{2}$		0,25,0
4 doubles		1 dollar		0	4	6		1,00,0
24 medins		1 silver chequin		0	3	4		$0,74,0\frac{20}{27}$
30 medins		1 dollar		0	4	6		1,09,0
180 aspers		1 zequin		0	8	10		$1,96,2\frac{26}{27}$
15 doubles		1 pistole		0	16	9		$3,72,2\frac{2}{9}$

MOROCCO.

Santa-Cruz, Mequinez, Fez, Tangiers, Sallee, &c.

				£.	s.	d.		D. c. m.
1 fluce	=		=	0	0	0$\frac{1}{12}$	=	0,00,1$\frac{44}{81}$
24 fluces		1 blanquil		0	0	2		0,03,7$\frac{1}{27}$
4 blanquils		1 ounce		0	0	8		0,14,8$\frac{4}{27}$
7 blanquils		1 octavo		0	1	2		0,25,9$\frac{7}{27}$
14 blanquils		1 quarto		0	2	4		0,51,8$\frac{14}{27}$
2 quartos		1 medio		0	4	8		1,03,7$\frac{1}{27}$
28 blanquils		1 dollar		0	4	6		1,00,0
54 blanquils		1 zequin		0	9	0		2,00,0
100 blanquils		1 pistole		0	16	9		3,72,2$\frac{2}{9}$

AMERICA.

ENGLISH WEST-INDIES.

Jamaica, Barbadoes, &c

				£.	s.	d.		D. c. m.
*1 halfpenny	=		=	0	0	0$\frac{57}{100}$	=	0,00,6$\frac{43}{72}$
2 halfpence		*1 penny		0	0	0$\frac{57}{85}$		0,01,3$\frac{7}{36}$
7$\frac{1}{2}$ pence		1 bitt		0	0	5$\frac{7}{8}$		0,10,8$\frac{41}{54}$
12 pence		*1 shilling		0	0	8$\frac{11}{28}$		0,15,8$\frac{1}{3}$
75 pence		1 dollar		0	4	6		1,00,0
7 shillings		1 crown		0	5	0		1,11,1$\frac{1}{9}$
20 shillings		*1 pound		0	14	3		2,16,6$\frac{2}{3}$
24 shillings		1 pistole		0	16	9		3,72,2$\frac{2}{9}$
30 shillings		1 guinea		1	1	0		4,66,6$\frac{2}{3}$

FRENCH WEST-INDIES.

St. Domingo, Martinico, &c.

				£.	s.	d.		D. c. m.
*1 half sol	=		=	0	0	0$\frac{117}{640}$	=	0,00,3$\frac{37}{96}$
2 half sols		1 sol		0	0	0$\frac{117}{320}$		0,00,6$\frac{37}{48}$
7$\frac{1}{2}$ half sols		1 half sealin		0	0	2$\frac{11}{16}$		0,04,9$\frac{83}{108}$
15 sols		1 sealin		0	0	5$\frac{3}{8}$		
20 sols		*1 livre		0	0	7$\frac{5}{16}$		
7 livres		1 dollar		0	4	6		
8 livres		1 ecu		0	4	10$\frac{1}{2}$		
26 livres		1 pistole		0	16	9		
32 shillings		1 Louis d'or		1	0	0		

NOTE.—For all the *Spanish*, *French*, *Portuguese*, *Dutch*, and *Danish* Dominions, either on the Continent or in the West-Indies, see the monies of the respective nations.

CONTINENT.

Canada, Florida, Cayenne, &c.

			£.	s.	d.		D. c. m.
*1 denier	=	=	0	0	$0\frac{1}{20}$	=	$0,00,0\frac{25}{27}$
12 deniers	*1 sol		0	0	$0\frac{1}{5}$		$0,01,1\frac{1}{9}$
20 deniers	*1 livre		0	0	1		$0,01,8\frac{14}{27}$
2 livres			0	0	2		$0,03,7\frac{1}{27}$
3 livres			0	0	3		$0,05,5\frac{5}{9}$
4 livres			0	0	4		$0,07,4\frac{2}{27}$
5 livres			0	0	5		$0,09,2\frac{16}{27}$
6 livres			0	0	6		$0,11,1\frac{1}{9}$
7 livres			0	0	7		$0,12,9\frac{17}{27}$
8 livres			0	0	8		$0,14,8\frac{4}{27}$
9 livres			0	0	9		$0,16,6\frac{2}{3}$
10 livres	1 livre Tournois		0	0	10		$0,18,5\frac{5}{27}$

UNITED STATES.

						Sterling.	
*1 mill	=	=	$\frac{1}{1000}$ of a Doll.	=	0	0	$0\frac{27}{500}$
10 mills	1 cent		$\frac{1}{100}$ do.		0	0	$0\frac{27}{50}$
10 cents	1 dime		$\frac{1}{10}$ do.		0	0	$5\frac{2}{5}$
10 dimes	1 dollar				0	4	6
10 dollars	1 eagle				2	5	0
100 cents	1 dollar				0	4	6

NOTE.—A Dollar is the *money-unit* of the United States, and contains $375\frac{64}{100}$ grains of fine silver; and the money of account is as follows, viz. 10 mills make 1 cent, and 100 cents, 1 dollar.—Thus 9 dollars and 345 mills is $9\frac{345}{1000}$ = 9D. 34c. 5m.

Dollars and Cents, compared with the several currencies of the individual States, are in value as follows.

New-Hampshire, Vermont, Massachusetts, Rhode-Island, Connecticut, Virginia, and Kentucky.

D. c. s. D. c. s. D. c. s. d. D. c. d. D. c. d.
1=100=6——$\frac{1}{2}$=50=3——$\frac{1}{4}$=25=1 6——$\frac{1}{8}$=12$\frac{1}{2}$=9——$\frac{1}{16}$=6$\frac{1}{4}$=4$\frac{1}{2}$

New-York and North-Carolina.

D. s. D. s. D. s. D. s. D. s.
1 = 8——$\frac{1}{2}$ = 4——$\frac{1}{4}$ = 2——$\frac{1}{8}$ = 1——$\frac{1}{16}$ = 6

New-Jersey, Pennsylvania, Delaware, and Maryland.

D. s. d. D. s. d. D. s. d. D. d. D. d.
1 = 7 6——$\frac{1}{2}$ = 3 9——$\frac{1}{4}$ = 1 10$\frac{1}{2}$——$\frac{1}{8}$ = 11$\frac{1}{4}$——$\frac{1}{16}$ = 5$\frac{5}{8}$

South-Carolina and Georgia.

D. s. d. D. s. d. D. s. d. D. d. D. d.
1 = 4 8——$\frac{1}{2}$ = 2 4——$\frac{1}{4}$ = 1 2——$\frac{1}{8}$ = 7——$\frac{1}{16}$ = 3$\frac{1}{2}$

TABLE OF USEFUL THINGS.

A Ream of paper is 20 quires.
A quire of paper, 24 sheets.
A bale of paper, 10 reams.
A roll of parchment or vellum, 5 dozen, or 60 skins.
A dicker of hides, 10 skins.
A dicker of gloves, 10 dozen pair.
A last of hides, 20 dickers.
A load of timber, unhewed, 40 feet.
A load of square timber, 50 feet.
A load of one inch plank, 600 square feet.
A load of $1\frac{1}{2}$ inch plank, 400 square feet.
A load of 2 inch plank, 300 square feet.
A load of $2\frac{1}{2}$ inch plank, 240 square feet.
A load of 3 inch plank, 200 square feet.
A load of $3\frac{1}{2}$ inch plank, 170 square feet.
A load of 4 inch plank, 150 square feet.
One hundred of deals, 120.
A chaldron of coals at London, 36 bushels, or about $27\frac{1}{2}$ cwt.
A hogshead of wine, 63 gallons.
A hogshead of beer, 54 gallons.
A barrel of beer, 34 gallons; but within the bills of mortality, 36 gallons.
A barrel of ale, 32 gallons.
A weigh of cheese, 236 lbs.
Pence in a pound, 240.
Farthings, 960.
Eight gallons a bushel of corn.
Eight bushels of corn, a quarter.
A last of corn or rape seed, 10 quarters, or 80 bushels.
A last of pot ashes, cod fish, white herrings, meal, pitch, and tar, 12 barrels.
A last of flax and feathers, 17 cwt.—of gunpowder, 24 barrels, or 2400 lbs.—of wool, 4368 lbs.
An ell English is 45 inches.
An ell Flemish, 27 inches.
A tun of wine, 252 gallons.
Oil of Greenland, ditto.
A ton in weight is 20 cwt. of iron, &c. but in lead there is but 19 cwt. and a half, called a fother, which is 2184 lbs.
A tod of wool is 28 pounds.
A pack of wool, 364 pounds.
$5\frac{1}{2}$ yards, a pole.
40 poles in length, a furlong.
8 furlongs in length, a mile.
1760 yards, a mile.
144 square inches, a foot.
9 square feet, a yard.
40 square poles, a rood.
4 square roods, an acre.
4840 square yards, an acre.
640 square acres, a mile.
1728 solid inches, a foot.
27 solid feet, a yard.
48 solid feet of timber, a tun.
231 solid inches, a wine gallon.
282 solid inches, a beer or ale gallon.
1 lb. avoirdupois is equal to 7000 grains troy.
1 oz. avoirdupois is equal to $437\frac{1}{2}$ grains troy.
4 lb. avoirdupois is equal to 3 lb. troy nearly.
A firkin of butter, 56 lb.
A pipe or butt is 120 gallons.
A quintal or kintal, 1 cwt.
A load of bricks, 500; and plain tiles 1000.
A stone of fish, 8 lb. and of wool 14 lb. The same for horseman's weight, hay, iron, shot, &c.
A stone of glass, 5 lb. and a seam of glass, 24 stone.
A cade of red herrings, 500; of sprats, 1000.

Barrels of sundry Commodities.

Anchovies, 30 lbs.
A double barrel, 60 lbs.
Nuts and apples, 3 bushels.
Pot ash or barilla, 200 lbs.
Oil, $31\frac{1}{2}$ gallons.
Candles, 10 dozen lbs.
Raisins, 1 cwt.
Spanish tobacco, 2 to 3 cwt.
Gunpowder, 1 cwt.
Soap, 250 lbs.
Herrings, 32 gallons.
Figs, 3 qrs. 14 lbs. to $2\frac{1}{4}$ cwt.

By troy weight, bread, corn, gold, silver, jewels, and liquors, are weighed; and by avoirdupois weight, every thing else. By dry measure, corn, salt, coals, lead, ore, oysters, muscles, and other dry goods, are measured. A firkin of soap or herrings is equal to a firkin of ale, two making a barrel.

FINIS.