A COMPLEAT

TREATISE

OF PRACTICAL

NAVIGATION

Demonstrated from its First

PRINCIPLES

Together with all the Necessary TABLES.

To which are added,

The Useful *Theorems* of MENSURATION, SURVEYING and GAUGING; with their Application to Practice.

Written for the Use of the ACADEMY *in* Tower-Street.

By *ARCHIBALD PATOUN*,
Fellow of the Royal-Society.

To this Third Edition is added a Large *Supplement* by SAMUEL FULLER.

CONTAINING

Sundry *New* Methods of Sailing and Correcting the *Errors* and *Defects* in several Nautical INSTRUMENTS, *&c.*

DUBLIN:
Printed by and for SAM. FULLER, at the *Globe* in *Meath-street*. M.DCC.XXXV.

1375

TO

WILLIAM CLELAND, Esq;

Of Rayhouse in the County of Essex.

SIR,

HAving had the Honour of your Acquaintance for some Time, and considering your Qualifications in this Subject, together with the Obligations I lie under to you, I could not find a more proper Person to patronize this Work:

Wherefore, as a grateful Ac-
knowledgment of the many
Favours received, I humbly
beg leave to dedicate this Piece
to you; and am with the greatest
Regard

SIR,

Your most Obliged

and

most Humble Servant

ARCHIBALD PATOUN.

THE

PREFACE

T*HERE are so many Books of Navigation already extant, that it may seem impertinent to trouble the World with a new one, especially since some good Mathematicians both at home and abroad, and many who were perfect Masters of the Practice, have written on this Subject. The former of these being fond of ingenious Speculations, have generally been too prolix on the Theory, and too short on the practical Part. Whereas the latter have in a great Measure neglected the Theory, and not being very solicitous about Language or Method, have delivered the practical Rules in such a Manner, as they cannot be easily comprehended, and much less remembred, especially since there is seldom mention made of the Reasons on which they depend.*

But I am very far from finding Fault with all the Books on this Subject; for there are some very full both on Theory and Practice, against which, I have no other Objection, but that they are too tedious to be taught, and too dear to be purchased by most People.

Youth ought to learn the Elements from ſhorter Treatiſes, and afterwards at their Leiſure ſhould read general Syſtems in order to perfect them.

For theſe Reaſons, I have ventured to publiſh this ſmall Treatiſe; wherein I have made it my chief Buſineſs to keep a due Medium betwixt the two Extremes, into which the ſpeculative Writers on the one Hand, and the practical ones on the other are apt to run. I have laid down all the uſeful Rules, and troubled the Reader with no more of the Theory than is neceſſary to explain them. I have alſo explained the principles of Menſuration, Surveying and Gauging, and ſhewed how they are applied to Practice, in order that my Book might better anſwer the particular End for which it is deſigned, namely, the Inſtruction of the young Gentlemen of Mr. WATTS's Academy.

As for the particular Contents of each Section, the Reader will find them at the End of the Book, and therefore they need not be repeated here. I ſhall only obſerve, that I have deſignedly omitted Great Circle-Sailing, *as being only ſpeculative, and depending on* Spherical Trigonometry, *which would require a particular Volum to explain it. There are indeed two or three Problems neceſſary in Practice, which depend on the Reſolution of Spherical Triangles; but for the Solution of theſe, I have laid down ſuch clear and ſhort Rules that no body can miſtake the Manner of applying them.*

I know, ſome are of Opinion, that the Demonſtrations are not to be eaſily learnt by every Capacity, on which account they teach the Practice only. This Book is therefore ſo written as to ſerve for their Purpoſe likewiſe, becauſe they may take the Rules alone without their Reaſons. It is true indeed, that there may be great Difficulty in finding out a proper Demonſtration; but after it is found, it is eaſier to be underſtood than that of which it is the Reaſon: and

therefore

therefore they who are not capable of understanding the Demonstrations, are much less capable of understanding the Practical Rules which depend on them. And I am inclined to believe, that what is commonly attributed to want of Genius in the Scholar, is often owing to want of Method and Perspicuity in the Master.

In preparing this Treatise for the Press, I own myself obliged to Mr. STIRLING, F. R. S. (of the Academy in Tower-Street) who on his first seeing my Papers, so far approved both of the Matter they contained and of the Order in which they were put together, as to think them fit to be made public with very little Alteration.

I acknowledge myself also obliged to that most excellent Book of Mr. HODGSON, entituled a System of Mathematics, which I take to be by far the most compleat Treatise on this Subject, both as to Theory and Practice. And on this Occasion I cannot but take notice of a late Writer, who has accused him and all Writers on Navigation of being guilty of a very gross Error; which is, that they took their Departure and Meridional Distance to be the same. Indeed in Plain-Sailing he took them to be the same; and is still of the same Opinion, notwithstanding what has been said to the contrary. But that he did not in other Cases take them to be the same, will appear by the following Passage of his Book at the End of Mercator's-Sailing.

" To give the Learner all the Helps necessary to a
" right Understanding of this most useful Part of
" Sailing, I shall endeavour (before I conclude
" this Part) to set his Notions right, concerning
" Difference of Longitude, Meridional Distance,
" and Departure; and let him see, that tho' these
" are synonymous Terms in Plain-Sailing, constant-
" ly signifying the same thing, and in every Ques-
" tion are represented by the same Right Line, yet

" in

" in the true Sailing they are eſſentially different
" one from another; and in the ſame Problem, are,
" as they really ſhould be, repreſented or expreſſed
" by different Lines, and are of different Values."

Now after reading this Paſſage, I ſhall leave it to the Public to judge as they think fit of the Writer, who owns that he has ſeen Mr. HODGSON'S Syſtem of Mathematics *by his quoting it, and at the ſame time affirms that he never met with an Author who made any Diſtinction between Departure and Meridional Diſtance.*

And I hope I may be excuſed for vindicating the Author to whom I have profeſſed myſelf ſo much obliged, leſt, from my Silence on this Head, it ſhould be ſuſpected that I were guilty of the ſame Error, which is unjuſtly laid to his Charge.

THE

CONTENTS.

SECT.

The CONTENTS.

The Supplement, *containing the easy Construction of the Tables of Sines,* &c. *Sailing by common Arithmetick, New and Full Moons, with the Visible Eclipses to the Year* 1657. *Also the sundry Errors and Defects in Charts, Compasses, Quadrant,* &c. *with proper Helps proposed.*

To which are added the Tables necessary in Navigation.

THE

THE PRINCIPLES OF NAVIGATION.

DEFINITION.

NAVIGATION is that Art whereby we are enabled to carry a Ship from one Port to another.

This Science depends upon ſome Parts of the Mathematicks, which muſt be known before we can treat of it; therefore we ſhall firſt lay down the Principles of *Geometry*.

SECT. I.

Of ſuch Geometrical Propoſitions as are abſolutely neceſſary for NAVIGATION.

ART. I. GEOMETRY is that Science wherein we conſider the Properties of *Magnitude.*

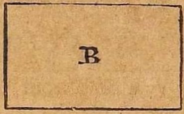
2. A Point is that which is not made up of Parts, or which is of it ſelf indiviſible, as A.

3. A Line is a Length without Breadth, as B——

4. The Extremities of a Line are Points; as the Extremities of the Line AB, are the Points A and B.

5. If the Line A B be the neareſt Diſtance between its Extremes A and B, then it is call'd a ſtrait Line, as A B in the former Figure; but if it be not the neareſt Diſtance, then it is called a curve Line, as A B.

6. A Surface is that which is conſidered as having only Length and Breadth, but no Thickneſs, as B.



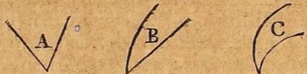
7. The Terms of a Surface are Lines.

8. A plain Surface is that which lies equally between its Extremes.

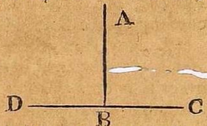
9. The Inclination between two Lines meeting one another, (provided they do not make one continued

tinued Line) or the Opening between them, is called an Angle; thus the Inclination of the Line A B to the Line C B, meeting one another at B, or the Opening between the two Lines A B and C B, is called an Angle.

10. When the Lines forming the Angle are right Lines, then it is called a right lin'd Angle, as A; if one of them be right and the other curv'd, it is called a mix'd Angle, as B; if both of them be curv'd, it is called a curve-lin'd Angle, as C.

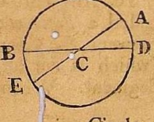


11. If a right Line A B, fall upon another D C, ſo as to incline neither to the one ſide nor to the other, but make the Angles A B D, A B C on each ſide equal to one another, then the Line A B is ſaid to be perpendicular to the Line D C; and the two Angles are called right Angles.



12. An obtuſe Angle is that which is greater than a right one, as A; and an acute Angle, that which is leſs than a right one as B.

13. If a right Line D C be faſtened at one of its Ends C, and the other End D, be carried quite round, then the Space comprehended is called a *Circle*; the curve Line deſcribed by the Point D, is called the *Perifery* or *Circumference* of the



 Circle;

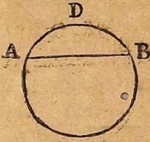
Circle; the fix'd Point C, is called the *Center* of it.

14. The deſcribing Line CD, is called the Radius, *viz.* any Line drawn from the Center to the Circumference; whence all Radii of the ſame or equal Circles are equal.

15. Any Line drawn through the Center, and terminated both Ways by the Circumference, is called a *Diameter*, as BD is a Diameter of the Circle BADE. And the Diameter divides the Circle and Circumference into two equal Parts, and is double the Radius.

16. The Circumference of every Circle is ſuppoſed to be divided into 360 equal Parts, called *Degrees*; and each Degree is divided into 60 equal Parts, called *Minutes*; and each Minute into 60 equal Parts, called *Seconds*; and theſe into *Thirds*, *Fourths*, &c. theſe Parts being greater or leſs according as the Radius is.

17. Any Part of the Circumference is called an *Arch*, or *Arc*; and is called an *Arc* of as many Degrees as it contains Parts of the 360, into which the Circumference was divided: Thus if AD (in the former Figure) be the ⅛ of the Circumference, then the *Arc* AD is an *Arc* of 45 Degrees.



18. A Line drawn from one End of an *Arc* to the other, is called a *Chord*, and is the Meaſure of the *Arc*; thus the right Line AB is the Chord of the *Arc* ADB.

19. Any Part of a Circle cut off by a Chord, is called a *Segment*; thus the Space comprehended between the Chord AB and Circumference ADB (which is cut off by the Chord AB) is called a Segment. Whence it is plain,

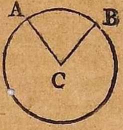
1ſt,

1ſt, That all Chords divide the Circle into two Segments.

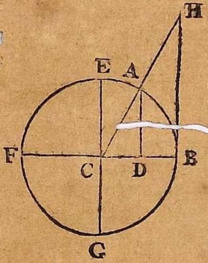
2dly, The leſs the Chord is the more unequal are the Segments, & *e contra.*

3dly, When the Chord is greateſt, *viz.* when it is a Diameter, then the Segments are equal, *viz.* each a Semicircle.

20. Any Part of a Circle (leſs than a Semicircle) contained between two Radii and an *Arc*, is called a *Sector*; thus the Space contained between the two Radii, A C, B C, and the *Arch* A B, is called a Sector.



21. The right Sine of any *Arc*, is a Line drawn perpendicular from one End of the *Arc*, to a Diameter drawn through the other End of the ſame *Arc*: thus A D is the right Sine of the *Arc* A B, it being a Line drawn from A, the one End of the *Arc* A B, perpendicular to C B, a Diameter paſſing through B, the other End of the *Arc* A B.



Now the Sines ſtanding on the ſame Diameter ſtill encreaſe till they come to the Center, and then becoming the Radius, it is plain that the Radius E C is the greateſt poſſible Sine, and for that Reaſon is called the *whole-Sine.*

Since the whole Sine E C muſt be perpendicular to the Diameter F B (by *Def.* 21.) therefore producing the Diameter E G, the two Diameters, F B, E G, muſt croſs one another at right Angles, and ſo the Circumference of the Circle muſt be divided by them into four parts E B, B G, G F, and F E, and theſe

these four parts are equal to one another (by *Def.* 11.) and so E B a Quadrant, or fourth Part of the Circumference; therefore the Radius E C is always the Sine of the Quadrant, or fourth Part of the Circle E B.

Sines are said to be of so many Degrees, as the *Arch* contains Parts of the 360, into which the Circumference is supposed to be divided; so the Radius being the Sine of a Quadrant, or fourth Part of the Circumference which contains 90 Degrees; (the fourth part of 360) therefore the Radius must be the Sine of 90 Degrees.

22. That Part of the Radius comprehended between the Extremity of the right Sine and the lower End of the *Arch, viz.* D B, is called the versed Sine of the *Arch* A B.

23. If to any Point in the Circumference, *viz.* B, there be drawn a Diameter F C B, and from the point B perpendicular to that Diameter, there be drawn the Line B H; that Line is called a *Tangent* to the Circle in the Point B, which Tangent can touch the Circle only in one point B, else if it touch'd it in more, it would go within it, and so not be a Tangent but a Chord (by *Art.* 18.)

24. The Tangent of any *Arch* A B, is a right Line drawn perpendicular to a Diameter through the one End of the *Arch* B, and terminated by a Line C A H, drawn from the Center through the other End A; thus B H is the Tangent of the *Arch* A B.

25. And the Line which terminates the Tangent, *viz.* C H, is called the Secant of the *Arch* A B.

26. What an *Arch* wants of a Quadrant is called the *Complement* of that *Arch*; thus A E being what the *Arch* A B wants of the Quadrant E B; is called the Complement of the *Arch* A B.

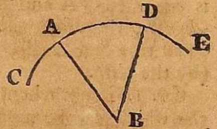
27. And what an *Arch* wants of a Semicircle is called the *Supplement* of that *Arch*; thus since A F is

is what the *Arch* A B wants of the Semicircle B A F, it is called the Supplement of the *Arch* A B.

28. The Sine, Tangent, &c. of the Complement of any *Arch*, is called the Co-Sine, Co-Tangent, &c. of that *Arch*; thus the Sine, Tangent, &c. of the *Arch* A E is called the Co-Sine, Co-Tangent, &c. of the *Arch* A B.

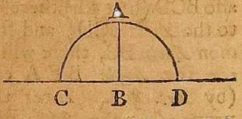
29. The Sine of the Supplement of an *Arch* is the ſame with the Sine of the *Arch* itſelf, for drawing them according to the Definitions, there reſults the ſelf ſame Line.

30. A right lin'd *Angle* is meaſured by an *Arch* of a Circle deſcribed upon the angular Point as a Center is comprehended between the two Legs that form the *Angle*; thus the *Angle* A B D is meaſured by the *Arch* A D of the Circle C A D E that is deſcribed upon the Point B as a Center; and the *Angle* is ſaid to be of as many Degrees as the *Arch* is; ſo if the *Arch* A D be 45 Degrees, then the *Angle* A B D is ſaid to be an *Angle* of 45 Degrees.



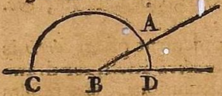
Hence *Angles* are greater or leſs according as the *Arch* deſcribed about the angular Point, and terminated by the two Legs, contain a greater or leſs Number of Degrees.

31. When one Line falls perpendicularly on another, (as A B on C D) then the *Angles* are right; (by the 11th) and deſcribing a Circle on the Center B, ſince the *Angles* A B C, A B D are equal, their Meaſures muſt be ſo too, *i. e.* the *Arches* AC, AD muſt be equal; but the whole C A D is a Semicircle



micircle, ſince C D, a Line paſſing through the Center B, is a Diameter, therefore each of the Parts A C, A D is a Quadrant, *i. e.* 90 Degrees; ſo the Meaſure of a right *Angle* is always 90 Degrees.

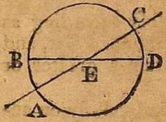
32. If one Line A B fall any way upon another, C D then the Sum of the two *Angles* A B C, A B D is always equal to the Sum of two right *Angles*. For on the point B, deſcribing the Circle C A D, it is plain, that C A D is a Semicircle, (by 15th); but C A D is equal to C A and A D the Meaſures of the two *Angles*; therefore the Sum of the two *Angles* is equal to a Semicircle, that is, to two right *Angles* (by the laſt).



Cor. 1. From whence it is plain, that all the *Angles* which can be made from a point in any Line, towards one ſide of the Line, are equal to two right *Angles*.

2. And that all the *Angles* which can be made about a Point, are equal to four right ones.

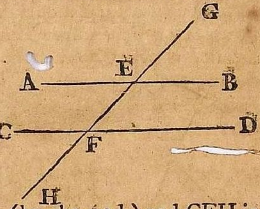
33. If one Line A C croſs another B D in the Point E, then the oppoſite *Angles* are equal, *viz.* BEA to CED, and BEC equal to AED. For upon the point E, as a Center, deſcribing the Circle ABCD, it is plain ABC is a Semicircle, as alſo BCD (by 15th) therefore the *Arch* ABC is equal to the *Arch* BCD; and from both taking the common *Arch* BC, there will remain AB equal to CD, *i. e.* the *Angle* B E A equal to the *Angle* C E D (by *Art.* 30). After the ſame Manner we may prove, that the *Angle* BEC is equal to the *Angle* AED.



34. Lines which are equally diſtant from one another are called *Parallel Lines*; as AB, CD.

35. If a Line G H croſs two Parallels A B, C D, then the external *Angles* are equal, *viz.* G E B equal to C F H and A E G equal H F D. For ſince A B and CD are parallel to one another, they may be conſidered as one broad Line, and G H croſſing it; then the vertical or oppoſite *Angles* GEB, CFH are equal (by the 33d) as alſo A E G and H F D by the ſame.

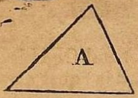
36. If a Line G H croſs two Parallels A B, C D then the alternate *Angles*, *viz.* A E F and E F D, or C F E and F E B are equal; that is, the *Angle* A E F is equal to the *Angle* E F D, and the *Angle* C F E is equal to the *Angle* F E B, for GEB is equal to AEF (by the 33d.) and CFH is equal to E F D by the ſame, but G E B is equal to C F H by the laſt. Therefore A E F is equal to E F D; the ſame way we prove F E B equal to E F C.



37. If a Line GH croſs two parallel Lines AB, CD, then the external *Angle* GEB is equal to the internal oppoſite one EFD, or GEA equal to CFE. For the *Angle* AEF is equal to the *Angle* EFD by the laſt; but A E F is equal to G E B (by the 33d) therefore G E B is equal to E F D; the ſame Way we may prove A E G equal to C F E.

38. If a Line GH cross two parallel Lines AB, CD, then the Sum of the two internal *Angles*, *viz.* BEF and DFE, or AEF and CFE are equal to two right Angles; for since the *Angle* GEB is equal to the *Angle* EFD (by the last) to both add the *Angle* FEB, then GEB and BEF are equal to BEF and DFE; but GEB and BEF are equal to two right *Angles* (by the 32d) therefore BEF and DFE are also equal to two right *Angles*. The same Way we may prove that AEF and CFE are equal to two right *Angles*.

39. A Figure is any part of Space bounded, by Lines or a Line. If the bounding Lines be strait, it is called a *Rectilineal Figure* as A; if they be curved, it is called a curvilineal Figure as B or C; if they be partly curve Lines and partly strait, it is called a *mixt Figure* as D.



40. The most simple rectilineal Figure is that which is bounded by three right Lines, and is called a *Triangle*, as A.

41. Triangles are divided into different Kinds, both with Respect to their Sides and *Angles*: with Respect to their Sides they are commonly divided into three Kinds, *viz.*

42. A Triangle having all it's three Sides equal to one another, is called an *Equilateral Triangle*, as A.

43. A Triangle having two of it's Sides equal to one another, and the third Side not equal to either of them, is called an *Isosceles Triangle*, as B.

44. A Triangle having none of it's Sides equal to one another, is called a *Scalene Triangle*, as C.

45. Tri-

…, containing the Right Ascensions, Declinations, Longitudes and Latitudes of above Sixty Eminent F[ixed Stars,] from the Flamstedian Observations, and fitted to the Year 1726.

…of the Fixed Stars.	Right Ascension. D.	M.	S.	Declination. D.	M.	S.	Denomination		Longitude. D.	M.	S.	Latitude. D.	M.	S.	Denomination	Magnitude
…ia Scheder	6	18	14	55	02	08	N	♉	4	00	00	46	35	54	N	2 3
… of the *Whale*	7	26	47	19	29	49	S	♓	28	43	02	20	46	52	S	3
…ng … *Fishes*	26	59	42	01	25	20	N	♈	25	32	33	09	05	10	S	3
-	27	56	17	21	08	48	N	♉	03	49	18	09	57	12	N	2
…*libula*	41	59	58	0[illegible]	59	18	N		10	29	15	12	36	59	S	2
-	42	36	25	39	52	38	N		22	20	42	22	23	47	N	2 3
-	46	14	15	48	51	27	N		28	16	04	30	05	20	N	2
…*Aldebaran*	65	02	57	15	55	23	N	♊	05	57	00	05	29	49	S	1
-	74	07	14	4[illegible]	41	19	N		18	01	41	22	51	47	N	1
…*Regel*	7[illegible]	20	46	0[illegible]	33	00	S		13	00	00	31	10	11	S	1
…he *Bull*	[illegible]7	13	40	2[illegible]	20	33	N		18	43	56	05	21	34	N	2
…of *Orion*	[illegible]7	37	10	0[illegible]	04	18	N		17	07	33	16	51	30	S	2
…the *Bull*	[illegible]0	19	12	2[illegible]	56	20	N		20	57	28	02	14	24	S	3
…Belt of *Orion*	[illegible]0	34	23	0[illegible]	24	49	S		19	37	44	24	33	23	S	2
…f *Orion*	81	44	34	0[illegible]	07	01	S		20	51	45	25	[illegible]	17	S	2
…f *Orion*	85	04	33	07	19	15	N		24	55	28	16	04	26	S	1
-	98	16	32	1[illegible]	20	59	S	♋	10	19	01	39	32	08	S	1
…Northermost Twin	109	15	42	3[illegible]	27	09	N		16	25	20	10	03	48	N	1 2
…tar	111	14	01	0[illegible]	54	26	N		22	00	21	15	57	55	S	1 2
…the Southermost Twin	112	07	34	2[illegible]	39	25	N		19	26	09	06	39	27	N	2
-	138	31	18	0[illegible]	29	23	S	♌	23	27	59	22	24	32	S	2
…us	148	46	00	1[illegible]	17	04	N		26	01	20	00	26	38	N	1
…g Stars in the *Square* of the *Gr. Bear*	161	16	20	57	50	44	N		15	34	12	45	06	16	N	2
-	161	37	22	16	51	06	S		19	56	03	22	42	47	S	3
…ding Stars in the Sqr. of the *Gr. Bear*	161	37	47	63	13	52	N		11	20	00	49	40	05	N	2
…f the Cup	164	34	01	21	20	16	S	♍	24	45	35	25	37	33	S	4
-	173	46	03	16	05	43	N		17	49	14	12	16	51	N	1 2
…ding Stars in the Sqr. of the *Gr. Bear*	174	49	43	55	13	05	N	♌	26	36	48	47	07	20	N	2
-	178	34	54	23	11	37	S	♎	08	25	35	21	44	26	S	4
…f the *Crow*	180	26	59	16	01	07	S		06	55	58	14	29	00	S	3
…llowing in the Sqr. of the *Gr. Bear*	180	27	34	58	34	48	N		27	10	40	41	29	36	N	2 3
…of the *Crow*	183	56	29	14	59	06	S		09	39	13	12	09	47	S	3
-	185	08	06	12	25	54	N		06	07	40	16	12	40	N	3
…the *Great Bear*	190	00	55	21	52	49	S		13	33	25	18	01	54	S	3
…the *Virgin Vindemiatrix*	192	30	42	[illegible]7	28	04	N	♍	05	03	05	54	19	35	N	2

The

The Names of the Fixed Stars.	Right Ascension. D.	M.	S.	Declination. D.	M.	S.	Denomination	
The *Virgin's Spike*	197	42	07	09	43	23	S	♎
The Middlemost of the three in the Tail of the *Great Bear*	197	43	57	56	22	18	N	♏
The last but one in the Tail of *Hydra*	196	02	04	21	43	20	S	
The last of the three in the Tail of the *Great Bear*	204	11	35	50	42	04	N	
In the following Shoulder of the *Centaur*	207	39	23	34	38	03	S	♏
Arcturus	210	47	42	10	38	44	N	♎
The Bright Star in the Southern *Ballance*	218	57	37	14	52	52	S	♏
The Bright Star in the Northern *Crown*	230	46	40	27	39	08	N	
The Bright Star in the Neck of the *Serpent*	232	41	37	07	18	12	N	♐
The Heart of the *Scorpion Antares*	243	10	10	25	47	22	S	
The Head of *Hercules*	[illegible]	32	58	14	43	16	N	
The Head of *Serpentarius*	260	32	35	12	46	49	N	
The following Shoulder of *Serpentarius*	262	29	02	04	42	23	N	
In the Head of the *Dragon*, a Bright Star	267	35	29	51	32	16	N	♑
The Bright Star in the *Harp*	276	54	03	38	33	02	N	
The middlemost of the three in the Head of *Sagittary*	282	04	37	22	06	12	S	
The Bright Star in the *Eagle*	294	19	56	08	10	01	N	♒
The Hand of *Antinous*	299	17	08	01	36	44	S	
The following Horn of *Capricorn*	301	24	21	15	37	01	S	
The following Shoulder of *Aquarius*	327	55	42	01	38	12	S	
The Bright Star in the Tail of *Capricorn*	321	58	46	17	19	10	S	
The Mouth of the Southern *Fish Fomalhaut*	340	34	51	31	03	20	N	
In the flying Horse, the bright Star *Scheat*	342	37	09	26	35	44	N	♓
In the flying Horse, the bright Star *Marchab*	342	46	03	13	43	40		♈
The Head of *Andromeda*	358	33	20	27	34	12	N	
In the flying Horse *Alfenib*	359	47	00	13	39	02	N	

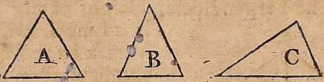
And for the Benefit of the Southern Navigation, I have added th[e] Right Ascensions and Declinations of the four remarkable S[tars] called the *Crosiers*; deduced from Dr. *Halley's* Observations.

The preceding of the two Middlemost in the *Cross*	180	21	30	57	10	37	S	♎
The Southern Foot of the *Cross*	183	05	20	61	31	16		
The Northermost of the Four	184	10	20	55	30	10		
The following, or Eastermost of the Four	188	10	48	58	05	57		

This to be plac'd opposite Page 22 of the Supplement, and read after Sect. VII.

A Table of all the Lunations and Visible Eclipses for 21 Years to come from the Beginning of

[Mar]ch F. ☽ D H	April N. ☽ D H	April F. ☽ D H	May N. ☽ D H	May F. ☽ D H	June N. ☽ D H	June F. ☽ D H	July N. ☽ D H	July F. ☽ D H	August N. ☽ D H	August F. ☽ D H	Sept. N. ☽ D H	Sept. F. ☽ D H	Octo. N. ☽ D H	Octo. F. ☽ D H	No[v]. N. ☽ D H
6. 0	29. 10.	13. 3	[illegible]. 9	14. 4.	27. 5.	13. 3	27. 4	12. 11	25. 9	10. 7.	[illegible]. 6.	9. 3	23. 2	8. 11	21. 2.
[illegible]. 8	19. 0	4. 2	18. 3.	3. 6.	17. 4	2. 10	16. 3.	1. 10. 31. 9.	15. 1	29. 6.	13. 10	28. 3	12. 7.	27. 1.	11. 5
4. 3	8. 2	22. 8.	7. 4.	22. 8.	6. 7	21. 1.	5. 11.	20. 5.	4. 11	19. 5	3. 1	17. [illegible]	2. 11 31. 9.	17. 5	30. 6.
3. 10	26. 7	11. 11.	26. 9	11. 1	25. 1	10. 3.	24. 4.	9. 6.	23. 7	9. 9	21. 9.	7. 1.	21. 9.	6. 2.	19. 10
1. 11. 31. 9	15. 2	29. 7.	14. 2.	29. 7	13. 2	27. 8	12. 4	26. 10	11. 8	26. 2.	10. 0	24. 5	9. 5.	24. 11.	8. 8
[illegible]1. 1	4. 5.	19. 10	4. 1	18. 7	2. 10	16. 4	1. 9. 31. 10	16. 3.	30. 1	15. 3	28. 6.	13. 5.	28. 1.	12. 11.	27. 6
[illegible]0. 5	23. 5	9. 2	23. 2	8. 11	21. [illegible]	6. 6	20. 6	6. 2	19. 8.	4. [illegible]	[illegible]. 1.	2. 10.	17. 11	2. 0.	16. 6
29. 5.	13. 7	28. 4	12. 10.	27. 3.	[illegible]	5. 7	10. 8	25. 2	8. [illegible]	[illegible]	[illegible]. 1	21. [illegible]	6. 2.	21. 3.	5. 6
8. 2	1. 10.	16. 4.	1. 9 30. 6.	16. 3	[illegible]	[illegible]. 0.	28. 8	13. 7.	[illegible]	12. [illegible]	25. 1	10. 9	24. 1.	9. 7.	23. 3
7. 3	20. 6.	5. 8.	20. 6	5. 0.	[illegible]	[illegible]. 0	18. 0	3. 10	[illegible]	[illegible]	14. 4.	29. 10	14. 2	28. 7.	12. 1.
25. 9.	9. 10.	24. 2.	9. 0.	24. [illegible]	[illegible]	[illegible]. 7.	7. 1.	22. 7	[illegible]	20. 5.	4. 8	19. [illegible]	3. 4.	18. 0.	2. 3
14. 0.	28. 1.	13. 1	28. 4	1[illegible]	[illegible]	1. 10	26. 9	11. 0.	24. 9.	10. 2	23. 9	10. 3	22. 7.	8. 3	21. 5
3. 9	16. 4.	1. 9	16. 5	[illegible]	[illegible]	30. 1.	14. 10	29. 5	13. 3.	27. 8.	11. 5.	26. 11	11. 7	26. 1	9. 8.
2. 9	6. 1	22. 7.	5. 11	[illegible]. 3	[illegible]	18. 6	3. 1.	18. 0	2. 3 31. 7.	16. 9.	30. 3.	15. 1.	30. 4	13. 6.	28. 8.
2. 1	25. 1	10. 10	24. 9	9. 6.	[illegible]	8. 3	22. 7	7. 1.	20. 8.	7. 1	19. 1.	4. 2.	19. 6	4. 6	18. 3.
1. 4. 1. 3	14. 5	29. 11	14. 1	28. 7.	12. 9	27. 3	11. 5.	26. 10	10. 2	24. 8.	8. 3	23. 8	8. 6	23. 0	7. 0.
9. 4.	3. 9	18. 3	2. 6.	17. 0.	[illegible]	15. 7.	29. 3.	14. 6	28. 0	13. 9	26. 11	11. 6.	26. 2	11. 5	24. 8.
[illegible]. 10.	22. 8	7. 1.	21. 5.	7. [illegible]	[illegible]	5. 11	19. 8.	4. 7.	17. 3.	3. [illegible]	15. 11	2. 9 30. 4.	15. 10	30. 4	14. 10
[illegible]4.	11. 2.	26. 8	11. 4	25. 10	9. 3	24. 9	9. 0.	23. 6.	7. 8	22. 1	5. 4.	20. 10	5. 1	19. 7.	3. 11
[illegible]4	30. 8	15. 9	29. 10.	15. [illegible]	28. 11.	13. 2	27. 10.	13. 5	26. 8	11. 4	24. 6.	10. 2.	24. 3	9. 11	22. 1.
[illegible]8.	18. 9	3. 11	18. 0	3. [illegible]	16. [illegible]	[illegible]. 6.	16. 5	1. 8 30. 11.	14. 6	20. 0.	13. 7	28. 1	12. 7.	27. 0.	11. 5.



45. Triangles, with Respect to their *Angles*, are divided into three different Kinds, *viz.*

46. A Triangle having one of it's *Angles*, right, is called a *Right-Angled Triangle*, as A.

47. A Triangle having one of it's *Angles* obtuse, or greater than a right *Angle*, is called an *Obtuse-Angled-Triangle*, as B.

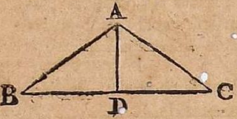
48. Lastly, a Triangle, having all it's Angles acute, is called an *Acute-Angled Triangle*, as C.

49. In all right-angled Triangles, the Sides comprehending the right *Angle* are called the Legs, and the Side opposite to the right *Angle* is called the *Hypothenuse.* Thus in the right angled Triangle ABC the right *Angle* being the two Sides AB and BC which comprehend the right *Angle* ABC, are the Legs of the Triangle, and the Side AC, which is opposite to the right *Angle* ABC, is the Hypothenuse of the right-angled-Triangle ABC.

50. Both obtuse and acute angled Triangles are in general called *Oblique-Angled-Triangles*; in all which any Side is called the *Base*, and the other two the Sides.

51. The

51. The Perpendicular Height of any Triangle is a Line drawn from the Vertex to the Base perpendicularly; thus if the Triangle A B C be proposed, and BC be made it's Base, then A will be the Vertex, *viz.* The *Angle* opposite to the Base; and if from A you draw the Line A D perpendicular to B C, then the Line A D is the Height of the Triangle A B C standing on B C as it's Base.



Hence all Triangles standing between the same Parallels have the same Height, since all the Perpendiculars are equal by the Nature of Parallels.

52. A Figure bounded by four Sides is called a *Quadrilateral* or *Quadrangular Figure*, as A B D C.

53. Quadrilateral Figures whose opposite Sides are parallel, are called *Parallelograms.* Thus in the quadrilateral Figure A B D C, if the Side A C be parallel to the Side B D which is opposite to it, and A B be parallel to C D, then the Figure A B D C is called a Parallelogram.

54. A Parallelogram having all it's Sides equal and *Angles* right, is called a *Square*; as A.

55. That which hath only the opposite Sides equal and it's *Angles* right, is called a *Rectangle*; as B.

56. That which hath equal Sides but oblique *Angles*, is called a *Rhombus*, as C; and is just an inclin'd Square.

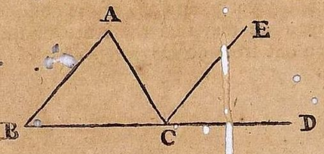
57. That

57. That which hath only the oppoſite Sides equal, and the *Angles* oblique, is called a *Rhomboides*, as D; and may be conceived as an inclined Rect-angle.

58. When none of the Sides are parallel to another, then the quadrilateral Figure is called a *Trapezium*.

59. Every other right-lined Figure, that has more Sides than four is in general called a *Polygon*. And Figures are called by particular Names according to the Number of their Sides, *viz.* One of five Sides is called a *Pentagon*, of ſix a *Hexagon*, of ſeven a *Heptagon*, and ſo on. When the Sides forming the Polygon are equal to one another, the Figure is called a regular Figure or Polygon.

60. In any Triangle A B C, one of it's Legs, as B C, being produced towards D, the external *Angle* A C D is equal to both the internal oppoſite ones taken together, *viz.* to A B C and B A C. In order to prove this, through C draw CE parallel to A B, then ſince C E is parallel to A B and A C croſſeth them, the *Angle* E C D is equal to A B C (by the 37th) and the *Angle* A C E equal to C A B (by the 36th) therefore the *Angles* E C D and E C A are equal to the *Angles* A B C and C A B; but the *Angles* E C D and E C A are together equal to the *Angle* A C D; therefore the *Angle* A C D is equal to both the *Angles* ABC and CAB taken together.



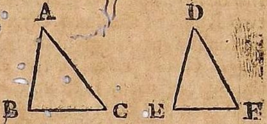
61. In any Triangle ABC all the three *Angles* taken together are equal to two right *Angles*. To prove this you must produce BC, one of it's Legs, to any Distance, suppose to D; then by the last Proposition, the external *Angle*, ACD, is equal to the Sum of the two internal opposite ones CAB and ABC; to both add the *Angle* ACB, then the Sum of the Angles ACD and ACB will be equal to the Sum of the Angles CAB and CBA and ACB. But the Sum of the Angles ACD and ACB, is equal to two right ones (by the 32d) therefore the Sum of the three Angles CAB and CBA and ACB, is equal to two right Angles; that is, the Sum of the three Angles of any Triangle ACB is equal to two right Angles.

Cor. 1. Hence in any Triangle given, if one of it's Angles be known, the Sum of the other two is also known; for since by the last, the Sum of all the three is equal to two right Angles, or a Semicircle, it is plain, that taking any one of them from a Semicircle or 180 Degrees, the Remainder will be the Sum of the other two. Thus (in the former Triangle ABC) if the Angle ABC be 40 Degrees, by taking 40 from 180 we have 140 Degrees; which is the Sum of the two Angles BAC, ACB, the Converse of this is also plain, *viz.* The Sum of any two Angles of a Triangle being given, the other Angle is also known by taking that Sum from 180 Degrees.

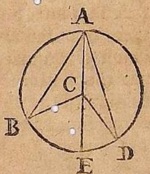
2. In any right angled Triangle, the two acute Angles must just make up a right one between them; consequently, any one of the oblique Angles being given we may find the other by subtracting the given one from 90 Degrees, which is the Sum of both.

to

62. If in any two Triangles, ABC, DEF, two Legs of the one, *viz.* AB and AC, be equal to two Legs in the other, *viz.* to DE and DF, each to each reſpectively *i. e.* AB to DE and AC to DF; and if the *Angles* included between the equal Legs be equal, *viz.* the *Angle* BAC equal to the *Angle* EDF; then I ſay, that the remaining Leg of the one ſhall be equal to the remaining Leg of the other, *viz.* BC to EF; and the *Angles* oppoſite to the equal Legs ſhall be equal, *viz.* ABC equal to DEF (being oppoſite to the equal Legs AC, and DF) alſo ACB equal to DFE (which are oppoſite to the equal Legs AB and DE) for if the Triangle ABC be ſuppoſed to be lifted up and put upon the Triangle DEF, and the point A on the point D; it is plain ſince BA and DE are of equal Length, the Point E will fall upon the Point B; and ſince the Angles BAC, EDF are equal, the Line AC will fall upon the Line DF, and they being of equal length, the Point C will fall upon the Point F, and ſo the Line BC will exactly agree with the Line EF, ſo the Triangle ABC will in all Reſpects be exactly equal to the Triangle DEF; and the *Angle* ABC will be equal to the *Angle* DEF, alſo the *Angle* ACB will be equal to the *Angle* DFE.



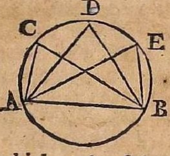
63. Any *Angle*, as BAD, at the Circumference of a Circle BADE, is but half the *Angle* BCD at the Center ſtanding on the ſame *Arch* BED. To demonſtrate this, draw through A and the Center C, the right Line ACE, then the *Angle* ECD is



equal

equal to both the *Angles* DAC and ADC (by the 60th); but ſince AC and CD are equal (being two Radii of the ſame Circle) it is plain the *Angles* ſubtended by them muſt be equal alſo; *i. e.* the *Angle* CAD equal to the *Angle* CDA, therefore the Sum of them is double any one of them, *i. e.* DAC and ADC is double of CAD, and therefore ECD is alſo double of DAC; the ſame Way it may be proved, that ECB is double of CAB, and therefore the Angle BCD is double of the *Angle* BAD, or BAD the half of BCD which was to be proved.

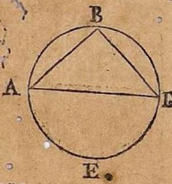
Cor. 1. Hence an *Angle* at the Circumference is meaſured by half the *Arch* it ſubtends, for the *Angle* at the Center (ſtanding on the ſame *Arch*) is meaſured by the whole *Arc* (by the 30th); but ſince the *Angle* at the Center is double that at the Circumference, it is plain the *Angle* at the Circumference muſt be meaſured by only half the *Arch* it ſtands upon.



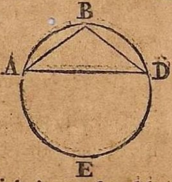
Cor. 2. Hence all *Angles* at the Circumference of a Circle, ſtanding on the ſame Chord AB are equal to one another; for by the laſt Corollary they are all meaſured by the ſame *Arc*, *viz.* half the Arc AB which each of them ſubtends.

Cor. 3. Hence an Angle in a Segment greater than a Semicircle is leſs than a right Angle; thus if ADB be a Segment, greater than a Semicircle, (ſee the laſt Figure) then the Arch AB, on which it ſtands, muſt be leſs than a Semicircle, and the half of it leſs than a Quadrant or a right Angle; but the Angle ADB in the Segment, is meaſured by the half of AB; therefore it is leſs than a right Angle.

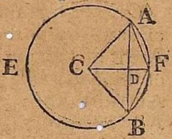
Cor. 4. An Angle in a Semicircle is a right Angle. For since ABD is a Semicircle, the Arch AED must also be a Semicircle; but the Angle A B D is measured by half the Arch AED, that is, by half a Semicircle or Quadrant; therefore the Angle ABD is a right one.



Cor. 5. Hence an Angle in a Segment less than a Semicircle, as ABD, is greater than a right Angle: for since the Arch A B D is less than a Semicircle, the Arch A E D must be greater than a Semicircle, and so it's half greater than a Quadrant, *i. e.* than the Measure of a right Angle; therefore the Angle A B D, which is measured by half the Arch AED is greater than a right Angle.



64. If from the Center C of the Circle A B E, there be let fall the Perpendicular CD on the Chord AB, then that Perpendicular will bisect the Chord AB in the Point D. To demonstrate this, draw from the Center to the Extremities of the Chord the two Lines C A, C B; then since the Lines C A and C B are equal, the Angles C A B, C B A, which they subtend must be equal also; but the Perpendicular CD divides the Triangle A C B into two right-angled Triangles A C D and C D B, in which the Sum of the Angles A C D and C A D in the one, is equal to the Sum of the Angles D C B and C B D in the other, each being equal to a right Angle, (by *Cor.* 2. of *Art.* 61.) but C A D is equal to C B D, therefore A C D is equal to BCD. So in the two



Triangles ACD and BCD, the two Legs AC and CD in the one are equal to the two Legs BC and CD in the other, each to each respectively, and the included Angles ACD and BCD are equal; therefore the remaining Legs AD and BD are equal (by the 62d) and consequently AB bisected in D.

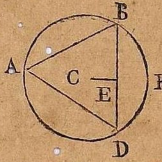
65. If from the Center C of a Circle ABE, there be drawn a Perpendicular CD on the Chord AB, and produced till it meet the Circle in F, then, I say, the Line CF bisects the Arch AB in the Point F; for (see the foregoing Figure) joining the Points A and F, F and B by the strait Lines AF, FB, then in the Triangles ADF, BDF, AD is equal to DB (by the last) and DF common to both; therefore AD and DF two Legs of the Triangle ADF, are equal to BD and DF two Legs of the Triangle BDF, and the included Angles ADF, BDF are equal, being both right, therefore (by the 62d) the remaining Legs AF and FB are equal, but in the same Circle equal Lines are Chords of equal Arches, therefore the Arches AF and FB are equal. So the whole Arch AFB is bisected in the Point F by the Line CF.

Cor. 1. From the 64th it follows, that any Line bisecting a Chord at right Angles is a Diameter; (if extended) for since (by the 64th) a Line drawn from the Center perpendicular to a Chord bisects that Chord at right Angles, therefore conversly a Line bisecting a Chord at right Angles, must pass thro' the Center and consequently be a Diameter.

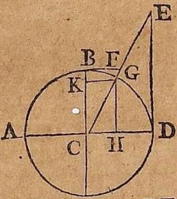
Cor. 2. From the two last it follows, that the Sine of any Arch is the half of the Chord of twice the Arch; for (see the foregoing Scheme) AD is the Sine of the Arch AF, by the Definition of a Sine, and AF is half the Arch AFB, and AD half the Chord AB (by the 64th); therefore the *Cor.* is plain.

66. In any Triangle, the half of each Side is the Sine of the opposite Angle; for if a Circle be suppo-
sed

sed to be drawn thro' the three angular Points A, B, and D of the Triangle ABD; then the Angle DAB is measured by half the Arch BKD (by *Cor.* 1. of *Art.* 63d); but the half of BD, *viz.* BE is the Sine of half the Arch BKD, *viz.* the Sine of BK (by *Cor.* 2. of the last) which is the Measure of the Angle BAD; therefore the half of BD is the Sine of the Angle BAD; the same Way it may be proved, that the Half of AD is the Sine of the Angle ABD, and the half of AB is the Sine of the Angle ADB.

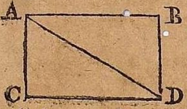


67. The Sine, Tangent, &c. of any Arch is called also the Sine, Tangent, &c. of the Angle whose Measure the Arch is; thus because the Arch GD is the Measure of the Angle GCD, and since GH is the Sine, DE the Tangent, HD the versed Sine, CE the Secant, also GK the Co-Sine, BF the Co-Tangent, and CF the Co-Secant, &c. of the Arch GD; then GH is called the Sine, DE the Tangent, &c. of the Angle GCD whose Measure is the Arch GD.



68. If two equal and parallel Lines, AB and CD, be joined by two others, AC and BD; then these shall also be equal and parallel. To demonstrate this, join the two opposite Angles A and D with the Line AD; then it is plain this Line AD divides the Quadrilateral, ACDB, into two Triangles, *viz.* ABD, ACD, in which AB, a Leg of the one, is equal to DC a Leg of the other by Supposition, and AD is common to both Triangles; and since AB is parallel to CD, the Angle BAD will

will be equal to the Angle A D C, (by *Art.* 36.) therefore in the two Triangles, B A, and A D, and the Angle B A D, is equal to C D and D A, and the Angle A D C, that is, two Legs and the included Angle in the one, is equal to two Legs and the included Angle in the other; (by



the 62d) so B D is equal to A C, and the Angle D A C is equal to the Angle A D B, therefore the Lines B D, A C are both equal and parallel.

Cor. 1. Hence it is plain, that the Quadrilateral ABDC is a Parallelogram, since the opposite Sides are parallel.

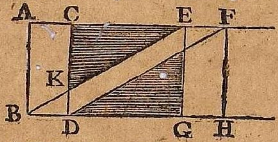
Cor. 2. In any Parallelogram the Line joining the opposite Angles (called the Diagonal) as A D, divides the Figure into two equal Parts, since it has been proved that the Triangles A B D, A C D are equal to one another.

Cor. 3. It follows also, that a Triangle A C D on the same Base C D, and between the same parallels with a Parallelogram A B D C, is the half of that Parallelogram.

Cor. 4. Hence it is plain, that the opposite Sides of a Parallelogram are equal; for it has been proved that A B D C being a Parallelogram, A B will be equal to C D and A C equal to B D.

69. All Parallelograms on the same or equal Bases, and between the same Parallels, are equal to one another; that is, if B D and G H be equal, and the Lines B H and A F be parallel, then the Parallelograms A B D C, B D F E, and E F H G are equal to one another. For AC is equal to EF each being equal to BD (by *Cor.* 4. of [illegible]) To both add CE, then AE will be equal to CF. So in the two Triangles A B E, C D F; A B, a Leg of the one, is equal to CD, a Leg in the other; and AE is equal

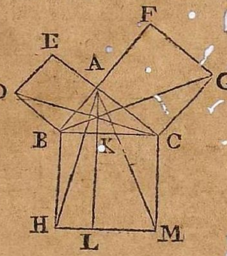
equal to CF and the Angle BAE is equal the Angle DCF (by the 37th); therefore the two Triangles ABE, CDF are equal (by the 62d); and taking the Triangle CKE from both, the Figure ABKC will be equal to the Figure KDFE; to both which add the little Triangle KBD, then the Parallelogram ABDC will be equal to the Parallelogram BDFE. The same Way it may be proved, that the Parallelogram EFHG is equal to the Parallelogram EFDB; so three Parallelograms ABDC, BDFE, and EFHG will be equal to one another.



Cor. Hence it is plain, that Triangles on the same Base, and between the same Parallels, are equal; since they are the half of the Parallelograms on the same Base and between the same Parallels.

70. In any right-angled Triangle, ABC, the Square of the Hypothenuse BC, *viz.* BCMH is equal to the Sum of the Squares made on the two Sides AB and AC, *viz.* to ABDE and ACGF. To demonstrate this, thro' the Point A draw AKL perpendicular to the Hypothenuse BC, join AH, AM, DC, and BG; then it is plain that DB is equal to BA (by the 54th), also BH is equal to BC (by the same); so in the two Triangles BDC, ABH the two Legs BD and BC in the one, are equal to the two Legs AB and BH in the other; and the included Angles DBC and ABH are also equal; (for DBA is equal to CBH being both right; to both add ABC, then 'tis plain that DBC is equal to ABH) therefore the Triangles DBC, ABH are equal (by the 62d), but the Triangle DBC is half of the Square ABDE (by *Cor.* 2 of 68th) and the Triangle ABH is half the Parallelogram BKLH (by the same), therefore half

half the Square ADBE is equal to half the Parallelogram BKLH. Consequently the Square ABDE is equal to the Parallelogram BKLH. The same Way it may be proved, that the Square ACGF is equal to the Parallelogram KCML. So the Sum of the Squares ABDE and ACGF is equal to the Sum of the Parallelograms BKLH and KCML; but the Sum of these Parallelograms is equal to the Square BCMH, therefore the Sum of the Squares on AB and AC is equal to the Square on BC.



Cor. 1. Hence in a right-angled Triangle, the Hypothenuse and one of the Legs being given, we may easily find the other, by taking the Square of the given Leg from the Square of the Hypothenuse, and the Square Root of the Remainder will be the Leg required.

Cor. 2. Hence, the Legs in a right-angled Triangle being given, we may find the Hypothenuse, by taking the Sum of the Squares of the given Legs, and extracting the Square Root of that Sum.

71. If upon the Line AB there be drawn a Semicircle ADB, whose Center is C, and on the Point C there be raised a Perpendicular to the Line AB, *viz.* CD; then 'tis plain the Arch DB is a Quadrant, or contains 90 Degrees; suppose the Arch DB to be divided into 9 equal Arches, each of which will contain 10 Degrees, then on the Point B raising BE perpendicular to the Line AB, it will be a Tangent to the Circle on the Point B, and if to every one of the Divisions of the Quadrant, *viz.* B 10, B 20, B 30, B 40, &c. you draw the Sine, Tangent,

gent, &c. (as in the Scheme) we shall have the Sine, Tangent, &c. to every ten Degrees in the Quadrant: and the same Way we may have the Sine, Tangent, &c. to every single Degree in the Quadrant,

Quadrant, by dividing into 90 equal Parts beginning from B, and drawing the Sine, Tangent, *&c.* to all the Arches beginning at the ſame Point B. By this Method they draw the Lines of Sines, Tangents, *&c.* of a certain Circle on the Scale; for after drawing them on the Circle they take the Length of them, and ſet them off in the Line drawn for that Purpoſe. The ſame Way, by ſuppoſing the Radius of any Number of equal Parts, (ſuppoſe 1000, or 10,000, *&c.*) 'tis plain the Sine, Tangent, *&c.* of every Arch muſt conſiſt of ſome Number of theſe equal Parts, and by computing them in Parts of the Radius, we have Tables of Sines, Tangents, *&c.* to every Arch in the Quadrant, called Natural Sines, Tangents, *&c.* and the Logarithms of theſe gives us Tables of Logarithmic Sines, Tangents, *&c.*

To underſtand the Nature of which, and the Method of uſing them, you muſt know that Logarithms are only artificial Numbers, contriv'd to avoid long Operations in natural Numbers, each of which has a Logarithm belonging to it. Their Nature is ſuch, that Addition of them anſwers to Multiplication in natural Numbers, and Subtraction anſwers to Diviſion; that is, when two Numbers are propos'd to be multiply'd into one another, if we take the Logarithms anſwering to the Numbers and add them together, the Sum will be the Logarithm anſwering to the natural Number, which is the Product of the two Numbers propoſed.

Again, when one Number is propoſed to be divided by another, if from the Logarithm of the Dividend we ſubtract the Logarithm of the Diviſor, the Remainder ſhall be the Logarithm of the Quotient.

Now to apply this to Practice: The firſt Table at the End of this Book, contains the Logarithms of all the Numbers from 1 to 10000; the Columns mark'd at the Top with *(N)* contain the natural

Numbers,

Numbers, and the adjacent Columns contain the Logarithms of theſe Numbers. So to find the Logarithm of any Integer Number between 1 and 10,000 we muſt look in the Columns mark'd with *N* at the Top, till we find the Number propos'd; and that ſtanding on the ſame Line with it on the adjacent Column is the Logarithm required.

Example. Let it be required to find the Logarithm of 365; by looking in the Table according to the above Direction, I find it to be 2.56229

The Reverſe of this, *viz.* Given a Logarithm, to find from your Tables the natural Number anſwering thereto, is perform'd by looking into the Columns mark'd with Logarithms at Top, for that which is either equal or neareſt to the one propos'd, and the Number anſwering to it in the adjacent Column is that required.

Example. Let it be required to find the natural Number anſwering to the Logarithm 2.56229, by proceeding according to the above Direction I find it to be 365.

Again, if it were required to find the Logarithm of a Number, having ſome Decimals in it. In order to do this, you may obſerve in the Table of Logarithms, that the Logarithm of 10 is 1, that of 100, 2; and of 1000, 3, *&c.* and the Logarithms of all the intermediate Numbers between 10 and 100, have 1 for the integral Part of each, and alſo thoſe between 100 and 1000 have 2 for their integral Part, and ſo on, which are called their Indices.

Now becauſe any Number conſiſting of both Integers and Decimals, is equal to the Quotient of the whole conſider'd as an Integer divided by the Denominator of the decimal Part; and ſince by the Nature of Logarithms, Subduction in them anſwers to Diviſion in other Numbers; therefore it follows, that when a Number is given conſiſting both of Integers

E

tegers and Decimals, we can find the Logarithm answering thereto in the following Manner: *viz.* Find the Logarithm of the whole consider'd as an Integer; then from that take the Logarithm of the Denominator of the decimal Part, or (which is the same) from the Index of the Logarithm of the whole consider'd as an Integer, subtract a Number less by Unity than the Number of Places in the Denominator of the Fraction, and the Remainder will be the Logarithm required.

Example 1. Suppose you were to find the Logarithm of 36.5, to do this you must first look for the Logarithm of 365, which is 2.56229 then because 10 is the Denominator of the decimal Part of the propos'd Number, and 1.00000 its Logarithm, therefore from 2.56229 take 1.00000 and there remains 1.56229 the Logarithm required.

Example 2. And to find the Logarithm of 6.543. First find the Logarithm of 6543 consider'd as an Integer, which by the Tables you will find to be 3.81578 then since 3.00000 is the Logarithm of 1000 the Denominator of the fractional Part, therefore from 3.81578 take 3.00000 and there will remain 0.81578 which is the Logarithm required.

The Reverse of this, *viz.* the Logarithm of a Number consisting of Integers and Decimals being given to find that Number, is perform'd according to the following Method.

Rule. Look in your Table of Logarithms (without regarding the Indices) for that whose decimal Part is equal or nearly equal to the decimal Part of the Logarithm proposed; then subtract the Index of the former from that of the latter; and lastly divide the Number answering the Logarithm found in your Tables, by a Number consisting of an Unit, and as many Cyphers as there are Units in the Difference between the two Indices; or, which is the same, cut off as many Figures (beginning at the lowest

loweſt Place) of the Number anſwering to the Logarithm in your Table, as there are Units in the Difference of the Indices, and the Number laſt found will be that required.

Example. Suppoſe it were required to find the Number anſwering to the Logarithm 2.73608.

In Order to do this I look in the Table of Logarithms (without minding the Indices) for that whoſe decimal Part is equal, or nearly equal, to .73608 the decimal Part of the Logarithm propos'd, and I find it to be 3.73608; from the Index of which, *viz.* 3, I take 2, the Index of the propos'd Logarithm, and there remains 1; Laſtly, I divide 5446, the Number anſwering the Logarithm found in the Tables, by 10, and the Quotient 544.6 is the Number required.

The Reaſon of this and the preceding Rule, is plain from the very Nature of Logarithms.

From what has been ſaid on this Head we may eaſily ſolve the following Problems by the Logarithms: *viz.*

Prob. 1. Given two Numbers, as 25.6 and 134, to find the Product of their Multiplication. To ſolve this by the Logarithms, I firſt look for the Logarithm of 25.6 which I find to be 1.40824, then for that of 134 which is 2.12710; then I add theſe two Logarithms together, and their Sum is 3.53534, which is the Logarithm of their Product; ſo I look in my Table for the Number anſwering to 3.53534, and I find it to be 3430, which is nearly equal to the Product of 25.6 into 134.

Again, if it were required to find the Product of 36 into 234, I proceed as in the laſt Example, and the Operation is as follows:

	2.36922	the Logarithm of 234
	1.55630	the Logarithm of 36
Sum	3.92552	the Logarithm of their Product,

 which,

which, by the Table, I find to be 8424, which is the Product of the two Numbers propos'd.

Prob. 2. Let it be required to find the Quotient that arises by dividing one Number by another, suppose 828 by 23.

To solve this by the Logarithms, I first look in the Tables for the Logarithm of 828, the Dividend, which I find to be 2.91803; then for the Logarithm of 23 the Divisor, which is 1.36173 and this last taken from the former Logarithm, there remains 1.556[illegible] to the Logarithm of the Quotient, which answers to the Number 36 the Quotient required.

Again, let it be required to divide 3055 by 47; by proceeding according to the last Example, the Operation will be as follows:

3.48501 the Logarithm of 3055 the Dividend,
1.67210 the Logarithm of 47 the Divisor,

1.81291 the Logarithm of the Quotient.

which answers to the Number 65 the Quotient required.

Prob. 3. Three Numbers being given to find a fourth proportional to them, *viz.* Such as shall have the same Proportion to the third as the second has to the first.

Rule. Take from the Tables the Logarithm of each of the propos'd Numbers, then add the Logarithms of the second and third together, and from the Sum take the Logarithm of the first, and the Remainder shall be the Logarithm of the fourth Number requir'd.

Example. Let the three propos'd Numbers be [illegible] 48, 66, to which we are to find a fourth proportional; by the preceding Rule, the Operation will stand as follows:

1.68124

1.68124 the Logarithm of 48 the 2d Term,
1.81954 the Logarithm of 66 the 3d Term,

3.50078 the Logarithm of their Product,
1.55630 the Logarithm of the 1ſt Term, 36.

1.94448 the Log. of the 4th Term requir'd.

which, by looking into the Table, I find anſwers to the natural Number 88, which is the 4th Proportional to the three propos'd Numbers.

Again, let it be required to find a fourth proportional to the three Numbers 24, 144, 123; by proceeding according to the foregoing Rule, the Operation will ſtand as follows:

2.15836 the Logarithm of the 2d Term 144.
2.08991 the Logarithm of the 3d Term 123.

4.24827 the Logarithm of their Product,
1.38021 the Logarithm of the 1ſt Term 24.

2.86806 the Log. of 738, the 4th Number requir'd.

Prob. 4. To find the Square of any Number by Logarithms.

Rule. Multiply the Logarithm of the given Number by 2, and the Product is the Logarithm of the Square ſought.

Example. Required to find the Square of 36. Firſt I look in the Table for the Logarithm of 36, and find it to be 1.55630, which doubled gives 3.11260 the Logarithm of the Square ſought, which by Inſpection I find anſwers to the natural Number 1296 the Square of 36, *viz.* the Product of 36 multiplied into itſelf.

Prob. 5. To extract the Square Root of any propos'd Number, *i. e.* to find a Number which multiply'd into itſelf, ſhall produce the given Number.

Rule

Rule. Divide the Logarithm of the propos'd Number by 2, and the Quotient will be the Logarithm of the Square Root required.

Example. Required to find the Square Root of 1296. Firſt I look in the Tables for the Logarithm of 1296, and find it to be 3.11261, which divided by 2 gives 1.55630 for the Logarithm of the Square Root, and the natural Number anſwering thereto is 36 the Root required.

If for the Sine, Tangent, &c. of every Degree and Minute in the Quadrant, in the natural Tables, we take the Logarithm agreeing to each, we ſhall have a Table of Logarithmic Sines, Logarithmic Tangents, &c. as is in the ſecond Table at the End of this Book.

In which you may obſerve, that each Page is divided into eight Columns, the firſt and laſt of which is Minutes, and the intermediate Ones contain the Sines, Tangents and Secants; the upper and lower Columns contain Degrees; the Column of Minutes on the left Hand of each Page, anſwers to the Degrees in the top Column, and the Sines, Tangents, and Secants, belonging to theſe Degrees, and Minutes are in the Columns mark'd at the Top with the Words, Sine, Tangent, Secant; the Column of Minutes on the right Hand of each Page, anſwers to the Degrees in the Foot of the Page, and the Sines, Tangents, and Secants, anſwering to theſe Degrees and Minutes, are in the Columns mark'd at the Bottom with the Words, Sine, Tangent, Secant; the Degrees in the top Column beginning at 0, proceed to 44 where they end, and thoſe at the Foot of the Page begin at 89 proceed to 45 in a decreaſing Series, the Degrees in the different Columns being the Complement of each other. From what has been ſaid, we may eaſily find the Sine, Tangent or Secant, of any Arch, from our Tables, by looking for the given Number of Degrees at the Head or Foot of the Page,

Page, according as they are leſs or greater than 45, and in the proper ſide Column for the odd Minutes, if there be any; then below or above the Word, Sine, Tangent, or Secant, and on the ſame Line with the Minutes, we ſhall have that requir'd.

Example 1. Required to find the Sine of 36 *deg.* 40 *min.* To find this, I look at the Head of the Page for 36 *deg.* and in the ſide Column, on the left Hand, for 40 *min.* then below the Word Sine, and on the ſame Line with 40, I find 9.77609 which is that required.

Example 2. Requir'd the Tangent of 54 *deg.* 30 *min.* To find this, I look at the Foot of the Page (becauſe the Degrees propos'd are greater than 45) for 54 *deg.* and in the right Hand ſide Column for 30 *min.* then in the Column mark'd with Tangent at it's Bottom, and on the ſame Line with the 30 *min.* in the ſide Column, I find 10.14673, which is the Log-Tangent requir'd.

The Reverſe of this, *viz.* The Logarithm of a Sine, Tangent or Secant, being given to find the Arch belonging to it, is perform'd by only looking in the proper Column for the neareſt Logarithm to that propos'd, and the Degrees and Minutes anſwering thereto is what was requir'd.

In theſe Tables the Secants might have been wanting, becauſe all the Proportions in which the Secants are concern'd may be wrought without them, by the Sines and Tangents only, as ſhall be ſhewn particularly in the Solution of the ſeveral Caſes of plain Trigonometry.

72. The Chord, Sine Tangent, &c. of any Arch in one Circle, is to the Chord, Sine, Tangent, &c. of the ſame Arch in another Circle, juſt as the Radius of the one is to the Radius of the other; for 'tis plain, the greater the Radius is, the greater is the Circle deſcribed by that Radius, and conſequently the greater any particular Arch of that Circle is, and

and ſo the Sine, Tangent, &c. of that Arch is alſo the greater; therefore, in general, the Chord, Sine, Tangent, &c. of any Arch is proportionable to the Radius of the Circle.

73. In all Circles the Chord of 60 is always equal in Length to the Radius. Thus in the Circle AEBD, if the Arch AEB be an Arch of 60 Degrees, then drawing the Chord AB, I ſay AB ſhall be equal to the Radius CB or AC; for in the Triangle ACB, the Angle ACB is 60 Degrees, being meaſured by the Arch AEB; therefore the Sum of the other two Angles is 120 Degrees, (by *Cor.* 1. of 61ſt) but

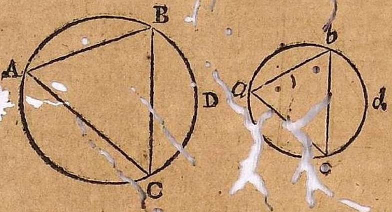
ſince AC and CB are equal the two Angles CAB, CBA will alſo be equal; conſequently each of them half their Sum 120, *viz.* 60 Degrees; therefore all the three Angles are equal to one another; conſequently all the Legs, therefore AB is equal to CB.

Cor. Hence the Radius from which the Lines on any Scale were form'd, is the Chord of 60 on the Line of Chords.

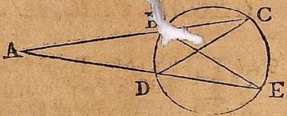
74. If in two Triangles ABC, *abc* all the Angles of the one be equal to all the Angles in the other, each to each reſpectively, that is, the Angle BAC equal to the Angle *bac*, the Angle ACB equal to the Angle *acb*, and the Angle ABC equal to the Angle *abc*; then the Legs oppoſite to the equal Angles are proportionable, *viz.* AB : *ab* :: AC : *ac* and AB : *ab* :: BC : *bc* and AC : *ac* :: BC : *bc*; for being inſcribed in two Circles, 'tis plain, ſince the Angle BAC is equal to the Angle *bac*, the Arch BDC is equal the Arch *bdc*, and conſequently the Chord BC is to the Chord *bc* as the Radius of the Circle ABC to the Radius of the Circle *abc* (by the 72d); the ſame Way the Chord

AB

A B is to the Chord *ab* in the fame Proportion. So AB : *ab* :: BC : *bc*; the fame way we may prove all the reft to be proportional.



75. If from a Point A without a Circle DBCE, there be drawn two Lines ADE, ABC, each of them cutting the Circle in two Points; then, I fay, the Product of the one whole Line into its external Part, *viz.* AC into AB is equal to the Rectangle of the other Line into its external Part, *viz.* AE into AD: for drawing the Lines DC, BE, 'tis plain in the two Triangles ABE, ADC, the Angle AEB in the one is equal to the Angle ACD in the other (by *Cor.* 2. of 63d), and the Angle at A is common; therefore, the other Angle ADC is equal to the Angle ABE (by *Cor.* 1. of 61.) therefore the Triangle

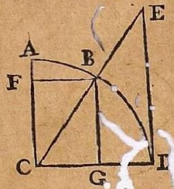


ABE is equi-angular to the Triangle ADC; confequently AC : AE :: AD : AB by the laft, and therefore AC into AB is equal to AE into AD.

76. Let ABD be a Quadrant of a Circle defcribed by the Radius CD; BD any Arch of it, and BA its Complement, BG or CF the Sine, CG or BF the Co-Sine, DE the Tangent, and CE the Secant of that Arch BD. Then fince the Triangles CDE, CGB are fimilar, or equi-angular, it

F will

will be by (*Art.* 74.) DE : EC : : GB : BC *i. e.* the Tangent of any Arch, is to the Secant of the ſame, as the Sine of it is to the Radius. Alſo ſince DE : EC : : GB : B C, therefore by inverting that Proportion we have EC : DE : : BC : GB *i. e.* the Secant is to the Tangent, as the Radius is to the Sine of any Arch.



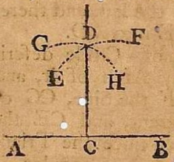
Again, ſince the Triangles CDE, CGB are ſimilar, therefore (by *Art.* 74.) it will be CD : CE : : CG : CB *i. e.* as the Radius is to the Secant of any Arch, ſo is the Co-ſine of that Arch to the Radius. And by inverting the Proportion we have this, *viz.* As the Secant of any Arch is to the Radius, ſo is the Radius to the Co-Sine of that Arch.

Having thus gone thro' the Theorems of *Geometry*, that are neceſſary for the Knowledge of *Navigation*; we ſhall next proceed to ſome Problems that are uſeful for the Practice of that Art.

GEOMETRICAL PROBLEMS.

Prob. I. FROM a Point C in a given Line A B to raiſe a Perpendicular to that Line.

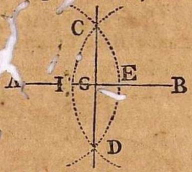
Rule. From the Point C take the equal Diſtances CB, CA on each Side of it. Then ſtretch the Compaſſes to any Diſtance greater than CB or CA, and with one Foot of them in B, ſweep the Arch EF with the other; again, with the ſame Opening, and one Foot in A, ſweep the Arch GH with the other, and then



theſe two Arches will interſect one another in the Point D; then join the given Points C and D with the Line CD, and that ſhall be the Perpendicular required.

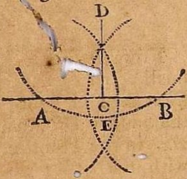
2. To divide a given right Line AB into two equal Parts; that is, to biſect it.

Rule. Take any Diſtance with your Compaſſes that you are ſure is greater than half the given Line; then ſetting one Foot of them in B, with the other ſweep the Arch DFC; and with the ſame Diſtance and one Foot in A, with the other ſweep the Arch CED; theſe two Arches will interſect one another in the Points C, D, which join'd by the right Line DC will biſect AB in G.



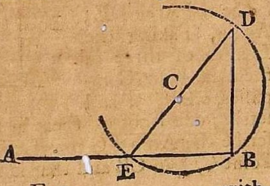
3. From a given Point D to let fall a Perpendicular on a given Line AB.

Rule. Set one Foot of the Compaſſes in the Point D, and extend the other to any Diſtance greater than the leaſt Diſtance between the given Point and and the Line, and with that Extent ſweep the Arch AEB, cutting the Line in the two Points A and B, then (by the laſt Problem) biſect the Line AB in the Point C, laſtly join C and D, and that Line CD is the Perpendicular required.



4. Upon the End B of a given right Line BA, to raiſe a Perpendicular.

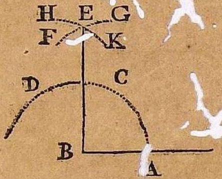
Rule. Take any Extent of your Compaſſes, and with one Foot in B fix the other in any Point C,



without the given Line, then with one Point of the Compaſſes in C, deſcribe with the other, the Circle EBD, and thro' E and C draw the Diameter, ECD meeting the Circle in D; join D and B, and the right Line DB is that required; for EBD is a right Angle (by *Cor.* 4. of 63d).

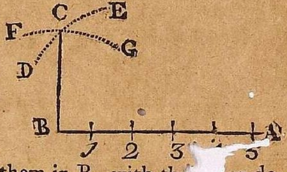
Another Way.

Upon the Point B as a Center, and with any Diſtance BA, deſcribe the Circle ACD; ſet off the Radius from A to C and from C to D, then with the ſame Extent of the Compaſſes, and one Foot in C, deſcribe with the other Foot the Arch FG, and with the ſame Opening on the Center D deſcribe the Arch KH which will cut the Former in E, then join E B and that ſhall be the Perpendicular requir'd.



Another Way.

From the Point B ſet off with your Compaſſes five ſmall equal Parts, then with the Diſtance of all the five taken in your Compaſſes, ſetting one Foot at the fourth Diviſion, *viz.* in the Point 4, with the other deſcribe the Arch DE; Again, Taking the Length of three of them in your Compaſſes, *viz.* B 3, and ſetting one Foot of them in B, with the other deſcribe the Arch FG interſecting the former in the Point C, join CB and that is the Line required.



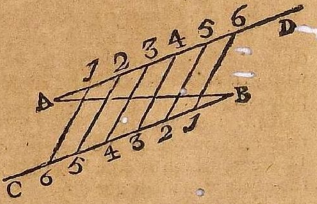
5. To

5. To draw one Line parallel to another given Line A B, that ſhall be diſtant from one another by any given Diſtance D.

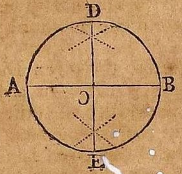
Rule. Extend your Compaſſes to the given Diſtance D; then ſetting one Foot of them in any Point of the given Line (ſuppoſe A) with the other ſweep the Arch FCG; again, at the ſame Extent, and one Foot in any other Point of the given Line B ſweep the Arch H D K, and draw the Line C D touching them, and that will be parallel to the given Line AB, and diſtant from it by the Line D as was requir'd.

6. To divide a given Line AB into any Number of equal Parts, ſuppoſe 7.

Rule. From the Point A draw any Line AD, making an Angle with the Line AB, then thro' the Point B draw a Line BC parallel to AD; and from A, with any ſmall opening of the Compaſſes, ſet off a Number of equal Parts (on the Line AD) leſs by one than the propos'd Number (here 6) then from B ſet off the ſame Number of the ſame Parts on the Line BC, laſtly, join 6 and 1, 2 and 5, 3 and 4, 4 and 3, 5 and 2, 6 and 1, and theſe Lines will cut the given Line as requir'd.



7. To

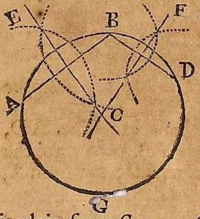


7. To quarter a given Circle, or to divide it into four equal Parts.

Rule Thro' the Center C of the given Circle draw a Diameter A B, then upon the Point C raiſe a Perpendicular D C E to the Line A B; and theſe two Diameters A B and D E ſhall quarter the Circle.

8. Thro' three given Points A, B, and D to draw a Circle. (*Note*, the three Points muſt not lie in the ſame ſtrait Line.)

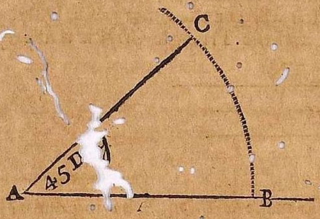
Rule. Join A and B, alſo B and D with the ſtrait Lines AB, BD, then by *Prob.* 2. biſect AB with the Line EC, alſo B D with the Line FC, which two Lines will cut one another in ſome Point C, that is the Center of the Circle required; then fixing one Point of your Compaſſes in C, and ſtretching the other to A, deſcribe the Circle A B D G, which will paſs through the three Points given. The Reaſon of this is plain from *Cor.* 1. of *Art.* 65.



9. From the Point A of the given Line A B, to draw another Line (ſuppoſe AC) that ſhall make with AB an Angle of any Number of Degrees, ſuppoſe 45.

Rule. Let the given Line AB be produced, then take off your Scale the Length of the Chord of 60 Degrees, which is equal to the Radius of the Circle the Scale was made for (by *Art.* 73.) And ſetting one Foot in A, with the other ſweep the Arch BC; then with your Compaſſes take from your Scale the Chord of 45 Degrees, and ſet off that Diſtance from B to

B to C. Laſtly join A and C, and the Line AC is that requir'd. For the Angle CAB, which is meaſur'd by the Arch BC, is an Angle of 45 Degrees as was requir'd.



10. An Angle BAC being given, to find how many Degrees it contains.

Rule. With your Compaſſes take the Length of the Chord of 60 from your Scale. Then ſetting one Foot of them in A, with the other ſweep the Arch BC, which is the Arch comprehended between the two Legs AB,

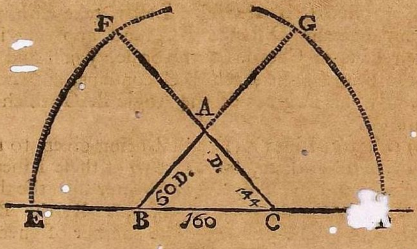
AC produc'd, if needful. Laſtly, take with your Compaſſes the Diſtance BC, and applying it to your Line of Chords on the Scale, you'll find how many Degrees the Arch BC contains, and conſequently the Degrees of the Angle BAC which was requir'd.

11. Three Lines X, Y, and Z being given, to form a Triangle of them, but any two of theſe Lines taken together, muſt always be greater than the third.

Rule. Make any one of them, as X, the Baſe; then with your Compaſſes take another of them, as Z, Z, and setting one Foot in one End of the Line X, as B, with the other sweep the Arch D E; and taking with your Compasses the Length of the other Y, set one Foot of them in A, the other End of the Line X, and with the other sweep the Arch FG, which will cut the other in C; lastly, join CA and CB, and the Triangle CAB is that requir'd.

12. To make a Triangle having one of its Legs of any Number of equal Parts (suppose 160), and one of the Angles at that Leg 50 Degrees and the other 44 Degrees.

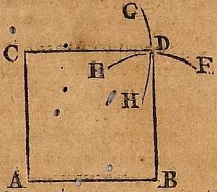
Rule. Draw an indefinite Line E D, then take off the Line of equal Parts with your Compasses 160 of them, and set them on the indefinite Line, as BC then (by *Prob.* 9.) draw BA making the Angle ABC of 50 Degrees, and by the same, draw from C the Line A C, making the Angle A CB of 44 Degrees; which two Lines will meet one another in A, and the Triangle ABC is that required.



13. Upon

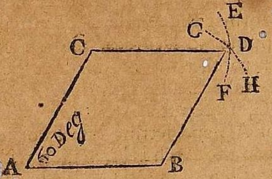
13. Upon a given Line AB to make a Square.

Rule. Upon the Extremity A of the given Line AB raise a Perpendicular AC (by *Prob.* 4.); then take AC equal to AB; and with that Extent, setting one Foot of the Compasses in C, sweep with the other Foot the Arch GH, then with the same Extent and one Foot in B, with the other sweep the Arch EF; which will meet the former in some Point D; lastly, join C and D, D and B, and the Figure ABDC will be the Square requir'd.



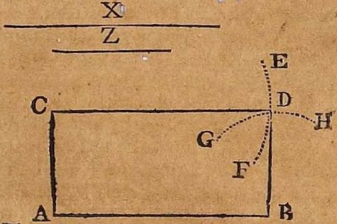
14. On a given Line AB to draw a Rhombus that shall have one of its Angles equal to any Number of Degrees, suppose 60 Degrees.

Rule. From the Point A of the given Line AB draw the Line AC, making the Angle CAB of 60 Deg. (by *Prob.* 9.); then take AC equal to AB, and with that Extent fixing one Foot of the Compasses in B, with the other describe the Arch GH, and at the same Extent fixing one Foot of the Compasses in C, with the other describe the Arch EF cutting the former in D; lastly, join CD and DB and the Figure ACDB is that requir'd.



15. Given two Lines X and Z, of theſe two to make a Rectangle.

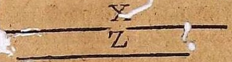
Rule. Draw a Line as AB, equal in Length to one of the given Lines X, and on the Extremity A of that Line raiſe a Perpendicular AC, on which take AC equal to the other Line Z; then take with your Compaſſes the Length of the Line AB, and at that Extent fixing one Foot of them in C, with the other ſweep the Arch EF; and alſo taking with your Compaſſes the Extent of the Line AC, fix one Foot of them in B, and with the other ſweep the Arch GH, which will meet the former in D; laſtly join CD and BD, and the Figure ABDC will be that requir'd.



16. Two Lines X and Z being given, of theſe to form a Rhomboides that ſhall have one of its Angles any Number of Degrees, ſuppoſe 50.

Rule. Draw a Line AB equal in Length to one of the Lines as X, then draw the Line AC, making with the former the Angle BAC equal to the propos'd, ſuppoſe 50 Degrees, and on that Line take AC equal to the given Line Z, then with your Compaſſes take the Length of AB, and fixing one Foot in C, ſweep the Arch EF; alſo taking the Length of AC and ſetting one Foot in B, with the other ſweep the Arch GH, which will cut the former in D; then join C D and B D, ſo the Figure ACDB will be that required.

X



And thus we have gone thro' all *Geometry* that is neceſſary for our preſent Buſineſs, both as to Theory and Practice. The next Thing we go on, is, the Principles of *Plane Trigonometry*.

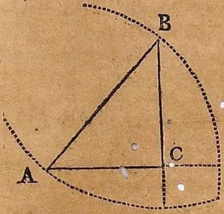
SECT. II.

Of Plane TRIGONOMETRY, *Right and Oblique Angled*.

1. PLANE TRIGONOMETRY, is that Science by which we meaſure the Sides and Angles of Plane Triangles.

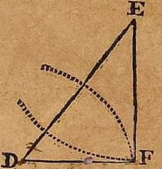
2. Since Triangles are either right or oblique-angled; therefore Trigonometry is commonly divided into two Kinds, *viz.* *Rectangular* and *Oblique-angular*: and firſt we ſhall treat of Rectangular.

3. In any right-angled Triangle as ABC, if the Hypothenuſe be made the Radius, and with that a Circle be deſcribed on the one End A as a Center; then 'tis plain that BC will be the Sine of the Angle BAC (by *Art.* 21. of *Sect.* I.) and if with the ſame Diſtance,



Diſtance, and on B as Center, a Circle be deſcribed, 'tis plain that A C will be the Sine of the Angle ABC; therefore, in general, if the Hypothenuſe of a right-angled Triangle be made the Radius, the two Legs will be the Sines of their oppoſite Angles.

4. If in a right-angled Triangle DEF, one of the Legs, as DF, be made the Radius, and on the Extremity D at one of the oblique Angles, *viz.* that which is form'd by the Hypothenuſe and the Leg made Radius) as a Center, a Circle be deſcrib'd; 'tis plain, that the other Leg EF will be the Tangent of the Angle at D, and the Hypothenuſe DE will be the Secant of the ſame Angle (by *Art.* 24, 25, and 67 of *Sect.* 1.). The ſame Way, making the Leg E F the Radius, and on the Center E deſcribing a Circle, the other Leg GF will become the Tangent of the Angle at E, and the Hypothenuſe DE the Secant of the ſame.



5. It has been already ſhewn, at *Art.* 72. of *Sect.* 1. that the Chord, Sine, Tangent, &c. of any Arch, or Angle, in one Circle, is proportionable to the Chord, Sine, Tangent, &c. of the ſame Arch, in any other Circle; from which, and the two foregoing Articles the Solutions of the ſeveral Caſes of rectangular Trigonometry naturally follows.

6. Since Trigonometry conſiſts in determining the Angles and Sides from others given, there ariſe various Caſes, which are ſeven in Rectangular and ſix in Oblique-angular Trigonometry.

We

We ſhall now proceed to the Solution of the ſeven Caſes of Rectangular Trigonometry.

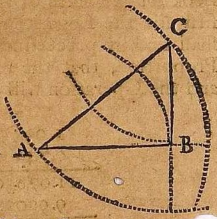
CASE I.

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

Example. In the Triangle ABC right-angled at B, ſuppoſe the Leg AB, 86 equal Parts, (as Feet, Yards, Miles, *&c.*) and the Angle A 33°, 40′. requir'd the other Leg BC in the ſame Parts with AB.

Geometrically.

Draw AB equal to 86, from any Line of equal Parts, then (by *Prob.* 4. of *Sect.* 1.) upon the Point B, erect the Perpendicular BC; laſtly from the Point A draw the Line AC, making with AB an Angle equal to 33°, 40′, and that Line produc'd will meet BC in C, and ſo conſtitute the Triangle. The Length of BC may be found by taking it in your Compaſſes, and



and applying it to the ſame Line of equal Parts that AB was taken from.

By Calculation.

Firſt by making the Hypothenuſe AC Radius, the other two Legs will be the Sines of their oppoſite Angles (by *Art.* 3. of this) *viz.* AB the Sine of C, and CB the Sine of A; now ſince (by *Art.* 72. of *Sect.* 1.) the Sine, Tangent, *&c.* of any Arch in one

one Circle is proportionable to the Sine, Tangent &c. of the ſame Arch in any other Circle, 'tis pl[illegible]n the Sines of the Angles A and C in the Circ[illegible] deſcribed by the Radius AC, muſt be proportionable to the Sine of the ſame Arches or Angles, in the Circle, that the ſecond Table at the End of this Book was calculated for; ſo the Proportion for finding B C will be

S, C : A B : : S, A : B C.

i. e. As the Sine of the Angle C i[illegible] the Tables, is to the Length of AB (or Sine of C [illegible] the Circle whoſe Radius is A C) ſo is the Sine of t[illegible] Angle A in the Tables, to the Length of BC [illegible] Sine of the ſame Angle in the Circle whoſe Radi[illegible]s is AC).

Now the Angle A being 33°,40′, the Angle C muſt be 56°,20′ (by *Art.* 61. *Cor.* 2. *Sect.* 1.); therefore looking in the ſecond Table at the End of this Book for the Sines of the two Angles, and in the firſt for the Logarithm of 86 the given Leg, we ſhall find by proceeding according to the foregoing Proportion, that the required Leg B C, is 57.28; and the Operation will ſtand as follows.

1.93450	A B 86
9.74380	S, A 33°,40′
11.67830	
9.92027	S, C 56°,20′
1.75803	B C 57.28

2*dly*, Making A B the Radius, 'tis plain BC, the Leg required, will be the Tangent of the given Angle A (by the 4th of this), and ſo the Proportion for finding BC, when AB is made the Radius, will be,

R : T, A : : A B : B C.

i. e. as the Radius in the Tables, is to the Tangent of the Angle A in the ſame, ſo is the Length of BA,

or

or Radius in the Scheme, to the Length of BC or Tangent of A in the Scheme; therefore looking in the Tables for the Parts given in the foregoing Proportion, and proceeding with them according to that Rule, we ſhall find BC to be 57.28 as before, and the Operation will be as follows:

9.82352	T, A	33°, 40′
1.93450	A B	86
11.75[illegible]		
10.0[illegible]0	Rad.	90°
1.758[illegible]	B C	57.28

Laſtly, by making B C, the Leg requir'd, the Radius, 'tis plain that A B will be the Tangent of C, and the Proportion for finding B C will be as follows:

T, C : R : : AB : BC

i. e. as the Tangent of C 56°, 20′		10.17648
is to Radius - - - - - -	90° -	10.00000
ſo is the Length of AB -	- 86 -	1.93450
		11.93450
		10.17648
to the Length of BC -	57.28 -	1.758[illegible]

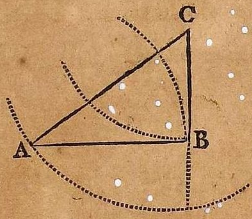
CASE 2.

The Angles and one of the Legs given, to find the Hypothenuſe.

Example. In the Triangle A B C, ſuppoſe A B 124, and the Angle A 34°, 20′; conſequently the Angle C 55°, 40′ requir'd the Hypothenuſe A C, in the ſame Parts with A B.

Geometrically

Geometrically.



This Caſe is conſtructed after the ſame Manner with the former, and the Hypothenuſe AC is found by taking it's Length in your Compaſſes, and applying that to the ſame Line of equal Parts you took AB from.

By Calculation.

1*ſt*, By making AC the Radius we ſhall have the following Proportion for finding AC, *viz.*

S, C : R : : AB : AC

i. e. as the Sine of C -	$55°,40'$ -	9.91686
is to Radius - - - - -	90 - -	10.00000
ſo is AB - - - - - -	124 - -	2.09342
to AC - - - - - -	150.2 - -	2.17656

2*dly*, Making AB the Radius we have this Proportion, *viz.*

R : Sec. A : : AB : AC

i. e. as Radius - -	$90°$ - - -	10.00000
is to the Secant of A -	$34°,20'$ - -	10.08314
ſo is AB - - - - -	124 - -	2.09342
to AC - - - - - -	150.2 - -	2.17656

This may be done without the Help of the Secants; for ſince (by *Art.* 76. *Sect.* 1) R : Sec. : : Co-S. : R; therefore the former Proportion will become

Co-S. A : R : : AB : AC

i. e. As

i. e. As the Co-Sine of A	34°, 20′	9.91686
is to the Radius - -	90° -	10.00000
so is AB - - - - - -	124 -	2.09342
to AC - - - - - -	150.2 - -	2.17656

3dly, Making BC the Radius, we have the following Proportion, *viz.*

T, C : Sec. C :: AB : AC

i. e. as the Tangent of C	55°, 40′	10.16558
is to Sec. C - - - -	55°, 40′	10.24872
so is AB - - - - - -	124 - -	2.09342
to AC - - - - - -	150.2 - -	2.17656

This likewise may be done without the Help of Secants, for since (by *Art.* 76. *Sect.* 1.) T, : Sec. :: S, : R; therefore the former Analogy will be reduc'd to this, *viz.*

S, C : R :: AB : AC

where no Secants do appear, and it coincides with that in the first Supposition of this Case, so we shall not repeat the Operation.

CASE 3.

The Angles and Hypothenuse given, to find either of the Legs.

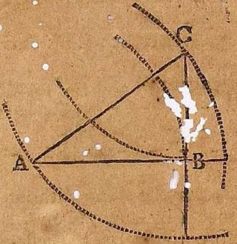
Example. In the Triangle ABC, suppose the Hypothenuse AC 146 equal Parts, and the Angle A 36°, 25′, consequently the Angle C 53°, 35′, requir'd the Leg AB.

Geometrically.

Draw the Line AB at Pleasure, and make the Angle BAC equal to 36°, 25′ (by *Prob.* 9. *Sect.* 1.) then take AC equal to 146 from any Line of equal

 Parts;

Parts; *Lastly*, from the Point C let fall the Perpendicular CB on the Line AB. So the Triangle is constructed, and AB may be measured from the Line of equal Parts.



By Calculation.

1st, Making AC the Radius, we shall have the following Proportion, *viz.*

R : S, C :: AC : AB

i. e. as Radius	90°	10.00000
is to the Sine of C	53°, 35′	9.90565
so is AC	146	2.16435
to AB	117.5	2.07000

2dly, Making AB the Radius, we have the following Analogy, *viz.*

Sec. A : R :: AC : AB

i. e. as the Secant of A	36°, 25′	10.09435
is to Radius	90	10.00000
so is AC	146	2.16435
to AB	117.5	2.07000

This may be done without the help of Secants, for since (by *Art.* 76. *Sect.* 1.) Sec. : R :: R : Co-S; therefore the former Proportion may be reduc'd to this, *viz.*

R :

R : Co-S, A : : AC : AB

which is the ſame with the Proportion in the firſt Suppoſition.

3dly, By ſuppoſing BC the Radius, we have the following Proportion, *viz.*

Sec. C : T. C : : AC : AB

i. e. as the Secant of C	53°, 35′		10.22647
is to the Tangent of C	53°, 35′		10.13212
ſo is AC - - - - - -	146	- -	2.16435
to AB - - - - - - -	117.5	-	2.07000

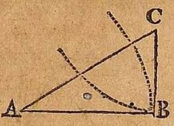
CASE 4.

The two Legs being given to find the Angles.

Example. In the Triangle ABC, ſuppoſe AB 94 and BC 56. requir'd the Angles A and C.

Geometrically.

Draw AB equal to 94, from any Line of equal Parts, then from the Point B raiſe BC perpendicular to AB (by *Prob.* 4. *Sect.* 1.) and take BC from the former Line of equal Parts equal to 56; *Laſtly*, join the Points A and C with the ſtrait Line AC, ſo the Triangle is conſtructed, and the Angles may be meaſur'd by *Prob.* 10. *Sect.* 1.



By Calculation.

1ſt, Suppoſing AB the Radius, we have this Analogy, *viz.*

AB : BC : : R : T. A

i. e. as AB - - -	94	- - - -	1.97313
is to BC - - - - -	56	- - - -	1.74819
ſo is the Radius - -	90°	- - -	10.00000
to the Tangent of A	30°, 47′	- -	9.77506

H 2

2dly,

2*dly*, Making BC the Radius we have this Proportion, *viz.*

BC : BA :: R : T, C

i. e. as BC - - -	56 - - - - -	1.74819
is to AB - - -	94 - - - -	1.97313
ſo is the Radius -	90° - - - -	10.00000
to the Tangent of C	59°, 13′ - -	10.22494

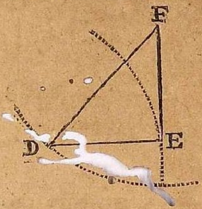
CASE 5.

The Hypothenuſe, and one of the Legs given, to find the Angles.

Example. In the Triangle DEF, ſuppoſe the Leg DE 83, and the Hypothenuſe DF 126, requir'd the Angles D and F.

Geometrically.

Draw the Line DE 83, from any Line of equal Parts, and from the Point E raiſe the Perpendicular EF, then take the Length of DF 126, from the ſame Line of equal Parts, and ſetting one Foot of your Compaſſes in D, with the other croſs the Perpendicular EF in F; *Laſtly*, join D and F, ſo the Triangle is conſtructed, and the Angles may be meaſured by *Prob.* 10. *Sect.* 1.



By Calculation.

1*ſt*, Making DF the Radius, we have this Proportion, *viz.*

DF : DE :: R : S, F

i. e. as

i. e. as DF	———	126 ———	2.10037
is to DE	———	83 ———	1.91908
ſo is the Radius	———	90° ———	10.00000
to the Sine of F	-	41°, 12′ -	9.81871

2*dly*, By ſuppoſing DE the Radius, we have the following Analogy, *viz.*

DE : DF :: R : Sec: D

i. e. as DE	———	83 ———	1.91908
is to DF	———	126 ———	2.10037
ſo is the Radius	———	90° ———	10.00000
to the Secant of D	-	48°, 48′ -	10.18129

This may be done without the Help of Secants, for ſince (by *Art.* 76. *Sect.* 1.) R : Sec, :: Co-S : R; therefore the preceding Analogy will become this, *viz.*

DF : DE :: R : Co-S, D.

in which no Secants do appear; and it plainly coincides with the Proportion deduc'd from the firſt Suppoſition.

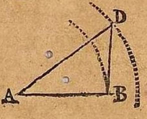
CASE 6.

The two Legs given to find the Hypothenuſe.

Example. In the Triangle ABD, ſuppoſe the Leg AB, 64, and BD 56, requir'd the Hypothenuſe.

Geometrically.

The Conſtruction of this Caſe is perform'd the ſame Way as in the fourth Caſe, and the Length of the Hypothenuſe AB is found by taking it in your Compaſſes, and applying it to the ſame Line of equal Parts, that the two Legs were taken from.



By

By Calculation.

This Caſe being a Compound of the *4th* and *2d* Caſes, we muſt firſt find the Angles by the *4th* thus:

AB : DB :: R : T, A.

i. e. as the Leg AB	- - 64	- -	1.80618
is to the Leg DB	- - 56	- -	1.74819
ſo is the Radius	- - - 90	- -	10.00000
to the Tangent of A	- - 41°, 11′	-	9.94201

Then by the *2d* Caſe we find the Hypothenuſe requir'd thus:

S, A : R :: BD : AD

i. e. as the Sine of A	- 41°, 11′	-	9.81854
is to the Radius	- - 90°	- -	10.00000
ſo is the Leg BD	- - 56	- - -	1.74819
to the Hypothenuſe AD	85.05	- -	1.92965

This Caſe may alſo be ſolv'd after the following Manner, *viz.*

From twice the Log. of the greater Side AB 3.61236
ſubtract the Log. of the leſſer Side BD - 1.74819

and there remains - - - - - - - - 1.86417
the Logarithm of 73.15 to which adding the leſſer Side BD, we ſhall have 189.15 whoſe Log. is 2.11093
to which add the Log. of the leſſer Side BD 1.74819

and the Sum will be - - - - - - - - 3.85912
the half of which is - - - - - - - - 1.92956
the Logarithm of the Hypothenuſe required.

Or it may be done by adding the Square of the two Sides together, and taking the Logarithm of that Sum, the half of which is the Logarithm of the Hypothenuſe requir'd thus in the preſent Caſe:

The

The Square of AB (64) is - - - -	4096
The Square of BD (56) is - - - -	3136
The Sum of theſe Squares, is - - - -	7232
The Logarithm of which, is - - - -	3.85926
The half of which, is - - - -	1.92963

The Logarithm of 85.05 the Length of the Hypothenuſe requir'd.

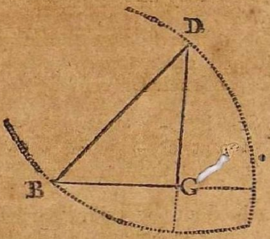
CASE 7.

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

Example. In the Triangle BGD, ſuppoſe the Leg BG, 87, and the Hypothenuſe BD 142, requir'd the Leg DG.

Geometrically.

The Conſtruction here is the ſame as in *Caſe* 5. the ſame Things being given; and the Leg DG is



found by taking its Length in your Compaſſes, and applying that to the ſame Line of equal Parts, the others were taken from.

By

By Calculation.

The Solution of this Case depends upon the 1*st* and 5*th*; and first we must find the Oblique Angles by Case 5*th*, thus;

DB : : BG : : R : S, D

i. e. as the Hypoth. DB	- 142	- -	2.15229
is to the Leg BG	- - 87	- -	1.93952
so is Radius	—— 90°,	——	10.00000
to the Sine of D	—— 37°,	——	9.78723

Then by Case 1*st* we find the Leg DG requir'd, thus;

R : S, B : : BD : DG.

i. e. as Radius	—— 90°	——	10.00000
is to the Sine of B	- 52°, 13′	- -	9.89781
so is the Hypoth. DB	142	——	2.15229
to the Leg DG	- 112.2	——	2.05010

The Leg DG may also be found in the following Manner, *viz.*

to the Log. of the Sum of the Hypothenuse and given Leg, *viz.* 229	2.35984
add the Log. of their Difference, *viz.* 55	1.74036
and their Sum is - - - - - -	4.10020
the Half of that is - - - - - - -	2.05010
the Log. of 112.2 the Leg requir'd.	

Or it may be done by taking the Square of the given Leg from the Square of the Hypothenuse, and the Square Root of the Remainder is the Leg requir'd thus in the present Case:

the Square of the Hypothenuſe 142, is - 20164
the Square of the Leg BG 87, is - - - 7569

The Difference of them is - - - - 12595
whoſe Logarithm is - - - - - - 4.10020
and half of that Logarithm is - - - 2.05010
which anſwers to the Natural Number 112.2 the Leg requir'd.

Thus we have gone thro' the ſeven Caſes of right-angled *Plane Trigonometry*, from which we may obſerve;

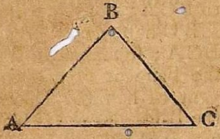
1. That to find a Side, when the Angles are given, any Side may be made the Radius.

2. To find an Angle, one of the given Sides muſt of Neceſſity be made the Radius.

We now proceed to the Solution of the ſix Caſes of Oblique-angled *Plane Trigonometry*, in order to which we muſt premiſe the following Theorems.

Theorem 1. In any Triangle, the Sides are proportional to the Sines of the oppoſite Angles. Thus in the Triangle ABC, I ſay AB : BC :: S, C : S, A and AB : AC :: S, C : S, B; alſo AC : BC :: S, B : S, A.

Demonſtration. Let the Triangle ABC be inſcrib'd in a Circle; then 'tis plain, from *Art.* 66. *Sect.* 1. that the half of each Side is the Sine of its oppoſite Angle, but (by *Art.* 72. *Sect.* 1.) the Sines of theſe Angles in Tabular Parts, are proportional to the Sines of the ſame in any other Meaſure; therefore in the Triangle ABC, the Sines of the Angles will be as the Halves of their oppoſite Sides; and ſince the



Halves are as the Wholes, it follows that the Sines of the Angles are as their oppoſite Sides, *i. e.* S, C : S, A :: AB : BC, &c.

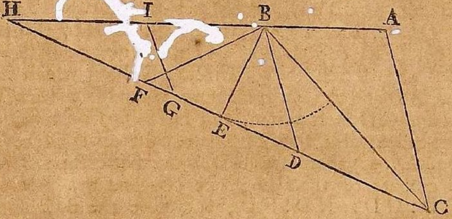
Theor. 2. In any plane Triangle, as ABC, the Sum of the Sides, AB and BC is to the Difference of these Sides, as the Tangent of half the Sum of the Angles at the Base, *viz.* A and C, is to the Tangent of half the Difference of these Angles.

Demon. Produce AB, and make BH equal to BC, join HC, and from B let fall the Perpendicular BE, thro' B draw BD parallel to AC, and make HF equal to CD, and join BF; also take BI equal to BA, and draw IG parallel to BD or AC.

Then 'tis plain that AH will be the Sum, and HI the Difference of the Sides AB and BC; and since HB is equal to BC, and BE perpendicular to HC, therefore HE is equal to EC, and BD being parallel to AC and IG, and AB equal to BI, therefore CD or HF is equal to GD, and consequently HG is equal to FD, and half HG is equal to half FD or ED. Again, Since HB is equal to BC, and BE perpendicular to HC; therefore the Angle EBC is half the Angle HBC; but (by *Art.* 60. *Sect.* 1.) the Angle HBC is equal to the Sum of the Angles A and C, consequently the Angle EBC is equal to half the Sum of the Angles A and C. Also since HB is equal to BC, and HF equal to CD, and the included Angles BHF, BCD equal, it follows (by *Art.* 62. *Sect.* 1.) that the Angle HBF is equal to the Angle DBC, which is equal to BCA (by *Art.* 36. *Sect.* 1.) and since HBD is equal to the Angle A (by *Art.* 37. *Sect.* 1.) and HBF equal to BCA; therefore FBD is the Difference, and EBD half the Difference of the two Angles A and BCA; so making EB the Radius, 'tis plain EC is the Tangent of half the Sum, and ED the Tangent of half the Difference of the two Angles at the Base. Now IG being parallel to AC, the Triangles HIG and HAC will be equiangular, consequently (by *Art.* 74. *Sect.* 1.) AH : IH :: CH : GH, but the Wholes are as their Halves; therefore

AH

AH : IH :: ½ CH : ½ GH; and ſince ½ CH is equal to EC, and ½ GH equal to ½ FD equal to ED; therefore AH : IH :: EC : ED. Now AH is the Sum and IH the Difference of the Sides, alſo EC is the Tangent of half the Sum, and ED the Tangent of half the Difference of the two Angles at the Baſe; conſequently in any Triangle, as the Sum of the Sides is to their Difference, ſo is the Tangent of half the Sum of the Angles at the Baſe, to the Tangent of half their Difference.

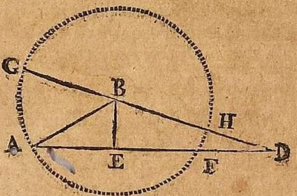


Theor. 3. If to half the Sum of two Quantities be added half their Difference, the Sum will be the greater of them, and if from half their Sum be ſubtracted half their Difference, the Remainder will be the leaſt of them.

Demon. Let the two Quantities be repreſented by the Lines AB and BC (making one continued Line) whereof AB is the greater, and BC the leſſer. Biſect the whole Line AC in E, and make AD equal to BC; then 'tis plain AC is the Sum, and DB the Difference of the two Quantities, and AE or EC their half Sum, and ED or EB their half Difference. Now if to AE we add EB, 'tis plain the Sum will be AB, that is, to half the Sum we add half the Difference, the Sum will be the greater Quantity; alſo if from EC we take EB, the Remainder will be BC, that is, if from half the Sum we take half the Difference of two Quantities, the Remainder will be the least of them.

Theor. 4. In any right lin'd Triangle, ABD, the Base AD is to the Sum of the Sides AB and BD, as the Difference of the Sides is to the Difference of the Segments of the Base made by the Perpendicular BE, *viz.* the Difference between AE and ED.

Demon. Produce DB till BG be equal to BA the lesser Leg; and on B as a Center, with the Distance BA or BG describe the Circle AGHF, which will cut BD and AD in the Points H and F; then 'tis plain, GD is the Sum, and HD the Difference of the Sides; also, since AE is equal to EF (by *Art.* 64. *Sect.* 1.) therefore FD is the Difference of the Segments of the Base; but (by *Art.* 75. *Sect.* 1.) AD : GD :: HD : FD; therefore the Base is to the Sum of the Sides, &c. as was to be proved.



CASE I.

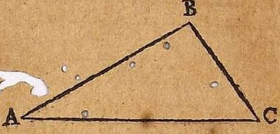
In any oblique-angled plane Triangle; two Sides, and an Angle opposite to one of them, given, to find the Angle opposite to the other.

Example,

[illegible] In the Triangle ABC, suppose AB [illegible], BC 84, and the Angle C, opposite to BA, [illegible], [illegible]0′; requir'd the Angle A opposite to BC.

Geometrically.

Draw the Line AC, and at any Point of it, suppose C, make the Angle C equal to 56°, 30′ (by *Prob.* 10. *Sect.* 1.) take C[illegible] equal to 84; and with the Length of 15[illegible] taken from the [illegible] Line of equal Pa[illegible]s with CB) in your Compasses, fixing one Foot in B, with the other cross AC in A. *Lastly*, join A and B; so the Triangle is constructed, and the requir'd Angle A may be measur'd by *Prob.* 11. *Sect.* 1.



By Calculation.

By *Theorem* 1. we have the following Proportion for finding the Angle A, *viz.*

AB : S, C :: BC : S, A.

i. e. as the Leg AB - - -	156°	- 2.19312
is to the Sine of its opposite Angle C,		
56°, 20′ - - - - - - - - -		- 9.92111
so is the Leg BC - - -	84	- - 1.92428
		11.84539
		2.19312
to the Sine of its opp. Angle A 26°, 41′		9.65227

CASE 2.

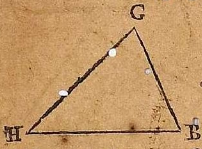
The Angles, and a Side opposite to one of them, given, to find a Side opposite to another.

Example

Example. In the Triangle HBG, ſuppoſe the Angle H 46°, 15′, and the Angle B 54°, 22′, conſequently the Angle G 79°, 23′, and the Leg HB 125, requir'd HG.

Geometrically.

Draw HB 125, from any Line of equal Parts, and make the Angle H 46°, 15′, and B 54°, 22′, then produce the Lines HG and BG, till they meet one another in the Point G; ſo the Triangle is conſtructed, and HG is meaſured by taking its Length in your Compaſſes, and applying it to the ſame Line of equal Parts that HB was taken from.



By Calculation.

By the firſt of the preceding Theorems, we have this Analogy for finding HG, *viz.*

S, G : HB : : S, B : HG.

i. e. as the Sine of G -	79°, 23′ -	9.99250
is to the Leg HB -	125 - - -	2.09691
ſo is the Sine of B - -	54°, 22′ -	9.90996
to the Leg HG - - -	103.4 - - -	2.01437

CASE 3.

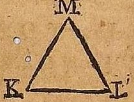
Two Sides and an Angle oppoſite to one of them, given, to find the third Side.

Example. In the Triangle KLM, ſuppoſe the Side KL 126 equal Parts, and KM 130 of theſe Parts, and the Angle L (oppoſite to KM) 63°, 20′, requir'd the Side ML.

Geometrically.

Geometrically.

The Geometrical Construction of this Case is the same with that in *Case* 1. (there being the same Things given in both) and the Leg ML may be measur'd by applying it to the same Line of equal Parts that the other two were taken from.



By Calculation.

The Solution of this Case depends upon the two preceding; and first we must find the other two Angles by *Case* 1. thus;

MK : S, L :: KL : S, M.

i. e. as the Side MK	130	2.11394
is to the Sine of L	63°, 20′	9.95116
so is the Side KL	126	2.10037
to the Sine of M	60°, 1′	9.93759

Then by *Case* 2. we find the requir'd Leg ML thus;

S, L : MK :: S, K : ML.

i. e. as the Sine of L	63°, 20′	9.95116
is to MK	130	2.11394
so is the Sine of K	53, 39	9.90602
to ML	117.2	2.06850

CASE 4.

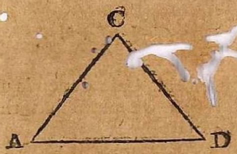
Two Sides and the contain'd Angle given, to find the other two Angles.

Example.

Example. In the Triangle ACD, ſuppoſe AC 103, and AD 126, and the Angle A 54°, 30′, required the Angles C and D.

Geometrically.

Draw AD 126 equal Parts, and make the Angle A, 54°, 30′, then ſet 103 equal Parts from A to C. *Laſtly*, join C and D; and ſo the Triangle is con-



ſtructed, and the Angles C and D may be meaſur'd by the Line of Chords.

By Calculation.

The Solution of this Caſe depends upon the ſecond and third of the preceding Theorems; and firſt we muſt find the Sum and Difference of the Sides, and half the Sum of the unknown Angles. Thus,

the Leg AD is	126
the Leg AC is	103
their Sum is	229
and their Difference is	23
the Sum of the three Angles A, D and C is	180°
the Angle A is	54°, 30′
ſo the Sum of the Angles C and D will be	125, 30
and half their Sum is	62°, 45′

then

Then by *Theorem* 2. we have the following Proportion, *viz.*

As the Sum of the Sides AD and AC 229 2.35984
is to their Difference - - - - - - 23 1.36173
so is the Tang. of half the Sum of the unknown Angles - - } 62°,45′ 10.28816
to the Tang. of half their Diff. - 11°. 2′ 9.29005

Now having half the Sum and half the Difference of the two unknown Angles C and D, we find the Quantity of each of them by *Theorem* 3. thus;

To half the Sum of the Angles C and D 62°. 45′
add half their Diffetence - - - - 11 . 02
and the Sum is the greater Angle C - 73 . 47

Again, from half the Sum - - - - 62 . 45
take half the Difference - - - - 11 . 02
and there will remain the lesser Angle D 51 . 43

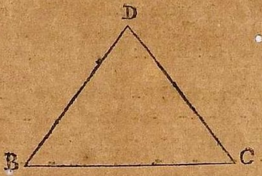
CASE 5.

Two Sides and the Contain'd Angle given, to find the third Side.

Example. In the Triangle BCD, suppose BC 154, and BD 133, and the Angle B 56°, 03′ requir'd the Side CD.

Geometrically.

The Geometrical Construction of this Case is the



same with that of the last, and the Length of DC is found by taking its Length in your Compasses, and applying it to the same Line of equal Parts that the two Legs were taken from.

By Calculation.

The Solution of this Case depends upon the second and fourth; and first we must find the Angles by the last Case, thus;

As the Sum of the Sides BD and BC	28[illegible]	2.45788
is to their Difference - - - -	21	1.32222
so is the Tangent of half [illegible] Sum of the Angles D and C	6[illegible], 58′	10.27372
to the Tangent of half their Diff.	7, 50	9.13806

So by *Theorem* 3. we have the Angles D and C, thus;

to half the Sum of the Angles D and C -	61° . 58′
add half their Difference - - - -	7 . 50
and the Sum is the greater Angle D -	69 . 48
Also from half the Sum - - - - - -	61 . 58
take half the Difference - - - - - -	7 . 50
and there remains the lesser Angle C - -	54 . 08

Then by *Case* 2. we have the following Analogy for finding DC the Leg requir'd, *viz.*

S, C : BD :: S, B : DC.

i. e. as the Sine of C -	54°, 08′ -	9.90869
is to BD - - - - - -	133 - - -	2.12385
so is the Sine of B - -	56, 03 - -	9.91883
to DC - - - - -	136.2 - - -	2.13399

CASE

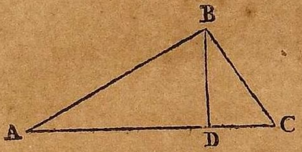
CASE 6.

Three Sides given, to find the Angles.

Example. In the Triangle ABC, ſuppoſe AB 156, BC 84, and AC 185.7; requir'd the Angles A, B, and C.

Geometrically.

Make AC 185.7 from any Line of equal Parts, and from the ſame Line taking 156, the Length of AB, in your Compaſſes, fix one Foot of them in A, and with the other ſweep an Arch; then take 84, the Length of BC, and fixing one Foot in C,



with the other ſweep an Arch, which will croſs the former in B; *Laſtly*, join the Points BA and BC, ſo the Triangle will be conſtructed, and the Angles may be meaſur'd by the Line of Chords.

By Calculation.

Let fall the Perpendicular BD from the Vertex B, upon the Baſe AC, which will divide the Baſe into the two Segments AD and DC, and to find the Lengths of theſe, we have, by *Theorem* 4. the following Proportion, *viz.*

As the Base AC	- - - - - -	185.7 - -	2.26893
is to the Sum of the Sides AB and BC		240 - -	2.38021
so is the Difference of the Sides	-	72 - -	1.85733
to the Diff. of the Segments of the Base		93 - -	1.96871

And having the Sum of the Segments, *viz.* the whole Base, and their Difference, we find the Segments themselves, by *Theorem* 3. thus;

To half the Sum of the Segments - - -	92.8
add half their Difference - - - -	46.5
and the Sum is the greater Segment AD -	139.3
Also from half the Sum of the Segments -	92.8
take half their Difference - - - - - -	46.5
the Remainder is the lesser Segment DC -	46.3

Now the Triangle ABC is divided by the Perpendicular DB into two Right-angled Triangles, ADB, and DBC; in the first of which are given the Hypothenuse AB 156, and the Base AD 139.3 to find the oblique Angles, for which we have (by *Case* 5. of Rectangular *Trigonometry*) the following Analogy, *viz.*

As AB - - - - - - - -	156 - -	2.19312
is to AD - - - - - - -	139.3 - -	2.14395
so is the Radius - - - -	90° - -	10.00000
to the Co-Sine of the Angle A	$26^\circ, 40'$ -	9.95083

Also the Angle C is found by the same Case, thus;

As BC - - - - -	84 - - - - -	1.92428
is to CD - - - - -	46.3 - - - -	1.66558
so is the Radius - -	90° - - -	10.00000
to the Co-Sine of C -	$56^\circ, 30'$ - -	9.74130

Having

Having found the two Angles A and C, we have the third, B, by taking the Sum of the other two from 180, thus;

The Sum of all the three Angles is -	180°
The Sum of A and C is	83 . 10
The Angle B is	96 . 50

All the Proportions us'd for the Solutions of the ſeveral Caſes in *Plane Trigonometry*, may be performed by the Scale and Compaſs. On the Scale there are ſeveral Logarithmic Lines, *viz.* one of Numbers, another of Sines, and one of Tangents, *&c.* And the Way of working a Proportion by theſe is this, *viz.* Extend your Compaſſes from the firſt Term of your Proportion, found on the Scale, to the ſecond, and with that Extent, fixing one Foot in the third Term, the other will reach the fourth Term requir'd.

S E C T. III.

Of the Principles of GEOGRAPHY *and* ASTRONOMY.

1. THE Land and Water of this Earth make up a Compoſition of a Spherical Form, or rather an Oblong Figure, which is call'd the *Terraqueous Globe.*

2. This Globe moves round its Axis in 24 Hours, from Weſt to Eaſt; and thereby cauſing the Celeſtial Bodies to revolve, apparently from Eaſt to Weſt, in the ſame Time, makes the Viciſſitudes of Day and Night.

3. Theſe

3. Theſe two Points in which the Axis of the Earth meets the Surface, are call'd the Poles of the Earth; and if the Axis be produc'd on both Sides, to the Heavens, it will cut them in two oppoſite Points call'd the *Celeſtial Poles*. The one towards the North, is called the *Arctic Pole*; and the other towards the South, the *Antarctic*.

4. Circles upon a Sphere, are either Great or Leſſer. A *Great Circle*, is that whoſe Plane paſſes thro' the Center of the Sphere, or whoſe Diameter is equal to the Diameter of the Sphere. A *Leſſer Circle* is that whoſe Plane does not paſs through the Center of the Sphere, or whoſe Diameter is leſs than the Diameter of the Sphere.

Cor. 1. Hence it is plain, that all great Circles upon a Sphere divide it into Halves, and all leſſer Circles divide it unequally.

Cor. 2. And ſince all great Circles have the ſame Center, *viz.* that of the Sphere, it is plain they muſt biſect one another.

5. Since the Earth moves round it's Axis, 'tis plain that every Point in the Surface (except the two Poles which are at reſt) will deſcribe the Circumference of a Circle; and that which is deſcrib'd by a Point lying in the middle between the two Poles, is call'd the *Equator*, or *Equinoctial Line*, or ſimply the *Line*.

6. If the Plane of the *Equator* be produc'd to the Heavens, it will there mark out a Circle call'd the *Celeſtial Equator*, which will divide the Earth and Heavens into two Hemiſpheres, that towards the North call'd the *Northern Hemiſphere*, and that towards the South, the *Southern*.

7. Great Circles paſſing through the Poles of the World, and cutting the Equator at Right Angles, are call'd *Meridians*; and that which paſſes over any Place, is call'd the Meridian of that Place.

8. The

8. The Diftance of any Place upon the Earth, from the Equator, counted in Degrees upon the Meridian, is call'd the *Latitude* of that Place; and it is either North or South, according as it lies upon the North or South Side of the Equator.

9. Since by the Rotation of the Earth about it's Axis, every Point upon it's Surface defcribes a Circle, 'tis plain all the Points between the Equator and Poles, muft defcribe Circles parallel to the Equator; and thefe are called *Parallels of Latitude.*

10. The *Difference of Latitude* between two Places, is the Arch of a Meridian, contain'd between the Parallels of Latitude paffing over thefe Places.

Cor. 1. Hence if the two Places lie both on the fame Parallel, they will have no Difference of Latitude.

Cor. 2. If the Places lie both on the fame Side of the Equator, and on different Parallels, then their Difference of Latitude is found by taking the leffer Latitude from the greater.

Cor. 3. But if the Places lie on different Sides of the Equator, then their Difference of Latitude is equal to the Sum of the two Latitudes.

11. The *Complement of the Latitude* of any Place, is that Latitude taken from 90 Degrees, or the Diftance of the Place from the neareft Pole.

12. The *Longitude* of any Place upon the Earth, is an Arch of the Equator intercepted between the firft Meridian, and the Meridian paffing thro' the propofed Place. Which is equal to the Angle at the Pole formed by the firft Meridian, and the Meridian of the Place.

13. The firft Meridian may be placed at Pleafure, paffing through any Place; as *London*, *Paris*, *Teneriff*, &c. and the Longitudes counted from it will be either Eaft or Weft, according as they lie on the Eaft or Weft Side of that Meridian.

14. The

14. The *Difference of Longitude* between two Places upon the Earth, is an Arch of the Equator, comprehended between the two Meridians of theſe Places: and the greateſt poſſible is 180 Degrees, *viz.* when the two Places lie on oppoſite Meridians.

15. Since by the Motion of the Earth about its Axis, every Point upon the Surface deſcribes the Circumference of a Circle or 360 Degrees, in 24 Hours time, 'tis plain in one Hour it muſt deſcribe 15 Degrees; therefore any Place lying 15 Degrees to the Eaſtward of another, has the Sun upon its Meridian 1 Hour ſooner than that other; ſo when it is Twelve a Clock in the Eaſtermoſt Place, it will be but Eleven in the other.

Cor. Hence the Difference of Longitude may be converted into Difference of Time, by allowing 1 Hour for every 15 Degrees, and proportionally for Minutes, *&c.* alſo Difference of Time may be converted into Difference of Longitude, by allowing 15 Degrees for every Hour, and proportionally for other Time. Conſequently by knowing the one, we can find the other.

16. If we ſuppoſe a Plane touching the Surface of the Earth in any Point, (upon which a Spectator is ſtanding) and produced to the Heavens, it will then make a Circle called the *Horizon*, which ſeparates the Viſible from the Inviſible Part of the Heavens. This Horizon is properly the *ſenſible Horizon*; the *true* or *rational Horizon* is a great Circle parallel to the ſenſible, and paſſing through the Center of the Earth, which divides the Heavens and Earth into two Halves, called the *Upper* and *Lower Hemiſpheres*.

17. Theſe two Horizons, when produced to the Heavens, may, without any ſenſible Error, be ſuppoſed to coincide the Diſtance between them, or the Earth's Semidiameter, vaniſhing when compared with ſuch a Diſtance.

18. Since

18. Since the Earth moves round its Axis from Weſt to Eaſt, 'tis plain a Spectator upon its Surface, together with his Horizon, muſt move the ſame Way; conſequently theſe Celeſtial Bodies towards the Eaſt, that were before inconſpicuous, will become viſible, the Horizon being depreſſed below them; and theſe towards the Weſt, that were before in View, will become inviſible, the Horizon being elevated above them. And hence ariſes the apparent Motion of all the Heavenly Bodies, by which they appear to deſcribe Circles round the Poles, parallel to the Celeſtial Equator, which are greater or leſs, according as they are more or leſs diſtant from the neareſt Pole.

19. When any Celeſtial Body comes firſt in View, or when it is on the Eaſtern Side of the Horizon, it is then ſaid to *Riſe*; and when by its apparent Motion it comes to the Meridian, it is then ſaid to *Culminate*: And *laſtly*, when it begins to diſappear, or is upon the Weſtern Side of the Horizon, it is then ſaid to *Set*.

23. If through the Center of the Earth there be drawn a Line perpendicular to the Plane of the Horizon, and produc'd to the Heavens, it will there mark out two Points; the one, which is directly over our Heads, is call'd the *Zenith*; and the oppoſite Point thereto, which is inviſible to us, *viz.* directly under our Feet, is call'd the *Nadir*.

21. *Vertical* or *Azimuth Circles*, are great Circles paſſing through the Zenith and Nadir, and cutting the Horizon at Right Angles. Among the Vertical Circles there are two principal ones, *viz.* the Meridian, which paſſes thro' the Zenith, Nadir, and Poles, and cuts both the Equator and Horizon at Right Angles; the Points in which it cuts the Horizon are the South and North Points; and the other principal Vertical, call'd the *Prime Vertical*, is that which cuts the Meridian at Right Angles,

 and

and meets the Horizon in two opposite Points, call'd the East and West Points.

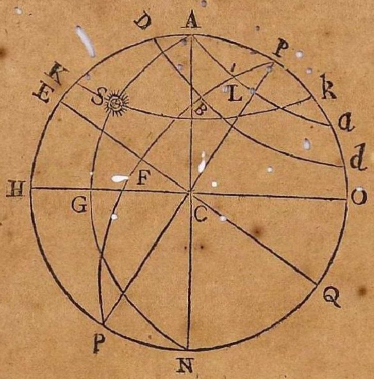
22. Lesser Circles, parallel to the Horizon, are call'd *Almicanthers*, or *Parallels of Altitude*. And these continually decrease, the nearer they are to the Zenith.

24. The *Altitude*, or Depression of any Heavenly Body, above or below the Horizon, is an Arch of a Vertical Circle, intercepted between the Horizon and Center of the Object.

25. The *Zenith-Distance* of any Heavenly Object, is that Arch of the Vertical Circle passing thro' it, intercepted between the Center of the Object and the Zenith, which is always the Complement of the Altitude.

26. Let the Circle A H N O represent the Earth, projected on the Plane of some Meridian, A some Place upon that Meridian; draw the Diameter H O at a Quadrant, or 90 Degrees, Distance from A; then H O will represent the Horizon of the Place A (by *Art.* 16. of this). Let P and *p* be the two Poles; consequently P *p*, the Axis of the Earth, and the Diameter E Q at Right Angles with that, will represent the Equator, (by *Art.* 5.) make P *a* equal to P A, and draw the Circle A *a* parallel to the Equator E Q, and this will be the Parallel of Latitude the Place A lies on. The Arch A E will be the Latitude of the Place A, and A P, the Complement of its Latitude (by *Art.* 8. and 11.) the Point in the Heavens directly above A will be the Zenith, and that directly above N will be the Nadir of the Place A (by *Art.* 20.) the great Circle A C N will be the Prime Vertical, (by *Art.* 21.) and the Points H and O will be the South and North Points, and C will represent the East and West Points in the Horizon of A. Let S be any Heavenly Object, and A S N a Vertical or Azimuth Circle passing thro' the Center of the Object; also K S its Parallel

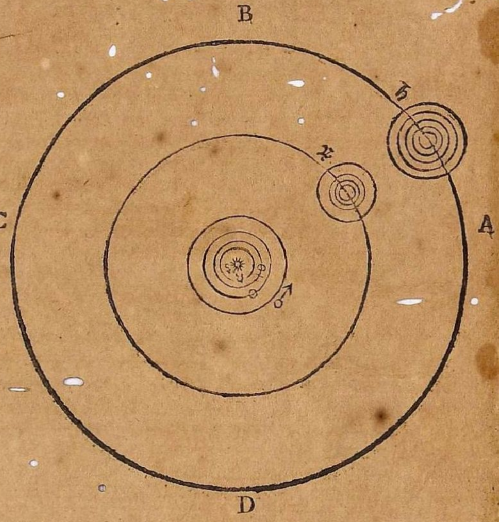
Parallel of Altitude; then SG will be the Altitude and SA the Zenith Diſtance of the Object S (by *Art.* 24. and 25.). Again, let any other Place upon



the Earth be aſſum'd, as B, and its Meridian will be PB*p*, and its Parallel of Latitude DB*d*; then the Latitude of B will be BF or DE, and the Complement of its Latitude will be BP or DP. Alſo the Difference of Latitude between the two Places A and B, will be BL or DA (by *Art.* 10.). If the Meridian paſſing through A, be ſuppos'd the firſt Meridian, then the Longitude of B will be EF (by *Art.* 12.) but if the Meridian of A be not ſuppos'd the firſt Meridian, then the Difference of Longitude between the two Places A and B will be EF (by *Art.* 14.)

27. The Syſtem of the Univerſe (according to the lateſt Aſtronomers) is as follows, *viz.* The *Sun* is

is ſuppos'd to be in the common Center of Gravity, of ſix Opake Spherical Bodies, called *Planets*, which are at different Diſtances from the Sun, and perform their ſeveral Periods round him in different Times; the Names of theſe Planets, and the Characters by which they are expreſs'd, are as follows, *viz.* *Mercury* ☿, *Venus* ♀, the Earth ⊖,



Mars ♂, *Jupiter* ♃, and *Saturn* ♄. And they all move round the Sun, from Weſt to Eaſt, in Orbs, very little inclin'd to one another, and the Planes of theſe Orbs cut one another in Lines paſſing thro' the Center of the Sun; conſequently a Spectator, plac'd plac'd in the Center of the Sun, will be in the Plane of each of their Orbs, and will there view the Planets performing their ſeveral Periods round him, from Weſt to Eaſt, according to the Order of the Letters ABCD, (in the annex'd Scheme) and in different Times, *viz.* *Mercury* ☿, which is neareſt the Sun, moves round his Orb in 87 Days; *Venus* ♀, which is next to *Mercury*, performs her Period in 224 Days and 17 Hours, or about 8 Months. The Planet which is third in Order from the Sun, is our Earth ⊖, which performs its Circuit in 365 Days, 5 Hours, and 49 Minutes, or a Year. Next to the Earth is *Mars* ♂, who moves round his Orb in 686 Days and 23 Hours, or a little leſs than 2 Years. Then *Jupiter* ♃, whoſe Orb is vaſtly extended beyond that of *Mars*, performs his Circuit in 4322 Days, 12 Hours, which is about 12 Years. And *laſtly*, *Saturn* ♄, who is further diſtant from the Sun, completes his Revolution in 10759 Days and 7 Hours, which is ſomething leſs than 30 Years. Their Diſtances from the Sun expreſs'd in the Scheme, are nearly proportional to their true Diſtance in the Heavens.

28. Three of the Planets, *viz.* *Mars*, *Jupiter*, and *Saturn*, whoſe Orbs are beyond that of the Earth, are called *ſuperior Planets*; and the two Planets, *Venus* and *Mercury*, whoſe Orbs are between the Earth's Orb and the Sun, are called the *inferior Planets*.

29. The three Planets, *Jupiter*, *Saturn*, and the Earth, are obſerved to have other ſmaller ones, conſtantly attending them, called *Secondary Planets*, or *Satellites*. Theſe Satellites always attend their reſpective Primaries in their Revolutions about the Sun, and at the ſame Time they are conſtantly moving about them; the Earth has one, *viz.* the

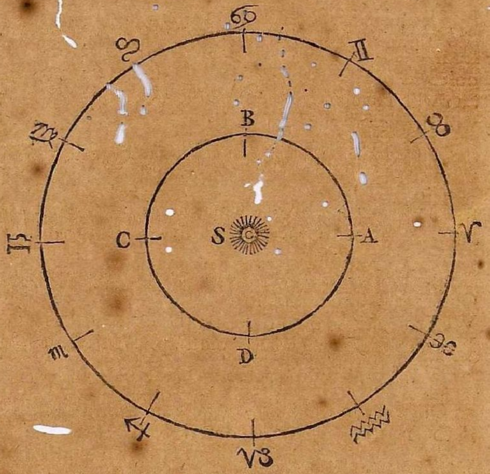
Moon,

Moon, which attends it in its Annual Revolution about the Sun, and at the ſame Time moves round it as a Center, in about 27 Days, and 7 Hours. *Jupiter* has four Satellites attending him, which are at different Diſtances from him, and move round him in different Times, *viz.* that which is innermoſt or neareſt his Body, revolves in 1 Day 18 Hours; the next deſcribes its Orbit in 3 Days and 13 Hours; the third moves round in 7 Days and 3 Hours; and that which is fartheſt from *Jupiter*'s Body, performs its Circuit in 16 Days and 18 Hours. *Saturn* has five Satellites moving round him as a Center, which are at different Diſtances from his Body, and perform their Revolutions in different Times, *viz.* the firſt or neareſt to him, performs its Circuit in 1 Day, 21 Hours; the ſecond in 2 Days, 17 Hours; the third, in 4 Days 13 Hours; the fourth, in 15 Days, 22 Hours; and the fifth, or the moſt remote from the Body of *Saturn*, completes its Revolution in 79 Days and 8 Hours.

30. The *fix'd Stars* are ſuppos'd to be of the ſame Matter with the Sun, and made for the ſame Ends, *viz.* each of them the Center of its own proper Syſtem, having Planets moving round it as our Sun has.

31. Having given a curſory View of the Syſtem of the Univerſe, we ſhall now conſider the Motion of the Earth, a little more particularly. Let S repreſent the Sun in the Center, A B C D the Orbit of the Earth, and ♈ ♋ ♎ ♑, the Heaven of the fix'd Stars; then if the Obſerver be ſuppos'd to be plac'd in the Sun at S, 'tis plain, when the Earth is in the Point A of its Orbit, it will appear to be at the fix'd Star ♈, and while in moving from Weſt to Eaſt, it goes from the Point A of its Orbit to B, it will appear to the Obſerver at S to paſs by the

the fix'd Stars ♈ ♉ ♊ ♋; and in moving from B to C, it will appear to paſs by the fix'd Stars



♋ ♌ ♍ ♎; and from C to D, the fix'd Stars ♎ ♏ ♐ ♑; and from D to A the fix'd Stars ♑ ♒ ♓ ♈. Again, let the Obſerver be remov'd from the Sun to the Earth, then 'tis plain, when the Earth is in the Point A of its Orbit, the Sun S will appear to be in the oppoſite Point of the Heavens, *viz.* at the fix'd Star ♎; and while the Earth is moving in its Orbit from A to B, the Sun will appear to paſs by the fix'd Stars ♎ ♏ ♐ ♑; alſo, while the Earth moves from B to A, the Sun will appear to have mov'd from ♑, by the fix'd Stars ♒ ♓, &c. to ♎; conſequently the Sun, to an Inhabitant

habitant of the Earth will appear to paſs over the ſame fix'd Stars, and towards the ſame Part of the Heavens, *i. e.* from Weſt to Eaſt, as the Earth appear'd to an Obſerver in the Sun.

32. Hence ariſes the apparent Motion of the Sun from Weſt to Eaſt. So that if any fix'd Star be obſerv'd to riſe with the Sun, ſome Days after, the Sun will have mov'd more Eaſterly, and the Star will riſe before the Sun, and alſo ſet before it: Alſo if a Star, in or near the Path which the Sun appears to deſcribe in his Annual Motion, and at ſome Diſtance from the Sun, be obſerv'd above the Horizon after Sun-ſet, it will ſome Time after that appear to ſet with the Sun, and for a while will not be viſible at Night.

33. The ſame Way the Sun will appear to an Obſerver in any of the other Planets to move from Weſt to Eaſt, and to deſcribe the ſame Orbit in the Heavens that the Planet would appear to do to an Obſerver in the Sun.

34. The Circle in the Heavens that the Earth to an Obſerver in the Sun, or the Sun to an Obſerver in the Earth, appears to deſcribe, is called the *Ecliptic*, and it is divided into twelve equal Parts, called *Signs*, each containing 30 Degrees, *viz.* the $\frac{1}{12}$ of 360, The Names and Characters by which theſe Signs are uſually expreſs'd, are as follows.

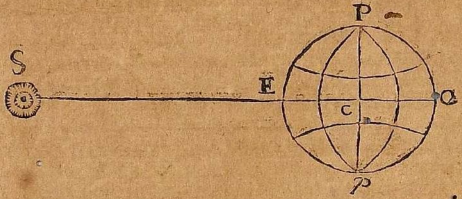
♈	♉	♊	♋	♌	♍	♎
Aries,	*Taurus,*	*Gemini,*	*Cancer,*	*Leo,*	*Virgo,*	*Libra,*

♏	♐	♑	♒	♓
Scorpio,	*Sagittarius,*	*Capricornus,*	*Aquarius,*	*Piſces,*

35. Since the Earth is a Spherical Body expoſed to the Rays of the Sun, 'tis plain, half of its Body muſt be enlightned, while the other Half is in Darkneſs; and if there be a Line drawn from the Center

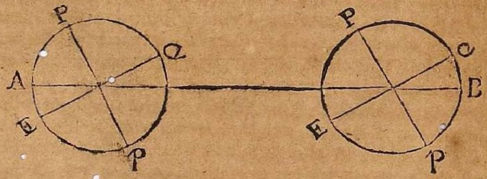
ter of the Sun to that of the Earth, and a plane Perpendicular to that Line paſſing through the Center of the Earth; then this Plane will cut the Earth in a great Circle, which will ſeparate the enlightned from the darkned Hemiſphere; and this Circle is called the *Terminator* of Light and Darkneſs upon the Earth.

36. If the Plane of the Earth's Equator lay in the Plane of the Ecliptic, and conſequently the Earth's Axis were perpendicular to the Ecliptic, then the *Terminator* of Light and Darkneſs would be a Meridian; for let the Circle PE*p*Q repreſent the Earth, P and *p* its two Poles, EQ the Equator, C the Center of the Earth, and S the Sun lying in the ſame Plane with EQ; then, by the laſt Article, the *Terminator* muſt be perpendicular to SC, and conſequently, in this Caſe, to the Plane of the Equator EQ; but ſince all great Circles perpendicular to the Equator muſt paſs thro' the Poles, and ſo be Meridians, it follows, that in this Caſe the *Terminator* muſt be a Meridian, as P*p*. And ſince all Meridians biſect the Equator (by *Art.* 4. *Cor.* 2. of this) they muſt alſo biſect its Parallels;



conſequently the *Terminator*, which is here a Meridian, muſt biſect the Equator and all its Parallels; ſo ſo the Half of each Parallel muſt be always enlightned, and the other Half in Darkneſs; and ſince by the Motion of the Earth about its Axis, every Point upon its Surface, except the Poles, deſcribes a Circle parallel to the Equator; it plainly follows, that if the Plane of the Equator lay in the Plane of the Ecliptic, every Point upon the Earth's Surface, except the two Poles, would have the Sun as long above its Horizon as below it, and ſo there would be a conſtant Equality of Day and Night, *viz.* 12 Hours each; and the two Poles would have the Sun conſtantly moving round their Horizon.

37. The Axis of the Earth is obſerv'd to be inclin'd to the Plane of the Ecliptic at an Angle of about 66½ Degrees, and conſequently the Plane of the Equator muſt be inclin'd to the Ecliptic, at an Angle of 23½ Degrees, *viz.* the Complement of the former. Alſo the Axis of the Earth in its Annual Motion about the Sun, keeps always parallel to the ſame Line; ſo if there be a Line drawn thro' the Center of the Sun, parallel to the Earth's Axis, while in any Point of its Orbit, that Line will continue parallel to the Axis, whatever Point of the Orbit the Earth be in (at leaſt in a Year's



Time the Difference is inſenſible). And this muſt neceſſarily happen, if the Earth had no other Motion

tion but a progreſſive one in its Orbit, and a Rotation about its Axis. For ſuppoſe any Spherical Body, as P E *p* Q, whoſe Center moves along the Line A B; and while in A, let any Diameter of it, as P *p*, be aſſum'd, inclin'd any Way to the Line A B; then 'tis plain, if the Body had no other but the progreſſive Motion, when it has come to B, the Diameter P *p* will ſtill be parallel to its former Situation, while in the Point A; and if the ſame Body be ſuppos'd alſo to move round its Axis P *p*, 'tis plain, all Parts of it would conſequently be changing their Situations, except the Axis which is no Way affected by the Rotation, and conſequently the Axis muſt always keep parallel to the ſame Right Line.

38. Since the Plane of the Equator is inclin'd to the Plane of the Ecliptic, therefore they muſt interſect one another in a Right Line paſſing thro' the Centers of the Earth and Sun, and ſo the Plane of the Ecliptic muſt cut the Earth in a great Circle, which will be inclin'd to the Equator at an Angle of 23½ Degrees, and this will mark out upon the Earth's Surface, the Path of the Sun in his Annual Motion; the Line in which the Equator interſects the Ecliptic, muſt always be parallel to the ſame Line, whatever Point of the Orb the Earth be in; for ſince (by the laſt *Art.*) the Earth's Axis always preſerves a Paralleliſm, and that Line being always inclin'd to the Axis at the ſame Angle, 'tis plain therefore, that it muſt alſo keep a conſtant Paralleliſm.

39. If through the Center of the Sun there be drawn a Line perpendicular to the Plane of the Ecliptic; then this Line is called the Axis of the *Ecliptic*; and the two oppoſite Points in which the Axis meets the Heavens, are called the *Poles of the Ecliptic.*

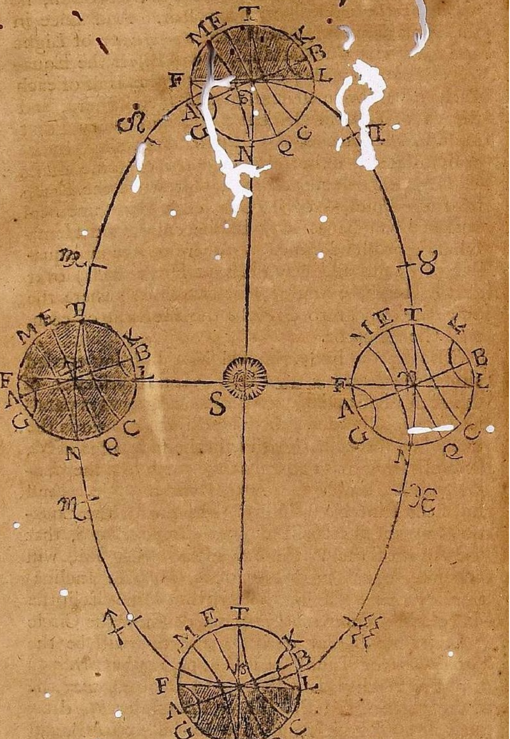
40. That great Circle in the Heavens which paſſes thro' the Poles of the World and the Points of interſection, of the Ecliptic and Equator, is called the *Equinoctial Colure*. And that great Circle which is at Right Angles with the former, and paſſes thro' the Poles of the Ecliptic and World, is called the *Solſtitial Colure*. The four Points in which theſe Colures cut the Ecliptic, are called the *Cardinal Points*. Theſe two in which the Equinoctial Colure meets the Ecliptic, are called *Equinoctial Points*; becauſe (as ſhall be ſhewn) when the Sun is in either of them there is an Equality of Day and Night to the Inhabitants of the Earth; and the two Points in which the Solſtitial Colure cuts the Ecliptic, are called the *Solſtitial Points*; becauſe when the Sun comes to either of theſe Points, he is then at his greateſt Diſtance from the Equator, and is beginning to return to it again.

41. To explain the Phænomena, or Appearances that ariſe from the Earth's Annual Motion about the Sun: Suppoſe ♑ ♈ ♋ ♎ the Earth's Orbit, and S the Sun; through S draw the Right Line ♎ S ♈, parallel to the common Line of Interſection, of the Ecliptic and Equator, and meeting the Ecliptic in the two Points ♈ and ♎; alſo thro' S draw the Line ♑ S ♋ perpendicular to the former; then 'tis plain, when the Earth is in the Point ♎ of its Orb, the Line S ♎, joining the Centers of the Sun and Earth, will coincide with the common Interſection of the Ecliptic and Equator, and ſo lie in the Plane of the Equator, and conſequently be perpendicular to the Earth's Axis; and ſince (by *Art.* 35.) this Line is alſo perpendicular to the *Terminator* of Light and Darkneſs, 'tis plain that the Axis of the Earth will lie in the Plane of the *Terminator*, which therefore muſt paſs thro' the two Poles, and ſo be a Meridian; alſo the Sun will appear in the oppoſite Point of the Orbit at ♈, *viz.* in the Line

♎ S

♎ S produc'd, that is, in the Plane of the Equator; and conſequently by his apparent daily Motion, he will deſcribe the Celeſtial Equator. And ſince in this Situation of the Earth, the *Terminator* of Light and Darkneſs is a Meridian, it will biſect the Equator and its Parallels; conſequently the Half of each Parallel will be in the enlightned Hemiſphere, and the other Half in the darkned; and every Point upon the Surface of the Earth, deſcribing, by its daily Motion, either the Equator or ſome of its Parallels; it plainly follows, that when the Earth is in the Point ♎ of its Orb, each Place upon its Surface, will be as long in the enlightned Hemiſphere as in the darkned, *i. e.* there will be an Equality of Night and Day (*viz.* 12 Hours each) over all the Earth, except at the two Poles, where the Sun will appear to deſcribe the Horizon of each, *viz.* the Equator.

The Earth, by its Annual Motion being carried along the Signs ♏ ♐, the Line of Interſection of the Eclipticк and Equator remaining always parallel to itſelf, it cannot now be directed towards the Sun; but when the Earth is in the firſt Point of ♑, it muſt make, with the Line S ♑, joining the Centers of the Earth and Sun, a Right Angle. And ſince the Line S ♑ is not in the Plane of the Equator, but of the Ecliptic, the Angle B ♑ S, that the Axis of the Earth A B makes with S ♑, will be acute, equal to 66½ Degrees, *viz.* the Inclination of the Axis of the Earth to the Ecliptic. Thro' the Center of the Earth ♑, draw the Circle F L, perpendicular to S ♑, and this will be the *Terminator* of Light and Darkneſs, (by *Art.* 35.) and the Arch B L will be 23½ Degrees, *viz.* the Complement of T B. Thro' the Center ♑, draw the Circle Q E perpendicular to the Axis A B, and this will be the Equator; then, ſince the Arch E B is equal to the Arch T L, (being each a Quadrant) by by taking away the common Arch TB, we have



ET equal to BL, *i. e.* 23½ Degrees. Make the Arch

Arch EM equal to ET, and thro' the Points T and M draw the Circles TC, MN parallel to the Equator; then 'tis plain, that when the Earth is in the Point ♑ of its Orbit, the Sun will be perpendicular to the Point T, diſtant from the Equator EQ, towards the North Pole B, 23½ Degrees, which is his greateſt Declination North. The Parallel TC is called the *Tropic of Cancer*, and the Circle in the Heavens concentric with this, which the Sun appears to deſcribe at that Time, is called the *Celeſtial Tropic of Cancer*; becauſe the Sun at that time appears to be in the Sign ♋. And becauſe of the Earth's Rotation about its Axis, 'tis plain, that all the Points ſituate upon the Parallel TC, will have the Sun, when upon their Meridian, in their Zeniths. Alſo, when the Earth is in this Poſition, 'tis plain, that the *Terminator* of Light and Darkneſs FL, will go beyond the North Pole B to L, 23½ Degrees diſtant from B; and conſequently the South Pole A muſt be as far, from the *Terminator* LF in the darkned Hemiſphere. Thro' the Points L and F, draw the Circles LK, FG parallel to the Equator, and theſe Circles are called *Polar Circles*, that towards the North is called the *Artic Circle*, and that towards the South is called the *Antarctic Circle*. Now, ſince the Earth moves round upon its Axis AB, 'tis evident, that every Point within the Artic Polar Circle KL, will, at that time, have have a continued Day; and on the contrary, every Point within the Antartic Polar Circle FG, will have a continued Night.

Again, the Earth moving forwards through the Signs ♒ ♓ to ♈, the Sun will appear to move thro' the Signs ♋, ♌, ♍, and by Degrees to return again to the Equator; and when the Earth has come to the Point ♈ of its Orbit, the Sun will appear to be at ♎. Now the common Interſection of the Ecliptic and Equator ſtill remaining parallel to the Line

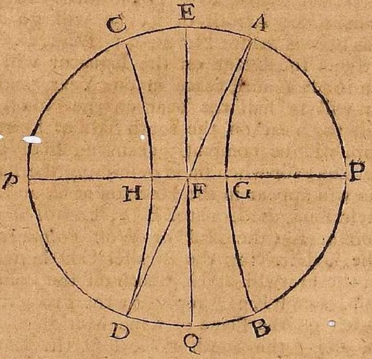
♎ S

♎ S ♈, 'tis plain, that when the Earth has come to ♈, the Line S ♈, joining the Centers of the Earth and Sun, will lie in the Plane of the Equator; and conſequently the Sun will appear in the Celeſtial Equator, and there will be an Equality of Night and Day, the ſame Way as when the Earth was in ♎; and in this Situation, the *Terminator* of Light and Darkneſs will again paſs through the two Poles.

The Earth moving forwards through the Signs ♈, ♉, ♊, the Sun will appear to move thro' the oppoſite Signs ♎, ♏, ♐, gradually declining from the Equator, towards the South Pole; and when the Earth comes to ♋, the Sun appears to be in ♑. Now, ſince the Axis of the Earth A B, does not change its Inclination to the Ecliptic, the Earth will have the like Aſpect and Poſition with reſpect to the Sun, as it had when in the Point ♑ of its Orbit; but with this Difference, that he is now as far on the South Side of the Equator, as (when the Earth was in ♑) he was on the North Side, *i. e.* $23\frac{1}{2}$ Degrees, and is perpendicular to the Point N; the Parallel N M is called the *Tropic* of *Capricorn*, and the Circle in the Heavens concentric to this which he appears to deſcribe at this time, is called the *Celeſtial Tropic* of *Capricorn*; becauſe at this time the Sun appears to be in the Sign ♑; alſo, all within the North Polar Circle K L, which was enlightned when the Earth was at ♑, is now in Darkneſs, and all within the South Polar Circle, is now enlightned.

42. We ſhall now conſider more particularly the Appearances that happen to the different Places upon the Earth, ariſing from its Annual Motion about the Sun, in Conjunction with the Rotation about its Axis. In order to which we muſt conſider, that the Inhabitants of this Earth, with reſpect to their Situation upon it, are divided into three Kinds, *viz.* *Firſt*, Such as live upon the Equator. *Secondly*,

condly, Such as live between the Poles and Equator. *Thirdly*, Such as live upon either Pole. As for thofe that live upon the Equator; Let E *p* Q P be the Projection of the Earth upon the Plane of fome Meridian, P the North, and *p* the South Pole, E Q the Equator, and E fome Place upon it; alfo D A the Ecliptic, C D the *Tropic* of *Capricorn*, and A B the *Tropic* of *Cancer*. Then 'tis plain, that an Inhabitant upon the Equator, fuppofe at E, will have the two Poles P and *p* in his Horizon, which therefore muft be a Meridian. And fince all Meridians bifect the Equator and its Parallels at Right Angles, and all the Heavenly Bodies defcribing Parallels in their apparent diurnal Motion; 'tis evident, that in

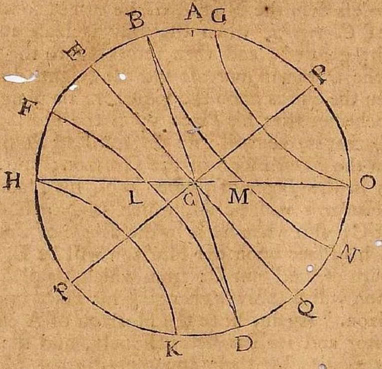


one intire Revolution of the Earth about its Axis, all the Heavenly Bodies muft come in View, and they muft rife and fet perpendicular to the Horizon, and be as long above it as below, *i. e.* twelve Hours each. Now the Sun always defcribing fome Parallel, or the Equator itfelf, in his diurnal Motion; it follows, that to an Inhabitant upon the Equator there muſt be a conſtant Equality of Night and Day, *viz.* twelve Hours each; and when the Sun in his Annual Motion comes to be perpendicular to the Point F, he will then deſcribe the Equator in his diurnal Motion; and conſequently when he comes upon the Meridian of any Place, E, on the Equator, he will be in the Zenith of it; and moving on in the Ecliptic till he be perpendicular to the Point A, (when he is at his greateſt Declination from the Equator towards the North Pole P, *viz.* 23½ Degrees) he will then deſcribe the *Tropic* of *Cancer* AB, and when he comes on the Meridian of E, he will be remov'd from the Zenith towards the North 23½ Degrees; and moving ſtill on in the Ecliptic, he will appear to return towards the South, and paſſing the Zenith of E, he will go as far South as he was before North, 23½ Degrees. Conſequently an Inhabitant on the Equator will have the Sun in his Zenith twice in one Year, and alſo the Sun will be half the Year on the North Side, and half the Year on the South Side of him; and therefore will be conſtantly changing his Place in the Horizon; for when he is deſcribing the Parallel AB, he will appear in the Horizon at G, and when he is deſcribing the Equator EQ, he will be in the Horizon at F (the Eaſt or Weſt Points); alſo when he is deſcribing the Parallel CD he will appear in the Horizon at H, South off the Point F.

Again, Let PE*p*Q repreſent the Projection of the Earth on the Plane of ſome Meridian, P the North, and *p* the South Pole, EQ the Equator, and A ſome Place upon that Meridian, lying between the Equator and North Pole, whoſe Horizon is HO; alſo BD the Ecliptic, BN the *Tropic* of *Cancer*, and FD the *Tropic* of *Capricorn*; through the Points H and O draw the Parallels OG, HK. Then 'tis plain, that to an Inhabitant at A, the

North

North Pole P will be elevated above, and the South Pole *p* depreſſed as much below the Horizon; and the Horizon will cut the Equator and its Parallels obliquely. Now, ſince the Horizon and Equator are both great Circles, they muſt biſect one another (by *Art.* [illegible] *Cor.* 2.); therefore half the Equator will be above, and half below the Horizon; conſequently, when the Sun is perpendicular to the Point C, that is, when he appears to be in the Equator, there will be an Equality of Night and Day. And ſince the Horizon cuts the Parallels obliquely, it muſt therefore cut them unequally; and 'tis plain from the Scheme, that of thoſe Parallels which lie between the Equator and neareſt Pole, the greater Part is above the Horizon, and the leſſer below; and thoſe that lie on the other Side of the Equator, have the leſſer Part above, and the greater



below the Horizon; and the nearer the Parallels are to the Poles, the more unequally are they cut by the Horizon. Conſequently, while the Sun is

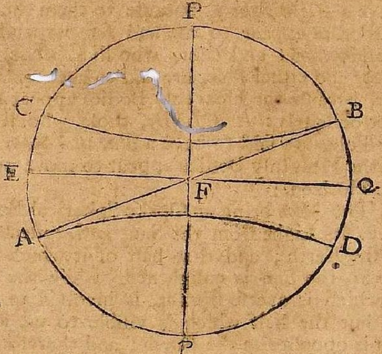
 upon

upon the North Side of the Equator, and by his diurnal Motion describing Parallels lying between the Equator and North Pole; 'tis plain, he will be longer above than below the Horizon of the Place A; and when he comes to his greatest Declination North, and then describes the *Tropic* of *Cancer*, 'tis plain, the Days must then be at the longest to the Place A; also the Sun returning towards the Equator, he will describe Parallels, whose Parts above the Horizon grow still nearer to an Equality with those below; and so the Days will still decrease, and come nearer to an Equality with the Nights, till he come to the Equator, when the Day and Night are equal; and proceeding from the Equator towards the South Pole, he will then describe Parallels lying between the Equator and South Pole, whose least Part is above, and greatest Part below the Horizon, and consequently the Days will still grow less than the Nights, till he comes to the *Tropic* of *Capricorn*, when the Day is least and the Night greatest; and then returning to the Equator, the Days will increase and the Nights decrease. When the Sun is upon the Equator, 'tis plain, from the Scheme, that his Place upon the Horizon will be C, that is, he will rise on the East Point, and set on the West Point of the Horizon; and when he is in the *Tropic* of *Cancer* B N, his Place upon the Horizon will be M, which is North of the Point C; also when he is in the *Tropic* of *Capricorn* F D, his Place upon the Horizon will be L, which is South of the Point C; from which 'tis plain, that the Sun will be always changing his Place upon the Horizon. Again, since the Horizon of A cuts the Equator and its Parallels obliquely, and the Heavenly Bodies by their apparent diurnal Motion, describing Parallels, 'tis plain, they must rise and set obliquely; also all of them within the Parallel

GO

GO can never riſe or ſet, but muſt be conſtantly in View; for which Reaſon this Parallel GO is called, *The Circle of conſtant Apparition*; and all within the Parallel HK can never come in View, but be conſtantly below the Horizon; and therefore the Parallel HK is called, *The Circle of Perpetual Occultation.*

Laſtly, Let P E *p* Q repreſent the Projection of the Earth upon ſome Meridian, P the North, and *p* the South Pole, E Q the Equator, A B the Ecliptic, B C the *Tropic* of *Cancer*, and A D the *Tropic* of *Capricorn*; then 'tis plain, that the Equator is the Horizon of both Poles, and conſequently the Northern Hemiſphere muſt always be in View, and the Southern always hid to an Inhabitant at P; alſo the Heavenly Bodies will appear to move in Circles parallel to the Horizon, and the fix'd Stars



will ever deſcribe the ſame Parallels, and always have the ſame Height above the Horizon. When the Sun by his Annual Motion comes to be perpendicular

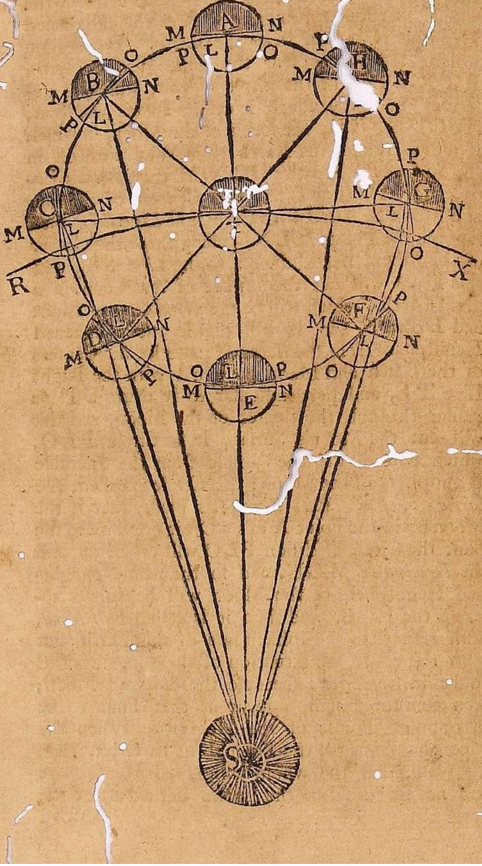
dicular to the Point F, and then deſcribes the Equator, 'tis plain, he will be in the Horizon of both Poles, and by his diurnal Motion will appear to move quite round it; and ſince half the Ecliptic F B is above, and the other half FA below the Horizon of P, 'tis plain, all the time the Sun is in deſcribing that half of the Ecliptic on the North Side of the Equator, he will be above the Horizon of P, and all the time he is in deſcribing the other half on the South Side of the Equator, he will be below the Horizon of P; from which 'tis plain, that an Inhabitant of either Pole will have half a Year continued Day, and as long Night. And ſince the Sun's greateſt Diſtance from the Equator, South or North, is 23½ Degrees, 'tis plain, his greateſt Altitude, or Depreſſion, above or below the Horizon of either Pole, muſt be 23½ Degrees.

43. Thoſe that live upon the Equator are ſaid to have a *Right Sphere*, becauſe to them the Heavenly Bodies appear to riſe and ſet perpendicular to the Horizon; and thoſe who live between the Equator and either Pole, are ſaid to have an *Oblique Sphere*, becauſe the Heavenly Bodies appear to riſe and ſet obliquely: And *Laſtly*, thoſe who live on either Pole, are ſaid to have a *Parallel Sphere*, becauſe the Heavenly Bodies appear to move parallel to the Horizon.

44. The *Moon* being an Opake Spherical Body, it receives its Light from the Sun, and reflects that upon the Earth; and that half of it which is oppoſite to the Sun is enlightned, while the other half, which is averſe from it, is involv'd in Darkneſs; but the half which is viſible to us, is that which is oppoſite to the Earth; and therefore, according to the various Situations of the Moon, with reſpect to the Earth and Sun, it will have different Illuminations; for ſometimes a greater, and ſome-

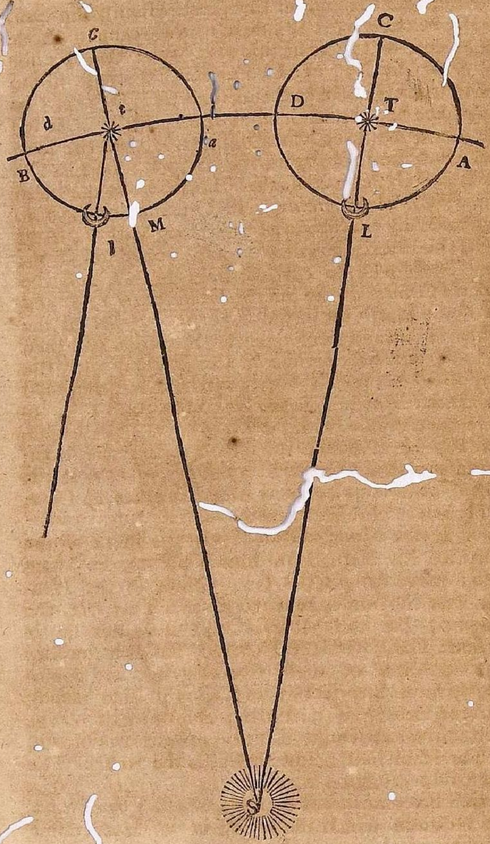
times a leſſer Part of the enlightned Hemiſphere is turn'd to the Earth, and likewiſe ſometimes the whole, and ſometimes none at all of the enlightned Hemiſphere is ſeen from the Earth. To explain which, let S repreſent the Sun, T the Earth, R T X a Part of the Earth's Orbit, which it deſcribes in its Annual Motion about the Sun, A B C D E F G H, the Orbit of the Moon, in which it moves round the Earth from Weſt to Eaſt, in the Space of a Month; P N O M the Moon's Body, and its Center L; let the Centers of the Sun and Moon be join'd with the Right Line S L, then ſuppoſe the Plane M L N, paſſing thro' the Center of the Moon, perpendicular to the Line S L; and this Plane will cut the Surface of the Moon in a great Circle, which will be the *Terminator* of Light and Darkneſs, *viz.* it will divide the enlightned Hemiſphere from the darkned; alſo let the Centers of the Earth and Moon be join'd with the Right Line T L, and perpendicular to it draw a Plane paſſing through the Center of the Moon, and this will cut the Moon's Surface in a Circle P L O, which will divide the Viſible from the Inviſible Hemiſphere of the Moon; this Circle is called, *The Circle of Viſion.* And hence 'tis plain, that if the Moon be in the Point A of its Orbit oppoſite to the Sun, the Circle of Viſion P L O will co-incide with the *Terminator* M L N, and ſo the whole enlightned Hemiſphere of the Moon will be turn'd towards the Earth, and then it is called *Full Moon,* with reſpect to the Inhabitants of this Earth, but with reſpect to the Situation of the Sun, it is ſaid to be in *Oppoſition*; becauſe the Sun and Moon, ſeen from the Earth, appear at that Time to be in oppoſite Points of the Heavens. When the Moon has come to the Point B of its Orbit, then 'tis plain, that the whole enlightned Hemiſphere will not be turn'd to the Earth, but a Part of the

Moon


A
B
H
C
G
D
F
E
L
M
N
O
P
R
X
S

as M P, will be without the viſible Hemiſphere, and therefore the viſible illuminated Part cannot be circular, but will appear gibbous; when the Moon is in the Point C of her Orbit, and the Angle C T S a Right Angle, then the Angle T C S will alſo be a Right Angle (at leaſt differing little from it) for becauſe of the vaſt Diſtance of the Sun, from the Earth and Moon, the Lines S T, S C may be taken as parallel, conſequently the Circle of Viſion will biſect the *Terminator* at Right Angles, and ſo only one half of the enlightned Hemiſphere will be in the Viſible, and then the Moon appears to be halv'd, and is call'd *Half-Moon*. In this Situation the Moon is only a Quadrant's Diſtance from the Sun, and therefore it is ſaid to be in one of its *Quadratures*. The Moon proceeding to D, 'tis plain, that in this Situation only a ſmall Part P N of the enlightned Hemiſphere is turn'd to the Earth, and the greateſt Part N O of the viſible Hemiſphere is darkned; and conſequently, becauſe of the ſpherical Figure of the Moon, it will then appear horned, and its Horns will be turned towards the Weſt. When the Moon is arriv'd at E, 'tis plain, the Circle of Viſion will again co-incide with the *Terminator*, and the whole darkned Hemiſphere will be turn'd to the Earth, and then it is ſaid to be *New Moon*; but with reſpect to its Situation with the Sun, it is ſaid to be in *Conjunction*, becauſe it appears to be in the ſame Point of the Ecliptic with the Sun; and when it has mov'd a little forward to F, 'tis plain, Part of the enlightned Hemiſphere, *viz.* M O, will be in the viſible, and ſo it will again appear horned, and having them turn'd towards the Eaſt; alſo when at G it will appear halv'd, and when at H gibbous; and *Laſtly*, when it comes to A it will again appear full.

45. Tho' (as it was ſaid in *Art.* 29.) the Moon moves quite round its Orbit in 27 Days, and 7 Hours, nearly, call'd the *Periodic Month*; yet the


C
C
d
t
D
T
a
B
A
M
l
L
S

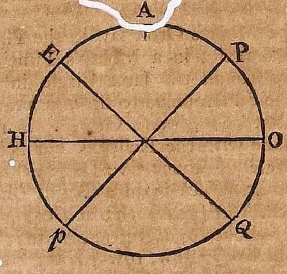
Time it takes from the Conjunction with the Sun, to the next, is greater; being 29 Days, and about 12 Hours, which is call'd, *the Synodic Month*; for let S be the Sun, T the Earth, A B a Part of the Earth's Orbit about the Sun, and A L D C the Orbit of the Moon; then when the Earth is in T, let the Moon be in L, in Conjunction with the Sun; and when the Moon is moving from L round its Orbit L A C D, 'tis plain, that the Earth in the mean Time will be moving on in its Orbit about the Sun, and carrying the Moon's Orbit along with it. And when the Moon has mov'd quite round its Orbit, the Earth will be carried from T to *t*, and the Moon's Orbit will be in the Situation, *l a c d*, and the Point L will be in the Line *t l*, parallel to the former T L, and consequently the Moon will then be in *l*; but will not be in Conjunction with the Sun, till it has mov'd a little further, and describ'd the Arch *l* M, which is similar to the Arch *t* T, because the Angles *l t* M, *t* S T are equal (by *Art.* 36. *Sect.* 1.) And hence it is that though the Moon moves round its Orbit in 27 Days, 7 Hours, yet from New Moon to New Moon it takes 29 Days, 12 Hours.

46. If the Moon's Orbit lay in the Plane of the Ecliptic, 'tis plain, in a Month's Time the Moon would move round the same Circle in the Heavens, that the Sun appears to do in a Year, *viz.* the Ecliptic; but the Moon's Orbit does not lie in the same Plane with the Ecliptic, but is inclin'd to it at an Angle of about five Degrees, and consequently must intersect it in a Right Line passing thro' the Center of the Earth; and one half of the Orbit will be above the Ecliptic towards the North, and the other half below, towards the South. The Line of Intersection is call'd, *the Line of the Nodes*, the two Extremities of which are called, *the Nodes*. The Node in which the Moon is, when ascending

O 2 above

above the Ecliptic towards the North, is called, *the Ascending Node*, or, *Dragon's Head*, for Brevity's ſake marked thus, ☊; and the oppoſite one, *viz.* that in which the Moon is, when deſcending below the Ecliptic towards the South, is called, *the Deſcending Node*, or, *Dragon's Tail*, marked thus, ☋. Hence 'tis plain, that the Moon cannot appear in the Ecliptic above twice in one Period, *viz.* when it is in the Nodes; and in other Points of its Orbit, it will be more or leſs diſtant from the Ecliptic, according as it is more or leſs removed from the neareſt Node; theſe two oppoſite Points in the Orbit, that lie in the Middle between the Nodes, are called, *the Limits*; and when the Moon is in either of theſe, ſhe is then at her greateſt Diſtance from the Ecliptic.

47. The Height of the neareſt Pole above the Horizon of any Place, is equal to the Latitude of that Place. For let A be any Place upon the Earth, AHO its Meridian, HO the Horizon, EQ the Equator, P and *p* the two Poles; then 'tis plain, AE will be the Latitude of the Place, and



PO the Height of the neareſt Pole above the Horizon. Now ſince the Arches PE and AO are equal,

equal, being each a Quadrant; from both take the common Arch A P, and there will remain A E, equal to P O; that is, the Height of the Pole above the Horizon is equal to the Latitude. Alſo, ſince the Arches A H and E P are are equal, being both Quadrants, from both take the common Arch A E, and there will remain E H equal to A P; that is, the Height of the Equator above the Horizon of any Place, is equal to the Complement of the Latitude of that Place.

48. Great Circles paſſing thro' the Poles of the Ecliptic, and cutting it at Right Angles, are called Secondaries of the Ecliptic.

49. *The Latitude* of any Heavenly Body is an Arch of the Secondary, paſſing thro' the Center of the Object, intercepted between it and the Ecliptic; and it is either North or South, according as the Object is on the North or South Side of the Ecliptic.

50. *The Longitude* of any Celeſtial Body is an Arch of the Ecliptic, intercepted between the Secondary paſſing thro' that Body, and the firſt Point of *Aries*.

51. *The Declination* of any Heavenly Body is an Arch of a Meridian, paſſing over that Body, intercepted between the Center of it and the Celeſtial Equator; and it is either North or South, according as the Body is on the North or South Side of the Equator.

32. Since the Sun by his annual Motion is always either approaching nearer to, or going further from, the Equator; 'tis plain, he muſt be continually changing his Declination. In the third Table, at the End of this Book, you have his Declination for every Day of the Year; in which you may obſerve, that in the Top Columns ſtand the Year, Month, and Kinds of the Declination, *viz.* whether it be South or North; and in the Left-hand Column

ſtands

ſtands the Day of the Month; the other Columns contain the Declinations anſwerable to theſe; conſequently to find the Sun's Declination for any Day, ſuppoſe the twentieth of *April*, 1731. I look at the Top for the Year 1731, and the Month *April*, and in the ſide Column for 20, then in the Column below *April*, and on the ſame Line with 20, I find 14°, 59′ for his Declination North; and the ſame Way his Declination may be found for any other Day. But you muſt obſerve, that this Table is calculated only for the Meridian of *London*, and the Noon there; that is, it ſhews the Declination of the Sun when upon the Meridian of *London*; and conſequently to find the Sun's Declination for any other Time of the Day, we muſt conſider whether the given Time be before or after Noon; if it be before, then ſay, as 24 Hours is to the Difference between the Declination of the Sun, the Noon of the preceding Day, and his Declination the Noon of the preſent Day; ſo is the Time from Noon laſt Day, to a fourth Proportional; which, if the Declination be increaſing, muſt be added to, but if decreaſing, ſubtracted from, the Sun's Declination the Noon of the preceding Day; and the Sum, or Remainder, is the Declination from the preſent Time.

Example. Suppoſe it were required to find the Sun's Declination, on the fourth Day of *April* 1731, at 8 Hours, 25 Minutes in the Morning. To do this, I firſt look in the Tables for the Sun's Declination, the fourth Day of *April* 1731, and find it to be 9°, 39′, then I look for it the third Day, and find it to be 9°, 17′, the Difference of theſe is 22′; then I ſay, as 24 Hours is to 22′; ſo is 20 Hours 25 Minutes, the Time elapſed ſince laſt Noon, to 18′; which added to 9°, 17′ (becauſe the Declination is increaſing) gives 9°, 35′, for the Sun's preſent Declination. Again, if the Time propoſed be after Noon; then to find the Declination for that

that Time, we muſt look in the Tables for the Sun's Declination, the Noon of the preſent Day; and for the ſame, the Noon of the following Day, and take the Difference of theſe Declinations; then ſay, as 24 Hours is to the Difference of the Declinations, ſo is the Time elapſed ſince Noon, to a fourth Proportional; which added to, or ſubſtracted from, the Sun's Declination the preſent Day at Noon (according as the Declination is increaſing or decreaſing) gives the Sun's Declination at the Time propoſed.

Example. Suppoſe it were required to find the Sun's Declination on the twelfth Day of *July* 1731, at 4 Hours, 23 Minutes after Noon. To do this we muſt firſt look in the Tables for the Sun's Declination the twelfth Day of *July* 1731, and will find it to be 20°, 13′; then for his Declination the following Day, which is 20°, 01′, and the Difference between theſe two is 12′; then ſay, as 24 Hours is to 12′, ſo is 4 Hours, 23 Minutes, the Time elapſed ſince Noon, to 2′, which (becauſe the Sun's Declination is decreaſing) ſubſtracted from 20°, 13′, the Declination of the Sun at Noon of the preſent Day, leaves 20°, 11′, the Sun's Declination for the Time propoſed.

And ſince the Table of the Sun's Declination, at the End of this Book, is fitted to the Meridian of *London*, 'tis plain, it cannot ſerve for the Meridian of any other Place, lying on the Eaſt or Weſt Side of the Meridian of *London*; for while the Sun, by his apparent diurnal Motion, is paſſing from one Meridian to another, he is at the ſame Time ſtill moving on in the Ecliptic, and conſequently altering his Declination. Now to find the Declination of the Sun, when he is on the Meridian of any Place, lying on the Eaſt or Weſt Side of *London*, we muſt take the Difference of Longitude between *London* and the given Place (or if the Meridian of

London

London be supposed the first Meridian, we must take the Longitude of the Place) and convert this into Difference of Time, which will shew the Time, before or after Noon at *London*, the Sun is upon the Meridian of the Place proposed; *viz.* if the Place lie on the East-Side of *London*, the Time will be before Noon; but if on the West, it will be after Noon; then finding, according to the preceding Examples, the Sun's Declination at the Time proposed, the same will be his Declination, when on the Meridian of the proposed Place.

This may be done another Way, *viz.* by the Help of the Table of Variation of the Sun's Declination, to every 15 Degrees of Longitude from the Meridian of *London*, annexed to the Table of Declination; the Upper Column of which contains the Degrees, and the Left-hand side Column contains the Minutes of the Sun's daily Variation; and the other Columns contain the Minutes answering to the Degrees and Minutes in the Top and Side Columns. Now, to find the Sun's Declination any Day, when he is on the Meridian of any Place, lying on the East or West Side of *London*, by this Table; we must first find the Sun's Declination for the present, and for the following Day; and the Difference between these two will give us the daily Variation at that Time; then look in the Table of Variation, &c. at the Top, for the Difference of Longitude between *London* and the proposed Place, and in the side-Column for the Minutes of Variation; then below these Degrees in the Top, and on the same Line, with the Variation in the side-Column, we will find the Variation required; which, if the proposed Place be West of *London*, and the Declination increasing, must be added to the Declination for the present Day, and the Sum is the Declination required; but if the Declination be creaſing, then the Variation ſubtracted from the Declination gives that required; again, if the Place lie on the Eaſt-Side of *London*, and the Declination encreaſing, then the Variation ſubtracted from the Declination for that Day, leaves the Declination required; but if the Declination be decreaſing, then the Variation added to the Declination gives that required.

Example. Let it be required to find the Sun's Declination, when he is on the Meridian of St. *Lucia* (whoſe Longitude from *London* is 60°, 15′ Weſt) on the ſixth Day of *April* 1731. To do this, I firſt look in the Tables for the Declination of the Sun the ſixth Day of *April* 1731, and find it to be 19°, 15′, then for the ſame the following Day, and I find it to be 19°, 29′, the Difference of which is 14 Minutes, the Sun's daily Variation at that time; then I look in the Top of the Table of Variation, &c. for 60, the Difference of Longitude, and in the ſide Column for 14; and below 60, and in the ſame Line with 14, I find 2 Minutes, which (becauſe the Place is Weſt off *London*, and the Declination encreaſing) I add to 19°, 15′, and the Sum is 19°, 17′, the Sun's Declination at St. *Lucia* the ſixth Day of *April* 1731.

From this you may obſerve, that the Method of ſolving this Problem by the Table of Variation, &c. is not near ſo good as the former; for here we can only enter the Table with a Number of Degrees, which is either 15°, or ſome Multiple of it below 195°, and all the odd Degrees and Minutes muſt be thrown away; but in the former Method we can uſe any Number of Degrees and Minutes.

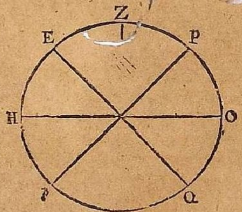
53. And ſince the fix'd Stars always keep the ſame Places in the Heavens (at leaſt in a few Years their Variation is inſenſible) 'tis plain, their Declination muſt ſtill be the ſame.

SECT. IV.

TO *find the Latitudes of Places by the Meridian-Altitude, and Declination of any Celeſtial Object.*

This *Problem* admits of ſeveral *Caſes*, according as the obſerved Object is ſituate with reſpect to the Equator, and Place of Obſervation; which are as follows.

Caſe 1. When the Sun or Star obſerved has no Declination, or is upon the Equator, then the Zenith-Diſtance of the Object is equal to the Latitude of the Place, which is North-Latitude if the Sun or Star come to the Meridian, on the South-

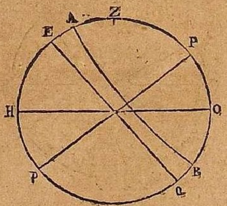


ſide of the Zenith; but South, if on the North-ſide. For in the annexed Scheme, let Z repreſent the Place of Obſervation, P Q *p* E its Meridian, E Q the

the Equator, HO the Horizon, P the North, and p the South-pole; then 'tis plain, ſince the obſerved Object is ſuppoſed to have no Declination, that EQ will repreſent the Path of its Diurnal Motion, and when it comes upon the Meridian, ZE will be its Zenith Diſtance, which is manifeſtly equal to the Latitude of the Place Z. And when the Object at E is South off Z, 'tis plain the Place Z muſt be North off E, and conſequently the Latitude will be North.

Caſe 2. If the Sun or Star, when on the Meridian, is in the Zenith; then the Declination of the Object is the ſame with the Latitude of the Place. For it is evident, that in this Caſe they are equally diſtant from the Equator, and on the ſame Side of it; conſequently, if the Declination be North, the Latitude will alſo be North, and if South, South.

Caſe 3. If the Sun or Star be between the Equator and Place of Obſervation, then the Latitude of the Place is equal to the Sum of the Zenith Diſtance and Declination of the Object; and it is of the ſame Name with the Declination, *viz.* if the Declination be North, the Latitude is alſo North, & *e contra.* For in the adjacent Scheme, let AB repreſent the Parallel deſcribed by the obſerved Object

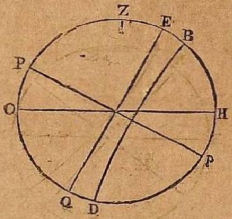


ject in its Diurnal Motion, and A its Place upon the Meridian, ſituate between Z, the Place of Obſervation, and EQ the Equator; then 'tis plain that ZE, the Latitude of the Place Z, is equal to the Sum of EA the Declination, and AZ the Zenith-Diſtance, and if the Declination be North, & *e contra*; ſince in this Caſe the Object and Place of Obſervation lie both on the ſame Side of the Equator.

Example. Suppoſe on the Twelfth Day of *April*, 1732, the Sun, when on the Meridian, had 52°, 12′ of Altitude, and conſequently 37°, 48′ Zenith-Diſtance, required the Latitude of the Place of Obſervation.

the Sun's Declination that Day is -	12°, 40′ N.
his Zenith-Diſtance - - - - - -	37 , 48
the Sum is the Latitude, *viz.* - -	50 , 28 N.

Caſe 4. If the Sun or Star be on the contrary Side of the Equator, with the Place of Obſervation, and



conſequently both Declination and Zenith-Diſtance be of the ſame Name, *viz.* either both North or both South; then the Latitude is found by taking the

the Declination from the Zenith-Diſtance, and it is of a contrary Name with the Declination. For in the adjacent Figure let B D repreſent the Parallel deſcribed by the obſerved Object in its Diurnal Motion, on the other Side of the Equator E Q, with the Place Z, and B will be its Place when upon the Meridian; then 'tis plain, that if from Z B, the Zenith-Diſtance, be taken B E the Declination, there will remain Z E, the Latitude of the Place of Obſervation Z, and the Latitude will be of a contrary Name with the Declination; ſince in this Caſe, the Object and Place are on contrary Sides of the Equator.

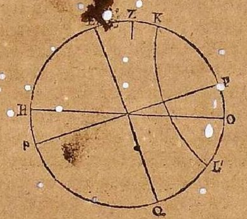
Example. Being at Sea the Twelfth Day of *January* 1732, I found the Meridian-Altitude of the Sun to be 43°, 15′; conſequently his Zenith-Diſtance 46°, 45′, and he was South off me: Required the Latitude of the Place of Obſervation, and which Way it is.

From the Meridional Zenith-Diſtance	46°, 45′, S.
take the Sun's Declination - - - -	19 , 35 , S.
there remains the Latit. of the Place -	27 , 10, N.

When the Zenith-Diſtance and Declination are equal, and both of the ſame Name, then the Latitude vaniſhes, and conſequently the Place is ſituated on the Equator.

Caſe 5. If the Sun or Star be between the Place of Obſervation and the neareſt Pole, and conſequently both Declination and Zenith-Diſtance be of the ſame Name; then, from the Declination ſubtract the Zenith-Diſtance, and the Remainder is the Latitude of the Place of Obſervation, and it is of the ſame Name with the Declination. For in the annex'd Scheme, let K L repreſent the Parallel deſcribed by the obſerved Object in its Diurnal Motion, and K will be its Place when upon the Meridian; then 'tis plain, that if from K E the Declination, be taken Z K, the Meridional Zenith-Diſtance, there

there will remain ZE, the Latitude of the Place, which will be of the ſame Name with the Declina-



tion, ſince the Object and Place of Obſervation are in this Caſe upon the ſame Side of the Equator.

Example 1. Suppoſe on the Twenty-third Day of *June* 1733, I obſerved the Meridian-Altitude of the Sun to be 82°, 4′; conſequently his Zenith-Diſtance 7°, 56′: Required the Latitude of the Place of Obſervation, and which Way it is.

The Sun's Declination that Day is - -	22°, 55′ N.
his Zenith-Diſtance is - - - - -	7 , 56 N.
the Difference is the Latitude, *viz.* - -	14 , 59 N.

Example 2. Being at Sea, I obſerved the Meridian-Altitude of the middlemoſt Star in the Tail of the *Great Bear*, to be 56°, 44′ North; conſequently its Zenith-Diſtance 33°, 16′, and its Declination being 56°, 22′ North: Required the Latitude of the Place of Obſervation, and which Way it is.

From the Declination - - - -	56°, 22′ N.
take the Zenith-Diſtance - - -	33 , 16 N.
there remains the Latitude - - -	23 , 06 N.

Caſe 6.

Case 6. If the Sun or Star be between the Horizon and the elevated Pole, then to the Altitude add the Complement of the Declination, and the Sum will be the Latitude of the Place of Observation, and of the same Name with the Declination. For let AB be the Parallel described by the Object in its diurnal Motion, B its Place on the Meridian, when between the Horizon and elevated Pole; then

'tis plain, that if to BO the Altitude, be added BP, the Complement of the Declination of the Object, the Sum PO will be equal to the Height of the Pole above the Horizon, which (by *Art.* 47. *Sect.* 3.) is equal to the Latitude of the Place of Observation Z, and it will be of the same Name with the Declination, since both the Place and the Object are on the same Side of the Equator.

Example. Being at Sea, I observed the bright Star of the *Harp* on the Meridian, between the Horizon and elevated Pole, its Altitude being 8°, 33'; and Declination 33°, 33' North. Required the Latitude of the Place of Observation.

To the Complement of the Declinat.	51°, 27' N.
add the Altitude - - - - - -	8 , 33 N.
the Sum is the Latitude - - - -	60 , 00 N.

Case 7.

Caſe 7. When the obſerved Object does not ſet, and conſequently the Complement of its Declination leſs than the Latitude of the Place; then 'tis plain, the Object will be twice upon the Meridian in 24 Hours, *viz.* at its leaſt and greateſt Altitude; when the Altitude is leaſt, the Object is then between the Horizon and elevated Pole, and by that Altitude and Declination of the Object, the Latitude of the Place may be found, (as in the laſt Caſe); but when the Altitude is greateſt, the Object is then on the other Side of the Pole. Now, with theſe two Meridian-Altitudes, without knowing the Declination of the Object, we can find the Latitude of the Place thus; if the two Altitudes be both on the ſame Side of the Zenith, then from the greateſt ſubtract the leaſt, and half the Remainder added to the leaſt gives the Latitude, of the ſame Name with the Zenith-Diſtance; for in the preceding Scheme, where AB repreſented the Parallel of Declination, deſcribed by the Object in its diurnal Motion, BO its leaſt, and AO its greateſt Meridian-Altitude, 'tis plain, if from AO be taken BO, the Difference will be AB, the half of which, PB, added to BO, gives PO the Height of the Pole above the Horizon, equal to the Latitude of the Place.

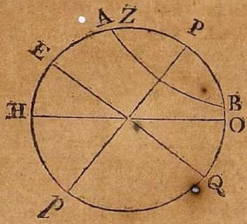
Example. Being at Sea, I obſerved the Northermoſt of the two preceding Stars in the Square of the *Great Bear*, which did not ſet, and found the leaſt Altitude to be 23°, 12′, and the greateſt 72°, 46′, both North off my Zenith. Required the Latitude of the Place of Obſervation.

From the greateſt Altitude - -	72°, 46′ N.
take the leaſt - - - - - -	23 , 12
the Remainder is - - - - -	49 , 34
the half of which is - - - -	24 , 47
to which adding the leaſt Altitude -	23 , 12
the Sum will be - - - - -	47 , 59

which

which is equal to the Latitude of the Place, and it is North, becauſe the Zenith Diſtance is on the North-Side.

But if the greateſt and leaſt Meridian Altitudes of the Objects be upon different Sides of the Zenith, *viz.* the one upon the North, and the other upon the South-Side; then, from the Supplement of the greateſt Altitude, ſubtract the leaſt, and half the Remainder added to the leaſt Altitude, will give the Latitude of the Place of Obſervation, which will be of the ſame Name with the leaſt Altitude, *viz.* North; if the leaſt Altitude be North of the Place, *& e contra.* For in the annex'd Figure, let B A repreſent the Parallel deſcribed by the Object in its diurnal Motion, B and A the Places of the Object when upon the Meridian, on contrary Sides of the Zenith Z; B O its leaſt Altitude, and H A its greateſt, the Supplement whereof is A O. Now 'tis plain, that if from A O we take O B, the Remainder will be A B, the half of



which, P B, added to B O, makes P O the Height of the Pole above the Horizon, or Latitude of the Place Z; which will be North, if the leaſt Altitude BO be on the North-Side of the Place, becauſe in this Caſe the North-Pole will be elevated.

Example. Being at Sea, I obſerved the Sun when he did not ſet, and found his leaſt Meridian Altitude to be 3°, 29′, on the North-Side of the Zenith, and his greateſt Meridian Altitude was 43°, 29′, on the South-Side: Required the Latitude of the Place of Obſervation.

From the Supplement of the Sun's greateſt Meridian Altitude - -	136°, 31′
take his leaſt Altitude - - - - - -	3, 29
and there remains - - - - - - -	133, 02
the half of which is - - - - - - -	66, 31
to which adding the leaſt Altitude -	3, 29
the Sum is - - - - - - - - - -	70, 00 N.

the Latitude of the Place of Obſervation.

SECT. V.

Of the Elements of Chronology.

1. TIME conſidered abſtractly, without any Relation to external Objects, flows always equally and uniformly, and it is called Abſolute, True, and Mathematical Time, or, ſimply, *Duration.* But that which commonly goes under the Name of Time, is a certain Part of Duration, meaſured by the ſimple and uniform Motion of ſome Body, ſuch as the Motion of the Celeſtial Bodies; and particularly of the Sun and Moon; this is called Relative, Apparent, or Vulgar Time.

2. Time is divided into Years, Months, Weeks, Days, Hours, Scruples or Minutes, *&c.*

3. A Day is of two Kinds, *viz. Natural* or *Artificial*; a *Natural Day* is that Space of Time that flows while the Sun moves from any Meridian, till he comes to the ſame again. An *Artificial Day* is that

that Space of Time that the Sun continues above the Horizon, and the Time he continues below it is called a Night.

4. An Hour is a certain determinate Part of the Day, and is either *Equal* or *Unequal*. An *Equal Hour* is the Twenty-fourth Part of a Natural Day; and an *Unequal Hour* is the twelfth Part of an Artificial Day, which is alſo called a *Diurnal-Hour*, as the twelfth Part of the Night is called a *Nocturnal-Hour*; theſe are likewiſe called *Temporary Hours*, becauſe at different Seaſons of the Year they are of different Lengths; for a diurnal Hour in the Summer is longer, and a Nocturnal ſhorter, than in the Winter; but in the Equinoctial Day, a *Diurnal Hour* is equal to a *Nocturnal*, and then they are called, *Equinoctial Hours*.

5. The *Diurnal Hours* begin at the riſing, and end at the ſetting of the Sun; and the *Nocturnal Hours* begin at the ſetting, and end at the riſing of the Sun. Theſe Hours were anciently in uſe among the *Jews* and *Romans*, and at preſent among the *Turks*. They were anciently called *Planetary Hours*, becauſe in every Hour one of the ſeven Planets was ſuppos'd to preſide over the World; thus for Example, on *Sunday*, the firſt Hour from Sun-riſing was allotted to the *Sun*, the ſecond fell to *Venus*, the third to *Mercury*, and ſo on to the reſt in order, *viz.* to the *Moon*, *Saturn*, *Jupiter* and *Mars*; by which Means, the firſt Hour from Sun-riſing, the next Day fell to the Moon; from which it was called *Monday*, and ſo on thro' the other Days of the Week, each Day getting its Name from the Planet that was ſuppoſed to preſide the firſt Hour of that Day.

6. The Day in different Nations begins at different Times. Thus the *Babylonians*, *Aſſyrians*, and ſeveral other Eaſtern Nations began their Day at Sun-riſing: The Hour after that, they called the

first Hour, and so counted on till they came to the Twenty-fourth, or last Hour, which was the Hour before Sun-rising. The *Jews* and *Grecians* began their Day at Sun-set; as at this Time the *Italians*, *Sicilians*, *Bohemians*, *Polanders* and *Austrians* do; the Hour before the Sun-set they call the last, or Twenty-fourth Hour; and the Hour after the Sun is set, they call the first Hour; and so count on to the Twenty-fourth, when the Sun sets again.

7. The *Egyptians* and *Romans* anciently began their Day at Mid-night; which was followed by *Hipparchus*, *Copernicus*, and other *Astronomers*, in their Astronomical Observations, and is still retained in *Britain*, *France*, *Spain*, and most other Places in *Europe*; but the *Arabs* and modern *Astronomers* begin the Day at Noon, *viz.* when the Sun is upon the Meridian.

8. A *Week* is a Succession of seven Natural Days, each of which has a particular Name allotted to it, *viz.* the first is called *Sunday*, the second *Monday*, and so on.

9. A *Month* is a certain System of Days, consisting of something more or less than thirty Days, and is of two Kinds, *viz. Astronomical* or *Civil*; an *Astronomical* Month is that which is governed either by the Motion of the *Sun*, or that of the *Moon*; and consequently is of two Kinds, *viz. Solar* or *Lunar*. A *Solar Month* is that Time which the Sun takes to run through a whole Sign, or the twelfth Part of the *Ecliptic*; and a *Lunar Month* is that which is measured by the Motion of the *Moon* round the Earth, and is of three Kinds, *viz. Periodical*, *Synodical*, and that of *Illumination*; the *Periodical* and *Synodical Months* are defin'd in *Art.* 45. *Sect.* 3. and the *Month of Illumination* or *Apparition*, is that Space of Time contained between the Day that the *Moon* begins to appear after Change, to the Day that she disappears; and this consists of

Twenty-

Twenty-eight Days nearly. A *Civil* or *Political* Month differs from the *Astronomical*, and consists of more or fewer Days, according to the Institution of the Country in which they are used.

10. A *Year* is a certain System of Months, and is either *Astronomical* or *Civil*; the *Astronomical Year* is of two Kinds, *viz. Solar*, or *Lunar*; and the *Solar Year*, is either *Sidereal* or *Tropical*. The *Sidereal Year* is that Space of Time that the *Sun* takes to move from a fix'd Star till he returns to the same again; and it consists of 365 Days, 6 Hours, 9 Minutes, and 14 Seconds; the *Tropical* Year is that Space of Time, which flows while the *Sun* moves from any one of the *Cardinal Points*, till he returns to the same again; and it consists of 365 Days, 5 Hours, 48 Minutes, and 57 Seconds, and commonly gets the Name of the *Solar Year*.

11. A *Lunar Year* consists of a certain Number of Months, and is either *Common* or *Embolismic*. A *Common Lunar Year* consists of twelve *Synodic Lunations*, and an *Embolismic* contains thirteen.

12. The *Civil* or *Political Year* consists of a certain Number of Days, more or fewer, according to the Laws and Customs of the Countries in which it is received.

13. Since the *Common Lunar Year* consists of twelve *Synodic Months*, or 354 Days nearly, and the *Solar* consists of 365 Days, (throwing away the odd Hours and Minutes) 'tis plain, that the *Solar Year* will exceed the *Lunar* by about 11 Days; and consequently in the Space of about Thirty-three Years the Beginning of the *Lunar Year* will be carried through all the Seasons; and hence it is called the *Moveable Lunar Year*. This Form of the Year is used at this Time by the *Turks* and *Arabians*; and because in three Years Time, the *Solar* exceeds the *Lunar* by 33 Days; therefore to keep the

the *Lunar Months* in the same Seasons and Times of the *Solar Year*, or near it, they added a whole Month to the *Lunar Year*, every third Year, and so made it consist of thirteen Months; this Year they called the *Embolismic Year*, and the additional Month, the *Embolimean* or *Intercalary Month*. This Form of the *Lunar Year* is called the fix'd *Lunar Year*; and it was used by the *Greeks* and *Romans* till *Julius Cæsar's* Time.

14. The *Egyptians* made use of the *Solar Years*, and made each consist of 365 Days, which wants of the *Tropical Year* almost 6 Hours; and consequently the *Egyptian Year* began always 6 Hours sooner than the immediately preceding *Tropical Year*; by which Means, in four times 365 or 1460 Years, (called the *Great Canicular Year* or *Sothiacal Period*) the Beginning of the Year moved thro' all the Seasons.

15. *Julius Cæsar*, in order to reduce the *Civil* or *Political Year* nearly to an Equality with the *Tropical*, and considering that the *Tropical Year* consisted of 365 Days, and 6 Hours nearly, which exceeded the *Civil Year* by 6 Hours each Year, and consequently in four Years exceeded it by one whole Day; he ordered, that to every fourth Year there should be one whole Day added, and so made it consist of 366 Days, by which Means the *Civil* and *Solar Years* were reduced pretty near to an Equality. This additional Day was put in the Month of *February*; and because in the common Year, the Twenty-fourth Day of *February* was called by the *Romans*, the sixth of the *Kalends* of *March*, therefore he ordering that this Day should be added after the Twenty-fourth Day of *February*, and called by the same Name; there happened every fourth Year two Sixths of the *Kalends* of *March*, and hence that Year was called *Bissextile* or *Leap Year*. This Way is still retained, and made use of by us.

16. But

16. But the true Length of the Year being 365 Days, 5 Hours, and 49 Minutes nearly, and by the *Julian* Account 365 Days and 6 Hours; 'tis plain, the *Civil Year* exceeds the *Solar* by 11 Minutes yearly. Consequently, if the *Sun* any Year enters the *Equinoctial* on the Twentieth Day of *March* at Noon, the next Year, he will enter the *Equinoctial* the same Day, 11 Minutes before Noon, the next, 22 Minutes before Noon, and so on. Consequently in 131 Years the *Solar* will anticipate the *Civil Year*, by one whole Day; and so either *Equinox* will not happen always on the same Day of the *Civil Year*, but be carried in a Retrograde Order thro' all the Days of it. This was what put Pope *Gregory* the XIIIth, upon reforming the *Julian* Kalendar; for finding that at the Time of the *Nicene Council*, when the Time of celebrating *Easter* was instituted, the Vernal *Equinox* happened the Twenty-first Day of *March*; and by flowing continually backwards, it happened at his Time, in the Year in 1572, on the Eleventh Day of *March*, anticipating its former Time, by 10 whole Days; he ordered that these 10 Days should be taken out of the *Kalendar*, and the Eleventh Day of *March* should be reckon'd the Twenty-first; and to prevent the Seasons of the Year from going any more backwards, as they were before, he ordered that every hundred Year of the *Christian Æra* (which according to the *Julian Kalendar* is *Bissextile*) should be a common Year, and so consist only of 365 Days; but this being too much, therefore every four hundredth Year was to remain *Bissextile* or *Leap-Year*. This Form of the Year is receiv'd in *France*, *Spain*, *Germany*, *Italy*, and other Countries that allow of the Pope's Authority; as also in *Holland*, and several other Places where the Reformed Religion is profess'd. But the *British* and other Reformed Northern Nations still

ſtill retain the *Julian* Form, which is called *Old Style*, and the *Gregorian*, *New Style*.

17. A *Kalendar* is a regular Diſpoſition of the Days in the *Civil Years* into Months and Weeks; each Day of every Week being diſtinguiſhed from another by one of the firſt ſeven Letters of the Alphabet, *viz.* A, B, C, D, E, F, G. Beginning at the firſt of *January*; to it is annexed the Letter A, to the ſecond the Letter B, to the third C, and ſo on to the ſeventh, to which is annexed the Letter G; and beginning again with the Letters, to the eighth is annexed A, to the ninth B, to the tenth C, and ſo on thro' the reſt of the Days of the Year, each of them having one of theſe Letters annexed to it. Hence 'tis plain, that whatever Letter is placed againſt any Day of any Week, that Letter will be placed againſt that Day through the whole Year: Thus; If the firſt Day of *January*, againſt which ſtands the Letter A, be a *Sunday*; then all the Days in the *Kalendar* having the Letter A ſtanding againſt them, will be *Sundays*. Alſo if the Fourth Day of *January*, againſt which ſtands the Letter D, be a *Sunday*, then all the Days in the *Kalendar*, having D annexed to them, will be *Sundays*. That Letter which anſwers to the *Sundays* throughout the Year, is called the *Dominical* or *Sunday Letter*, for that Year.

But ſince the *Common Year* conſiſts of 365 Days, if that be divided by ſeven, the Quotient will be 52 Weeks, and one Day over; and ſince if nothing remained, then whatever Day of the Week the Year began on, the ſame Day of the Week would be the firſt Day of each ſucceeding Year; 'tis plain, that whatever Day of the Week any Year begins on, the ſame Day of the Week will be the laſt Day of the Year; and conſequently, if the Firſt Day of *January*, to which is annexed the Letter A, be *Sunday*, the laſt Day of the Year will be *Sunday*.

Year wi[illegible] *Sunday*, and the firſt of the next will be *Monday*, and the firſt *Sunday* of the Year will fall on the ſeventh Day, to which is annexed the Letter G, which therefore will be the *Dominical Letter* all that Year; and ſince the Year began on *Monday*, it will alſo end on *Monday*, and the firſt Day of the next Year will be *Tueſday*; conſequently the firſt *Sunday* will fall on the ſixth Day, to which is annexed F, which therefore will be the *Dominical Letter* all that Year. And the ſame Way the *Dominical Letter* the Year following will be E, and for the next D; and in this retrograde Order the *Dominical Letter* is carried ſucceſſively thro' the ſeven, after which it begins again.

18. From what has been ſaid 'tis plain, that if the Year conſiſted of 365 Days exactly after a Period of ſeven Years, the ſame Day of each Month would fall on the ſame Day of the Week. But becauſe every fourth Year is *Biſſextile*; conſiſting of 366 Days, which is equal to 52 Weeks, and 2 Days; therefore if that Year begins on a *Sunday*, it will end on *Monday*, and the next will begin on *Tueſday*, and the firſt *Sunday* of that Year will fall on the ſixth Day of *January*, to which is annex'd the Letter F, which will be the *Dominical Letter* for the Year following the *Leap Year*, whoſe *Dominical Letter* was A. And ſince the *Biſſextile* or *Leap Year* returns every fourth Year, 'tis plain the Series of *Dominical Letters* will be interrupted, and will not return till after four times Seven, or twenty eight Years. And hence ariſes the Cycle of twenty eight Years called the *Solar Cycle*, which being completed, the Days of the Month return in the ſame Order to the ſame Day of the Week.

19. And ſince in every *Leap-Year* the *Intercalary* Day is placed between the twenty third and twenty fourth Day of *February*, and ſo makes

two twenty Fourths of *February*; which in the *Kalendar* are esteemed as one and the same Day, and have the same Letter affixed to them, and which by our Way of Reckoning are called the twenty fourth and twenty fifth Day of *February*; 'tis plain the Order of the *Dominical Letter* will at that Time be interrupted; and the succeeding Letter will take Place; thus if in a *Leap Year* the first of *January* be *Sunday*, and consequently the *Dominical Letter* A; the twenty fourth Day of *February*, will fall upon a *Friday*, and the twenty fifth on a *Saturday*; and since both these Days are mark'd in the *Kalendar* with the same Letter F; the following Day, which is *Sunday*, will be mark'd with G, which Letter will mark out all the *Sundays*, and consequently be the *Dominical Letter*, the remaining Part of the Year. And hence it is that every *Leap-Year* has two *Dominical Letters*, the first of which serves from the Beginning of the Year to the twenty fourth or twenty fifth Day of *February*, and then the other takes Place, and serves for the rest of the Year.

20. The first Year of the *Solar Cycle* was plac'd in a *Leap Year*, having for it's *Dominical Letters* G and F, whence the *Dominical Letter* for the second is E, for the third D, for the fourth C; and the fifth Year of the *Cycle* is again *Bissextile*, whose *Dominical Letters* are B and A, consequently the *Dominical Letter* for the sixth Year is G, and so on, as in the following Table which shows the *Dominical Letter* for every Year in the *Cycle*.

1	GF	5	BA	9	DC	13	FE	17	AG	21	CB	25	ED
2	E	6	G	10	B	14	D	18	F	22	A	26	C
3	D	7	F	11	A	15	C	19	E	23	G	27	B
4	C	8	E	12	G	16	B	20	D	24	B	28	A

Whence

Whence 'tis plain, that by knowing the Year of the *Cycle*, we can find the *Dominical Letter* anſwering thereto from the Table. Now ſince the firſt Year of the *Chriſtian Æra* happen'd on the tenth Year of the *Cycle*, and conſequently 9 Years of the *Cycle* were elaps'd before the *Chriſtian Æra* commenced; therefore to find the Year of the *Solar Cycle* for any Year of the *Chriſtian Æra*, and the *Dominical Letter* belonging to it, we muſt add 9 to the given Year and divide the Sum by 28, then the Quotient will ſhow how many complete *Cycles* have paſt ſince the firſt Year of the *Solar Cycle*, that the *Chriſtian Æra* commenc'd in, and the Remainder, if there be any, will ſhow the current Year of the *Cycle*; but if there be no Remainder then the Year is the laſt, or twenty eighth Year of the current *Solar Cycle*; and having found the Year of the *Cycle*, we have the *Dominical Letter* anſwering it from the preceding Table.

Example. Suppoſe it were required to find what Year of the *Solar Cycle* the Year 1734 is, and the *Dominical Letter* belonging to it.

Firſt, I add 9 to the given Year and the Sum is 1743, which divided by 28, the Quotient 62 ſhows that there are 62 complete *Cycles* elaps'd, ſince the firſt Year of that *Cycle* in which the *Chriſtian Æra* commenced and the Remainder 7 ſhows that the Year 1734 is the ſeventh Year of the current *Cycle*; then looking in the preceding Table, for the ſeventh Year of the *Cycle*, I find the *Dominical Letter* anſwering thereto is F.

21. Since the Revolutions of the *Sun* and *Moon* are found conſtantly to be the ſame, the *Moon* moving with about thirteen Times the Velocity of the *Sun*; it follows, that after a certain Number of Revolutions, they muſt meet again in the ſame Point of the Heavens they did ſome time before,

 which

which by *Meton* the *Athenian*, was said to be 19 Years just; after the Expiration of which Time the *new* and *full Moons* were supposed to happen on the same Day and Time of that Day, and in the same Month, they did 19 Years before that. This Cycle is from its Author called the *Metonic Cycle*; also 'tis called the *Lunar Cycle.*

22. This *Cycle* began 1 Year before the Commencement of the *Christian Æra*, and consequently to find what Year of the *Cycle* any Year in the *Christian Æra* is; we must to the given Year add 1, and divide the Sum by 19; then the Quotient will show how many *Cycles* have revolv'd since the Commencement of the *Christian Æra*, and the Remainder will shew what Year of the *Cycle* the present Year is; if there be no Remainder then the given Year will be the last or nineteenth Year of the *Cycle.* The Year of the *Cycle* answering to any given Year, is, for its great Use in determining the Times of the *new* and *full Moon*, and thereby knowing what Day of the Month *Easter-Day* falls upon, called the *Golden Number* or *Prime* for that Year.

Example. Required the *Golden Number* for the Year 1732.

First, I add one to the given Year, and the Sum is 1733, this divided by 19, gives 91 for the Quotient, and 4 for the Remainder; which shows that there have revolved 91 complete *Lunar Cycles* since the first Year of that *Cycle* in which the *Christian Æra* commenced, and that the given Year is the fourth Year of the current *Cycle*, consequently 4 is the *Prime* or *Golden Number* for the Year 1732.

23. It has been shown, at *Art.* 13. of this, that the *Solar Years* exceed the *Lunar* by 11 Days nearly; consequently if the Moon be New, or in Conjunction with the Sun, on the last Day, or thirty first

first of *December* in any Year on the last Day of the next Year it will be 11 Days past Conjunction, and on the last Day of the following Year it will be 22 Days after new Moon; but because in the succeeding Year this amounts to 33 Days, and 30 Days being allowed for a complete Moon: 'tis plain, in that Year there will have happened 13 Conjunctions, and the Moon will be 3 Days past Change on the last Day of it; consequently on the last Day of the next Year the Moon will be 14 Days past the Conjunction, and so continually increasing by eleven Days yearly, till after the End of 19 Years it will become the same as before. The Age of the Moon or Number of Days past since the Conjunction, on the last Day of any Year is called the *Epact* for the succeeding Year.

24. Now since the *Epact* for the first Year of the *Lunar Cycle* was 11, the *Epact* for the Second will be 22, for the Third 3, for the Fourth 14, for the Fifth 25, and so on constantly increasing by 11; it follows that to find the *Epact* for any Year, we must multiply the *Golden Number* for that Year by 11, and divide the Product by 30, and the Quotient, if there be any, will show how many *Embolimean* or *Intercalary* Months have happened since the first Year of the current *Cycle*, and the Remainder will be the *Epact* for the given Year; or will shew how many Days has elapsed between the last Day of the former Year and the immediately preceding Conjunction.

Example. Required the *Epact* for the Year 1735.

First, By *Art.* 22. I find the *Golden Number* for the Year 1735 to be 7, which multiplied by 11, gives 77, and this divided by 30 gives 2 for the Quotient and 17 for the Remainder, and consequently there have been 2 *Intercalary* Months since the Commencement of the current *Cycle* to the Year 1735, and 17 is the *Epact* for that Year, or it is the

the Age of the Moon, the laſt Day of *December* 1734.

25. Since by *Art.* 23. the *Epact* for any Year ſhews the Age of the Moon on the laſt Day of the preceding Year, 'tis plain if to the *Epact* we add 1, the Sum will be the Age of the Moon the firſt Day of that Year; but becauſe the *Synodical Month*, or time between any two immediate Conjunctions, is equal to 29 Days and an Half, and *January* containing 31 Days; therefore if to the Age of the Moon on the firſt of *January* be added 1½ (or to avoid Fractions) 2 Days, the Sum will be the Age of the Moon on the firſt of *February*; and becauſe in common Years the Days in *January* and *February* taken together make 59, which is exactly equal to two intire Lunations, therefore the Age of the Moon on the firſt of *January* will be the ſame with its Age on the firſt of *March*, and conſequently to its Age on the firſt of *January*, there is nothing added, in common Years, for its Age on the firſt of *March*; but in *Leap Years* the Sum of the Days in *January* and *February* being 60, which is more than two intire *Lunations* by 1 Day, it is evident that in this Caſe, we muſt add 1 Day to the *Moon's* Age on the firſt of *January*, and the Sum will be its Age on the firſt of *March*. And by the ſame Way of Reaſoning it will appear, that to find the Age of the Moon on the firſt Day of any Month, we muſt add to its Age on the firſt of *January* the following Numbers, *viz.* for *February* 2, for *March* 0, in common Years, and 1 in *Leap Years*, for *April* 2, for *May* 3, for *June* 4, for *July* 5, for *Auguſt* 6, for *September* 8, for *October* 8, for *November* 10, and for *December* 10. Theſe additional Numbers are called the Numbers of the Months.

26. From

26. From what has been said in the two last Articles there naturally follows this Rule for finding the *Age of the Moon* on any Day, of a given Year, *viz.* To the *Epact* for the given Year, add the Day of the Month and Number of the Month, and if the Sum be less than 30 it is the Age of the Moon required; but if it exceed 30 then take 30 from it and the Remainder is the Moon's Age.

Example. Required the Moon's Age on the 13th Day of *May* 1733.

First, By *Art.* 24. I find the *Epact* for that Year to be 25 to which adding 13 the Day of the given Month and 3 the Number of it, the Sum is 41; from which taking 30 there remains 11, the Moon's Age on the given Day.

27. Since the Moon takes 30 Days from one Conjunction with the Sun to the next following, 'tis plain she must be 15 Days old when Full, and $7\frac{1}{2}$ when in the first Quarter; and $22\frac{1}{2}$ Days old when in the last Quarter. Consequently to find in any Month of a given Year the Day of the Moon's Change, and when Full, and when in either Quarter, we have this Rule, *viz.* Assume any Day of that Month at Pleasure, and by the last *Art.* find the Age of the Moon on that Day; then if it be 15 the Moon will be Full that Day, and counting $7\frac{1}{2}$ Days backwards and forwards from that Day, we'll have the Times of the first and last Quarters, and by counting backwards and forwards from it, 15 Days we'll have the Times of the last and next Change. But if the Age of the Moon be greater than 15, then take 15 from it and the Remainder will show how many Days have run since last Full Moon. So counting those backwards we'll have the Day the last Full Moon happen'd on; and by knowing that, we can find the Days of the Change and either Quarter as before. Again, if the Age of the Moon on the assumed Day be less than 15, then

then take that from 15, and the Remainder will show how many Days are to run till the next Full Moon; and therefore counting so many forwards, we will have the Day of the Full Moon, by which we may find the Days of the Change, and either *Quarter* as above.

Example. Required the Times of Full Moon, New Moon, and first and last Quarters in *October* 1734.

First, I assume any Day at Pleasure, suppose the tenth of that Month; then by the last *Art.* I find the *Moon*'s Age on that Day to be 24 Days, from which taking 15 there remains 9, the Number of Days since the last Full Moon; therefore counting so many Days backwards, I find the Full Moon happens on the first Day of that Month, and counting $7\frac{1}{2}$ Days forwards from that I find that the last Quarter happens on the ninth Day; then from the first Day, on which the Full Moon happens, counting 15 Days forwards, I find that the Change falls on the 16 Day, and reckoning $7\frac{1}{2}$ Days forward from that, I find that the first Quarter falls on the twenty fourth Day.

28. When the Moon is in Conjunction with the Sun, then they both come to the Meridian at the same Time; but the Moon moving still Easterly with a Velocity much greater than that of the Sun, 'tis evident that when the Sun comes on the Meridian the next Day, the Moon will be on the East Side of it, and consequently cannot be upon the Meridian till some time after the Sun; and because she completes her Revolution in 30 Days, therefore in that Time, the Difference of Time between the Sun and Moon's being on the Meridian will run thro' the whole 24 Hours: and hence by observing any Day how long Time the Moon takes to be upon the Meridian after the Sun, we may by this find the Age of the Moon that Day, making the following Proportion, *viz.* As 24 Hours, the whole

Difference

Difference of Time, is to 30 Days, the whole Number of Days from Change to Change, so is the observed Difference of Time on any Day, to the Days Run since the last Change, or the Age of the Moon at that Time.

Example. Suppose on any Day the Moon is observed to be upon the Meridian 5 Hours after the Sun; Required the Age of the Moon at that Time. Make it, as 24 is to 30, so is 5 to $6\frac{1}{4}$; consequently the Moon is $6\frac{1}{4}$ Days old at the Time of Observation.

29. The Moon moving round her Orbit, or 360 Degrees, in 30 Days, she must move 12 Degrees in 1 Day; but since her Motion is from West to East, and an Heavenly Body, 15 Degrees to the Eastward of another being 1 Hour later of Coming to the Meridian than that other; therefore making it as 15 Degrees is to 1 Hour, so is 12 Degrees to $\frac{4}{5}$ of an Hour, or 48 Minutes; we find that the Moon is always 48 Minutes later of Coming to the Meridian any Day, than she was the Day before; and because she comes on the Meridian at the same Time with the Sun on the Day of her Change; therefore to find her Southing, or Time of her Coming on the Meridian, any Day, we must first find her Age (by *Art.* 26.) for that Day, then this multiplied by 48, will give the Minutes of Difference of Time between the Sun and Moon's Coming on the Meridian; which divided by 60, will show how many Hours and Minutes the Moon is later of Coming on the Meridian than the Sun; and counting so many forwards from twelve of the Day, we have the Time of the Moon's Southing. If the Hours and Minutes found as above be less than 12, then that will be the Time of the Moon's Southing after Noon; but if greater than 12, then take 12 from them, and the Remainder will be the Time of the Moon's Southing in the Morning.

Example. Required the Time of the Moon's Southing on the 12th of *October* 1732.

First, (By *Art.* 26.) I find the Age of the Moon that Day to be 4 Days, which multiplied by 48 gives 192 Minutes, for the Difference of Time between the Sun and Moon's Coming to the Meridian that Day; and this divided by 60 gives 3 Hours and 12 Minutes; which being less than 12 Hours, is the Time of the Moon's Southing after Noon.

Example 2. Required the Time of the Moon's Southing the 21st Day of *May* 1733.

First, (By *Art.* 26.) I find the Moon's Age that Day to be 19 Days, which multiplied by 48 gives 912 Minutes, the Difference of Time between the Sun and Moon's being on the Meridian that Day, and this reduced makes 15 Hours and 12 Minutes; from which taking 12, there remains 3 Hours 12 Minutes, which shews that on the 22d of *May* 1733. the Moon comes on the Meridian at 12 Minutes past 3 in the Morning.

30. It was said at *Art.* 20. of this, that the first Year of the *Solar Cycle* was *Leap-Year*; consequently the fifth must be *Leap-Year*, and the ninth must also be *Leap-Year*; but the *Christian Æra* commencing on the tenth Year of the *Solar Cycle*, therefore the first Year of that was the first after *Leap-Year*, and the fourth was *Leap-Year*, also the eighth, twelfth, sixteenth, &c, were *Leap-Years*; whence to find whether any proposed Year of the *Christian Æra* be *Leap-Year*, or how many it is past the last *Leap-Year*; we must divide the proposed Year by 4, and if nothing remain, then the proposed Year is *Leap-Year*; but if any thing remain, that will show how many Years have past since last *Leap-Year*.

Example. Requir'd whether the Year 1730 be *Leap-Year*, or how many since last *Leap-Year*?

I divide

I divide the propoſed Year 1730. by 4, and there remains 2, ſo I conclude that the Year 1730 is the ſecond after *Leap Year*.

31. It has been ſhewn at *Art.* 17, of this, that to every Day of the Year there is annexed one of the firſt ſeven Letters of the Alphabet, beginning with A, which is always annexed to the firſt of *January*, and in any common Year, the Letter annexed to the firſt Sunday of *January* is called the *Dominical Letter* for that Year; but each *Leap Year* having two *Dominical Letters* (by *Art.* 19.) the firſt of which ſerves from the Beginning of the Year to the twenty fourth or twenty fifth of *February*, and the other for the reſt of the Year; conſequently the *Dominical Letter* for any common Year, will ſhew what Day of *January* the firſt Sunday of that Year happens upon, reckoning from A (which is annexed to the firſt of *January*) according to the natural Order of the Letters, and in any *Leap-Year* the firſt of it's two *Dominical Letters* will ſhew what Day of *Jan.* the firſt Sunday of that Year falls on, counting from A, as above; thus in the Year 1730, the *Dominical Letter* is D, ſo counting from A, *viz.* making A one, B two, C three, and D four, I find that the firſt Sunday of that Year falls on the fourth Day of *January*; and by knowing what Day of *January* the firſt Sunday of any Year falls on, we may know what Day of the Week the firſt Day of that Year falls upon, by counting ſo many Days back from Sunday; thus, ſince in the Year 1730, the firſt Sunday falls upon the fourth of *January*; therefore the third will be Saturday, the ſecond Friday, and the firſt Thurſday; conſequently the Year 1730, begins upon Thurſday. From what has been ſaid there ariſeth the following Rule for finding what Day of the Week any Day of a given Year falls upon, *viz.* Find the Day of the Week anſwering to the firſt of *January* that

 Year;

Year; then add together the Days contained in each Month from the Beginning of the Year to the Month in which the proposed Day is, and to this add the Day of the given Month: *Lastly*, divide this Sum by 7, and if nothing remain, then the Day of the Week, preceding that Day which answers to the first of *January* that Year, is the Day answering to the proposed Day; but if any thing remain, then counting so many forward (beginning with that Day the first of *January* falls on) we shall have the Day of the Week, the proposed Day falls upon. *Note*, The Days contained in each Month, are as follow, *viz. January* 31, *February* 28 in common Years, and 29 in Leap-Years, *March* 31, *April* 30, *May* 31, *June* 30, *July* 31, *August* 31, *September* 30, *October* 31, *November* 30, *December* 31.

Example. Required what Day of the Week the eighth of *July* 1730 falls upon.

First, By the preceding Rule in this *Article*, I find that the first of *January* 1730, falls upon a *Thursday*; then to the Numbers, 31, 28, 31, 30, 31, 30. answering to the elapsed Months, I add 8 the Day of the given Month, and the Sum 189 divided by 7, there remains nothing, so I conclude that the 8th of *July* 1730 falls upon a Wednesday.

Example 2. Required what Day of the Week the twenty first of *March* 1730 falls upon.

By proceeding as in the last Example, I find after Division that 3 remain, and the Year beginning upon a Thursday, therefore counting Thursday 1, Friday 2, and Saturday 3, I find that the proposed Day falls upon Saturday.

32. According to the Decree of the *Nicene Council* (which is followed by the Church of *England*) the Sunday after the fourteenth Day of that *Moon* which happens after the twenty first of *March* inclusively, *i. e.* after the Commencement of the twenty

twenty firſt of *March*, is *Eaſter Sunday*. And ſince the fourteenth Day of that *Moon*, or the *Paſchal Full-Moon* can never happen before the twenty firſt of *March*, nor after the eighteenth of *April*; therefore *Eaſter Day* can never happen ſooner than the twenty ſecond of *March*, nor later than the twenty fifth of *April*. Now to find what Day of *March* or *April*, *Eaſter Day* falls upon in any Year, we have from the foregoing *Articles*, the following Rule, *viz. Firſt*, (by *Art.* 26.) find the Age of the Moon on the twenty firſt of *March* that Year, and if it be 14, then by the laſt *Article* find the Day of the Week anſwering to it, and the Sunday following is *Eaſter Day*; but if the Moon's Age on the twenty firſt of *March* be not 14, then reckon forward to the Day in which her Age is 14 and by the laſt *Article*, find the Day of the Week anſwering to that Day, and reckoning forward to the next Sunday, we ſhall have the Day required.

Example. Required when *Eaſter-Day* happens in the Year 1730.

Firſt, I find (by *Art.* 26.) that the Age of the Moon on the twenty firſt of *March* 1730, is 13; conſequently counting 1 forward, I find that the 14 Days of the Moon, or the *Paſchal Full-Moon*, happens on the twenty ſecond Day of *March*; then (by *Art.* 31.) I find that the twenty ſecond of *March* 1730, is *Sunday*; therefore counting forwards to the next Sunday, which is *Eaſter Day*, I find it happens on the twenty ninth of *March*. *Note*, In *Leap-Years*, inſtead of the twenty firſt of *March* you muſt uſe the twentieth; becauſe in theſe Years *February* is increaſed by one Day.

33. From the *Cycles* of the Sun and Moon (explained in *Art.* 18. and 21.) multiplied into one another, there ariſes another *Cycle* of 532 Years, called the *Victorian* or *Dionyſian Cycle*, from *Diony-*

ſius

ſius it's Author; after the completing of which not only the *New-Moons* and *Full-Moons* return to the ſame Day of the Month nearly; but likewiſe the Days of every Month return to the ſame Days of the Week; and conſequently the *Dominical Letters*, and all the *Moveable Feaſts*, return in the ſame Order: whence this *Cycle* is called the *Great Paſchal Cycle*. Now, becauſe the *Chriſtian Æra* commenced on the 457th Year of the *Cycle*; therefore to find the Year of the *Dionyſian Period* for any Year of the *Chriſtian Æra*, we have the following Rule, *viz.* To the current Year of the *Chriſtian Æra*, add 458, and divide the Sum by 532; then the Quotient will ſhew how many *Periods* have paſt ſince the Beginning of that in which the *Chriſtian Æra* commenced, and the Remainder will ſhew the Year of the *Dionyſian Period*, anſwering to the given Year.

Example. Required the Year of the *Dionyſian Period*, for the Year of *Chriſt* 1733.

Firſt, I add to 1733 the Number 457, and the Sum is 2120; then I divide this by 532, and the Quotient is 4, and Remainder 62; conſequently there has paſt 4 *Dionyſian Periods* ſince the Beginning of that in which the *Chriſtian Æra* commenced, and the given Year is the 62d of the *Current Cycle*.

34. Beſides the *Cycles* of the *Sun* and *Moon* there is another *Cycle* conſiſting of 15 Years, called the *Cycle of Indiction*, which hath no Connection with the Celeſtial Motions, and which was made uſe of by the *Romans* for ſome *Civil* Purpoſes, and is ſtill uſed by the *Popes of Rome* in their *Bulls* and *Diploma's*. The Year before *the Birth of* CHRIST was the third Year of this *Cycle*; and conſequently to find the Year of *Indiction* for any Year in in the *Chriſtian Æra*, we have this Rule, *viz.* to the given Year, add 3, and divide the Sum

by

by 15, then if there be no Remainder, the given Year is the fifteenth of the *Indiction*; but if there be any Remainder that will ſhew what Year of the *Indiction* the given Year is; and the Quotient will ſhew how many complete *Cycles of Indiction* have paſt ſince the firſt Year of that in which the *Chriſtian Æra* commenced.

Example, Required the Year of *Indiction*, for the Year 1733 of the *Chriſtian Æra*.

Firſt, I add 3 to the given Year, and the Sum is 1736; then I divide this Sum by 15, and the Quotient is 115, and Remainder 11. Conſequently there has been 115 complete *Cycles of Indiction* from the firſt Year of that in which the *Chriſtian Æra* commenced, and the Year 1733, is the 11th Year of *Indiction*.

35. From the Multiplication of the three *Cycles*, *viz*. the *Solar* of 28 Years, the *Lunar* of 19, and that of *Indiction* of 15; ariſes a Period of 7980 Years, called the *Great Julian Period*. This is ſuppoſed to have begun 764 Years before the *Creation of the World*, and is not yet completed; conſequently it muſt comprehend all the Actions that have happened from the Beginning of the World; and ſince the Year before *Chriſt* was the 4713th Year of this *Period*, therefore to find what Year of the *Julian Period* any current Year is, we muſt to the given Year of *Chriſt*, add 4713, and the Sum will be the required Year of the *Julian Period*.

Example, Required what Year of the *Julian Period* anſwers to the current Year of *Chriſt* 1734.

To the given Year 1734, I add 4713, and the Sum 6447, ſhews that the current Year of *Chriſt* 1734 is the 6447th Year of the *Julian Period*.

36. As in the Heavens, there are certain Points from which *Aſtronomers* begin their Computations; ſo likewiſe there are certain Points of Time, from which, as *Roots Chronological* Computations begin; and

and all memorable Actions are recorded by *Hiſtorians* according to the Series of Years following theſe *Roots*, or fixed Points of Time which are called *Epocha*'s or *Æra*'s. The moſt celebrated and beſt known to us, is the *Chriſtian Æra*, which commenced on the firſt of *January*, immediately following the Birth of *Chriſt*.

37. The moſt Ancient *Epocha*, is that of the Creation of the World; which commenced 3950 Years before *Chriſt*. The next to this is that of the *Deluge*, which began 2956 Years before *Chriſt*. Then follows the *Epocha* of the *Olympiads*, which was the moſt antient and famous *Epocha* among the *Greeks*, and other *Eaſtern Nations*; each *Olympiad* contained 4 Years, and they had their Riſe from certain Games that were celebrated by the *Grecians* every fourth Year; in Honour of *Jupiter Olympius*, which were called *Olympic Games*. The Beginning of this *Epocha*, is ſuppoſed to have been on the 777th Year before *Chriſt*, and in the 3931th Year of the *Julian Period*. The next *Epocha*, is that of the Building of *Rome*, which began about the End of the third Year of the *Sixth Olympiad*, 764 Years before *Chriſt*, and in the 3959th Year of the *Julian Period*. Then follows the *Æra of Nabonaſſar King of Babylon*, from the Beginning of whoſe Reign it commenced. This *Æra* is famous among *Aſtronomers*, being made uſe of by *Ptolomy*, *Albategnus*, &c. as a proper *Æra* for computing the Motions of the Celeſtial Bodies from. It began according to *Ptolomy*, on the fourth of the *Kalends* of *March*, 747 Years before *Chriſt*, in the 3966th Year of the *Julian Period*, and in the ſeventh Year after the Building of *Rome*, and in the ſecond Year of the eighth *Olympiad*. The next is the *Epocha* of *Alexander the Great*, which commenced at his Death; and this happened about the middle of the Spring,

in

in the first Year of the 114th *Olympiad*, 324 Years before *Christ*, in the 4390th Year of the *Julian Period*, and in the 424th Year of the *Æra of Nabonassar*. There are several other *Epochas* besides these already mentioned of less Note, which I shall pass over, it not being the Design here to give a particular Description of all the *Epochas* and their several Uses, but only to give a general Account of the most remarkable among them.

38. Since by the Rotation of the *Earth* about its Axis, the *Moon* appears to move quite round from *East* to *West* in 24 Hours, therefore in that Time she must pass over all the Points in the *Compass*, and so must move from one Point to the next succeeding in 45 Minutes. Consequently in moving from the *North* Point to the *South*, she must take 12 Hours, and from the *North*, to the N*b*E, or from the *South* to the S*b*W 45 Minutes; also from the *North* to the N N E, or from the *South* to SSW; 1 Hour 30 Minutes; and so on as in the following Table.

Points	*H: ,, M.*	*Points*
N	12 ,, 00	S
N*b*E	0 ,, 45	S*b*W
NNE	1 ,, 30	SSW
NE*b*N	2 ,, 15	SW*b*S
NE	3 ,, 00	SW
NE*b*E	3 ,, 45	SW*b*W
ENE	4 ,, 30	WSW
E*b*N	5 ,, 15	W*b*S
E	6 ,, 00	W
E*b*S	6 ,, 45	W*b*N
ESE	7 ,, 30	WNW
SE*b*E	8 ,, 15	NW*b*W
SE	9 ,, 00	NW
SE*b*S	9 ,, 45	NW*b*N
SSE	10 ,, 30	NNW
S*b*E	11 ,, 15	N*b*W

39. The *Flux* and *Reflux*, or *Ebbing* and *Flowing* of the Seas, does constantly respect the Motion of the *Moon*, and in every Place when the *Moon* is on a certain Point of the *Compass*, or at a certain Distance from the Meridian, it is then high Water at that Place; and since she is twice at the same Distance from the Meridian, or in two opposite Points of the *Compass*, in her diurnal Motion; therefore in most Places there is a double Ebbing and Flowing in a little more than 24 Hours. There has been found by Observation for the most remarkable Coasts, the Points in which the Moon is when it is high Water in each of them; as in the following Table.

A TABLE of the most remarkable Sea-Coasts, in an Alphabetical Order; shewing in each of them the Points *of the* COMPASS, *the* MOON *must be on, when it is high Water.*

A.

AT *Abarwark*, ENE and WSW.

At *Abenmerick* and *Antwerp*, E and W.

At *Alborough*, SE *b* S, and NW *b* N.

At *Amsterdam* and *Armenties*, NE and SW.

At *Army*, NNE, and SSW.

B.

At *Beachy* and *Blacktail*, and before the Race of *Blanquet*, N and S.

At *Blackness* in *Bluet*, at *Bell Isle*, NNE, and SSW.

Without *Bluet*, and at *Berwick*, NE *b* N. and SW *b* S.

At the River *Bourdeaux*, the South Coast of *Britaigne*, the Coast of *Biscay*, and at *Bookness*, NE, and SW.

At *Brest*, before the *Bass*, the River of *Bourdeaux* within the *Haven*, NE *b* E, and SW *b* W.

In the *Breesound*, *Bloy*, and *Baltimore*, ENE, and WSW.

Before *Bremen*, and at *Blackney*, and in the Channel before *Bourdeaux*, E and W.

At *Bridgwater*, ESE, and WNW.

At *Bristol Key*, E *b* S, and W *b* N.

At *Bullen deep*, SSE, and NNW.

C.

Before the Haven of *Caen*, in the Chamber, between *Cripplesand* and the

the *Creyl*, and at *Culhot*, S b E, and N b W.

At *Caldy*, and in the Bay of *Carnarvan*, E b N, and W. b S.

Without *Calais*, at *Corpus Christi Point*, before and at *Camfer*, N N E, and S S W.

Between *Calais* and Dover, be[illegible] *Conquet*, and at the *N. Cape*, [illegible] S. W.

At the *Caskets*, and at *Chamberness*, S E b S, and N W b N.

Between *Guernsey* and the *Caskets*, before *Cromer*, before the *Caskets* at *Guernsey*, at *Seven* [illegible]*ifts*, and at *Catness*, S E, and N W.

In the Chamber of [illegible] and S b W.

Without the *Caskets* in the Channel, S E b E, and N W b W.

At *Concalo* E and W.

In *Condado* N and S.

At *Cork*, *Calais*, Cape *Clear*, and in the *Creek*, E N E, and W S W.

At *Cows* in the Foss of *Caen*, in *Calais Road*, and in *Chamberness Road*, S S E, and N N W.

D.

At *Dartmouth*, E and W.

At *Diep*, *Dover*, and in the *Downs*, S S E, and N N W.

At *Dover Pier*, and before *Dunkirk*, N and S.

At *Denbigh* and *Downs*, in the Road, N E b N, and S W b S.

At *Dublin*, S S E, and N N W.

At *Dunbar*, S E, and N W.

At *Dungeness* and *Dunnose*, S E b S, and N W b N.

At *Dungersan*, E N E, and W S W.

E.

At *Edam* N N E, and S S W.

At *Emden*, before the *Elve*, before the *Eyder*, and before *Enchusen*, N and S.

Before the *Eastern* and *Western Emes*, and *Engemonts*, S E and N W.

F.

In the *Fair Isle Roads*, and at the *North Foreland*, S b E, and N b W.

At the *Frith*, and at the S. *Foreland*, S S E, and N N W.

Before the *Fen*, in the Channel, N N E, and S S W.

At *Flamborough* and *Bradlington*, N E, and S W.

On the Coast of *Flanders*, N and S.

Without the Banks of *Flanders*, NE, and S W.

At *Flushing*, N b E, and S b W.

On the Coast of *Flanders*, N and S.

At the *Forn*, in *Foy*, at *Falmouth* E b N, and W b S.

Without the *Fly*, S E b E, and N W b W.

Before the Coast of *Friesland*, and the *Fly*, E S E, and W N W.

Between *Foy* and *Falmouth*, in the in the Channel, and at *Foulness*, E b S, W b N.

At *Frize*, and the *Fair Isle*, N W, and S E.

G.

In the Road of *Gibraltar*, at *Graveling*, and before *Cherburgh*. N and S.

Before *Goree*, at *Guernsey*, and at *Gravesend*, N N E, and S S W.

At *Groin*, at *Gascoign*, and the Coast of *Galicia*, N E. and S W.

Thwart of *Guernsey*, in the Channel, S E b S, and N W b N.

H.

Before *Hamburgh*, at *Hull*, at the *Holms*, and before *Humber's Mouth*, E and W.

At *Hampton Key*, before the *Hever*, before *Horn*, N and S.

At *Harlem*, *Havre de Grace*, and *Homehead*, S E and N W.

Before *Hartlepool*, N E, and S W.

At *St. Helen's*, at *Harwich*, and without the Banks of *Harwich*, S S E, and N N W.

At *Humber*, E b N, and W b S.

Under *Holy Island*, and at *Horn*, N N E, and S S W.

At *Huncliff-Foot*, N E b E, and S W b S.

I.

In all the Havens on the S. Coasts of *Ireland*, E b N, and W b S.

On the W. Coasts of *Ireland*, NE, and S W.

At *Jutland Islands*, N and S.

 At

K.

At *Kelliers*, N E, and S W.
At *Kentish Knock*, N and S.
At *Kilduyn*, E S E, and W N W.
At *Kildrive*, S E, and N W.
At *Kingsale*, E N E, and W S W.

L.

At *Lambay*, S E *b* E, and N W *b* W.
At *Leith*, N and S.
At *Lynn*, E *b* S, and W *b* N.
At *Lisbon*, N E *b* N, and S W *b* S.
At the *Lizard*, by the Land, E S E, and W N W.
At *Leostoff*, and thwart of it without the Banks, S E *b* S, and N W *b* N.
In *Leostoff-Road*, and *Longsand Head*, S S E, and N N W.
At *London*, N E, and S W.
At *Londey*, E and W.
Thwart of *Londey*, and before *Lynn*, E *b* N, and W *b* S.

M.

Within the *Maes*, at *Malden*, N *b* E, and S *b* W.
Before the *Maes*, and before *St. Matthew's Point*, N E *b* E, and S W *b* W.
In *St. Magnes Sound*, and at the *Magnes Castle*, S E *b* E, and N W *b* W.
At the *Isle of Man*, S E, and N W.
Before *Margate*, S *b* E, and N *b* W.
In *Milford*, at *Moonless*, at *St. Maloes*, E *b* N, and W *b* S.
Between *Mousehole* and *Falmouth*, and in *Milford Haven*, E S E, and W N W.
In *Mousehole*, at *St. Matthews*, and within *Mounts Bay*, E N E and W S W.

N.

Between the *Naze*, and *Warhead* of *Lower*, S *b* E, and N *b* W.
Before the River of *Nants*, N E, and S W.
At the *Needles*, at the *Isle of Whits*, S E *b* E, and N W *b* W.
At *Newcastle*, E *b* N, and W *b* S.
At *Newport*, half Tide, N and S.
At the West End of the *Nore*, N *b* E, and S *b* W.
Before St. *Nicholas*, E *b* S, and W *b* N.
All the Coast of *Normandy*, and *Picardy*, S S E, and N N W.

O.

At *Orfordness*, S E *b* S, and N W *b* N.
At *Orfordness*, without the Banks, and between *Orford* and *Orwell-Waves*, S S E, and N N W.
[illegible] *[illegible]ness*, within the Sands, [illegible] and N *b* W.
At *Orkness*, N E, and S W.
At *Orkney*, S E, and N W.

P.

At St. *Paul's* in the Haven, E and W.
At the *Pens*, *Porthus*, and *Poictu*, N E, and S W.
In *Plymouth*, and before St. *Paul's*, E *b* N, and W *b* S.
Thwart of *Plymouth*, E S E, and W N W.
Before *Podessemeck*, E *b* S, and W *b* N.
At the Race of *Portland*, S E, and N W.
At *Portsmouth*, half Tide, N and S.

Q.

At *Queenborough*, N and S.

S

In the *Sleve*, between *Usham* and *Scilly*, at the *Shooe*, at the *Spitt*, at *Southampton*, and all along the *Swin*, N and S.
Upon the Coast of *Spain*, and in *Shetland*, N E and S W.
At *Scilly*, in the *Sound*, *Scarburgh*, and at *Staples*, N E *b* E, and S W *b* W.
At *Seven Isles*, without the Haven, in the *Broad Sound*, E N E, and W S W.
At the Mouth of *Severn*, between *Scilly* and the *Lizard*, at the *Spurn* and *Stockton*, E *b* N, and W *b* S.

Without

Without *Scilly*, in the Channel, and *Salcomb*, E and W.

At *Sedmouth*, and at the *Start*, E *b* S, and W *b* N.

Off the *Start* in the Channel, E S E, and W N W.

W[illegible] the *Seyn*, and before *Sh*[illegible]*bergh*, and at *Seven Clifts*, S E, and N [illegible]W.

[illegible] *Shoram*, S E *b* [illegible] and N [illegible].

A[illegible] *Seyn Head*, S [illegible] E, and N [illegible] W.

T.

Within *Terv*[illegible], N *b* E, and S *b* W.

Before *Terver*[illegible] before the River of *Thames*, and at [illegible] N N E, and S S W.

Before the *Trees*, and *Tinmou*[illegible] before the Bay of *Tinmouth*, N E, an[illegible] S W.

At the Clifts of the *Texel*, E N E, and W S W.

In *Torbay*, and before the *Texel*, E and W.

In the Road of the *Texel*, E S E, and W N W.

At *Torgon*, S E *b* S, and N W *b* N.

U.

Before *Urek*, N and S.

At *Use*, N E, and S W.

Between *Ushant*, and the *Main*, N E *b* E, and S W *b* W.

St. *Vallery*, S S E, and N N W.

W.

At *Winchelsea*, N *b* E, and S *b* W.

At the *Weilings*, and from the W. End of the *Wight*, N N E, and S S W.

Before the *Weilings*, N E *b* N, and S W *b* S.

At *Whitby*, N E, and S W.

In the Sea of *Wales*, and *Severn*, E N E, and W S W.

In *Wales*, E [illegible] N, and W *b* S.

At *Wells*, at *Weymouth*, and at *Waterford*, E and W.

At *Weymouth Key*, E *b* S, and W *b* N.

At the *Ness*, by *Wieringhen*, at *Winterton*, E S E, and W N W.

Thwart the *Isle of Wight*, in the Channel, all within the *Isle of Wight*, between the *Isle of Wight*, and *Beachy*, by the Shore, S E *b* E, and N W *b* W.

At the East End of *Wight*, and on *Wierington Flats*, S E, and N W.

Y.

Before *Yarmouth*, N N E, and S S W.

At *Youghall*, E N E, and W S W.

At *Yarmouth*, S E *b* E, and N W *b* W.

In *Yarmouth Road*, in *Yarmouth Haven*, S S E, and N N W.

Z.

On the Coast of *Zealand*, N N E, and S S W.

In the *Ziercek* Sea, N E, and S W.

40. By knowing the Point of the *Compass*, the Moon is on when it is high Water at any Place, we know by *Art.* 38. the Time she takes to move from the *Meridian* to that Point; and since we can find by *Art.* 29. the Time of the Moon's coming on the *Meridian* any Day; therefore to find the Time of high Water at any Place, and on any Day, we have this Rule, *viz.* To the Hours and Minutes of the Moon's Southing (found by *Art.* 29.) add the Hours and Minutes answering to the Point of flowing

ing (found from the Table of *Art.* 38.) the Sum is the Time of full Sea requir'd; counting from Noon or Midnight.

Example. Requir'd the Time of High Water at *Bristol Key*, on the tenth of *May* 1731.

First, By *Art.* 29. I find the Moon comes on the *Meridian* that Day, 48 Minutes past 12 at Night, then because by the Table in the last *Article* the *Moon* must be on the E *b* S, or W *b* N Point of the *Compass* before it be high Water at *Bristol*; and since by the Table of *Art.* 28. it takes 6 Hours, 45 Minutes, in moving from the Meridian to either of these Points; therefore to the 48 Minutes before found, I add 6 Hours, 45 Minutes and the Sum is 7 Hours, 33 Minutes in the Morning, the Time of full Sea at *Bristol*, for the Day proposed, which is also the Time at Night, when it is full Sea again, that Day.

SECT. VI.

Concerning the LOG-LINE *and* COMPASS.

1. THE Method commonly made uſe of for meaſuring the Ship's Way at Sea, or how far ſhe runs in a given Space of Time, is by the *Log-Line*, and *Half-Minute Glaſs*.

2. The *Log* is a flat Piece of Wood, in Shape like a Flounder, having a Piece of Lead faſten'd to its Bottom, which makes it ſtand or ſwim upright in the Water; to this *Log* is tied or faſtned a long Line, which is called the *Log-Line*; and this is commonly divided into certain Spaces, each of which is, or ought to be, ſuch proportional Part of a nautical Mile (60 of which make a Degree of a great Circle on the Earth) as half a Minute (the Time allow'd for the Experiment) is of an Hour.

3. Theſe Spaces are called *Knots*, becauſe at the End of each of them, there is a Piece of Twine with *Knots* in it, inreeved between the Strands of the *Line*, which ſhews how many of theſe Spaces or *Knots* are run out during the half Minute. They commonly commence or begin to be counted, at the Diſtance of about 10 Fathom, or 60 Feet from the *Log*; that ſo the *Log*, when it is hove over Board, may be out of the *Eddy* of the Ship's *Wake* before

before they begin to count, and for the more ready Diſcovery of this Point of Commencement, there is commonly faſtned at it a Piece of red Rag.

4. The *Log* being thus prepar'd, and hove over Board from the *Poop*, and the Line veer'd out (by the Help of a Reel, that turns eaſily, and about which it is wound) as faſt as the *Log* will carry it away, or rather as the Ship ſails from it, will ſhew according to the Time of Veering, how far the Ship has run in a given Time; and conſequently her Rate of Sailing.

5. A Degree of a *Meridian*, which is a great Circle on the Earth, according to the exacteſt Meaſures, contains about 69.545 *Engliſh* Miles; and each Mile, by the Statute being 5280 Feet, therefore a Degree of a *Meridian* will be about 367200 Feet; whence the $\frac{1}{60}$ of that, *viz.* a Minute, or nautical Mile, muſt contain 6120 ſtandard Feet; conſequently ſince $\frac{1}{2}$ Minute is the $\frac{1}{120}$ Part of an Hour, and each *Knot* being the ſame Part of a nautical Mile (by *Art.* 2.) It follows, that each *Knot* will contain the $\frac{1}{120}$ Part of 6120 Feet, *viz.* 51 Feet.

6. Hence it is evident, that whatever Number of *Knots* the Ship runs in half a Minute, the ſame Number of Miles ſhe will run in one Hour; ſuppoſing her to run with the ſame Degree of Velocity during that Time, and therefore it is the general Way to heave the *Log* every Hour, to know her Rate of Sailing; but if the Force or Direction of the Wind vary, and not continue the ſame during the whole Hour, or if there has been more Sail ſet, or any Sail handed, that ſo the Ship has run ſwifter or ſlower in any Part of the Hour, than ſhe did at the Time of heaving the *Log*; then there muſt be Allowance made accordingly for it, and this muſt be according to the Diſcretion of the Artiſt.

7. Some-

7. Sometimes when the Ship is before the Wind, and there is a great Sea ſetting after her, it will bring home the *Log*, and conſequently the Ship will ſail faſter than is given by the *Log*. In this Caſe it is uſual, if there be a very great Sea, to allow one Mile in ten, and leſs in Proportion, if the Sea be not ſo great. But for the Generality, the Ship's Way is really greater than that given by the *Log*; and therefore in Order to have the Reckoning rather before than behind the Ship, (which is the ſafeſt Way) it will be proper to make the Space of the *Log-Line* between *Knot* and *Knot*, to conſiſt of 50 Feet inſtead of 51. Some, upon the Suppoſition that 60 Miles make a a Degree on the Meridian, make the Diſtance between *Knot* and *Knot* 42 Feet; when at the ſame Time, by common Experience they are oblig'd to leſſen the *Half-Minute-Glaſs* by near 6 Seconds, making it to run only 24 Minutes nearly; which plainly is correcting one Miſtake by another.

8. If the Space between *Knot* and *Knot* on the *Log-Line* ſhould happen to be too great in Proportion to the *Half-Minute-Glaſs*, *viz.* greater than 50 Feet; then the Diſtance given by the *Log*, will be too ſhort, and if that Space be too ſmall, then the Diſtance run (given by the *Log*) will be too great; therefore to find the true Diſtance run in either Caſe, having meaſured the Diſtance between *Knot* and *Knot*, we have the following Proportion, *viz.*

As the true Diſtance 50 Feet, is to the meaſured Diſtance, ſo is the Miles of Diſtance given by the *Log*, to the true Diſtance in Miles that the Ship has run.

Example 1. 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 Diſtance in Miles.

 Making

Making it as 50 Feet is to 56 Feet, so is 6.25 *Knots* to 7 *Knots*; I find that the true Rate of sailing is 7 Miles in the Hour.

Example 2. 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.

Making it as 50 Feet, is to 44 Feet, so is 6.5 *Knots*, to 5.72 *Knots*; I find that the true Rate of Sailing is 5.72 Miles in the Hour.

9. Again, supposing the Distance between *Knot* and *Knot* on the *Log-Line* to be exactly 50 Feet, but that the *Glass* is not 30 Seconds; then if the *Glass* require longer Time to run than 30 Seconds, the Distance given will be too great, if estimated by allowing 1 Mile for every *Knot* run, in the Time the *Glass* runs; and on the Contrary, if the *Glass*, require less Time to run than 30 Seconds, it will give the Distance sail'd too small. Consequently to find the true Distance in either Case, we must measure the Time the Glass requires to run out (by the Method in the following Article) then we have the following Proportion, *viz.*

As the Number of Seconds the *Glass* runs, is to half a Minute, or 30 Seconds, so is the Distance given by the *Log*, to the true Distance.

Example 1. Suppose a Ship runs at the Rate of $7\frac{1}{2}$ *Knots* in the Time the *Glass* runs, but measuring the *Glass*, I find it runs 34 Seconds: Required the true Distance sail'd.

Making it as 34 Seconds is to 30 Seconds, so is 7.5, to 6.6; I find that the Ship sails at the Rate of 6.6 Miles an Hour.

Example 2. Suppose a Ship runs at the Rate of $6\frac{1}{2}$ *Knots*, but measuring the *Glass*, I find it runs only 25 Seconds: Required the true Rate of Sailing.

Making

Making it as 25 *Seconds* is to 30 *Seconds*, so is 6.5 *Knots*, to 7.8 *Knots*; I find that the true Rate of Sailing is 7.8 Miles an Hour.

10. In Order to know how many *Seconds* the *Glass* runs, you may try it by a Watch or Clock, that vibrates *Seconds*; but if neither of these be at Hand, then take a Line, and to the one End fastening a *Plummet*, hang the other upon a *Nail* or *Peg*, so as the Distance from the *Peg* to the Center of the *Plummet* be 39⅛ Inches: Then this put into Motion will vibrate *Seconds*, *i. e.* every Time it passes the Perpendicular you are to count one *Second*; consequently by observing the Number of Vibrations that it makes during the Time the *Glass* is running, we know how many *Seconds* the *Glass* runs.

11. If there be an Error both in the *Log-Line* and *Half-Minute-Glass*, *viz.* if the Distance between *Knot* and *Knot* on the *Log-Line*, be either greater or less than 50 Feet, and the *Glass* runs either more or less than 30 *Seconds*, then the finding of the Ship's true Distance will be somewhat more complicate, and admit of three Cases, *viz.*

Case 1. If the *Glass* runs more than 30 *Seconds*, and the Distance between *Knot* and *Knot* be less than 50 Feet, then the Distance given by the *Log-Line*, *viz.* by allowing 1 Mile for each *Knot* the Ship sails while the *Glass* is running, will always be greater than the true Distance; since either of these Errors give the Distance too great. Consequently to find the true Rate of Sailing in this Case, we must first find (by *Art.* 8.) the Distance, on the Supposition that the *Log-Line* is only wrong, and then with this (by *Art.* 9.) we shall find the true Distance.

Example. Suppose a Ship is found to run at the Rate of 6 *Knots*; but examining the *Glass*, I find it runs 35 *Seconds*, and measuring the *Log-Line*, I find the Diſtance between *Knot* and *Knot* to be but 46 Feet: Required the true Diſtance run.

Firſt, By *Art.* 8. we have the following Proportion, *viz.* As 50 *Feet* : 46 *Feet* : : 6 *Knots* : 5.52 *Knots*. Then by *Art.* 9. As 35 *Seconds* : 30 *Seconds* : : 5.52 *Knots* : 4.73 *Knots*. Conſequently the true Rate of Sailing is 4.73 Miles an Hour.

Caſe 2. If the *Glaſs* be leſs than 30 *Seconds*, and the Space between *Knot* and *Knot* be more than 50 Feet; then the Diſtance given by the *Log*, will always be leſs than the true Diſtance, ſince either of theſe Errors leſſen the true Diſtance.

Example. Suppoſe a Ship is found to run at the Rate of 7 *Knots*, but examining the *Glaſs*, I find it runs only 25 *Seconds*, and meaſuring the Space between *Knot* and *Knot* on the *Log-Line*, I find it is 54 Feet: Required the true Rate of Sailing.

Firſt, By *Art.* 9. As 25 *Seconds* : 30 *Seconds* : : 7 *Knots* : 8.4 *Knots*. Then by *Art.* 8. As 50 *Feet* : 54 *Feet* : : 8.4 *Knots* : 9.072 *Knots*. Conſequently the true Rate of Sailing is 9.072 Miles an Hour.

Caſe 3. If the *Glaſs* runs more than 30 *Seconds*, and the Space between *Knot* and *Knot* be greater than 50 Feet, or if the *Glaſs* runs leſs than 30 *Seconds*, and the Space between *Knot* and *Knot* be leſs than 50 Feet; then ſince in either of theſe two Caſes the Effects of the Errors are contrary, 'tis plain the Diſtance will ſometimes be too great and ſometimes too little, according as the greater Quantity of the Error lies; as will be evident from the following Examples.

Example 1. Suppoſe a Ship is found to run at the Rate of $9\frac{1}{2}$ *Knots* per *Glaſs*, but examining the *Glaſs*, it is found to run 36 *Seconds*, and by meaſuring the Space between *Knot* and *Knot*, it is found to be 58 Feet: Required the true Rate of Sailing.

Firſt,

First, By *Art.* 8. As 50 *Feet* : 58 *Feet* : : 9.5 *Knots* : 11.02 *Knots*. Then by *Art.* 9. As 38 *Seconds* : 30 *Seconds* : : 11.02 *Knots* : 8.7 *Knots*. Consequently the Ship's true Rate of Sailing is 8.7 Miles an Hour.

Example 2. Suppose a Ship runs at the Rate of 6 *Knots* per *Glass*; but examining the *Glass*, it is found to run only 20 Seconds, and by measuring the *Log-Line*, the Distance between *Knot* and *Knot* is found to be but 38 Feet: Required the true Rate of Sailing.

First, By *Art.* 8. As 50 *Feet* : 38 *Feet* : : 6 *Knots* : 4. 56 *Knots*. Then by *Art.* 9. As 20 *Seconds* : 30 *Seconds* : : 4. 56 *Knots* : 6. 84 *Knots*. Consequently the true Rate of Sailing is 6.84 Miles an Hour.

But if in this Case it happen, that the Time the *Glass* takes to run, be to the Distance between *Knot* and *Knot*, as 30, the *Seconds* in half a Minute, is to 50, the true Distance between *Knot* and *Knot*; then 'tis plain, that whatever Number of *Seconds* the *Glass* consists of, and whatever Number of Feet is contain'd between *Knot* and *Knot*; yet the Distance given by the *Log-Line* will be the true Distance in Miles.

12. Though the Method of measuring the Ship's Way by the *Log-Line*, described in the foregoing Articles, be that which is now commonly made use of; yet it is subject to several Errors, and these pretty cosiderable. For first, the *Half-Minute* or *Quarter-Minute-Glasses* (by which, and the *Log*, the Ship's Way is determin'd) are seldom or never true, because dry and wet Weather have a great Influence on them; so that at one Time they may run more, and at another Time fewer than thirty *Seconds*, and 'tis evident that a small Error in the *Glass*, will cause a sensible one in the Ship's Way. Again, the chief Property of the *Log* is to have it

it ſwim upright, or perpendicular to the *Horizon*; but this is too often wanting in *Logs*, becauſe few Seamen examine whether it is ſo or not, and generally take it upon Truſt, being ſatisfied, if it weigh a little more at the Stern than the Head; and from this there flows an Error in the Reckoning, for if the *Log* does not ſwim upright, it will not hold Water, nor remain ſteady in the Place where it is heav'd, ſince the leaſt Check of the Hand, in veering the Line will make it come up ſeveral Feet; this repeated will make the Errors become Fathoms, and perhaps Knots, which how inſignificant ſoever they appear, are Miles and Parts of Miles, and amount to a good deal in a long Voyage. Another Inconvenience attending the *Log-Line* is it's ſtretching and ſhrinking; for when a new Line is firſt uſed, let it be ever ſo well ſtretched upon the Deck, and meaſured as true as poſſible, yet after wetting it ſhrinks conſiderably; and conſequently to be the better aſſur'd of the Ship's Way by the *Log-Line*, we ought to meaſure and alter the Knots on it every Time before we uſe it; but this is ſeldom done oftner than once a Week, and ſometimes not above once or twice in a whole Voyage; alſo when the Line is meaſured to its greateſt Degree of ſhrinking, it is generally left there; and when by much Uſe, it comes to ſtretch again it is ſeldom or never mended, though it will ſtretch beyond what it firſt ſhrunk. Theſe and many other Errors too well known, attending that Method of meaſuring the Ship's Way by the *Log-line*, plainly anſwers for a great many Errors committed in Reckonings. So 'tis to be wiſh'd that either this Method were improved or amended, or that ſome other Method leſs ſubject to Error, were found out. There was a Machine ſometime ago invented by Mr. *Henry de Saumarez*, of the Iſland of *Guernſey*, for meaſuring the Ship's Way, called the

Marine

Marine Surveyor, which is indeed leſs ſubject to Error than the *Log-line*, and was found by ſeveral Experiments to anſwer the End much more exactly than the *Log-line*; a Deſcription of which may be ſeen in the *Philoſophical Tranſactions* of the *Royal Society*, Vol. xxxiii. for the Months of *November* and *December* 1725; and alſo in thoſe for the Months of *March* and *April* 1726; and for *March* and *April* 1729.

13. It was ſaid at *Art.* 21. *Sect.* 3 that the Meridian and *Prime Vertical* of any Place cuts the Horizon in 4 Points, at 90 Degrees Diſtance from one another, *viz.* the *North*, *South*, *Eaſt* and *Weſt*; that Part of the Meridian which extends itſelf from the Place to the *North* Point of the *Horizon*, is called the *North Line*; that which tends to the *South* Point of the *Horizon*, is called the *South Line*; and that Part of the *Prime Vertical* which extends towards the Right Hand of the Obſerver, when his Face is turn'd to the *North*, is called the *Eaſt Line*; and laſtly, that Part of the *Prime Vertical* which tends towards the Left Hand, is called the *Weſt Line*; the four Points in which theſe Lines meet the *Horizon*, are called the *Cardinal Points*.

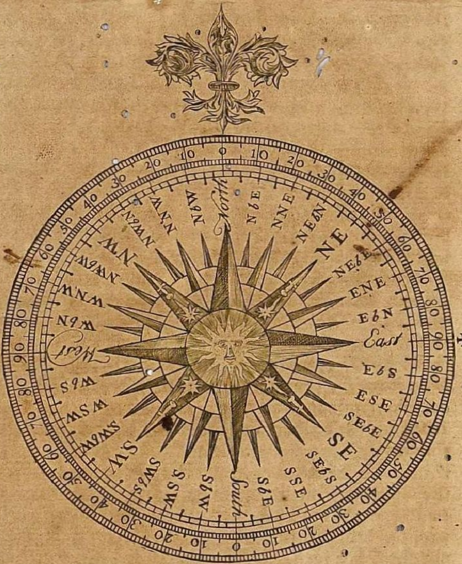
14. In Order to determine the *Courſe* of the *Winds*, and to diſcover their various Alterations or Shiftings; each Quadrant of the *Horizon* intercepted between the *Meridian* and *Prime Vertical*, is uſually divided into eight equal Parts, and conſequently the whole *Horizon* into thirty two; and the Lines drawn from the Place on which the Obſerver ſtandeth, to the Points of Diviſion in his *Horizon*, are called *Rumb Lines*, the four principal of which are thoſe deſcribed in the preceding Article, each of them having its Name from the *Cardinal Point* in the *Horizon* towards which it tends; the reſt of the *Rumb-Lines* have their Names compounded of the

the principal Lines on each Side of them, as in the following Figure; and over which-ſoever of theſe Lines the Courſe of the Wind is directed, that Wind takes its Name accordingly.

15. The Inſtrument commonly uſed at Sea for directing the Ship's Way, is called the *Mariners Compaſs*; which conſiſts of a *Chard* and two *Boxes*. The *Chard* is a Circle made to repreſent the *Horizon*, whoſe Circumference is quartered and divided into Degrees, and alſo into thirty two equal Parts, by Lines drawn from the Center to the ſeveral Points of Diviſion called *Points of the Compaſs*. On the Back-ſide of the *Chard*, and juſt below the *South* and *North Line*, is fixed a *Steel Needle*, with a *Braſs Cupola*, or hollow Center in the Middle, which is plac'd upon the End of a fine *Pin*, upon which the *Chard* may eaſily turn about; the *Needle* is touch'd with a *Load-Stone*, by which a certain Virtue is infus'd into it, that makes it (and conſequently the *South* and *North Line* on the *Chard*, above it) hang nearly in the Plane of the *Meridian*, by which Means the *South* and *North Lines* on the *Chard* produc'd would meet the *Horizon* in the *South* and *North* Points; and conſequently all the other Lines on the *Chard* produc'd would meet the *Horizon* in their reſpective Points.

16. The *Chard* is repreſented in the annexed Scheme, in which you may obſerve, that the Capital Letters N, S, E, W, denote the four Cardinal Points, *viz.* N the *North*, S the *South*, &c. and the ſmall Letter *b* ſignifies the Word *by*: the *Rumbs* in the Middle between any two of the Cardinals, are expreſs'd by the Letters denoting thoſe Cardinals, that which denotes the Point lying in the *Meridian* having the Precedence; thus the *Rumb* in the Middle between the North and Eaſt is expreſs'd N E, which is to be read *North-Eaſt*; alſo

alſo S W denotes the *South-Weſt* Rumb, &c. the other Rumbs are expreſs'd according to their Situ-



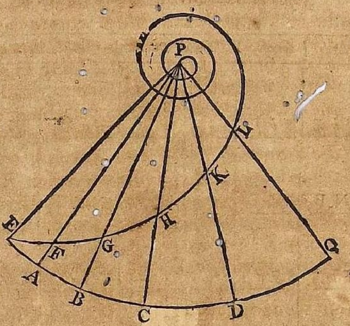
ation with reſpect to theſe middle Rumbs, and the neareſt Cardinals, as is plain from the prefixed Scheme.

17. The *Card* is put into a round *Box*, made for it, having a Pin erected in the Middle, upon which the hollow Center of the *Needle* is fix'd, so as the *Card* may lie Horizontal, and easily vibrate according to the Motion of the *Needle*; the *Box* is covered over with a smooth Glass, and is hung in a brass Hoop upon two cylindrical Pins, diametrically opposite to one another, and this Hoop is hung within another brass Circle, upon two Pins at right Angles with the former. These two Circles, and the *Box*, are placed in another square wooden *Box*, so that the innermost *Box*, and consequently the *Card*, may keep *Horizontal*, which way soever the Ship heels.

18. Since the *Meridians* do all meet at the *Poles*, and there form certain Angles with one another; and since if we move never so little towards the *East* or *West*, from one Place to another, we thereby change our *Meridian*, and in every Place the *East* and *West Line* being perpendicular to the *Meridian*; it follows, that the *East* and *West Line* in the first Place, will not coincide with the *East* and *West Line* in the second, but be inclin'd to it, at a certain Angle: and consequently all the other *Rhumb Lines* at each Place, will be inclin'd to each other, they always forming the same Angles with the *Meridian*. Hence it follows that all *Rumbs*, except the four Cardinals, must be *Curves* or *Helispherical* Lines, always tending towards the *Pole*, and approaching it by infinite Gyrations or Turnings, but never falling into it. Thus let P be the Pole, E Q an Arch of the Equator, P E, P A, &c. *Meridians*, and E F G H K L any Rumb; then because the Angles P E F, P F G, &c. are by Nature of the *Rumb-Line* equal, it is evident that it will form a Curve-Line on the Surface of the Globe, always approaching the *Pole* P, but never falling into it; for

if

for if it were possible for it to fall into the *Pole*; then it would follow, that the same Line could cut



an infinite Number of other Lines at equal Angles, in the same Point; which is absurd.

19. Because there are 32 *Rumbs* (or Points in the *Compass*) equally distant from one another, therefore the Angle contain'd between any two of them adjacent, will be 11°, 15′ *viz.* $\frac{1}{32}$ Part of 360°; and so the Angle contain'd between the *Meridian*, and the N *b* E, will be 11°, 15′, and between the *Meridian* and the N N E, will be 22°, 30′, and so of the rest, as in the following Table.

A Table of the Angles which every ¼ Point of the Compass makes with the Meridian.

North.	South.	Points.	D.	M.	North.	South.
		¼	02	49		
		½	05	37		
		¾	08	26		
N b E	S b E	1	11	15	N b W	S b W
		1 ¼	14	04		
		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	07		
		2 ¾	30	56		
N E b N	S E b S	3	33	45	N W b N	S W b S
		3 ¼	36	34		
		3 ½	39	22		
		3 ¾	42	11		
N E	S E	4	45	00	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 b W	S W b W
		5 ¼	59	04		
		5 ½	61	52		
		5 ¾	64	41		
E N E	E S E	6	67	30	W N W	W S W
		6 ¼	70	19		
		6 ½	73	07		
		6 ¾	75	56		
E b N	E b S	7	78	45	W b N	W b S
		7 ¼	81	34		
		7 ½	84	22		
		7 ¾	87	11		
East		8	90	00	West	

SECT VII.

SECT. VII.

Of Plane Sailing.

1. THIS Method of Sailing supposes the Earth to be a *Plane*, and the *Meridians* parallel to one another; and likewise the Parallels of Latitude at equal Distance from one another, as they really are upon the Globe. Tho' this Method be in it self evidently false; yet in a short Run, and especially near the *Equator*, an Account of the Ship's Way, may be kept by it tolerably well.

2. The Angle form'd by the *Meridian* and Rumb, that a Ship sails upon, is called the Ship's *Course*, Thus if a Ship sails on the N N E Rumb, then her *Course* will be 22°, 30′, and so of others.

3. The Distance betwixt two Places lying on the same Parallel counted in Miles of the *Equator*, or the Distance of one Place from the *Meridian* of another, counted as above, on the Parallel passing over that Place, is called *Meridional-Distance*; which in *Plane-Sailing*, goes under the Name of *Departure*.

4. Let A denote a certain Point on the Earth's Surface, A C its *Meridian*, and A D the Parallel of Latitude passing thro' it; and suppose a Ship to sail from A on the N N E Rumb till she arrive at B; and thro' B draw the Meridian B D (which according the Principles of *Plane-Sailing*, must be Parallel to C A) and the Parallel of Latitude B C; then the Length of A B, *viz.* how far the Ship has sail'd upon the N N E Rumb, is called her *Distance*; A C or B D will be her *Difference of Latitude*, or Northing, C B will be her *Departure*, or Easting, and the Angle C A B will be her *Course*.

Hence

Hence it is plain, that the Diſtance ſail'd, will always be greater, than either the *Difference of Latitude*, or *Departure*, it being the Hypothenuſe of a right-angled Triangle, whereof the other two are the Legs; except the Ship ſails either on a *Meridi-*

an, or a *Parallel of Latitude*; for if the Ship ſails on a *Meridian*, then it is plain, that her *Diſtance* will be juſt equal to her *Difference of Latitude*, and ſhe will have no *Departure*; but if ſhe ſail on a Parallel, then her *Diſtance* will be the ſame with her *Departure*, and ſhe will have no *Difference of Latitude*. It is evident alſo from the Scheme, that if the *Courſe* be leſs than 4 Points, or 45 Degrees, its Complement, *viz.* the other *Oblique* Angle, will be greater than 45 Degrees, and ſo the *Difference of Latitude* will be greater than the *Departure*; but if the *Courſe* be greater than 4 Points, then the *Difference of Latitude* will be leſs than the *Departure*; and laſtly, if the *Courſe* be juſt 4 Points, the *Difference of Latitude* will be equal to the *Departure*.

5. Since the Diſtance, Difference of Latitude, and Departure, form a right-angled Triangle, in which the *Oblique* Angle oppoſite to the Departure

is the Courſe, and the other its Complement; there fore having any two of theſe given, we can (by *Sect.* 2.) find the reſt; and hence ariſe the Caſes of *Plane-Sailing*, which are as follow.

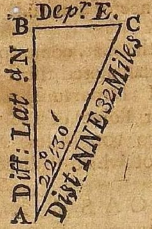
CASE 1.

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

Example.

Suppoſe a Ship ſails from the Latitude of 30°, 25′ North; NNE, 32 Miles. Requir'd the Difference of Latitude and Departure, and the Latitude come to.

The Geometrical Conſtruction of this Caſe, is the ſame as in *Caſe* 3. *of Right-Angled Trigonometry*, the



ſame Things being given in both; and from it we have the following Analogy, for finding the Departure, *viz.*

As Radius	- - - - -	10.00000
to the Diſtance A C	- 32 - - -	1.50515

so

so is the Sine of the Course A 22°, 30′. 9.58284
to the Departure BC . . . 12.25 . 1.08799
so the Ship had made 12.25 Miles of Departure Easterly, or has got so far to the Eastward of her Meridian. Then for the Difference of Latitude, or Northing, the Ship has made, we have, by *Case* 3. *of Rectangular Trigonometry*, the following Analogy, *viz.*

As Radius		10.00000
is to the Distance AC . . .	32	1.50515
so is the Co-Sine of the Course A	22°, 30′	9 96562
to the Diff. of Lat. AB . .	29.57	1.47077

so the Ship has differ'd her Latitude, or made of Northing 29.57 Minutes.

And since her former Latitude was North, and her Difference of Latitude also North. Therefore,

To the Latitude sail'd from . .	30°, 25′ N
add the Difference of Latitude . .	00 , 29.57
and the Sum is the Lat. come to .	30 , 54.57 N

By this Case is calculated the Table of Difference of Latitude, and Departure, to every Degree, Point, and quarter Point of the Compass; for the Distance from 1 to 100 Miles, at the End of this Section; the Use of which shall be there explain'd.

CASE 2.

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

Example.

Suppose a Ship in the Latitude of 45°, 25′ North, sails N b N ½ Easterly, till she come to the

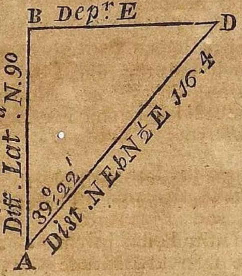
the Latitude of 46°, 55′ North. Required the Diſtance and Departure made good upon that Courſe.

Since both Latitudes are Northerly, and the Courſe alſo Northerly. Therefore,

From the Latitude come to	46°, 55′
ſubtract the Latitude ſail'd from . .	45 , 25
and there remains	01 , 30

the Difference of Latitude, equal to 90 Miles.

The Geometrical Conſtruction of this Caſe, is the ſame with that of *Caſe* 1. *of Rectangular Trigonome-*



try, and by it we have the following Analogy, for finding the Departure B D, *viz.*

As Radius . . .		10.00000
is to the Diff. of Latitude A B .	90 .	1.95424
ſo is the Tangent of Courſe A . .	39°, 22′	9.91402
to the Departure B D . . .	73.84 .	1.86828

ſo the Ship has got 73.84 Miles to the Eaſtward of her former Meridian.

Again, for the Distance A D, we have by *Case* 2. *of Rectangular Trigonometry*, the following Proportion, *viz*.

As Radius . . . . ,		10.00000
is to the Secant of the Course. .	39°, 22′	10.11176
so is the Diff. of Latitude A B .	90 . . .	1.95424
to the Distance A D. . . .	116.4 . .	2.06600

CASE 3.

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

Example.

Suppose a Ship sails from the Latitude of 56°, 50′ North, on a Rumb between South and West, 126 Miles, and she is then found by Observation to be in the Latitude of 55°, 40′ North. Required the Course she sail'd on, and her Departure from the Meridian.

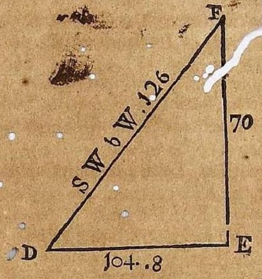
Since the Latitudes are both North, and the Ship sailing towards the *Equator*. Therefore,

From the Latitude sail'd from . .	56°, 50′
subtract the observ'd Latitude . ,	55 , 40′
and the Remainder	01 , 10

equal to 70 Miles, is the Difference of Latitude.

This

This Case is constructed the same Way as Case 5. of *Rectangular Trigonometry*, and by it we have the



following Proportion for finding the Angle of the Course F, *viz.*

As the Distance sail'd D F . . 126 . 2.10037
is to Radius 10.00000
so is the Diff. of Latitude F E . 70 . 1.84510
to the Co-Sine of the Course F . 56°, 15′ 9.74473
which, because she sails between South and West, will be South 56°, 15′ West, or S W *b* W. Then for the Departure, we have, by *Case* 3. *of Rectangular Trigonometry*, the following Proportion, *viz.*

As Radius 10.00000
is to the Distance sail'd D F . 126 . 2.10037
so is the Sine of the Course F . 56°, 15′ 9.91985
to the Departure D E . . 104.8 . . 2.02022
consequently she has made 104.8 Miles of Departure Westerly.

CASE 4.

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

Example.

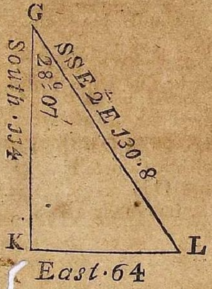
Suppoſe a Ship ſails from the Latitude of 44°, 50′ North, between South and Eaſt, till ſhe has made 64 Miles of Eaſting, and is then found by Obſervation to be in the Latitude of 42°, 56 North. Requir'd the Courſe and Diſtance made good.

Since the Latitudes are both North, and the Ship ſailing towards the *Equator*. Therefore,

From the Latitude ſail'd from . . .	44°, 50′ N
take the Latitude come to . . .	42 , 56
and there remains	01 , 54

equal to 114 Miles, the Difference of Latitude or Southing.

This Caſe is conſtructed the ſame Way, as *Caſe* 4. *of Rectangular Trigonometry*, and by it we have the



following Proportion to find the Courſe KGL, *viz.*

As

As the Diff. of Latitude GK	-	114	2.05690
is to Radius	-		10.00000
so is the Departure KL	-	64	1.80618
to the Tang. of the Course G	-	29°, 19′	9.74928

which because the Ship is sailing between South and East, will be South 29°, 19′ East, or SSE ½ East nearly.

Then for the Distance, we shall have, by *Case* 2. of *Rectangular Trigonometry*, the following Analogy, *viz.*

As Radius	-		10.00000
is to the Diff. of Latitude GK		114	2.05690
so is the Secant of the Course	-	23, 19′	10.05952
to the Distance GL	-	130.8	2.11642

consequently the Ship has sail'd on a SSE ½ East Course 130.8 Miles.

CASE 5.

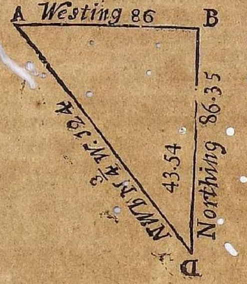
Distance and Departure given, to find the Course and Difference of Latitude.

Example.

Suppose a Ship at Sea, sails from the Latitude of 34°, 24′ North, between North and West 124 Miles, and is found to have made of Westing 86 Miles. Required the Course steer'd, and the Difference of Latitude or Northing made good.

This

This Case is constructed the same Way as *Case* 5. of *Rectangular Trigonometry*, and by it we have the



following Proportion for finding the Course A D B, *viz.*

As the Distance A D - - - 124 - - 2.09342
is to Radius - - - - 10.00000
so is the Departure A B - - 86 - - 1.93450
to the Sine of the Course D - 43°, 54′ - 9.84108
so the Ship's Course is North 43°, 54′ West, or N W *b* N ¾ West nearly.

Then for the Difference of Latitude, we have by *Case* 3. *of Rectangular Trigonometry*, the following Analogy.

As Radius - - - - - 10.00000
is to the Distance A D - - 124. - 2.09342
so is the Co-sine of the Course - 43°, 54′ 9.85726
to the Diff. of Latitude B D - 89.35 - 1.95108
which is equal to 1 Degree, and 29 Minutes nearly.

ly. Hence to find the Latitude the Ship is in, since both Latitudes are North, and the Ship sailing from the *Equator*. Therefore,

To the Latitude sail'd from - - -	32°, 24′
add the Difference of Latitude - -	3, 29
the Sum is - - -	35, 53

the Latitude the Ship is in North.

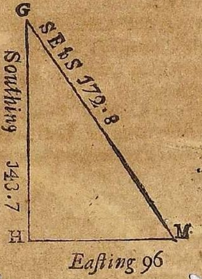
CASE 6.

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

Example.

Suppose a Ship at Sea, in the Latitude of 24°, 30′ South, sails S E *b* S, till she has made of Easting 96 Miles. Required the Distance and Difference of Latitude made good on that Course.

This Case is projected the same Way as *Case* 1. of *Rectangular Trigonometry*, and by *Case* 2. we have



the following Proportion for finding the Distance, viz.

As

As the Sine of the Courfe G	33°, 45′		9.74474
is to the Departure H M	96		1.98227
fo is Radius			10.00000
to the Diftance G M	172.8		2.23753

Then for the Difference of Latitude, we have by *Cafe* 1. of *Rectangular Trigonometry*, the following Analogy, *viz.*

As the Tang. of the Courfe	33°, 45′	9.82489
is to the Departure H M	96	1.98227
fo is Radius		10.00000
to the Diff. of Latitude G H	143.7	2.15738

equal to 2°, 24′ nearly. Confequently fince the Latitude the Ship fail'd from was South, and fhe failing ftill towards the South.

To the Latitude fail'd from	24°, 30′
add the Difference of Latitude	2 , 24
and the Sum	26 , 54

is the Latitude fhe is come to South.

6. When a Ship ftems feveral Courfes in 24 Hours, then the Reducing all thefe into one, and thereby finding the Courfe and Diftance made good upon the Whole, is commonly called the Refolving of a *Traverfe*.

7 At Sea they commonly begin each Day's Reckoning from the *Noon* of that Day, and from that Time, they fet down all the different Courfes and Diftances ftemm'd by the Ship till *Noon* the next Day upon the *Log-Board*; then from thefe feveral Courfes and Diftances had from the *Compafs* and *Log-Line*, they compute the Difference of Latitude and Departure for each Courfe (by *Cafe* 1. of *Plane-Sailing*) are fet down in a Table called *the Traverfe-Table*, which confifts of five Columns; in the firft of which are

are placed the Courſes and Diſtances, in the two, next, the Differences of Latitude belonging to theſe Courſes, according as they are North or South, and in the two laſt are placed the Departures belonging to theſe Courſes, according as they are Eaſt or Weſt. Then they ſum up all the Northings, and all the Southings; and taking the Difference of theſe they know the Difference of Latitude made good by the Ship, in the laſt 24 Hours, which will be North or South, according as the Sum of the Northings or Southings is greateſt; the ſame way by taking the Sum of all the Eaſtings, and likewiſe of all the Weſtings, and ſubtracting the leſſer of theſe from the greater, the Difference will be the Departure made good by the Ship, laſt 24 Hours, which will be Eaſt or Weſt according as the Sum of the Eaſtings is greater or leſs than the Sum of the Weſtings; then from the Difference of Latitude and Departure made good by the Ship laſt 24 Hours, found as above, they find the true Courſe and Diſtance made good upon the whole (by *Caſe* 4. *of Plane-Sailing*), as alſo the Courſe and Diſtance to the intended Port.

Example.

Suppoſe a Ship at Sea, in the Latitude of 48°, 24′ North at *Noon* any Day, is bound to a Port in the Latitude of 43°, 40′ North, whoſe Departure from the Ship is 144 Miles Eaſt; conſequently the direct Courſe and Diſtance of the Ship is S S E $\frac{1}{4}$ E 315 Miles; but by reaſon of the ſhifting of the Winds ſhe is oblig'd to ſteer the following Courſes till *Noon* next Day, *viz.* S E *b* S 56 Miles, S S E 64 Miles, N W *b* W 48 Miles, S *b* W $\frac{1}{4}$ Weſt 54 Miles, and S E *b* S $\frac{1}{2}$ E 74 Miles. Required the Courſe and Diſtance made good the laſt 24 Hours, and the Bearing

ing and Distance of the Ship from the intended Port,

The Solution of this *Traverse* depends entirely on the 1st and 4th *Cases of Plane-Sailing*; and first, we must (by *Case* 1.) find the Difference of Latitude and Departure for each Course. Thus,

1 Course S E *b* S Distance 56 Miles.
For Departure.

As Radius - - - - -		10.00000
is to the Distance - - -	56. - -	1,74819
so is the Sine of the Course - -	33°, 45′	9.74474
to the Departure - - -	31.11 - -	1.49293

For Difference of Latitude.

As Radius - - - -		10.00000
is to the Distance - -	56. - -	1.74819
so is the Co-Sine of the Course -	33°, 45′	9.91985
to the Diff. of Latitude -	46.57 -	1.66804

2. Course S S E and Distance 64 Miles.
For Departure.

As Radius - - -		10.00000
is to the Distance -	64. - -	1.80618
so is the Sine of the Course -	22°, 30′ -	9.58284
to the Departure - -	24.5 - -	1.38902

For Difference of Latitude.

As Radius - - -		10.00000
is to the Distance - - -	64. -	1.80618
so is the Co-Sine of the Course -	22°, 30	9.96562
to the Diff. of Latitude - -	59.13 -	1.77180

3. Course

3. Courſe N W *b* W and Diſtance 48 Miles,
For Departure.

As Radius		10.00000
is to the Diſtance	48.	1.68124
ſo is the Sine of the Courſe	56°, 15′	9.91985
to the Departure	39.91	1.60109

For Difference of Latitude.

As Radius		10.00000
is to the Diſtance	48	1.68124
ſo is the Co-Sine of the Courſe	56°, 15′	9.74474
to the Diff. of Latitude	26.67	1.42598

4. Courſe S *b* W $\frac{1}{2}$ Weſt and Diſtance 54 Miles.
For Departure.

As Radius		10.00000
is to the Diſtance	54	1.73239
ſo is the Sine of the Courſe	16°, 52′	9.46262
to the Departure	15.67	1.19501

For Difference of Latitude.

As Radius		10.00000
is to the Diſtance	54	1.73239
ſo is the Co-Sine of the Courſe	16°, 52′	9.98050
to the Diff. of Latitude	51.67	1.71329

5. Courſe S E *b* S $\frac{1}{2}$ Eaſt and Diſtance 74 Miles.

As Radius		10.00000
is to the Diſtance	74	1.86923
ſo is the Sine of the Courſe	39°, 22′	9.80228
to the Departure	46.94	1.67151

For

For Difference of Latitude.

As Radius		10.00000
is to the Diſtance	74.	1.86923
ſo is the Co-Sine of the Courſe	39°, 22′.	9.88824
to the Difference of Latitude	57.21	1.75747

Now theſe ſeveral Courſes and Diſtances together with the Differences of Latitude and Departures deduced from them, being ſet down in their proper Columns in the *Traverſe-Table*, will ſtand as follows.

The Traverſe Table.

Courſes.	*Diſtan.*	*Diff. of Lat.* *N.*	*Diff. of Lat.* *S.*	*Departure.* *E.*	*Departure.* *W.*
SE*b*S	56	—	46.57	31.11	—
SSE	64	—	59.13	24.5	—
NW*b*W	48	26.67	—	—	39.91
S*b*W½W	54	—	51.67	—	15.67
SE*b*S½E	74	—	57.21	46.94	—
		26.67	214.58	102.55	55.58
			26.67	55.58	
	Diff. of Lat.		187.91	46.97	*Dep.*

Hence it is plain, ſince the Sum of the Northings is 26.67, and of the Southings 214.58, the Difference between theſe, *viz.* 187.91 will be the Southing made good by the Ship, the laſt 24 Hours; alſo the Sum of the Eaſtings being 102.55, and of the Weſtings 55.58, the Difference 46.97 will be the Eaſting or Departure made good by the Ship's laſt 24 Hours; conſequently to find the true Courſe and Diſtance made good by the Ship in that Time, it will be by *Caſe* of 4. *Plane-Sailing.*

As

As the Diff. of Latitude .	. 187.91	. .	2.27393
is to Radius . .	..	. .	10.00000
ſo is the Departure . .	46.97	. . .	1.67182
to the Tang. of Courſe . .	14°, 03′.	.	9.39789

which is S *b* E ¼ Eaſt nearly. Then for the Diſtance it will be

As Radius . . .		. .	10.00000
is to the Diff. of Latitude . .	187.91	. .	2.27393
ſo is the Sec. of the Courſe .	14°, 03′	.	10.01319
to the Diſtance	193.7	. .	2.28712

conſequently the Ship has made good the laſt 24 Hours, on a S *b* E ¼ Eaſt Courſe, 193.7 Miles; and ſince the Ship is ſailing towards the Equator. Therefore,

From the Latitude ſail'd from . .	48°, 24′ N
take the the Diff. of Latitude made good	3 , 08 S
there remains	45 , 16 N

the Latitude the Ship is in North. And becauſe the Port the Ship is bound for, lies in the Latitude of 43°, 40′ North, and conſequently South of the Ship. Therefore,

From the Latitude the Ship is in . .	45°, 16′ N
take the Latitude ſhe is bound for . .	43°, 40 N
and there remains . . .	1 , 36

or 96 Miles, the Difference of Latitude or Southing the Ship has to make. Again, the whole Eaſting the Ship had to make being 144 Miles, and ſhe having already made 46.97 or 47 Miles of Eaſting; therefore the Departure or Eaſting, ſhe ſtill has to make will be 97 Miles. Conſequently to find the direct Courſe and Diſtance between the Ship and the intended Port, it will be by *Caſe* 4. of *Plane-Sailing.*

As the Diff. of the Latitude	96. . . .	8.98227
is to the Radius		10.00000
ſo is the Departure . .	97. . . .	1.98677
to the Tang. of the Courſe . .	45°, 19′	10.00450

And,

As Radius		10.00000
is to the Diff. of Latitude .	96. . . .	1.98227
ſo is the Sec. of the Courſe .	45°, 19′.	10.15293
to the Diſtance	136.5 . . .	2.13520

whence the true Bearing and Diſtance of the intended Port is S E 136.5 Miles.

8. In the following Table, computed by *Caſe* 1. *of Plane-Sailing*, for the more ready working a Traverſe, you may obſerve; that in the top-Column of each Page are placed the Courſes beginning at 1 Degree, and proceeding thro' the ſeveral Degrees, Points, and quarter Points, to 45 Degrees, the bottom-Column beginning with 45°, where the upper ends and proceeding to 90 Degrees, the Degrees in the upper and lower Columns being the Complements of one another. The two ſide-Columns in each Page contain the Diſtances, *viz.* thoſe on the left Hand contain the Diſtances from 1 to 50, and thoſe on the right-Hand Page contain the Diſtances from 50 to 100. The other intermediate Columns contain the Differences of Latitude and Departures, anſwering to the Courſes in the top and Diſtances in the ſide-Columns. The Uſe of this will be plain, from the following Example.

Example 1.

Suppoſe the Courſe to be S E *b* S ½ Eaſt, and Diſtance 48 Miles. Required the Difference of Latitude and Departure.

Firſt

First, I look in the Top-Column for $3\frac{1}{2}$ Points (because it is less than 4 Points, or 45 Degrees) and in the side-Column on the left-Hand Page (because the Distance is less than 50) for the Distance 48; then below the $3\frac{1}{2}$ Points, and on the same Line with 48, I find 37.1 for the Difference of Latitude, and 30.4 for the Departure.

Example 2.

Suppose the Course N E *b* E, and the Distance 76 Miles. Required the Difference of Latitude and Departure.

First, I look in the bottom-Column for the Course, *viz.* 5 Points (because it exceeds 4 Points or 45 Degrees) and in the side Column on the right-Hand Page (because the Distance exceeds 50) for the Distance 76; then above the Course, and on the same Line with the Distance, I find 63.2 for the Departure, and 42.2 for the Difference of Latitude.

If the given Distance exceed the Limits of the Table, *i. e.* be greater than 100, then that Distance must be divided into two or more Parts, each of which must be less or equal to 100; then find as in the preceding Examples, the Difference of Latitude and Departure for each Distance on the given Course, and the Sum of these Differences of Latitudes will be the Difference of Latitude required, also the Sum of the Departures, will be the Departure required.

Example 3.

Suppose the Course S W *b* S, and Distance 146 Miles. Required the Difference of Latitude and Departure.

First,

Firſt, I divide the given Diſtance into two, *viz.* 100 and 46; then the Differences of Latitude and Departures anſwering to theſe on a S W *b* S Courſe, found in the Table, will be as follows, *viz.*

Courſe.	*Diſt.*	*Diff. of Lat.*	*Depar.*
S W *b* S	100	83.1	55.6
——	46	38.2	25.5
——	146	121.3	81.1

The Sum of the Differences of Latitude, *viz.* 121.3 is the Difference of Latitude required, and the Sum of the Departures, *viz.* 81.1 is the Departure required.

After the ſame Manner may a Traverſe be wrought by the Table, *viz.* by finding the Difference of Latitude and Departure (from the Table) to each Courſe and Diſtance, and ſetting them down in their proper Columns in the Traverſe-Table, and then working as in the foregoing Example of a Traverſe.

Example.

Suppoſe a Ship in the Latitude of 36°, 43′ North, ſails on the following Courſes, *viz.* S E *b* S, 56 Miles, S S E 42 Miles, S *b* W 64 Miles, and N E *b* N 40 Miles. Required the Courſe and Diſtance made good upon the whole, and the Latitude the Ship has come to.

Firſt, I take from the Table, the Difference of Latitude and Departure belonging to each Courſe and Diſtance, and theſe ſet down in their proper

Columns

Columns in the *Traverse Table*, will stand as follows.

Courses.	*Distan.*	*Diff. of Lat.* N.	S.	*Departure.* E.	W.
SEbS	56	——	46.6	31.1	——
SSE	43	——	39.7	16.5	——
SbW	64	——	62.8	——	12.5
NEbN	40	33.3	——	22.2	——
		33.3	149.1	69.8	12.5
			33.3	12.5	
		Diff. of Lat.	115.8	57.3	*Dep.*

Whence it is plain, that the Difference of Latitude made good is 115.8 Miles, and the Departure is 57.3 Miles; then, for the direct Course and Distance it will be, (by *Case* 4. *of Plane Sailing.*)

As the Difference of Lat. - 115.8 - 2.09968
is to Radius - - - - - 10.00000
so is the Departure - - 57.3 - 1.75815
to the Tangent of the Course 24°. 30′ 9.65847

which, because the Ship is sailing between the South and East, will be SSE $\frac{1}{4}$ East nearly. Again, for the Distance it will be,

As Radius - - - - - 10.00000
is to the Difference of Lat. 115.8 - 2.09968
so is the Sec. of the Course 24°, 30′ - 10.04098
to the Distance - - - 138.3 - - 2.14066

And since the Ship is sailing towards the Equator, consequently diminishing her Latitude, therefore,

From the Latitude ſail'd from - -	36°, 43′ N
ſubtract the Difference of Latitude	1 , 55 Sly
and there remains - - - - - -	34 , 48 N

the Latitude the Ship has come to.

A Large

A LARGE and very USEFUL

TABLE

OF

Difference of LATITUDE and DEPARTURE, in Minutes and Tenth Parts, to every *Degree* and *Quarter-Point* of the Compass, for the Exact Working of a *Traverse*.

Dist.	1 Deg.		2 Deg.		¼ Point		3 Deg		4 Deg.		5 Deg.		Dist.
	Lat.	Dep	Lat	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	01.0	00.0	01.0	00.0	01.0	00,0	01,0	00,0	01,0	00,1	01.0	00.1	1
2	02.0	00.0	02.0	00.1	02.0	00,1	02,0	00.1	02,0	00.1	02.0	00.2	2
3	03.0	00.1	03.0	00.1	03.0	00,1	03,0	00.2	03,0	00.2	03,0	00,3	3
4	04.0	00.1	04.0	00.1	04.0	00,2	04,0	00.2	04.0	00,3	04.0	00,3	4
5	05.0	[illegible]	05.0	00.2	05.0	00,2	05,0	00.3	05,0	00,3	05.0	00.4	5
6	06.0	00.1	06.0	00.2	06.0	00.3	06,0	00.3	06,0	00.4	[illegible]	00,5	6
7	07.0	00.1	07.0	00.2	07.0	00.3	07.0	00,4	07.0	00.5	07,0	00.6	7
8	08.0	00.1	08.0	00.3	08.0	00.4	08.0	00,4	08,0	00,6	08,0	00,7	8
9	09.0	00.2	09.0	00.3	09.0	00.4	09,0	00,5	09,0	00,6	09.0	00.8	9
10	10.0	00.2	10.0	00.4	10.0	00.5	10.0	00,5	10,0	00,7	10.0	00.9	10
11	11.0	00.2	11.0	00.4	11.0	00,5	11,0	00,6	11.0	00,8	11.0	01.0	11
12	12.0	00.2	12.0	00.4	12.0	00.6	12,0	00.6	12.0	00,8	12.0	01,0	12
13	13.0	00.2	13.0	00.5	13.0	00,6	13.0	00.7	13,0	00.9	12.9	01.1	13
14	14.0	00.2	14.0	00.5	14.0	00.7	14,0	00.7	14,0	01,0	13.9	01.2	14
15	15.0	00.3	15.0	00.6	15.0	00.7	15,0	00,8	15,0	01,0	14.9	01,3	15
16	16.0	00.3	16.0	00.6	[illegible]	00.8	16,0	00,8	16.0	01.1	15,9	01.4	16
17	17.0	00.3	17.0	00.6	17.0	00.8	17.0	00.9	17.0	01,2	16,9	01.5	17
18	18.0	00.3	18.0	[illegible]	18.0	00.9	18,0	00,9	17,9	01,3	17.9	01.6	18
19	19.0	00.3	19.0	00.7	19.0	00.9	19,0	01.0	18,9	01.3	18,9	01.7	19
20	20.0	[illegible]	20.0	00.7	20,0	00,9	20,0	01,0	19,9	01,4	19.9	01.7	20
21	21.0	00.4	21.0	00.7	21.0	01,0	21,0	01,1	20,9	01,5	20.9	01.8	21
22	22.0	00.4	22.0	00.8	22.0	01,1	22.0	01.1	21.9	01.5	21,9	01.9	22
23	23.0	00.4	23.0	00.8	23.0	01,1	23,0	01,2	22,9	01,6	22.9	02,0	23
24	[illegible]	00.4	24.0	00.8	24.0	01,1	24.0	01,3	23,9	01.7	23.9	02,1	24
25	25.0	00.4	25.0	00.9	25.0	01,2	25,0	01.3	24.9	01,7	24.9	02.2	25
26	26.0	00.5	26.0	00.9	26.0	01,3	26.0	01.4	25,9	01.8	25.9	02.3	26
27	27.0	00.5	27.0	00.9	27.0	01,3	27,0	01,4	26,9	01,9	26,9	02.4	27
28	28.0	00.5	28.0	01.0	28.0	01,4	28.0	01,5	27.9	02,0	27,9	02.4	28
29	29.0	00.5	29.0	01.0	29.0	01,4	29.0	01.5	28.9	02,0	28.9	02.5	29
30	30.0	00.5	30.0	01.1	30.0	01.5	30.0	01,6	29.9	02,1	29.9	02,6	30
31	31.0	00.5	31.0	01.1	30.9	01.5	31,0	01,6	30,9	02.2	30.9	02.7	31
32	32.0	00.6	32.0	01.1	31.9	01,6	31,9	01,7	31,9	02.2	31.9	02.8	32
33	33.0	00.6	33.0	01.2	32.9	01,6	32,9	01,7	32,9	02,3	32.9	02.9	33
34	34.0	00.6	34.0	01.2	33.9	01,7	33.9	01,8	33.9	02.4	33.9	03.0	34
35	35.0	00.6	35.0	01.2	34.9	01,7	34,9	01.8	34,9	02,4	34.9	03.1	35
36	36.0	00.6	36.0	01.3	35.9	01,8	35,9	01,9	35,9	02.5	35.9	03.1	36
37	37.0	00.7	37.0	01.3	36.9	01,8	36,9	01,9	36.9	02.6	36,9	03.2	37
38	38.0	00.7	38.0	01.3	37.9	01.9	37,9	02,0	37.9	02,7	37.9	03,3	38
39	39.0	00.7	39.0	01.4	38.9	01.9	38.9	02.0	38,9	02,7	38.9	03,4	39
40	40.0	00.7	40.0	01.4	39.9	02,0	39.9	02.1	39.9	02,8	39.8	03.5	40
41	41.0	00.7	41.0	01.4	40.9	02,0	40,9	02.1	40.9	02,9	[illegible]	03.6	41
42	42.0	00.7	42.0	01.5	41.9	02.1	41,9	02,2	41.9	02.9	41,8	03.7	42
43	43.0	00.8	43.0	01.5	42.9	02,1	42.9	02,2	42,9	03,0	42,8	03.8	43
44	44.0	00.8	44.0	01.5	43.9	02.2	43.9	02,3	43,9	03,1	43.8	03.8	44
45	45.0	00.8	45.0	01.6	44.9	02,2	44,9	02.4	44,9	03,1	44.8	03.9	45
46	46.0	00.8	46.0	01.6	45.9	02,2	45,9	02,4	45,9	03.2	45,8	04.0	46
47	47.0	00.8	47.0	01.6	46.9	02,3	46.9	02.5	46,9	03,3	46,8	04,1	47
48	48.0	00.8	48.0	01.7	47.9	02.3	47.9	02,5	47.9	03.4	47.8	04.2	48
49	49.0	00.9	[illegible]	01.7	48.9	02.4	48.9	02.6	48,9	03.4	48.8	04.3	49
50	50.0	00.9	50.0	01.8	49.9	02.4	49,9	02,6	49.9	03,5	49.8	04.4	50
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	
Dist.	89 Deg.		88 Deg.		7¾ Point.		87 Deg.		86 Deg.		85 Deg.		Dist.

Dist.	1 Deg.		2 Deg.		¼ Point		3 Deg.		4 Deg		5 Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	51.0	00.9	51,0	01,8	50,9	02.5	50,9	02,7	50,9	03.6	50,8	04,4	51
52	52.0	00.9	52,0	01.8	51,9	02.5	51.9	02,7	51.9	03,6	51.8	04.5	52
53	53.0	00.9	53,0	01,8	52.9	02,6	52,9	02,8	52.9	03.7	52.8	04.6	53
54	54.0	00.9	54.0	01,9	53,9	02.6	53.9	02.8	53,9	03,8	53.8	04.7	54
55	55.0	01.0	55,0	01.9	54,9	02,7	54.9	02.9	54.9	03.8	54,8	04,8	55
56	56.0	01.0	56,0	02.0	55.9	02.7	55.9	02.9	55,9	03.9	55,8	04.9	56
57	57.0	01.0	57,0	02.0	56.9	02,8	56.9	03,0	56.8	04,0	56.8	05,0	57
58	58.0	01.0	58,0	02,0	57.9	02.8	57.9	03.0	57,8	04.1	57,8	05,1	58
59	59.0	01.0	59,0	02,1	58.9	02.9	58.9	03,1	58,8	04,1	58,8	05,2	59
60	60.0	01.0	60,0	02,1	59.9	02.9	59,9	03,1	59.8	04,2	59.8	05.2	60
61	61.0	01.1	61.0	02,1	60.9	03.0	60.9	03.2	60,8	04.3	60,8	05,3	61
62	62.0	01.1	62,0	02,2	61,9	03,0	61,9	03,3	61.8	04,3	61,8	05.4	62
63	63.0	01.1	63,0	02.2	62,9	03.1	62,9	03.3	62,8	04.4	62.8	05.5	63
64	64,0	01.1	64.0	02.3	63,9	03.1	63,9	03.4	63.8	04.5	63,8	05.6	64
65	65.0	01.1	65,0	02.3	64,9	03.2	64.9	03,4	64.8	04.5	64.7	05.7	65
66	66.0	01,1	66,0	02,3	65,9	03.3	65.9	03.5	65.8	04.6	65.7	05.8	66
67	67.0	01,2	66.9	02,3	66.9	03.3	66,9	03.5	66,8	04,7	66,7	05,9	67
68	68.0	01,2	67,9	02.4	67,9	03.3	67.9	03,5	67.8	04,8	67.7	05,9	68
69	69.0	01,2	68.9	02,4	68,9	03.4	68.9	03,6	68,8	04.8	68,7	06,0	69
70	70.0	01.2	69,9	02.4	69,9	03.4	69.9	03,7	69.8	04,9	69,7	06,1	70
71	71.0	01,2	70.9	02.5	70,9	03.5	70.9	03,7	70.8	[illegible]	70.7	06.2	71
72	72.0	01.3	71,9	02,5	71,9	03.5	71,9	03,8	71.8	05.0	71.7	06,3	72
73	73.0	01,3	72,9	02,5	72,9	03.6	72,9	03,8	72.8	05.1	72,7	06.4	73
74	74.0	01,3	73,9	02,6	73,9	03.6	73,9	03,9	73,8	05,2	73.7	06,5	74
75	75.0	01.3	74,9	02.6	74.9	03.7	74.9	03,9	74,8	05,2	74.7	06.6	75
76	76.0	01.3	75,9	02,7	75,9	03.7	75.9	04.0	75,8	05.3	75.7	06,6	76
77	77.0	01,3	76,9	02,7	76,9	03.8	76,9	04,0	76.8	05,4	76,7	06,7	77
78	78.0	01,4	77.9	02,7	77.9	03.8	77.9	04.1	77.8	05.4	77,7	06.8	78
79	79.0	01,4	78,9	02.8	78,9	03.9	78.9	04,1	78,8	05,5	78.7	06,9	79
80	80.0	01,4	79,9	02.8	79,9	03.9	79.9	04.2	79,8	05,6	79,7	07,0	80
81	81.0	01.4	80,9	02,8	80,9	04.0	80.9	04.2	80.8	05,7	80,7	07,1	81
82	82.0	01,4	81,9	02.9	81 9	04,0	81.9	04,3	81,8	05.7	81.7	07,2	82
83	83.0	01,4	82,9	02,9	82 9	04.1	82.9	04,4	82.8	05.8	82.7	07,3	83
84	84,0	01,5	83,9	02,9	83 9	04.1	83.9	04,4	83.8	05.9	83.7	07,4	84
85	85.0	01,5	849	03,0	84,9	04,2	84.9	04,5	84.8	05.9	84,7	07,4	85
86	86.0	01,5	85.9	03.0	85,9	042	85.9	04,5	86.8	06.0	85.7	07,5	86
87	87.0	01,5	86,9	03,0	86.9	04.3	86,9	04.6	86,8	06,1	86.7	07.6	87
88	88.0	01.5	87,9	03,1	87.9	04.3	87,9	04.6	87.8	06.2	87,7	07,7	88
89	89.0	01.5	88,9	03,1	88,9	04.4	88,9	04,7	88.8	06.2	88.7	07.8	89
90	90.0	01.6	89,9	03,1	89,9	04.4	89,9	04,7	89,8	06.3	89.7	07.9	90
91	91.0	01.6	90,9	03.2	90,9	04,5	90,9	04,8	90,8	06.4	90.7	08.0	91
92	92.0	01,6	91,9	03.2	91.9	04.5	91.9	04.8	91,8	06.4	91.6	08.0	92
93	93.0	01,6	92,9	03.2	92,9	04.6	92.9	04,9	92.8	06.5	92.6	08.1	93
94	94.0	01,6	93,9	03.3	93,9	04,6	93.9	04.9	93,8	06,6	93.6	08,2	94
95	95.0	01.6	94,9	03,3	94.9	04.7	94.9	05,0	94,8	06,6	94.6	08.3	95
96	96.0	01,7	95.9	03.4	95.9	04.7	95.9	05,0	95,8	06,7	95.6	08,4	96
97	97.0	01.7	96,9	03,4	96.9	04.8	96.9	05,1	96.8	06.8	96,6	08.5	97
98	98.0	01,7	97,9	03,4	97.9	04.8	97,9	05.1	97.8	06.9	97.6	08.6	98
99	99.0	01,7	98,9	03,5	98,9	04,9	98,9	05,2	98.8	06.9	98,6	08,7	99
100	100	01,7	99,9	03,5	99,9	04,9	99.9	05.2	99.8	07,0	99,6	08,7	100
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	89 Deg.		88 Deg.		7 ¾ Point		87 Deg.		86 Deg.		85 Deg.		

Dist.	½ Point Lat.	½ Point Dep.	6 Deg. Lat.	6 Deg. Dep	7 Deg. Lat.	7 Deg. Dep.	8 Deg. Lat.	8 Deg. Lat	¾ Point Lat.	¾ Point Dep.	9 Deg. Lat.	9 Deg. Dep.	Dist.
1	01,0	00,1	01,0	00.1	01,0	00.1	01,0	00.1	01,0	00,1	01,0	00,2	1
2	02,0	00.2	02,0	00,2	02,0	00,2	02.0	00.3	02.0	00,3	02,0	00,3	2
3	03,0	00,3	03,0	00.3	03,0	00.4	03,0	00.4	03.0	00,4	03,0	00.5	3
4	04.0	00.4	04,0	00.4	04,0	00.5	04.0	00.6	04,0	00.6	03,9	00,6	4
5	05.0	00,5	05,0	00.5	05,0	00,6	04,9	00,7	04,9	00,7	04.9	00,8	5
6	06,0	00,6	06,0	00,6	06.0	00,7	05,9	00,8	05.9	00,9	05,9	00,9	6
7	07.0	00,7	07,0	00,7	06,9	00,8	06,9	01,0	06.9	01,0	06,9	01,1	7
8	08,0	00.8	07,9	00,8	07.9	01,0	07,9	01,1	07.9	01,2	07,9	01,2	8
9	09.0	00,9	08,9	00,9	08,9	01,1	08,9	01,2	08,9	01,[illegible]	08,9	01.4	9
10	09,9	01.0	09,9	01.0	09.9	01.2	09,9	01,4	09,9	01.5	09.9	01.6	10
11	10.9	01.1	10,9	01.1	10.9	01,3	10.9	01.5	10,9	01,6	10,9	01.7	11
12	11,9	01,2	11,9	01.2	11,9	01.5	11 9	01,7	11,9	01,8	11,8	01,9	12
13	12.9	01.3	12,9	01,4	12,9	01,6	12,9	01,8	12.9	01,9	12,8	02,0	13
14	13,9	01,4	13,9	01,5	13,9	01.7	13,9	01.9	13.8	02.1	13.8	02,2	14
15	14,9	01,5	14,9	01,6	14.9	01,8	14,8	02,1	14.8	02,2	14,8	02,3	15
16	15,9	01,6	15,9	01.7	15.9	01.9	15.8	02,2	15,8	02,3	15.8	02,5	16
17	16,9	01.7	16.9	01,8	16,9	02,1	16.8	02.4	16,8	02,5	16,8	02,7	17
18	17.9	01,8	17,9	01,9	17.9	02,2	17,8	02,5	17.8	02,6	17.8	02.8	18
19	18.9	01.9	18,9	02,0	18,9	02,3	18.8	02,6	18,8	02,8	18,7	03.0	19
20	19,9	02,0	19,9	02.1	19.8	02,4	19.8	02,8	19.8	02,9	19,7	03.1	20
21	20,9	02,1	20.9	02,2	20.8	02,6	20,8	02.9	20,8	03.1	20.7	03.3	21
22	21.9	[illegible]	[illegible]	02.3	21,8	02,7	21,8	03,1	21.8	03,2	21,7	03.4	22
23	22,9	02.2	22,9	02,4	22.8	02,8	22,8	03,2	22.7	03.4	22,7	03,6	23
24	23,9	02.3	23,9	02.5	23.8	02,9	23,8	03.3	23.7	03,5	23,7	03,8	24
25	24,9	02.4	24,9	02.6	24,8	03.0	24,8	03,5	24.7	03,7	24,7	03,9	25
26	25.9	02,5	25,9	02,7	25.8	03,2	25,7	03,6	25.7	03.8	25,7	04.1	26
27	26.9	02.6	26,9	02,8	26.8	03,3	26.7	03.7	26.7	04,0	26.7	04,2	27
28	27.9	02.7	27.8	02,9	27,8	03.4	27.7	03,9	27.7	04,1	27,6	04.4	28
29	28,9	02,8	28,8	03,0	28,8	03,5	28,7	04,0	28.7	04.2	28.6	04.5	29
30	29,9	02,9	29,8	03,1	29,8	03.7	29.7	04,2	29.7	04,4	29.6	04,7	30
31	30.8	03.0	30,8	03,2	30,8	03.8	30,7	04.3	30,7	04.5	30,6	04.9	31
32	31,8	03.1	31.8	03.3	31,8	03,9	31,7	04,4	31.6	04.7	31,6	05,0	32
33	32,8	03.2	32,8	03,4	32,7	04,0	32,7	04.6	32,6	04.8	32.6	05.2	33
34	33.8	03.3	33.8	03.5	33,7	04,1	33.7	04.7	33,6	05,0	33.6	05,3	34
35	34,8	03.4	34.8	03,7	34,7	04,3	34,7	04,9	34,6	05.1	34,6	05,5	35
36	35,8	03,5	35.8	03,8	35,7	04,4	35,6	05,0	35,6	05,3	35.5	05.6	36
37	36,8	03,6	36,8	03.9	36,7	04,5	36,6	05,1	36,6	05,4	36,5	05,8	37
38	37.8	03,7	37,8	04,0	37,7	04.6	37,6	05.3	37,6	05,6	37.5	06,0	38
39	38.8	03.8	38,8	04.1	38,7	04,8	38,6	05.4	38,6	05,7	38,5	06,1	39
40	39,8	03,9	39,8	04,2	39,7	04,9	39.6	05,6	39,6	05.9	39,5	06.3	40
41	40.8	04,0	40,8	04,3	40.7	05,0	40.6	05.7	40,6	06.0	40,5	06.4	41
42	41,8	04.1	41,8	04.4	41,7	05.1	41,6	05.8	41.5	06.2	41,5	06,6	42
43	42.8	04.2	42,8	04,5	42,7	05,2	42.6	06,0	42.5	06.3	42.5	06.7	43
44	43,8	04.3	43.7	04,6	43,7	05,4	43,6	06,1	43.5	06,5	43,5	06.9	44
45	44,8	04,4	44.7	04.7	44,7	05.5	44.6	06.3	44,5	06,6	44,5	07.0	45
46	45,8	04,5	45,7	04.8	45,7	05,6	45.5	06,4	45,5	06,7	45.5	07,2	46
47	46,8	04.6	46,7	04.9	46.7	05,7	46.5	06,5	46,5	06.9	46,4	07,3	47
48	47.8	04,7	47.7	05.0	47,6	05.9	47,5	06,7	47,5	07,0	47.4	07,5	48
49	48,8	04.8	48,7	05,1	48.6	06.0	48.5	06,8	48.5	07,2	48,4	07,7	49
50	49.8	04,9	49,7	05.2	49.6	06.1	49,5	07.0	49,5	07,3	49,[illegible]	07.8	50
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	7½ Point		84 Deg.		83 Deg.		82 Deg.		7¼ Point.		81 Deg.		

Dist.	½ Point.		6 Deg.		7 Deg.		8 Deg.		¾ Point.		9 Deg		Dist.
	Lat.	Dep	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	50,7	05.0	50,7	05.3	50,0	06,2	50,5	07,1	50,4	07,5	50.4	08,0	51
52	51,7	05,1	51,7	05,4	51.6	06,3	51,[illegible]	07.2	51,4	07,6	51,4	08,1	52
53	52.7	05,2	52,7	05.5	5[illegible].6	06,[illegible]	52.5	07,4	5[illegible].4	07,8	52,3	08.3	53
54	53.7	05.3	53,7	05,6	53.6	06.6	53.5	07,5	53.4	07.9	53,3	08.4	54
55	54,7	05.4	54,7	05,8	54.6	06.7	54.5	07.6	54,4	08.1	54,3	08.6	55
56	55.7	05.5	55.7	05,9	55,6	06.9	55,5	07.8	55,4	08.2	55,3	08.7	56
57	56,7	05.6	56.7	06,0	56.6	07.0	56,5	07.9	56.4	08.4	56,3	08,9	57
58	57.7	05.7	57,7	06,1	57,6	07,1	57,4	08,1	57.4	08.5	57,3	09.1	58
59	58,7	05,8	5[illegible],7	06.2	58,6	07.[illegible]	58.4	08.2	58,4	08.7	58,3	09.2	59
60	59.7	05.9	59.7	06.3	59.5	07.3	59,4	08,3	59,4	08.8	59,3	09.4	60
61	60,7	06,0	60,7	06,4	60,5	07.4	60,4	08,5	60.3	08,9	60.2	09.5	61
62	61.7	06,1	61,6	06.5	61.5	07.6	61.4	08,6	61,3	09,1	61,2	09.7	62
63	62,7	06.2	62,6	06,6	62,5	07.7	62,4	08,8	6[illegible].3	09,2	62,2	09,9	63
64	63,7	06.3	63,6	06.7	63,5	07.8	63,4	08,9	63.3	09.4	63,2	10,0	64
65	64.7	06,4	64,6	06.8	64,5	07.9	64,4	09,1	64.3	09.5	64,2	10,2	65
66	65,7	06,5	65,6	06,9	65.5	08,0	65.4	09.2	65.3	09.7	65,2	10.3	66
67	66,7	06,6	66,6	07.0	66,5	08,2	66,3	0[illegible]	66,3	09,8	66,2	10.5	67
68	67.7	06,7	67,6	07,1	67,5	08,3	67,3	09,[illegible]	67,3	10,0	67,2	10.6	68
69	68,7	06,8	68,6	07,2	68,5	08.4	68,3	09,6	[illegible]8,2	10.1	68,1	10,8	69
70	69.7	06,9	69.6	07.3	69.5	08.5	69.3	09,7	69.2	10.3	69,1	10,9	70
71	70.6	07.0	70.6	07.4	70.5	08,7	70,3	09.9	70,[illegible]	[illegible]0,4	7[illegible].1	11,1	71
72	71.6	07,1	71,6	07,5	71,5	08.8	71.3	10,0	71.2	[illegible]	71,1	11,3	72
73	72,6	07,1	72,6	07,6	72.4	08.9	72,3	10,2	72.2	10.7	72,1	11.4	73
74	73,6	07.2	73,6	07.7	73,4	09.0	73.3	10,3	73,2	10.9	73,1	11,6	74
75	74,6	07,3	74,6	07.8	74.4	09.1	74.3	10.4	74,2	11,0	74,1	11.7	75
76	75.6	07,4	75,6	07,9	75,4	09.3	75,3	10,6	75,2	11.1	75.1	11.9	76
77	76,6	07,5	76,6	08,0	76,4	09.4	76,2	10,7	76,2	11.3	76.0	12,0	77
78	77,6	07,6	77.6	08,1	77,4	09,5	77,2	10,9	77,1	11.4	77,0	12,2	78
79	78,6	07,7	78,6	08,3	78.4	09,6	78,2	11,0	78,1	11.6	78.0	12,4	79
80	79,6	07.8	79.6	08,4	79.4	09.8	79,2	11,1	79,1	11.7	79.0	12,5	80
81	80.6	07.9	80.5	08,5	80,4	09.9	80.2	11.3	80.1	11,9	80.0	12,7	81
82	81,6	08,0	81.5	08,6	81.4	10.0	81,2	11,4	81.1	12,0	81,0	12,8	82
83	82,6	08,1	82,5	08,7	82.4	10.1	82,2	11.5	82.1	12,2	82,0	13,0	83
84	83.6	08,2	83.5	08,8	83.3	10,2	83.2	11.7	83.1	12,3	83,0	13.1	84
85	84,6	08.3	84.5	08,9	84,4	10,3	84,2	11,8	84.1	12,5	83.9	13.3	85
86	85,6	08.4	85.5	09.0	85,4	10,4	85.2	12.0	85.1	12,6	84,9	13,4	86
87	86,6	08,5	86.5	09,1	86.3	10.5	86,1	12.1	86.0	12,8	85,9	13.6	87
88	87,6	08,6	87.5	09.2	87,[illegible]	10,7	87.1	12,2	87.0	12.9	86.9	13.8	88
89	88,6	08,7	88,5	09.3	88.3	10.9	88.1	12.4	88,0	13.1	87,9	13.9	89
90	89.6	08,8	89.5	09,4	89.3	11,0	89.1	12,5	89,0	13,2	88,9	14,1	90
91	90,6	08.9	90,5	09.5	90,3	11.1	90.1	12,7	90.0	13,4	89.9	14,2	91
92	91.6	09.0	91,5	09.6	91,3	11.2	91.1	12.8	91.0	13.5	90,9	14,4	92
93	92,6	09.1	92,5	09.7	92.3	11.3	92.1	12.9	92,0	13.6	91,8	14,5	93
94	93.5	09,2	93,5	09.8	93.3	11.5	93,1	13.1	93.0	13.8	92,8	14,7	94
95	94.5	09,3	94,5	09,9	94.3	11,6	94,1	13,2	94,0	13.9	93.8	14,9	95
96	95.5	09.4	95.5	10,0	95.3	11.7	95.1	13,4	95.0	14.1	94,8	15,0	96
97	96,5	09.5	96,5	10.1	96,3	11.8	96.0	13.5	95.9	14,2	95,8	15,2	97
98	97,5	09.6	97.5	10,2	97,3	12.0	97,0	13.6	96,9	14.4	96,8	15.3	98
99	98.5	09.7	98.5	10,3	98.3	12.1	98.0	13.8	97.9	14.5	97,8	15,5	99
100	99.[illegible]	09.8	99.4	10,4	99,2	12,2	99.0	13.9	98.9	14.7	98,8	15,6	100
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	La	Dep.	La	Dep.	Lat.	Dep.	Lat	Dist.
	7½ *Point.*		84 Deg		83 Deg		82 Deg		7¼ *Point*		81 Deg.		

Dist.	10 Deg.		11 Deg.		1 Point		12 Deg.		13 Deg		14 Deg.		Di.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	01,0	00,1	01,0	00,2	01,0	00,2	01,0	00,2	01.0	00.3	01,0	00.2	1
2	02,0	00,3	02,0	00,4	02,0	00,4	02,0	00.4	01,9	00.4	01.9	00.5	2
3	02,9	00,5	02,9	00,6	02,9	00,6	02,9	00.6	02.9	00,7	02,9	00.7	3
4	03,9	00,7	03,9	00,8	03,9	00,8	03,9	00.8	03,9	00.8	03.9	01,0	4
5	04,9	00,8	04,9	00.9	04,9	01,0	04,9	01,0	04,9	01,0	04.8	01.2	5
6	05.9	01,0	05,9	01,1	05,9	01,2	05,9	01,3	05.3	01.3	05,8	01,4	6
7	06.9	01,2	06,9	01,3	06,8	01,4	06,8	01,5	06,8	01.6	06,8	01.7	7
8	07.9	01,4	07,8	01,5	07,8	01,6	07,8	01,7	07,8	01.8	[illegible]	01.9	8
9	08,9	01,6	08.8	[illegible]	08,8	01,8	08,8	01,9	08.8	02.0	08.7	02.2	9
10	09.8	01,7	09,8	01,9	09,8	02.0	09,8	02,1	[illegible]	02,3	09,7	02.4	10
11	10.8	01,9	10,8	02,1	10,8	02,1	10,8	02,3	10.7	02.5	10.7	02,7	11
12	11.8	02,1	11,8	02,4	11,8	02,3	11,7	02,5	11,7	02,7	11.6	02.9	12
13	12.8	02,2	12,8	02,5	12,7	02,5	12,7	02,7	12,7	02,8	12.6	03,1	13
14	13.8	02,4	13,7	02,7	13,7	02,7	13,7	02.9	13,6	03,1	13.6	03,3	14
15	14.8	02,6	14,7	02,9	14,7	02,9	14,7	03,1	14.6	03.3	14.5	03.6	15
16	15.7	02,8	15,7	03,0	15,7	03,1	15,6	03,3	15.6	03.6	15.5	03.9	16
17	16,7	02,5	16,7	03,2	[illegible]	03,3	16,6	03,5	16,6	03,8	16.5	04,1	17
18	17.7	03,1	17,7	03,4	17,7	03,6	17,6	03,7	17,5	04,0	17,5	04,4	18
19	18.7	03,3	18,6	03,6	18,6	03,7	18,6	03,9	18,5	04.2	18.4	04,6	19
20	19.7	03,5	19,6	03,8	[illegible]	03,9	19,6	04,2	19,5	04.5	19.4	04,8	20
21	20.7	03,6	[illegible]	[illegible]	20,6	04,1	20,5	04,4	20.5	04.7	20 4	05,1	21
22	21.7	03,8	21,6	04,2	21,6	04,3	21,5	04,6	21.4	04,9	21.3	05.3	22
23	22.6	04,0	22,6	04,4	22,6	04,5	22,5	04,8	22,4	05,2	22,3	05,6	23
24	23 6	04,2	23,6	04,6	23,5	04,7	23,5	05,0	23,4	05,4	23.3	05.8	24
25	24.6	04,3	24,5	04,8	24,5	04,9	24,4	05.2	24 4	05,6	24.3	06.0	25
26	25.6	04,5	25,5	05,0	25,5	05,1	25,4	05,4	25.3	05.8	25,2	06,3	26
27	26.6	04,7	26,5	05,1	26,5	05,3	26,4	05.6	26.3	06,1	26.2	06.5	27
28	27.6	04,9	27,5	05,3	27.4	05,5	27,4	05,8	27,3	06.3	27,2	06.8	28
29	28.6	05,0	28,5	05,5	28,4	05,7	28,4	06,0	28.3	06.5	28.1	07.0	29
30	29.5	05,2	29,4	05,7	29,4	05,8	29,3	6,2	29.3	06.7	29,1	07.3	30
31	30.5	05,4	30,4	06,0	30,4	06,0	30,3	06,4	30,2	07.0	30.1	07.5	31
32	31.5	05,5	31,4	06,1	31,4	06,2	31,3	06,6	31,2	07.2	31.0	07.7	32
33	32.5	05,7	32,4	06,3	32,4	06,4	32,3	06,8	32,1	07.4	32,0	08.0	33
34	33.5	05,9	33,4	06,5	33,4	06,6	33,2	07,1	33,1	07,6	33.0	08,2	34
35	34.5	06,1	34.4	06,7	34,4	06,9	34.2	07.3	34,1	07,9	34.0	08.5	35
36	35.4	06,2	35,3	06,9	35,3	07,0	35,2	07,5	35.1	08.1	34.9	08.7	36
37	36.4	06,4	36,3	07,1	36,3	07,2	36.2	07,7	36,0	08.3	35.9	09,0	37
38	37.4	06,6	37,3	07,2	37,3	07,4	37,2	07,9	37,0	08.5	36.9	09.2	38
39	38.4	06,8	38,3	07,4	38,2	07.6	38,1	08,1	38,0	08.8	37.8	09.4	39
40	39.4	06,9	39,3	07,6	39,2	07,8	39,1	08.3	39.0	09.0	38.8	09.7	40
41	40.4	07,1	40,2	07,8	40,2	08,0	40,1	08,5	39.9	09.2	39.8	09.9	41
42	41.4	07,3	41,2	08,0	41,2	08,2	41,1	08,7	40,9	09.4	40.7	10.2	42
43	42.3	07,5	42,2	08,2	42,2	08,4	42,1	08,9	41.9	09.7	41.7	10.4	43
44	43.3	07,7	43,2	08,4	43,1	08,6	43,0	09,1	42.9	09.9	42.7	10.7	44
45	44.3	07,8	44,2	08,6	44,1	08,8	44.0	09,4	43,8	10.1	43.7	11.0	45
46	45.3	08,0	45,2	08,8	45,1	09,0	45,0	09,6	44,8	10.3	44,6	11.2	46
47	46.3	08,1	46,1	09,0	46,1	09,2	46,0	09,8	45.8	10.6	45.6	11.4	47
48	47.3	08,3	47,1	09,2	47,1	09,4	47,0	10,0	46,7	10.8	46.6	11.6	48
49	48.3	08,5	48,1	09,3	48,1	09,6	48.9	10,2	47.7	11.0	47,5	11.9	49
50	49.2	08,7	49 0	09,5	49,0	09,8	49,9	10,4	48.7	11.2	48.5	12,1	50
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	80 Deg		79 Deg.		7 Point		78 Deg.		77 Deg.		76 Deg.		

Dist.	10 Deg.		11 Deg		1 Point		12 Deg		13 Deg		14 Deg		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	50.2	08,8	50,1	09,7	50,0	10,0	50.0	10.6	49.7	11.5	49.5	12,3	51
52	51.2	09.0	51,0	09.[illegible]	51,0	10,1	50,9	10.[illegible]	50.7	11,7	50,5	12,6	52
53	52.2	09,2	52,0	10.1	52.0	10.3	51,8,	11.0	51.6	11.9	51.4	12,8	53
54	53.2	09,4	53,0	10.3	53,0	10.5	52.8	11.2	52.6	12,1	52.4	13,1	54
55	54.2	09,5	54.0	10.5	53,9	10,7	53,8	11.4	53,6	12.4	53.4	13.3	55
56	55.1	09.7	55,0	10,7	54,9	10,9	54.8	11.6	54.[illegible]	12.6	54,3	13,5	56
57	56.1	09,9	56,0	10,8	55.9	11.1	55,8	11.8	55,5	12.8	55,3	13,8	57
58	57.1	10,[illegible]	56,9	11,1	56.9	11.3	56.7	12,1	56.5	13,0	56.3	14,0	58
59	58.1	10,2	57,9	11.3	57.9	11,5	57,7	12.3	57.5	13.3	57,2	14.3	59
60	59.1	10,4	58,9	1[illegible].4	58.8	11.7	58,7	12,5	58,5	13.5	58,2	14,5	60
61	60.1	10,6	59,9	11.6	59.8	11.9	59.7	12.7	59.4	13,7	59.2	14,8	61
62	61.1	10.8	60,9	11.8	60.8	12,1	6[illegible],6	12.[illegible]	60,4	13.9	60,2	15,0	62
63	62.0	10.9	61.8	12.0	61,8	12,3	61.6	13.1	61.4	14.2	61,1	15.2	63
64	63.0	11.1	62,8	12.2	62,8	12,5	62,6	13,3	62.4	14,4	62.1	15,5	64
65	64,0	11,3	63,8	12,4	63,7	12.7	63.6	13.5	63.3	14,6	63,1	15,7	65
66	65.0	11.5	64.8	12.6	64,7	12.9	64.5	13.7	64,3	14,8	64,0	16.0	66
67	66.0	11.6	65,8	12.8	65,7	13,1	65.5	1[illegible].9	65.3	14.1	65.0	16,2	67
68	67.0	11,8	66.7	13.0	66,7	13.3	66,5	14.[illegible]	66.2	15.3	66,0	16.4	68
69	68.0	12.0	67,7	13.2	67,7	13,5	67.5	14.3	67.2	15.5	66,9	16,7	69
70	68.9	12,2	68.7	13.4	68,7	13.7	68,5	14.[illegible]	68.2	15,7	67.0	16,9	70
71	69.9	12,3	69,7	13.5	69,6	13,9	69.4	14.8	69,[illegible]	[illegible]	[illegible]8,9	17.2	71
72	70.9	12.5	70.7	13.7	70,6	14,0	70.4	15,0	70.1	16,2	69,9	17.4	72
73	71.9	12.7	71,7	13.9	71,6	14,2	71.4	15.2	71,1	16,4	70.8	17.6	73
74	72.9	12.8	72,6	14,1	72,6	14,4	72.4	15.4	72.1	16.6	71.8	17,9	74
75	73.9	13.0	73,6	14.3	73,6	14,6	73.4	15.6	73.1	16.9	72,8	18,1	75
76	74.8	13.2	74,6	14,5	74.5	14,8	74,3	15.8	74,0	17.1	73.7	18,4	76
77	75.8	13.4	75,6	14.7	75,5	15,0	75,3	16.0	75.0	17,3	74.7	18,6	77
78	76.8	13.5	76,6	14.9	76,5	15.2	76.3	16.2	76,0	17.5	75.7	18,8	78
79	77.8	13,7	77.5	15.1	77.5	15.4	77.3	16.4	77,0	17.8	76,7	19,1	79
80	78.8	13.9	78,5	15,3	78,5	15.6	78,2	16.6	77.9	18,0	77,6	19.3	80
81	79.8	14.1	79,5	15,5	79,4	15.8	79,2	16.8	78.9	18.2	78.6	19.4	81
82	80.8	14.2	80,5	15.6	80,4	16,0	80.2	17,0	79.9	18,4	79,6	19.8	82
83	81.7	14,4	81,5	15,8	81,4	16.2	81,2	17 2	80.9	18,7	80,4	20,1	83
84	82.7	14.6	82,5	16,0	82,4	16.4	82.2	17,5	81,8	18,9	81.5	20.3	84
85	83.7	14.8	83,4	16.2	83,4	16.6	83.1	17.7	82,8	19,1	82.5	20,6	85
86	84,7	14,9	84,4	16.4	84,3	16,8	84.1	17.9	83.8	19,3	83.4	20.8	86
87	85.7	15,1	85.4	16,6	85,3	17,0	85,1	18,1	84,8	19,[illegible]	84,4	21,0	87
88	86.7	15.3	86,4	16,8	86.3	17,2	86,1	18,3	85,7	19,8	85.4	21.3	88
89	87.6	15.4	87,4	17,0	87.3	17.4	87.1	18,5	86,7	20,0	86.4	21.5	89
90	88.6	15,6	88,3	17,2	88,3	17,6	88.0	18.7	87,7	20.2	87,3	21.8	90
91	89.6	15.8	89,3	17,4	89,2	17.7	89,0	18.9	88.7	20,5	88.3	22.0	91
92	90.6	16.0	90,3	17.6	90,2	17,9	90,0	19,1	89.6	20.7	89.3	22,3	92
93	91.6	16,1	91,3	17,7	91.2	18.1	91,0	19.3	90,6	20,9	90.2	22,5	93
94	92.6	16.3	92,3	17,9	92,2	18.3	92.0	19.5	91,6	21,1	91.2	22.7	94
95	93.5	16.5	93,3	18,1	93,2	18.5	92.9	19,7	92,6	21,4	92.2	23.0	95
96	94.5	16.7	94,2	18,3	94.2	18,7	93,9	20.0	93,5	21.6	93.1	23.2	96
97	95.5	16.8	95.2	18,5	95.1	18,9	94,9	20,2	94.5	21,8	94.1	23.5	97
98	96.5	17.0	96,2	18.7	96.1	19,1	95,9	20.4	95.5	22.0	95.1	23,7	98
99	97.5	17.2	97,2	18,9	97.1	19,3	96.8	20,6	96.5	22.3	96,1	23.9	99
100	98.5	17.4	98,2	19,1	98,1	19,5	97.8	20,8	97,4	22,5	97.0	24.2	100
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	80 Deg		79 Deg.		7 Point.		78 Deg.		77 Deg.		76 Deg.		

Dist.	1¼ Point		15 Deg.		16 Deg.		1½ Point		17 Deg.		18 Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	01,0	00,2	01,0	00.3	01.0	00.3	01,0	00.3	01.0	00.3	00,9	00.3	1
2	01,9	00,5	01.9	00,5	01,9	00.5	01,9	00,6	01,9	00.6	01,9	00.6	2
3	02,9	00.7	02,9	00.8	02.9	00.8	02.9	00,9	02.9	00.9	02.8	00.9	3
4	03.9	01,0	03,9	01.0	03,9	01.1	03,8	01,2	03.8	01,1	03,8	01.2	4
5	04.8	01.2	04,8	01.3	04.8	01.3	04,8	01.5	04.8	01,5	04.8	01.5	5
6	05,8	01.5	05.8	01,5	05.8	01.6	05,8	01.7	05.7	01,7	05,7	01.8	6
7	06,8	01,7	06.8	01.8	06.8	01.9	06,8	02,0	06,7	02,0	06.7	02.2	7
8	07.8	01.9	07,7	02,1	07,7	02.2	07,7	02,3	07.6	02,3	07,6	02.5	8
9	08,7	02.2	08,7	02.3	08.6	02.5	08.6	02.6	08,6	02,6	08.6	02.8	9
10	09.7	02.4	09,7	02,6	09.6	02.8	09.6	02.9	09,6	02,9	09.5	03.1	10
11	10.7	02.6	10,6	02,8	10.6	03.0	10,5	03.2	10,5	03.2	10,5	03.4	11
12	11,6	02,9	11,6	03.1	11.5	03.3	11,5	03,5	11.5	03.5	11.4	03,7	12
13	12,6	03,2	12.6	03.4	12.5	03.6	12,4	03.8	12,4	03.8	12,4	04.0	13
14	13.6	03,4	13.5	03.6	13.5	03.9	13,4	04,1	13,4	04.1	13,3	04.3	14
15	14.5	03,6	14.5	03,9	14.4	04.1	14,4	04,4	14,3	04,4	14,5	04.6	15
16	15,5	04,0	15,5	04,1	15,4	04.4	15,3	04,6	15.3	04,7	15.2	04.9	16
17	16,5	04,1	16,4	04,4	16,3	04.7	16.3	04.9	16,3	05.0	16,2	05.2	17
18	17.5	04,4	17,4	04.7	17,3	05.0	17,2	05.2	17,2	05.3	17.1	05.6	18
19	18.4	04.6	18,4	04.9	18,3	05.2	18,2	05.5	18,2	05,5	18.1	05.9	19
20	19,4	04.9	19,3	05.2	19,2	05.5	19,1	05.8	19,1	05.8	19.0	06.2	20
21	20,4	05.1	20,3	05,4	20,2	05.8	20.1	06.1	20.1	06,1	20.0	06,5	21
22	21.3	05,4	21,2	05.7	21.1	06.1	21.0	06.4	21.1	06,4	20.9	06.8	22
23	22,3	05,6	22.2	06,0	22,1	06.3	22,0	06.7	22.0	06.7	21,9	07.1	23
24	23,3	05.8	23.2	06,2	23.1	06.6	23,0	06.8	22.9	07,0	22,8	07.4	24
25	24,2	06.0	24.1	06,5	24,0	06.9	23.9	07,3	23.9	07.3	23.8	07.7	25
26	25.2	06.3	25,1	06.7	24,9	07.2	24,9	07.5	24.9	07.6	24.7	08.0	26
27	26.2	06.6	26,1	07.0	25,9	07.4	25,8	07.8	25.8	07,9	25.7	08.3	27
28	27.2	06.8	27.0	07.2	26,9	07.7	26,8	08,1	26.8	08.2	26.6	08.6	28
29	28,1	07.0	28,0	07.5	27,8	08.0	27.8	08,4	27.7	08.5	27.6	09.0	29
30	29,1	07,3	29.0	07.8	28.8	08.3	28.7	08.7	28.7	08,8	28.5	09.3	30
31	30.1	07,5	29.9	08,0	29,8	08.5	29,7	09.0	29,6	09.1	29.5	09.6	31
32	31,0	07,9	30.9	08.3	30,7	08.8	30,6	09.3	30,6	09,3	30.4	10.0	32
33	32,0	08.0	31,9	08.5	31,7	09.1	31.6	09,6	31.6	09.6	31.4	10.2	33
34	33.0	08,3	32.8	08.8	32,7	09.4	32,5	09,9	32.5	09,9	32.3	10.5	34
35	33.9	08.5	33.8	09,0	33.6	09.6	33.5	10.2	33,5	10.2	33.3	10.8	35
36	34,9	08,7	34.8	09,3	34,6	09.9	34.4	10.4	34.4	10.5	34.2	11.1	36
37	35,9	09.0	35,7	09,6	35.6	10,2	35.4	10.7	35.4	10,8	35.2	11.4	37
38	36,9	09.2	36,7	09,8	36,5	10.5	36,4	11.0	36,3	11.1	36,1	11.7	38
39	37.8	09.5	37,7	10.1	37.5	10.7	37,3	11,3	37,3	11,4	37,1	12,0	39
40	38.8	09.7	38.6	10.3	38.4	11,0	38,3	11.6	38,2	11,7	38.0	12.4	40
41	39,8	10,0	39,6	10,6	39.4	11.3	39,2	11.9	39.2	12.0	39.0	12.7	41
42	40.7	10.2	40.6	10,9	40.4	11.6	40,2	12.2	40.2	12.3	39.9	13.0	42
43	41,7	10,4	41,5	11,1	41.3	11,8	41,1	12.5	41.1	12.6	40.9	13.3	43
44	42.7	10.7	42,5	11,5	42,3	12.1	42,1	12.8	42.1	12,9	41.8	13.6	44
45	43,6	10.9	43,5	11.7	43.3	12.4	43.1	13.1	43.0	13,1	42.8	13.9	45
46	44,6	11,2	44,4	11.9	44,2	12.7	44.0	13.3	44.0	13.4	43.7	14.2	46
47	45,6	11,4	45.4	12.2	45,2	12.9	45,0	13.6	44,9	13.7	44,7	14.5	47
48	46,5	11,7	46,4	12,4	46,1	13,3	45.9	13.9	45.9	14.0	45.6	14.8	48
49	47.5	11.8	47,3	12.7	47,1	13.5	46,9	14.2	46.9	14.3	46.6	15.1	49
50	48,5	12,1	48,3	12.9	48,1	13.8	47.8	14.5	47.8	14,6	47.5	[illegible]	50
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	6¾ Point		75 Deg.		74 Deg.		6½ Point		73 Deg.		72 Deg.		

Dist.	1¼ Point		15 Deg.		16 Deg.		1½ Point.		17 Deg.		18 Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	49.5	12.4	49.3	13.2	49.0	14.0	48.8	14.8	48.8	14.9	48.5	15.8	51
52	50.4	12.6	50.2	13.5	49.9	14.3	49.7	15.[illegible]	49.7	15.2	49.4	16.1	52
53	51.4	12.9	51.2	13.7	50.9	14.6	50.7	15.4	50.7	15.5	50.4	16.4	53
54	52.4	13.1	52.2	14.0	51.9	14.9	51.7	15.7	51.6	15.8	51.3	16.7	54
55	53.3	13.4	53.1	14.2	52.9	15.2	52.6	16.0	52.6	16.1	52.3	17.0	55
56	54.3	13.6	54.1	14.5	53.8	15.4	53.6	16.2	53.[illegible]	16.4	53.3	17.3	56
57	55.3	13.8	55.1	14.8	54.8	15.7	54.5	16.5	54.5	16.7	54.2	17.6	57
58	56.3	14.[illegible]	56.1	15.0	55.7	16.0	55.5	16.8	55.5	17.0	55.2	17.9	58
59	57.3	14.3	57.0	15.3	56.3	16.3	56.5	17.1	56.5	17.2	56.1	18.2	59
60	58.2	14.6	58.0	15.5	57.7	16.5	57.4	17.4	57.4	17.5	57.1	18.5	60
61	59.2	14.8	58.9	15.8	58.6	16.8	58.4	17.7	58.4	17.8	58.0	18.8	61
62	60.1	15.1	59.9	16.1	59.6	17.1	59.3	18.[illegible]	59.3	18.1	59.0	19.2	62
63	61.1	15.3	60.8	16.3	60.5	17.4	60.3	18.3	60.2	18.4	59.9	19.5	63
64	62.1	15.5	61.8	16.6	61.5	17.6	61.2	18.6	61.2	18.7	60.9	19.8	64
65	63.0	15.8	62.8	16.8	62.5	17.9	62.2	18.9	62.2	19.0	61.8	20.1	65
66	64.0	16.0	63.7	17.1	63.4	18.2	63.2	19.2	63.1	19.3	62.8	20.4	66
67	65.0	16.3	64.7	17.4	64.4	18.5	64.1	[illegible].4	64.1	19.6	63.7	20.7	67
68	66.0	16.5	65.7	17.6	65.4	18.7	65.1	19.7	65.1	19.9	64.[illegible]	21.0	68
69	66.9	16.8	66.6	17.9	66.3	19.0	66.0	20.0	66.0	20.2	65.6	21.3	69
70	67.9	17.0	67.6	18.1	67.3	19.3	67.0	20.3	66.9	20.5	66.6	21.6	70
71	68.9	17.2	68.6	18.3	68.[illegible]	19.6	67.9	20.6	67.9	20.8	67.5	21.9	71
72	69.8	17.5	69.5	18.6	69.2	19.8	68.9	20.9	68.8	21.0	68.5	22.2	72
73	70.8	17.7	70.5	18.9	70.2	20.1	69.8	21.2	69.8	21.3	69.4	22.6	73
74	71.8	18.0	71.5	19.1	71.1	20.4	70.8	21.5	70.8	21.6	70.4	22.9	74
75	72.7	18.2	72.4	19.4	72.1	20.7	71.8	21.8	71.7	21.9	71.3	23.2	75
76	73.7	18.5	73.4	19.7	73.0	20.9	72.7	22.1	72.7	22.1	72.3	23.5	76
77	74.7	18.7	74.4	19.9	74.0	21.2	73.7	22.3	73.6	22.4	73.2	23.8	77
78	75.7	18.9	75.3	20.2	75.0	21.5	74.6	22.6	74.6	22.8	74.2	24.1	78
79	76.6	19.2	76.3	20.4	75.9	21.8	75.6	22.9	75.5	23.1	75.1	24.4	79
80	77.6	19.4	77.3	20.7	76.9	22.0	76.6	2[illegible].2	76.5	23.4	76.1	24.7	80
81	78.6	19.7	78.2	21.0	77.9	22.3	77.5	23.[illegible]	77.5	23.7	77.0	25.0	81
82	79.5	19.9	79.2	21.2	78.8	22.6	78.4	23.8	78.4	24.0	78.0	25.3	82
83	80.5	20.3	80.2	21.5	79.8	22.5	79.4	24.1	79.4	24.3	78.9	25.6	83
84	81.5	20.4	81.1	21.7	80.8	23.1	80.3	24.4	80.3	24.5	79.9	26.0	84
85	82.4	20.7	82.1	22.0	81.7	23.3	81.4	24.[illegible]	81.3	24.8	80.8	26.3	85
86	83.4	20.9	83.1	22.[illegible]	82.7	23.7	82.3	25.0	82.2	25.1	81.8	26.6	86
87	84.4	21.4	84.0	22.5	83.6	24.0	83.3	25.2	83.2	25.4	82.7	26.9	87
88	85.4	21.6	85.0	22.8	84.6	24.2	84.2	25.5	84.1	25.6	83.7	27.2	88
89	86.3	21.8	86.0	23.0	85.6	24.5	85.2	25.8	85.1	26.0	84.6	27.5	89
90	87.3	21.9	86.[illegible]	23.3	86.5	24.8	86.1	26.1	86.1	26.3	85.6	27.8	90
91	88.3	22.1	87.[illegible]	[illegible]3.5	87.5	25.1	87.1	26.4	87.0	26.6	86.5	28.1	91
92	89.[illegible]	22.4	88.[illegible]	23.8	88.4	25.3	88.5	26.7	88.0	26.9	87.5	28.4	92
93	90.2	22.6	89.8	24.1	89.4	25.5	89.0	27.0	88.9	27.2	88.4	28.7	93
94	91.2	22.8	90.8	24.3	90.4	25.9	90.0	27.3	89.9	27.5	89.4	29.0	94
95	92.1	23.1	91.8	24.6	91.2	26.2	90.9	27.6	90.8	27.8	90.3	29.3	95
96	93.1	23.3	92.7	24.8	92.3	26.4	91.9	27.9	91.8	28.1	91.3	29.7	96
97	94.1	23.6	93.7	25.1	93.2	26.7	92.8	28.2	92.8	28.4	92.3	30.0	97
98	95.1	23.8	94.7	25.4	94.2	27.0	93.8	28.4	93.7	28.6	93.2	30.3	98
99	96.0	24.1	95.6	25.6	95.2	27.3	94.7	28.7	94.7	28.9	94.2	30.6	99
100	97.0	24.[illegible]	96.6	25.9	96.1	27.6	95.7	29.0	95.[illegible]	[illegible]9.2	95.1	30.9	100
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	6¾ Point.		75 Deg.		74 Deg.		6½ Point.		73 Deg.		72 Deg.		

Dist.	19 Deg.		1¾ Point		20 Deg.		21 Deg.		22 Deg.		2 Points		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	00.9	00,3	00,9	00,3	00.9	00,3	00.9	00.4	00,9	00,4	00.9	00,4	1
2	01.9	00,6	01.9	00,7	01,9	00.7	01,9	00.7	01,8	00,7	01,8	00,8	2
3	02,8	01.0	02,8	01.0	02.8	01.0	02,8	01.0	02,8	01.1	02.8	01.1	3
4	03,8	01,3	03,8	01,3	03,8	01.4	03.7	01.4	03.7	01,5	03.7	01.5	4
5	04,7	01.6	04,7	01,7	04,7	01.7	04,7	01,8	04,6	01.9	04.6	01.9	5
6	05,7	01.9	05,6	02,0	05,6	02,0	05,6	02.1	05.6	02.2	05.5	02,3	6
7	06,6	02.3	06.6	02,4	06.6	02,4	06.5	02,5	06,5	02,6	06,5	02.7	7
8	07,6	02.6	07,5	02.7	07,5	02.7	07,5	02.9	07,4	03.0	07,4	03,1	8
9	08.5	02.9	08.5	[illegible]	08,5	03,1	08.4	03.2	08,3	03.4	08,3	03.4	9
10	09.5	03,3	09.4	03.4	09,4	03.4	09,3	03.6	[illegible]	03,7	09,2	03.8	10
11	10.4	03.6	10.4	03.7	10,3	03.8	10,3	03.9	10,2	04.1	10.2	04,2	11
12	11,3	03.9	11.3	04.0	11,3	[illegible]	11.2	04.3	11,1	04.5	11,1	04,6	12
13	12.3	04.2	12.2	04,4	12.2	04,4	12,1	04,7	12,0	[illegible]	[illegible]	05,0	13
14	13.2	04,6	13,2	04.7	13.2	04.8	13.1	05.0	13,0	05.2	12.9	05.4	14
15	14,2	04,9	14.1	05.1	14 1	05.1	14,0	05,4	13,9	05.6	13.9	05,7	15
16	15.1	05.2	15,1	[illegible]	15.0	05.4	14.9	05,7	14.8	06,0	14,8	06,1	16
17	16.1	05,6	16,0	05,7	16,0	[illegible]	15.9	06.1	15,8	06,4	15,7	06.5	17
18	17,0	05,9	16,9	06,1	16.9	06.3	16.8	06,4	16.7	06.7	16,6	06,8	18
19	18,0	06,1	17.9	06.4	17.9	06,5	17,7	06,8	17.6	07.1	17.6	07,3	19
20	18.9	06,5	18.9	06.7	[illegible]	06.8	18,7	07,2	18,5	07,5	18.5	07,6	20
21	19.9	06,8	[illegible]	[illegible]	19.7	07,2	19.6	07.5	19.5	07.9	19,4	08 0	21
22	20.8	07.2	20,7	07,4	20,7	07.5	20,5	07.9	20,4	08,2	20.3	08,4	22
23	21,7	07.5	21,7	07.7	21,6	07.9	21,5	08,2	21,3	08.6	21,2	08.8	23
24	22,7	07,8	22.6	08,1	22.5	08.2	22,4	08.6	22.2	09,0	22,2	09,2	24
25	23.6	08,1	23,5	08.4	23,5	08.5	23.3	09,0	23.2	09,4	23,1	09.6	25
26	24.6	08.5	24.5	08,8	24,4	08,9	24.3	09.3	24,1	09.7	24,0	09,9	26
27	25,5	08,8	25,4	09.1	25,4	09.2	25,2	09.7	25,0	10.1	24,9	10.3	27
28	26.5	09,1	26,4	09.4	26,2	09,6	26.1	10.0	26.0	10.5	25.9	10,7	28
29	27.4	09.4	27,3	09.8	27.3	09,9	27.1	10,4	26,9	10.9	26.8	11,1	29
30	28,4	09,8	28.2	10,1	28,2	10,3	28.0	10,7	27,8	11,2	27,7	11.5	30
31	29,3	10,1	29.2	10.4	29,1	10.6	28,9	11.1	28.7	11.6	28,6	11,9	31
32	30.3	10.4	30.1	10,8	30,1	10.9	29,9	11,5	29.7	12.0	29.6	12,2	32
33	31,2	10,7	31,1	11.1	31.1	11,3	30.8	11,8	30,6	12,4	30,5	12,6	33
34	32,1	11,1	32,0	[illegible]	31.9	11,6	31,7	12.2	31.5	12.7	31,4	13,0	34
35	33.1	11,4	33,0	11,8	32.9	12,0	[illegible]	12.5	[illegible]	13.1	32,3	13.4	35
36	34,0	11.7	33,9	12.1	33.8	12,3	33.6	12.9	33,4	13.5	33,3	13.8	36
37	35.0	12.1	34,8	12.5	34,8	12,6	34.5	13.3	34.3	13.9	34,2	14.2	37
38	35,9	12,4	35,8	12,8	35.7	13.0	35,5	13,6	35.2	14.2	35,1	14.5	38
39	36,9	12.8	36,7	13,1	36.6	13,3	36,4	14,0	36,2	14,6	36,0	14,9	39
40	37,8	13.0	37.7	13,5	37,6	13,7	37,3	14.3	37,1	15,0	36.9	15,3	40
41	38,8	13,3	38,6	13.8	38.5	14.0	38,3	14,7	38.0	15.3	37.9	15,7	41
42	39.7	13,7	39,5	14,1	39,5	14,4	39.2	15,1	38,9	15.7	38.8	16.1	42
43	40.7	14,0	40,5	14,5	40.4	14,7	40.1	15.4	39,9	16.1	39,7	16,5	43
44	41.7	14,3	41.4	14.8	41,3	[illegible]	41.1	15,8	40,8	16.5	40.6	16,8	44
45	42,6	14.6	42.4	15.2	42.3	15,5	42.0	16.1	41,7	16.8	41.6	17.2	45
46	[illegible]	15.0	43,3	15,5	43,3	15.7	42.9	16.5	42.6	17,2	42,5	17,6	46
47	44,4	15,3	44,2	15,8	44,2	16.1	43,9	16.8	43.6	17,5	[illegible]	[illegible]	47
48	45.4	15,6	45,2	16.2	45.1	16,4	44.8	17,2	44,5	[illegible]	44,3	[illegible]	48
49	46.3	15,9	46.1	16.5	46,0	16.8	45,7	17.6	45,4	18.3	45,3	18,7	49
50	47.3	16.3	47,1	16.8	47,0	17,1	46,7	17,9	[illegible]	[illegible]	[illegible]	19,1	50
	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	
Dist.	71 Deg.		6¼ Point		70 Deg.		69 Deg.		68 Deg.		6 Points		Dist.

Diff.	19 Deg		1¾ Point		20 Deg.		21 Deg.		22 Deg.		2 Points.		Diff.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	48,2	16,6	48,0	17.2	47,9	17,4	47,6	18,3	47.3	19,1	47,1	19.5	51
52	49,2	16,9	49,0	17,5	48,9	17,8	48,5	[illegible]	48,2	19,4	48,0	19,9	52
53	50.1	17,3	49,9	17.9	49.8	18,1	49,5	19,0	49.1	19,8	49,0	20.3	53
54	51.1	17,6	50.8	18.2	50,7	18,5	50,4	19,3	50.1	20.2	49,9	20,7	54
55	52.0	17,9	51.8	18,5	51,7	18,8	51,3	19,7	51.0	20.6	[illegible]	21,0	55
56	52,9	18.2	52,7	[illegible]	52.6	19.7	52,3	20,1	51,9	21,0	51.7	21,4	56
57	53,0	18.6	53,7	19,2	53.6	19,5	53.2	20,4	52,8	21,3	52.7	21,8	57
58	54,8	18.9	54.6	19,5	54,5	19,8	54.1	20.8	53,8	21,7	53.6	22,2	58
59	55.7	19.2	55,5	19.9	55,4	20,2	55.1	21,1	54,7	22,1	54.5	22,6	59
60	56.7	19.5	56,5	20,2	56,4	20.5	56,1	21,5	55.6	22,5	55,4	23.0	60
61	57,7	19.9	57,4	20,5	57,3	20.9	56.9	21,9	56.5	22.8	56.3	23,3	61
62	[illegible]	20,2	58.4	20,9	58.3	21,0	57,9	[illegible]	57.5	23,2	57.3	23.7	62
63	59.6	20,5	59,3	21,2	59.2	21,5	58,8	22,6	58,4	23.6	58,2	24,1	63
64	60,5	20,8	60,3	21,6	60,1	21,9	59,7	22.9	59,3	24,0	59.1	24,5	64
65	61.5	21,2	61,2	21 9	61,1	22,2	60.7	23,3	60.3	24,3	60,0	24,9	65
66	62,4	21,5	62.1	22.2	62,0	22,6	61,6	23.6	61,2	24,7	61,0	25,3	66
67	63,3	21,8	63.1	22.6	63,0	22,9	62.5	24,0	62,1	25,1	61,9	25,6	67
68	64,3	22,1	64,0	22,9	63,9	23,3	63,5	24,4	63,0	25,5	62,8	26,0	68
69	65,2	22 5	65,0	23,2	64,8	23.6	64,4	24,7	64.0	25,8	63.7	26,4	69
70	66.2	22.8	65,9	23.6	65.8	23,9	65.3	25.1	64,9	26.2	64,7	26.8	70
71	67.1	23.1	66.8	23,9	66,7	[illegible]	66,3	25.4	65.8	26.6	65,6	27.2	71
72	68,1	23.4	67,8	24.2	67,7	24,6	67.2	25,8	66,7	27.0	66,5	27.6	72
73	69,0	23,8	68,7	24.6	68,6	25,0	68.1	26,2	67.7	27,3	67,4	27.9	73
74	70,0	24,1	69,7	24.9	69,5	25,3	69,1	26,5	68,6	27,7	68,4	28,3	74
75	70,9	24.4	70,6	25 3	70,5	25,6	70,0	26,9	69.5	28,1	69.3	28,7	75
76	71.9	24.7	71,6	25,6	71,4	26,0	70,9	27,2	70,5	28,5	70.2	29,1	76
77	72,8	25.1	72,5	25,9	72,4	26.3	71,9	27.6	71.4	28.8	71,1	29.5	77
78	73,7	25,4	73,4	26,3	73,3	26,7	72.8	27,9	72.3	29.2	72.1	29,8	78
79	74,7	25.7	74,4	26,6	74,2	27,0	73.7	28.3	73.2	29,6	73,0	30.2	79
80	75,6	26,0	75.2	26.9	75.2	[illegible]	[illegible]	28,7	74,2	30,0	73.9	30,6	80
81	76,6	26,4	76,3	27,3	76.1	27,7	75,0	29.0	75,1	30.3	74,8	31,0	81
82	77,5	26,7	77,2	27,6	77,1	28,0	76,5	29,4	76,0	30.7	75,8	31,4	82
83	78,5	27,0	78,1	28,0	78,0	28,4	77,5	29,7	76,9	31,1	76,7	31.8	83
84	79,4	27.3	79,1	28,3	78,9	28,7	78.4	30,1	77,9	31,5	77.6	32,1	84
85	80,4	27,7	80.1	28.6	79,9	29,1	79,3	30,5	78,8	31,8	78.6	32,5	85
86	81,3	28,0	81,0	29,0	80,8	29,4	80.3	30.8	79,7	32.2	79,4	32.9	86
87	82.3	28 3	81,9	29,3	81.8	29,7	81,2	31,2	80,7	32.6	80.4	33,3	87
88	83,2	28,6	82,8	29,6	82,7	30.1	82.1	31,5	81.6	33,0	81,3	33,7	88
89	84,1	29,0	83.8	30,0	83.6	30,4	83.1	31,9	82,5	33,3	82.2	34,1	89
90	85.1	29,3	84,7	30.3	84.6	30,8	84.0	32,3	83,4	33,7	83.1	34,4	90
91	86.0	29,6	85.7	30,7	85,5	31.1	84.9	32,6	84.4	34,1	84.1	34.8	91
92	87.0	29.9	86,6	31,0	86.4	31.5	85,9	33.0	85.3	34.5	85,0	35,2	92
93	88.0	30,3	87,6	31.3	87,4	31,8	86.8	33,3	86.2	34.8	85.9	35,6	93
94	88.9	30,6	88,5	31,7	88.3	32,1	87,7	33,7	87,2	35.2	86.8	36,0	94
95	89.8	30.9	89.4	[illegible]	89,3	32.5	88,7	34 0	88.1	35.6	87,8	36,3	95
96	90,8	31,3	90,4	[illegible]	[illegible]	32.9	89,6	34,4	89.0	35.9	88.7	[illegible]	96
97	91.7	31,6	[illegible]	32.7	91.1	33.2	90.5	34.8	89.9	36,3	89.6	37,1	97
98	92,7	31,9	92,3	33,0	92,1	33,5	91,5	35.1	90,9	36,7	90.5	37,5	98
99	93,6	32,2	93 2	[illegible]	93,0	33,9	92,4	35.5	91,8	37.1	91.5	37.9	99
100	94,5	32,6	64,2	33.7	[illegible]	34.2	93,4	35,8	92.7	37,5	92.4	38,3	100
Diff.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Diff.
	71 Deg.		6¼ Point		70 Deg		69 Deg		68 Deg.		6 Points		

Dist.	23 Deg.		24 Deg.		25 Deg.		2¼ Point		26 Deg		27 Deg		Dist.
	Lat.	Dep	Lat.	Dep.	Lat.	Dep	Lat.	Dep.	Lat.	Dep.	Lat.	Dep	
1	00.9	00,4	00,9	00,4	00,9	00.4	00,9	00.4	00,9	00.4	00,9	00.4	1
2	01.8	00,8	01,8	00,8	01,8	00,8	01.8	00.9	01.8	00.9	01.8	00.9	2
3	02,8	01.2	02,7	01.2	02,7	01,3	02,7	01,3	02.7	01.3	02.7	01.4	3
4	03.7	01,6	03.6	01,6	03,6	01.7	03,6	01.7	03.6	01.7	03.6	01,8	4
5	04,6	01,9	04.6	02.0	04.5	02,1	04,5	02.1	04,5	02,2	04.5	02,3	5
6	05,5	02.3	05,5	02.4	05,4	02.5	05,4	02.6	05.4	02.6	05,3	02.7	6
7	06,4	02,7	06,4	02.8	06,3	03,0	06.3	03.0	06,3	03.1	06.2	03,2	7
8	07.4	03,1	07,3	03.2	07,2	03.4	07.2	03,4	07.2	03.5	07.1	03.6	8
9	08.3	03,5	08.2	03.7	08,2	03.8	08,1	03.8	08,1	03.9	08.0	04,1	9
10	09.2	03,9	09.1	04,1	09,1	04,2	09.0	04.3	09,0	04.4	08.9	04.5	10
11	10,1	04.3	10.0	04.5	10.0	04.6	09,9	04.7	09,9	04,8	09.8	05.0	11
12	11,0	04.7	11,0	04.9	10,9	05.1	10.8	05,1	10.8	05,3	10.7	05,4	12
13	12.0	05,1	11,9	05.3	11,8	05,5	11,7	05.6	11.7	05.7	11.6	05.8	13
14	12,9	05,5	12,8	05.7	12,7	05.9	12,7	05.9	12.6	[illegible]	12.5	06,4	14
15	13,8	05,9	13.7	06.1	13,6	06,3	13,6	06,4	13,5	06.6	13.4	06,8	15
16	14.7	06,2	14,6	06.5	14.5	06.8	14.5	06,8	14.4	07.0	14.3	07.3	16
17	15,6	06.6	15,5	06.9	15.4	07,2	15.4	07.3	15.3	07.4	15,1	07.7	17
18	16,6	07,0	16,4	07,3	16,3	07.6	16.3	07,7	16.2	07.9	16,0	08.2	18
19	17.5	07,4	17,4	07.7	17.2	08,0	17,2	08.1	17,1	08,3	16,9	08.6	19
20	18,4	07.8	18,3	08,1	18.1	08.4	18.1	08.5	18,0	08.8	17,8	09.1	20
21	19.3	08.2	20,2	08.5	19.0	08,9	19,0	09.0	18.9	09.2	18,7	09,5	21
22	20.2	08.6	20.1	08.9	19,9	09.3	19,9	09.4	19.8	09.9	19.6	10.0	22
23	21.2	09.0	21.0	09.3	20.8	09,7	20,8	09.8	20.7	10,1	20.5	10.4	23
24	22.1	09,4	21.9	09,8	21,7	10,1	21.7	10.3	21,6	10,5	21.4	10,9	24
25	23.0	09,8	22.8	10,2	22.7	10.6	22.6	10,7	22.5	11,0	22.3	11.3	25
26	23,9	10,2	23.7	10.6	23.6	11.0	23.5	11.1	23.4	11.4	23.2	11,8	26
27	24,8	10.5	24.7	11.0	24.5	11,4	24.4	11,5	24.3	11.8	24.1	12.3	27
28	25,8	10,9	25.6	11.4	25,4	11.8	25,3	12,0	25.2	12,3	24,9	12.7	28
29	26,7	11.3	26.5	11.8	26.3	12.3	26,2	12.4	26,1	12,7	25,8	13.2	29
30	27,6	11,7	27.4	12,2	27.2	12.7	27.1	12,8	27,0	13.1	26,7	13.6	30
31	28,5	12,1	28.3	12.6	28,1	13.1	28,0	13,3	27,9	13,6	27.6	14,1	31
32	29,5	12.5	29,2	13.0	29,0	13.5	28,9	13.7	28.8	14.0	28.5	14,5	32
33	30,4	12,9	30,1	13.4	29.9	13.9	29,8	14.1	29.7	14.4	29,4	15,0	33
34	31.3	13,3	31.1	13.8	30.8	14.4	30,7	14.5	30.6	14,9	30,3	15,4	34
35	2.2	13.7	32.0	14,2	31.7	14.8	31.6	15,0	31.5	15,3	31.2	15,9	35
36	33,1	14,1	32,9	14,0	32,6	15,2	32.5	15,4	32,4	15,8	32.1	16,3	36
37	34,1	14,4	33,8	15,0	33,5	15,6	33,4	15,8	33,2	16,2	33.0	16.8	37
38	35.0	14.8	34,7	15.4	34,4	16.0	34.3	16.2	34,1	16,6	33.9	17,2	38
39	35.9	15.2	35.6	15,9	35,3	16.5	35,3	16.7	35,0	17.1	34.7	17.7	39
40	36,8	15.6	36.5	16.3	36.2	16.9	36,2	17,1	35,9	17,5	35.6	18.2	40
41	37,7	16.0	37,5	16.7	37.2	17.3	37,1	17.5	36,8	18.0	36,5	18,6	41
42	38.7	16.4	38.4	17,1	38.1	17.7	38.0	18,0	37.7	18,4	37.4	19.1	42
43	39.6	16.8	39,3	17,5	39,0	18,2	38.9	18.4	38.6	18.8	38.3	19,5	43
44	40,5	17,2	40.2	17,9	39,9	18,6	39.8	18,8	39,5	19,3	39.2	20,0	44
45	41.4	17,6	41,1	18.3	40,8	19.0	40,7	19,2	40.4	19.7	40.1	20,4	45
46	42.3	18.0	42,0	18.7	41.7	19.4	41.6	19,7	41,3	20.2	41.0	20.9	46
47	43.3	18,4	42.9	19.1	42,6	19.9	42,5	20.1	42,2	20.6	41,9	21.3	47
48	44.2	18,8	43.8	19.5	43.5	20.3	43.4	20.5	43,4	21.0	42,8	21,8	48
49	45,1	19,2	44.8	19,9	44,4	20.7	44.3	20.9	44.0	21.5	43.7	22,2	49
50	46,0	19.5	45,7	20,3	45,3	21,1	45.2	21.4	44,9	21.9	44.5	22,7	50
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	67 Deg		66 Deg		65 Deg		5¾ Point		64 Deg.		63 Deg.		

Dist.	23 Deg Lat.	23 Deg Dep.	24 Deg Lat.	24 Deg Dep.	25 Deg Lat.	25 Deg Dep.	2¼ Point Lat.	2¼ Point Dep.	26 Deg Lat.	26 Deg Dep.	27 Deg Lat.	27 Deg Dep.	Dist.
51	46,9	19.9	46.6	20.7	46,2	21.5	46.1	21.8	45.8	22.3	45,4	23,2	51
52	47.9	20.3	47.5	21,1	47.1	22,0	[illegible]	22,2	46,7	22.8	46,3	23,5	52
53	48.8	20,7	48.4	21.5	48,0	[illegible]	47,9	22.7	47.6	23.2	47.2	24.1	53
54	49.7	21.1	49.3	22.0	48,9	22,8	48.8	23.1	48.5	23.7	48,1	24,5	54
55	50.6	21,5	50,2	22,4	49.8	23.2	49.7	23.5	49.4	24.1	49.0	25,0	55
56	51,5	21,9	51.2	22.8	50.7	23,7	50.6	23,9	50,3	24,5	49.9	25.4	56
57	52,5	22,3	52.1	23,2	51.7	24,1	51,5	24.4	51.2	25,0	50.8	25.9	57
58	53.4	22,7	53,0	23.6	52.6	24,5	52,4	24.8	52.1	25.4	51,7	26,3	58
59	54.3	23,0	53.9	24,0	53.5	24.9	53.3	25,2	53,0	25.9	52.6	26,8	59
60	55,2	23.4	54.8	24.4	54,4	25,4	54,2	25.6	53.9	26.3	53,5	27,2	60
61	56,1	23.8	55,7	24.8	55.3	25.8	55,1	26.1	54,8	26.7	54.4	27.7	61
62	57.1	24.2	56,6	25,2	56,2	26.2	56,0	26.5	55,7	27.2	55.2	28,1	62
63	[illegible]	[illegible]	57.5	25,6	57,1	26.6	56.9	26,9	[illegible]	27.6	56.1	28.6	63
64	58,9	25.0	58.5	26.0	58,0	27.0	57.9	27.4	57,5	28.0	57.0	29.1	64
65	59.8	25,4	59.4	26.4	58.9	27,5	58,8	27.8	58.4	28.5	57,9	29,5	65
66	60,7	25.8	60.3	26.8	59,8	27.9	59.7	28,2	[illegible]	28.9	58.8	30,0	66
67	61.7	26.2	61.2	27,2	60.7	28.3	60,6	28,6	60.2	29,4	59.7	30.4	67
68	62,6	26,6	62.1	27.7	61,6	28,7	61.5	29,1	61,1	29,8	60,6	30,9	68
69	63.5	27,0	63,0	28,1	62.5	29,2	62.4	[illegible]	62,0	30,2	61.5	31,3	69
70	64.4	27.3	63,9	28.5	63,4	29,6	63,3	29,9	62,9	30,7	62,4	31.8	70
71	65.4	27.7	64.9	28.9	64.3	30.0	64.2	30,4	63.8	31.1	63.3	32.2	71
72	66.3	28.1	65,8	29.3	65,2	30.4	65.1	30.8	64,7	31.6	64.2	32,7	72
73	67,2	28,5	66.7	29.7	66,2	30,8	66,0	31,2	65,6	32,0	65,0	33,1	73
74	68.1	28.9	67.6	30.1	67.1	31.3	66,9	31,6	66.5	32.4	65,9	33,6	74
75	69,0	29,3	68,5	30.5	68.0	31,7	67,8	32.1	67.4	32,9	66,8	34.1	75
76	70.0	29.7	69,4	30,9	68,9	32.1	68.7	32,5	68,3	33.3	67.7	34.5	76
77	70,9	30,1	70.3	31,3	69.8	32.5	69,6	32,9	69.2	33,7	68,6	35.0	77
78	71.8	30.5	71.2	31.7	70,7	33,0	70,5	33,3	70.1	34.2	69,5	35,4	78
79	72.7	30.9	72,1	32,1	71,6	33.5	71.4	33,8	71,0	34,6	70.5	35,9	79
80	73.6	31.3	73.1	32,5	72.5	33,8	72,3	34.2	71.9	35,1	71,3	36,3	80
81	74,6	31,6	74.0	32,9	73,4	34.2	73,2	34.6	72.8	35.5	72.2	36,8	81
82	75,5	32.0	74,9	33.3	74,3	34.7	74.1	35.1	73.7	35,9	73.1	37,2	82
83	76.4	32,4	75.8	33,8	75,2	35,1	75,0	35,5	74.6	36.4	74.0	37.7	83
84	77,3	32.8	76,7	34,2	76.1	35.5	75.9	35.9	75,5	36.8	74.8	38.1	84
85	78.2	33.2	77,6	34.6	77,0	35,9	76.8	36.3	76.4	37,3	75.7	38,6	85
86	79,2	33,6	78.6	35.0	77.9	36,3	77.7	36.8	77,3	37,7	76,6	39.0	86
87	80.1	34,0	79,5	35,4	78.8	36,8	78,6	37.2	78,2	38.1	77.5	39.5	87
88	81,0	34,4	80.4	35,8	79,7	37.2	79,5	37.6	79,1	38.6	78.4	40,0	88
89	81,9	34.8	81,3	36.2	80.7	37,6	80.5	38.1	80,0	39.0	79.3	40.4	89
90	82,8	35,2	82,2	36.6	81,6	38,0	81,4	38.5	80,9	39.4	80,2	40.9	90
91	83,7	35,6	83.1	37,0	82.5	38.5	82,3	38.9	81,8	39.8	81.1	41,3	91
92	84,7	35,9	84,0	37.4	83.4	38,9	83,2	39,3	82.7	40,3	82,0	41.8	92
93	[illegible]	36.3	85,0	37,8	84.3	39,3	84.1	39.8	83.6	40.8	82.9	42.2	93
94	865	36,7	85,9	38.2	85.2	39.7	85,0	40,2	84,5	41,2	83,8	42.7	94
95	87.4	37.1	86.8	38.6	86,1	40.1	85,9	40.6	85.4	41,6	84,6	43.1	95
96	88,4	37.5	87.7	39.0	87,0	40,6	86.8	41.0	86.3	42,1	85.5	43,6	96
97	89,3	37.5	88.6	39.4	87,9	41.0	87.7	41.5	87.2	42,5	86,4	44.0	97
98	90.2	38.3	89,5	[illegible]	88,8	41,4	88,6	41.9	88.1	43,0	87.3	44.5	98
99	91.1	38.7	90,4	40.3	89,7	41.8	89,5	42,3	89.0	43,4	88,2	44.9	99
100	[illegible]	39,1	91,4	40,7	90,6	42.3	[illegible]	42,7	89.9	43,8	89,1	[illegible]	100
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	67 Deg.		66 Deg.		65 Deg.		5¾ Point.		64 Deg.		63 Deg.		

Dist.	28 Deg. Lat.	28 Deg. Dep.	2½ Point Lat.	2½ Point Dep.	29 Deg. Lat.	29 Deg. Dep.	30 Deg. Lat.	30 Deg. Dep.	2¾ Poin Lat.	2¾ Poin Dep.	31 Deg. Lat.	31 Deg. Dep.	Dist.
1	00,9	00.5	00.9	00.5	00,9	00,5	00.9	00.5	00,9	00,5	00.9	00.5	1
2	01.8	00,9	01.8	00.9	01,7	01.0	01,7	01.0	01,7	01,0	01,7	01.0	2
3	02,6	01,4	02.6	01,4	02,6	01.4	02,6	01.5	02.6	01,5	02,6	01.5	3
4	03.5	01,9	03,5	01.9	03,5	01,9	03,5	02,0	03.4	02.1	03,4	02.1	4
5	04,4	02,3	04,4	02.4	04,4	02,4	04,3	02.5	04.3	02,6	04.3	02,6	5
6	05.3	02.8	05.3	02,8	05.2	02,9	05,2	03,0	05.1	03,1	05.2	03,1	6
7	06.2	03.3	06.2	03.3	06.1	03.4	06,1	03.5	06,0	03,6	06,1	03,6	7
8	07,1	03,8	07,1	03,8	07.0	03,9	07.0	04,0	06,9	04,1	06.9	04.1	8
9	07.9	04,2	07,9	04,2	07,9	04,4	07.8	04,5	07,7	04,6	07.7	04.6	9
10	08.8	04,7	08,8	04.7	08.7	04.8	08.7	05.0	08,6	05.1	08,6	05,1	10
11	09.7	05,2	09.7	05,2	09.6	05,3	09.5	05,5	09,4	05.6	09,4	05.7	11
12	10.6	05.6	10,6	05.6	10,5	05,8	10.4	06.0	10,3	06,2	10,3	06,2	12
13	11.5	06.1	11.5	06.1	11.4	06.[illegible]	11,3	06,5	11,1	06.7	11.2	06.7	13
14	12.3	06,6	12,3	06.6	12.2	06.8	12,1	07,0	12,0	07[illegible]	[illegible]	07,2	14
15	13.2	07,0	13,2	07.1	13.1	07.3	13,0	07,5	12,9	07,7	12,9	07,7	15
16	14,1	07,5	14.1	07.5	14,0	07.7	13.9	08,0	13,7	08,2	13.7	08,2	16
17	15.0	08.0	15,0	08.0	14,9	08,2	14,7	08,5	14,6	08,7	14,6	08,8	17
18	15.9	08,4	15.9	08.5	15,7	08,7	15,6	09,0	15,4	09,2	15,4	09,3	18
19	16,8	08,9	16,8	08,9	16,[illegible]	09.2	16,4	09,5	16,3	09,8	16,3	09,8	19
20	17.7	09.4	17.6	09.4	1[illegible].5	09.7	17,3	10.0	17,1	10,3	17,1	10,3	20
21	18,5	09.9	18.5	09,9	18,4	10.2	18,2	10,5	18,0	10,8	18,0	10.8	21
22	19.4	10,3	19,4	10,8	19,2	10,7	19.0	11,0	18,9	11.3	18,9	11.3	22
23	20,3	10.8	20,3	10,8	20.1	11.1	19,9	11.5	19.7	11,8	19.7	11.8	23
24	21,2	11.3	21,2	11.3	21,0	11,6	20,8	12,0	20.6	12.3	20,6	12,4	24
25	22.1	11,7	22,0	11.8	21.9	12.1	21.6	12,5	21,4	12,8	21,4	12.9	25
26	23.0	12,3	22.9	12.3	22,7	12.6	22.5	13,0	22,3	13,4	22,3	13,4	26
27	23.8	12.7	23.8	12.8	23,6	13.1	23,4	13,5	23,1	13.9	23,1	13.9	27
28	24,7	13.1	24.7	13.1	24.5	13.6	24,2	14.0	24,0	14,4	24,0	14,4	28
29	25.6	13,6	25.6	13.7	25,4	14.1	25.1	14,5	24,9	14.9	24,9	14,9	29
30	26.5	14,1	26,5	14,1	26,2	14,5	26.0	15.0	25,7	15,4	25.7	15,4	30
31	27,4	14,5	27,3	14,6	27.1	15.0	26.8	15,5	26,6	15.9	26,6	16.0	31
32	28,2	15.0	28.2	15,1	28,0	15.5	27,7	16.0	27,4	16.4	27,4	16.5	32
33	29,1	15,6	29.1	15,5	28.9	16,0	28,6	16.5	28.3	17.0	28,5	17.0	33
34	30.0	16,0	30.0	16,0	29,7	16,5	29.5	17.0	29.2	17,5	29.1	17,5	34
35	30.9	16,4	30.9	16.5	30.6	17,0	30.3	17,5	30.0	18,0	30.0	18,0	35
36	31.8	16.9	31.7	17,0	31.5	17,4	31,2	18,0	30,9	18,5	30.9	18,5	36
37	32,7	17,4	32.6	17.4	32,4	17,9	32.0	18,5	31,7	19.0	31,7	19,1	37
38	33,5	17,9	33.5	17,9	33,2	18,4	32.9	19,0	32,5	19,5	32.6	19,6	38
39	34,4	18,3	34.4	18.4	34,1	18.9	33,8	19,5	33,4	20.0	33,4	20,1	39
40	35,3	18.8	35 3	18.9	35,0	19,4	34,6	20,0	34,3	20.6	34,3	20.6	40
41	36.2	19.1	36.1	19,3	35.8	19.9	35,5	20,5	35,2	21,1	35.1	21.1	41
42	37,1	19,7	37.0	19.8	36.7	20,4	36.4	21.0	36,0	21,6	36,0	21,6	42
43	38,0	20.1	37.9	20.3	37,6	20.8	37.2	21,5	36,9	22,1	36,9	22.1	43
44	38,8	20.6	38,8	20,7	38,5	21.3	38.1	22,0	37.7	22,6	37,7	22,6	44
45	39.7	21.1	39.7	21,2	39,3	21,8	39.0	22,5	38,6	23,1	38,6	23,2	45
46	40.6	21.6	40,6	21,7	40,2	22.3	39,8	23.0	39.5	23,6	39,4	23,7	46
47	41,5	22.1	41,4	22.2	41,1	22.8	40.7	23,5	40.3	24,2	40,3	24,2	47
48	42,4	22.5	42.3	22,6	42,0	23.3	41.6	24,0	41,2	24.7	41.1	24.7	48
49	43.3	23,0	43.2	23.2	42,8	23.7	42,4	24,5	42,0	25,2	42,0	25.2	49
50	44,1	23,5	44,1	23,6	43,7	24,2	43,3	25,0	42,9	25,7	42,9	25,7	50
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	62 Deg.		5½ Point		61 Deg.		60 Deg.		5¼ Poin		59 Deg.		

Dist.	28 Deg		2½ Points		29 Deg		30 Deg		2¾ Points		31 Deg		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	45,0	23.9	45.0	24,0	44.6	24.7	44,2	25.5	43 8	26,2	43.7	26,3	51
52	45,9	24,4	45.9	24.5	45.5	25,[illegible]	45.0	26,1	44.6	26.7	44,6	26.8	52
53	46.8	24,9	46.7	25.[illegible]	46.[illegible]	25.7	45,9	26.5	45.5	27.2	45,4	27.3	53
54	47,7	25,3	47.6	25,5	47.2	26,2	46.8	27.0	46,3	27,8	46.2	27,8	54
55	48,6	25,8	48,5	25.9	48,1	26.7	47.6	27.5	47,[illegible]	28.3	47.1	28.3	55
56	[illegible]9.4	26.3	49.4	26,4	49,0	27,[illegible]	48.5	28.0	48.0	28.8	48,0	28.8	56
57	50.3	26.8	50.3	26.9	49.8	27,6	49.4	28.5	48,9	29,3	48.9	29.4	57
58	[illegible]1,2	27,2	51.2	27.3	50.7	28.1	50.2	29,[illegible]	49,7	29,8	49,7	29.9	58
59	52.1	[illegible].7	52.0	27,8	51.6	28.6	51.1	29,5	50.6	30.3	50.6	30,4	59
60	53,0	28.2	52.9	28,[illegible]	52.5	29,1	52.0	30,0	51,5	30.8	51 4	30.9	60
61	53,9	28.6	53,8	28,7	53,3	29,6	52.8	30.5	52,3	31.4	52,3	31.4	61
62	54.7	29.1	54,7	29.2	54.2	30.1	53,7	31,0	53,2	31.9	53.1	31.9	62
6[illegible]	[illegible]	29.6	55.6	29,7	55,1	30.5	54.6	3[illegible].5	54.0	32,4	54.0	32.4	63
64	56.5	30.[illegible]	[illegible]4	30,2	56,0	31,0	55,4	32.0	54,9	32 9	54.9	33.0	64
65	57,4	30.5	57.3	30.6	56,8	31.5	56,3	32,5	55,7	33.4	55.7	33.5	65
6[illegible]	58,3	31,0	58.2	31.1	57.7	32,0	57.2	33.0	[illegible]6	33.9	56.6	34.0	66
6[illegible]	59.2	31,4	59.1	31,6	58.6	32,5	58,0	33,5	57.5	34,4	57.4	34.5	67
6[illegible]	60,0	31,9	60.0	32,0	59.5	33,0	58,[illegible]	34.0	58.3	35.0	58,3	35.0	68
69	60.9	32,4	60.8	32.5	60.3	33,4	59,7	[illegible].5	59,2	35,5	59,1	35.5	69
70	61,8	32.9	61.7	33.0	61,2	33,9	60,6	3[illegible].0	60.0	36.0	60,0	36.0	70
71	62.7	33.3	62.6	33,5	62,1	34,4	61.5	35.5	60.9	36.5	60,9	36,6	71
72	63,6	33.8	63,5	33,9	63.0	34.9	62.3	36,0	61,8	37,0	61.7	37.2	72
73	64,4	34,3	64.4	34,4	63,8	35.4	63.2	36,5	62,6	37.5	62.6	37.6	73
74	65,3	34,7	65.3	34.9	64.7	35,9	64,1	37.0	63,5	38.0	63,4	38.1	74
75	66,2	35,2	66.1	35.4	65,6	36,4	64.9	37,5	64.3	38,6	64,3	38.6	75
76	67,1	35,7	67.0	35,8	66,4	36.8	65.8	38,0	65.2	39.1	65,1	39,1	76
77	68.0	36.1	67,9	36,3	67,3	37.3	66.7	38,[illegible]	66.0	39.6	66.0	39,7	77
78	68.9	36,[illegible]	68,8	36,[illegible]	68,2	37,8	67.5	39.0	66.9	40,1	66,9	40,2	78
79	69,7	37,[illegible]	69,7	37,2	69,1	38,3	68,4	39.5	67.8	40,6	67,7	40.7	79
80	70,6	37.6	70,5	37.7	70.0	38.8	69.3	40.[illegible]	68.6	41,1	68,6	41,2	80
81	71,5	38,[illegible]	71,4	38.2	70.8	39,3	70.[illegible]	40.[illegible]	69.4	41,6	69,4	41,7	81
82	72.4	38,[illegible]	72.3	38.6	71.7	39.7	70.9	41,0	70,3	42.2	70.3	42.2	82
83	73.3	39[illegible]	73,2	39,1	72,6	40.2	71,8	41,3	71.2	42.7	71.1	42.7	83
84	74,2	39.[illegible]	74,1	39,6	73.5	40.7	72.7	42.0	72.1	43,2	72.0	43,3	84
85	75,0	39.9	75,0	40.1	74.3	41.2	73.6	42.5	72,9	43.7	72.9	43.8	85
86	75.9	40.4	75,8	40,5	75,2	41,7	74,5	43,0	73,8	44.2	73.7	44.3	86
87	76,8	40.8	76.7	41.0	76,1	42,2	75.3	43.5	74.6	44,7	74.6	44,8	87
88	77,7	41.3	77,6	41.5	77,0	42.7	76.2	44,0	75.5	45,2	75.4	45.3	88
89	78,6	41.7	78.5	41,9	77,8	43,1	77,1	44,5	76,3	45.7	76,3	45,8	89
90	79.5	42,2	79,4	42,4	78.7	43,6	77.9	45,0	77.2	46,3	77,1	46.3	90
91	80,3	42,7	80.2	42,9	79.6	44.1	78,8	45.5	78,1	46.8	78.0	46,9	91
92	81.2	43,2	81.1	43,4	80,5	44.6	79.7	46,0	78,9	47.3	78.9	47,4	92
93	82,1	43.6	82.0	43.8	81.3	45,1	80.5	46.5	79.8	47,8	79,7	47.9	93
94	83.0	44,1	[illegible]2,9	44.3	82,2	45.6	81,4	47,0	80,6	48,3	80,6	48.4	94
95	83.9	44,6	83,8	44.8	83,1	46.1	82,3	47,5	81,5	48.8	81.4	48.9	95
96	84,8	45.1	84.7	45,2	84,0	46,5	83,1	48.0	81,3	49,3	82.3	49.4	96
97	85,6	45.5	85,5	45,7	84,8	47,0	84,0	48,5	83,2	49.9	83.1	50,0	97
98	86,5	46,0	86[illegible]	46,2	85.7	47,5	84,9	49.0	84.1	50,4	84.0	50,5	98
99	87,4	46,5	87,3	46,7	86,6	48.0	85.7	49,[illegible]	84.9	50.9	84.9	51,0	99
100	88,3	46,9	88.2	47.1	87,5	48.5	86.6	50,0	85.8	51.4	85.7	51.3	100
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	62 Deg.		5½ Points		61 Deg.		60 Deg.		5¼ Points		59 Deg.		

Dist.	32 Deg		33 Deg		3 Points		34 Deg		35 Deg		36 Deg		Dist.
	Lat.	Dep.	Lat.	Dep	Lat.	Dep	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	00,8	00,5	00.8	00.5	00,8	00,6	00,8	00.6	00.8	00.6	00,8	00,6	1
2	01,7	01.1	01,7	01,1	01,7	01.1	01.7	01.1	01.6	01.1	01.6	01,2	2
3	02,5	01.6	02,5	01,6	02,5	01,7	02.[illegible]	01.7	02,5	01,7	02,4	01,8	3
4	03,4	02,1	03,4	02,2	03.3	02,2	03,3	02,2	03.3	02,3	03.2	02.3	4
5	04,2	02,6	04.2	02,7	04.2	02.8	04,1	02.8	04.1	02,9	04.0	02.9	5
6	05,1	03.2	05,0	03,3	05,0	03.3	05.0	03.4	04.9	03.4	04.8	03,5	6
7	05,9	03.7	05,9	03.8	05,8	03,9	05.8	03,9	05.7	04.0	05,7	04,1	7
8	06.8	04,2	06,7	04,4	06.6	04,4	06,0	04,5	06.5	04.6	06,5	04,7	8
9	07,6	04,8	07.5	04,9	07.5	05,0	07.5	05.0	07.4	05.2	07,3	05,3	9
10	08.5	05.3	08,4	05,4	08,3	05.6	08.3	05,6	08,2	05,7	08,1	05,9	10
11	09.3	05,8	09,2	06,0	09,1	06.1	09.1	06,1	09.0	06.3	08,9	06.5	11
12	10,2	06.4	10.1	06,5	10.0	06,7	09.9	06,7	09.8	06,9	09.7	07.0	12
13	11.0	06,9	10.9	07,1	10.8	07,2	10.8	07.3	10.6	07.5	10,5	07.6	13
14	11,9	07,4	11,7	07,6	11,6	07.8	11,6	07.8	11.5	[illegible]	[illegible]	[illegible]	[illegible]
15	12,7	07,9	12.6	08,2	12,5	08,3	[illegible]	08.4	[illegible]	08.6	12,1	08,8	15
16	13,6	08.5	13,4	08,7	13,3	08.9	13.3	08.9	13,1	09.2	12.9	09.4	16
17	14,4	09,0	14,3	09.3	14.1	09.4	14,1	09,5	13,9	09,8	13.7	10.0	17
18	15.3	09.5	15,1	09.8	15,0	10.0	14,9	10.1	14,8	10.3	14.6	10.6	18
19	16.1	10,1	15,9	10,3	[illegible]	10,6	15.7	10,6	15,7	10,9	15,4	11,2	19
20	17,0	10.6	16.[illegible]	10.9	[illegible]	11,1	16.6	11.2	16.4	11,5	16,2	11,8	20
21	17,8	11,1	17.6	11,4	17,5	11.7	17.4	11.7	17,2	12.0	17,0	12.3	21
22	18.0	11.7	18,5	12,0	18,3	12,2	18,2	12.3	18,0	12.6	17,8	12,9	22
23	19,5	12.2	19.3	12,5	19.1	12.8	19.0	12,8	18,8	13.2	18,6	13.5	23
24	20,3	12,7	20,1	13,1	20.0	13,3	19,9	13,4	19.7	13,8	19.4	14,1	24
25	21,2	13.2	21.0	13,6	20,7	13.9	20.7	14.0	20,5	14.3	20.1	14,7	25
26	22,0	13.8	21,8	14.2	21,6	14.4	21.5	14.5	21,3	14.9	21.0	15.3	26
27	22,9	14,3	22,6	14,7	22.4	15.0	22.4	15.1	22,1	15,5	21,8	15.9	27
28	23,7	14,8	23,5	15,2	23,3	15.5	23,2	15.6	22.9	16.1	22.6	16.5	28
29	24.6	15,4	24,3	15,8	24,1	16.1	24,0	16.2	23,8	16,6	23,5	17,0	29
30	25,4	15,9	25,2	16,3	24.9	16.7	24,9	16,8	24,6	17,2	24,3	17,6	30
31	26,3	16,4	26,0	16.9	25.[illegible]	17.2	25.7	17,3	25.4	17,8	25,1	18,0	31
32	27,1	17,0	26,8	17.4	26.6	17,8	26.5	17,9	26.2	18.3	25,9	18.6	32
33	28,0	17,5	27,7	18,0	27,4	18.3	27.4	18,4	27.0	18,9	26,7	19.4	33
34	28.8	18,0	28,5	18,5	28,3	18.9	28.2	19.0	27.9	19,5	27,5	20.0	34
35	29.7	18.5	29,4	19,1	29.1	19,4	29.0	19,6	28.7	20,1	28,3	20,6	35
36	30.5	19.1	30,2	19,6	29.9	20,0	29,8	20.1	29,5	20,6	29,1	21.2	36
37	31,4	19,6	31,0	20,1	30,8	20,6	30,7	20,7	30.3	21,2	29,9	21,7	37
38	32,2	20,1	31,9	20.7	31,6	21,1	31,5	21.1	31.1	21,8	30.7	22.3	38
39	33,1	20,7	32,7	21,2	32.5	21,7	32,3	21.8	32.0	22.3	31.5	22.9	39
40	33,9	21.2	33,6	21,8	33,3	22,2	33.2	22,2	32,8	22.9	32.4	23,5	40
41	34.8	21,7	34,4	22.3	34.1	22.8	34,0	22,9	33,6	23,5	33,2	24,1	41
42	35,6	22,3	35,2	22,9	34,9	23.3	34.8	23,5	34,4	24,1	34,0	24.7	42
43	36,5	22,8	36,1	23.4	35.7	23,9	35,6	24,0	35.2	24,6	34,8	25.3	43
44	37,3	23,3	36,9	24,0	36,6	24,4	36,5	24.9	36,0	25.2	35.6	25.9	44
45	38,1	23.8	37,7	24,5	37.4	25,0	37.2	25,2	36,9	25,8	36.4	26.4	45
46	39,0	24,4	38,6	25,0	38.2	25,5	38.1	25.7	37,7	26,4	37,2	27.0	46
47	39,9	24.9	39,4	25.6	39,1	26,1	39,0	26.5	38,5	26,9	38.0	27,6	47
48	40,7	25,4	40,3	26.1	39,9	26,7	39.8	26,8	39,3	27.5	38,8	28,2	48
49	41,5	26,0	41,1	26,7	40,7	27.2	40.6	27,4	40.1	28.1	39,6	28,8	49
50	42.4	26.5	41,9	27,2	41,6	27,8	41.4	28,0	41.0	28,7	40,4	29,4	50
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	58 Deg		57 Deg		5 Points		56 Deg		55 Deg		54 Deg		

Dist.	32 Deg		33 Deg		3 Points		34 Deg		35 Deg		36 Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	43.2	27.0	42.8	27.8	42,4	28.3	42.3	28.5	41.8	29.2	41,3	30.0	51
52	44,1	27.6	43.6	28.3	43,2	28,9	43.1	29.1	42,6	29.8	42.1	30.6	52
53	44,9	28,1	44.5	28,9	44,1	29.6	43,9	29.4	43,4	30.4	42,9	31,2	53
54	45,8	28.6	45,3	29.4	44.9	30,0	44.5	30.2	44,2	31.0	43,7	31.7	54
55	46.6	29,1	46.1	30,0	45.7	30,6	45,6	30.7	45,1	31.5	44,5	32.3	55
56	47,5	29,7	47.0	30,5	46.6	31.1	46.4	31.3	45.9	32,1	45,3	32,9	56
57	48.3	30,2	47,8	31,0	47,4	31,7	47.3	31,9	46,7	32.7	46,1	33,5	57
58	49.2	30,7	48.7	31,6	48,2	32.2	48,1	32,4	47,5	33.3	46.[illegible]	34.1	58
59	50,0	31.3	49,5	32.1	49,0	32.8	48.9	33,0	48.3	33,8	47.7	34.7	59
60	50,9	31,8	50,3	32,7	49,9	33,3	49,7	33,5	49,1	34.4	48.5	35.3	60
61	51,7	32.2	51,2	33,2	50.7	33,9	50,6	34.1	50,0	34,9	49.3	35,9	61
62	52.6	32.9	52.0	33,8	51.5	34.4	51,4	34.7	50.8	35.6	50,2	36.3	62
63	53.4	33.4	52.9	34.3	52.4	35.0	52,2	35,2	51.6	36.1	51,0	37.0	63
64	54,3	[illegible]	53.7	34.9	53,2	35,5	53.1	35,[illegible]	52,4	36.7	51.8	37,6	64
65	55,1	34.4	54.[illegible]	35,4	54.0	[illegible]	53.9	36,3	53,2	37.3	52.6	38,2	65
66	56.0	35,0	55,3	35,9	54,9	36,7	54.7	36,9	54.1	37,9	53.4	38.8	66
67	56,8	35,5	56,2	36,5	55,7	37,2	55,5	37,5	54[illegible]	38,4	54,2	39.4	67
68	57.7	36,0	57,0	37,0	56,5	37.8	56.4	38,0	55.7	39.0	55,0	40.0	68
69	58,5	36,6	57,9	37.6	57.4	38,3	57.2	3[illegible],6	56.5	39.6	55,8	40,6	69
70	59,4	37,1	58.7	38.1	58,2	38.9	58.0	39.1	57,3	40.1	56,6	41.1	70
71	60,2	37.6	59.6	38.7	59.0	39.4	58,9	39.[illegible]	58,2	40.7	57.4	41.7	71
72	61.0	38,1	60.4	39,2	59,8	40,0	59.7	40,3	59.0	41,3	58.2	42,3	72
73	61,9	38.7	61.2	39,8	60.7	40.6	60,5	40,8	59,8	41,9	59.0	42.9	73
74	62,7	39,2	62,1	40.3	61,5	41.1	61,3	41.4	60,6	42,4	59,9	43,5	74
75	63.6	39.7	62.9	40.8	62.4	41,7	62,2	41.9	61,4	43.0	60.7	44.1	75
76	64.4	40.3	63,8	41,5	63,2	42.1	63,0	42,5	62,3	43.6	61.5	44,7	76
77	65,3	40.8	64,6	41,9	64,0	42,8	63.8	43.0	63,1	44.2	62,3	45,3	77
78	66.1	41.3	65.4	42,5	64.8	43,3	64.7	43,6	63.9	44,7	63.1	45,8	78
79	67,0	41,9	66,3	43,0	65,7	44,9	65,5	44,2	64,7	45.3	63,9	46.4	79
80	67,8	42,4	67,1	43,6	66.5	44,4	66.3	44,7	65.5	45.9	64.7	47.0	80
81	68,7	42.9	68,0	44,1	67.3	45.0	67.1	45.3	66,4	46.5	65,5	47,6	81
82	69.5	43,4	68.8	44.7	68,2	45,5	68,0	45,8	67,2	47.0	66.3	48,2	82
83	70.4	44.0	69,6	45.2	69,0	46,1	68.8	46,4	68.0	47,6	67,1	48.8	83
84	71.2	44,5	70.5	45.8	69,8	46.7	69,6	47.0	68.8	48,2	68.0	49.4	84
85	72.1	45.0	71.3	46,3	70.7	47.2	70.5	47,5	69.6	48,8	68,8	50,0	85
86	72.9	45.6	72.1	46,8	71,5	47,7	71,3	48.1	70.5	49,3	69,6	50,5	86
87	73,8	46,1	73,0	47,3	72,3	48.3	72,1	48,6	71.3	49,9	70.4	51,1	87
88	74,6	46.5	73.8	47,9	73,2	48.9	72,9	49,2	72,1	50.5	71.2	51.7	88
89	75,5	47,2	74,7	48,5	74.0	49.4	73.8	49.8	72,9	51.0	72.0	52,3	89
90	76.3	47,7	75,5	49,0	74.8	50.0	74,6	50,3	73,7	51,6	72.8	52,9	90
91	77,2	48,2	76.3	49.6	75,7	50.6	75.4	50.9	74.5	52,2	73,6	53.5	91
92	78.0	48.7	77,2	50.1	76,5	51.1	76.3	51.4	75.4	52.8	74.4	54.1	92
93	78.9	49.3	78,0	50,6	77,3	51,7	77,1	52,0	76.2	53,3	75.2	54,7	93
94	79,7	49,8	78.9	51,2	78,2	52,2	77,9	52,6	77,0	53.9	76,0	55.2	94
95	80.6	50,3	79,7	51,7	79.0	52.7	78,7	53,1	77,8	54.5	76,9	55.8	95
96	81,4	50.9	80.5	52.3	79.8	53,3	79.5	53,7	78.6	55,1	77,7	56.4	96
97	82.3	51,4	81,4	52,8	80,6	53.9	80.4	54,2	79.5	55,6	78.5	57,0	97
98	83,1	51,9	82.2	53,4	81.5	54.4	81.2	54,8	80,3	56,2	79,3	57,6	98
99	84.0	52,5	83.1	53.9	82,3	55,0	82.0	55,4	81,1	56.8	80,1	58,2	99
100	84.8	53.0	83.9	54,5	83,1	55,5	82.9	55,9	81,9	57.4	80.9	58.8	100
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	58 Deg.		57 Deg.		5 Points.		56 Deg.		55 Deg		54 Deg		

Dist.	3¼ Point.		37 Deg.		38 Deg.		39 Deg		3½ Point		40 Deg.		Dist.
	Lat.	Dep	Lat.	Dep.	Lat.	Dep	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
1	00.8	00.6	00.8	00,6	00.8	00.6	00.8	00,7	00.8	00.6	00,8	00,6	1
2	01,6	01.2	01.6	01.2	01,6	01,2	01.5	01,3	01,5	01,3	01.5	01.3	2
3	02,4	01.8	02,4	01,8	02.4	01,8	02.3	01,9	02.3	01,9	02.3	01.9	3
4	03,2	02,4	03,2	02,4	03,1	02,5	03,5	02,5	03,1	02,5	03.1	02,5	4
5	04.0	[illegible]	04.0	[illegible]	03,9	03,1	03,9	03,1	03,9	03,2	03.8	03.2	5
6	04.8	03,6	04,8	03.6	04,7	03.7	04,6	03.9	04.6	03.8	04,6	03.9	6
7	05,6	04,2	05.6	04.2	05,5	04,3	05,4	04,4	05,4	04.4	05.4	04,6	7
8	06.4	04,8	06.4	04,8	06,3	04.9	06.2	05,0	05,2	05,1	06,1	05.1	8
9	07.2	05,4	07,2	05.4	07,1	[illegible]	[illegible]	05.7	07.0	05,7	06,9	05.8	9
10	08.0	06,0	08,0	06,0	07,9	06,2	07.8	06.3	07,7	06.3	07,7	06,4	10
11	08.8	06,6	08,8	06,6	08.7	06,8	08.5	06,9	08.5	07,0	08,4	07.1	11
12	09,6	07,1	09,5	07.2	09,4	07.4	09,3	07.5	09.3	07,6	09.2	07.7	12
13	10.4	07.7	10.4	07.8	10.2	08,1	10,1	08,2	10,0	08,2	[illegible]	[illegible]	13
14	11,2	08.3	11,2	08,4	11,0	08,7	[illegible]	[illegible]	[illegible]	[illegible]	10.7	09,0	14
15	12,0	08,9	12.0	09,0	11.8	[illegible]	11,6	09.4	11.6	09.5	11.5	09.6	15
16	12,8	09.5	12,8	09,6	12,6	[illegible]	12,4	10,1	12.4	10.1	12,3	10,3	16
17	13,6	10,1	13,6	10.2	13.4	10,5	[illegible]	10,7	13,1	10.8	13.0	10.9	17
18	14.5	10.7	14.4	10,8	[illegible]	11.1	13,3	[illegible]	13,9	11,4	13.8	11,6	18
19	15,3	11,3	15.2	11,4	[illegible]	11,7	14,8	[illegible]	14.7	12,0	14,5	12,2	19
20	16,1	11,9	16,0	12,0	15.8	12.3	15.5	[illegible]	[illegible]	12,7	15,3	12,9	20
21	16,9	12.5	16.8	12,6	16,5	12.9	16,3	13.2	16.2	13,3	16.1	13.5	21
22	17,7	13,1	17,6	13,2	17,3	13.5	17,1	13.8	17,0	14.0	16,8	14.1	22
23	18.5	13,7	18.4	13,8	18,1	14,2	17,9	14,5	17.8	14,6	17.6	14.9	23
24	19.3	14,3	19.2	14,4	18,9	14,8	18,6	15,1	18,5	15,2	18,4	15,4	24
25	20,1	14,9	20,0	15.0	19,7	15.4	19,4	15.7	19,3	15.9	19,1	16.1	25
26	20,9	15,5	20,8	15,6	20.5	16.0	20,2	16.4	20.1	16.5	19.9	16,7	26
27	21.7	16.1	21,6	16.2	21.3	16.6	21,0	17,0	20.9	17,1	20,7	17.4	27
28	22,5	16,7	22.4	16,8	22.1	17,2	21.8	17.6	21.6	17,8	21,4	18.0	28
29	23.3	17,3	23,2	17.4	22,8	17,8	22,6	18,3	22,4	18,4	22,2	18.6	29
30	24,1	17,9	24,0	18,0	23.6	18,5	23.3	18.9	23.2	19,0	23.0	19.3	30
31	24,9	18.5	24.8	18,6	24.4	19,1	24.1	19,5	24.0	19.7	23.7	19.9	31
32	25,7	19,1	25,6	19.3	25,2	19,7	24,9	20.1	24.7	20.3	24,5	20,6	32
33	26,5	19,7	26,4	19,9	26,0	20,5	25,6	20.8	25.5	20.9	25,3	21.2	33
34	27.3	20,2	27,1	20,5	26.8	20.9	26,4	21.4	26,1	21.6	26,0	21.9	34
35	28,1	20.8	28,9	21,1	27,6	21,5	27.2	22,0	27.0	22.2	26.8	22,5	35
36	28,9	21.4	28,7	21.7	28,4	22.2	27,9	22,7	27.8	22,8	27,6	23,1	36
37	29,7	22.0	29,5	22,3	29,2	22.8	28,8	23.3	28,6	23,5	28,2	23,8	37
38	30.5	22.6	30,3	22,9	29.9	23.4	29,5	23.9	29,4	24,1	29.1	24,4	38
39	31,3	23.2	31,1	23.5	30,7	24.0	30.3	24,5	30.1	24.7	29.9	25.1	39
40	32,1	23,8	31,9	24,1	31,5	24,6	31,1	25.2	30.9	25.4	30,6	25,7	40
41	32,9	24,4	32,7	24.7	32,3	25.2	31,9	25,8	31,7	26.0	31,4	26.4	41
42	33,7	25.0	33,5	25.3	33,1	25.9	32.6	26.4	32.5	26.6	32.2	27,0	42
43	34,5	25.6	34,3	25.9	33,9	[illegible]	33.4	27.1	33,2	27,3	32.9	27,6	43
44	35,3	26,2	35,1	26.5	34.7	27,1	34.2	27.7	34.0	27,9	33,7	28,3	44
45	36.1	26,8	36,9	27,1	35.5	27,7	35,0	28.3	34,8	28,5	34,5	28,9	45
46	36.9	27,4	36.7	27,7	36,2	28,3	35.9	29,0	35,6	29,2	35,2	29,6	46
47	37.7	28,0	37.5	28,3	37,0	28,9	36.8	29,6	36.3	29,8	36.0	30.2	47
48	38,5	28,6	38,3	28,9	37,8	29,5	37,6	30,2	37,1	30,4	36,8	30,9	48
49	39.3	29,2	39,1	29.5	38,6	30,2	38,1	30.8	37,9	31.1	37,5	[illegible]	49
50	40,1	29.8	39.9	30,1	39.4	30,8	38,9	31,9	38.6	31,7	38,3	[illegible]	50
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	4¾ Point.		53 Deg.		52 Deg.		51 Deg.		4½ Point.		50 Deg.		

Dist.	3¼ Point		37 Deg.		38 Deg.		39 Deg.		3½ Point		40 Deg.		Dist.
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	
51	41,0	30.4	40.7	30,7	40,2	31,4	39,6	32.1	39.4	32.3	39,1	32.8	51
52	42.8	31.0	41,5	31,3	[illegible]	32.0	40,4	32.7	40.2	33,0	39.8	[illegible]	52
53	42.6	31,6	42.3	31.9	41.8	32,6	41.2	33.3	41,0	33.6	40.6	[illegible]	53
54	43,4	32.2	43,1	32,5	42.5	33.2	42,0	34.0	[illegible]	[illegible]	[illegible]	[illegible]	54
55	44,2	32.8	43,9	33.1	43,3	33.9	42,7	34.6	42,5	34.9	42.1	[illegible]	55
56	45,0	33.3	44,7	33,7	44.1	34,5	43,5	35.2	43.3	35,5	[illegible]	36,0	56
57	45,8	33.9	45.5	34.2	44.9	35,1	44,3	35.9	44,1	36,2	[illegible]	36,6	57
58	46.6	34.5	46.3	34.9	[illegible]	[illegible]	45.1	36.5	44,8	36,8	44.4	37,3	58
59	47,4	35.1	47.1	35,5	46,5	[illegible]	45.8	37.1	45.6	37,4	45.2	37.9	59
60	48.2	35.7	47,9	36,1	47.3	36.9	46.6	37.8	46,4	38.1	46,0	38,6	60
61	49.0	36.3	48.7	36,7	48,1	37,5	47,4	38,4	47,1	38.7	46,7	39,3	61
62	49.8	36,9	49,5	37,3	48,9	[illegible]	48.2	39.0	47,9	39.3	47,5	39,9	62
63	[illegible]	[illegible]	50.3	37,9	49.6	38.8	49.0	39.6	48,7	40.0	48,3	40,5	63
64	51.4	38.1	[illegible]	[illegible]	[illegible]	[illegible]	49.7	40.3	49,5	40,6	49,0	41.2	64
65	52,2	38,7	51.9	39,1	51.2	[illegible]	[illegible]	40.9	50,2	41.2	49,8	41.8	65
66	53.0	39.3	52,7	39.7	52,0	[illegible]	[illegible]	41.5	51,0	41,9	50.5	42.4	66
67	53.8	39.9	53,5	40.3	[illegible]	[illegible]	52.1	42,2	51.8	42,5	51.3	43,1	67
68	54,6	40,5	54,3	40.9	[illegible]	41.9	52,8	[illegible]	52,6	43,1	52,1	43,7	68
69	55.4	41,1	55,1	[illegible]	[illegible]	42,5	53,6	[illegible]	53.3	43.8	52,9	44.4	69
70	56.2	41,7	55.9	[illegible]	55.2	43,1	54,4	44,0	54.1	44,4	53.6	45,0	70
71	57.0	42,3	56,7	42.7	55.9	43.7	55.2	44.7	54.9	45,0	54.4	45.6	71
72	57,8	42,9	57.5	43,3	56.7	44.3	55.9	45.3	55.7	45.7	55.1	46.3	72
73	58,6	43.5	58,2	43.9	57,5	44,9	56.7	45,9	56,4	46,3	55,9	46.9	73
74	59,4	44.1	59.1	44,5	58,3	45,6	57.5	46.6	57.2	46.9	56.7	47,6	74
75	60.2	44,7	59,9	45,1	59,2	46.2	58,3	47,2	58.0	47.6	57.4	48.2	75
76	61.0	45.3	60,7	45,7	60,0	46,8	59,1	47,8	58.7	48.2	58.2	48,9	76
77	61.8	45,9	61.5	46.3	60.7	47.4	59,8	48,5	59.5	48,8	59.0	49,5	77
78	62.7	46.5	62.3	46.9	61,5	48.0	60.6	49,1	60,3	49.5	59,7	50,1	78
79	63,5	47,1	63.1	47.5	62,2	48.6	61,4	49,7	61,1	50.1	60,5	50,8	79
80	64,3	47,7	63.9	48,1	63,0	49,3	62,2	50,3	61.8	50,7	61.3	51,4	80
81	65.1	48.3	64,7	48,7	63.8	49.9	62,9	51.0	62,6	51,4	62.0	52,1	81
82	65,9	48.8	65,5	49.3	64,6	50.5	63,7	51,6	63.5	52,0	62,8	52.7	82
83	66,7	49,4	66.3	49,9	65.4	51.1	64,5	52.2	64,2	52.6	63,6	53.4	83
84	67,5	50.0	67.1	50.5	66.2	51.7	65,3	52.9	64,9	53.3	64.3	54.0	84
85	68,3	50,6	67.9	51.1	67.0	52,3	66,1	53.5	65.7	53,9	65.1	54.6	85
86	69.1	51,2	68.7	51,7	67,8	52.9	66.8	54.1	66,5	54.6	65.9	55,3	86
87	69.9	51,8	69,5	52.4	68,6	53,6	67.6	54.8	67.2	55,2	66,6	55.9	87
88	70,7	52,4	70.3	53,0	69.3	54,2	68.4	55,4	68.0	55,8	67.4	56,6	88
89	71.5	53.0	71.1	53,5	70.1	54.8	69,2	56.0	68.8	56,5	68.2	57,2	89
90	72,3	53,6	71,9	54,2	70,9	55.4	69,9	56,6	69,6	57,1	68,9	57.8	90
91	73,1	54,2	72,7	54,8	71.7	56,0	70,7	57.2	70,3	57,7	69.7	58,5	91
92	73.9	54.8	73,5	55.4	72,5	56,6	71.5	57.9	71.1	58.4	70.5	59.1	92
93	74.7	55.4	74,3	56.0	73,3	57,3	72.3	58.5	71,9	59,0	71.2	59.8	93
94	75.5	56.0	75,1	56.6	74,1	57,9	73.0	59.2	72,7	59,6	72.0	60.4	94
95	76.3	56.6	75,9	57.2	74.9	58.5	73.8	59.8	73,4	60,3	72.8	61,1	95
96	77,1	57,2	76,7	57.8	75,6	59.1	74,6	60,4	74,2	60.9	73,5	61.7	96
97	77.9	57,8	77.5	58.4	76,4	59.7	75,4	61,0	75,0	61.5	74,3	62,1	97
98	78.7	58,4	78.3	59.0	77,2	60,3	76,2	61,7	75,7	62,2	75,2	63,0	98
[illegible]	[illegible]	59,0	79,1	59,6	78.0	60.9	76,9	62,3	76.5	62,8	75.8	63.6	99
[illegible]	[illegible]	59,6	79,9	60,2	78,8	61.6	77,7	62,9	77.8	63,4	76.6	64,3	100
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	4¾ Point		53 Deg		52 Deg		51 Deg.		4½ Point.		50 Deg.		

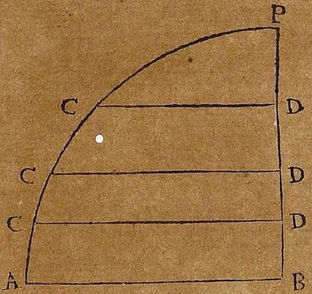
Dist.	41 Deg. Lat.	41 Deg. Dep.	42 Deg Lat.	42 Deg Dep.	3¾ Point. Lat.	3¾ Point. Dep.	43 Deg. Lat.	43 Deg. Dep.	44 Deg Lat.	44 Deg Dep.	4 Points. Lat.	4 Points. Dep.	Dist.
1	00.7	00,7	00,7	00,7	00.7	00,7	00.7	00,7	00.7	00,7	00.7	00,7	1
2	01,5	01,3	01.5	01,3	01,5	01,3	01,5	01,4	01,4	01.4	01,4	01.4	2
3	02.3	02,0	02,2	02,0	02,2	02.0	02,2	02,0	02.2	02,1	02,1	02,1	3
4	03,0	02,6	03,0	02.7	03,0	02,7	02,9	02.7	02.9	02,8	02.8	02.8	4
5	03,8	03,3	03,7	03,3	03.7	03,4	03,6	03.4	03,6	03,5	03.5	03.5	5
6	04,5	03,9	04,5	04.0	04,4	04,0	04,4	04,1	04,3	04.2	04.2	04,2	6
7	05,3	04,6	05,2	04.7	05,2	04,7	05.1	04,8	05.0	04,9	04.9	04,9	7
8	06,0	05,2	05,9	05,3	05,9	05,4	05.8	05.5	05,7	05.6	05,7	05,7	8
9	06.8	05.9	06,7	06.0	06,7	06.0	06,6	06,1	06,5	[illegible]	06,4	06,4	9
10	07.5	06,6	07.4	06.7	07,4	06,7	07,3	06.8	07,2	06.9	07,1	07,1	10
11	08.3	07.2	08,2	07.4	08.1	07.4	08,0	07.5	07,9	07,6	07,8	07,8	11
12	09,1	07,9	08,9	08.0	08,9	08,1	08,8	08,2	08,6	08,3	08,5	08.5	12
13	09,8	08.5	09.7	08,7	09,6	08.7	09,5	08,9	09,3	09,0	[illegible]	[illegible]	13
14	10.6	09.2	10,4	09.4	10,4	09,4	[illegible]	[illegible]	[illegible]	09,7	09.9	09.9	14
15	11,3	09.8	11,1	10.0	[illegible]	[illegible]	11,0	10.2	10.8	10,4	10,6	10,6	15
16	12,1	10.5	11.9	10,7	11.9	[illegible]	11.7	10,9	11,5	11,1	11,3	11.3	16
17	12,8	11,1	12.7	11,4	12,6	[illegible]	[illegible]	11.6	12,2	11,8	12.0	12,0	17
18	13,6	11.8	13.4	12,0	[illegible]	12.1	[illegible]	12.3	12.9	12,5	12,7	12.7	18
19	14,3	12,5	14.1	12,7	14.1	12,8	[illegible]	[illegible]	13.7	13.2	13,4	13.4	19
20	15.1	13,1	14.9	13,4	14,8	13,4	14,6	[illegible]	[illegible]	13.9	14,1	14.1	20
21	15,8	13,8	15.6	14.0	15,6	14,1	15.4	14,3	15,1	14.6	14.8	14,8	21
22	16.6	14,4	16.3	14.7	16.3	14.8	16.1	15.0	15,8	15,3	15,5	15.5	22
23	17.4	15,1	17.1	15.4	17.0	15,4	16,8	15.7	16,5	16,0	16.3	16,3	23
24	18,1	15,7	17.8	16,1	17.8	16,1	17,5	16,4	17,3	16.7	17.0	17.0	24
25	18,9	16,4	18,6	16.7	12.5	16.8	18,3	17,1	18.0	17,4	17,7	17.7	25
26	19.6	17.1	19.3	17.5	19.3	17,4	19.0	17,7	18,7	18,1	18,4	18.4	26
27	20,4	17,7	20.1	18.1	20.0	18.1	19.7	18.4	19,4	18,8	19,1	19.1	27
28	21,1	18,4	20,8	18,7	20.7	18,8	20,5	19,1	20.2	19,4	19.8	19.8	28
29	21,9	19,0	21.5	19,4	21,5	19,5	21,2	19,8	20,9	20,1	20.5	20.5	29
30	22,6	19.7	22.3	20.1	22,2	20,1	21,9	20,5	21,6	20.8	21.2	21.2	30
31	23.4	20,3	23,0	20.7	23.0	20.8	22,6	21.1	22,3	21,5	21.7	41.9	31
32	24,1	21,0	23.8	21,4	23.7	21.5	23,4	21,8	23,0	22,2	22,2	22,6	32
33	24,9	21,6	24.5	22.1	24,4	22,2	24.1	22,5	23,7	22,9	22.9	23.3	33
34	25 7	22,3	25.3	22,7	25.2	22.8	24,9	23,2	24,5	23,6	23,6	24,0	34
35	26.4	23.0	26,0	23,4	25.9	23.5	25.6	23,9	25,2	24,8	24,3	24,7	35
36	27.2	23.6	26,7	24,1	26,7	24,2	26,3	24,5	25,9	25,0	25,4	25,4	36
37	27.9	24,3	27,5	24,7	27.4	24,8	27.0	25,2	26,6	25,7	26,1	26.1	37
38	28,7	24.9	28,2	25,4	28,2	25,5	27,8	25.9	27,3	26,4	26,9	26,9	38
39	29,4	25 6	29,0	26,1	28,9	26,2	28.5	26,6	28.0	27,1	27,6	27.6	39
40	30,2	26,2	29,7	26,8	29,6	26,9	29,2	27,3	28,8	27.8	28.3	28,3	40
41	31.0	26.9	30,5	27,4	30,4	27,5	30,0	28,0	29,5	28,5	29.0	29,0	41
42	31.7	27.5	31.2	28,1	31,1	28.2	30.7	28,6	30.2	29.2	29,7	29.7	42
43	32.5	28,2	31,9	28,8	[illegible]	[illegible]	31,4	29.3	30,9	29.9	30.4	30.4	43
44	33.2	28.9	32,7	29,4	[illegible]	29,5	32,2	30.0	31,6	30.6	31,1	31,1	44
45	34,0	29.5	33,4	30.1	33.3	30.2	32.9	30,7	32.4	31,3	31.8	31,8	45
46	34,7	30.2	34.2	30,8	34.1	30,9	33,6	31,4	33,1	32.0	32.5	32.5	46
47	35,5	30.8	34,9	31,4	34,8	31,6	34.4	32,1	33 8	32,6	33.2	33.2	47
48	36,3	31,5	35,7	32.1	35.6	32,2	35,1	32,7	34.5	33,3	33,9	33.9	48
49	37.0	32,1	36,1	32.8	36,3	32,9	35,8	33,4	35,2	34.0	34.6	34.6	49
50	37.7	32,8	37,8	33,5	37,0	33.6	36,6	34.1	36.0	34.7	35,3	35,3	50
Dist.	Dep.	Lat.	Dep.	Lat.	Dep	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	49 Deg		48 Deg.		4¼ Point.		46 Deg.		46 Deg.		4 Points.		

Dist.	41 Deg Lat.	41 Deg Dep.	42 Deg. Lat.	42 Deg. Dep.	3¾ *Point.* Lat.	3¾ *Point.* Dep.	43 Deg. Lat.	43 Deg. Dep.	44 Deg Lat.	44 Deg Dep.	4 *Points* Lat.	4 *Points* Dep.	Dist.
51	38,5	33,5	37,9	34,1	37,8	34.2	37,3	34,8	36,7	35,4	36,1	36.1	51
52	39.2	34,1	38,6	34,8	38,5	34.9	[illegible]	35.5	37.4	36.1	36.8	36,8	52
53	40.0	34.8	39,4	35,5	39,3	[illegible]	38.8	36,1	38.1	36,8	37.5	37.5	53
54	40,8	35.4	40.1	36.1	40.0	36.3	39,5	36.8	38.8	37,5	38.2	[illegible]	54
55	41,5	36.0	40.9	36,8	40,7	36.9	40.2	57,5	39.6	38.2	38.9	[illegible]	55
56	42.3	36.7	41,6	37.5	41,5	37.6	41.0	38,2	[illegible]	38,9	39.6	[illegible]	56
57	43.0	37,4	42.4	[illegible]	42,2	38.3	41.7	38.9	41.0	39,6	40,3	[illegible]	57
58	43,8	38.1	43.1	38,8	43,0	38,9	42.4	39.5	41.7	40,3	[illegible]	41,0	58
59	44.5	[illegible]	43,8	39.5	43,7	[illegible]	43,1	40,2	42.4	41.0	41,7	41,7	59
60	45,3	39,4	44,6	40.1	44.5	40,3	43,8	40.9	43,2	41,7	42,4	42,4	60
61	46.0	40,0	45.3	40,8	45,2	41,0	44,6	41,7	43,9	42,4	43,1	43.1	61
62	46,8	40.7	46.1	41.5	46.0	41,6	45.3	42,3	44,6	43.1	43,8	43.8	62
63	[illegible]	41,3	46,8	42.2	46.7	42.3	[illegible]	43.0	[illegible]	43.8	44.5	44.5	63
64	48,3	42,0	47,5	[illegible]	[illegible]	43,0	46,8	43,6	46,0	44,5	45,3	45,3	64
65	49.1	42,6	48,3	43,5	48,2	[illegible]	[illegible]	[illegible]	46,8	45,1	46.0	46.0	65
66	49.8	43.3	49,0	44.2	48,9	44,3	[illegible]	[illegible]	47.5	45.8	46,7	46.7	66
67	50.6	44.0	49.8	44.8	49,6	[illegible]	[illegible]	45,7	48,2	46,5	47,4	47,4	67
68	51,3	44,6	50,5	45.5	50,4	[illegible]	49,7	[illegible]	48,9	47,2	48,1	48,1	68
69	52,1	45,3	51.3	46.2	[illegible]	46,3	50.5	[illegible]	49,6	47,9	48.8	48.8	69
70	52.8	45,9	52,0	46,8	[illegible]	47,0	51.2	[illegible]	50.3	48,6	49,5	49,5	70
71	53.6	46,6	52.8	47,5	52,6	47.7	51.9	48,4	51,1	49.3	50,2	50.2	71
72	54.3	47.2	53,5	48,2	53,3	48,3	52.7	49,1	51,8	50.0	50.9	50,9	72
73	55.1	47,9	54,2	48,8	54.1	49.0	53,4	49.8	52.5	50.7	51,6	51,6	73
74	55.9	48.5	55.0	49,5	54,8	49.7	54,1	50.5	53,2	51.4	52.3	52.3	74
75	56,8	49.2	55.7	50.2	55,6	50.4	54.8	51,1	53,9	52.1	53.0	53.0	75
76	57.4	49.9	56.5	50,9	56,3	51,0	55.6	51.8	54,7	52.8	53.7	53,7	76
77	58.1	50.5	57.2	51,5	57,1	51,7	56.3	52,5	55,4	53.5	54.4	54.4	77
78	58.9	51.2	58.0	52,1	57.8	52.4	57,0	53.2	56,1	54,2	55.2	55.2	78
79	59,6	51.8	58.7	52.8	58.5	53,0	57.8	53,9	56.8	54,9	55.9	55,9	79
80	60.4	52.5	59,4	53.5	59.3	53.7	58.5	54,6	57.5	55.6	56.6	56.6	80
81	61.1	53,1	60.2	54.2	60.0	54,4	59,2	[illegible]	58,3	56.3	57.3	57.3	81
82	61,9	53.8	60.9	54,9	60.8	55.1	60,0	55,9	59.0	57.0	58,0	58,0	82
83	62,6	54,5	61,7	55.5	61.5	55,7	60,7	56,6	59.7	57.6	58.7	58,7	83
84	63,4	55,1	62,4	56,2	62.2	56,4	61.4	57.3	60,4	58.3	59.4	59.4	84
85	64,2	55.9	63,2	56,9	63,0	57,1	62.2	58,0	61,1	59.0	60.1	60,1	85
86	64,9	56,4	63,9	57.5	63,7	57.7	63.0	58.6	61,9	59.7	60,8	60,8	86
87	65,7	57.1	64,7	58,2	64.5	58.4	63,6	59.3	62.6	[illegible]	61,5	61,5	87
88	66,4	57,7	65.5	58.9	65,2	59.1	64,4	60,0	63,3	61.1	62,2	62.2	88
89	67,2	58.4	66,1	59,6	65,9	59,8	65,1	60.7	64,0	61.8	62,9	62.9	89
90	67.9	59,0	66.9	60,2	66,7	60.4	65.8	61.4	64,7	62.5	63.6	63,6	90
91	68,7	59.7	67,6	60,9	67.4	61,1	66,5	62.1	65.5	63,2	64,3	64,3	91
92	69,4	60,4	68,4	61.6	68,2	61.8	67,3	62,7	66.2	63,9	65.0	65.0	92
93	[illegible]	61,0	69,1	62,2	68,9	62.4	[illegible]	[illegible]	66.9	64.6	65.8	65,8	93
94	71.0	61,7	69.9	62,9	69,6	63.1	[illegible]	[illegible]	67.6	65.3	66.5	66.5	94
95	71.7	62.3	70.6	63,6	70.4	63.8	69,5	64,8	68.3	66.0	67,2	67.2	95
96	72,5	63.0	71.3	64.2	71.1	64,5	70.2	65,5	69.1	66,7	67.9	[illegible]	96
97	73,2	63,6	72,1	64.9	71,9	65.1	70,9	66,1	69,8	67,4	68.6	68.6	97
98	74.0	64.3	72,8	65,6	72.6	65.8	71,7	66.8	70.5	68.1	69,3	69.3	98
99	74,7	65.0	73.6	66,2	73,4	66.5	72,4	67,5	71,2	68.8	70.0	70,0	99
100	[illegible]	65.6	74,3	66.9	74.1	67.2	73.1	68,2	71,9	69.5	70.7	70,7	100
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.
	49 Deg		48 Deg		4¼ *Point*		47 Deg.		46 Deg.		4 *Points*		

SECT. VIII.

Of Parallel Sailing.

1. SINCE the *Parallels of Latitude* do always decrease, the nearer they approach the *Pole*, it is plain, a Degree on any of them must be less than a Degree upon the *Equator*. Now, in order to know the Length of a Degree on any of them; let P B represent half the Earth's Axis, P A, a Quadrant of a *Meridian*, and consequently A, a



Point on the *Equator*, C, a Point on the *Meridian*, and CD a Perpendicular from that Point upon the Axis, which plainly will be the Sine of C P, the Distance of that Point from the Pole, or the Co-sine of C A, its Distance from the Equator, and C D will be to A B, as the Sine of C P, or Co-sine of C A, is to the Radius. Again, if the Quadrant P A B be turn'd round upon the Axis P B, 'tis plain, the Point A will deſcribe the Circumference of the *Equator*, whoſe Radius is A B, and any other Point C upon the Meridian will deſcribe the Circumference of a *Parallel*, whoſe Radius is C D.

Cor. 1. Hence (becauſe the Circumferences of Circles are as their *Radii*) it follows, that the Circumference of any *Parallel* is to the Circumference of the *Equator*, as the Co-ſine of its Latitude is to Radius.

Cor. 2. And ſince the Wholes are as their ſimilar Parts, it will be, as the Length of a Degree on any *Parallel*, is to the Length of a Degree upon the *Equator*, ſo is the Co-ſine of the Latitude of that *Parallel* to Radius.

Cor. 3. Hence, as Radius is to the Co-ſine of any Latitude, ſo is the Minutes of Difference of Longitude between two *Meridians*, or their Diſtance in Miles upon the Equator, to the Diſtance of theſe two Meridians on the *Parallel* in Miles.

Cor. 4. And as the Co-ſine of any *Parallel* is to Radius, ſo is the Length of any Arch on that *Parallel* (intercepted between two *Meridians*) in Miles, to the Length of a ſimilar Arch on the *Equator*, or Minutes of Difference of Longitude.

Cor. 5. Alſo as the Co-ſine of any one *Parallel*, is to the Co-ſine of any other *Parallel*, ſo is the Length of any Arch on the firſt, in Miles, to the Length of the ſame Arch on the other in Miles.

2. From what has been ſaid, ariſes the Solution of the ſeveral Caſes of *Parallel Sailing*, which are as follow.

CASE I.

Given the Difference of Longitude between two Places, both lying on the ſame Parallel, *to find the Diſtance between thoſe Places.*

Example I.

Example 1.

Suppoſe a Ship in the Latitude of 54°, 20′ North, ſails directly Weſt on that *Parallel*, till ſhe has differ'd Longitude 12°, 45′. Required the Diſtance ſail'd on that *Parallel*.

Firſt, The Difference of Longitude reduced into Minutes, or nautical Miles, is 765′, which is the Diſtance between the Meridian ſail'd from, and the Meridian come to, upon the *Equator*; then, to find the Diſtance between thoſe Meridians on the *Parallel* of 54°, 20′, or the Diſtance ſail'd, it will be, by *Cor.* 3. of the laſt *Article*.

As Radius - - - - - -		10.00000
is to the Co-ſine of the Lat.	54°, 20′	9.76572
ſo is the Min. of Diff. of Long.	765 -	2.88366
to the Diſtance on the Parallel	446.1 -	2.64938

Example 2.

A Degree on the *Equator* being 60 Minutes, or nautical Miles. Required the Length of a Degree on the *Parallel* of 51°, 32′.

By *Cor.* 3. of the laſt *Article*, it will be

As Radius - - - - - - -		10.00000
is to the Co-ſine of the Lat. -	51°, 32′	9.79383
ſo is the Min. in 1 Deg. on the *Eq.*	60. -	1.77815
to - - - - - - -	37.32 -	1.57198

the Miles anſwering to a Degree on the *Parallel* of 51°, 32′.

By

By this *Problem* the following Table is construct-ed, shewing the Geographic Miles answering to a Degree on any *Parallel* of Latitude; in which you may observe, that the Columns mark'd at the Top with *D. L.* contain the Degrees of Latitude belong-ing to each *Parallel*; and the adjacent Columns mark'd at the Top, *Miles*, contain the Miles answer-ing to a Degree upon these *Parallels*.

A Table *shewing 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	3[illegible]	47.92	55	34.41	73	17.54
2	59.97	20	56.38	[illegible]	47.28	[illegible]6	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	45.96	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	44.95	60	30.00	78	12.48
7	59.56	25	54.38	43	43.88	61	29.09	79	11.45
8	59.42	26	53.93	44	43.16	62	28.17	80	10.42
9	59.26	27	53.46	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	90	0.[illegible]

Tho' this Table does only shew the Miles answer-ing to a Degree of any *Parallel*, whose Latitude consists of a whole Number of Degrees; yet it may be made to serve for any *Parallel*, whose Latitude is some Number of Degrees and Minutes, by mak-ing the following Proportion, *viz.*

As 1 Degree, or 60 Minutes, is to the Difference between the Miles answering to a Degree in the next greater and next less Tabular Latitude than that

that propofed, fo is the Excefs of the propofed Latitude above the next lefs Tabular Latitude, to a proportional Part; which, fubtracted from the Miles anfwering to a Degree of Longitude in the next lefs Tabular Latitude, will give the Miles anfwering to a Degree in the propofed Latitude.

Example.

Required to find the Miles anfwering to a Degree on the *Parallel* of 56°, 44′.

Firft, The next lefs *Parallel* of Latitude in the Table, than that propofed, is that of 56°, a Degree of which (by the Table) is equal to 33.55 Miles; and the next greater Parallel of Latitude in the Table, than that propofed, is that of 57°, a Degree of which is (by the Table) equal to 32.68 Miles; the Difference of thefe is .87, and the Diftance between thefe *Parallels* is 1 Degree or 60 Minutes; alfo the Diftance between the *Parallel* of 56°, and the propofed *Parallel* of 56°, 44′ is 44 Minutes; then by the preceding Proportion it will be: As 60 is to .87, fo is 44 to .638, the Difference between a Degree on the *Parallel* of 56°, and a Degree on the *Parallel* of 56°, 44′, which therefore taken from 33.55, the Miles anfwering to a Degree on the *Parallel* of 56°, leaves 32.912, the Miles anfwering to a Degree on the *Parallel* of 56°, 44′, as was required.

CASE 2.

The Diftance fail'd in any Parallel *of Latitude, or the Diftance between any two Places on that* Parallel *being given, to find the Difference of Longitude.*

Example.

Example.

Suppose a Ship in the Latitude of 55°, 36′ North, sails directly East 685.6 Miles. Required how much she has differ'd her Longitude.

By *Cor.* 4. *Art.* 1. of this *Section*, it will be,

As the Co-sine of the Lat. -	55°, 36′ -	9.75202
is to Radius - - -	-	10.00000
so is the Distance sail'd	685.6 -	2.83607
to Min. of Diff. of Longit.	1213. -	3.80405

which reduc'd into Degrees, by dividing by 60, makes 20°, 13′ the Difference of Longitude the Ship has made.

This may also be solv'd by Help of the foregoing Table, *viz.* by finding from it, the Miles answering to a Degree on the proposed *Parallel*, and dividing with this the given Number of Miles, the Quotient will be the Degrees and Minutes of Difference of Longitude required.

Thus, in the last *Example*; I find, from the foregoing Table, that a Degree on the Parallel of 55°, 36′ is equal to 33.89 Miles; by this I divide the proposed Number of Miles 685.6 and the Quotient is 20.23 Degrees, *i. e.* 20°, 13′, the Difference of Longitude required.

CASE 3.

The Difference of Longitude between two Places on the same Parallel, *and the Distance between them being given, to find the Latitude of that* Parallel.

Example.

Example.

Suppoſe a Ship ſails on a certain *Parallel* directly Weſt 624 Miles, and then has differ'd her Longitude 18°, 46', or 1126 Miles. Required the Latitude of the *Parallel* ſhe ſail'd upon.

By *Cor.* 3. *Art.* 1. of this *Section*, it will be,

As the Min. of Diff. of Long.	1126.	-	3.05154
is to the Diſtance ſail'd	- 624.	-	2.79518
ſo is Radius	- - - - -	-	10.00000
to the Co-ſine of the Lat.	- 56°, 21'		9.74364

conſequently the Latitude of the Ship, or *Parallel* ſhe ſail'd upon, was 56°, 21'.

From what has been ſaid, may be ſolv'd the following Problems.

Problem I.

Suppoſe two Ships in the Latitude of 46°, 30' North, diſtant aſunder 654 Miles, ſail both directly North 256, and conſequently are come to the Latitude of 50°, 46' North. Required their Diſtance on that *Parallel*.

By *Cor.* 5. of *Art.* 1. of this *Section*, it will be,

As the Co-ſine of - -	46°, 30'	-	9.83781
is to the Co-ſine of -	50, 46	-	9.80105
ſo is - - - -	654. - -	-	2.81558
to - - - -	601. - -	-	2.77882

the Diſtance between the Ships, when on the *Parallel* of 50°, 46'.

Problem

Problem 2.

Suppose two Ships in the Latitude of 45°, 48' North, distant asunder 846 Miles, sail directly North, till the Distance between them is 624 Miles. Required the Latitude come to, and the Distance sail'd.

By *Cor.* 5. of *Art.* 1. of this *Section*, it will be,

As their first Distance - - -	846 - -	2.92737
is to their second Distance -	624 - -	2.79518
so is the Co-sine of -	45°, 48'	9,84334
to the Co-sine of - -	59, 04	9.71115

the Latitude of the *Parallel* the Ships are come to.

Consequently to find their Distance sail'd,

From the Latitude come to - -	59°, 04'
subtract the Latitude sail'd from -	45, 48
and there remains - - - - -	13, 16

equal to 796 Miles, the Difference of Latitude or Distance sail'd.

3. Tho' in solving the Problems in this Section, we supposed the Earth to be really spherical, yet it is not so, but rather an *Oblate Spheroid*, having the Diameter of the Equator about 34 Miles longer than the Axis, which makes the Length of a Degree on the Meridian, near the Pole, about a Mile longer than the Length of a Degree near the Equator; and the *Radii* of the *Parallels*, instead of being Sines in a Circle, will be *Ordinates* to the lesser Axe of an *Ellipse*. Consequently, the true Length of a Degree on any *Parallel*, will somewhat differ from its Length on the Supposition of the Earth's being a Sphere; but this Difference is so small, that in all *nautical* Cases it may safely be neglected.

SECT. IX.

SECT. IX.

Of Middle Latitude Sailing.

1. WHEN two Places lie both on the ſame *Parallel*, we ſhew'd in the laſt Section, how from the Difference of Longitude given, to find the Miles of Eaſting or Weſting between them, & *e contra*; but when two Places lie not on the ſame Parallel, then their Difference of Longitude cannot be reduced to Miles of Eaſting or Weſting on the Parallel of either Place; for if counted on the Parallel of that Place that has the greateſt Latitude it would be too ſmall, and if on the Parallel of that Place having the leaſt Latitude it would be too great. Hence the common Way of reducing the Difference of Longitude between two Places lying on different Parallels, to Miles of Eaſting or Weſting, & *e contra*, is by counting it on the middle Parallel between the Places, which is found by adding the Latitudes of the two Places together, and taking half the Sum, which will be the Latitude of the middle Parallel required. And hence ariſes the Solution of the following Caſes.

CASE I.

The Latitudes of two Places, and their Difference of Longitude given, to find the direct Courſe and Diſtance.

Example.

Requir'd the direct Courſe and Diſtance between the *Lizard* in the Latitude of 50°, 00′ N. and

Longitude of 5°, 14′ W. and St. *Vincent* in the Latitude of 17°, 10′ N. and Longitude of 24° 20′ W.

	° ′
First, To the Latitude of the *Lizard* -	50, 00 N
add the Latitude of St. *Vincent* - -	17, 10
The Sum is - - - - - - - - - -	67, 10
Half the Sum or Latitude of the middle Parallel is - - -	33, 35
Also the Difference of Latitude is -	32, 50

equal to 1970 Miles of Southing. Again,

	° ′
From the Long. of St. *Vincent* - -	24, 20 W
take the Long. of the *Lizard* - -	05, 14 W
there remains - - - - - - - - -	19, 06

equal to 1146 Min. of Diff. of Long. West.

Then for the Miles of Westing, or Departure, it will be, by *Case* 1. *of Parallel Sailing*,

As Radius - - - - - - - - - - -		10.00000
is to the Co-sine of the middle Parallel	33° 35′ - -	9.92069
so is Min. Diff. of Long. -	1146 - -	3.05918
to the Miles of Westing -	954.7 - -	2.97987

And for the Course it will be, by *Case* 4. *of Plain Sailing*,

As the Diff. of Lat. - -	1970 - -	3.29447
is to Radius - - - - - - -		10.00000
so is the Departure - -	954.7 - -	2.97987
to the Tang. of the Course	25° 51′ - -	9.68540

which because it is between South and West will be S SW¼ West nearly.

For the Distance it will be, by the same *Case*,

As Radius - - - - - - - - - -		10.00000
is to the Diff. of Lat. -	1970 - -	3.29447

so

so is the Secant of the Course	25° 51′	-	10.04579
to the Distance - - - -	2189	-	3.34026

whence the direct Course and Distance from the Lizard to St. *Vincent* is S S W¼ W, 2189 Miles.

CASE 2.

One Latitude, Course and Distance sail'd, being given, to find the other Latitude, and Difference of Longitude.

Example.

Suppose a Ship in the Latitude of 50°, 00′ North, sails South 50°, 06′ West 150 Miles. Required the Latitude the Ship has come to, and how much she has differ'd her Longitude.

First, For the Difference of Latitude it will be, by *Case* 1. *of Plain Sailing*,

As Radius - - - - - -		10.00000
is to the Distance - -	150 -	2.17609
so is the Co-sine of the Course	50°, 06′	9.80716
to the Diff. of Latitude -	96.22	1.98325

equal to 1°, 36′, and since the Ship is sailing towards the Equator. Therefore,

From the Latitude she was in - -	50°, 00′
take the Diff. of Latitude - -	1, 36
and there remains - - - - -	48, 24

the Latitude she has come to North. Consequently the Latitude of the middle Parallel will be 49°, 12′.

Then for Departure or Westing it will be, by the same *Case*,

As

As Radius - - - - - - - - - -		10.00000
is to the Diſtance - -	150 - -	2.17609
ſo is the Sine of the Courſe	50°, 06′ -	9.88489
to the Departure - -	115.1 - -	2.06098

and for the Difference of Longitude, it will be by *Caſe* 2. *of Parallel Sailing,*

As the Co-ſine of the mid. Par.	49°, 12′	9.81519
is to Radius - - - - - - -		10.00000
ſo is the Departure - -	115.1 -	2.06098
to the min. Diff of Longitude	176.1 -	2.44579

equal to 2°, 56′, which is the Difference of Longitude, the Ship has made Weſterly.

CASE 3.

Courſe and Difference of Latitude given, to find the Diſtance ſail'd, and Difference of Longitude.

Example.

Suppoſe a Ship in the Latitude of 53°, 34′ North, ſails S E *b* S, till by Obſervation ſhe's found to be in the Latitude of 51°, 12′, and conſequently has differ'd her Latitude 2°, 22′, or 142 Miles. Required the Diſtance ſail'd, and the Difference of Longitude.

Firſt, For the Departure, it will be (by *Caſe* 2. *of Plain Sailing*)

As Radius - - - - - - - - - - -		10.00000
is to the Diff. of Latitude -	142 -	2.15229
ſo is the Tang. of Courſe	33°, 45′	9.82489
to the Departure - - -	94.88	1.97718

And for the Diſt. it will be, by the ſame *Caſe*,

As

As Radius	- - - - - - - -		10,00000
is to the Diff. of Lat.	- -	142 -	2.15229
so is the Secant of the Course		33°, 45′	10.08015
to the Dist.	- - - - - -	170.8 -	2.23244

Then, since the Latitude sail'd from was 53°, 34′ North, and the Latitude come to 51°, 12′ N. therefore the middle Parallel will be 47°, 23′, and consequently for the Diff. of Longitude, it will be (by Case 2. of Parallel Sailing)

As the Co-sine of the mid. Par.	47°, 23′	9.83065
is to the Depart. - - - -	94.88 -	1.97718
so is Radius - - - - - - - - - -		10.00000
to min. of Diff. of Longit. -	140 -	2.14653

equal to 2°, 20′, the Difference of Longitude Easterly.

CASE 4.

Difference of Latitude, and Distance sail'd given, to find the Course and Difference of Longitude.

Example.

Suppose a Ship in the Latitude of 43°, 26′ N. sails between S. and E 246 Miles, and then is found by Observation to be in the Latitude of 41°, 06′ N. Required the direct Course and Difference of Longitude.

First, For the Course it will be, by Case 3. of Plain Sailing,

As the Dist. - -	246 - -	2.39094
is to Radius - - - - -		10.00000

so

so is the Diff. of Latitude 140 - - 2.1[illegible]
to the Co-sine of the Course 55°, 19′ 9.7[illegible]519
which because the Ship sails between [illegible]ou[illegible]n and East, will be South 55°, 19′ East, [illegible] S E b E. nearly.

Then for Departure it will be, by the sam[illegible] *Case*,

As Radius - - - - - -		10.00000
is to the Dist. - -	246 - -	2.39094
so is the Sine of the Course 55°, 19′ -		9.91504
to the Depart. - -	202.3 -	2.30598

Lastly, For the Difference of Longitude, it will be, by Case 2. of Parallel Sailing.

As the Co-sine of the mid. Par. 42°, 16′		9.86924
is to the Depart. - - -	202.3 -	2.30598
so is Radius - - - -		10.00000
to min. of Diff. of Longit. -	273.3 -	2.43674

equal to 4°, 33′, the Difference of Longitude Easterly.

CASE 5.

Course and Departure given, to find Difference of Latitude, Difference of Longitude, and Distance sail'd.

Example.

Suppose a Ship in the Latitude of 48°, 23′ N. sails S W b S. till she has made of Westing 123 Miles. Required the Latitude come to, the Difference of Longitude, and the Distance sail'd.

First, For the Distance it will be, by Case 6. of Plain Sailing,

As

As the Sine of the Courſe	33°, 45′	-	9.74474
is to the Depart.	123	- -	2.08991
ſo is Radius	- - -	- -	10.00000
to the Diſtance	- - -	221.4 -	2.34517

And for the Difference of Latitude it will be, by the ſame *Caſe*,

As the Tang. of Courſe	- 33°, 45′	-	9.82489
is to the Departure	- - 123	- -	2.08991
ſo is Radius	- - - -	-	10.00000
to the Diff. of Latitude	- 184	-	2.26502

equal to 3°, 04′, and ſince the Ship is ſailing towards the Equator, the Latitude come to will be 45°, 19′ North; and conſequently the middle Parallel will be 46°, 51′.

Then to find the Difference of Longitude by *Caſe* 2. of Parallel Sailing,

As the Co-ſine of mid. Par.	46°, 51′	-	9.83500
is to the Departure	- 123	-	2.08901
ſo is Radius	- -	-	10.00000
to min. of Diff. of Longit.	180	-	2.25491

which is equal to 3°, 00′, the Difference of Longitude Weſterly.

CASE 6.

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

Example.

Suppoſe a Ship in the Latitude of 46°, 37′ North, ſails between South and Eaſt, till ſhe has made of Eaſting, 146 Miles and is then found by by Obſervation to be in the Latitude of 43°, ... North. Required the Courſe, Diſtance and Difference of Longitude.

Firſt, By *Caſe* 4. of Plain Sailing, it will be for the Courſe,

As the Diff. of Latitude -	193 -	2.28556
is to Departure - -	146 -	2.16137
ſo is Radius - - - -		10.00000
to the Tang. of the Courſe	36°, 55′	9.87581

which becauſe the Ship is ſailing between South and Eaſt, will be South 36°, 55′ Eaſt, or SE*b*S ¼ Eaſt nearly.

For the Diſtance it will be by the ſame *Caſe*,

As Radius - - - -		10.00000
is to the Diff. of Latitude -	193 -	2.28556
ſo is the Sec. of the Courſe	36°, 55′	10.09718
to the Diſtance - -	241.4 -	2.38274

Then for the Difference of Longitude it will be, by *Caſe* 2. of Parallel Sailing.

As the Co-ſine of the mid. Par.	45°, 00′	9.84959
is to the Departure - -	146 -	2.16137
ſo is Radius - - - -		10.00000
to min. of Diff. of Longitude	205 -	2.31178

equal to 3°, 25′, the Difference of Longitude Eaſterly.

CASE 7.

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

Example.

Example.

Suppose a Ship in the Latitude of 33°, 40′ North, ſails between South and Eaſt 165 Miles, and has then made of Eaſting 112.5 Miles. Required the Difference of Latitude, Courſe, and Difference of Longitude.

Firſt, For the Courſe it will be, (by *Caſe* 5. of *Plane Sailing*.

As the Diſtance - - -	- 165 -	2.21748
is to Radius - - - - - -		10.00000
ſo is the Departure -	- 102.5 -	2.05115
to the Sine of the Courſe -	42°, 59′	9.83367

which becauſe the Ship ſails between South and Eaſt, will be South 42°, 59′ Eaſt, or S E *b* S, ¾ Eaſt, nearly.

And for the Difference of Latitude it will be, by the ſame *Caſe*,

As Radius - - - - - -		10.00000
is to the Diſtance - -	165 -	2.11748
ſo is the Co-ſine of the Courſe	42°, 59′	9.86436
to the Difference of Latitude	120.7 -	2.08184

equal to 2°, 00′. Conſequently the Latitude come to will be 31°, 40′ North, and the Latitude of the middle *Parallel* will be 32°, 40′. Hence to find the Difference of Longitude it will be, by *Caſe* 2. of *Parallel Sailing*.

As the Co-Sine of the mid. *Par.*	32°, 40′	9.92522
is to the Departure - -	112.5 -	2.05115
ſo is Radius - - - - - -	-	10.00000
to the Min. of Diff. of Long.	133.6 -	2.12593

 equal

equal to 2°, 13′ nearly, the Difference of Longitude Easterly.

CASE 8.

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

Example.

Suppose a Ship in the Latitude of 50°, 46′ North, sails between South and West, till her Difference of Longitude is 3°, 12′, and is then found to have departed from her former Meridian 126 Miles. Required the Difference of Latitude, Course, and Distance sail'd.

First, For the Latitude she has come to it will be, by *Case* 3. *of Parallel Sailing*,

As the Min. of Diff. of Long.	192	- 2.28330
is to the Departure - - -	126	- 2.10037
so is Radius - - - - - -		- 10.00000
to the Co-sine of the mid. *Par.*	48°, 59′	9.81707

Now, since the Middle-Latitude is equal to half the Sum of the two Latitudes (by *Art.* 1. of this *Sect.*) and so the Sum of the two Latitudes equal to double the middle Latitude; it follows, that if from double the middle Latitude we subtract any one of the Latitudes, the Remainder will be the other. Hence from twice 48°, 59′, *viz.* 97°, 58′, taking 50°, 46′, the Latitude sail'd from, there remains 47°, 12′, the Latitude come to. Consequently the Difference of Latitude is 3°, 34′, or 214 Minutes.

Then,

Then, for the Course it will be, by *Case* 4. of *Plane Sailing.*

As the Difference of Lat. -	214	-	2.33041
is to Radius - - - - - - -			10.00000
so is the Diff. of Long. -	126	-	2.10037
to the Tang. of the Course -	30°, 29′		9.76996

which, because it is between South and West, will be South 30°, 29′ West, or SSW ¾ West, nearly.

And for the Distance it will be, (by the same *Case*,

As Radius - - - - - - -			10.00000
is to the Difference of Lat.	214	-	2.33041
so is the Sec. of the Course -	30°, 29′		10.06461
to the Distance - - -	248.4	-	2.39502

2. From what has been said, it will be easy to solve a *Traverse*, by the Rules of *Middle-Latitude Sailing.*

Example.

Suppose a Ship in the Latitude of 43°, 25′ North, sails upon the following Courses, *viz.* SW *b* S 63 Miles, SSW ½ West 45 Miles, S *b* E 54 Miles, and SW *b* W 74 Miles. Required the Latitude the Ship has come to, and how far she has differ'd her Longitude.

First, By *Case* 2. of this *Sect.* find the Difference of Latitude, and Difference of Longitude belonging to each Course and Distance, and they will stand as in the following Table.

		Diff. of Lat.		*Diff. of Longit.*	
Course	*Dist.*	*N.*	*S.*	*E.*	*W.*
SW b S	63	——	52.4	——	47.85
SSW ½ W	45	——	39.7	——	28.62
S b E	54	——	53.0	13.75	
SW b W	74	——	41.1	——	81.08
	Diff. of Lat.		186.2		157.55
					13.75
			Diff. of Long.		143.80

Hence it is plain, the Ship has differ'd her Latitude 186.2 Minutes, or 3°, 06′, and so has come to the Latitude of 40°, 19′ North, and has made of Difference of Longitude 143.8 Minutes, or 2° 23′, 48″ Westerly.

3. This Method of Sailing, tho' it be not strictly true, yet it comes very near the Truth, as will be evident, by comparing an Example wrought by this Method, with the same wrought by the Method deliver'd in the next *Section*, which is strictly true; and it serves without any considerable Error, in Runnings of 450 Miles between the *Equator* and *Parallel* of 30 Degrees; of 300 Miles between that and the Parallel of 60 Degrees; and of 150 Miles, as far as there is any Occasion, and consequently must be sufficiently exact for 24 Hours Run.

SECT. X.

Of *Mercator's* Sailing.

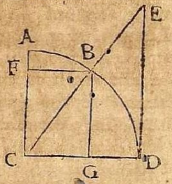
1. THO' the *Meridians* do all meet at the *Pole*, and the *Parallels* to the *Equator* do continually decrease, and that in Proportion to the Co-

fines

sines of their Latitudes; yet, in old Sea-*Charts* the *Meridians* were drawn parallel to one another, and consequently the *Parallels* of Latitude, made equal to the *Equator*, and so a Degree of Longitude on any *Parallel*, as large as a Degree 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 Places were very erroneously mark'd down upon the Chart; thus, for Instance, an Island on the *Parallel* of 60, would in this Chart be represented in a double Proportion, as to its Length, in *Easting* and *Westing*, but the same as to its Breadth in *Northing* and *Southing*; whereas in order to its being truly drawn upon the Chart, it ought to be lengthened, as to its *Southing* and *Northing*, in the same Proportion as it is in its *Easting* and *Westing*, so as the whole may be represented on the Chart proportionally as it is on the Globe itself.

3. To remedy this Inconvenience, so as still to keep the *Meridians* parallel, 'tis 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* and *Westing*, may be the same with that of *Southing* and *Northing*.

3. In the annex'd Scheme let A B D be a Quadrant of a Meridian, B F or C G, the Radius of the Parallel describ'd by the Point B and C D the Radius of the Equator; draw the Tangent D E and Secant C E, also the right Sine B G. Then it has been demonstrated, in *Sect.* 8. that a Degree upon any *Parallel*, is to a Degree on the *Equator*, as the Co-sine of its Latitude, is to Radius. Thus, a Degree on the *Parallel* describ'd by the Point B, is to a Degree on the *Equator*, as



BF

BF or CG is to CD the Radius; but (by *Art.* 74. *Sect.* 1.) CG : CD :: CB : CE; therefore a Degree on any *Parallel*, is to a Degree on the *Equator*, as Radius is to the Secant of the Latitude; and since in this Projection the *Meridians* are suppos'd to be parallel, and consequently each of the *Parallels* equal to the *Equator*, 'tis plain, the Radius of any *Parallel* will become equal to the Radius of the *Equator*, and so CG will every where become equal to CD; but when CG becomes equal to CD, 'tis plain, CB will become equal to CE. Consequently in this Projection, the Radius of the *Meridian* at any *Parallel*, will be equal to the Secant of the Latitude of that *Parallel*. Also since a Degree, or any small Arch upon the *Equator*, is equal to a Degree, or the like Arch upon the *Meridian*; therefore as the Secant of any *Parallel*, is to Radius, so is the Length of a Degree, or any small Arch on the *Meridian*, to the Length of a Degree, or like Arch on that *Parallel*. Hence 'tis evident that, in this Projection, where the *Meridians* are parallel, a Degree on any *Parallel* will be increas'd beyond its just Proportion, at such Rate as the Secant of the Latitude is greater than Radius; and consequently the Degrees on the *Meridian* must every where be increas'd in the same Rate; that so the Proportion in *Northing* and *Southing* may be the same with that of *Easting* and *Westing*, that is, the Length of a Degree, or any small Arch on the enlarg'd *Meridian*, must every where be to a Degree, or like Arch of the *Meridian* on the Globe, as the Secant of the Latitude is to Radius. Hence, by supposing the Length of any small Arch of the *Meridian* Radius, it follows, from what has been said.

Cor. 1. That the Length of a Degree, or any small Arch on the enlarg'd *Meridian*, is every where equal to the Secant of the Arch contain'd between it and the *Equator*.

2. The

2. The Diſtance of any Point upon the enlarg'd *Meridian* from the *Equator*, is equal to the Sum of all the Secants contain'd between it and the *Equator*.

3. The Diſtance between any two *Parallels* on the ſame Side of the *Equator*, is equal to the Difference of the Sums of all the Secants contain'd between the *Equator* and each of the *Parallels*.

4. The Diſtance between any two *Parallels* on contrary Sides of the *Equator*, is equal to the Sum of the Sums of all the Secants contain'd between the *Equator* and each *Parallel*.

5. Now, ſince it has been ſhewn, that in this Projection the Diſtance of each Point of the *Meridian* from the *Equator*, is equal to the Sum of all the Secants contain'd between it and the *Equator*; 'tis plain, that by a continual Addition of the Secants, beginning at the *Equator*, we ſhall have the Diſtance of every particular Point in the *Meridian* from the *Equator*, which Diſtances collected together from the Table, commonly call'd, *A Table of Meridional Parts*, which is annex'd to the End of this *Section*, and in which you may obſerve that the Top-Column contains the Degrees, and the Left-hand Side Column the Minutes; the other Columns contain the Meridional Parts anſwering to theſe Degrees and Minutes. There is alſo upon *Gunter's Scale*, a Line of Meridional Parts, mark'd *Mer.* which ſhews the Diſtance of each Point of the *Meridian* from the *Equator*.

6. By either of theſe, *viz.* the Table of Meridional Parts, or the *Meridian* Line upon *Gunter's Scale*, may a *Mercator's Chart* be conſtructed. Thus for Example, let it be required to make a Chart that ſhall commence at the *Equator*, and reach to the Parallel of 60 Degrees, and ſhall contain 80 Degrees of Longitude.

Draw

Draw the Line EQ representing the *Equator*; (see *Plate* I.) then take from any convenient Line, of equal Parts, 4800 (the Number of Minutes contain'd in 80 Degrees) which set off from E to Q, and this will determine the Breadth of the Chart.

Divide the Line EQ into eight equal Parts, in the Points 10, 20, 30, &c. each containing 10 Degrees, and each of these divided into 10 equal Parts, will give the single Degrees upon the *Equator*; then thro' the Points E, 10, 20, &c. drawing Lines perpendicular to EQ, these shall be the Meridians.

From the Scale of equal Parts take 4527.4 (the Meridional Parts answering to 60 Degrees) and set that off from E to A, and from Q to B, and join AB; then this Line will represent the Parallel of 60, and will determine the Length of the Chart.

Again, from the Scale of equal Parts take 603.1, (the Meridional Parts answering to 10 Degrees) and set that off from E to 10, on the Line EA, and through the Point 10 draw 10, 10, parallel to EQ, and this will be the *Parallel* of 10 Degrees. The same Way setting off from E on the Line EA, the Meridional Parts answering to each Degree, &c. of Latitude, and thro' the several Points drawing Lines parallel to EQ, we shall have the several *Parallels* of Latitude.

If the *Chart* does not commence from the *Equator*, but is only to serve for a certain Distance on the *Meridian*, between two given *Parallels* on the same Side of the *Equator*; then the *Meridians* are to be drawn, as in the last *Example*; and for the Parallels of Latitude you are to proceed thus; *viz.* 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 Differences severally, from the Parallel of the least Latitude, upon the two extreme Meridians, and the

Lines

Lines joining theſe Points of the Meridians ſhall repreſent the ſeveral *Parallels* upon your *Chart.*

Thus let it be required to draw a *Chart* that ſhall ſerve from the Latitude of 20 Degrees North to 60 Degrees North, and that ſhall contain 80 Degrees of Longitude.

Having drawn the Line DC to repreſent the Parallel of 20 Degrees (ſee *Plate* 1.) and the *Meridians* to it, as in the foregoing Example; ſet off 663.3 (the Difference between the Meridional Parts anſwering to 30 Degrees, and thoſe of 20 Degrees) from D to 30, and from C to 30; then join the Points 30 and 30 with a Right Line, and that ſhall be the Parallel of 30. Alſo ſet off 1397.6 (the Difference between the Meridional Parts anſwering to 40 Degrees, and thoſe of 20 Degrees) from D to 40, and from C to 40, and joining the Points 40, and 40 with a Right Line, that ſhall be the Parallel of 40. And proceeding after the ſame Way, we may draw as many of the intermediate Parallels as we ſhall have occaſion for.

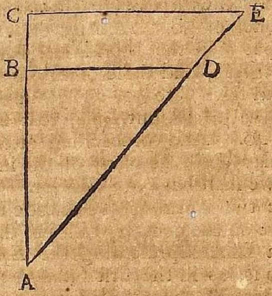
But if the two *Parallels* of Latitude that bounds the *Chart*, are on the contrary Sides of the *Equator*; then draw a Line repreſenting the *Equator*, and *Meridians* to it, as in the firſt *Example*; and from the *Equator* ſet off on each Side of it the ſeveral Parallels contained between it and the given Parallels, as above, and your *Chart* is finiſhed.

N. B. Here you muſt Notice; that in all *Charts*, the upper Part is the *North* Side, and the lower Part, or Bottom, is the *South* Side; alſo that Part of it towards the Right-hand is the *Eaſt*, and that towards the Left-hand, the *Weſt* Side of the *Chart.*

6. Since, according to this Projection, the *Meridians* are parallel Right Lines, 'tis plain, that the *Rumbs*, which form always equal Angles with the *Meridians*, will be ſtrait Lines; which Property renders this Projection of the Earth's Surface much more eaſy and proper for Uſe, than any other.

7. This Method of projecting the Earth's Surface upon a Plane, was first invented by Mr. *Edward Wright*, but first published by *Mercator*; and hence the Sailing by the *Chart*, was called *Mercator's* Sailing.

8. In the annexed Scheme, let A and D represent two Places upon the Surface of the Globe, A C the Meridian of A, and A D the Rumb Line between the two Places; thro' D draw B D perpendicular to A C, and this will be the *Parallel* of Latitude of the Place D; from A set off upon the



Meridian, the Length A C, equal to the *Meridional* or *enlarg'd Difference of Latitude*; and thro' C draw C E parallel to B D meeting A D produced in E; then A B will be the *proper Difference of Latitude*, and A C the *enlarg'd Difference of Latitude*, or the Difference of Latitude, according to *Mercator's Chart*, between the Places A and D: C E will be the *Difference of Longitude*, and B D the *Departure*; also A D will be the *proper Distance*, and A E the enlarg'd, or according to *Mercator's Chart*, and the Angle B A D will be the *Course*.

9. Now

9. Now since in the Triangle ACE, BD is parallel to one of its Sides CE; 'tis plain, the Triangles ACE, ABD will be fimilar, and confequently the Sides proportional (by *Art.* 74. *Sect.* 1.) Hence arife the Solutions of the feveral *Cafes* in this Sailing, which are as follow.

CASE I.

The Latitudes of two Places given, to find the Meridional or enlarg'd Difference of Latitude between them.

Of this *Cafe* there are three Varieties, *viz.* either one of the Places lies on the *Equator*, or both on the fame Side of it; or *Laftly*, on different Sides.

1. If one of the propofed Places lies on the *Equator*, then the Meridional Difference of Latitude is the fame with the Latitude of the other Place, taken from the Table of Meridional Parts.

Example.

Required the Meridional Difference of Latitude between *St. Thomas*, lying on the *Equator*, and *St. Antonio*, in the Latitude of 17°, 20′ North. I look in the following Table for the Meridional Parts anfwering to 17°, 20′, and find it to be 1056.2, the enlarg'd Difference of Latitude required.

2. If the two propofed Places be on the fame Side of the *Equator*, then the Meridional Difference of Latitude is found by fubtracting the Meridional Parts anfwering to the leaft Latitude, from thofe anfwering to the greateft, and the Difference is that required.

Example.

Required the Meridional Difference of Latitude between the *Lizard*, in the Latitude of 50°, 00′ North, and *Antegoa*, in the Latitude of 17°, 30 North.

From the Meridional Parts of -	50°, 00′ -	3474.5
ſubtract the Merid. Parts of -	17°, 30 -	1066.7
there remains - - - - - - -		2407.8

the Meridional Difference of Latitude required.

3. If the Places lie on different Sides of the *Equator*, then the Meridional Difference of Latitude is found by adding together the Meridional Parts anſwering to each Latitude, and the Sum is that required.

Example.

Required the Meridional Difference of Latitude between *Antegoa*, in the Latitude of 17°, 30′ North, and *Lima*, in *Peru*, in the Latitude of 12°, 30′ South.

To the Merid. Parts anſwering to	17°, 30′	1066.7
add theſe anſwering to - -	12 , 30	756.1
the Sum is - - - - - - -		1822.8

the Meridional Difference of Latitude required.

CASE 2.

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

Example.

Example.

Required to find the direct Course and Distance between the *Lizard*, in the Latitude of 50°, 00′ North, and *Port-Royal* in *Jamaica*, in the Latitude of 17°, 40′; differing in Longitude 70°, 46′, *Port-Royal* lying so far to the Westward of the *Lizard*.

Preparation.

From the Latitude of the *Lizard* - -	50°, 00′
subtract the Latitude of *Port-Royal* -	17 , 40
and there remain - - - - -	32 , 20

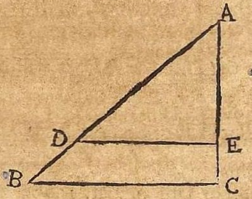
equal to 1940 Minutes, the proper Difference of Latitude.

Then from the Merid. Parts of	50°, 00′ -	3474.5
subtract those of - -	17 , 40 -	1077.2
and there remain - - - - -		- 2397.3

the Meridional or enlarg'd Difference of Latitude.

Geometrically.

Draw the Line AC representing the *Meridian* of



the *Lizard* at A, and set off from A, upon that Line,

Line, AE equal to 1940 (from any Scale of equal Parts) the proper Difference of Latitude, alſo AC equal to 2397.3 (from the ſame Scale) the Meridional or enlarg'd Difference of Latitude. Upon the Point C raiſe CB perpendicular to AC, and make CB equal to 4246, the Minutes of Difference of Longitude.

Join AB, and thro' E draw ED parallel to BC; ſo the *Caſe* is conſtructed, and AD applied to the ſame Scale of equal Parts the other Legs were taken from, will give the direct Diſtance, and the Angle DAE, meaſured by the Line of Chords, will give the Courſe.

By Calculation.

For the Angle of the Courſe EAD it will be, (by *Caſe* 4. *of Rectangular Trigonometry.*)

AC : CB :: R : T, BAC, *i. e.*

As the Meridional Diff. of Lat.	2397.3 -	3.37970
is to the Difference of Long.	4246.0 -	3.62798
ſo is Radius	- - - - - -	10.00000
to the Tang. of the dir. Courſe	60°, 33′	10.34828

which becauſe *Port-Royal* is Southward of the *Lizard*, and the Difference of Longitude Weſterly, will be South 60°, 33′ Weſt, or S W *b* W ½ Weſt, nearly.

Then for the Diſtance AD, it will be, by *Caſe* 2. *of Rectangular Trigonometry.*

R : AE :: Sec. A : AD, *i. e.*

As the Radius	- - - - - -	10.00000
is to the proper Diff. of Lat.	1940 -	3.28780
ſo is the Sec. of the Courſe	60°, 33′	10.30833
to the Diſtance - -	3945.6 -	3.59613

conſe-

consequently the direct Course and Distance between the *Lizard* and *Port-Royal* in *Jamaica*, is South 60°, 33′ West, 3945.6 Miles.

CASE 3.

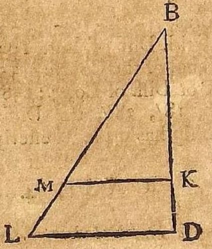
Course and Distance sail'd given, to find the Difference of Latitude and Difference of Longitude.

Example.

Suppose a Ship from the *Lizard* in the Latitude of 50°, 00′ North, sails South 35°, 40′ West 156 Miles. Required the Latitude come to, and how much she has alter'd her Longitude.

Geometrically.

1. Draw the Line BK representing the Meridian of the *Lizard* at B; from B draw the Line BM,



making with BK an Angle equal to 35°, 40′, and upon this Line set off BM equal to 156, the given Distance,

Distance, and from M [illegible] fall the Perpendicular MK upon BK.

Then for BK, the proper Difference of Latitude, it will be, by *Case* 3. *of Rectangular Trigonometry.*

R : MB : : S, BMK : BK.

i. e. As Radius - - - - -		10.00000
is to the Distance - -	156 -	2.19312
so is the Co-sine of the Course	35°, 40′	9.90978
to the proper Diff. of Latitude	127 -	2.10290

equal to 2°, 07′, and since the Ship is sailing from a North Latitude towards the South, therefore the Latitude come to will be 47°, 53′ North. Hence the Meridional Difference of Latitude will be 193.4.

2. Produce BK to D, till BD be equal to 193.4; thro' D draw DL parallel to MK, meeting DM produced in L; then DL will be the Difference of Longitude: to find which by Calculation; it will be, (by *Case* 1. *of Rectangular Trigonometry.*)

R : BD : : T, LBD : DL.

i. e. As Radius - - - - - -		10.00000
is to the Merid. Diff. of Lat.	193.4 -	2.28646
so is the Tang. of the Course	35°, 40′	9.85594
to the Min. of Diff. of Long.	138.8 -	2.14240

equal to 2°, 18′, 38″, the Difference of Longitude the Ship has made Westerly.

CASE 4.

Given, Course and both Latitudes, viz. *the Latitude sail'd from, and the Latitude come to, to find the Distance sail'd, and the Difference of Longitude.*

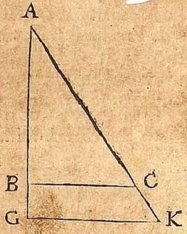
Example.

Example.

Suppose a Ship in the Latitude of 54°, 20′ North, sails South 33°, 45′ East, until by Observation she's found to be in the Latitude of 51°, 45′ North. Required the Distance sail'd, and the Difference of Longitude.

Geometrically.

Draw A B, to represent the Meridian of the Ship in the first Latitude, and set off from A to B 155, the Minutes of the proper Difference of Latitude, also A G equal to 257.9 the Minutes of the enlarg'd Difference of Latitude. Thro' B and G draw the Lines B C and G K perpendicular to A G; also draw A K making with A G an Angle of 33°, 45′ which will meet the two former Lines in the Points C and K; so the Case is constructed, and A C and GK may be found from the Line of equal Parts, to find which



By Calculation.

First, For the Difference of Longitude it will be, by *Case* 1. *of Rectangular Trigonometry.*

R : A G : : T, G A K : G K.

i. e. As Radius - - - - 10.00000
is to the enlarg'd Diff. of Lat. - 257.9 - 2.41145

ſo is the Tang. of the Courſe 33° 45′ - - 9.82489
to the Min. of Diff. of Longit. - 172.3- - 2.23634

equal to 2°, 52′, 18″, the Difference of Longitude the Ship has made Eaſterly.

This might alſo have been found, by firſt finding the Departure BC (by *Caſe* 2. *of Plane Sailing.)* and then (by *Art.* 74. *Sect.* 1.) it would

AB: BC:: AG: GK. The Difference of Longitude required.

Then for the direct Diſtance A C, it will be, by *Caſe* 2. *of Rectangular Trigonometry.*

R : AB :: Sec. A : AC.

i. e. As Radius	- - -		10.00000
is to the proper Diff. of Lat.	155	- - -	2.19033
ſo is the Secant of the Courſe	33°, 45′		10.08015
to the direct Diſtance - -	186.4	- -	2.27048

conſequently the Ship has ſail'd South 33°, 45′ Eaſt, 186.4 Miles, and has differ'd her Longitude 2°, 52′, 18″ Eaſterly.

CASE 5.

Both Latitudes, and Diſtance ſail'd, given, to find the direct Courſe, and Difference of Longitude.

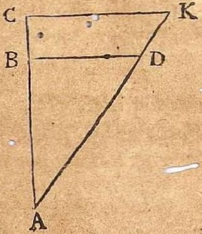
Example.

Suppoſe a Ship from the Latitude of 45°, 26′ North, ſails between North and Eaſt 195 Miles, and then by Obſervation ſhe's found to be in the Latitude of 48°, 06′ North. Required the direct Courſe and Difference of Longitude.

Geometrically.

Geometrically.

Draw A B equal to 160 the proper Difference of Latitude, and from the Point B raise the perpendicular B D; then take 195 in your Compasses, and setting one Foot of them in A, with the other cross the Line B D in D. Produce A B till A C be equal to 233.6 the enlarg'd Difference of Latitude. Thro' C draw C K parallel to B D, meeting A D produc'd in K; so the Case is constructed, and the Angle A may be measured by the Line of Chords, and C K by the Line of equal Parts. To find which



By Calculation.

First, For the Angle of the Course B A D it will be, (by *Case* 5. of *Rectangular Trigonometry.*)

A B : R :: A D : Sec. A. *i. e.*

As the proper Diff. of Lat.	160. - -	2.20412
is to Radius - -	- -	10.00000
so is the Distance -	-195. - -	2.29003
to the Sec. of the Course	34°, 52' -	10.08591

which because the Ship is sailing between North and East, will be North 34°, 52' East, or S E *b* S 1°, 07' Easterly:

Then for the Difference of Longitude it will be, (by *Case* 1. *of Rectangular Trigonometry.*)

R: AC:: T, A: CK.

i. e. As Radius	-	-	10.00000
is to the Merid. Diff. of Lat.	- 233.	-	2.36847
so is the Tangent of the Course	34°, 32′		9.84307
to the Min. Diff. of Long.	- 162.8	-	2.21154

equal to 2°, 42′, 48″, the Difference of Longitude Easterly.

CASE 6.

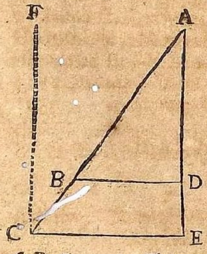
One Latitude, Course, and Difference of Longitude, given, to find the other Latitude, and Distance sail'd.

Example.

Suppose a Ship from the Latitude of 48°, 50′ North, sails South 34°, 40′ West, till her Difference of Longitude is 2°, 44′. Required the Latitude come to, and the Distance sail'd.

Geometrically.

1. Draw A E to represent the Meridian of the Ship in the first Latitude, and make the Angle E A C equal to 34°, 40′, the Angle of the Course; then draw F C parallel to A E, at the Distance of 164 the Minutes of Difference of Longitude, which will meet A C in the Point C. From C let fall upon A E the perpendicular C E; then A E will be the enlarg'd Difference of Latitude. To find which, *by Calculation* it will be, by *Case* 1. *of Rectangular Trigonometry.*



T,

T, A: R:: CE: AE.

i. e. As the Tang. of the Course	34°, 40′	9.83984
is to the Radius	- - - -	10.00000
so are the Min. of Diff. Long.	164.	2.21484
to the enlarg'd Diff. of Lat.	237.2	2.37500

and because the Ship is sailing from a North Latitude Southerly. Therefore,

From the Merid. Parts of the Latitude sail'd from	48°, 50′	3366.9
take the Merid. Diff. of Lat.	- - -	237.2
and there remains	- - - -	3129.7

the Meridional Parts of the Latitude come to, *viz.* 46°, 09′.

Hence for the proper Difference of Latitude,

From the Latitude sail'd from	48°, 50′ N
take the Latitude come to	46 , 09 N
and there remain	2 , 41

equal to 161, the Minutes of Difference of Latitude.

2. Set off upon AE the Length AD equal to 161 the proper Difference of Latitude, and thro' D draw DB parallel to CE; then AB will be the direct Distance. To find which, *by Calculation*, it will be, by *Case* 2. *of Rectangular Trigonometry*.

R: AD:: Sec. A: AB.

i. e. As Radius	- - - -	10.00000
is to the proper Diff. of Lat.	161	2.20683
so is the Sec. of the Course	34°, 40′	10.08488
to the direct Distance	195.8	2.29171

CASE 7

CASE 7.

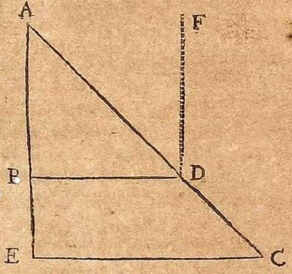
One Latitude, Course and Departure given, to find the other Latitude, Distance sail'd, and Difference of Longitude.

Example.

Suppose a Ship sails from the Latitude of 54°, 36′ North, South 42°, 33′ East, until she has made of Departure 116 Miles. Required the Latitude she is in, her direct Distance sail'd, and how much she has alter'd her Longitude.

Geometrically.

1. Having drawn the Meridian A B, make the Angle B A D equal to 42°, 33′. Draw F D pa-



rallel to A B at the Distance of 116, which will meet A D in D. Let fall upon A B the perpendicular D B. Then A B will be the proper Difference

rence of Latitude, and A D the direct Diſtance, to find which, *by Calculation*; firſt, for the Diſtance A D it will be, by *Caſe* 2. *Rectangular Trigonometry.*

S, A: BD:: R: A D.

i. e. As the Sine of the Courſe	42°, 33′	9.83010
is to the Departure - - -	116. - -	2.06446
ſo is Radius - - - -	-	10.00000
to the direct Diſtance - -	171.5 - -	2.23436

Then for the proper Difference of Latitude it will be, by *Caſe* 1. *of Rectangular Trigonometry*,

T, A: BD:: R: AB.

i. e. As the Tang. of the Courſe	42°, 33′	9.96281
is to the Departure - - -	116. - -	2.06446
ſo is Radius - - - -	-	10.00000
to the proper Diff. of Lat. - -	126.4 - -	2.10165

equal to 2°, 6′, conſequently the Ship has come to the Latitude of 52°, 30′ North, and ſo the Meridional Difference of Latitude will be 212.2.

2. Produce A B to E, till A E be equal to 212.2; and thro' E draw E C parallel to B D, meeting A D produc'd in C; then E C will be the Difference of Longitude, to find which, *by Calculation*, it will be, by *Caſe* 1. *of Rectangular Trigonometry.*

R: AE: T, A: EC.

i. e. As Radius - - - - -	-	10.00000
is to the Meridian Diff. of Lat. -	212.2 -	2.32675
ſo is the Tang. of the Courſe	42°, 33′	9.96281
to the Min. of Diff. of Long. -	194.8 - -	2.28956

equal to 3°, 14′, 48″, the Difference of Longitude Eaſterly.

This

This might have been found otherwiſe; thus, becauſe the Triangles A C E, A D B are ſimilar, therefore (by *Art.* 74. *Sect.* 1.) it will be

AB: BD:: AE: EC:

i. e. As the proper Diff. of Lat. -	126.4 -	2.10165
is to the Departure - - - - -	116. -	2.06446
ſo is the enlarged Diff. of Lat. - -	212.2 -	2.32675
to the Min. of Diff. of Long. - -	194.8 -	2.28956

CASE 8.

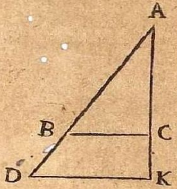
Both Latitudes and Departure given, to find the Courſe, Diſtance and Difference of Longitude.

Example.

Suppoſe a Ship from the Latitude of 46°, 20′ North, ſails between South and Weſt, till ſhe has made of Departure 126.4 Miles; and is then found by Obſervation to be in the Latitude of 43°, 35′ North. Required the Courſe and Diſtance ſail'd, and Difference of Longitude.

Geometrically.

Draw AK to repreſent the Meridian of the Ship in her firſt Latitude, ſet off upon it A C, equal to 165, the proper Difference of Latitude. Draw BC perpendicular to A C, equal to 126.4 the Departure, and join A B. Set off from A, A K equal to 233.3, the enlarg'd Difference of Latitude, and through K draw K D parallel to B C, meeting A B produc'd in D; ſo the *Caſe* is conſtructed,



ſtructed, and D K will be the Difference of Longitude, A B the Diſtance, and the Angle A the Courſe; to find which

By Calculation.

Firſt, For D K, the Difference of Longitude, it will be (by *Art.* 7. *Sect.* 1.)

AC : CB :: AK : KD.

i. e. As the proper Diff. of Lat.	165	- 2.21748
is to the Departure - -	126.4	- 2.10175
ſo is the enlarg'd Diff. of Lat.	233.3	- 2.36791
to the Minutes of Diff. of Long.	178.7	- 2.25218

equal to 2°, 58′, 42″, the Difference of Longitude Weſterly.

Then for the Courſe it will be, (by *Caſe* 4. *of Rectangular Trigonometry.*

AC : BC :: R : T, A.

i. e. As the proper Diff. of Lat.	165	- 2.21748
is to the Departure - -	126.4	- 2.10175
ſo is Radius - - - - - -		- 10.00000
to the Tang. of the Courſe -	37°, 27′	9.88427

which, becauſe the Ship ſails between South and Weſt, will be South 37°, 27′ Weſt, or S W *b* S 6°, 30′ Weſterly.

Laſtly, For the Diſtance AB, it will be, (by *Caſe* 2. *of Rectangular Trigonometry.*

S, A : BC :: R : AB.

i.e. As the Sine of the Course	$37^{\circ}, 27'$	-	9.78395
is to the Departure - -	126.4	-	2.10175
so is Radius - - - - -		-	10.00000
to the direct Distance -	207.9	-	2.31780

CASE 9.

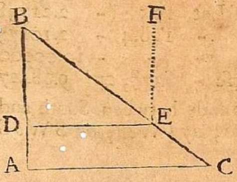
One Latitude, Distance sail'd, and Departure given, to find the other Latitude, Difference of Longitude and Course.

Example.

Suppose a Ship in the Latitude of $48^{\circ}, 33'$ North, sails between South and East 138 Miles, and has then made of Departure 112.6. Required the Latitude come to, the direct Course and Difference of Longitude.

Geometrically.

1. Draw BD for the Meridian of the Ship at B, and parallel to it draw FE, at the Distance of 112.6, the Departure. Take 138, the Distance, in your Compasses, and fixing one Point of them in B, with the other cross the Line FE in the Point E; then join B and E, and from E let fall upon BD the Perpendicular ED; so BD will be the proper Difference of Latitude, and the Angle B will be the Course; to find which, *by Calculation.*



First,

First, For the Courſe it will be, (by *Caſe* 5. of *Rectangular Trigonometry.*)

BE : R : : DE : S, B.

i. e. As the Diſtance	- -	138 -	2.13988
is to Radius	- - - - - -		10.00000
ſo is the Departure	- -	112.6 -	2.05154
to the Sine of the Courſe	-	54°, 41′	9.91166

which becauſe the Ship ſails between South and Eaſt, will be South 54°, 41′ Eaſt, or S E 9°, 41′ Eaſterly.

Then for the Difference of Latitude it will be, (by *Caſe* 3. of *Rectangular Trigonometry.*)

R : BE : : Co-S, B : BD.

i. e. As Radius - - - - -		10.00000
is to the Diſtance - -	138 -	2.13988
ſo is the Co-ſine of the Courſe	54°, 41′	9.76200
to the Difference of Latitude	79.8 -	1.90188

equal to 1°, 19′. Conſequently the Ship has come to the Latitude of 47°, 13′. Hence the Meridional Difference of Latitude will be 117.7.

2. Produce B to A, till BA be equal to 117.7, and through A draw AC parallel to DE, meeting BE produc'd in C; then AC will be the Difference of Longitude, to find which, *by Calculation* it will be (by *Art.* 74. *Sect.* 1.)

BD : DE : : BA : AC.

i. e. As the proper Diff. of Lat.	79.8 -	1.90188
is to the Departure - - -	112.6 -	2.05154
ſo is the enlarg'd Diff. of Lat.	117.7 -	2.07078
to the Difference of Longitude	166.1 -	2.22044

 equal

equal to 2°, 46′, 06″, the Difference of Longitude Easterly.

9. From what has been said, it will be easy to solve a *Traverse* according to the Rules of *Mercator's Sailing*.

Example.

Suppose a Ship at the *Lizard* in the Latitude of 50°, 00′ North, is bound to the *Madera*, in the Latitude of 32°, 20′ North, the Difference of Longitude between them, being 11°, 40′ the West End of the *Madera*, lying so much to the Westward of the *Lizard*, and consequently the direct Course and Distance (by *Case* 2. of this *Sect.*) is South 26°, 15′ West 1181.9 Miles; but by reason of the Winds she is forced to sail on the following Courses (Allowance being made for *Lee-way* and *Variation*, &c.) SSW 44 Miles, S*b*W ½ West 36 Miles, SW*b*S 56 Miles, and S*b*E 28 Miles. Required the Latitude the Ship is in, her Bearing and Distance from the *Lizard*, and her direct Course and Distance from the *Madera*, at the End of these Courses.

The *Geometrical Construction* of this *Traverse* is perform'd by laying down the two Ports, according to the Construction of *Case* 2. of this *Sect.* and the several Courses and Distances according to *Case* 3. by which we have the following Solution *by Calculation*.

1. Course SSW, Distance 44 Miles.
For Difference of Latitude,

As Radius - - - - - - -		10.00000
is to the Distance - -	44 -	1.64345
so is the Co-sine of the Course	22°, 30′	9.96562
to the Difference of Latitude	40.65 -	1.60907

and

and ſince the Courſe is Southerly, therefore the Latitude come to will be 49°, 20′ North, and conſequently the Meridional Difference of Latitude will be 61.8. Then,

For the Difference of Longitude.

As Radius - - - - - -		10.00000
is to the enlarg'd Diff. of Lat.	61.8 -	1.79099
ſo is the Tang. of the Courſe	22°, 30′	9.61722
to the Minutes of Diff. of Long.	25.6 -	1.40821

2. Courſe S*b*W ¼ Weſt, Diſtance 36 Miles.
For Difference of Latitude.

As Radius - - - - - - -		10.00000
is to the Diſtance - -	36 -	1.55630
ſo is the Co-ſine of the Courſe	16°, 52′	9.98090
to the Difference of Latitude	34.46 -	1.53720

and ſince the Courſe is Southerly, therefore the Latitude come to will be 48°, 45′. Hence the Meridional Difference of Latitude will be 53.4 Then,

For the Difference of Longitude.

As Radius - - - - - -		10.00000
is to the enlarg'd Diff. of Lat.	53.4 -	1.72754
ſo is the Tang. of the Courſe	16°, 52′	9.48171
to the Difference of Longitude	16.19 -	1.20925

3. Courſe SW*b*S, Diſtance 56 Miles.
For Difference of Latitude.

As Radius - - - - - - -		10.00000
is to the Diſtance - -	56 -	1.74819
ſo is the Co-ſine of the Courſe	33°, 45′	9.91985
to the Difference of Latitude	46.56 -	1.66804

conſe-

consequently the Latitude come to is 47°, 59'; and therefore the enlarg'd Difference of Latitude will be 69.2. Then,

For the Difference of Longitude.

As Radius - - - - - - - -		10.00000
is to the enlarg'd Diff. of Lat.	69.2 -	1.84011
so is the Tang. of the Course	33°, 45'	9.82489
to the Difference of Long. -	46.24 -	1.66500

4. Course S b E, Distance 28 Miles.
For Difference of Latitude.

As Radius - - - - - - -		10.00000
is to the Distance - -	28 -	1.44716
so is the Co-sine of the Course	11°, 15'	9.99157
to the Difference of Latitude	27.46 -	1.43873

consequently the Latitude come to will be 47°, 31', and hence the Meridional Difference of Latitude will be 43.2. Then,

For the Difference of Longitude.

As Radius - - - - - - -		10.00000
is to the enlarg'd Diff of Lat.	43.2 -	1.63548
so is the Tang. of the Course	11°, 15'	9.29866
to the Difference of Long. -	8.59 -	0.93414

Now these several Courses and Distances, together with the Difference of Latitude and Longitude, belong to each of them, being set down in their proper Columns in the *Traverse Table*, will stand as follows.

Course	Dist.	Diff. of Lat. N.	Diff. of Lat. S.	Diff. of Longit. E.	Diff. of Longit. W.
S S W	44	——	40.65	——	25.00
S b W ½ W	36	——	34.46	——	16.19
S W b S	56	——	46.56	——	46.24
S b E	28	——	27.46	8.59	——
	Diff. of Lat.		149.13	8.59	88.03
					8.59
				Diff. of Long.	79.44

Hence it is plain, that the Ship has made of Southing 149.13 Minutes, and consequently has come to the Latitude of 47°, 31′ North, and so the Meridional Difference of Latitude between that and her first Latitude will be 226.1; and since she has made of Difference of Longitude 79.44 Minutes Westerly; therefore for the direct Course and Distance between the *Lizard* and the Ship, it will be, (by *Case* 2. *of this Section.*)

For the direct Course.

As the Merid. Diff. of Lat.	226.1	- -	2.35430
is to Radius	- - - - -	-	10.00000
so is the Diff. of Long.	- 79.44	-	1.90004
to the Tang. of the Course	19°, 22′	-	9.54574

which because the Difference of Latitude is Southerly, and the Difference of Longitude Westerly, will be South 19°, 22′ West, or S b W 8°, 07′ Westerly. Then,

For the direct Distance.

As Radius	- - - - - - -		10.00000
is to the proper Diff. of Lat.	149.13	-	2.17349
so is the Sec. of the Course	- 19°, 22′		10.02530
to the direct Distance	- 158	- -	2.19879

From

From the Latitude the Ship is in - 47°, 31′ N
subtract the Lat. of the *Madera* - 32 , 20 N

and there remains - - - - - 15 , 11
equal to 911 Minutes, the proper Difference of Latitude between the Ship and the *Madera*.

Again, from the Merid. Parts answering to the Latitude the Ship is in - 3248.4
Take the Meridional Parts answering to the Latitude of the *Madera* - 2052.0

and there remains - - - - - - - 1196.4
the enlarg'd Difference of Latitude between the Ship and the *Madera*.

Alſo, from the Diff. of Long. between the *Liz.* and the *Madera* 11°, 40′ W
Take the Difference of Long. between the *Lizard* and the Ship 1 , 19 $\frac{44}{100}$ W

and there remains - - - - 10 , 20 $\frac{56}{100}$ W
equal to 620.56 Min. of Difference of Longitude between the Ship and the *Madera* Weſterly.

Then, for the direct Courſe and Diſtance between the Ship and the *Madera*, it will be

For the direct Courſe.

As the Merid. Diff. of Lat.	1196.4 -	3.07788
is to Radius - - - - - -	-	10.00000
ſo is the Diff. of Long.	620.56 -	2.79278
to the Tang. of the Courſe	27°, 25′	9.71490

For the direct Diſtance.

As Radius - - - - - -	-	10.00000
is to the proper Diff. of Lat.	911 -	2.95952

ſo

ſo is the Sec. of the Courſe	27°, [illegible]	[illegible]0.05174
to the direct Diſtance - -	102 [illegible]	3.01126

10. It is very common in working a Day's Reckoning at Sea, to find the Difference of Latitude and Departure to each Courſe and Diſtance, and adding all the Departures together, and all the Differences of Latitudes for the whole Departure and Difference of Latitude made good that Day; from thence (by *Caſe* 8. of this *Section*) to find the Difference of Longitude, &c. made good that Day. Now that this Method is falſe, will evidently appear, if we conſider that the ſame Departure reckon'd on two different Parallels will give unequal Differences of Longitude; and conſequently when ſeveral Departures are compounded together and reckon'd on the ſame Parallel, the Difference of Longitude reſulting from that, cannot be the ſame with the Sum of the Differences of Longitude reſulting from the ſeveral Departures on different Parallels; and therefore, I have choſen in the laſt *Example* of a *Traverſe*, to find the Difference of Longitude anſwering to each particular Courſe and Diſtance, the Sum of which muſt be the true Difference of Longitude made good by the Ship on theſe ſeveral Courſes and Diſtances.

11. We ſhew'd at *Art.* 5. of this *Section*, how to conſtruct a *Mercator's* Chart, and now we ſhall proceed to its ſeveral Uſes; contain'd in the following *Problems*.

Prob. 1. Let it be required to lay down a Place upon the Chart, its Latitude, and the Difference of Longitude between it, and ſome known Place upon the Chart being given.

Example. Let the known Place be the *Lizard*, lying on the Parallel of 50°,00′ N. and the Place to be laid down St. *Katharines*, on the Eaſt Coaſt of *America*, differing in Longitude from the *Lizard* 42°, 36′, lying ſo much to the Weſtward of it.

 Let

Let L represent the *Lizard* on the Chart, (see Plate I.) l on the Parallel of 50°, 00′ North, its Meridi E. Set off from E upon the Equator EQ 4 , 36′, towards Q, which will reach from E to F. Thro' F draw the Meridian FG, and this will be the Meridian of St. *Katharines*; then set off from Q o H upon the graduated Meridian Q B, 28 Degrees; and thro' H draw the Parallel of Latitude H M, which will meet the former Meridian in K the Place upon the Chart required.

Prob. 2. Given two Places upon the Chart, to find their Difference of Latitude and Difference of Longitude.

Thro' the two Places draw Parallels of Latitude; then the Distance between these Parallels number'd in Degrees and Minutes upon the graduated Meridian, will be the Difference of Latitude required; and thro' the two Places drawing Meridians, the Distance between these counted in Degrees and Minutes on the Equator, or any graduated Parallel, will be the Difference of Longitude required.

Prob. 3. To find the Bearing of one Place from another upon the Chart.

Example. Required the Bearing of St. *Katharines* at K, (see Plate I.) from the *Lizard* at L.

Draw the Meridian of the *Lizard* A E, and join K and L with the right Line KL, then by the Line of Chords measuring the Angle K L E, and with that entering the Table at Page 156, we shall have the Thing required.

This may also be done, by having Compasses drawn on the Chart (suppose at two of its Corners) then lay the Edge of a Ruler over the two Places and let fall a Perpendicular, or take the nearest Distance from the Center of the Compass next the first Place, to the Ruler's Edge; then with this Distance in your Compasses slide them along by the Ruler's Edge, keeping one Foot of them close to the

the Ruler, and the other as near as you can judge perpendicular to it, which will de[illegible] the Rumb required.

Prob. 4. To find the Diſtance betw[illegible]n two given Places upon the Chart.

This *Problem* admits of four Cases, according to the Situation of the two Places, wi[illegible] Reſpect to one another.

Caſe 1. When the given Places lie both upon the Equator.

In this *Caſe* their Diſtance is found by converting the Degrees of Difference of Longitude intercepted between them into Minutes.

Caſe 2. When the two Places lie both on the ſame Meridian.

Draw the Parallels of thoſe Places, and the Degrees upon the graduated Meridian, intercepted between thoſe Parallels reduced to Minutes, give the Diſtance required.

Caſe 3. When the two Places lie on the ſame Parallel.

Example. Required to find the Diſtance between the Points K and N, (ſee Plate 1.) both lying on the Parallel of 28°, 00′ North. Take from your Scale the Chord of 60°, or Radius in your Compaſſes, and with that Extent on K N as a Baſe, make the *Iſoſceles* Triangle KPN; then take from the Line of Sines the Co-ſine of the Latitude, or Sine of 62°, and ſet that off from P to S and T. Join S and T with the right Line ST, and that applied to the graduated Equator will give the Degrees and Minutes upon it equal to the Diſtance; which, converted into Minutes, will be the Diſtance required.

The Reaſon of this is evident from *Sect.* 8. for it has been there demonſtrated, that Radius is to the Co-ſine of any Parallel, as the Length of any Arch on the Equator, to the Length of the ſame Arch on that

that Parallel; now in this Chart KN is the Diſtance of the Me[illegible] of the two Places K and N upon the Equator, and ſince in the Triangle PNK, ST is parallel to KN, therefore PN : PT :: NK : TS. Conſequently TS will be the Diſtance of the two Places K and N upon the Parallel of 28°.

If the Parallel of the two Places lies on be not far from the Equator, and they not far aſunder; then their Diſtance may be found thus. Take the Diſtance between them in your Compaſſes, and apply that to the graduated Meridian, ſo as the one Foot may be as many Minutes above, as the other is below the given Parallel, and the Degrees and Minutes intercepted, reduced to Minutes, will give the Diſtance.

Or it may alſo be found thus. Take the Length of a Degree on the Meridian at the given Parallel, half a Deg. above, and half a Deg. below the Parallel, and turn that over on the Parallel from the one Place to the other, as oft as you can; then as oft as that Extent is contain'd between the Places, ſo many times 60 Miles will be contain'd in the Diſtance between them.

Caſe 4. When the Places differ both in Longitude and Latitude.

Example. Suppoſe it were required to find the Diſtance between the two Places *a* and *e* upon the *Chart.* By,

Prob. 2. Find the Difference of Latitude between them, and take that in your Compaſſes from the graduated Equator, which ſet off on the Meridian of *a*, from *a* to *b*; then thro' *b* draw *b c* parallel to *d e*, and taking *a c* in your Compaſſes, apply it to the graduated Equator and it will ſhow the Degrees and Minutes contain'd in the Diſt. required, which multiplied by 60 will give the Miles of Diſtance.

The Reaſon of this is evident from *Art.* 8. of this *Sect.* for 'tis plain *a d* is the enlarg'd Difference

of

of Latitude and *ab* the proper; c fquently *ae* the enlarg'd Diftance and *ac* the pr

Prob. 5. To lay down a Place upon *Chart*, its Latitude and Bearing from fome know Place upon the Chart being known; or (which is the fame) having the Courfe and Difference of Latitude that a Ship has made, to lay down the Running of the Ship, and find her Place upon the Chart.

Example. A Ship from the *Lizard* in the Latitude of 50°, 00′ North, fails SSW till fhe has differ'd her Latitude 36°, 40′. Required her Place upon the Chart.

Count from the *Lizard* at L, on the graduated Meridian downwards (becaufe the Courfe is Southly) 36°, 40′ to g; thro' which draw a Parallel of Latitude, which will be the Parallel the Ship is in; then from L draw a SSW Line L*f*, cutting the former Parallel in *f*, and this will be the Ship's Place upon the Chart.

Prob. 6. One Latitude, Courfe and Diftance fail'd, given to lay down the Running of the Ship, and find her Place upon the Chart.

Example. Suppofe a Ship at *a* in the Latitude of 20°, 00′ North, fails North 37°, 20′ Eaft, 191 Miles. Required the Ship's Place upon the Chart.

Having drawn the Meridian and Parallel of the Place *a*, fet off the Rhumb-Line *a e*, making with *a b* an Angle of 37°, 20′, and upon it fet off 191 from *a* to *c*; thro' *c* draw the Parallel *c b*, and taking *a b* in your Compaffes, apply it to the graduated Equator, and obferve the Number of Degrees it contains; then count the fame Number of Degrees on the graduated Meridian from C to *b*, and thro' *b* draw the Parallel *b e*, which will cut *a c* produc'd in the Point *e*, the Ship's Place requir'd.

Prob. 7.

Prob. 7. Both Latitudes, and Diſtance ſail'd given, to find the Ship's Place upon the Chart.

Example. Suppoſe a Ship ſails from *a* in the Latitude of 20°, 00′ North, between North and E. 191 Miles and is then in the Latitude of 45°,00′ N. Required the Ship's Place upon the Chart.

Draw *d e* the Parallel of 45°, and ſet off upon the Meridian of *a* upwards, *a b* equal to the proper Difference of Latitude taken from the Equator or graduated Parallel. Thro' *b* draw *b c* parallel to *d e*; then with 191 in your Compaſſes taken as before from the Equator or graduated Parallel, fixing one Foot of them in *a* with the other croſs *b c* in *c*. Join *a* and *c* with the right Line *a c*, which produc'd will meet *d e* in *e* the Ship's Place required.

Prob. 8. One Latitude, Courſe and Difference of Longitude, given to find the Ship's Place upon the Chart.

Example. Suppoſe a Ship from the *Lizard* in the Latitude of 50°, 00′ North, ſails S W *b* W, till her Difference of Longitude is 42°, 36′. Requir'd the Ship's Place upon the Chart.

Having drawn A F the Meridian of the *Lizard* at L, count from E to F upon the Equator 42°, 36′, and thro' F draw the Meridian F G; then from L draw the SW*b*W Line LK and where this meets FG, as at K, will be the Ship's Place requir'd.

Prob. 9. One Latitude, Courſe, and Departure, given, to find the Ship's Place upon the Chart.

Example. Suppoſe a Ship at *a* in the Latitude of 20°, 00′ North, ſails North 37°, 20′ Eaſt, till ſhe has made of Departure 116 Miles. Requir'd the Ship's Place upon the Chart.

Having drawn the Meridian of *a*, at the Diſtance of 116, draw Parallel to it the Meridian *k l*. Draw the Rumb Line *a c*, which will meet *k l* in ſome Point *c*; then thro' *c* draw the Parallel *c b*, and

a b

a b will be the proper Difference of Latitude, and *b c* the Departure. Take *a b* in your Compasses and apply it to the Equator or graduated Parallel; then observe the Number of Degrees it contains, and count so many on the graduated Meridian from C upwards to *b*. Thro' *b* draw the Parallel *b e*, which will meet *a c* produc'd in some Point as *e*, which is the Ship's Place upon the Chart.

Prob. 10. One Latitude, Distance, and Departure, given, to find the Ship's Place upon the Chart.

Example. Suppose a Ship at *a* in the Latitude of 20°, 00′ North, sails 191 Miles between North and East, and then is found to have made of Departure 116 Miles. Requir'd the Ship's Place upon the Chart.

Having drawn the Meridian and Parallel of the Place *a*, set off upon the Parallel *a m* equal to 116, and thro' *m* draw the Meridian *k l*. Take the given Distance 191 in your Compasses setting one Foot of them in *a*, with the other cross *k l* in *c*, join *a c*, and thro' *c* draw the Parallel *c b*; so *c b* will be the Departure, and *a b* the proper Difference of Latitude; then proceeding with this as in the foregoing *Problem*, you'll find the Ship's Place to be *e*.

Prob. 11. The Latitude sail'd from, Difference of Latitude and Departure given, to find the Ship's Place upon the Chart.

Example. Suppose a Ship from *a* in the Latitude of 20°, 00′ North, sails between North and East, till she be in the Latitude of 45°, 00′ North, and is then found to have made of Departure 116 Miles. Requir'd the Ship's Place upon the Chart.

Having drawn the Meridian of *a*, set off upon it from *a* to *b*, 25 Degrees, (taken from the Equator or graduated Parallel) the proper Difference of Latitude; then thro' *b* draw the Parallel *b c*, and make *b c* equal to 116 the Departure, and join *a c*. Count from the Parallel of *a* on the graduated Meridian

Meridian upwards to *b* 25 Degrees, and thro' *b* draw the Parallel *b e*, which will meet *a c* produc'd in some Place *e*, and this will be the Place of the Ship required.

12. In *Sect.* [illegible] 'tis plain that the Terms *Meridional* Distance, Departure, and Difference of Longitude were synonymous, constantly signifying the same Thing; which evidently follow'd from the Supposition of the Earth's Surface being projected on a Plane, in which the Meridians were made parallel and the Degrees of Latitude equal to one another and to those of the Equator. But since it has been demonstrated (in this *Section*) that, if in the Projection of the Earth's Surface upon a Plane, the Meridians be made parallel, the Degrees of Latitude must be unequal, still increasing the nearer they come to the Pole. It follows that these Terms must denote Lines really different from one another. Difference of Longitude is defin'd at *Art.* 14. *Sect.* 3. Meridional Distance at *Art.* 3. *Sect.* 7. and Departure at *Art.* 8. of this *Section.*

A
TABLE
OF
MERIDIONAL PARTS.

L.	0	1	2	3	4	5	6	7	[illegible]
M.	Mni.	Min.	Min.	Min.	Min.	Mi[illegible].	M[illegible]n.	Min.	Min.
0	0.	60.[illegible]	120.0	180.1	240.2	3[illegible]	360.7	4[illegible]	481.[illegible]
1	1.0	61.0	121.0	181.1	241.[illegible]	[illegible]1.4	[illegible]1.7	[illegible]2.1	482.6
2	2.0	6[illegible].0	12[illegible].0	182.1	242[illegible]	302.[illegible]	362.[illegible]	[illegible].1	483.6
3	3.0	63.0	123.0	18[illegible]	[illegible]	3[illegible]3.4	363.[illegible]	[illegible]4.1	484.6
4	4.0	64.0	12[illegible]	184.1	[illegible]2	304.4	36[illegible]	425.1	485.6
5	5.0	65.[illegible]	[illegible]5.0	185.[illegible]	[illegible]5	305.4	365.7	426.1	486.6
6	6.0	66.0	[illegible]26.0	186.[illegible]	[illegible]46.2	306.4	366.7	427.1	487.6
7	7.0	67.0	127.0	187.[illegible]	247.2	307.4	367.7	428.1	488.6
8	8.0	68.0	128.0	188.1	[illegible]48.2	308.4	368.7	429.1	489.6
9	9.0	69.0	129.0	189.1	249.2	309.4	369.7	430.1	490.7
10	10.0	70.0	130.0	190.1	25[illegible].2	310.4	370.7	431.1	491.7
11	11.0	71.0	131.0	191.1	25[illegible]2	311.4	371.7	432.1	492.7
12	12.0	72.0	132.0	192.1	252.[illegible]	312.4	372.7	433.1	493.7
13	13.0	73.0	133.0	193.1	253.2	313.4	373.7	434.2	494.7
14	14.0	74.0	134.0	194.1	254.2	314.4	374.7	435.2	495.7
15	15.0	75.0	135.0	195.1	255.2	315.5	375.8	436.2	496.7
16	16.0	76.0	136.0	196.1	256.2	316.5	376.8	437.2	497.7
17	17.0	77.0	137.0	197.1	257.2	317.5	377.8	438.2	498.7
18	18.0	78.0	138.0	198.1	258.2	318.5	378.8	439.2	499.8
19	19.0	79.0	139.0	199.1	259.2	319.5	379.8	440.2	500.8
20	20.0	80.0	140.0	200.1	260.3	320.5	380.8	441.2	501.8
21	21.0	81.0	141.0	201.1	261.3	321.5	381.8	442.2	502.8
22	22.0	82.0	142.0	202.1	262.3	322.5	382.8	443.2	503.8
23	23.0	83.0	143.0	203.1	263.3	323.5	383.8	444.2	504.8
24	24.0	84.0	144.0	204.1	264.3	324.5	384.8	445.2	505.8
25	25.0	85.0	145.0	205.1	265.3	325.5	385.3	446.3	506.8
26	26.0	86.0	146.0	206.1	266.3	326.5	386.[illegible]	[illegible]47.3	5[illegible]7.8
27	27.0	87.0	147.0	207.1	267.3	327.5	387.8	4[illegible]8.3	5[illegible].9
28	28.0	88.0	148.1	208.1	268.3	328.5	388.8	44[illegible]	[illegible]9
29	29.	89.0	149.1	209.1	269.3	329.5	389.8	450[illegible]	[illegible]9
M.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	[illegible]
L.	0	1	2	3	4	5	6	7	8

L.	0	1	2	3	4	5	6	7	8
M.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	270.3	330.5	390.8	451,3	511,9
31	31.0	[illegible]	[illegible]	[illegible]	271.3	331.5	391.9	[illegible]	512,9
32	32.0	[illegible]	152.1	[illegible]	272.3	[illegible]	392.9	453,3	513,9
33	33.0	[illegible]	153.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	514,9
34	34.0	94.0	154.1	214.1	[illegible]	[illegible]	[illegible]	[illegible]	515.9
35	35.0	95.0	155.1	[illegible]	[illegible]	335.5	[illegible]	456,3	516.9
36	36.0	96.0	156.1	216.1	[illegible]	336.5	[illegible]	457,3	518,8
37	37.0	97.0	157.1	217.1	[illegible]	337.5	397.9	458.4	519.0
38	38.0	98.0	158.1	218.2	[illegible]	338.6	398.9	459,4	520,0
39	39.0	99.0	159.1	219.2	279.3	339.6	399.9	460.4	521.0
40	40.0	100.0	160.1	220.2	280.3	340.6	400.9	461,4	522,0
41	41.0	101.0	161.1	221.2	281.3	341.6	401.9	462,4	523,0
42	42.0	102.0	162.1	222.2	282.3	342.6	402.9	463,4	524,0
43	43.0	103.0	163.1	223.2	283.3	343.6	403.9	464,4	525,0
44	44.0	104.0	164.1	224.2	284.3	344.6	404.9	465,4	526,0
45	45.0	105.0	165.1	225.2	285.3	345.6	405.9	466,4	527.1
46	46.0	106.0	166,1	226.2	286.3	346.6	407.0	467,4	528,1
47	47.0	107.0	167.1	227.2	287.3	347.6	408.0	468,4	529,1
48	48.0	108.0	168.1	228.2	288.3	348.6	409.0	469,5	530,1
49	49.0	109.0	169.1	229.2	289.3	349.6	410.0	470,5	531.1
50	50.0	110.0	170.1	230.2	290.3	350.6	411.0	471,5	532,1
51	51.0	111.0	171.1	231.2	291.4	351.6	412.0	472,5	533,1
52	52.0	112.0	172.1	232.2	292.4	352.6	413,0	473.5	534,1
53	53.0	113.0	173.1	233.2	293.4	353.6	414,0	474.5	535,1
54	54.0	114.0	174.1	234.2	294.4	354.6	415,0	475.5	536.2
55	55.0	115.0	[illegible]	235.2	295.4	355.6	416.0	476.5	537.2
56	[illegible]	[illegible]	176.1	236.2	296.4	356.6	417.0	477.5	538,2
57	[illegible]	[illegible]	177.1	237.2	297.4	357.6	418,0	478.5	539,2
58	[illegible]	[illegible]	178.1	238.2	298.4	358.7	419,0	479.6	540.2
[illegible]	[illegible]	119.0	179.1	239.2	299.4	359.7	420.0	480,6	541.2
M.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.
L.	0	1	2	3	4	5	6	7	8

L.	9	10	11	12	13	14	15	16
M.	Min.	Min.	Min.	Min.	Min.	Min.	Min,	Min.
0	542,2	[illegible]	664,1	725.3	[illegible]	848,5	[illegible]	[illegible]
1	543 3	[illegible]	665,1	726.4	[illegible]	[illegible]	[illegible]	973,8
2	544,3	[illegible]	[illegible]	727,4	[illegible]	[illegible]	[illegible]	974,8
3	545.3	[illegible]	[illegible]	[illegible]	[illegible]	851.6	[illegible]	975,9
4	546.3	[illegible]	[illegible]	[illegible]	[illegible]	852.6	[illegible]	976.9
5	547,3	[illegible]	669,2	[illegible]	[illegible]	853.7	915,7	978,0
6	548,3	[illegible]	670,2	[illegible]	793,0	854,7	916,9	979,0
7	549,3	610,2	671,2	[illegible]	794,0	855,7	917,7	980,0
8	550,3	611,2	672,2	[illegible]	795,0	856,8	918.8	981,1
9	551,4	612.2	673.2	734.6	796,1	857.8	919,8	982.1
10	552,4	613,2	674,3	735,6	[illegible]	858,9	920,8	983,2
11	553,4	614,2	675,3	736,6	[illegible]	859,9	921,8	984.2
12	554,4	615,3	676.3	737,6	[illegible]	861,0	922,9	985.2
13	555,4	616,3	677.3	738,7	800,2	862,0	923.9	986,3
14	556.4	617.3	678,3	739.7	801,2	863.0	925,0	987.3
15	557,4	618,3	679,4	740,7	802,2	864,1	926,0	988,4
16	558,4	619,3	680,4	741,7	803,2	865,0	927,0	989.4
17	559,4	620,3	681,4	742,8	804,3	866.1	928,1	990.4
18	560,5	621.3	682,4	743,8	805.3	867.2	929,1	991.5
19	561,5	622.4	683.4	744,8	806.3	868,2	930.1	992,5
20	562,5	623,4	684,5	745,8	807,3	869.2	931,2	993.6
21	563.5	624,4	685,5	746,9	808,4	870,3	932,2	994.6
22	564,5	625,4	686,5	747,9	809,4	871.3	933.2	995.6
23	565,5	626,6	687,5	748,9	810,4	872,3	934,3	996.7
24	566.6	627,4	688,5	749 9	811.4	873.4	935,3	997.7
25	567.6	628,5	689,6	751,0	812,5	874.4	[illegible]	998.8
26	568,6	629,5	690 6	752,0	813,5	875,4	[illegible]	999.8
27	569 6	630,5	691,6	753,0	814,5	876.5	[illegible]	[illegible]
28	570,6	631,5	692.6	754,0	815,5	877.5	939.4	[illegible]
29	571 6	632.5	693,6	755.1	816.6	878.5	940,5	[illegible]
M.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.
L.	9	10	11	12	13	14	15	16

[illegible]	9	10	11	12	13	14	15	16
M[illegible]	[illegible]in.	Min.	[illegible]in.	Min.	Min.	Min.	Min.	Min.
3[illegible]	[illegible]6	633.5	69[illegible]7	756.1	817.6	879.6	[illegible]41,5	1004,0
31	57[illegible]	634.[illegible]	695.[illegible]	[illegible]57.1	818.6	880.6	9[illegible]2,5	1005,0
32	[illegible]	635.6	[illegible]6.7	[illegible]58.1	819.7	[illegible]81,6	9[illegible]3.6	1006,1
33	57[illegible]	[illegible]26.6	[illegible]	[illegible]9.[illegible]	8[illegible]0.7	[illegible]82,7	9[illegible],6	1007,1
34	576.7	[illegible]37.6	[illegible]7	[illegible]2	821.7	[illegible]3.7	9[illegible]5.6	1008 1
35	577.7	6[illegible]8.6	69[illegible].8	7[illegible]	822.7	88[illegible]7	[illegible]46,7	1009.2
36	578.7	639.6	700.8	762[illegible]	823.7	88[illegible]	947.7	1010,2
37	579.7	640.6	701.8	763.[illegible]	824.8	886.8	648,7	1011,3
8	580.8	641.7	702.8	764.[illegible]	825.8	887,8	949.8	1012,3
39	581.8	642.7	703.8	76[illegible].3	826.8	888,9	950.8	1013.4
40	582.8	643.7	704.9	7[illegible]6.3	827.9	889.9	951,9	1014,4
41	583.8	644.5	705,9	[illegible]57.4	828.9	890,9	952,9	1015,4
42	584.8	645.7	706.[illegible]	768.4	829.9	892,0	953,9	1016,5
43	585.8	646.7	707.9	769.4	831.9	893,0	955,0	1017,5
44	586.8	647.7	709.0	770.4	832.0	894,0	956,0	1018,6
45	587.9	648.8	710.0	771.5	833.0	895,1	957,1	1019.6
46	588.9	649.8	711.0	772.5	834.1	896,1	958,1	1020,6
47	589.9	650.8	712.0	773.5	835.1	897.1	959,2	1021.7
48	590.9	651.8	713.0	774.5	836.1	898,2	960,2	1022,7
49	591.9	652.8	714.1	775.6	837.2	899,2	961.3	1023.8
50	592.9	653.9	715.1	776.6	838.2	900,2	962,3	1024,8
51	593.9	654.9	716.1	777.6	839.2	901,2	963,4	1025,9
52	595.0	655,9	717.1	778.6	840.3	902,3	964,4	1026.9
53	596.0	656,9	718.2	779.7	841.3	903.3	965.5	1028,0
54	597.0	657.9	719.2	780.7	842.3	904,3	966,5	1029.0
55	598.[illegible]	659.0	720.2	781.7	843.4	905,4	967,6	1030,1
56	59[illegible]	660.0	721.2	782.7	844,4	906,4	968,6	1031,1
57	6[illegible].0	661.0	722.3	783.8	845.4	907.4	969.6	1032.2
[illegible]	[illegible]01.0	662.0	723.3	784.8	846.5	908,4	970.7	1033.2
[illegible]	602.1	663 0	724.3	785.8	847.5	909.5	971.7	1034.3
M.	Min	Min.	Min.	Min.	Min.	Min.	Min.	Min.
L.	9	10	11	12	13	14	15	16

L.	17	18	19	20	21	22	23
M.	Min.	Min.	Min.	Min.	Min.	Min.	Min.
0	1035,3	1098,2	1161,5	1225,1	[illegible]	1353,7	[illegible]
1	1036,3	1099,3	1162,5	1226,2	1290,2	[illegible]	1419,7
2	1037,4	[illegible]	1163,6	[illegible]	[illegible]	[illegible]	1420,8
3	[illegible]	1101,4	1164,7	[illegible]	[illegible]	[illegible]	1421,9
4	1039,5	1102,4	[illegible]	[illegible]	1293,5	[illegible]	1423,0
5	1040,5	[illegible]	1166,8	[illegible]	1294,5	[illegible]	1424,1
6	1041,6	[illegible]	1167,8	[illegible]	1295,6	1360,1	1425,1
7	1042,6	1105,6	1168,9	[illegible]	1296,7	1361,2	1426,2
8	1043,7	1106,6	1169,0	[illegible]	1297,8	1362,3	1427,3
9	1044,7	1107,7	1171,0	[illegible]	1298,8	1363,3	1428,4
10	1045,8	1108,7	1172,1	[illegible]	1299,9	1364,4	1429,5
11	1046,8	1109,8	1173,1	1236,8	1301,0	1365,5	1430,6
12	1047,9	1110,8	1174,2	[illegible]	1302,0	1366,6	1431,7
13	1048,9	1111,9	1175,2	1239,0	1303,1	1367,6	1432,8
14	1049,9	1112,9	1176,3	1240,0	1304,2	1368,7	1533,9
15	1051,0	1114,0	1177,4	1241,1	1305,3	1369,8	1434,9
16	1052,0	1115,0	1178,4	1242,2	1306,3	1370,9	1436,0
17	1053,1	1116,0	1179,5	1243,2	1307,4	1372,0	1437,1
18	1054,1	1117,1	1180,5	1244,3	1308,5	1373,1	1438,3
19	1055,2	1118,2	1181,6	1245,4	1309,6	1374,2	1439,3
20	1056,2	1119,2	1182,7	1246,4	1310,6	1375,3	1440,4
21	1057,3	1120,3	1183,7	1247,5	1311,7	1376,4	1441,5
22	1058,3	1121,3	1184,8	1248,6	1312,8	1377,4	1442,6
23	1059,3	1122,4	1185,8	1249,6	1313,8	1378,5	1443,7
24	1060,4	1123,4	1186,9	1250,7	1314,8	1379,6	1444,8
25	1061,4	1124,5	1188,0	1251,8	1316,0	1380,7	1445,8
26	1062,5	1125,5	1189,0	1252,8	1317,1	[illegible]	1446,9
27	1063,5	1126,6	1190,1	1253,9	1318,1	[illegible]	[illegible]
28	1064,6	1127,6	1191,1	1255,0	1319,2	1383,9	[illegible]
29	1065,6	1128,7	1192,2	1256,0	1320,3	1385,0	[illegible]
M.	Min.	Min.	Min.	Min.	Min.	Min.	Min.
L.	17	18	19	20	21	22	23

	17	18	19	20	21	22	23
M.	Min.	Min	Min.	Min.	Min.	Min.	Min.
30	[illegible]	1129.7	[illegible]	1257.1	1321.4	1386.1	1451.3
31	[illegible]	[illegible]	[illegible]	1258.2	1322,4	[illegible]	1452,4
32	[illegible]	[illegible]	[illegible]	1259.2	[illegible]	[illegible]	1453.6
33	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1454.6
34	[illegible]	[illegible]	1197.5	[illegible]	[illegible]	[illegible]	1455.7
35	1072.0	[illegible]	1198.5	[illegible]	1326.7	[illegible]	1456.8
36	1073.0	1136,1	1199,6	[illegible]	1327.8	[illegible]	1457.9
37	1074,1	1137,2	1200,7	[illegible]	1328.9	1393.7	1458.9
38	1075,1	1138,2	1201,7	[illegible]	1330.0	1394.8	1460.0
39	1076,2	1139,3	1202.8	[illegible]	1331.0	1395.9	1461.1
40	1077.2	1140,3	1203,9	1267.8	1332.1	1396.9	1462.2
41	1078,3	1141,3	1204,9	1268.8	1333.2	1398.0	1463.3
42	1079,3	1142,4	[illegible]	1269.9	1334.2	1399.1	1464.4
43	1080,4	1143,5	1207,1	1271.0	1335.2	1400.2	1465.5
44	1081,4	1144,6	1208,1	1272.1	1336.4	1401,3	1466.6
45	1082,5	1145,6	1209,2	1273.1	1337.5	1402.4	1467.7
46	1083,5	1146,6	1210,2	1274.2	1338.6	1403.4	1468.8
47	1084,6	1147,7	1211,3	1275.3	1339.7	1404.5	1469.8
48	1085,6	1148,8	1212,4	1276.3	1340,7	1405.6	1470.9
49	1086.7	1149,8	1213.4	1277.4	1341.8	1406.7	1472.0
50	1087.7	1150,9	[illegible]	1278.5	1342.9	1407.8	1473.1
51	1088,8	1152,0	1215,5	1279.5	1344.0	1408.8	1474.2
52	1089,8	1153,0	1216,6	1280.6	1345.0	1409.9	1475.3
53	1090,9	1154.1	1217,6	1281.7	1346.1	1411.0	1476.5
54	1091,9	1155,1	1218,7	1282.7	1347.2	1412.1	1477.5
55	1093,0	1156,2	1219,8	1283.8	1348.3	1413.2	1478.6
56	[illegible]	[illegible]	1220,9	1284.9	1349.4	1414.3	1479.6
[illegible]	[illegible]	1158,3	1221.9	1286.0	1350.4	1415.4	1480.8
[illegible]	[illegible]	1159,4	1223.0	1287.0	1351.5	1416.5	1481.9
[illegible]	[illegible]	1160,4	1224.1	1288.1	1352.6	1417.6	1483.0
M	Min.	Min.	Min	Min.	Min.	Min.	Min.
L.	17	18	19	20	21	22	23

L.	24	25	26	27	28	29	30
M.	Min.	Min.	Min.	Min.	Min.	Min.	Min.
0	1484.1	1550.0	1616.5	1683.6	[illegible]	1819.5	[illegible]
1	1485.2	[illegible]	1617.6	1684.7	1752.3	[illegible]	[illegible]
2	1486.3	1552.2	1618.7	1685.8	[illegible]	[illegible]	[illegible]
3	1487.3	1553.2	1619.8	1686.9	[illegible]	[illegible]	[illegible]
4	1488.4	[illegible]	1620.9	[illegible]	1755.7	[illegible]	1893.0
5	1489.5	[illegible]	1622.0	[illegible]	[illegible]	[illegible]	1894.2
6	1490.6	[illegible]	1623.2	[illegible]	1758.0	1826.3	1895.3
7	1491.7	1557.7	1624.3	[illegible]	1759.1	1827.6	1896.5
8	1492.8	1558.8	1625.4	[illegible]	1760.2	1828.6	1897.6
9	1493.9	1559.9	1626.5	[illegible]	1761.4	1829.7	1898.8
10	1495.0	1561.0	1627.6	[illegible]	1762.5	1830.9	1899.9
11	1496.1	1562.2	1628.7	[illegible]	1763.6	1832.0	1901.1
12	1497.2	1563.2	1629.8	1697.0	1764.8	1833.2	1902.3
13	1498.3	1564.3	1631.0	1698.1	1765.9	1834.3	1903.4
14	1499.4	1565.4	1632.3	1699.2	1767.0	1835.5	1904.6
15	1500.5	1566.5	1633.2	1700.4	1768.2	1836.6	1905.7
16	1501.6	1567.6	1634.3	1701.5	1769.3	1837.8	1906.9
17	1502.7	1568.7	1635.3	1702.6	1770.5	1838.9	1908.1
18	1503.8	1569.8	1636.5	1703.8	1771.6	1840.1	1909.2
19	1504.9	1571.0	1637.7	1704.9	1772.7	1841.2	1910.4
20	1506.0	1572.1	1638.8	1706.0	1773.9	1842.4	1911.5
21	1507.1	1573.2	1639.9	1107.1	1775.0	1843.5	1912.7
22	1508.2	1574.3	1641.0	1708.3	1776.1	1844.6	1913.8
23	1509.3	1575.4	1642.1	1709.4	1777.2	1845.8	1915.0
24	1510.4	1576.5	1643.2	1710.5	1778.4	1846.9	1916.2
25	1511 5	1577.6	1644.3	1711.6	1779.5	[illegible]	1917.3
26	1512.6	1578.7	1645.5	1712.8	1780.6	1849.2	1918.5
27	1513.7	1579.8	1646.7	1713.9	1781.8	1850.4	[illegible]
28	1514.8	1580.9	1647.8	1715.0	1783.0	1851.5	[illegible]
29	1515.9	1582.0	1648.8	1716.1	1784.1	1852.7	[illegible]
M.	Min.	Min.	Min-	Min.	Min.	Min.	Min.
L.	24	25	26	27	28	29	30

L. / M.	24 Min.	25 Min.	26 Min.	27 Min.	28 Min.	29 Min.	30 Min.
30	[illegible]	1583.2	1649.9	1717.3	1785.2	1853.8	1923.1
31	1518.1	[illegible]	1651.0	1718.4	1786.4	1855.0	1924.3
32	1519.[illegible]	[illegible]85.4	[illegible]	1719.5	1787.5	1856.1	[illegible]925.4
33	1520.3	[illegible]6.5	1653.[illegible]	1720.7	1788.6	1857.2	1926.6
34	1521.4	[illegible]7.6	1654.4	[illegible]1.8	1789.8	185[illegible].4	1927.8
35	1522.5	[illegible]	[illegible]	[illegible]	1790.9	18[illegible]9.6	1928.9
36	1523.5	1589.8	1656.6	[illegible]	1792.1	1860.7	1930.1
37	1524.7	1590.9	1657.8	[illegible]	1793.2	1861.9	1931.3
38	1525.8	[illegible]	1658.9	[illegible]	1794.3	1863.0	1932.4
39	1526.9	1593.2	1660.0	[illegible]7.4	1795.5	1864.2	1933.6
40	1528.0	1594.3	1661.1	[illegible]28.6	1796.6	1865.3	1934.7
41	1529.1	1595.4	1662.2	1729.6	1797.8	1866.5	1935.9
42	1530.1	1596.5	1663.4	1730.7	1798.9	1867.6	1937.1
43	1531.3	1597.5	1664.5	1731.1	1800.0	1868.8	1938.2
44	1532.4	1598.7	1665.6	1733.1	1801.2	1869.9	1939.4
45	1533.5	1599.8	1666.7	1734.2	1802.3	1871.1	1940.5
46	1534.6	1600.9	1667.8	1735.3	1803.5	1872.2	1941.7
47	1535.7	1602.0	1669.0	1736.5	1804.6	1873.4	1942.9
48	1536.8	1603.1	1670.1	1737.6	1805.7	1874.5	1944.0
49	1537.9	1604.3	1671.2	[illegible]738.7	1806.9	1875.7	1945.2
50	1539.0	1605.4	1672.3	1739.9	1808.0	1876.8	1946.4
51	1540.1	1606.5	1673.4	1741.0	1809.2	1878.0	1947.5
52	1541.2	1607.6	1674.6	1742.1	1810.3	1879.2	1948.7
53	1542.3	1608.7	1675.7	1743.2	1811.4	1880.3	1949.9
54	1543.4	1609.8	1676.9	1744.4	1812.6	1881.5	1951.0
55	1544.5	1610.9	1678.0	1745.5	1813.7	1882.6	1952.2
56	[illegible]545.6	1612.0	1679.1	1746.6	1814.9	1883.8	1953.4
57	1546.7	1613.1	1680.2	1747.8	1816.0	1884.9	1954.5
5[illegible]	15[illegible]7.8	[illegible]614.[illegible]	1681.3	1748.9	1817.2	1886.1	1955.7
5[illegible]	1548.9	1615.4	1682.4	1750.0	1818.3	1887.2	1956.9
L. / M.	Min. 24	Min. 25	Min. 26	Min. 27	Min. 28	Min. 29	Min. 30

L.	31	32	33	34	35	36	37
M.	Min.	Min.	Mn.	Min.	Min.	Min.	Min.
0	[illegible]	2028,4	2099,6	2171,5	[illegible]	[illegible]	2392,8
1	1959.2	2029,6	2100,7	2172,7	[illegible]	[illegible]	2393,9
2	[illegible]	2030,7	2101,9	[illegible]	2246,8	[illegible]	2395,2
3	1961.5	2031,9	2103,1	2175,1	[illegible]	[illegible]	2396,4
4	[illegible]	2033.1	2104 3	2176,3	2249.2	2323.0	2397.7
5	1963.9	2034,3	2105,5	2177,5	2250,4	2324,2	2398,9
6	1965.0	2035,5	[illegible]	2178,7	2251,6	2325,4	2400,2
7	1966,2	2036.7	[illegible]	2180,0	2252,9	2326,7	2401,4
8	1967,4	2037,8	[illegible]	2181.2	2254,1	2327,9	2402.7
9	1968.5	2039 0	2110,3	2182.4	2255.3	2329,2	2403.9
10	1969,7	2040,2	2111,5	2183 6	2256,5	2330,4	2405,2
11	1970,9	2041.4	2112,7	2184.8	2257,8	2331.6	2406,4
12	1972,0	2042.6	2113.9	2186,0	2259,0	2332,9	2407.8
13	1973,2	2043.8	2115,1	2187,2	2260 2	2334,1	2409.0
14	1974.4	2044.5	2116.3	2188,4	2261,4	2335.3	2410.2
15	1975,6	2046.1	2117,5	2189,6	2262,7	2336.6	2411.5
16	1976.8	2047,3	2118.7	2190,8	2263,9	2337.8	2412.7
17	1977,9	2048.5	2119;8	2192,0	2265,1	2339.0	2414,0
18	1979.1	2049 7	2121,0	2193 3	2266.2	2340,3	2415.2
19	1980.3	2050.8	2122.2	2194.5	2267 6	2341.5	2416,5
20	1981,4	2052.0	2123,4	2195.7	2268,8	2342,8	2417.8
21	1982 6	2053.2	2124,6	2196.9	2270.0	2344,0	2419,0
22	1983,7	2054,4	2125,8	2198,1	2271,2	2345,3	2420,3
23	1984.9	2055,6	2127,0	2199 3	2272,5	2346,5	2421,5
24	1986,1	2056.9	2128.2	2200 5	2273.7	2347.9	2422.8
25	1987 3	2058.0	2129,4	2201,7	2274.9	2349,0	2424,0
26	1988,4	2059,1	2130,6	2203 0	2276.1	2350,2	[illegible]
27	1989,6	2060.3	2131 8	2204.2	2277.4	2351.5	[illegible]
28	1990 8	2061.5	2133,0	2205,4	2278.6	2352.7	[illegible]
29	1992.0	2062 7	2134.2	2206 6	2279,8	2254.0	[illegible]
M	Min.	Min	Min.	Min.	Min	Min.	Min.
L.	31	32	33	34	35	36	39

L.	31	32	33	34	35	36	37
M.	Min.	Min.	Min.	Min.	Min.	Min.	Min.
30	1993.3	2063.9	2135.4	2207.8	2281.0	2355.2	2430.3
31	1994 3	2065.1	2136.6	2209.0	2282.3	2356,5	2431.6
32	1995.[illegible]	2066.2	2137.8	2210.2	2283.5	2357.7	2432,9
33	1996.6	[illegible]7.4	2139.0	2211.4	2284.7	2358.0	2434.1
34	1997,8	2068.6	2140.2	2212,7	2286.0	23[illegible]0.2	2435.[illegible]
35	1999,0	2069.8	2141.4	2213,9	2287.2	[illegible]61,4	2436.7
36	2000,2	2071.0	2142.6	2215.1	2288.4	2362.7	2437.9
37	2001,3	2072 2	2143.8	22[illegible].3	2289.7	2363.9	2439.2
38	2002 5	2073.4	2145.0	2[illegible]17.5	2290,9	2365.2	2440.4
39	2003.7	2074.6	2146.2	2218.7	2292.1	2366.4	2441,7
40	2004,9	2075.7	2147.4	2219.9	2293.3	2367.7	2443.0
41	2006.0	2076 9	2148.6	2221.2	2294.6	2368.9	2444 2
42	2007,2	2078.1	2149.8	2222.4	2295.8	2370.2	2445.5
43	2008,4	2079 3	2151,0	2223.6	2297.0	2371.4	2446 8
44	2009.6	2080.5	2152.2	2224.8	2298.3	2372.7	2448.0
45	2010.7	2081.7	2153.4	2226.0	2299.5	2373.9	2449.3
46	2011.9	2082.9	2154.6	2227.2	2300 7	2375.2	2450.6
47	2013,1	2084.1	2155.8	2228.5	2302.0	2376.4	2451,8
48	2014,3	2085.3	2157.0	2229.7	2303.2	2377.7	2453,1
49	2015.4	2086.5	2158.2	2230.9	2304.4	2378,9	2454.3
50	2016 6	2087.7	2159.4	2232.1	2305,7	2380.1	2455.5
51	2017.8	2088.9	2160.7	2233.3	2306.9	2381.4	2456.9
52	2019.0	2090.1	2161.9	2234.6	2308.1	2382,6	2458,1
53	2020.2	2091.3	2163.1	2235.8	2309.4	2383.9	2459,4
54	2021.3	2092 5	2164.3	2237.0	2310.6	2385.1	2460.7
55	2022,5	20[illegible]3 7	2165.5	2238.2	2311 8	2386.4	2461.9
56	2023 7	20[illegible]4.9	2166.7	2239.4	2313.1	2387.6	2463.2
57	2024.9	2096.2	2167.9	2240.7	2314.3	2388 9	2464.5
58	2026.0	2097.3	2169.1	2241.9	2315.5	2390.2	2465.8
59	2027.2	2098.5	2170 3	2243.1	2316.7	2391.4	2467.0
M.	Min.	Min.	Min.	Min.	Min.	Min.	Min.
L.	31	32	33	34	35	36	37

L.	38	39	40	41	42	43	44
M.	Min.	Min.	Min.	Min.	Min.	Min.	Min.
0	2468.3	2545.0	2622,7	2701.6	[illegible]	2863,1	2945.7
1	2469,6	2546,2	2624.0	2702.9	[illegible]	[illegible]	2947.2
2	2470.8	2547.5	2625,3	[illegible]	[illegible]	[illegible]	2948.6
3	[illegible]	2548,8	2626.6	2705.6	2785.8	[illegible]	2950.0
4	[illegible]	2550.1	2627,9	2706.9	2787.1	[illegible]	2951.4
5	2474.6	2551,4	2629.2	[illegible]	2788,5	2870.0	2952.8
6	2475.9	2552,7	2630.5	2709,6	2789.8	2871.3	2954.2
7	2477,1	2554.0	[illegible]	2710.9	2791.2	2872.7	2955.6
8	2478.5	2555.3	2633.2	[illegible]	2792.5	2874,1	2957,0
9	2479.7	2556.6	2634.5	[illegible]	2793.8	2875.4	2958.4
10	2481.0	2557.8	2635.8	2714.9	2795.1	2876.8	2959.9
11	2482,3	2559.1	2637.1	2716,2	2796.5	2878.2	2961.1
12	2483.5	2560.4	2638,4	2717.5	2797,9	2879.6	2962.5
13	2484,8	2561.7	2639.7	2718.9	2799,3	2880.9	2963.9
14	2486.1	2563,0	2641.0	2720.2	2800.6	2882.3	2965.3
15	2487,4	2564,3	2642.3	2721,5	2802.0	2883.7	2966.7
16	2488.6	2565,6	2643.6	2722.9	2803.3	2885.0	2968.1
17	2489,9	2566.9	2644.9	2724.2	2804.7	2886,4	2969.5
18	2491,2	2568.2	2646.3	2725.5	2806.0	2887,8	2970.8
19	2492,5	2569.5	2647.6	2726,9	2807.4	2889.2	2972.3
20	2493.8	2570,7	2648.8	2728.2	2808.7	2890.5	2973.7
21	2495,0	2572.0	2650.2	2729.5	2810,1	2891.9	2975.1
22	2496,3	2573.3	2651,5	2730.8	2811.4	2893.3	2976.5
23	2497.6	2574.6	2652.8	2732,2	2812.8	2894.7	2977.9
24	2498.8	2575.9	26541	2733.5	2814.1	2896,0	2979.3
25	2500.1	2577.2	2655,4	2734.8	2815,5	2897.4	2980.7
26	2501.4	2578,5	2656.8	2736.2	2816.8	2898.8	2982.1
27	2502,7	2579.8	2658.7	2737.5	2818.2	2900.2	2983.5
28	2503.4	2581.1	2659.4	2738.8	2819.5	2901.5	2984.9
29	2505.2	2582.4	[illegible]	2740.2	2820.9	2902.9	2986.3
M.	Min.	Min.	Min.	Min.	Min.	Min.	Min.
L.	38	39	40	41	42	43	44

L.	38	39	40	41	42	43	44
M.	Min.	Min.	Min.	Min.	Min.	Min.	Min.
30	2506.5	2583.7	2662.0	2741.5	2822.	2904.3	2987.7
31	2507.8	2585.0	2663.3	2742.9	2823.6	2905.7	2989.1
32	2509.0	2586.3	2664,6	2744.2	2825.0	2907.1	2990.5
33	2510.3	2587.6	2666.0	2745.5	2826.3	2908.4	2991.9
34	2511.6	2588.9	2667.3	2746.9	2827.7	2909.7	2993.3
35	2512.9	2590.2	2668.6	2748,2	2829.0	2911.2	2994.7
36	2514.2	2591.5	2669.9	2749.5	2830.3	2912.6	2996.5
37	2515.4	2592.9	2671.2	2750.9	2831.8	2914.0	2997.5
38	2516.7	2594.1	2672.5	2752.2	2833.1	2915.3	2998.9
39	2518.0	2595.4	2673.[illegible]	2753.5	2834.5	2916.7	3000.1
40	2519.3	2596.7	2675,1	2754.4	2835.8	2918.1	3001.3
41	2520.6	2598.0	2676.5	2756.2	2837.2	2919.5	3003.2
42	2521.8	2599.3	2677.8	2757.6	2838.6	2920.9	3004.6
43	2523.1	2600.6	2679.1	2758.9	2839.9	2922.3	3006.0
44	2524.4	2601.9	2680.5	2760.2	2841.3	2923.6	3007.4
45	2525.7	2603.2	2681.8	2761.5	2842.6	2925.0	3008.8
46	2527,0	2604.5	2683.1	2762.9	2844.0	2926,4	3010.2
47	2528.3	2605.8	2684.4	2764.3	2845.4	2927.8	3011.6
48	2529.5	2607.1	2685.7	2765.6	2846.7	2929.2	3013.0
49	2530.8	2608.4	2687.1	2766.9	2848.1	2930.6	3014.4
50	2532.1	2609.7	2688.4	2768,3	2849.5	2932.0	3015.8
51	2533 4	2611.0	2689.7	2769.6	2850.8	2933.3	3017.2
52	2534.7	2612.3	2691.9	2771,0	2852.2	2934.7	3018.7
53	2536.0	2613 6	2692.3	2772.3	2853.6	2936.1	3020.1
54	2537.2	2614.9	2693.7	2773.7	2854.9	2937.5	3021.5
55	2538.5	2616.2	2695.0	2775.0	2856.3	2938.9	3022.9
56	2539.8	2617.5	2696.3	2776.4	2857.7	2940.3	3024.3
57	2541.1	2618 8	2697.6	2777.7	2859.1	2941.8	3025.7
58	2542.4	2620.1	2699.0	2779.0	2860.5	2943.1	3027.1
59	2543.7	2621.4	2700.3	2780.4	2861.8	2944.4	3028.5
M.	Min.	Min.	Mni.	Min.	Min.	Min.	Min.
L.	38	39	40	41	42	43	44

L.	45	46	47	48	49	50	51
M.	*Min.*	*Min.*	*Min.*	Min.	*Min.*	Min.	Min.
0	3030.0	3115.6	3202,8	3291,5	3382,1	3474.5	3568.8
1	3031.4	3117.0	3204.2	3293,1	3383.6	3476,1	3570.4
2	3032.[illegible]	3118.5	3205.7	3294.5	[illegible]85,2	3477.6	3572.0
3	3034.2	3120.0	3207,2	3296,1	3386,7	34[illegible].2	3573.6
4	3035.6	3121.4	3208.6	3297,5	3388,2	348[illegible],7	3575.2
5	3037.0	3122.9	3210,1	3299,0	3389.7	3482.3	3576.8
6	3038.4	3124.2	3211,6	3300,5	3391,3	3483.9	3578.4
7	3039.8	3125.9	3213.0	3302,0	3392,8	3485.4	3580.0
8	3041.3	3127,1	3214,5	330[illegible],5	3394,3	3487.0	3581.6
9	3042.7	3128.6	3216.0	3305.0	3395,9	3488.5	3583.2
10	3044.1	3130,0	3217.4	3306.5	3397,4	3490.1	3584.9
11	3045.5	3131.5	3218.9	3308,0	3398.9	3491.7	3586,4
12	3047.0	3132.9	3220,4	3309,5	3400.4	3493.2	3588,0
13	3048.4	3134.3	3221,9	3311,1	3402,0	3494,8	3589.5
14	3049.8	3135.8	3223,3	3312.5	3403,5	3496,3	3591.1
15	3051.2	3137,2	3224,8	3314,0	3405.0	3497.9	3592,7
16	3052.6	3138,7	3226,3	3315,5	3406,6	3499.5	3594,2
17	3054.1	3140,1	3227,7	3317,0	3408,1	3501.0	3595,9
18	3055.5	3141,6	3229,1	3318,0	3409,6	3502.6	3597,5
19	3056.9	3143,0	3230,7	3320.0	3411.2	3504.2	3599.1
20	3058.3	3144.5	3232,7	3321,5	3412.7	3505.7	3600,7
21	3059.7	3145.9	3233,6	3323.1	3414,2	3507.3	3602,2
22	3061.2	3147,4	3235,1	3324,6	3415,8	3508,9	3603,9
23	3062.6	3148,8	3236.6	3326,1	3417.5	3510,5	3605.5
24	3064.0	3150.3	3238,1	3327.6	3418.8	3512,0	3607.1
25	3065.4	3151.7	3239.5	3329.6	3420,4	3513.6	3608,7
26	3066.9	3153.2	3241.0	3330.6	3421.9	3515,1	3610,3
27	3068.3	3154,6	3242.5	3332,1	3423.5	3516,7	3611,9
28	3069.7	3156,1	3244.0	3333,6	3425.0	3518.3	3613.6
29	3071.1	3157.5	3245.7	3335,1	3426,5	3519.8	3615,2
M.	Min.	Min.	Min.	Min.	Min.	Min.	Min.
L.	45	46	47	48	49	50	51

L.	45	46	47	48	49	50	51
M.	Min.	Min.	Min.	Min.	Min.	Min.	Min.
30	3072,6	3159,0	3246,9	3336,6	3428.1	3521,4	3616.8
31	3074,0	3160,4	3248,4	3338,1	3429,6	3523,0	3618,4
32	3075.4	3161,9	3249,9	3339.6	3431,2	3524,6	3620.0
33	3076,9	3163,3	3251,4	3341.1	3432,7	3526.1	3621.6
34	3078,3	3164.8	3252 9	3342.7	3434,2	3527.8	3623,0
35	3079,7	3166,2	3254.4	3344.2	3435.8	3529.3	3624.8
36	3081.1	3167,7	3255,8	3345,7	3437.3	3530.9	3626,4
37	3082,6	3169,1	3257.3	3347.2	3438.9	3532.4	3628.0
38	3084,0	3170,6	3258,4	3348.7	3440.4	3534,0	3629,6
39	3085,4	3172.1	3260.3	3350.1	3442.0	3535.6	3631,3
40	3086,9	3173.5	3261,8	3351.7	3443,5	3537.2	3632.9
41	3088,3	3175,0	3263.3	3353.2	3445.9	3538,8	3634,5
42	3089.7	3176,4	3264.7	3354.8	3446.6	3540,3	3636.1
43	3091,2	3177,9	3266.2	3356.3	3448.1	3541.9	3637.7
44	3092.6	3179.3	3267.7	3357.8	3449.7	3542.5	3639.3
45	3094,9	3180,8	3269,2	3359.3	3451.2	3545.1	3640.9
46	3095.5	3182,3	3270.7	3360.8	3452.8	3546.7	3642.5
47	3096,9	3183,7	3272.2	3362.3	3454.3	3548.2	3644.2
48	3098,3	3185,2	3273,7	3363,9	3455,9	3549.8	3645.8
49	3099.8	3186,6	3275.2	3365.4	3457,4	3551.4	3647.4
50	3101,2	3188.1	3276,6	3366.9	3459.0	3553.0	3649.0
51	3102,6	3189.6	3278,1	3368.4	3460,5	3554.6	3650.6
52	3104.1	3191,0	3279.5	3369.9	3462,1	3556.1	3652.3
53	3105.6	3192,5	3281,1	3371.5	3463.6	3557.7	3653.9
54	3107.0	3194.1	3282.6	3373.0	3465.2	3559.3	3655.5
55	3108.4	3195,4	3284,1	3374.5	3466.7	3560.9	3657.1
56	3109.9	3196.9	3285,6	3376.0	3468,3	3562.5	3658.7
57	3111.2	3198.4	3287,1	3377.6	3469.8	3564.1	3660.4
58	3112.7	3199.8	3288.6	3379.1	3471.4	3565.7	3662,0
59	3114,1	3201.1	3290.1	3380.6	3473.0	3567,3	3663.6
M.	Min.	Min.	Min	Min.	Min.	Min.	Min
L	45	46	47	48	49	50	51

L.	52	53	54	55	56	57	58
M.	Min.	Min.	Min.	Min.	Min.	Min.	Min.
0	3665.2	3763.8	3864.7	3968.0	4073.9	4182.7	4294.3
1	3666.9	3765,5	3866,4	3969.7	4075.7	4184.5	4296.2
2	3668.5	3767,1	3868.1	3971,5	4077.5	4186.3	4298,1
3	3670.1	3768.8	3869.8	3973,2	4079,3	4188.2	4300.9
4	3671.7	3770.4	3871.5	3975.0	4081.1	4190.0	4301.9
5	3673.4	3772.1	3873,2	3976.7	[illegible]	[illegible]91.8	4303.8
6	3675,0	3773.8	3874.9	3978,5	4084.7	4193,7	4305.7
7	3676.6	3775,4	3876,6	3980.2	4086,5	4195.5	4307.6
8	3678,2	3777,1	3878.3	3982.0	4088,3	4197,4	4309.5
9	3679,9	3778.8	3880.0	3983.7	4090.1	4199.2	4311.4
10	3681.5	3780.4	3881,7	3985,5	4091.9	4201.3	4313,2
11	3683.1	3782.1	3883,4	3987.2	4093 7	4202,9	4315.1
12	3684.8	3783,8	3885,1	3989.0	4095.5	4204.7	4317.0
13	3686.4	3785,5	3886,8	3990.7	4097.3	4206,6	4318,9
14	3688.0	3787.1	3888.6	3992.5	4099.1	4208.4	4320.8
15	3689.7	3788.8	3890.3	3994,2	4100.9	4210,3	4322.7
16	3691.3	3790.5	3892,0	3996.0	4102.7	4212.1	4324,6
17	3692,9	3792,1	3893.7	3997.7	4104.5	4214.0	4326.5
18	3694.6	3793,8	3895,8	3999.5	4106.3	4215.8	4328.4
19	3696.2	3795.5	3897.1	4001.3	4108.1	4217.7	4330,3
20	3697.8	3797.2	3898.8	4003.0	4109.9	4219,5	4332.2
21	3699,5	3798.8	3900.5	4004.8	4111.7	4221,4	4334,2
22	3701.1	3800,5	3902.4	4006.5	4113.5	4223.2	4336.1
23	3702,7	3802.2	3904.0	4008.3	4115,3	4225.1	4338.0
24	3704,4	3803.9	3905.7	4010.0	4117.1	4227.0	4339,9
25	3706.0	3805.5	3907,4	4011.8	4118,9	4228.8	4341,8
26	3707,7	3807.2	3909.1	4013.6	4120,5	4230,7	4343.7
27	3709.9	3808.9	3910.9	4015.3	4122.5	4232,5	4345.6
28	3710.9	3810.6	3912,6	4017.1	4124.3	4234.4	4347,5
29	3712 6	3812.3	3914.2	4018.9	4126.1	4236.2	4349.4
M.	Min.	Min.	Min.	Min.	Min.	Min.	Min.
L.	52	53	54	55	56	57	58

L.	52	53	54	55	56	57	58
M.	Min.	Min.	Min.	Min.	Min.	Min	Min.
30	3714.2	3813.9	3916.0	4020.6	4127.9	4238.1	4351.2
31	3715.9	38[illegible]5.6	3917.7	4022.4	4129.7	4240.0	4353.3
32	3717.5	3817.3	3919.5	4024.2	4131.6	4241.8	4355.2
33	3719.2	3819.0	[illegible]921.2	4025.9	4133.4	4243.7	4357.1
34	3720.7	3820.7	3922.5	4027.7	4135.2	4245.6	4359.0
35	3722.4	[illegible]	[illegible]4.6	4029.5	4137.0	4247.4	4360.9
36	3724.1	3824.0	392[illegible].4	4031.2	4138.8	4249.3	4362.8
37	3725.7	3825.7	3928.1	4033.0	4140.6	4251.2	4364.8
38	3727.4	3827.4	3929.8	4034.8	4142.5	4253.0	4366.7
39	3729.0	[illegible]	3931.5	4036.6	4144.3	4254.9	4368.6
40	3730.7	3830.8	3933.3	4038.3	4146.1	4256.8	4370.5
41	3732.3	3832.5	3935.9	4040.1	4147.9	4258.6	4372.5
42	3734.0	3834.2	3936.7	4041.9	4149.7	4260.5	4374.4
43	3735.6	3835.8	3938.5	4043.6	4151.6	4262.4	4376.4
44	3737.3	3837.5	3940.2	4045.4	4153.4	4264.3	4378.2
45	3738.9	3839.2	3941.9	4047.2	4155.2	4266.1	4380.2
46	3740.6	3840.9	3943.7	4049.0	4157.0	4268.0	4382.1
47	3742.2	3842.6	3945.4	4050.7	4158.8	4269.9	4384.0
48	3743.9	3844.3	3947.1	4052.5	4160.7	4271.8	4385.9
49	3745.6	3846.0	3948.9	4054.3	4162.5	4273.6	4387.9
50	3747.2	3847.7	3950.6	4056.1	4164.3	4275.5	4389.8
51	3748.9	3849.4	3952.3	4057.9	4166.2	4277.4	4391.7
52	3750.5	3851.1	3954.1	4059.7	4168.0	4279.3	4393.7
53	3752.2	3852.8	3955.8	4061.4	4169.8	4281.1	4395.6
54	3753.8	3854.5	3957.6	4063.2	4171.7	4283.0	4397.5
55	3755.5	3856.2	3959.3	4065.0	4173.5	4284.9	4399.5
56	3757.2	3857.9	3961.0	4066.8	4175.3	4286.8	4401.4
57	3758.8	3859.6	3962.8	4068.6	4177.2	4288.7	4403.4
58	3760.5	3861.3	3964.5	4070.4	4179.0	4290.6	4405.3
59	3762.2	3863.0	3966.3	4072.2	4180.8	4292.5	4407.2
M.	Min.	Min.	Min.	Min.	Min	Min.	Min.
L.	52	53	54	55	56	57	58

L.	59	60	61	62	63	64	65
M.	Min.	Min.	Min.	Min.	Min.	Min.	Min.
0	4409.2	4527,4	4649,3	4775.0	4905.0	5039.5	5178.[illegible]
1	4411.0	4529.4	4651,3	4777,1	4907,2	5041.7	5181,2
2	4413,1	4531.4	4653,4	4779,3	4909,4	5044,0	5183 6
3	4415.0	4533.4	4655,5	4781,4	4911,6	5046,3	5186,0
4	4417.0	4535,4	4657,5	4783 5	4913.8	5048 6	5188 3
5	4418.9	4537,4	4659,6	4785.7	[illegible]	5050,9	5190 7
6	4420,8	4539,4	4661.7	4787,3	4918,2	5053,2	5193,1
7	4422,8	4541,4	4663.7	4790.0	4920,4	5055,5	5195,4
8	4424.7	4543:4	4665,8	4792.1	4922,6	5057:7	5197,8
9	4426.7	4545.4	4667.9	4794.2	4924,8	5060 0	5200,2
10	4428.6	4547.5	4669,9	4796,4	4927,1	5062,3	5202,6
11	4430.6	4549.5	4672,0	4798,5	4929.3	5064.6	5205,0
12	4432.5	4551,5	4674,1	4800:7	4931 6	5066,9	5207,3
13	4434.5	4553,5	4676,2	4802,8	4933.7	5069,2	5209,7
14	4436.4	4555.6	4678.2	4804,9	4936,9	5071.5	5212,1
15	4438,4	4557,5	4680,3	4807.1	4938,1	5073,9	5214,5
16	4440,4	4559.5	4682,4	4809.2	4940,4	5076,1	5216.9
17	4442,3	4561.5	4684.5	4811,4	4942.6	5078,4	5219,3
18	4444.3	4563 6	4686.6	4813.5	4944,8	5080,7	5221,7
19	4446.2	4565.6	4688,6	4815.7	4947.0	5083 0	5224.1
20	4448.2	4567.6	4690.7	4817,8	4949,3	5085.3	5226,5
21	4450.2	4569,6	4692,8	4820,0	4951,5	5087,7	5228,9
22	4452,1	4571,6	4694,9	4822.2	4953,7	5090,0	5231,3
23	4454.1	4573,7	4697,0	4824.3	4956,0	5092.3	5233.7
24	4456.0	4575.7	4699.1	4826 5	4958.2	5094.6	5236.1
25	4458,0	4577,7	4701.2	4828,6	4960,4	5096.9	5238,5
26	4460.0	4579,6	4703 2	4830,8	4962,7	5099.2	5240.9
27	4461.9	4581.8	4705.3	4832.9	4964.9	5102.5	5243.3
28	4463.9	4583,8	4707,4	4835,1	4967,1	5103.9	5245.7
29	4466.6	4585.8	4709,6	4837.3	4969 4	5106.2	5248.1
M.	Min.	Min.	Min.	Min.	Min.	Min.	Min.
L	59	60	61	62	63	64	65

L.	59	60	61	62	63	64	65
M.	Min.	Min.	Min.	Min.	Min.	Min.	Min.
30	4467.8	4[illegible]87.8	4711.6	4839.4	4971.6	5108.5	5250.5
31	4469.8	45[illegible]9,9	4713.7	4841,6	4973.5	5110.8	5252.9
32	4471.8	4591.9	4715.8	4843.8	4976.1	5113.1	5255.3
33	4473.8	4593,9	4717.9	4845,9	4978.3	5115.5	5257.7
34	4475.7	4596.0	4720.0	4848.1	4980.6	5117.8	5260.1
35	4477.7	45[illegible]8.0	47[illegible]2.6	4850.3	4982.8	5120.1	5262.6
36	4479.7	4600,1	4724.2	4852.5	4985.1	5122,5	5265.0
37	4481.7	4602.[illegible]	4726.3	4854.6	4987,3	5124.8	5267.4
38	4483.6	4604,1	4728.4	4856.8	4989,6	5127,1	5269.8
39	4485.6	4606,2	4730.5	4859.0	4991.8	5129.5	5272.3
40	4487.6	4608.2	4732.6	4861.2	4994.1	5131.8	5274.7
41	4489.6	4610.3	4734.7	4863.3	4996.3	5134.1	5277.1
42	4491.6	4612.3	4736.9	4865.5	4998,6	5136.5	5279.5
43	4493.5	4614,3	4739.0	4867.7	5000,9	5138,8	5282.0
44	4495,5	4616.4	4741.1	4869.9	5003.1	5141.2	5284,4
45	4497.5	4618,4	4743.2	4872,1	5005.4	5143.5	5286.8
46	4499,5	4620.5	4745.3	4874,3	5007,6	5145.9	5289,3
47	4501.5	4622.5	4747.4	4876.4	5009.9	5148.2	5291.7
48	4503,5	4624.6	4749.5	4878.6	5012.2	5150.6	5294,2
49	4505.5	4626.6	4751.7	4880.8	5014.4	5152,9	5296.6
50	4507.5	4628.7	4753.8	4882,0	5016.7	5155.3	5299.0
51	4509.4	4630.7	4755.9	4885.2	5019.0	5157.6	5301.5
52	4511.4	4632,8	4758.0	4887.4	5021,2	5160.0	5303.9
53	4513.4	4634.8	4760.1	4889.6	5023.5	5162.3	5306.4
54	4515.4	4636.9	4762.3	4891.8	5025.8	5164.7	5308,8
55	4517.4	4639,0	4764.4	4894.0	5028.1	5167.0	5311.3
56	4519.4	4641,0	4766.5	4896.2	5030.3	5169.4	5313.7
57	4521.4	4643.1	4768.6	4898,4	5032.7	5171.8	5316.2
58	4523.4	4645,1	4770.8	4900.6	5034,9	5174.1	5318.6
59	4525.4	4647.2	4772.9	4902,8	5037.2	5176.5	5321.1
L.	Min.	Min.	Min.	Min.	Min.	Min.	Min.
M.	59	60	61	62	63	64	65

L.	66	67	68	69	70	71	72
M.	Min.	Min	Min.	Min.	Min.	Min.	Min.
0	5323.6	5474.0	5630.9	5794.6	5966.0	6145.7	6334.[illegible]
1	5326.0	5476,6	5633.5	5797.4	5968.9	6148.8	6338.1
2	5328.5	5479,2	5636.2	5800.2	5971.8	6151,9	6341,4
3	5330.9	5481,7	5638.9	5803.0	5974.7	6155,0	6344.6
4	533[illegible].4	5484.3	5641.6	5805.8	5977.7	6158.0	6347.8
5	5335.9	5486.9	5644,2	5808.6	5980.6	6161.1	6351,1
6	5338.3	5489.4	5646.9	5811.[illegible]	5983,5	6164.2	6354.3
7	5340.8	5492.0	5649.0	5814.2	5986,5	6167.3	6357.6
8	5343.3	5494.6	5652.3	5817.0	5989.4	6170.4	6360,9
9	5345.7	5497.1	5655.0	5819,8	5992.4	6173,5	6364.1
10	5348.2	5499.7	5657.6	5822.6	5995.3	6176,6	6367.4
11	5350,7	5502.3	5660,3	5825.4	5998,3	6179.7	6370.6
12	5353.2	5504.9	5663.0	5828.2	6001,2	6182,8	6373.9
13	5355,7	5507.5	5665.7	5831,0	6004.2	6185.9	6377.2
14	5358,1	5510.0	5668.4	5833.9	6007,1	6189,0	6380,5
15	5360.6	5512,6	5671.1	5836,7	6010.1	6192,1	6383.7
16	5363,1	5515.2	5673.8	5839,5	6013.0	6195.2	6387.0
17	5365,6	5517.8	5676,5	5842.7	6016,0	6198.3	6390.3
18	5368,1	5520.4	5679,2	5845.5	6019,0	6201.4	6393.6
19	5370.5	5523.0	5681.9	5848,0	6021.9	6204,6	6396.9
20	5373,0	5525.6	5684.6	5850.8	6024.9	6207.7	6400.2
21	5375.5	5528.3	5687.3	5853,7	6027.9	6210.8	6403.6
22	5378,0	5530,8	5690,0	5856,5	6030.8	6213.8	6406.8
23	5380.5	5533.4	5692,8	5859.3	6033,8	6217.1	6410.1
24	5383.0	5536.0	5695.5	5862.2	6036,8	6220.2	6413.4
25	5385.5	5538,6	5698,2	5865.0	6039,8	6223.3	6416.7
26	5388,0	5541,2	5700.9	5867.7	6042,7	6226.5	6420,0
27	5390.5	5543.8	5703.6	5870.9	6045,7	6229.6	6423.3
28	5393.0	5546,4	5706.3	5873.5	6048.7	6232.7	6426.6
29	5395,5	5549.0	5709.1	5876.4	6051.7	6235.9	6429,9
M.	Min.	Min.	Min.	Min.	Min.	Min.	Min.
L.	66	67	68	69	70	71	72

L.	66	67	68	69	70	71	72
M	Min.	Min.	Min.	Min.	Min.	Min.	Min.
30	5398.0	5551.6	5711,8	5879.3	6054,7	6239,0	6433.2
31	5400.5	5554,2	5714.5	5882,1	6057.7	6242,2	6436.6
32	5403.0	5556.8	5717,3	5885.0	6060.7	6245.3	6439,9
33	5405.6	5559.5	5720,0	5887.8	6063.7	6248,5	6443.2
34	5408.1	5562,1	5722.7	5890.7	6066.7	6251,7	6446.6
35	5410.6	[illegible]	[illegible]	5893.6	6069.7	6254.8	6449,9
36	5413.1	5567.3	5728.2	5896.4	6072,7	6258.0	6453.3
37	5415.6	5569.9	5731,0	5899.3	6075.7	6261.2	6456,6
38	5418.1	5572,6	5733.7	5902,2	6078,8	6264.4	6460.0
39	5420.7	5575.2	5736,4	5905.1	[illegible]	6267.5	6463.3
40	5423.2	5577.8	5739,2	5907.9	6084.8	6270,7	6466.7
41	5425.7	5580.5	5741.9	5910.8	6087.7	6273.9	6470.0
42	5428.2	5583,1	5744.7	5913.7	6090,8	6277.1	6473.4
43	5430.8	5585,7	5747.5	5916.6	6093,9	6280.3	6476.8
44	5433,3	5588.4	5750.2	5919.5	6096,9	6283.5	6480.1
45	5435.8	5591.0	5753.0	5922,4	6099.9	6286,6	6483.5
46	5438,4	5593.7	5755.7	5925.2	6103,0	6289,8	6486.9
47	5440.9	5596,3	5758.5	5928.1	6106.0	6293.0	6490.3
48	5443.5	5599.0	5761.3	5931,0	6109,1	6296,2	6493.6
49	5446,0	5601.6	5764.0	5933,9	6112.1	6299.4	6497.0
50	5448,5	5604.3	5766.8	5936.8	6115.1	6302,7	6500.[illegible]
51	5451.1	5606,9	5769,6	5939.7	6118,2	6305.9	6503.9
52	5453.6	5609.6	5772.3	5942.6	6121.2	6309.1	6507.2
53	5456.2	5612.2	5775,1	5945.5	6124.3	6312.3	6510.6
54	5458.7	5614.9	5777.9	5948.5	6127,4	6315.5	6514,0
55	5461.3	5617.5	5780.7	5951,4	6130.4	6318.7	6517.4
56	5463.8	5620.2	5783,5	5954,3	6133.5	6322.0	6520.8
57	5466,4	5622,9	5786.2	5957.2	6136.5	6325.2	6524,2
58	5468.9	5625,5	5789.0	5960.1	6139.6	6328.4	6527.6
59	5471,5	5628.2	5791.8	5963.0	6142,7	6331.7	6531.0
M.	Min.	Min.	Min.	Min.	Min.	Min.	Min.
L.	66	67	68	69	70	71	72

L.	73	74	75	76	77	78	79
M	Min.	Min	Min.	Min.	Min.	Min.	Min.
0	6534,5	6745.7	6970.3	7210.1	7467.[illegible]	774[illegible].6	8045.7
1	6537,9	6749.4	6974.2	7214.2	7471.7	7749.4	8051.0
2	6541.3	6753.0	6978.1	7218.3	7476.1	7754.2	8056.2
3	6544.7	6756.6	6980.9	7222.5	7480.[illegible]	7759.0	8061,5
4	6548.2	6760.3	6985.8	7226.6	7485.0	7763.9	8066.8
5	6551,6	6763.9	6989.7	7230.9	748[illegible]	[illegible]8.7	8072.0
6	6555,0	6767.6	6993.6	7234.9	7[illegible]94.[illegible]	7773.5	8077.3
7	6558.5	6771.2	6997.[illegible]	7239,1	7498.5	7778.4	8082.6
8	6561.9	6774.9	7001.4	7243.3	7502,9	7783,2	8087.9
9	6565.4	6778.5	7005.3	7247.5	7507.4	7788,1	8093.2
10	6568,8	6782.2	7009.2	7251.6	7511.9	7793.0	8098,5
11	6572.3	6785,8	7013.1	7255.8	7516,4	7797.8	8103,8
12	6575.7	6789.5	7017,0	7260.0	7520.9	7802.7	8109,2
13	6579.2	6793.2	7020.9	7264.2	7525.4	7807,6	8114.5
14	6582.6	6796.9	7024.8	7268.4	7530,0	7812.5	8119.8
15	6586.1	6800.5	7028.7	7272.6	7534.5	7817,4	8125.2
16	6589.5	6804.2	7032.7	7276.8	7539.0	7822.3	8130.6
17	6593.0	6807,9	7036,6	7281.0	7543.6	7827.2	8135.9
18	6596.5	6811.6	7040,5	7285.2	7548.1	7832,2	8141.3
19	6600.0	6815.8	7044.5	7289,4	7552.7	7837.1	8146.7
20	6603.4	6819.0	7048.4	7293.7	7557.2	7842,0	8152,1
21	6606.9	6822.7	7052.4	7297.9	7561.8	7847.0	8157.5
22	6610.4	6826.4	7056.3	7302.1	7566.3	7851.9	8162.9
23	6613.9	6830.1	7060.3	7306,4	7570,9	7856.9	8168.3
24	6617.4	6833.8	7064,2	7310.6	7575,5	7861.9	8173.7
25	6620.9	6837.6	7068.2	7314.9	7580,1	7866.8	8179,2
26	6624.4	6841.3	7072,2	7319.1	7584.7	7871,7	8184.6
27	6627.9	6845.0	7076.2	7323.4	7589.3	7876.8	8190.1
28	6631.4	6848.7	7080.1	7327.7	7593.9	7881.8	8195.5
29	6635.0	6852.5	7084.1	7332.0	7598.3	7886.8	8201.0
M	Min.	Min.	Min.	Min.	Min.	Min.	Min.
L.	73	74	75	76	77	78	79

L.	73	74	75	76	77	78	79
M	Min.	Min.	Min.	Min.	Min.	Min.	Min.
30	6638.5	6856,2	7088.1	7336.2	7603.1	7891.8	8206.5
31	6642.0	6860.0	7092.1	7340,5	7607.7	7896.8	82[illegible]2.0
32	6645.5	6863.7	7096.1	7344.8	7612.3	7901.9	8217.5
33	6649.1	6867,5	7100.1	7349,1	7617.0	7906.[illegible]	8223.0
34	6652.6	6871.2	7104.1	7353.4	7621.6	7911.9	8229.5
35	6656.1	68[illegible]	7108.2	7357.7	7626.3	7917.0	8234.1
36	6659,7	6878 7	7112.2	7362,0	7630.9	7922.1	8239.6
37	6663,2	6882.5	7116,2	7366.4	7635.6	7927.1	8245.1
38	6666,8	6886.3	7120.2	7370,7	7640.2	7932.2	8250.7
39	6670.3	6890.1	7124.3	7375.0	7644.9	7937.3	8256.3
40	6673 9	6893,8	7128,3	7379,4	7649.6	7942,4	8261.8
41	6677.4	6897.6	7132.3	7383.7	7654.3	7947.5	8267.4
42	6681.0	6901,4	7136.3	7388.0	7659.0	7952.6	8273.0
43	6684.6	6905.2	7140.4	7392.4	7663.7	7957.7	8278.6
44	6688.1	6909.0	7144.5	7396.8	7668,0	7962.8	8284.2
45	6691.7	6912.8	7148.6	7401,1	7673.1	7968.0	8289.9
46	6695,3	6916.6	7152.6	7405 5	7677.8	7973.1	8295.5
47	6698.9	6920.4	7156.7	7409.9	7682.6	7978.2	8301.1
48	6702,4	6924,2	7160,8	7414.2	7687.3	7983.4	8306.8
49	6706.0	6928.1	7164.9	7418.6	7692.0	7988.5	8312.4
50	6709,6	6931.9	7169.0	7423.0	7696.8	7993.7	8318.[illegible]
51	6713.2	6935.7	7173.0	7427,[illegible]	7701.5	7998.9	8323.8
52	6716,8	6939.5	7177.1	7431.8	7706,3	8004.0	8329.4
53	6720,4	6943.4	7181,2	7436.2	7711.0	8009.2	8335.1
54	6724.0	6947.2	7185.3	7440 6	7715.8	8014.4	8340,8
55	6727,6	6951,1	7189,5	7445.0	7720.6	8019.6	8346.6
56	6731.2	6954.9	7193.6	7449.5	7725.4	8024.8	8352.3
57	6734.9	6958,8	7197,7	7453.9	7730.2	8030 0	8358.0
58	6738.5	6962,6	7201.8	7458,3	7735.0	8035.3	8363.7
59	6742.1	6966.5	7205.0	7462.8	7739.8	8040.5	8369.5
M.	Min.	Min.	Min.	Min.	Min.	Min.	Min.
L.	73	74	75	76	77	78	79

L.	80	81	82	83	84
M.	Min.	Min.	Min.	Min.	Min.
0	8375.3	8739,1	9145,5	9605.9	10137.0
1	8381,0	8745.5	9152.7	9614.1	10146.6
2	8386.8	8751.9	9159.9	9622.4	10156.2
3	8392.6	8758,2	9167.2	9630.6	10165,8
4	8398,3	8764.9	9174.4	9638.9	10175.4
5	8404.1	8771.2	9181,6	9647.2	10185.1
6	8409.9	8777.7	9188.9	9655,5	10194,8
7	8415.8	8784,1	9156,2	9663.8	10204,6
8	8421,6	8790.6	9203,5	9672,2	10214.4
9	8427.4	8797,1	9210.8	9680,6	10224.2
10	8433,3	8803.6	9218.1	9689,0	10234,0
11	8439.1	8810.1	9225.4	9697,4	10243,8
12	8445.0	8816.6	9232.8	9705,8	10253.7
13	8450,9	8823,2	9240.2	9714,2	10263,6
14	8456.8	8829.7	9247.6	9722.7	10273.5
15	8462.6	8836.3	9255.0	9731.2	10283,5
16	8468.6	8842.8	9262.4	9739.7	10293 5
17	8473.5	8849.4	9269.9	9748.3	10303.5
18	8480.4	8856,0	9277.3	9756.8	10313.6
19	8486.3	8862.6	9284.8	9765.4	10323.7
20	8492.3	8869,3	9292.3	9774.0	10333.8
21	8498.2	8875.9	9299,8	9782,7	10344.0
22	8504.2	8882.6	9307,3	9791.3	10354.1
23	8510.2	8889.2	9314.8	9800.0	10364.3
24	8516.2	8895,9	9322.4	9808.6	10374.5
25	8522 2	8902.6	9330,0	9817.3	10384.8
26	8528 2	8909.3	9337.7	9826.1	10395.1
27	8534.2	8916.0	9345.2	9834.8	10405.4
28	8540.2	8922,7	9352,8	9843.6	10415,8
29	8546.2	8929.5	9360.4	9852.4	10426,2
M.	Min.	Min.	Min.	Mni.	Min.
L.	80	81	82	83	84

L.	80	81	82	83	84
M	Min.	Min.	Min.	Min.	Min.
30	85[illegible].3	8936.2	9368.1	9861.3	10436.6
31	8558.4	8943.0	9375.8	9870.1	10447.[illegible]
32	8564.4	8949.8	9383.5	9879.0	104[illegible]7.5
33	8570.5	8956.6	9391.2	9887.8	[illegible]04[illegible]8.0
34	8576.6	8963.4	9398.9	9896.7	[illegible]0478.5
35	8582.7	8970.8	9406.6	9905.8	10489.1
36	8588.9	8977.1	9414.4	9914.6	10499.7
37	8595.0	8983.9	9422.1	9923.6	10510.4
38	8601.1	8990.8	9429.9	9932.7	10521.1
39	8607.3	8997.7	9437.3	9941.7	10531.8
40	8613.5	9004.6	9445.6	9950.0	10542.6
41	8619.6	9011.5	9453.3	9959.8	10553.3
42	8625.8	9018.4	9461.3	9968.9	10564.1
43	8632.0	9025.4	9469.1	9978.0	10574.9
44	8638.2	9032.3	9477.0	9987.2	10585.8
45	8644.5	9039.3	9484.9	9996.3	10596.7
46	8650.7	9046.3	9492.9	10005.5	10607.7
47	8656.9	9053.3	9500.8	10014.8	10618.7
48	8663.2	9060.3	9508.8	10024.0	10629.7
49	8670.5	9067.3	9516.8	10033.3	10640.8
50	8675.7	9074.4	9524.8	10042.6	10651.9
51	8682.0	9081.4	9532.9	10051.9	10663.0
52	8688.3	9088.4	9540,9	10061.3	10674.1
53	8694.6	9095.5	9548.9	10070.6	10685.3
54	8701.0	9102.7	9557.0	10080.0	10696.5
55	8707.3	9109.8	9565.1	10089.4	10707.7
56	8713.6	9116.9	9573.2	10098.9	10719.1
57	8720.0	9124.0	9581.4	10108.4	10730.4
58	8726.4	9131.2	9589.5	10117.9	10741.8
59	8732.7	9138.4	9597.7	10127.4	10753.3
M.	Min.	Min.	Min.	Min.	Min.
L.	80	81	82	83	84

L.	85	86	87	88	89
M.	Min.	Min.	Min.	Min.	Min.
0	10764.7	11532.6	12522.4	13916.	16299.8
1	10776,2	11547.0	12541.4	13945.4	16357.5
2	10787.7	1156[illegible].4	12560.7	13974.4	16416.3
3	10799.3	11575.9	12580.0	14003.7	16476.1
4	1081[illegible].9	11590.5	12599.5	14033.2	16537.0
5	10822.5	11605.0	12619.1	14063.0	16594.9
6	10834,2	11619.8	12638.9	14093.0	16662.0
7	10845.9	11634.5	12658.6	14123.3	16726.2
8	10857.7	11649.3	12678.6	1415[illegible].9	16791.7
9	10869.6	11664.1	12698.6	14184.7	16858.5
10	10881.4	11679.1	12718.8	14215.8	16926.5
11	10893.3	11694.0	12739.1	14247.2	16990.6
12	10905.2	11709.1	12759.5	14278.5	17066.9
13	10917.2	11724.2	12780.0	14310.9	17130.3
14	10929.1	11739.4	12800.7	14343.2	17213.3
15	10941.2	11754.7	12821.5	14375.8	17288.0
16	10953.3	11770.0	12842.5	14408.7	17366.7
17	10965.5	11785.4	12863.5	14441.9	17445.0
18	10977.7	11800.9	12884.7	14475.4	17525.9
19	10989.9	11816.4	12906.0	14509.3	17608.7
20	11002.2	11832.0	12927.4	14543.5	17693.6
21	11014.5	11847.6	12948.9	14578.1	17780.7
22	11026.9	11863.4	12970,6	14613.0	17869.9
23	11039.3	11879.2	12992.5	14648.3	17961.6
24	11051.7	11895.1	13014.4	14683.9	18055.8
25	11064.2	11911.0	13036.6	14719.9	18152.6
26	11076.8	11927.1	13058.8	14756.3	18252.3
27	11089.3	11943.1	13081.2	14793.0	18354.9
28	11102.0	11959.4	13103.8	14830.2	18460.7
29	11114.6	11975.6	13126.5	14867.8	18569.8
M.	Min.	Min.	Min.	Min.	[illegible]
L.	85	86	87	88	89

L.	85	86	87	88	89
M.	Min.	Min.	Min.	Min.	Min.
30	11127.4	11992.0	13149.3	14905,8	18682.5
31	11140.1	12008.4	13172.3	14944.2	1879[illegible].1
32	11152.9	12024.9	13195.5	14983.0	1[illegible]919.7
33	11165.8	12041.5	13218.8	15022.3	1[illegible]044.7
34	11178.7	12058.2	13242.4	1506[illegible]	19174.4
35	11191.7	12074.9	13265.9	15102.3	19309,2
36	11204.7	12091.7	13289.7	15143,0	19449,5
37	11217.7	12108.6	133[illegible]3.7	15184.2	19595.8
38	11230.9	1212[illegible].6	13337.8	15225.8	19748,5
39	11244.0	12142.7	13362.[illegible]	15268,0	19908.6
40	11257.2	12159.9	13386.6	15310.7	20075.2
41	11[illegible]70.5	12177.1	13411.2	15354.0	20252.5
42	11283.8	12194.4	13436.1	15397.8	20438.3
43	11297.1	12211.8	13461.1	15442.1	20634.8
44	11310.6	12229.3	13486.3	15487.0	20843.1
45	11324.0	12246.9	13511.6	15532.6	21064.9
46	11337.6	12264.6	13537.2	15578.7	21302.0
47	11351.1	12282.4	13563.0	15625.5	21556.6
48	11364.8	12300.2	13588.9	15673.0	21831.7
49	11378.4	12318.2	13615.1	15721.0	22130.6
50	11392.2	12356.3	13641.4	15769.8	22458.0
51	11406.0	12354.4	13668.0	15819.3	22819.9
52	11419.8	12372.7	13694.7	15869.5	23224.3
53	11433.7	12391.0	13721.7	15920.4	23582.6
54	11447.7	12409.5	13748.9	15972.1	24211.8
55	11461.7	12428.0	13776.3	16024.6	24836,9
56	11475.8	12446.7	13803.9	16077.9	25600,8
57	11489.9	12465.3	13831.7	16132.0	26582.9
58	11504.1	12484.2	13859,8	16187.0	27958.0
59	11518.3	12503.1	13888.1	16242.9	30364.3
M.	Mnin.	Min.	Min.	Min.	Min.
L.	85	86	87	88	89

SECT. XI.

Of Oblique Sailing.

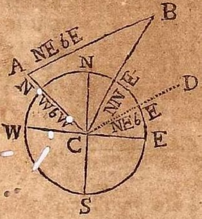
THE Questions that may be propos'd on this Head being innumerable, I ſhall only give a few of the moſt uſeful.

Problem I.

Coaſting along the Shore I ſaw a Cape bear from me N N E, then I ſtood away N W *b* W 20 Miles, and I obſerv'd the ſame Cape to bear from me N E *b* E. Required the Diſtance of the Ship from the Cape at each Station.

Geometrically.

Draw the Circle N W S E to repreſent the Compaſs, N S the Meridian, and E W the Eaſt and Weſt Line, and let C be the Place of the Ship in her firſt Station; then from C ſet off upon the NW*b*W Line, C A 20 Miles, and A will be the Place of the Ship in her ſecond Station.



From C draw the N N E Line C B and from A draw A B parallel to the N E *b* E Line C D, which will meet C B in B the Place of the Cape, and C B will be the Diſtance of it from the Ship in its firſt Station, and A B the Diſtance in the Second, to find which

By

By Calculation.

In the Triangle ACB are given AC, equal to 20 Miles, the Angle ACB equal to 78°, 45′; the Diſtance between the NNE and NW*b*W Lines; alſo the Angle ABC, equal to BCD (by *Art.* 36 *Sect.* 1.) equal to 33°, 45′; the Diſtance between the NNE and NE*b*E Lines; and conſequently the Angle A equal to 67°, 30′, (by *Cor.* 1. *Art.* 61 *Sect.* 1.)

Hence for CB, the Diſtance of the Cape from the Ship in her firſt Station, it will be (by *Caſe* 2. of *Oblique Trigonometry.*)

S, ABC : AC :: S, BAC : CB.

i. e. As the Sine of the Angle B	33°, 45′	9.74474
is to the Diſtance run AC -	20. -	1.30103
ſo is the Sine of BAC - -	67, 30 -	9.96562
to CB - - - - -	33.26 -	1.52191

the Diſtance of the Cape from the Ship at the firſt Station. Then for AB it will be *by the ſame Caſe.*

S, ABC : AC :: S, ACB : AB.

i. e. As the Sine of B - -	33°, 45′ -	9.74474
is to AC - - - - -	20. - - -	1.30103
ſo is the Sine of C - -	78, 45 -	9.99157
to AB - - - - -	35.31 -	1. 54786

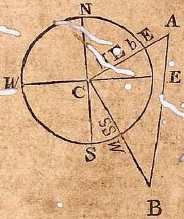
the Diſtance of the Ship from the Cape at her ſecond Station.

Problem 2.

Coaſting along the Shore I ſaw two Headlands, the firſt bore from me NE*b*E 17 Miles, the other SSW 20 Miles. Required the Bearing and Diſtance of theſe Headlands from one another.

Geometrically.

Having drawn the Compaſs N W S E, let C



repreſent the Place of the Ship, ſet off upon the N E *b* E Line C A 17 Miles, from C to A, and upon the S S W Line C B, 20 Miles from C to B, and join A B, then A will be the firſt Headland, and B the ſecond; alſo A B will be their Diſtance, and the Angle A will be the Bearing from the N E *b* E Line, to find which,

By Calculation.

In the Triangle A C B are given, A C 17, C B 20, and the Angle A C B equal to 101°, 15′, the Diſtance between the N E *b* E and S S W Lines. Hence, (by *Caſe* 4. *of Oblique-Angular Trigonometry*, it will be,

As the Sum of the Sides A C and C B	37.	1.56820
is to their Difference - - -	3.	0.47712
ſo is the Tang. of ½ the Sum of the Angles A and B	39°, 22½′	9.91417
to the Tang. of half their Diff.	3 , 49	8.82309

conſequently the Angle A will be 43°, 11′, and the Angle B 35°, 34′; alſo the Bearing of B from A will be S *b* W 1°, 49′, Weſterly, and the Bearing of A from B will be N *b* E 1°, 49′ Eaſterly.

Then for the Diſtance A B it will be, by *Caſe* 2. *of Oblique-Angular Trigonometry.*)

S, A :

S, A : CB : : S, C : AB.

i. e. As the Sine of A	43°, 11′	-	9.83527
is to CB - - -	20.	- -	1.30103
ſo is the Sine of C -	101,15	-	9.99157
to AB - - -	28.67	-	1.45733

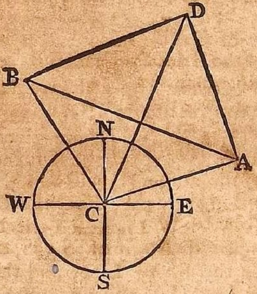
the Diſtance between the two Headlands.

Problem 3.

Coaſting along the Shore, I ſaw two Headlands, the firſt bore from me N W *b* N, and the ſecond N N E; then ſtanding away E *b* N $\frac{3}{4}$ Northerly 20 Miles, I found the firſt bore from me W N W $\frac{1}{2}$ Weſterly, and the ſecond N *b* W $\frac{1}{2}$ Weſterly. Required the Bearing and Diſtance of theſe two Headlands.

Geometrically.

Having drawn the Compaſs N W S E, let C repreſent the firſt Place of the Ship, from which



draw the N W *b* N Line C B, and the N N E Line C D, alſo the E *b* N $\frac{3}{4}$ N Line C A, which make

 equal

equal to 20. From A draw AB parallel to the WNW $\frac{1}{2}$ W Line, and AD parallel to the N*b*W $\frac{1}{2}$ W meeting the two first Lines in the Points B and D; then B will be the first, and D the second Headland. Join the Points B and D, and BD will be the Distance between them, and the Angle CDB the Bearing from the N N[illegible] Line, to find which

By Calculation.

1. In the Triangle ABC is given the Angle BCA, equal to 104°, 04′, the Distance between the NW*b*N Line, and the ENE $\frac{1}{4}$ E Line, the Angle BAC equal to 36°, 34′, the Distance between the WSW $\frac{1}{4}$ W Line and the WNW $\frac{1}{2}$ W Line, the Angle ABC equal to 39°, 22′, the Distance between the ESE $\frac{1}{2}$ E Line, and the SW*b*S Line, also the Side CA equal to 20 Miles, whence for CB it will be, (*by Case* 2. *of Oblique Trigonometry.*)

As the Sine of CBA	-	39°, 22′	-	9.80228
is to AC	- -	20.	- -	1.30103
so is the Sine of CAB	-	36°, 34′	-	9.77507
to CB	- - - -	18.79	-	1.27382

the Distance between the first Headland and the Ship in her first Station.

2. In the Triangle ACD, are given the Angle ACD, equal to 47°, 49′, the Distance between the ENE $\frac{1}{4}$ E Line, and the NNE Line; the Angle CAD, equal to 92°, 49′, the Distance between the WSW $\frac{1}{4}$ W Line, and the N*b*W $\frac{1}{2}$ W Line, the Angle CDA, equal to 39°, 22′, the Distance between the SSW Line, and the S*b*E $\frac{1}{2}$ E Line, also the Leg CA equal to 20.

Hence for CD it will be, (by *the* 2. *Case of Oblique Trigonometry.*)

As

As the Sine CDA	39°, 22′	-	9.80228
is to AC	20.	-	1.30103
ſo is the Sine of CAD	92°, 34′	-	9.99960
to CD	31.5	-	1.49835

the Diſtance between the ſecond Headland, and the Ship in her firſt Station.

3. In the Triangle BCD are given BC 18.79, CD 31.5, and the Angle BCD, equal to 56°, 15′ the Diſtance between the NW*b*N Line, and the NNE Line.

Hence, for the Angle CDB, it will be, (by *Caſe* 4. *of Oblique Trigonometry.*)

As the Sum of the Sides	50.29	-	1.70148
is to the Diff. of the Sides	12.71	-	1.10415
ſo is the Tang. of ½ the Sum of the unknown Angles	61°, 52′	-	10.27189
to the Tang. of half their diff.	25, 18	-	9.67456

conſequently the Angle CBD is 87°, 10′, and the Angle CDB 36°, 35′. Hence the Bearing of the firſt Headland from the ſecond will be S 59°, 08′, W or SW*b*W ½ W nearly, and and for the Diſtance between them it will be

As the Sine of BDC	36°, 35′	-	9.77525
is to BC	18.79	-	1.27382
ſo is the Sine of BCD	56°, 15′	-	9.91985
to BD	26.21	-	1.41843

the Diſtance between the two Headlands.

This, and the firſt Problem, are of great Uſe in drawing the Plot of any Harbour, or laying down any Sea-Coaſt.

Problem 4.

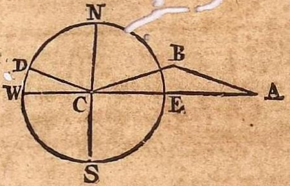
Suppoſe a Ship that makes her Way good within 6½ Points of the Wind, at North, is bound to a Port bearing Eaſt 86 Miles diſtance from her. Re-

quir'd

quir'd the Courſe and Diſtance upon each Tack, to gain the intended Port.

Geometrically.

Having drawn the Compaſs N E S W, let C repreſent the Ship's Place, and ſet off on the Eaſt, Line C A 86 Miles, ſo A will be the intended Port. Draw C D and C B on each Side of the North Line, at 6½ Points Diſtance from it, and thro' A draw A B



parallel to C D meeting C B in B; then the E N E ½ E Line C B will be the Courſe of the Ship upon the Starboard Tack, and C B its Diſtance on that Tack; alſo the E S E ½ E Line A B will be the Courſe on the Larboard Tack, and B A the Diſtance on that Tack, to find which

By Calculation.

In the Triangle A B C are given the Angle A C B equal to 16°, 53′, the Diſtance between the Eaſt and E N E ½ E Line, the Angle C B A equal to 146°, 14′, the Diſtance between the E N E ½ E and the W N W ½ W Lines, the Angle B A C equal to 16°, 53′, the Diſtance between the Eaſt, and E S E ½ E Lines, alſo A C 86 Miles.

Hence, ſince the Angle at A and C are equal, the Legs C B and B A will likewiſe be equal; to find

find either of which (ſuppoſe CB) it will be (by *Caſe* 2. *of Oblique-Angled Trigonometry.*)

As the Sine of B -	146°, 14′ -	9.7[illegible]493
is to AC - - -	86. - -	1.9[illegible]450
ſo is the Sine of A -	16,53 - -	9.[illegible]03
to CB - -	44.94 - -	1.65260

the Diſtan[illegible] the Ship muſt ſail on each Tack.

There is a great Variety of uſeful Queſtions of this Nature that may be propos'd, but the Nature of them being better underſtood by Practice at Sea, we ſhall leave them, and go on to *Current Sailing.*

SECT. XII.

Concerning Currents, *and how to make proper Allowances for them.*

1. CURRENTS are certain Settings of the *Stream*, by which all Bodies (as Ships, *&c.*) moving therein, are compell'd to alter their Courſe or Velocity, or both; and ſubmit to the Motion impreſſed upon them by the *Current.*

CASE 1.

If the *Current* ſets juſt with the Courſe of the Ship, *(i. e.)* moves on the ſame Rumb with it; then the Motion of the Ship is encreas'd, by as much as is the Drift or Velocity of the *Current.*

Example.

Suppoſe a Ship ſails SE*b*S at the Rate of 6 Miles an Hour, in a *Current* that ſets SE*b*S 2 Miles an Hour. Requir'd her true Rate of Sailing.

Here it is evident, that the Ship's true Rate of Sailing, will be 8 Miles an Hour.

CASE

CASE 2.

If the *Current* ſets directly againſt the Ship's Courſe, then the Motion of the Ship 's leſſen'd by as much as is the Velocity of the *Current.*

Example.

Suppoſe a Ship ſails SSW at the Rate of 10 Miles an Hour, in a *Current* that ſets NNE 6 Miles an Hour. Requir'd the Ship's true Rate of Sailing.

Here it is evident, that the Ship's true Rate of Sailing will be 4 Miles an Hour. Hence it is plain,

Cor. 1. If the Velocity of the *Current* be leſs than the Velocity of the Ship, then the Ship will get ſo much *a-Head* as is the Difference of theſe Velocities.

Cor. 2. If the Velocity of the *Current* be greater than that of the Ship, then the Ship will fall ſo much *a-Stern* as is the Difference of theſe Velocities.

Cor. 3. *Laſtly*, If the Velocity of the *Current* be equal to that of the Ship, then the Ship will ſtand ſtill; the one Velocity deſtroying the other.

CASE 3.

If the *Current* thwarts the Courſe of the Ship, then it not only leſſens or augments her Velocity, but gives her a new Direction compounded of the Courſe ſhe ſteers, and the ſetting of the *Current*, as is manifeſt from the following

Lemma.

If a Body at A be impell'd by two Forces at the ſame Time, the one in the Direction AB, capable

pable to carry that Body from A to B in a certain Space of Time, and the other in the Direction AD capable to carry it from A to D in the same Time: Compleat the Parallelogram ABCD, and draw the Diagonal AC; then the Body at A, agitated by these two Forces together, will move along the Line AC, and will be in the Point C at the End of the Time in which it would have mov'd along AD or AB with the Forces separately applied.

Hence the Solution of the following Examples will be evident.

Example 1.

Suppose a Ship sails (by the Compass) directly South 96 Miles in 24 Hours, in a *Current* that sets East 45 Miles in the same Time. Requir'd the Ship's true Course and Distance.

Geometrically.

Draw AD (see the last Scheme) to represent the South and North Line of the Ship at A, which make equal to 96; from D draw DC perpendicular to AD equal to 45, and join AC. Then C will be the Ship's true Place, AC her true Distance, and the Angle CAD the true Course. To find which,

By Calculation

First, For the true Course DAC, it will be (by *Case* 4. of *Rectangular Trigonometry*.)

As the apparent Distance AD	- 96.	-	1.98227
is to the Current's Motion DC	45.	-	1.65321

so

so is Radius - - - - 10.00000
to the Tangent of the true Course D A C - - } 25°, 07′ - 9.67094

consequently the Ship's true Course is S 25°, 07′ E. or SSE 2°, 37′ Easterly.

Then for the true Distance A C, it will be, (by *Case* 2. *of Rectangular Trigonometry*,)

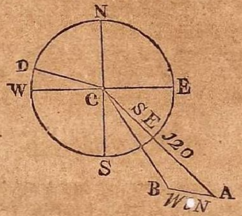
As the Sine of the Course A 25°, 07′ - 9.62784
is to the Curr. Motion D C 45. - - 1.65321
so is Radius - - - - 10.00000
to the true Distance A C 106. - - 2.02537

Example 2.

Suppose a Ship sails S E 120 Miles in 20 Hours, in a *Current* that sets W *b* N, at the Rate of 2 Miles an Hour. Requir'd the Ship's true Course and Distance sail'd in that Time.

Geometrically.

Having drawn the Compass N E S W, let C represent the Place the Ship sail'd from; draw the



SE Line C A, which make equal to 120; then will A be the Place the Ship caped at.

From

From A draw AB parallel to the W*b*N Line CD, equal to 40, the Motion of the *Current* in 20 Hours, and join CB; then B will be the Ship's true Place at the End of 20 Hours, CB her true Diſtance, and the Angle SCB her true Courſe. To find which,

By Calculation.

In the Triangle ABC are given CA 120, AB 40, and the Angle CAB equal to 33°, 45′, the Diſtance between the E*b*S and SE Lines, to find the Angles B and C, and the Side CB.

Firſt, For the Angles C and B it will be, (by *Caſe* 4. *of Oblique Trigonometry*,)

As the Sum of the Sides CA and AB	160.	2.20412
is to their Difference - - -	80.	1.90309
ſo is the Tang. of half the Sum of the Angles B and C	73°, 07′ -	10.51783
to the Tang. of half their Diff.	58 , 45 -	10.21680

conſequently the Angle B will be 131°, 52′, and the Angle ACB 14°, 23′. Hence the true Courſe is S 30°, 37′ E, or SSE 8°, 07′ Eaſterly.

Then, for the true Diſtance CB, it will be, (by *Caſe* 2. *of Oblique Trigonometry*,)

As the Sine of B - -	131°, 52′ -	9.87198
is to AC - -	120. - -	2.07918
ſo is the Sine of A - -	33°, 45′ -	9.74474
to the true Diſtance CB -	89.53 -	1.95194

Example 3.

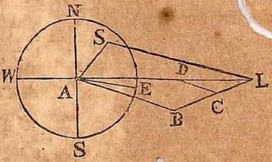
Suppoſe a Ship coming out from Sea in the Night, has Sight of *Scilly* Light, bearing NE*b*N Diſtance 4 Leagues, it being then Flood-Tide, ſetting ENE 2 Miles an Hour, and the Ship running after the Rate of 5 Miles an Hour. Requir'd upon what

Course, and how far she must sail to hit the *Lizard* which bears from *Scilly* E ½ S Distance 17 Leagues.

Geometrically.

Having drawn the Compass N E S W, let A represent the Ship's Place at Sea, and draw the N E *b* N Line A S, which make equal to 12 Miles, so S will represent *Scilly*.

From S draw S L, equal to 51 Miles, and parallel to the E ½ S Line; then L will represent the *Lizard*.



From L draw L C parallel to the E N E Line, equal to 2 Miles, and from C draw C D equal to 5 Miles, meeting A L in D; then from A draw A B parallel to C D, meeting L C produc'd in B, and A B will be the requir'd Distance, and S A B the true Course. To find which,

By Calculation.

In the Triangle A S L are given the Side A S, equal to 12 Miles, the side S L, equal to 51, and the Angle A S L equal to 118°, 07′, the Distance between the N E *b* N and W ½ N Lines, to find the Angles S A L and S L A. Consequently, (by *Case* 4. of *Oblique Trigonometry*, it will be

As

As the Sum of the Sides AS and SL 63. 1.79934
is to their Difference - - - 39. 1.59106
ſo is the Tang. of half the Sum of the Angles SAL and SLA } 30°, 56′ 9.77763
to the Tang. of half their Diff. 20°, 21′ 9.56925
conſequently the Angle SAL, will be 51°, 17′, and ſo the direct Bearing of the *Lizard* from the Ship, will be S 85°, 02′ E, or E *b* N 6°, 17′ E, and for the Diſtance AL, it will be, (by *Caſe* 2. *of Oblique Trigonometry*,)

As the Sine of SAL - 51°, 17′ - 9.89223
is to SL - - - - 51. - - - 1.70757
ſo is the Sine of ASL 118°, 07′ - 9.94546
to AL - - - - - 57.65 - - 1.76080
the Diſtance between the Ship and the *Lizard*.

Again, in the Triangle DLC, are given the Angle L, equal to 17°, 32′, the Diſtance between the ENE and N 85°, 02 E Lines, the Side LC equal to 2 Miles, the Current's Drift in an Hour, and the Side CD equal to 5 Miles the Ship's Run in the ſame Time. Hence, for the Angle D, it will be, (by *Caſe* 1. *of Oblique Trigonometry*,)

As the Ship's Run in 1 Hour DC 5. - 0.69897
is to the Sine of L - - - 17°, 32′ 9.47894
ſo is the Current's Drift LC - 2. - 0.30103
to the Sine of D - - - 6°, 55′ 9.08100
conſequently, ſince by Conſtruction the Angle LAB is equal to the Angle LDC, the Courſe the Ship muſt ſteer is S 88°, 03′ E.

Then for the Diſtance AB, it will be, (by *Caſe* 2. *of Oblique Trigonometry*,)

As the Sine of B - - 155°, 33′ - - 9.61689
is to AL - - - - - 57.65 - - 1.76080
ſo is the Sine of L - 17,32 - - 9.47894
to AB - - - - - - 41.96 - - 1.62285.

conſequently,

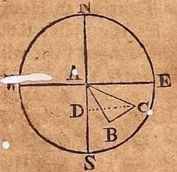
consequently, since the Ship is sailing at the Rate of 5 Miles an Hour, it follows, that in sailing 8 Hours, 24 Min. S 8[illegible]°, 03′ E. she will arrive at the *Lizard*.

Example 4.

A Ship from a certain Headland in the Latitude of 34°, 00′ North, sails S E *b* S 12 Miles in three Hours, in a *Current* that sets between North and East, and then the same Headland is found to bear W N W, and the Ship to be in the Latitude of 33°, 52′ North. Requir'd the Setting and Drift of the *Current*.

Geometrically.

Having drawn the Compass N E S W, let A represent the Place of the Ship, and draw the S E *b* S Line A B equal to 12 Miles, also the E S E Line A C.



Set off from A upon the Meridian, A D, equal to 8 Miles, the Difference of Latitude, and thro' D draw D C parallel to the East and West Line W E, meeting A C in C. Join C and B with the Right Line B C; then C will be the Ship's Place, the Angle A B C the setting of the *Current* from the S E *b* S Line, and the Line B C will be the Drift of the *Current* in 3 Hours. To find which,

By Calculation.

In the Triangle A B C, Right-angled at D, are given the Difference of Latitude A D equal to 8 Miles, the Angle D A C equal to 67°, 30′. Whence for A C, the Distance the Ship has sail'd, it will be,

As

As Radius	- - - -		10.00000
is to the Difference of Lat AD	8.	-	0.00309
ſo is the Sec. of the Courſe DAC	67°, 30′	-	10.41716
to the Diſtance run AC	20.9	- -	1.32025

Again, in the Triangle ABC are given AB equal to 12 Miles, AC equal to 20.9, and the Angle BAC equal to 33°, 45′, the Diſtance between the SE*b*S and ESE Lines. Whence, for the Angle at B, it will be,

As the Sum of the Sides AC and AB	32.9	1.51720
is to their Difference	8.9	0.94939
ſo is the Tang. of half the Sum of the Angles B and C	73°, 07′	10.51806
to the Tang. of ½ their Diff.	41°, 43′½	9.95025

conſequently the Angle B is 114°, 51′, and ſo the Setting of the *Current* will be N 81°, 06′ E or E*b*N 2°, 21′ E. Then for BC, the *Current*'s Drift in three Hours, it will be,

As the Sine of B	- -	114°, 51′	- 9.95780
is to the Diſtance run AC		20.9	- - 1.32025
ſo is the Sine of A	- -	33°, 45′	- 9.74474
to BC	- - - - -	12.8	- - 1.10719

the *Current*'s Drift in 3 Hours, and conſequently the *Current* ſets E*b*N 2°, 21′ E 4.266 Miles an Hour.

SECT.

SECT. XII.

Concerning the Variation of the Compass, and how to find it from the true and observ'd Amplitudes or Azimuths of the Sun.

1. THE *Variation* of the Compass is how far the North or South Point of the *Needle* stands from the true South or North Point of the Horizon towards the East or West; or 'tis an Arch of the Horizon intercepted between the Meridian of the Place of Observation and the Magnetic Meridian.

2. It is absolutely necessary to know the *Variation* of the Compass at Sea, in order to correct the Ship's Course; for since the Ship's Course is directed by the Compass, 'tis evident, that if the Compass be wrong, the true Course will differ from the observed, and consequently the whole Reckoning differ from the Truth.

3. The Sun's true *Amplitude* is an Arch of the Horizon, comprehended between the true East or West Point thereof, and the Center of the Sun at Rising or Setting; or it is the Number of Degrees, &c. that the Center of the Sun is distant from the true East or West Point of the Horizon, towards the South or North.

4. The Sun's *Magnetic Amplitude* is the Number of Degrees that the Center of the Sun is from the East or West Point of the Compass, towards the South or North Point of the same at Rising or Setting.

5. Having the Declination of the Sun, together with the Latitude of the Place of Observation, we may from thence find the Sun's true *Amplitude*, by the following Astronomic Proposition, *viz.*

As the Co-sine of the Latitude
is to the Radius

so

so is the Sine of the Sun's Declination
to the Sine of the Sun's true Amplitude.

which will be North or South according as the Declination is North or South.

Example.

Requir'd the Sun's true Amplitude in the Latitude of 41°, 50′ North, on the 23 Day of *April* 1731.

First, I find from the third Table at the End of this Book, that the Sun's Declination the 23*d* of *April* 1731, is 15°, 54′ North, then for the true Amplitude, it will be, by the former Analogy.

As the Co-Sine of the Lat. . .	41°, 50′ .	9.87221
is to Radius	. . . . .	10.00000
so is the Sine of the Declination	15°, 54′ .	9.43769
to the Sine of the Amplitude	21, 35′ .	9.56548

which is North, because the Declination is North at that Time; and consequently in the Latitude of 41°, 50′ North, the Sun rises on the 23*d* of *April* 1731, 21°, 35′, from the East-Part of the Horizon towards the North, and sets so much from the West the same Way.

6. The Sun's true *Azimuth* is the Arch of the Horizon intercepted between the Meridian and the Vertical Circle passing thro' the Center of the Sun at the Time of Observation.

7. The Sun's *Magnetic Azimuth* is the Arch of the Horizon intercepted between the Magnetic Meridian and the Vertical, passing thro' the Sun.

8. Having the Latitude of the Place of Observation, together with the Sun's Declination and Altitude at the Time of Observation, we may find his true Azimuth after the following Method, *viz.*

 Make

Make it,

As the Tangent of half the Complement of the Latitude
is to the Tangent of half the Sum of the Diſtance of
the Sun from the Pole and Complement of the Altitude,
ſo is the Tangent of half the Difference between the
Diſtance of the Sun from the Pole and Complement of
the Altitude . . . . .
to the Tangent of a fourth Arch.

which fourth Arch added to half the Complement of the Latitude, will give a fifth Arch, and this fifth Arch leſſened by the Complement of the Latitude will give a ſixth Arch; then make it

As the Radius . . . .
is to the Tangent of the Altitude
ſo is the Tangent of the ſixth Arch
to the Co-Sine of the Sun's Azimuth,

which is to be counted from the South or North, to the Eaſt or Weſt, according as the Sun is ſituated with reſpect to the Place of Obſervation.

If the Latitude of the Place and Declination of the Sun be both North or both South, then the Declination taken from 90°, will give the Sun's Diſtance from the Pole; but if the Latitude and Declination be on contrary Sides of the Equator, then the Declination added to 90°, will give the Sun's Diſtance from the neareſt Pole to the Place of Obſervation.

Example.

In the Latitude of 51°, 32′ North, the Sun having 19°, 39′ North Declination, his Altitude was found by Obſervation to be 38°, 18′. Requir'd the Azimuth.

By

By the firſt of the foregoing Analogies it will be

As the Tangent of ½ the Complement of the Latitude	19°, 14′	9.54269
is to the Tangent of ½ the Sum of the Diſtance of the Sun from the Pole and Complement of the Altitude	61,,01	10.25655
ſo is the Tangent of half their Difference	9,,19	9.21499
to the Tang. of a fourth Arch	40,,20	9.92885

which fourth Arch 40°, 20′, added to 19°, 14′ half the Complement of the Latitude gives a fifth Arch 59°, 34′, and this fifth Arch leſſened by 38°, 28′, the Complement of the Latitude gives the ſixth Arch 21°, 06′; then for the Azimuth it will be by the ſecond of the preceding Analogies,

As Radius		10.00000
is to the Tang. of the Altitude	38°, 18,	9.89749
ſo is the Tang. of the ſixth Arch	21, 06	9.58644
to the Co-Sine of the Azimuth	72,,15	9.48393

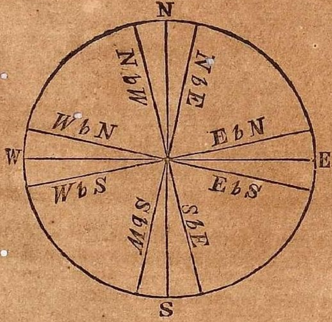
which, becauſe the Latitude is North, and the Sun South off the Place of Obſervation, muſt be counted from the South towards the Eaſt or Weſt; and conſequently if the Altitude of the Sun was taken in the Morning, the Azimuth will be S 72°, 15′ E, or E S E 4°, 45′ E; but if the Altitude was taken in the Afternoon, the Azimuth will be S 72°, 15′ W, or W S W 4°, 45′ Weſterly.

9. Having found the Sun's true Amplitude or Azimuth by the preceding Analogies, and his Magnetic Amplitude or Azimuth by Obſervation, 'tis evident if they agree there is no *Variation*; but if they diſagree, then if the true and obſerv'd Amplitudes at the Riſing or Setting of the Sun, be both of the ſame

ſame Name, *i. e.* either both North, or both South, their Difference is the *Variation*. But if they be of different Names, *i. e.* one North, and the other South, their Sum is the *Variation*. Again, if the true and obſerv'd Azimuths be both of the ſame Name, *i. e.* either both Eaſt or both Weſt, their Difference is the *Variation*; but if they be of different Names their Sum is the *Variation*: And to know whether the *Variation* is Eaſterly or Weſterly, obſerve this general Rule, *viz.*

Let the Obſerver's Face be turn'd to the Sun, then if the true Amplitude or Azimuth be to the Right-Hand of the obſerv'd, the *Variation* is Eaſterly; but if to the Left, Weſterly.

To explain which, let N E S W repreſent a Compaſs, and ſuppoſe the Sun is really E *b* S at the Time of Obſervation, but the Obſerver ſees him off



the Eaſt-Point of the Compaſs, and ſo the true Amplitude or Azimuth of the Sun, is to the Right of the Magnetic, or obſerv'd; here 'tis evident that the

the E *b* S Point of the Compaſs ought to lie where the Eaſt-Point is, and ſo the North where the N *b* W is; conſequently the North-Point of the Compaſs is a Point too far Eaſt, *i. e.* the Variation in this Caſe is Eaſterly. The ſame will hold when the Amplitude or Azimuth is taken on the Weſt-ſide of the Meridian.

Again, let the true Amplitude or Azimuth be to the Left-Hand of the obſerv'd; thus ſuppoſe the Sun is really E *b* N at the Time of Obſervation, but the Obſerver ſees him off the Eaſt-Point of the Compaſs, and ſo the true Amplitude or Azimuth to the Left of the obſerv'd: Here it is evident that the E *b* N Point of the Compaſs ought to ſtand where the Eaſt-Point is, and ſo the North where the N *b* E Point is; conſequently the North-Point of the Compaſs lies a Point too far Weſterly, ſo in this Caſe the Variation is Weſt. The ſame will hold when the Sun is obſerv'd on the Weſt-ſide of the Meridian.

Example 1.

Suppoſe the Sun's true Amplitude at Riſing is found to be E 14°, 20′ N, but by the Compaſs it is found to be E 26°, 12′ North. Required the Variation, and which Way it is.

Since they are both the ſame Way; therefore,

From the Magnetic Amplitude -	E 26°, 12′ N.
take the true Amplitude - - - -	E 14°, 20′ N.
and there remains the Variation -	11 , 52 E.

which is Eaſterly, becauſe in this Caſe the true Amplitude is to the Right of the obſerv'd.

Example

Example 2.

Suppose the Sun's true Amplitude at Setting is W 34°, 26′ S, and his Magnetic Amplitude W 23°, 13′ S. Requir'd the Variation, and which Way it is. Since they lye both the same Way, therefore,

From the Sun's true Amplitude	W 34°, 26′ S.
take the Magnetic Amplitude	W 23°, 13′ S.
there remains the Variation - - -	11 , 13 W.

which is Westerly, because the true Amplitude in this Case is to the Left-Hand of the observ'd.

Example 3.

Suppose the Sun's true Amplitude at Rising is found to be E 13°, 24′ N, and his Magnetic E 12°, 32′ S. Requir'd the Variation, and which Way it lies.

Since the true and observ'd Amplitudes lie different Ways, therefore,

To the true Amplitude - - -	E 13°, 24′ N.
add the Magnetic Amplitude	E 12° , 32 S.
the Sum is the Variation - - -	25 , 56 W.

which is Westerly, because the true Amplitude is, in this Case, to the Left of the observ'd.

Example 4.

Suppose the Sun's true Amplitude at Setting is found to be W 8°, 24′ N, but his Magnetic Amplitude is W 10°, 13′ S. Requir'd the Variation.

To

To the true Amplitude . . .	W 8°, 24′ N.
add the Magnetic	W 10, 13′ S.
the Sum is the Variation . .	18, 37 E.

which is Eaſterly, becauſe the true Amplitude is to the Right of the obſerv'd.

Example 5.

Suppoſe the Sun's true Azimuth at the Time of Obſervation, is found to be N 86°, 40′ E, but by the Compaſs it is N 73°, 24′ E. Requir'd the Variation, and which Way it lies.

From the Sun's true Azimuth,	N 86°, 40′ E.
take the Magnetical, - - -	N 73, 24 E.
There remains the Variation,	13, 16 E.

which is Eaſterly, becauſe the true Azimuth is to the Right of the obſerv'd.

Example 6.

Suppoſe the Sun's true Azimuth is S. 3°, 24′ E. and the Magnetical S. 4°, 36′ W. Requir'd the Variation, and which Way it lies.

To the true Azimuth - -	S. 3°, 24′ E.
add the Magnetical Azimuth. -	S. 4, 36 W.
The Sum is the Variation. - -	8, 00 W.

which is Weſterly, becauſe the true Azimuth is (in this Caſe) to the Left of the obſerv'd.

10. The Variation of the Compaſs was firſt obſerv'd at *London*, in the Year 1580, to be 11°, 15′ Eaſterly, and in the Year 1622 it was 6°, 0′ E. alſo in the Year 1634, it was 4°, 05′ E. ſtill decreaſing, and the Needle approaching the true Meridian, till it coincided with it, and then there

there was no Variation; after which, the Variation began to be Westerly, and in the Year 1672, it was observ'd to be 2°, 30′ W, also in the Year 1683, it was 4°, 30′ W, and since that Time the Variation still continues at *London* to encrease Westerly; but how far it will go that Way, Time and Observations will probably be the only Means to discover.

Again, at *Paris*, in the Year 1640, the Variation was 3°, 30′ E, and in the Year 1666, there was no Variation; but in the Year 1681, it was 2°, 30′ W, and still continues to go Westerly.

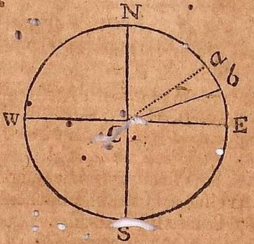
In short, from Observations made in different Parts of the World, it appears, that in different Places the Variation differs both as to its Quantity and Denomination, it being East in one Place, and West in another; the true Cause and Theory of which, for Want of a sufficient Number of Observations, has not yet been fully explain'd.

SECT. XIV.

The Method of keeping a Journal at Sea, and how to Correct it, by making proper Allowances for the Lee-way, Variation, *&c.*

1. LEE-WAY is the Angle that the Rumb-Line upon which the Ship endeavours to sail, makes with the Rumb she really sails upon. This is occasion'd by the Force of the Wind, or Surge of the Sea; when she lies to the Windward, or is close-haul'd, which causes her to fall off and glide

glide ſide-ways from the Point of the Compaſs ſhe capes at. Thus let NESW repreſent the Compaſs and ſuppoſe a Ship at C capes at, or endeavours to ſail upon the Rumb *Ca*; but by the Force of the Wind and Surge of the Sea, ſhe's oblig'd to fall off, and make her Way good upon the Rumb *Cb*; then the Angle *aCb* is the *Lee-way*, and if that Angle be equal to one Point, the Ship is ſaid to make one Point *Leeway*; and if equal to two Points, the Ship is ſaid to make two Points *Leeway*, &c.



2. The Quantity of this Angle is very uncertain, becauſe ſome Ships, with the ſame Quantity of Sail, and with the ſame Gale, will make more *Lee-way* than others; it depending much upon the Mould and Trim of the Ship, and the Quantity of Water that ſhe draws. The common Allowances that are generally made for the *Lee-way*, are as follows:

1. If a Ship be cloſe haul'd, has all her Sails ſet, the Water ſmooth, and a moderate Gale of Wind, ſhe is then ſuppoſ'd to make little or no *Lee-way*.

2. If it blow ſo freſh as to cauſe the ſmall Sails to be handed, 'tis uſual to allow one Point.

3. If it blow ſo hard that the Top-ſails muſt be cloſe reeft, then the common Allowance is two Points for *Lee-way*.

4. If one Top-ſail muſt be handed, then the Ship is ſuppoſ'd to make between two and three Points *Lee-way*.

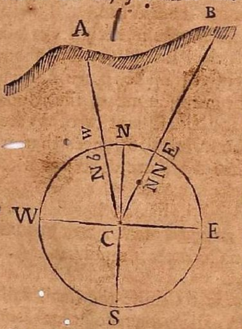
5. When both Top-ſails muſt be handed, then the Allowance is about four Points for *Lee-way.*

6. If it blows ſo hard, as to occaſion the Fore-Courſe to be handed, the Allowance is between 5½ and 6 Points.

7. When both Main and Fore-Courſes muſt be handed, then 6 or 6½ Points are commonly allow'd for *Lee-way.*

8. When the *Mizen* is handed, and the Ship is trying a Hull, ſhe is then commonly allow'd about 7 Points for *Lee-way.*

3. Though theſe Rules are ſuch as are generally made uſe of, yet ſince the *Lee-way* depends much upon the Mould and Trim of the Ship, 'tis evident that they can't exactly ſerve to every Ship; and therefore the beſt Way is to find it by Obſervation: Thus, let the Ship's *Wake* be ſet by a *Compaſs* in the *Poop*, and the oppoſite *Rumb* is the true *Courſe* made good by the Ship; then the Difference between this and the *Courſe* given by the *Compaſs* in the *Bittacle*, is the *Lee-way* required. If the Ship be within Sight of Land; then the *Lee-way* may be exactly found by obſerving a Point on the Land which continues to bear the ſame Way, and the Diſtance between the Point of the Compaſs it lies upon, and the Point the Ship capes at, will be the *Lee-way*. Thus, ſuppoſe a Ship at Sea is lying up



N *b* W

N *b* W towards A; but instead of keeping that Course, she is carried on the N N E Line C B, and consequently the Point B continues to bear the same Way from the Ship: Here 'tis evident, that the Angle A C B, or the Distance between the N *b* W Line that the Ship capes at, and the N N E Line that the Ship really sails upon, will be the *Lee-way*.

4. Having the Course steer'd, and the *Lee-way* given, we may from thence find the true Course by the following Method, *viz.* Let your Face be turn'd directly to the Windward, and if the Ship have her Larboard Tacks on Board, count the *Lee-way* from the Course steer'd towards the Right-hand; but if the Starboard Tacks be on Board, then count it from the Course steer'd towards the Left-hand. Thus, suppose the Wind at North, and the Ship lies up within 6 Points of the Wind, with her Larboard Tacks on Board, making one Point *Lee-way*; here 'tis plain, that the Course steer'd is E N E, and the true Course E *b* N; also, suppose the Wind is at N N W, and the Ship lies up within 6 ½ Points of the Wind with her Starboard Tacks on Board, making 1 ½ Point *Lee-way*; 'tis evident that the true Course, in this Case, is W S W.

5. We have shew'd, in the last Section, how to find the Variation of the Compass; and from what has been said there, we have this general Rule for finding the Ship's true Course, having the Course steer'd and the Variation given, *viz.* Let your Face be turn'd towards the Point of the Compass upon which the Ship is steer'd; and if the Variation be Easterly, count the Quantity of it from the Course steer'd, towards the Right-hand; but if Westerly, towards the Left-hand; and the Course thus found, is the true Course steer'd. Thus, suppose the Course steer'd is N *b* E, and the Varia-

tion one Point Easterly; then the true Course steer'd, will be N N E: Also suppose the Course steer'd is N E *b* E, and the Variation one Point Westerly; then in this Case, the true Course will be N E; and so of others.

Hence, by knowing the *Lee-way*, *Variation* and *Course* steer'd, we may from thence find the Ship's true Course; but if there be a Current under Foot, then that must be try'd, and proper Allowances made for it, as has been shewn at *Sect.* 12. from thence to find the true Course.

6. After making all the proper Allowances for finding the Ship's true Course, and making as just an Estimate of the Distance as we can; yet by reason of the many Accidents that attend a Ship in a Days Running, such as different Rates of sailing between the times of heaving the Log, the Want of due Care at the Helm, by not keeping her steady, but suffering her to yaw and fall off, sudden Storms, when no Account can be kept, &c. the Latitude by Account, frequently differs from the Latitude by Observation, and when that happens, 'tis evident there must be some Error in the Reckoning; to discover which and where it lies, and also how to correct the Reckoning, you may observe the following *Rules*.

1. If the Ship sail near the Meridian, or within 2 or 2½ Points thereof; then, if the Latitude by Account, disagrees with the Latitude by Observation, 'tis most likely that the Error lies in the Distance run; for it is plain, that in this Case it will require a very sensible Error in the Course to make any considerable Error in the Difference of Latitude, whith can't well happen, if due Care be taken at the Helm, and proper Allowances be made for the *Lee-way*, *Variation*, and *Currents*. Consequently, if the Course be pretty near the Truth, and the Error in the Distance run regu-

larly

larly through the whole, we may from the Latitude obtain'd by Observation, correct the Distance and Departure by Account, by the following Analogies, *viz.*

As the Difference of Latitude by Account
is to the true Difference of Latitude,
so is the Departure by Account
to the true Departure,
and so is the direct Distance by Account
to the true direct Distance.

The Reason of this is plain; for let A B denote the Meridian of the Ship at A, and suppose the Ship sails upon the *Rumb* A E, near the Meridian, till, by Account, she is found in C, and consequently her Difference of Latitude by Account is A B; but by Observation she's found in the Parallel E D, and so her true Difference of Latitude is A D, her true Distance A E, and her true Departure D E; then since the Triangles A B C, A D E are similar, it will be A B : A D :: B C : D E and A B : A D :: A C : A E.

Example.

Suppose a Ship from the Latitude of 45°, 20′ North, after having sail'd upon several Courses near the Meridian for 24 Hours, her Difference of Latitude is computed to be upon the whole 95 Miles Southerly, and her Departure 34 Miles Easterly; but by Observation she is found to be in Latitude 43°, 10′ North, and consequently her true Difference of Latitude is 130 Miles Southerly; then for the true Departure it will be. As the Difference of Latitude by Account 95, is to the true Difference

rence of Latitude 130, so is the Departure by Account 34, to the true Departure 46.52, and so is the Distance by Account [illegible].9, to the true Distance 138.

2. If the Courses are for the most Part near the Parallel of East and West, and the Direct Course be not less than 6 Points off the Meridian, then, if the Latitude by Account differs from the observ'd Latitude, it is most probable that the Error lies in the Course, or Distance, or perhaps both; for in this Case 'tis evident, the Departure by Account will be very nearly true; and thence, by the Help of this, and the true Difference of Latitude, may the true Course and direct Distance be readily found *by Case 4th of Plane Sailing.*

Example.

Suppose a Ship from the Latitude of 43°, 50′ North, after having sail'd upon several Courses near the Parallel of East and West, for the Space of 24 Hours, is found by dead-Reckoning to be in the Latitude of 42°, 45′ North, and to have made 160 Miles of Westing; but by a good Observation the Ship is found to be in the Latitude of 42°, 35′ North. Requir'd the true Course, and direct Distance sail'd.

With the true Difference of Latitude 75 Miles, and Departure 160 Miles, we shall find *(by Case 4th of Plane Sailing)* the true Course to be S. 64°, 53′ W, and the direct Distance 176.7 Miles.

3. If the Courses are for the most Part near the Middle of the Quadrant, and the direct Course within 2 and 6 Points of the Meridian; then the Error may be either in the Course, or in the Distance, or in both, which will cause an Error both in the Difference of Latitude and Departure, to correct

correct which, having found the true Difference of Latitude by Obſervation; with this, and the direct Diſtance by dead Reckoning, find a new Departure *(by Caſe 3d of Plane Sailing)* then half the Sum of this Departure, and that by dead Reckoning, will be nearly equal to the true Departure; and conſequently with this, and the true Difference of Latitude, we may *(by Caſe 4th of Plane Sailing)* find the true Courſe and Diſtance.

Example.

Suppoſe a Ship from the Latitude of 44°, 38′ North, ſails between *South* and *Eaſt* upon ſeveral Courſes, near the middle of the Quadrant, for the Space of 24 Hours, and is then found, by dead Reckoning, to be in the Latitude of 42°, 15′ North, and to have made of Eaſting 136 Miles; but by Obſervation ſhe's found to be in the Latitude of 42°, 04′ North. Requir'd her true Courſe and Diſtance.

With the true Difference of Latitude 154 Miles, and the direct Diſtance, by dead Reckoning, 197.4 you'll find *(by Caſe 3d of Plane Sailing)* the new Departure to be 123.4, and half the Sum of this and the Departure, by dead Reckoning, will be 124.7 the true Departure; then with this, and the true Difference of Latitude, you'll find *(by Caſe 4th of Plane Sailing)* the true Courſe to be S 39°, 00′ E, and the direct Diſtance 198.2 Miles.

7. In keeping a Ship's Reckoning at Sea, the common Method is to take from the *Log-board* the ſeveral Courſes and Diſtances ſtemm'd by the Ship laſt 24 Hours, and to transfer theſe, together with the moſt remarkable Occurrences into the *Log-Book*, in which alſo are inſerted the Courſes corrected, and the Difference of Latitude and Difference of Longitude

Longitude made good upon each; then the whole Days Work being finiſh'd in the *Log-Book*, if the Latitude by Account agrees with the Latitude by Obſervation, the Ship's Place will be truly determin'd; if not, then the Reckoning muſt be corrected according to the preceding Rules, and plac'd in the *Journal*.

The Form of the *Log-Book* and *Journal*, together with an Example of 2 Days Work, you have here ſubjoin'd.

Note, To expreſs the Days of the Week, they commonly uſe the Characters by which the Sun and Planets are expreſs'd, *viz.* ☉ denotes *Sunday*, ☽ *Monday*, ♂ *Tueſday*, ☿ *Wedneſday*, ♃ *Thurſday*, ♀ *Friday*, and ♄ denotes *Saturday*.

THE

The FORM of the

LOG-BOOK,

With the Manner of working Days Works at *SEA*.

The Log-Book.

H.	K.	½K.	Courſes.	Winds.	Obſervations and Accidents. ☽ —— Day of ——
1					Fair Weather, at four this Afternoon I took my Departure from the *Lizard*, in the Latitude of 50°, 00′ North, it bearing N N E, Diſtance five Leagues.
2				North	
3					
4					
5	7		S W *b* S	N *b* E	
6	7				
7	7	1			
8	7	1			
9	6				
10	6				
11	6		S S W	E *b* S	
12	6	1			The Gale increaſing and being under all our Sails.
1	6	1			
2	6	1	S W *b* W	N N E	
3	6	1			After three this Morning, frequent Showers with thick Weather, till near Noon.
4	7				
5	7	1			
6	8				
7	8				The Variation I reckon to be one Point Weſterly.
8	8		S W	E N E	
9	8	1			
10	9				
11	8	1	S W ½ W	N E *b* E	
12	8				

The Log-Book.					
Courses Correct.	Dist.	Diff. Lat.		Diff. Long.	
		N	S	E	W
S S W	50		46[illegible]2		29.4
S *b* W	19		18[illegible]6		5.5
S W	49		2[illegible].7		45.5
S W *b* S	24.5		2[illegible]2		20.0
S W $\frac{1}{2}$ S	25.5		19[illegible]		24.6
			134.[illegible]		125.0

Hence the Ship, by Account, has come to the Latitude of 47°, 46′ North, and has differ'd her Longitude 2°, 5′ westerly; so this Day I have made my Way good S 31°, 31′ W. Distance 157.4 Miles.

At Noon the *Lizard* bore from me N. 31°, 31′ E. Distance 157.4 Miles, and having observ'd the Latitude, I found it agreed with the Latitude by Account.

The Log-Book.

H.	K.	½ K.	Courses.	Winds.	Observations and Accidents ♂ —— Day of ——
1	2		SSW	W	This 24 Hours,
2	1	1	Handed the Main		strong Gale of
3	1	1	and Fore Courses		Wind and Vari-
4	1	1	Lee-way 6 Points.		able.
5	1	1			
6	1				
7	1				
8	1	1	The Wind encrea-		
9	1		sing, we try'd a		The Variation I
10	1		Hull, Lee-way 7		judge to be 1 Point
11	1		Points.		West.
12	1	1			
1	2		SWbW	NWbW	
2	1	1	Set Main-sail Lee-		
3	1		way 4½ Points.		
4	1				
5	1				
6	1	1			
7	1				
8	4		SbE	SWbW	
9	4	1	Set Fore-sail, Lee-		Lat. by Observa-
10	4	1	way 3 Points.		tion, 47°, 06′ N.
11	5				
12	4	1			

The Log-Book.						
		Diff.	Lat.	Diff.	Long.	
Courses Correct.	Dist.	N	S	E	W	
S E *b* E	32.5		17.[illegible]	37.7		
E S E	6		2[illegible]	10.6		
S ½ E	9		8.9	1.3		
			2[illegible].0	49.6		

Hence the Ship, by Account, has come to the Latitude of 47°, 17′ North, and has differ'd her Longitude 49′ Easterly; consequently, she has got 1°, 16′ to the Westward of the *Lizard*, and has made her Way good the last 24 Hours, S. 49°, 08′ E. Distance 44.3 Miles.

At Noon the *Lizard* bore from me North, 17°, 07′ East, Distance 170.6 Miles.

This Day I had an Observation, and found the Latitude, by Account, to disagree with the Latitude by Observation by 11 Minutes, I being so much further to the Southward than by dead Reckoning, which by the third of the preceding Rules, I correct as in the *Journal*.

A JOUR-

A JOURNAL *from the* Lizard *towards* Jamaica, *in the Ship* Neptune, *J. M. Commander.*

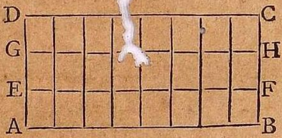
Week Days.	Months Years.	Month Days.	Winds.	Direct Courſe	Diſt. Miles.	Latitude Correct.	Whole Diff. Longitude made	Bearing and Diſt. from the Lizard.	Remarkable Obſerv. & Accidents.
☽			N *b* E E *b* S N N E E N E N E *b* E	S 31, 31 W	157.4	47°, 46′	2°, 05′ W	At Noon the *Lizard* bore N 31°, 31 E. Diſt. 157.4 Miles.	Fair Weather at four *P. M.* I took my Depart. from the *Lizard*, it bearing N N E Diſt. 5 Leagues.
♂			Weſt N W *b* W S W *b* W	S 34, 01 E	48.2	47°, 06′	1°, 35′ W	At Noon the *Lizard* bore S 17°, 55 W. Diſt. 183 Miles	Strong Gales of Wind and Variable.

SECT. XV.

Of MENSURATION.

Def. THE *Area* of any plane Surface in Inches, Feet, or any other Meaſure, is the Number of Square Inches, Feet, *&c.* that the Surface contains.

1. Let ABCD repreſent a Rectangular Parallelogram, and ſuppoſe the Side AB, or DC contains Six equal Parts, and the Side AD or BC three of the ſame Parts; then let the Line AB be moved along in the Direction of AD, till it has come to EF, where AE



or FB (the Diſtance of it from its firſt Situation) may be equal to one of the equal Parts: Here 'tis evident, that the generated Parallelogram ABFE will contain as many Squares as the Side AB contains equal Parts (in this Caſe, ſix) each Square having for its Side one of the equal Parts, into which AB or AD is divided. Again, let AB move on till it comes to GH, ſo as GE or HF may be equal to AE or BF; then 'tis plain, that the Parallelogram AGHB will contain twice as many Squares as the Side AB contains equal Parts, each Square having one of the equal Parts, into which AB or AD is divided, for its Side; and by the ſame Way of Reaſoning it will appear, that the Parallelogram ADCB will contain three times as many Squares as the Side AB contains equal Parts, and in general, that every rectangular Parallelogram contains

contains as many Squares as the Product of the Number of equal Parts in the Base, multiply'd into the Number of the same equal Parts in the Height, contains Units, each Square having for its Side one of the equal Parts.

Hence arises the Solution of the following Problems.

Problem 1.

To find the Area of a Rectangular Parallelogram.

Rule. Multiply the Base into the Perpendicular Height, and the Product is the Area requir'd.

Example.

Suppose the Base AB (see the preceding Figure) of the Rectangular Parallelogram ABCD, is six Inches in Length; and the Perpendicular AD three Inches, requir'd the Area of that Parallelogram in Inches.

6 the Base AB,
3 the Perpendicular AD,

Product 18, the Area of the Parallelogram ABCD in Inches.

Problem 2.

To find the Area of an Oblique-Angular Parallelogram.

Rule. Multiply the Base into the perpendicular Height, and the Product is the Area. The Reason of this Rule is evident from *Art.* 69. *Sect.* 1.

Example.

Example.

Suppose the Base AD, of the Oblique-Angular Parallelogram ADCB is 30 Inches, and the Perpendicular BE 12 Inches. Requir'd the Area in Inches.

Multiplying 30, the Base, into 12, the Perpendicular Height, the Product 360, is the Area or Number of square Inches contain'd in the propos'd Figure.

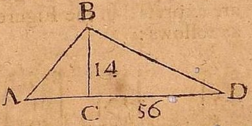
Problem 3.

To find the Area of a Triangle.

Rule. Multiply the Base into half the Perpendicular Height, and the Product is the Area requir'd. The Reason of this Rule is plain from *Cor.* 3. *Art.* 68. *Sect.* 1.

Example.

In the Triangle ABD, suppose the Base AD is 56 Feet, and the Perpendicular BC 14. Requir'd the Area.



The Base 56, multiply'd into 7, half the Perpendicular, gives 392, the Area or square Feet contained in the given Triangle.

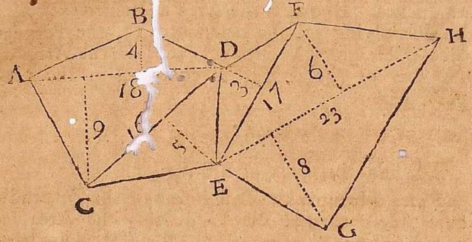
Problem 4.

To find the Area of any irregular Figure.

Rule. Reduce the Figure to Triangles by drawing Diagonals therein; then find the Area of each Triangle, and the Sum of these is the Area of the propos'd Figure.

Example.

Requir'd the Area of this Irregular Figure, ABDFHGEC.



Draw the Diagonals EH, EF, ED, DC and DA, which will divide the Figure into six Triangles, in each of which let fall from any one of its Angles a Perpendicular to the opposite Side; then supposing the Lengths of these to be, as they are express'd in the Figure, the Operation will stand as follows:

2	into	18	is	36	The Area of the Triangle	ABD
4.5		18		81		ACD
2.5		16		40		CED
1.5		17		25.5		EDF
3		23		69		EFH
4		23		92		EGH

343.5 the Area of the whole Figure.

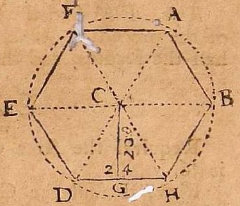
Problem

Problem 5.

To find the Area of any regular Polygon.

Rule. Thro' any three of the Angular Points draw a Circle (by *Prob.* [illegible]. *Sect.* 1.) which will pass thro' the rest also; then from the Center of this Circle let fall, upon any of the Sides, a Perpendicular, and half this Perpendicular multiply'd into the Sum of the Sides, will give the Area requir'd.

Example.



Requir'd the Area of the Hexagon ABHDEF, the Center of whose circumscrib'd Circle is C, and the Perpendicular CG from the Center upon one of the Sides is 20.8, each Side of the Polygon being 24.

The Sum of the Sides is 144, which multiply'd by 10.4, half the Perpendicular, gives 1497.6, the Area of the propos'd Hexagon.

2. It has been found by Calculation, that if the Diameter of a Circle be 1, the Circumference of the same will be 3.1416 nearly; and consequently the Diameter of any Circle will be to its Circumference as 1 to 3.1416, *& e contra.*

Cor. 1. Hence, multiplying the Diameter of any Circle by 3.1416, the Product will be the Circumference. Thus, let the Diameter of a Circle be 36; then 36 multiply'd by 3.1416, will give 113.0976, the Circumference of the propos'd Circle.

Cor. 2. Hence, dividing the Circumference of a Circle by 3.1416, the Quotient will be the Diameter. So if the Circumference of a Circle be 75.3984 then this divided by 3.1416 will give 24 the Diameter of the propos'd Circle.

Now a Circle being a Polygon of an infinite Number of Sides, the Sum of all which is the Circumference, and the Perpendicular on any of them, the Radius; therefore

Problem 6.

Given the Diameter of a Circle, to find its Area.

Rule. First find the Circumference (by the first of the preceding *Corollaries*) then multiply that by half the Radius, and the Product is the Area.

Example.

Requir'd the Area of a Circle whose Diameter is 36.

First, I find the Circumference is 113.0976, which multiply'd by 9 half the Radius, gives 1017.8784 the Area requir'd.

Problem 7.

The Circumference of a Circle given, to find its Area.

Rule. Find the Diameter by *Cor.* 2; then multiply the Circumference by half the Radius, and the Product is the Area.

Example.

Requir'd the Area of a Circle, whose Circumference is 75.3984.

First,

First, I find the Diameter to be 24; then multiplying the Circumference 75.3984 by half the Radius, *viz.* 6, the Product 452.3904 is the Area requir'd.

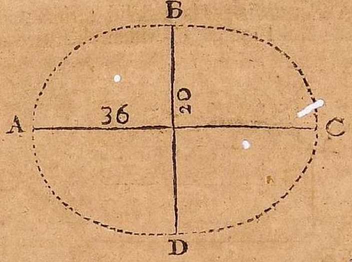
Problem 8.

To find the Area of an Ellipse.

Rule. Multiply the greatest Diameter into the least, and the Product into .7854; this last Product is the Area.

Example.

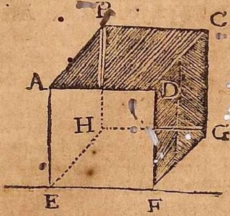
Suppose in the Ellipse ABCD the greatest Dia-



meter AC is 36, and the least Diameter BD 20. Requir'd the Area of that Ellipse.

Multiplying 36 into 20, the Product is 720, which multiply'd into .7854, gives 565.488 the Area of the propos'd Ellipse.

3. A *Solid* is that which has Length, Breadth, and Thickness.

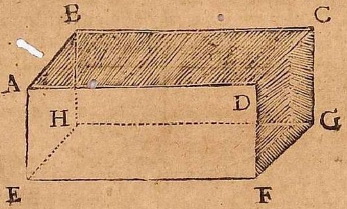


4. A *Cube* is a Solid bounded by Six equal Squares. Thus the Solid ABCGFEHD, bounded by the Six equal Squares ABCD, CDFG, ADFE, ABHE, BCGH, and HGFE, is a Cube.

If the terminating Squares be square Inches, then the Solid is call'd a Cubic Inch; if square Feet, a Cubic Foot, &c.

5. The Solidity of any Body in Inches, Feet, &c. is the Number of Cubic Inches, Feet, &c. the Body contains.

6. A *Parallelipiped* is a Solid terminated by six Quadrilateral Figures, of which each two opposite



to one another are equal and parallel, as ABCG, FDHE.

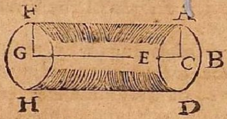
The Solidity of this Body is found by multiplying the Length, Breadth, and Thickness, into one another; and the Product is that requir'd.

Example. Suppose in the *Parallelipiped* ABCDFGHE, the Length EF is 36 Feet, the Breadth DF 16, and the Thickness FG 12; then these

theſe three multiply'd into one another will give 6912 for the Solidity, or Number of Cubic Feet the propos'd Body contains.

The Area of the Surface, or ſuperficial Content of that Body, is found by taking the Sum of the Areas of the Quadrilateral Figures that terminate it.

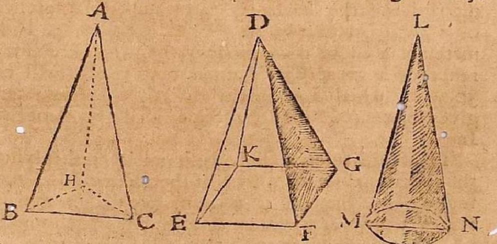
7. If in a rectangular Parallelogram ACGF, one of the Sides GC remain fix'd, and the Parallelogram move quite round to its firſt Place; then the generated Solid ADHF is call'd a Cylinder.



The Solidity of this Body is found by multiplying the Area of one of its circular Baſes into the Length. Thus let the Radius AC of one of the Baſes of the *Cylinder* be 6 Inches, and the Length AF 36; then the Area of the Baſe ABDF will be 113.0976 (by *Problem* 6.) which multiply'd into the Length 36, gives 4071.5136 for the Solidity.

The ſuperficial Content is found by multiplying the Circumference of one of the Baſes into the Length, and to the Product adding the Areas of the two Baſes.

8. Solids that decreaſe from the Baſe gradually,



till they come to a Point, are in general call'd *Pyramids*,

ramids, and are of different Kinds, according to the Figure of their Bases. Thus a *Pyramid*, having a Triangular Base, is called a *Triangular Pyramid*, as ABCH; and if the Base be a Parallelogram, it's call'd a *Parallelogrammic Pyramid*, as DEFGK, and if a Circle, it's call'd a *Circular Pyramid*, or simply a *Cone*, as LMN, &c. The Point in which the *Pyramid* ends, is call'd, the *Vertex*, and a Line drawn from the Vertex, perpendicular to the Base, is call'd, the *Height* of the *Pyramid*.

The Solidity of a *Pyramid* is found by multiplying the Area of the Base into $\frac{1}{3}$ of the Height. Thus, suppose the Diameter of the Base of a *Cone* is 24 Inches, and the Height 51; then the Area of the Base will be 452.3904, which multiply'd by 17, the third Part of the Height, gives 7690.6368. The superficial Content of a Cone is found by multiplying the Circumference of the Base into half the Line joining the Vertex, and any Point in that Circumference, and to that Product adding the Area of the Base.

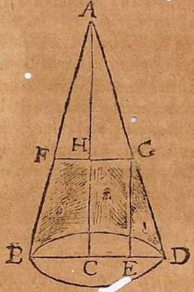
9. If a Semicircle be turn'd quite round upon its Diameter as an Axis, it will generate a Solid call'd a *Globe* or *Sphere*.

The Area of the Surface of a Globe is found by multiplying the Diameter into the Circumference of a great Circle upon it. Thus, suppose the Diameter of a Globe is 16 Inches; then the Circumference of a great Circle upon that Globe will be 50.2656, which multiply'd by 16, the Diameter, gives 804.2496 for the Superficial Content in Inches.

The Solidity of a Globe is found by multiplying the superficial Content by $\frac{1}{6}$ of the Diameter. Thus, suppose the Diameter of a Globe is 18, then the Area of the Surface will be 1017.8784, which multiply'd by 3, gives 3053.6352 for the Solidity.

10. We

10. We have shewn how to find the Solidity of a Cone, having the Diameter of the Base, and the Height given, and thence we have a Method of finding the Solidity of a *Frustum* of a Cone, having the Diameter of the two Bases and the Height of the *Frustum* given. Let FBDG denote a *Frustum* of the Cone ABD, BD the greatest, and FG the least Diameter of the *Frustum*. Join the Vertex of the Cone A, and the Center of the Base C, with the Right Line AC, which will pass thro' H, the Center of the least Base of the *Frustum*; and thro' G draw GE parallel to AC, which will be equal to HC, the Height of the *Frustum*; then 'tis evident, that ED will be the Difference between the greatest and least Semidiameters of the *Frustum*; and since the Triangles ACD and GED are similar, therefore (by *Art.* 74. *Sect.* 1.) DE : DC :: EG : CA, *i. e.* as the Difference between the greatest and least Semidiameters of the *Frustum*, is to the greatest Semidiameter, so is the Height of the *Frustum* to the Height of the whole Cone. Consequently, having the Diameter of the Base, and Height of the whole Cone, we can find its Solidity; and from AC, the Height of the whole Cone, taking CH, the Height of the *Frustum*, we have AH, the Height of the Cone, cut off, with which, and the Base FG, which is given, we may find the Solidity of the Cone cut off, AFG. Consequently, from the Solidity of the whole Cone ABD, taking the Solidity of the small Cone AFG, there will remain the Solidity of the *Frustum* FBDG.



Example. Suppose the greatest Diameter of the *Frustum* of a Cone is 20, and the least 12, and the Height 12, then the Difference between the two Semidiameters will be 4, and making it as 4 : 10 :: 12 : 30; we have 30 for the Height of the whole Cone, and from 30 taking 12, there remains 18, the Height of the least Cone; so the Solidity of the whole Cone is 3141.6, and the Solidity of the least Cone is 678.5856, the Difference of these is 2463.0144, which is the Solidity of the propos'd *Frustum*.

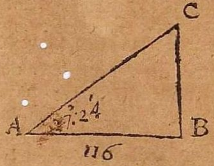
The Superficial Content of the *Frustum* of a Cone is found by adding to the Superficial Content of the whole Cone, twice the Area of the Base of the small Cone, and from that Sum taking the Superficial Content of the small Cone.

11. We have (in the preceding Part of this Book) shewn the Use of *Plane Trigonometry* in solving Problems of *Navigation*; and now we shall apply in the following Problems, to the Measuring the Heights of accessible and inaccessible Objects.

Problem 1.

To find the Height of any accessible Object.

Let BC be the Object to be observ'd, and from any Point A in the Level, upon which the Object stands, let the Angle of Altitude CAB be observed, and measure the Distance AB; then in the Right-Angled Triangle ABC are given the two oblique Angles A and C, and the Side AB, whence to find BC it will be, *by Case* 1. *of Rectangular Trigonometry*.



R : T, A :: AB : BC.

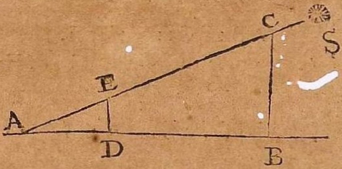
Example.

Example. Suppose the Angle of Altitude C A B is 37°, 24′, and the Length A B 116 Feet, then for B C it will be

As Radius - - - - - - - -		10.00000
is to the Tang. of Altitude -	37°, 24′ -	9.88341
ſo is A B - - - - - - - -	116 - -	2.06446
to the Height of the Object B C	88.69 -	1.94787

Note, In taking the Height of any Object, if the Eye be not in the Level upon which the Object ſtands; then to or from the Height found, you muſt add or ſubtract the Diſtance of the Eye from the Level, according as it is placed above or below it, and the Sum, or Difference, is the true Height of the Object.

The Height of an acceſſible Object may alſo be found by Means of its Shadow. Thus, ſuppoſe C B is the Object, and B A its Shadow, cauſ'd by

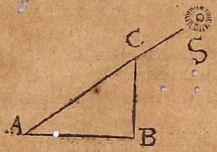


the Sun at S, and let D E be a Stick of a known Length, plac'd perpendicular to the Line of the Shadow, and in ſome Point of it D, ſo as the Extremity of the Shadows of the Object and Stick may coincide at A. Meaſure A D and A B, the Lengths of the Shadows; and then, ſince E D and C B are both perpendicular to A B, it will be; as A D, the Stick's Shadow, is to D E, the Length of the Stick, ſo is A B, the Object's Shadow, to C B the Height of the Object.

Problem 2.

To find the Altitude of the Sun by the Length of the Shadow of an acceſſible Object, whoſe Meaſure is alſo known.

Let CB repreſent a Stick, or any other acceſſible Object of a known Length, ſtanding perpendicular to the Horizontal Plane AB, and let AB be its Shadow made by the Sun at S. Meaſure, the Length of the Shadow AB, and then in the Right-Angled Triangle ABC are given the two Sides



AB and BC, whence to find the Angle CAB, or the Altitude of the Sun at the Time of Obſervation, it will be, *by Caſe 4th of Rectangular Trigonometry*,

AB : BC :: R : T, A.

Example. Suppoſe the Stick BC is 4 Feet, and the Shadow of it AB 5, then for the Sun's Altitude it will be

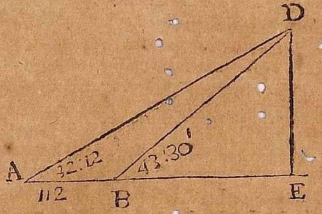
As the Length of the Shadow	- 5	- 0.69897
is to the Length of the Stick	- 4	- 0.60206
ſo is Radius	- - - - - - - - -	- 10.00000
to the Tang. of the Sun's Altitude	38°, 39′	9.90309

Problem 3.

To find the Height and Diſtance of an inacceſſible Object.

Let DE repreſent an inacceſſible Object, and B a Point in the Horizontal Plane on which it ſtands, and from whence we can obſerve the Angle of Altitude DBE. At any other Point in the ſame Plane, as A, obſerve the Angle of Altitude DAE, and meaſure

measure the Length of AB, the Distance between the two Stations A and B; then in the Triangle



ABD, having the external Angle DBE, together with the internal opposite one A, we have the Angle ADB (by *Art* 60. *Sect.* 1.) and also the Side AB; whence for BD, the Hypothenuse of the Right-angled Triangle DBE, it will be, *by Case* 2. *of Oblique-angled Trigonometry*,

S, ADB : AB :: S, A : BD.

Then in the Right-angled Triangle BDE are given the Hypothenuse BD and the Oblique Angles; whence for DE, the Height of the Object, it will be, *by Case 3d of Rectangular Trigonometry*,

R : S, DBE :: BD : DE.

And for BE, the Distance of the Object from the nearest Situation, it will be, by the same,

R : S, BDE :: BD : BE.

Example. Suppose the Angle of Altitude at B is 43°, 30′, and at A 32°, 12′, and the Distance AB between the two Stations is 112 Feet; then the Angle ADB will be 11°, 18′, and the Angle BDE will be 46°, 30′. Hence for BD it will be

As the Sine of ADB -	11°, 18′ -	9.29214
is to AB - - - - -	112 - - -	2.04922
so is the Sine of A - -	32°, 12′ -	9.72663
to BD - - - - - -	304.6 - -	2.48371

Then

Then for DE, the Height of the Object, it will be,

As Radius		10.00000
is to the Sine of DBE	43°, 30′	9.83781
ſo is BD	304.6	2.48371
to DE	209.7	2.32152

Laſtly, For BE, the Diſtance of the Object from the neareſt Station, it will be,

As Radius		10.00000
is to the Sine of BDE	46°, 30′	9.86056
ſo is BD	304.6	2.48371
to BE	221	2.34427

If the Object ſtands upon a Riſing Ground, then find the Height of the Object above the Plane on which you ſtand (*by the laſt Problem*) as alſo the Height of ſome Point on the Riſing Ground near the Foot of the Object, and this laſt Height taken from the former, will give the true Height of the Object.

SECT. XVI.

Of SURVEYING.

1. THE Inſtruments chiefly in Uſe for taking Angles in the Field are, the *Plane-Table*, *Theodolite*, *Compaſs*, *Semicircle*, &c. The Nature and Uſe of which is much eaſier obtain'd by viewing the Inſtruments themſelves, than by a Deſcription of them, from their Draughts upon Paper.

2. To meaſure Diſtances upon the Field, they commonly uſe Mr. *Gunter*'s Chain, which contains 22 Yards in Length, the fourth Part of which is 5½ Yards, or * 16½ Feet, is call'd a *Perch* or *Pole*; conſe-

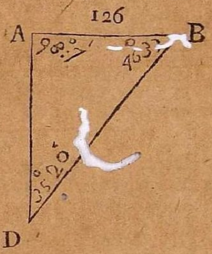
* But in *Ireland* there are 21 Feet to a Perch, *Plantation* Meaſure.

conſequently a Square Chain contains 16 Square Poles; and ſince an Acre contains 10 Square Chains, therefore 160 Square Poles is equal to one Acre. This Chain is commonly divided into 100 equal Parts, called *Links*, and is ſometimes mark'd at every 10 Links, for the Conveniency of working by Decimals.

Problem I.

To find the Diſtance of any Object from a given Point.

Let the Object be D, and the given Point A; then let the Diſtance between A and any other Point B (from whence we can ſee the Object) be meaſur'd, and with a Semicircle, or any other proper Inſtrument, take the Angles DAB and ABD; then in the Triangles ABD are given the Angles and the Side AB, whence to find the Side AD it will be, by *Caſe 2d of Oblique Angled Trigonometry*,



S, D : AB :: S, B : AD.

Example. Suppoſe BA is 126 Feet; the Angle A 98°, 7′, the Angle B 46°, 33′, and conſequently the Angle D 35°, 20′; then for AD it will be

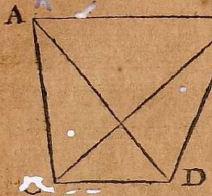
As the Sine of D - - -	35°, 20′ -	9.76218
is to the Diſtance AB - -	126 - - -	2.10037
ſo is the Sine of B - - -	46°, 33′ -	9.86392
to the Diſt. between A and D	158.2 - -	2.19911

Problem

Problem 2.

To find the Diſtance between two inacceſſible Objects.

Let the two Objects be A and B, to which we cannot approach, being hinder'd by a River, &c.



aſſume in ſome convenient Place two Points C and D, from each of which you can ſee the two Objects; and meaſure the Diſtance between them; then at the Point C obſerve the Angles ACD and DCB, and at D obſerve the Angles CDB and CDA; ſo in the Triangle CDB are given the two Angles BCD and CDB (and conſequently the Angle CBD) and the Side CD; whence to find CB it will be S, CBD : S, CDB :: CD : CB. Again, in the Triangle ACD are given the two Angles ACD and ADC (and conſequently the Angle CAD) and the Side CD; whence to find AC it will be S, CAD : S, CDA :: CD : CA. *Laſtly*, from the Angle ACD take the Angle DCB, and there will remain the Angle ACB; then in the Triangle ACB are given the two Sides AC and CB, and the included Angle ACB; whence AB, the Diſtance between the two Objects, is found by *Caſe* 5*th of Oblique Trigonometry*.

Example.

Example. Suppose the Angle ACD is 94°, 55′, the Angle BCD 41°, 25′, the Angle CDB 103°, 14′, the Angle ADC 46°, 44′, and the Side CD 144 Feet: Then 1*st*, for CB it will be

As the Sine of CBD	35°, 21′	9.76236
is to the Sine of CDB	103, 14	9.98831
so is CD	144	2.15836
to CB	242.3	2.38431

2*dly*, For CA it will be

As the Sine of CAD	38°, 21′	9.79256
is to the Sine of CDA	46, 44	9.86223
so is CD	144	2.15836
to CA	169.1	2.22803

Lastly, For AB it will be

As the Sum of the Sides AC and CB	411.4	2.61426
is to their Difference	73.2	1.86451
so is the Tang. of ½ the Sum of the Ang. CAB and CBA	63°, 15′	10.29753
to the Tang. of ½ their Diff.	19, 26	9.54778

Then,

As the Sine of CBA	43°, 49	9.84033
is to the Sine of ACB	53, 30	9.90518
so is AC	169.1	2.22803
to AB	196.3	2.29288

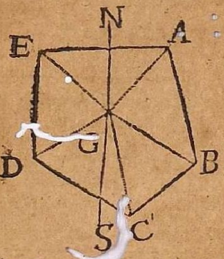
Consequently the Distance between the two Objects A and B is 196.3 Feet.

Problem 3.

To take the Plot of a Field at one Station, in or near the Middle of it; when we can from thence see all the Angles or Corners of the Field.

This may either be done by the *Plane-Table* or *Theodolite*, or any of the other Instruments above-mentioned.

Let ABCDE repreſent the Field; and firſt, ſuppoſe you are to plot it with the *Plane-Table*: Having planted the Table with a Sheet of white Paper, fix'd upon it, in or near the Middle of the Field, as at G; mark a Point upon the Paper to repreſent the Point of the Field on which the Table ſtands, and laying the Edge of your Index upon that Point, and keeping it there, turn it about ſo as you can, thro' the Sights, ſee one of the Angles, as A; then from the Point, along the Edge of the Index, draw the Line GA, and meaſuring the diſtance on the Field from the *Plane-Table* to the Angle at A in Chains and Links, take it from any convenient Line of equal Parts, and ſet it off upon the Paper, from G to A, along the Line GA; then (keeping the Table ſtill fix'd as it was) turn the Index ſo as it lying with its Edge upon the Point G, you may, thro' the Sights, ſee the Angle B; and drawing the Line GB, meaſure the Diſtance GB in the Field, which ſet off upon the Table from G to B; after the ſame Manner, drawing the Lines GC, GD and GE, and joining the Extremities of them with the Right-Lines AB, BC, CD, DE and EA, the Field is protracted, and the Lines BA, AE, &c. taken from the Scale from which you protracted the reſt, will give the Lengths of them in the Field.



To perform the ſame with the *Theodolite*, place the Inſtrument in, or near, the Middle of the Field, as at G, and ſo as the Needle may hang directly

over

over the Meridian Line of the Chart, which let N S repreſent; then direct your Sights from G to the Angle A, and obſerve the Number of Degrees it cuts, or the Bearing of A, which ſuppoſe to be N 16°, 24′ E, and place this in the Field-Book, together with the Diſtance in Chains and Links from C to A, and proceeding the ſame Way with the reſt of the Angles, you'll have the Bearing of each Angle from the Meridian, together with the Diſtance of each from the Inſtrument, in your Field-Book, the Form of which follows.

The FIELD-BOOK.

Angles.	Bearings.	Chains.	Links.	Remarks.
A	N 16, 24 E	7	20	
B	S 73, 35 E	7	60	
C	S 19, 15 E	7	65	
D	S 54, 56 W	6	6[illegible]	
E	N 59, 40 W	7	26	

The Table is rul'd into five Columns; in the firſt are mark'd down the Angles expreſs'd by Letters, or any other Characters at Pleaſure; the ſecond contains the Bearings of theſe Angles from the Meridian; the third and fourth their Diſtances in Chains and Links from the Place of Obſervation, and the fifth is for any remarkable Occurrence.

Having mark'd down the Bearings of all the Angles in the Field from the Meridian, together with their Diſtances in Chains from the Place of Obſervation in your Field-Book, you may afterwards protract it upon Paper in the following Manner, *viz.* Aſſume any convenient Point in the Paper to repreſent the Place of Obſervation, and thro' it draw a Line repreſenting the Meridian; then from that Point draw Lines, making Angles with the Meridian, as in the Field-Book, and ſet off from the ſaid Point upon theſe Lines the ſeveral Diſtances expreſs'd in the Field-Book, taken from any Scale of equal Parts; *Laſtly*, joining the Extremities of them with Right-Lines, the Field will be protracted; and the Area of it in Chains may be found by *Prob.* 4. *Sect.* 15. which divided by 10, will give the Area in Acres.

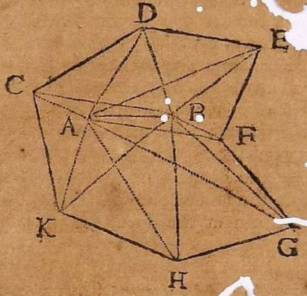
The Method of plotting a Field by the *Semicircle*, *Circumferentor*, &c. differs ſo little from the Way of doing the ſame by the *Theodolite*, that it would be altogether needleſs to ſhew it in each of them. When the Angles of the Field are at ſuch a Diſtance from you, that you can't perfectly perceive them from your Station, then put Marks of white Paper, or Pieces of Linnen at each of them, ſo as you may eaſily ſee them.

If it be more convenient to plot the Field at one Station, in or near ſome Corner of the Field; then you are to do it the ſame Way by the *Plane-Table*, *Theodolite*, or any other of the Inſtruments, as when your Station was in or near the Middle of the Field.

Problem 4.

To plot a Field at two Stations near the Middle thereof, the Diſtance between which Stations is known, and from each of which all the Angles in the Field can be eaſily ſeen.

Let the Field to be plotted be CDEFGHK, in which chuſe two convenient Points A and B near the Middle, from each of which you can perceive all the Angles, and the Diſtance between which you know; then if you are to plot it by the *Plane-Table*, plant the Table upon the Point A, and mark a cera certain Point upon the Table to repreſent it, upon which lay the Edge of the Index, and direct the Sights to the other Station B, and by the Side of the Index draw AB; then from A, along that Line, ſet off a Line AB, taken from any convenient Scale of equal Parts, equal to the Diſtance between your two Stations; then laying the Edge of



your Index upon the Point A, and directing your Sights to D, draw the Line AD; the ſame Way keeping the Edge of the Index on A, direct the Sights to all the other Angles of the Field ſucceſſively, and draw the Lines AE, AF, &c. then remove the Table to the other Station B, and laying the Edge of the Index along the Line AB, turn the Table about till you can, thro' the Sights, ſee the other Station A, and fixing the Table. lay the Edge of the Index on B, and direct the Sights to D, and draw the Line BD, which will interſect AD in D; the ſame Way keeping the Edge of the Index ſtill on the Point B, direct the Sights to all the other Angles of the Field, and draw the Lines BE, BF, &c. which will interſect the former Lines drawn from A in the Points E, F, G, &c. and joining theſe Points with Right Lines, you'll

have

have the Plot of the Field, and the Lines DE, EF, &c. taken from the same Scale of equal Parts that AB was taken from, will give the Distances of the Angles in the Field from one another. *Lastly*, The Area of the Field being thus protracted, may be be found by *Prob.* 4. *of the last Section.*

In plotting of a Field at two Stations, you ought to take the Stations as far asunder as conveniently you can; for the nearer they are together, the more Danger there is of contracting an Error, & *e contra.*

To plot the same by the *Theodolite*; having fix'd the Instrument in one of the Stations as A, turn it about till the Needle be directly over the Meridian Line of the Chart; then turn about the Index till you can, thro' the Sights, see the other Station B, and observe the Bearing of it from the Meridian, and measure the Distance in Chains and Links, both which set down at the Head of the Field-Book. Thus,

AB—S 7[illegible] 23', E—3 Chains, 24 Links.

Then turn the Index to the Angle D, and observe its Bearing from the Meridian, and the same Way, turning the Index to all the Angles of the Field, observe the Bearing of each of them, which set down in the Field-Book in the second Column, mark'd at the Top thus, *Station* A. Then go to the Station B, and fixing your Instrument as before, turn the Sights to the Angle D, and observe the Bearing of it from the Meridian; and the same Way, turning the Sights to the rest of the Angles, observe the Bearing of each of them, which mark down in another Column of your Field-Book, mark'd at the Top with *Station* B, and your Work in the Field is finish'd; the plotting of which upon Paper is so plain and easy, that it needs no Example.

By

By this Method the principal Places in a Survey of a County, or any large Piece of Ground, may be placed in a Map, *viz.* By making Choice of two Eminences for your two Stations, the Diſtance between which you can meaſure, and from each of which you can ſee all the principal Objects, ſuch as *Churches*, *Caſtles*, *Hills*, *Gentlemens-Seats*, and whatever elſe is remarkable in the Ground you are Surveying.

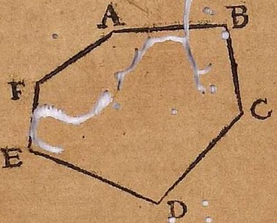
If all the Angles in the Field can't be ſeen at two Stations, then make Choice of a third, from whence you can ſee any of the former two, and the Diſtance between which you can meaſure; and if that be not ſufficient, then uſe a 4th, 5th, *&c.* Station; by which Means you'll always have two Stations to proceed with thro' the Country you are to Survey, be it ever ſo large; and even in a Field, where you can take the Survey of it at two Stations alone; the chuſing a third Station, from whence you can ſee one of the former ones, and alſo all the Angles of the Field, and thence taking the Plot of it, as before, is a ſure Way of proving your former Work.

Problem 5.

To plot a Field by going round it.

Let the Field be ABCDEFA, and ſuppoſe you are to plot it by the *Plane-Table.* Having fix'd your Inſtrument at any of the Angles, of the Field, as A, mark a Point upon the Paper to repreſent it; then laying the Edge of the Index upon A, turn it about, till through the Sights you can ſee the adjacent Angle F, and along the Edge of the Index draw the Line AF, which meaſure in the Field, and taking that from any Scale of equal Parts, ſet it off upon the Line AF on the Table

Table from A to F ; then move your Table from A to F in the Field, and laying the Edge of the Index on F, turn it about till, thro' the Sights, you can ſee E, and draw the Line F E, which meaſure in the Field, and taking it from the ſame Scale, ſet it off upon the Table from F to E : After the ſame Manner, proceeding with the reſt of the Angles, you'll have the Plot of the Field.



To plot the ſame by the *Theodolite*: Having placed your Inſtrument at the Corner of the Field, you are to begin from, as at A, ſet the Index at 00 Deg. 00 Min. then turn the Inſtrument about with that End of the Index forward (or towards F) that lies upon 00 Deg. 00 Min. till you can, thro' the Sights, ſee the Angle F ; and there fixing the Inſtrument, turn the Index about till you can, through the Sights, ſee the Corner B, and mark the Degrees (in your Field-Book) cut by the Index, which will be the Meaſure of the Angle F A B, and meaſure A F in Chains and Links, which alſo mark down in your Field-Book ; then remove your Inſtrument to F, and placing the Index upon the Beginning of the Degrees, as before, turn the Inſtrument about till you can, thro' the Sights, ſee the Corner A, and fixing the Inſtrument there, turn the Index about till you ſee, thro' the Sights, the Corner E, and mark the Degrees cut by the Index in your Field-Book, which will be the Angle A F E, then meaſure F E in Chains and Links, which alſo mark down in your Field-Book : the

ſame

ſame Way, proceeding with the reſt of the Angles, mark down the Quantity of each, together with the Diſtance from the preceding, in your Field-Book; and thence you may project it at Leiſure upon Paper.

This Method of plotting a Field by going round it, is much leſs liable to Error than any of the two former; and is more eſpecially uſeful in meaſuring large Fields, or Fields upon which are Woods, or other Things to obſtruct the Sight, in which Caſe the other Methods are impracticable.

SECT. XVII.

Of GAGING.

1. WE have ſhewn in Section 1[illegible]. how to find the Solidity of ſeveral Sorts of Bodies, in Inches or Feet, *&c.* which Solidity (if taken in Inches) divided by the Inches contain'd in a Gallon, Buſhel, *&c.* will ſhew the Number of Gallons, Buſhels, *&c.* contain'd in the Veſſel.

The Number of ſolid Inches contain'd in a Gallon, Buſhel, *&c.* as determin'd by Act of Parliament, are as follows,

A Gallon of	Ale or Beer	contains	282.	Solid Inches.
	Wine		231.	
	Corn		268.8	
A Buſhel of	Malt		2150.4	
	Coals		2246.	
A Scots Pint	—		102.3	
An Iriſh Gallon	—		217.6	

 2. In

2. In *Gaging.* The Veſſels that are not Cylindrical are commonly reduc'd to Cylinders, and their Solidities found as ſuch;

A *Cask* having different Diameters at the *Head* and *Bung*, is reduc'd to a Cylinder, by taking the mean or equated Diameter between the two, for the Diameter of the Cylinder, equal in Length and Solidity to the propos'd Cask; the common Method for finding the equated Diameter, and which ſerves pretty juſtly in moſt Casks, is this, *viz.* Multiply the Difference between the Head and Bung Diameters by .65, and adding the Product to the Head Diameter, the Sum will be the Diameter of a Cylinder of equal Length and Solidity with the Cask.

Hence we have the following Rule for finding the Content of any Cask in *Wine*, *Beer*, &c. The Head and Bung Diameter, and Length of the Cask being given in Inches, *viz.* Find the equated Diameter between the Head and Bung Diameters of the Cask, and thence find the Area of the Circle belonging to that Diameter; then multiply this Area by the Length of the Cask, and the Product will be the Solidity of the Cask in Inches, which divided by the ſolid Inches contain'd in a Gallon of Wine, Beer, *&c.* will give the Content of the Cask in Wine, Beer, *&c.*

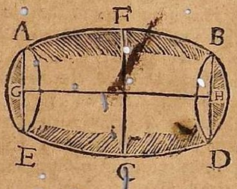
Example.

Let it be requir'd to find the Content of the Cask AEDB in Wine Gallons, whoſe Head Diameter AE or BD, is 26 Inches, the Bung Diameter FC 34 Inches, and the Length GH 55 Inches.

The Difference between the Head and Bung Diameters is 8, which multiply'd by .65, gives 5.2 and this added to 26, the Head Diameter, makes

31.2

31.2. for the equated Diameter, or Diameter of the Cylinder equal in Length and Solidity with the propos'd Cask, the Area of whose Base is 764.539776, which multiply'd into 55 the Length, gives 42049.68768 for the Solidity in Inches; and this divided by 231 the solid Inches contain'd in a Gallon of Wine, gives 182.03328 for the Content of the propos'd Cask in Wine-Gallons.



3. If the propos'd Cask be standing with its Axis perpendicular to the Horizon, and is not quite full of Liquor; then, in order to find the Contents of the contain'd Liquor, you must find the equated Diameter, as above, and thence the Area of the Base of the Cylinder, the Cask is reduced to; which multiply'd into the Depth of the Liquor, will give the solid Content of the contain'd Liquor in Inches, and this divided by the Inches in a Gallon of Wine, Beer, &c. according to the Liquor contain'd, will give the Contents of the Liquor in the Cask.

This Rule more especially serves when the Cask is more than half full of Liquor; but when it is less than half full; then the Content of the contain'd Liquor is better found by subtracting the Content of the empty Part of the Cask (found as above) from the Content of the whole. and the Remainder will be the Content of the contain'd Liquor.

4. In *Gaging*, by the Area of any Surface in Wine, &c. Gallons is meant the Content of it at one Inch Depth. Consequently the Area of a Circle, 1 Inch Diameter, being .7854, this divided by

282 will give .002785, for the Content of that Circle, 1 Inch Depth in Ale or Beer Gallons, and the ſame divided by 231 will give .0034 for its Content in Wine Gallons; and ſince Circles are to one another as the Squares of their Diameters; therefore, as 1, the Square of 1 Diameter, is to .0034, or 002785, the Area of that Circle in Wine or Ale-Gallons, ſo is the Square of the Diameter of any other Circle, to the Area of that Circle in Wine or Ale-Gallons; hence, ſince the firſt Term of the Proportion is Unity, it follows, that the Area of any Circle, in Wine or Ale-Gallons, is found by multiplying the Square of the Diameter by .0034 for Wine-Gallons, and by .002785 for Ale-Gallons; and this Area, multiply'd into the Length of the Cask to which the Circle belongs, will give the Content of the Cask in Wine or Ale-Gallons; and hence the two Numbers .0034 and .002785 are called *Fix'd Multipliers*.

Again, If 1 be divided by the former Numbers .0034 and .002785, there will be produc'd their Reciprocals 294.12 and 359, with the firſt of which, dividing the Square of the Diameter of any Circle, the Quotient will be the Area of that Circle in Wine-Gallons; and if the ſame be divided by the laſt, the Quotient will be the Area of that Circle in Ale-Gallons; hence theſe two Numbers 294.12 and 359 are called *Fix'd Diviſors*, and in *Practice*, are commonly made uſe of by the Gagers.

5. When a *Cask* is lying upon its Side, with the Axis parallel to the *Horizon*, and is not full; but the Surface of the contain'd Liquors cuts the Heads of the Cask; then to find the Content of the Liquor contain'd in the Cask, we muſt firſt know how to find the Area of any Segment of a given Circle. In order to which,

Let AEBH repreſent a Circle, whoſe Diameter AB is 2; then (by *Cor.* 1. *Art.* 2. *Sect.* 15.) the Circumference

cumference of that Circle will be 6.2832, and the Area 3.1416 (by *Prob.* 6. *Sect.* 15. Hence 'tis evident, that if the Diameter of a Circle be two Inches or Feet, &c. the Circumference of that Circle will contain twice as many Inches or Feet, &c. in Length, as the Area of it contains square Inches or Feet, &c. *i. e.* the Length of the Circumference is double the Area; and since the Area of the whole Circle, is to the Area of any Sector of it, as the Length of the whole Circumference, to the Length of the Arch of that Sector: it follows, that the Length of half the Arch of any Sector of a Circle, whose Diameter is 2, is equal to the Area of that Sector. So in the annexed Scheme the Length of DE, half the Arch of the Sector DCFE, will be the Area of that Sector.

In the annex'd Scheme, suppose GE (the versed Sine of half the Arch of the Sector DCFE) to be equal to .4; then, since the Radius CE is 1, 'tis evident CG (the Right Sine of DA, the Complement of DE half the Arch of the Sector) will be equal to .6; so making it as 1 is to .6, or (to avoid Fractions) as 100 is to 60, so is the Radius of the Tables to a fourth Number; this will be the Sine of AD, and looking in the Table we shall find it answer to 36.87 Degrees; the Complement of which, *viz.* 53.13 Degrees is the Arch DE; which multiply'd by .017453 the $\frac{1}{360}$ of 6.2832, gives .92727789 for the Length of the Arch DE, which is equal to the Area of the Sector DEFC.

Again, In the Right-Angled Triangle CGD, 'tis evident, (by *Cor.* 1. *Art.* 70. *Sect.* 1.) if from 1, the Square of CD, we take .36, the Square of CG, there will remain .64, the Square of DG, the Square Root

Root of which, *viz.* .8 is equal to DG, and this doubled gives 1.6 equal to DF, which multiply'd into .3, the half CG produces .48 for the Area of the Triangle DCF. Then, from .92727789 for the Area of the Sector DCFE taking .48 the Area of the Triangle DCF, there will remain .44727789 for the Area of the Segment DEFD, and this taken from 3.1416, the Area of the whole Circle, there will remain 2.69432211 for the Area of the other Segment DHFD, whose versed Sine is 1.6.

After the same Manner, by dividing the Diameter of the Circle, *viz.* 2, into 100, or any other Number of equal Parts, we may find the Area of the Segment answering to each versed Sine.

Having by the foregoing Method found the Area of a Segment belonging to any versed Sine in that Circle whose Diameter is 2, and Area 3.1416; we may find the Area of the similar Segment in any other Circle by the following Analogy, *viz.*

As the Area of that Circle, whose Diameter is 2, *viz.* 3.1416, is to the Segment belonging to any Part of its Diameter, so is the Area of any other Circle, to the Segment belonging to the like Part of its Diameter.

And hence arises the Construction of the following Table,

A TABLE

A Table of the Segments of a Circle, whose Area is 1 the Diameter, (*viz.* 1.128378) being divided into 100 equal Parts.

V.	Segm.	V.	Segm.	V.	Segm.	V.	Segm.	V.	Segm.
1	.0017	21	.1526	41	.3860	61	.6389	81	.8677
2	.0048	22	.1631	42	.3986	62	.6514	82	.8776
3	.0087	23	.1738	43	.4112	63	.6636	83	.8873
4	.0134	24	.1845	44	.4238	64	.6759	84	.8968
5	.0187	25	.1955	45	.4365	65	.6881	85	.9059
6	.0245	26	.2066	46	.4401	66	.7002	86	.9149
7	.0308	27	.2178	47	.4618	67	.71[illegible]2	87	.9236
8	.0375	28	.2292	48	.4745	68	.7241	88	.9320
9	.0446	29	.2407	49	.4873	69	.7360	89	.9402
10	.0520	30	.2523	50	.5000	70	.7477	90	.9480
11	.0598	31	.2640	51	.5127	71	.7593	91	.9554
12	.0680	32	.2759	52	.5255	72	.7[illegible]08	92	.9625
13	.0764	33	.2878	53	.5382	73	.7822	93	.9692
14	.0851	34	.2998	54	.5509	74	.7934	94	.9755
15	.0941	35	.3119	55	.5635	75	.8[illegible]45	95	.9813
16	.1032	36	.3241	56	.5762	76	.8155	96	.9866
17	.1127	37	.3364	57	.5888	77	.8262	97	.9913
18	.1224	38	.3486	58	.6014	78	.8369	98	.9952
19	.1323	39	.3611	59	.6140	79	.8474	99	.9983
20	.1424	40	.3735	60	.6265	80	.8576	100	1.0000

In this *Table* you may obſerve, that the Columns mark'd at the Top with V, contain the verſed Sines, proceeding from 1 to 100, and the adjacent Columns contain the Areas of the Segments belonging to theſe verſed Sines.

By this *Table* the Content of the Liquor contain'd in a Cask, not full, lying with its Axis parallel to the Horizon, and the contain'd Liquor cutting the Heads of the Cask, may be found after the following Manner, *viz.*

To the wet Inches of the Bung-Diameter add a competent Number of Cyphers, and divide this by the

the whole Diameter, then seek for the Quotient in the Columns mark'd V, at the Top in the preceding Table, and opposite to this, in the adjacent Column, you'll find the Area of a Segment, which multiply into the whole Content of the Cask, and the Product is the Content of the Liquor in the Cask. If instead of the wet Inches we had us'd the dry, then the last Product would have been the Content of the empty Part of the Cask, which is call'd the *Ullage*.

Example.

Suppose a Cask lying with its Axis parallel to the Horizon, has a certain Quantity of Wine in it, the Bung-Diameter is 32 Inches, the Head-Diameter 28, the Length 48, and the wet Inches 20. Requir'd the Content of the Liquor.

To the wet Inches 20 I add a Number of Cyphers, and dividing it by 32, I find the Quotient 66, which I look for in the Table, and find it answer to the Segment .7002, which multiply'd by 152.8, the whole Content of the Cask in Wine-Gallons (found by *Art.* 2. of this *Sect.*) gives 107 for the Content of the Liquor in the Cask, in Wine Gallons.

6. Malt, when lying on a Floor, is gaged by taking the Depth of it in Inches, in several Places, and dividing the Sum of these Depths by the Number of them, the Quotient will be the mean Depth; which multiply'd into the Area of the Surface, gives the Solidity in Inches; and this divided by 2150.4 gives the Content in Bushels.

7. Solid Timber is measur'd by the solid Foot, each containing 1728 solid Inches, the common Way is this, *viz.* Girth the Tree in several Places, and take $\frac{1}{4}$ of the mean Girth in Inches, for the Side of a Square; which Square multiply into the

Length

Length of the Tree, and the Product will be the Solidity in Inches, and this divided by 1728, will will give the Solidity of the Tree in Feet.

8. The Solidity of irregular Bodies may be found exactly, after the following Method, *viz.* Let the Body be immers'd in Water in a Parallelipiped, whose Sides are exactly divided into Inches, and the Solidity of the Water rais'd, will be equal to the Solidity of the immers'd Body.

9. The common Rule for finding the Tunnage of a Ship, is as follows.

Multiply the Length of the Keel by the Breadth, and the Product by half the Breadth; then divide this last Product by 95, and the Quotient will give the Tunnage.

Example.

Suppose a Ship's Keel is 135 Feet, and her Breadth from out to out, 48 Feet. Requir'd the Tunnage of that Ship.

The Length of the Keel, *viz.* 135 multiply'd into the Breadth 48, produces 6480, and this multiply'd into 24, half the Breadth, gives 155520, which last divided by 95, the Quotient is 1637, the Tunnage of the propos'd Ship.

FINIS.

A TABLE *of the Latitudes and Longitudes of some of the most principal Harbours, Headlands, and Islands in the most frequented Parts of the World; the Longitude being counted from the Meridian of* LONDON.

Places Names.	Lat.			Long.		Denom.
The Coast of *England.*	D.	M.		D.	M.	
BERWICK - -	55	50	Latitude North.	01	39	W
Newcastle - - -	54	58		01	30	W
Scarborough - - - -	54	20		01	20	W
Stockton - - - - - -	54	33		01	25	W
Flamborough-Head - -	54	08		00	11	E
Yarmouth - - - - -	52	45		01	40	E
Ipswich	52	14		01	00	E
Colchester - - - - -	52	04		00	58	E
LONDON - - -	51	32		00	00	
The *Downs* - - -	51	25		01	21	E
Dover - - - - - -	51	15		01	18	E
Beachy - - - - - -	50	48		00	25	E
Portsmouth - - - - -	50	48		01	00	W
Dartmouth - - - - -	50	27		03	36	W
Plymouth - - - - - -	50	36		04	13	W
Lizard - - - - - -	50	00		05	14	W
Bristol - - - - - -	51	32		02	35	W
Liverpool - - - - - -	53	20		03	10	W
White-Haven - - - -	54	10		03	50	W
The Coast of *Scotland.*						
Glasgow - - - - -	55	53		04	05	W
Aberdeen - - - - -	57	24		01	37	W
Leith - - - - - -	56	00		02	55	W
St. Kilda - - - - -	58	02		10	05	W
Cat-Ness - - - - -	58	47		02	06	W
Buchan-Ness - - - - -	57	55		01	20	W
Orkney Isles - - - -	59	13		03	32	W

Places Names.	Lat. D.	Lat. M.	Long. D.	Long. M.	Denom.
Coast of *Ireland*.					
London-Derry	55	05	08	00	W
Belfast	54	36	06	50	W
Cork	51	49	09	30	W
Cape-Clear	51	10	10	30	W
Lambay	53	24	07	30	W
Dublin	53	20	06	55	W
Coast of *Holland* and *Flanders*.					
Hamborough	53	41	10	25	E
Bremen	53	50	08	00	E
The *Texel*	53	10	04	59	E
Amsterdam	52	21	04	51	E
Roterdam	51	55	04	21	E
Dunkirk	51	[illegible]4	02	20	E
Calais	50	57	01	55	E
On the Coast of *France* and *Portugal*.					
Guernsey	49	36	02	40	W
Jersey	49	20	02	19	W
Rochel	46	10	01	14	W
Bourdeaux	44	50	00	24	W
Bilboa	43	30	03	00	W
Porta-Port	41	18	09	20	W
Cadiz	36	20	06	28	W
Coast on the main Continent within the *Straits*, and on the Coast of *Spain*, &c.					
Gibraltar	36	11	05	20	W
Malaga	36	50	03	17	W
Barcelona	41	26	02	26	E
Marseilles	43	20	05	27	E
Toulon	43	06	05	40	E

Latitude North.

Places Names.	Lat. D.	Lat. M.		Long. D.	Long. M	Den.
Genoa	44	27	North Latitude.	09	06	E
Leghorn	43	18		10	44	E
Rome	41	51		13	05	E
Naples	41	05		15	40	E
Gallipoli	40	08		18	42	E
Venice	45	18		12	40	E
Constantinople	41	07		31	45	E
Smyrna	38	28		27	20	E
Scanderoon	36	00		35	58	E
Tripoli	34	40		35	48	E
Alexandria	31	07		33	00	E
Algier	36	40		03	05	E
Coast of *Barbary* and *Guinea*, &c.						
Sallee	33	43		06	30	W
Cape de Verde	14	30		16	26	W
River *Gambia*	13	16		15	20	W
Monserado	06	05		09	20	W
Cape Corce	04	40		05	10	E
Cape Formosa	04	40		08	00	E
River *Congo*	05	45	S. Lat.	15	27	E
Angela	08	51		15	56	E
C. St. Thomas	23	10		14	23	E
Cape of Good Hope	34	15		17	00	E
Western Islands.						
Corvo	40	05	North Lat.	31	55	W
Fyal	39	32		31	52	W
Pico	38	45		28	34	W
Gratiosa	39	30		28	15	W
St. Michael	37	50		24	52	W
St. Maries	37	00		22	17	W
Porto Sancto	32	45		16	05	W
Madera West End	32	20		17	30	W

Places Names.	Lat. D.	Lat. M.	Long. D.	Long. M.
Teneriff	27	50	17	05
Canary	27	40	16	10
St. Antonio	17	20	24	50
Fuego	15	00	24	05
Jago	15	19	23	30
St. Lucia	17	20	24	00
St. Nicholas	17	12	23	30
St. Vincent	17	10	24	20
Antegoa.	17	30	60	40
Barbadoes	13	30	58	10
Berbuda	17	58	60	40
St. Cruz	18	00	63	25
Coast of *Carolina, Virginia, Maryland*, &c.				
Charles Town on *Ashly* River	32	40	78	50
Cape Henry	37	00	74	25
Quebeck	47	15	68	10
New-York	41	00	72	05
Boston	42	35	68	50
Trinity-Bay	48	27	52	15
Cape St. Mary	47	10	53	20
Placentia	47	57	53	00
Cape Charles	37	14	74	15
St. John's Harbour . .	47	28	51	23
Coast of *Hudson's Bay*, and the *Straits.*				
Cape Jones	55	03	78	56
Albany River	51	16	79	44
Shark Point	64	27	83	16
Button's Isle	60	05	66	50
Cape Charles	62	35	74	36
Port Nelson	57	10	92	50

North Latitude.

West Longitude.

Places Names.	Lat. D.	Lat. M.		Long. D.	Long. M.	Den.
Coast of *America* in the *South-Sea.*						
C. St. Sebastian	42	40	N. Lat.	129	40	
Panama	08	56		82	18	
Aquatulco	15	27		101	03	
Cape St. Luca	23	25		111	56	
Cape del Ajugo	16	38	South Latitude.	88	50	West Longitude.
Arica	18	12		74	07	
Baldivia	39	35		81	18	
Cape Victory	52	15		82	56	
Cape Horn	57	58		79	44	
Coast of *Brazil* in S. *America.*						
River *Julian*	48	40		74	32	
Cape Blanco	46	50		72	05	
St. Katharine's Isle . .	28	00		47	50	
Cape Frio	23	10		42	56	
Cape Roque	05	00		35	52	
Coast on the main Continent in the *West-Indies.*						
North Cape	02	05	North Latitude.	49	55	
Surnam	06	00		56	44	
Carthagena	10	50		75	50	
Campeche	19	20		93	05	
Portobello	09	55		80	15	
La vera Cruz	19	15		100	22	
Cape Florida	24	48		81	55	
Southern Islands.						
Ascension	07	40	S	14	50	
St. Helena	16	06	S	06	30	
St. Matthew's	01	40	S	07	50	
Princeps	01	35	N	09	03	E
St. Thomas	00	00		08	00	E
Annabona	01	05	S	07	30	E

Places Names.	Lat.			Long.		
	D.	M.		D.	M.	
Coast of the *East-Indies.*						
Mosambique	15	05	S	42	30	
River *de Fugos* . . .	00	00		41	15	
Cape de Bassus . . .	04	00		44	50	
Surrat	21	08		73	25	
Siam Entrance	13	10		101	01	
Goa	15	30	Lat. North.	73	50	
Fort St. George . . .	13	08		81	34	
Dew Point	15	50		81	50	
Bengal	22	27		91	49	
Malacca	23	32		105	05	
Cambodia	10	30		104	20	
Nanquim	32	55		129	30	East Longitude.
Islands in the *East-Indies.*						
Abdeleur	12	27	N	52	35	
Almircant Isles, the Eastermost	03	42	S	52	20	
Bantam in *Javes* . . .	05	37	S	105	11	
Batavia	05	47	S	106	27	
Babelmandel, in the Mouth of the *Red Sea* . .	12	25	N	45	45	
Borneo	04	20	S	109	50	
Good Fortune	01	28	S	97	20	
Java, East-End . . .	06	20	S	113	37	
Japan, S. East Point .	34	30	N	135	35	
——S. West Point .	35	20	N	126	50	
Joanna	12	10	S	41	20	
Princes Isle	05	47	S	105	11	
Zocatra	12	28	N	54	20	
Madagascar, South End of *St. Sebastian*	25	32	S	74	15	
Coast of the *Sound* and *Baltic Sea.*						
Gottenberg	57	33	N	12	25	
Christiana	59	10	N	9	45	

Places Names.	Lat.		Long.	
	D.	M.	D.	M.
	North Latitude.		Eaſt Latitude.	
Elſinore	56	00	12	32
Copenhagen	55	40	12	30
Stockholm	59	20	18	25
Vyburgh	60	20	29	26
Petersburgh	59	24	29	50
Riga	56	50	24	50
Coningsberg	55	00	20	13
Dantzick	54	22	19	10
Scaw	57	26	10	14
Coaſt from the *Naze* of *Norway* to *Archangel.*				
Naze of *Norway*	57	50	07	22
Dronton	64	00	10	40
North Cape	71	25	22	10
Standland	62	10	04	38
Kilduyn	69	32	30	12
Archangel-Bar	64	30	40	30
Croſs Iſland	66	31	36	10
Coaſt of the Northern *Iſlands, Nova Zembla, Iceland,* and *Greenland.*				
Bear Iſle	74	35	18	12
Hope Iſle	76	13	21	44
Catnoſe	65	44	33	13
Point Lookout	76	40	16	25
Horn Sound	77	30	13	56
Grims Iſland	66	43	17	45
Whales Back	65	27	10	05
Sound Royal	66	20	14	12

A

CORRECT and CONCISE

TABLE

OF

LOGARITHMS,

For NUMBERS increasing in their Natural Order from Unity to 10000.

a

N.	Logar.	N.	Logar.	N.	Logar.	N	Logar.
1	0.00000	46	1.66276	91	1.95904	136	2.13354
2	0.30103	47	1.67210	92	1.96379	137	2.13672
3	0.47712	48	1.68124	93	1.96848	138	2.13988
4	0.60206	49	1.69020	94	1.97313	139	2.14301
5	0.69897	50	1.69897	95	1.97772	140	2.14613
6	0.77815	51	1.70757	96	1.98227	141	2.14922
7	0.84510	52	1.71600	97	1.98677	142	2.15229
8	0.90309	53	1.72428	98	1.99123	143	2.15534
9	0.95424	54	1.73239	99	1.99564	144	2.15836
10	1.00000	55	1.74036	100	2.00000	145	2.16137
11	1.04139	56	1.74819	101	2.00432	146	2.16435
12	1.07918	57	1.75587	102	2.00860	147	2.16732
13	1.11394	58	1.76343	103	2.01284	148	2.17026
14	1.14613	59	1.77085	104	2.01703	149	2.17319
15	1.17609	60	1.77815	105	2.02119	150	2.17609
16	1.20412	61	1.78533	106	2.02531	151	2.17898
17	1.23045	62	1.79239	107	2.02938	152	2.18184
18	1.25527	63	1.79934	108	2.03342	153	2.18469
19	1.27875	64	1.80618	109	2.03743	154	2.18752
20	1.30103	65	1.81291	110	2.04139	155	2.19033
21	1.32222	66	1.81954	111	2.04532	156	2.19312
22	1.34242	67	1.82607	112	2.04922	157	2.19590
23	1.36173	68	1.83251	113	2.05308	158	2.19866
24	1.38021	69	1.83885	114	2.05690	159	2.20140
25	1.39794	70	1.84510	115	2.06070	160	2.20412
26	1.41497	71	1.85126	116	2.06446	161	2.20683
[illegible]	1.43136	72	1.85733	117	2.06819	162	2.20952
[illegible]	1.44716	73	1.86332	118	2.07188	163	2.21218
[illegible]	1.46240	74	1.86923	119	2.07555	164	2.21484
[illegible]	1.47712	75	1.87506	120	2.07918	165	2.21748
[illegible]	[illegible]	76	1.88081	121	2.08279	166	2.22011
[illegible]	[illegible]	77	1.88649	122	2.08636	167	2.22272
[illegible]	[illegible]	78	1.89209	123	2.08991	168	2.22531
34	1.53148	79	1.89763	124	2.09342	169	2.22789
35	1.54407	80	1.90309	125	2.09691	170	2.23045
36	1.55630	81	1.90849	126	2.10037	171	2.23300
37	1.56820	82	1.91381	127	2.10380	172	2.23553
38	1.57978	83	1.91908	128	2.10721	173	2.23805
39	1.59106	84	1.92428	129	2.11059	174	2.24055
40	1.60206	85	1.92942	130	2.11394	175	2.24304
41	1.61278	86	1.93450	131	2.11727	176	2.24551
42	1.62[illegible]	87	1.93952	132	2.12057	177	2.24797
43	1.63347	88	1.94448	133	2.12385	178	2.25042
44	1.64345	89	1.94939	134	2.12710	179	2.25285
45	1.65321	90	1.95424	[illegible]	2.13033	180	2.25527

N.	Logar.	N	Logar.	N.	Logar.	N.	Logar.
181	2.25768	226	2.35411	271	2.43297	316	2.49969
182	2.26007	227	2.35603	272	2.43457	317	2.50106
183	2.26245	228	2.35793	273	2.43616	318	2.50243
184	2.26482	229	2.35984	274	2.43775	319	2.50379
185	2.26717	230	2.36173	275	2.43933	320	2.50515
186	2.26951	231	2.36361	276	2.44091	321	2.50651
187	2.27184	232	2.36549	277	2.44248	322	2.50786
188	2.27416	233	2.36736	278	2.44405	323	2.50920
189	2.27646	234	2.36922	279	2.44560	324	2.51055
190	2.27875	235	2.37107	280	2.44716	325	2.51188
191	2.28103	236	2.37291	281	2.44871	326	2.51322
192	2.28330	237	2.37475	282	2.45025	327	2.51455
193	2.28556	238	2.37658	283	2.45179	328	2.51587
194	2.28780	239	2.37840	284	2.45332	329	2.51720
195	2.29003	240	2.38021	285	2.45485	330	2.51851
196	2.29226	241	2.38202	286	2.45637	331	2.51983
197	2.29447	242	2.38382	287	2.45788	332	2.52114
198	2.29667	243	2.38561	288	2.45939	333	2.52244
199	2.29885	244	2.38739	289	2.46090	334	2.52375
200	2.30103	245	2.38917	290	2.46240	335	2.52504
201	2.30320	246	2.39094	291	2.46389	336	2.52634
202	2.30535	247	2.39270	292	2.46538	337	2.52763
203	2.30750	248	2.39445	293	2.46687	338	2.52892
204	2.30963	249	2.39620	294	2.46835	339	2.53020
205	2.31175	250	2.39794	295	2.46982	340	2.53148
206	2.31387	251	2.39967	296	2.47129	341	2.53275
207	2.31597	252	2.40140	297	2.47276	342	2.53403
208	2.31806	253	2.40312	298	2.47422	343	2.53529
209	2.32015	254	2.40483	299	2.47567	344	2.53656
210	2.32222	255	2.40654	300	2.47712	345	2.53782
211	2.32428	256	2.40824	301	2.47857	346	2.53908
212	2.32634	257	2.40993	302	2.48001	347	2.54033
213	2.32838	258	2.41162	303	2.48144	348	2.54158
214	2.33041	259	2.41330	304	2.48287	349	2.54283
215	2.33244	260	2.41497	305	2.48430	350	2.54407
216	2.33445	261	2.41664	306	2.48572	351	2.54531
217	2.33646	262	2.41830	307	2.48714	352	2.54654
218	2.33846	263	2.41996	308	2.48855	353	2.54778
219	2.34044	264	2.42160	309	2.48996	354	2.54900
220	2.34242	265	2.42325	310	2.49136	355	2.55023
221	2.34439	266	2.42488	311	2.49276	356	2.55145
222	2.34635	267	2.42651	312	2.49415	357	2.55267
223	2.34830	268	2.42813	313	2.49554	358	2.55388
224	2.35025	269	2.42975	314	2.49693	359	2.55509
225	2.35218	270	2.43136	315	2.49831	360	2.55630

N.	Logar.	N.	Logar.	N	Logar.	N.	Logar.
361	2.55751	406	2.60853	451	2.65418	496	2.69548
362	2.55871	407	2.60960	452	2.65514	497	2.69636
363	2.55991	408	2.61066	453	2.65610	498	2.69723
364	2.56110	409	2.61172	454	2.65706	499	2.69810
365	2.56229	410	2.61278	455	2.65801	500	2.69897
366	2.56348	411	2.61384	456	2.65897	501	2.69984
367	2.56467	412	2.61490	457	2.65992	502	2.70070
368	2.56585	413	2.61595	458	2.66087	503	2.70157
369	2.56703	414	2.61700	459	2.66181	504	2.70243
370	2.56820	415	2.61805	460	2.66276	505	2.70329
371	2.56937	416	2.61909	461	2.66370	506	2.70415
372	2.57054	417	2.62014	462	2.66462	507	2.70501
373	2.57171	418	2.62118	463	2.66558	508	2.70586
374	2.57287	419	2.62221	464	2.66652	509	2.70672
375	2.57403	420	2.62325	465	2.66745	510	2.70757
376	2.57519	421	2.62428	466	2.66839	511	2.70842
377	2.57634	422	2.62531	467	2.66932	512	2.70927
378	2.57749	423	2.62634	468	2.67025	513	2.71012
379	2.57864	424	2.62737	469	2.67117	514	2.71096
380	2.57978	425	2.62839	470	2.67210	515	2.71181
381	2.58093	426	2.62941	471	2.67302	516	2.71265
382	2.58206	427	2.63043	472	2.67394	517	2.71349
383	2.58320	428	2.63144	473	2.67486	518	2.71433
384	2.58433	429	2.63246	474	2.67578	519	2.71517
385	2.58546	430	2.63347	475	2.67669	520	2.71600
386	2.58659	431	2.63448	476	2.67761	521	2.71684
387	2.58771	432	2.63548	477	2.67852	522	2.71767
388	2.58883	433	2.63649	478	2.67943	523	2.71850
389	2.58995	434	2.63749	479	2.68034	524	2.71933
390	2.59106	435	2.63849	480	2.68124	525	2.72016
391	2.59218	436	2.63949	481	2.68215	526	2.72099
392	2.59329	437	2.64048	482	2.68305	527	2.72181
393	2.59439	438	2.64147	483	2.68395	528	2.72263
394	2.59550	439	2.64246	484	2.68485	529	2.72346
395	2.59660	440	2.64345	485	2.68574	530	2.72428
396	2.59770	441	2.64444	486	2.68664	531	2.72509
397	2.59879	442	2.64542	487	2.68753	532	2.72591
398	2.59988	443	2.64640	488	2.68842	533	2.72673
399	2.60097	444	2.64738	489	2.68931	534	2.72754
400	2.60206	445	2.64836	490	2.69020	535	2.72835
401	2.60314	446	2.64934	491	2.69108	536	2.72916
402	2.60423	447	2.65031	492	2.69197	537	2.72997
403	2.60531	448	2.65128	493	2.69285	538	2.73078
404	2.60638	449	2.65225	494	2.69373	539	2.73159
405	2.60746	450	2.65321	495	2.69461	540	2.73239

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
541	2.73320	586	2.76790	631	2.80003	676	2.82995
542	2.73400	587	2.76864	632	2.80072	677	2.83059
543	2.73480	588	2.76938	633	2.80140	678	2.83123
544	2.73560	589	2.77012	634	2.80209	679	2.83187
545	2.73640	590	2.77085	635	2.80277	680	2.83251
546	2.73719	591	2.77159	636	2.80346	681	2.83315
547	2.73799	592	2.77232	637	2.80414	682	2.83378
548	2.73878	593	2.77305	638	2.80482	683	2.83442
549	2.73957	594	2.77379	639	2.80550	684	2.83506
550	2.74036	595	2.77452	640	2.80618	685	2.83569
551	2.74115	596	2.77525	641	2.80686	686	2.83632
552	2.74194	597	2.77597	642	2.80754	687	2.83696
553	2.74273	598	2.77670	643	2.80821	688	2.83759
554	2.74351	599	2.77743	644	2.80889	689	2.83822
555	2.74429	600	2.77815	645	2.80956	690	2.83885
556	2.74507	601	2.77887	646	2.81023	691	2.83948
557	2.74586	602	2.77960	647	2.81090	692	2.84011
558	2.74663	603	2.78032	648	2.81158	693	2.84073
559	2.74741	604	2.78104	649	2.81224	694	2.84136
560	2.74819	605	2.78176	650	2.81291	695	2.84198
561	2.74896	606	2.78247	651	2.81358	696	2.84261
562	2.74974	607	2.78319	652	2.81425	697	2.84323
563	2.75051	608	2.78390	653	2.81491	698	2.84386
564	2.75128	609	2.78462	654	2.81558	699	2.84448
565	2.75205	610	2.78533	655	2.81624	700	2.84510
566	2.75282	611	2.78604	656	2.81690	701	2.84572
567	2.75358	612	2.78675	657	2.81757	702	2.84634
568	2.75435	613	2.78746	658	2.81823	703	2.84696
569	2.75511	614	2.78817	659	2.81889	704	2.84757
570	2.75587	615	2.78888	660	2.81954	705	2.84819
571	2.75664	616	2.78958	661	2.82020	706	2.84880
572	2.75740	617	2.79029	662	2.82086	707	2.84942
573	2.75815	618	2.79099	663	2.82151	708	2.85003
574	2.75891	619	2.79169	664	2.82217	709	2.85065
575	2.75967	620	2.79239	665	2.82282	710	2.85126
576	2.76042	621	2.79309	666	2.82347	711	2.85187
577	2.76118	622	2.79379	667	2.82413	712	2.85248
578	2.76193	623	2.79449	668	2.82478	713	2.85309
579	2.76268	624	2.79518	669	2.82543	714	2.85370
580	2.76343	625	2.79588	670	2.82607	715	2.85431
581	2.76418	626	2.79657	671	2.82672	716	2.85491
582	2.76492	627	2.79727	672	2.82737	717	2.85552
583	2.76567	628	2.79796	673	2.82802	718	2.85612
584	2.76641	629	2.79865	674	2.82866	719	2.85673
585	2.76716	630	2.79934	675	2.82930	720	2.85733

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
721	2.85794	766	2.88423	811	2.90902	856	2.93247
722	2.85854	767	2.88480	812	2.90956	857	2.93298
723	2.85914	768	2.88536	813	2.91009	858	2.93349
724	2.85974	769	2.88593	814	2.91062	859	2.93399
725	2.86034	770	2.88649	815	2.91116	860	2.93450
726	2.86094	771	2.88705	816	2.91169	861	2.93500
727	2.86153	772	2.88762	817	2.91222	862	2.93551
728	2.86213	773	2.88818	818	2.91275	863	2.93601
729	2.86273	774	2.88874	819	2.91328	864	2.93651
730	2.86332	775	2.88930	820	2.91381	865	2.93702
731	2.86392	776	2.88986	821	2.91434	866	2.93752
732	2.86451	777	2.89042	822	2.91487	867	2.93802
733	2.86510	778	2.89098	823	2.91540	868	2.93852
734	2.86570	779	2.89154	824	2.91593	869	2.93902
735	2.86629	780	2.89209	825	2.91645	870	2.93952
736	2.86688	781	2.89265	826	2.91698	871	2.94002
737	2.86747	782	2.89321	827	2.91751	872	2.94052
738	2.86806	783	2.89376	828	2.91803	873	2.94101
739	2.86864	784	2.89432	829	2.91855	874	2.94151
740	2.86923	785	2.89487	830	2.91908	875	2.94201
741	2.86982	786	2.89542	831	2.91960	876	2.94250
742	2.87040	787	2.89597	832	2.92012	877	2.94300
743	2.87099	788	2.89653	833	2.92065	878	2.94349
744	2.87157	789	2.89708	834	2.92117	879	2.94399
745	2.87216	790	2.89763	835	2.92169	880	2.94448
746	2.87274	791	2.89818	836	2.92221	881	2.94498
747	2.87332	792	2.89873	837	2.92273	882	2.94547
748	2.87390	793	2.89927	838	2.92324	883	2.94596
749	2.87448	794	2.89982	839	2.92376	884	2.94645
750	2.87506	795	2.90037	840	2.92428	885	2.94694
751	2.87564	796	2.90091	841	2.92480	886	2.94743
752	2.87622	797	2.90146	842	2.92531	887	2.94792
753	2.87680	798	2.90200	843	2.92583	888	2.94841
754	2.87737	799	2.90255	844	2.92634	889	2.94890
755	2.87795	800	2.90309	845	2.92686	890	2.94939
756	2.87852	801	2.90363	846	2.92737	891	2.94988
757	2.87910	802	2.90417	847	2.92788	892	2.95036
758	2.87967	803	2.90472	848	2.92840	893	2.95085
759	2.88024	804	2.90526	849	2.92891	894	2.95134
760	2.88081	805	2.90580	850	2.92942	895	2.95182
761	2.88138	806	2.90634	851	2.92993	896	2.95231
762	2.88196	807	2.90687	852	2.93044	897	2.95279
763	2.88252	808	2.90741	853	2.93095	898	2.95328
764	2.88309	809	2.90795	854	2.93146	899	2.95376
765	2.88366	810	2.90849	855	2.93197	900	2.95424

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
901	2.95472	946	2.97589	991	2.99607	1036	3.01536
902	2.95521	947	2.97635	992	2.99651	1037	3.01578
903	2.95569	948	2.97681	993	2.99695	1038	3.01620
904	2.95617	949	2.97727	994	2.99739	1039	3.01662
905	2.95665	950	2.97772	995	2.99782	1040	3.01703
906	2.95713	951	2.97818	996	2.99826	1041	3.01745
907	2.95761	952	2.97864	997	2.99870	1042	3.01787
908	2.95809	953	2.97909	998	2.99913	1043	3.01828
909	2.95856	954	2.97955	999	2.99957	1044	3.01870
910	2.95904	955	2.98000	1000	3.00000	1045	3.01912
911	2.95952	956	2.98046	1001	3.00043	1046	3.01953
912	2.95999	957	2.98091	1002	3.00087	1047	3.01995
913	2.96047	958	2.98137	1003	3.00130	1048	3.02036
914	2.96095	959	2.98182	1004	3.00173	1049	3.02078
915	2.96142	960	2.98227	1005	3.00217	1050	3.02119
916	2.96190	961	2.98272	1006	3.00260	1051	3.02160
917	2.96237	962	2.98318	1007	3.00303	1052	3.02202
918	2.96284	963	2.98363	1008	3.00346	1053	3.02243
919	2.96332	964	2.98408	1009	3.00389	1054	3.02284
920	2.96379	965	2.98453	1010	3.00432	1055	3.02325
921	2.96426	966	2.98498	1011	3.00475	1056	3.02366
922	2.96473	967	2.98543	1012	3.00518	1057	3.02408
923	2.96520	968	2.98588	1013	3.00561	1058	3.02449
924	2.96567	969	2.98632	1014	3.00604	1059	3.02490
925	2.96614	970	2.98677	1015	3.00647	1060	3.02531
926	2.96661	971	2.98722	1016	3.00689	1061	3.02572
927	2.96708	972	2.98767	1017	3.00732	1062	3.02613
928	2.96755	973	2.98811	1018	3.00775	1063	3.02653
929	2.96802	974	2.98856	1019	3.00817	1064	3.02694
930	2.96848	975	2.98900	1020	3.00860	1065	3.02735
931	2.96895	976	2.98945	1021	3.00903	1066	3.02776
932	2.96942	977	2.98989	1022	3.00945	1067	3.02816
933	2.96988	978	2.99034	1023	3.00988	1068	3.02857
934	2.97035	979	2.99078	1024	3.01030	1069	3.02898
935	2.97081	980	2.99123	1025	3.01072	1070	3.02938
936	2.97128	981	2.99167	1026	3.01115	1071	3.02979
937	2.97174	982	2.99211	1027	3.01157	1072	3.03019
938	2.97220	983	2.99255	1028	3.01199	1073	3.03060
939	2.97267	984	2.99300	1029	3.01242	1074	3.03100
940	2.97313	985	2.99344	1030	3.01284	1075	3.03141
941	2.97359	986	2.99388	1031	3.01326	1076	3.03181
942	2.97405	987	2.99432	1032	3.01368	1077	3.03222
943	2.97451	988	2.99476	1033	3.01410	1078	3.03262
944	2.97497	989	2.99520	1034	3.01452	1079	3.03302
945	2.97543	990	2.99564	1035	3.01494	1080	3.03342

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
1081	3.03383	1126	3.05154	1171	3.06856	1216	3.08493
1082	3.03423	1127	3.05192	1172	3.06893	1217	3.08529
1083	3.03463	1128	3.05231	1173	3.06930	1218	3.08565
1084	3.03503	1129	3.05269	1174	3.06967	1219	3.08600
1085	3.03543	1130	3.05308	1175	3.07004	1220	3.08636
1086	3.03583	1131	3.05346	1176	3.07041	1221	3.08672
1087	3.03623	1132	3.05385	1177	3.07078	1222	3.08707
1088	3.03663	1133	3.05423	1178	3.07115	1223	3.08743
1089	3.03703	1134	3.05461	1179	3.07151	1224	3.08778
1090	3.03743	1135	3.05500	1180	3.07188	1225	3.08814
1091	3.03782	1136	3.05538	1181	3.07225	1226	3.08849
1092	3.03822	1137	3.05576	1182	3.07262	1227	3.08884
1093	3.03862	1138	3.05614	1183	3.07298	1228	3.08920
1094	3.03902	1139	3.05652	1184	3.07335	1229	3.08955
1095	3.03941	1140	3.05690	1185	3.07372	1230	3.08991
1096	3.03981	1141	3.05729	1186	3.07408	1231	3.09026
1097	3.04021	1142	3.05767	1187	3.07445	1232	3.09061
1098	3.04060	1143	3.05805	1188	3.07482	1233	3.09096
1099	3.04100	1144	3.05843	1189	3.07518	1234	3.09132
1100	3.04139	1145	3.05881	1190	3.07555	1235	3.09167
1101	3.04179	1146	3.05918	1191	3.07591	1236	3.09202
1102	3.04218	1147	3.05956	1192	3.07628	1237	3.09237
1103	3.04258	1148	3.05994	1193	3.07664	1238	3.09272
1104	3.04297	1149	3.06032	1194	3.07700	1239	3.09307
1105	3.04336	1150	3.06070	1195	3.07737	1240	3.09342
1106	3.04376	1151	3.06108	1196	3.07773	1241	3.09377
1107	3.04415	1152	3.06145	1197	3.07809	1242	3.09412
1108	3.04454	1153	3.06183	1198	3.07846	1243	3.09447
1109	3.04493	1154	3.06221	1199	3.07882	1244	3.09482
1110	3.04532	1155	3.06258	1200	3.07918	1245	3.09517
1111	3.04571	1156	3.06296	1201	3.07954	1246	3.09552
1112	3.04610	1157	3.06333	1202	3.07990	1247	3.09587
1113	3.04650	1158	3.06371	1203	3.08027	1248	3.09621
1114	3.04689	1159	3.06408	1204	3.08063	1249	3.09656
1115	3.04727	1160	3.06446	1205	3.08099	1250	3.09691
1116	3.04766	1161	3.06483	1206	3.08135	1251	3.09726
1117	3.04805	1162	3.06521	1207	3.08171	1252	3.09760
1118	3.04844	1163	3.06558	1208	3.08207	1253	3.09795
1119	3.04883	1164	3.06595	1209	3.08243	1254	3.09830
1120	3.04922	1165	3.06633	1210	3.08279	1255	3.09864
1121	3.04961	1166	3.06670	1211	3.08314	1256	3.09899
1122	3.04999	1167	3.06707	1212	3.08350	1257	3.09934
1123	3.05038	1168	3.06744	1213	3.08386	1258	3.09968
1124	3.05077	1169	3.06781	1214	3.08422	1259	3.10003
1125	3.05115	1170	3.06819	1215	3.08458	1260	3.10037

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
1261	3.10072	1306	3.11594	1351	3.13066	1396	3.14489
1262	3.10106	1307	3.11628	1352	3.13098	1397	3.14520
1263	3.10140	1308	3.11661	1353	3.13130	1398	3.14551
1264	3.10175	1309	3.11694	1354	3.13162	1399	3.14582
1265	3.10209	1310	3.11727	1355	3.13194	1400	3.14613
1266	3.10243	1311	3.11760	1356	3.13226	1401	3.14644
1267	3.10278	1312	3.11793	1357	3.13258	1402	3.14675
1268	3.10312	1313	3.11826	1358	3.13290	1403	3.14706
1269	3.10346	1314	3.11860	1359	3.13322	1404	3.14737
1270	3.10380	1315	3.11893	1360	3.13354	1405	3.14768
1271	3.10415	1316	3.11926	1361	3.13386	1406	3.14799
1272	3.10449	1317	3.11959	1362	3.13418	1407	3.14829
1273	3.10483	1318	3.11992	1363	3.13450	1408	3.14860
1274	3.10517	1319	3.12024	1364	3.13481	1409	3.14891
1275	3.10551	1320	3.12057	1365	3.13513	1410	3.14922
1276	3.10585	1321	3.12090	1366	3.13545	1411	3.14953
1277	3.10619	1322	3.12123	1367	3.13577	1412	3.14983
1278	3.10653	1323	3.12156	1368	3.13609	1413	3.15014
1279	3.10687	1324	3.12189	1369	3.13640	1414	3.15045
1280	3.10721	1325	3.12222	1370	3.13672	1415	3.15076
1281	3.10755	1326	3.12254	1371	3.13704	1416	3.15106
1282	3.10789	1327	3.12287	1372	3.13735	1417	3.15137
1283	3.10823	1328	3.12320	1373	3.13767	1418	3.15168
1284	3.10857	1329	3.12353	1374	3.13799	1419	3.15198
1285	3.10890	1330	3.12385	1375	3.13830	1420	3.15229
1286	3.10924	1331	3.12418	1376	3.13862	1421	3.15259
1287	3.10958	1332	3.12450	1377	3.13893	1422	3.15290
1288	3.10992	1333	3.12483	1378	3.13925	1423	3.15320
1289	3.11025	1334	3.12516	1379	3.13956	1424	3.15351
1290	3.11059	1335	3.12548	1380	3.13988	1425	3.15381
1291	3.11093	1336	3.12581	1381	3.14019	1426	3.15412
1292	3.11126	1337	3.12613	1382	3.14051	1427	3.15442
1293	3.11160	1338	3.12646	1383	3.14082	1428	3.15473
1294	3.11193	1339	3.12678	1384	3.14114	1429	3.15503
1295	3.11227	1340	3.12710	1385	3.14145	1430	3.15534
1296	3.11261	1341	3.12743	1386	3.14176	1431	3.15564
1297	3.11294	1342	3.12775	1387	3.14208	1432	3.15594
1298	3.11327	1343	3.12808	1388	3.14239	1433	3.15625
1299	3.11361	1344	3.12840	1389	3.14270	1434	3.15655
1300	3.11394	1345	3.12872	1390	3.14301	1435	3.15685
1301	3.11428	1346	3.12905	1391	3.14333	1436	3.15715
1302	3.11461	1347	3.12937	1392	3.14364	1437	3.15746
1303	3.11494	1348	3.12969	1393	3.14395	1438	3.15776
1304	3.11528	1349	3.13001	1394	3.14426	1439	3.15806
1305	3.11561	1350	3.13033	1395	3.14457	1440	3.15836

N.	Logar.	[illegible]	Logar.	N.	Logar.	N.	Logar.
1441	3.15866	1486	3.17202	1531	3.18498	1576	3.19756
1442	3.15897	1487	3.17231	1532	3.18526	1577	3.19783
1443	3.15927	1488	3.17260	1533	3.18554	1578	3.19811
1444	3.15957	1489	3.17289	1534	3.18583	1579	3.19838
1445	3.15987	1490	3.17319	1535	3.18611	1580	3.19866
1446	3.[illegible]017	1491	3.17348	1536	3.18639	1581	3.19893
1447	3.16047	1492	3.17377	1537	3.18667	1582	3.19921
1448	3.16077	1493	3.17406	1538	3.18696	1583	3.19948
1449	3.16[illegible]07	1494	3.17435	1539	3.18724	1584	3.19976
1450	3.16137	1495	3.17464	1540	3.18752	1585	3.20003
1451	3.16167	1496	3.17493	1541	3.18780	1586	3.20030
1452	3.16197	1497	3.17522	1542	3.18808	1587	3.20058
1453	3.16227	1498	3.17551	1543	3.18837	1588	3.20085
1454	3.16256	1499	3.17580	1544	3.18865	1589	3.20112
1455	3.16286	1500	3.17609	1545	3.18893	1590	3.20140
1456	3.16316	1501	3.17638	1546	3.18921	1591	3.201[illegible]7
1457	3.16346	1502	3.17667	1547	3.18949	1592	3.20194
1458	3.16376	1503	3.17696	1548	3.18977	1593	3.20222
1459	3.1640[illegible]	1504	3.17725	1549	3.19005	1594	3.20249
1460	3.16435	1505	3.17754	1550	3.19033	1595	3.20276
1461	3.16465	1506	3.17783	1551	3.19061	1596	3.20303
1462	3.16495	1507	3.17811	1552	3.19089	1597	3.20330
1463	3.16524	1508	3.17840	1553	3.19117	1598	3.20358
1464	3.16554	1509	3.17869	1554	3.19145	1599	3.20385
1465	3.16584	1510	3.17898	1555	3.19173	1600	3.20412
1466	3.16613	1511	3.17926	1556	3.19201	1601	3.20439
1467	3.16643	1512	3.17955	1557	3.19229	1602	3.20466
1468	3.16673	1513	3.17984	1558	3.19257	1603	3.20493
1469	3.16702	1514	3.18013	1559	3.19285	1604	3.20520
1470	3.16732	1515	3.18041	1560	3.19312	1605	3.20548
1471	3.16761	1516	3.18070	1561	3.19340	1606	3.20575
1472	3.16791	1517	3.18099	1562	3.19368	1607	3.20602
1473	3.16820	1518	3.18127	1563	3.19396	1608	3.20629
1474	3.16850	1519	3.18156	1564	3.19424	1609	3.20656
1475	3.16879	1520	3.18184	1565	3.19451	1610	3.20683
1476	3.16909	1521	3.18213	1566	3.19479	1611	3.20710
1477	3.16938	1522	3.18241	1567	3.19507	1612	3.20737
1478	3.16967	1523	3.18270	1568	3.19535	1613	3.20763
1479	3.16997	1524	3.18299	1569	3.19562	1614	3.20790
1480	3.17026	1525	3.18327	1570	3.19590	1615	3.20817
1481	3.17056	1526	3.18355	1571	3.19618	1616	3.20844
1482	3.17085	1527	3.18384	1572	3.19645	1617	3.20871
1483	3.17114	1528	3.18412	1573	3.19673	1618	3.20898
1484	3.17143	1529	3.18441	1574	3.19700	1619	3.20925
1485	3.17173	1530	3.18469	1575	3.19728	1620	3.20952

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
1621	3.20978	1666	3.22168	1711	3.23325	1756	3.24452
1622	3.21005	1667	3.22194	1712	3.23350	1757	3.24477
1623	3.21032	1668	3.22220	1713	3.23376	1758	3.24502
1624	3.21059	1669	3.22245	1714	3.23401	1759	3.24527
1625	3.21085	1670	3.22272	1715	3.23426	1760	3.24551
1626	3.21112	1671	3.22298	1716	3.23452	1761	3.24576
1627	3.21139	1672	3.22324	1717	3.23477	1762	3.24601
1628	3.21165	1673	3.22350	1718	3.23502	1763	3.24625
1629	3.21192	1674	3.22376	1719	3.23528	1764	3.24650
1630	3.21219	1675	3.22401	1720	3.23553	1765	3.24674
1631	3.21245	1676	3.22427	1721	3.23578	1766	3.24695
1632	3.21272	1677	3.22453	1722	3.23603	1767	3.24724
1633	3.21299	1678	3.22479	1723	3.23629	1768	3.24748
1634	3.21325	1679	3.22505	1724	3.23654	1769	3.24773
1635	3.21352	1680	3.22531	1725	3.23679	1770	3.24797
1636	3.21378	1681	3.22557	1726	3.23704	1771	3.24822
1637	3.21405	1682	3.22583	1727	3.23729	1772	3.24847
1638	3.21431	1683	3.22608	1728	3.23754	1773	3.24871
1639	3.21458	1684	3.22634	1729	3.23780	1774	3.24895
1640	3.21484	1685	3.22660	1730	3.23805	1775	3.24920
1641	3.21511	1686	3.22686	1731	3.23830	1776	3.24944
1642	3.21537	1687	3.22712	1732	3.23855	1777	3.24969
1643	3.21564	1688	3.22737	1733	3.23880	1778	3.24993
1644	3.21590	1689	3.22763	1734	3.23905	1779	3.25018
1645	3.21617	1690	3.22789	1735	3.23930	1780	3.25042
1646	3.21643	1691	3.22814	1736	3.23955	1781	3.25066
1647	3.21669	1692	3.22840	1737	3.23980	1782	3.25091
1648	3.21696	1693	3.22866	1738	3.24005	1783	3.25115
1649	3.21722	1694	3.22891	1739	3.24030	1784	3.25139
1650	3.21748	1695	3.22917	1740	3.24055	1785	3.25164
1651	3.21775	1696	3.22943	1741	3.24080	1786	3.25188
1652	3.21801	1697	3.22968	1742	3.24105	1787	3.25212
1653	3.21827	1698	3.22994	1743	3.24130	1788	3.25237
1654	3.21854	1699	3.23019	1744	3.24155	1789	3.25261
1655	3.21880	1700	3.23045	1745	3.24180	1790	3.25285
1656	3.21906	1701	3.23070	1746	3.24204	1791	3.25310
1657	3.21932	1702	3.23096	1747	3.24229	1792	3.25334
1658	3.21958	1703	3.23121	1748	3.24254	1793	3.25358
1659	3.21985	1704	3.23147	1749	3.24279	1794	3.25382
1660	3.22011	1705	3.23172	1750	3.24304	1795	3.25406
1661	3.22037	1706	3.23198	1751	3.24329	1796	3.25431
1662	3.22063	1707	3.23223	1752	3.24353	1797	3.25455
1663	3.22089	1708	3.23249	1753	3.24378	1798	3.25479
1664	3.22115	1709	3.23274	1754	3.24403	1799	3.25503
1665	3.22141	1710	3.23300	1755	3.24428	1800	3.25527

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
1801	3.25551	1846	3.26623	1891	3.27669	1936	3.28691
1802	3.25575	1847	3.26647	1892	3.27692	1937	3.28713
1803	3.25600	1848	3.266[illegible]	1893	3.2771[illegible]	1938	3.28735
1804	3.25624	1849	3.26694	1894	3.27738	1939	3.28758
1805	[illegible]	1850	3.26717	1895	3.27761	1940	3.28780
1806	[illegible]	1851	3.26741	1896	3.27784	1941	3.28803
1807	3.25696	1852	3.26764	1897	3.27807	1942	3.28825
1808	[illegible]	1853	3.26788	1898	3.27830	1943	3.28847
1809	3.25744	1854	3.26811	1899	3.27853	1944	3.28870
1810	3.25768	1855	3.26834	1900	3.27875	1945	3.28892
1811	3.25792	1856	3.26858	1901	3.27898	1946	3.28914
1812	3.25816	1857	3.26881	1902	3.27921	1947	3.28937
1813	3.25840	1858	3.26905	1903	3.27944	1948	3.28959
1814	3.25864	1859	3.26928	1904	3.27967	1949	3.28981
1815	3.25888	1860	3.26951	1905	3.27990	1950	3.29003
1816	3.25912	1861	3.26975	1906	3.28012	1951	3.29026
1817	3.25935	1862	3.26998	1907	3.28035	1952	3.29048
1818	3.2596[illegible]	1863	3.27[illegible]	1908	3.28058	1953	3.29070
1819	3.2598[illegible]	1864	3.27045	1909	3.28081	1954	3.29092
1820	3.2600[illegible]	1865	3.27068	1910	3.28103	1955	3.29115
1821	3.26031	1866	3.27091	1911	3.28126	1956	3.29137
1822	3.26055	1867	3.27114	1912	3.28149	1957	3.29159
1823	3.26079	1868	3.27138	1913	3.28172	1958	3.29181
1824	3.26102	1869	3.27161	1914	3.28194	1959	3.29203
1825	3.26126	1870	3.27184	1915	3.28217	1960	3.29226
1826	3.26150	1871	3.27207	1916	3.28240	1961	3.29248
1827	3.26174	1872	3.27231	1917	3.28262	1962	3.29270
1828	3.26198	1873	3.27254	1918	3.28285	1963	3.29292
1829	3.26221	1874	3.27277	1919	3.28308	1964	3.29314
1830	3.26245	1875	3.27300	1920	3.28330	1965	3.29336
1831	3.26269	1876	3.27323	1921	3.28353	1966	3.29358
1832	3.26293	1877	3.27346	1922	3.28375	1967	3.29380
1833	3.26316	1878	3.27370	1923	3.28398	1968	3.29403
1834	3.26340	1879	3.27393	1924	3.28421	1969	3.29425
1835	3.26364	1880	3.27416	1925	3.28443	1970	3.29447
1836	3.26387	1881	3.27439	1926	3.28466	1971	3.29469
1837	3.26411	1882	3.27462	1927	3.28488	1972	3.29491
1838	3.26435	1883	3.27485	1928	3.28511	1973	3.29513
1839	3.26458	1884	3.27508	1929	3.28533	1974	3.29535
1840	3.26482	1885	3.27531	1930	3.28556	1975	3.29557
1841	3.26505	1886	3.27554	1931	3.28578	1976	3.29579
1842	3.26529	1887	3.27577	1932	3.28601	1977	3.29601
1843	3.26553	1888	3.27600	1933	3.28623	1978	3.29623
1844	3.26576	1889	3.27623	1934	3.28646	1979	3.29645
1845	3.26600	1890	3.27646	1935	3.28668	1980	3.29667

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
1981	3.29688	2026	3.30664	2071	3.31618	2116	3.32552
1982	3.29710	2027	3.30685	2072	3.31639	2117	3.32572
1983	3.29732	2028	3.30707	2073	3.31660	2118	3.32593
1984	3.29754	2029	3.30728	2074	3.31681	2119	3.32613
1985	3.29776	2030	3.30750	2075	3.31702	2120	3.32634
1986	3.29798	2031	3.30771	2076	3.31723	2121	3.32654
1987	3.29820	2032	3.30792	2077	3.31744	2122	3.32675
1988	3.29842	2033	3.30814	2078	3.31765	2123	3.32695
1989	3.29863	2034	3.30835	2079	3.31785	2124	3.32715
1990	3.29885	2035	3.30856	2080	3.31806	2125	3.32736
1991	3.29907	2036	3.30878	2081	3.31827	2126	3.32756
1992	3.29929	2037	3.30899	2082	3.31848	2127	3.32777
1993	3.29951	2038	3.30920	2083	3.31869	2128	3.32797
1994	3.29973	2039	3.30942	2084	3.31890	2129	3.32818
1995	3.29994	2040	3.30963	2085	3.31911	2130	3.32838
1996	3.30016	2041	3.30984	2086	3.31931	2131	3.32858
1997	3.30038	2042	3.31006	2087	3.31952	2132	3.32879
1998	3.30060	2043	3.31027	2088	3.31973	2133	3.32899
1999	3.30081	2044	3.31048	2089	3.31994	2134	3.32919
2000	3.30103	2045	3.31069	2090	3.32015	2135	3.32940
2001	3.30125	2046	3.31091	2091	3.32035	2136	3.32960
2002	3.30146	2047	3.31112	2092	3.32056	2137	3.32980
2003	3.30168	2048	3.31133	2093	3.32077	2138	3.33001
2004	3.30190	2049	3.31154	2094	3.32098	2139	3.33021
2005	3.30211	2050	3.31175	2095	3.32118	2140	3.33041
2006	3.30233	2051	3.31197	2096	3.32139	2141	3.33062
2007	3.30255	2052	3.31218	2097	3.32160	2142	3.33082
2008	3.30276	2053	3.31239	2098	3.32181	2143	3.33102
2009	3.30298	2054	3.31260	2099	3.32201	2144	3.33122
2010	3.30320	2055	3.31281	2100	3.32222	2145	3.33143
2011	3.30341	2056	3.31302	2101	3.32243	2146	3.33163
2012	3.30363	2057	3.31323	2102	3.32263	2147	3.33183
2013	3.30384	2058	3.31345	2103	3.32284	2148	3.33203
2014	3.30406	2059	3.31366	2104	3.32305	2149	3.33224
2015	3.30428	2060	3.31387	2105	3.32325	2150	3.33244
2016	3.30449	2061	3.31408	2106	3.32346	2151	3.33264
2017	3.30471	2062	3.31429	2107	3.32366	2152	3.33284
2018	3.30492	2063	3.31450	2108	3.32387	2153	3.33304
2019	3.30514	2064	3.31471	2109	3.32408	2154	3.33325
2020	3.30535	2065	3.31492	2110	3.32428	2155	3.33345
2021	3.30557	2066	3.31513	2111	3.32449	2156	3.33365
2022	3.30578	2067	3.31534	2112	3.32469	2157	3.33385
2023	3.30600	2068	3.31555	2113	3.32490	2158	3.33405
2024	3.30621	2069	3.31576	2114	3.32511	2159	3.33425
2025	3.30643	2070	3.31597	2115	3.32531	2160	3.33445

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
2161	3.33465	2206	3.34361	2251	3.35238	2296	3.36097
2162	3.33486	2207	3.34380	2252	3.35257	2297	3.36116
2163	3.33506	2208	3.344[illegible]	2253	3.35276	2298	3.36135
2164	3.33526	2209	3.34420	2254	3.35295	2299	3.36154
2165	3.3[illegible]6	2210	3.34439	2255	3.35315	2300	3.36173
2166	3.[illegible]66	2211	3.34459	2256	3.35334	2301	3.36192
2167	3.335[illegible]6	2212	3.34479	2257	3.35353	2302	3.36211
2168	3.3[illegible]60[illegible]	2213	3.34498	2258	3.35372	2303	3.36229
2169	3.33626	2214	3.34518	2259	3.35392	2304	3.36248
2170	3.33646	2215	3.34537	2260	3.35411	2305	3.36267
2171	3.33666	2216	3,34557	2261	3.35430	2306	3.36286
2172	3.33686	2217	3.34577	2362	3.35449	2307	3.36305
2173	3.33706	2218	3.34596	2263	3.35468	2308	3.36324
2174	3.33726	2219	3.34616	2264	3.35488	2309	3.36342
2175	3.33746	2220	3.34635	2265	3.35507	2310	3.36361
2176	3.33766	2221	3.34655	2266	3.35526	2311	3.36380
[illegible]177	3.33786	222[illegible]	3.34674	2267	3.35545	2312	3.36399
2178	3.33806	[illegible]223	3.346[illegible]	2258	3.35564	2313	3.36418
2179	3.33826	2224	3.34713	2269	3.35583	2314	3.36436
2180	3.33846	2225	3.34733	2270	3.35602	2315	3.36455
2181	3.33866	2226	3.34753	2271	3.35622	2316	3.36474
2182	3.33885	2227	3.34772	2272	3.35641	2317	3.36493
2183	3.33905	2228	3.34792	2273	3.35660	2318	3.36511
2184	3.33925	2229	3.34811	2274	3.35679	2319	3.36530
2185	3.33945	2230	3.34830	2275	3.35698	2320	3.36549
2186	3.33965	2231	3.34850	2276	3.35717	2321	3.36568
2187	3.33985	2232	3.34869	2277	3.35737	2322	3.36586
2188	3.34005	2233	3.34889	2278	3.35755	2323	3.36605
2189	3.34025	2234	3.34909	2279	3.35774	2324	3.36624
2190	3.34044	2235	3.34928	2280	3.35793	2325	3.36642
2191	3.34064	2236	3.34947	2281	3.35813	2326	3.36661
2192	3.34084	2237	3.34967	2282	3.35832	2327	3.36680
2193	3.34104	2238	3.34986	2283	3.35851	2328	3.36698
2194	3.34124	2239	3.35005	2284	3.35870	2329	3.36717
2195	3.34143	2240	3.35025	2285	3.35889	2330	3.36736
2196	3.34163	2241	3.35044	2286	3.35908	2331	3.36754
2197	3.34183	2242	3.35064	2287	3.35927	2332	3.36773
2198	3.34203	2243	3.3508[illegible]	2288	3.35946	2333	3.36791
2199	3.34223	2244	3.35102	2289	3.35965	2334	3.36810
2200	3.34242	2245	3.35122	2290	3.35984	2335	3.36829
2201	3.34262	2246	3.35141	2291	3.36003	2336	3.36847
2202	3.34282	2247	3.35160	2292	3.36021	2337	3.36866
2203	3.34301	2248	3.35180	2293	3.36040	2338	3.36884
2204	3.34321	2249	3.35199	2294	3.36059	2339	3.36903
2205	3.34341	2250	3.35218	2295	3.36078	2340	3.36922

N.	Logar.	N	Logar.	N.	[illegible]r.	N.	Logar.
2341	3.36940	2386	3.37767	2431	3.38579	2476	3.39375
2342	3.36959	2387	3.37785	2432	3.38596	2477	3.39393
2343	3.36977	2388	3.37803	2433	3.38614	2478	3.39410
2344	3.36996	2389	3.37822	2434	3.38632	2479	3.39428
2345	3.37014	2390	3.37840	2435	3.38650	2480	3.39445
2346	3.37033	2391	3.37858	2436	3.38668	[illegible]	3.39463
2347	3.37051	2392	3.37876	2437	3.38686	[illegible]	3.39480
2348	3.37070	2393	3.37894	2438	3.38703	[illegible]	3.39498
2349	3.37088	2394	3.37912	2439	3.38721	2484	3.39515
2350	3.37107	2395	3.37931	2440	3.38739	2485	3.39533
2351	3.37125	2396	3.37949	2441	3.38757	2486	3.39550
2352	3.37144	2397	3.37967	2442	3.38775	2487	3.39568
2353	3.37162	2398	3.38985	2443	3.38792	2488	3.39585
2354	3.37181	2399	3.38003	2444	3.38810	2489	3.39602
2355	3.37199	2400	3.38021	2445	3.38828	2490	3.39620
2356	3.37217	2401	3.38039	2446	3.38846	2491	3.39637
2357	3.37236	2402	3.38057	2447	3.38863	2492	3.39655
2358	3.37254	2403	3.38075	2448	3.3[illegible]81	2493	3.396[illegible]
2359	3.37273	2404	3.38093	2449	3.38899	2494	3.39690
2360	3.37291	2405	3.38112	2450	3.38917	2495	3.397[illegible]
2361	3.37310	2406	3.38130	2451	3.38934	2496	3.39724
2362	3.37328	2407	3.38148	2452	3.38952	2497	3.39741
2363	3.37346	2408	3.38166	2453	3.38970	2498	3.39759
2364	3.37365	2409	3.38184	2454	3.38987	2499	3.39777
2365	3.37383	2410	3.38202	2455	3.39005	2500	3.39794
2366	3.37401	2411	3.38220	2456	3.39023	2501	3.39811
2367	3.37420	2412	3.38238	2457	3.39041	2502	3.39829
2368	3.37438	2413	3.38256	2458	3.39058	2503	3.39846
2369	3.37457	2414	3.38274	2459	3.39076	2504	3.39863
2370	3.37475	2415	3.38292	2460	3.39094	2505	3.39881
2371	3.37493	2416	3.38310	2461	3.39111	2506	3.93898
2372	3.37511	2417	3.38328	2462	3.39129	2507	3.39915
2373	3.37530	2418	3.38346	2463	3.39146	2508	3.39933
2374	3.37548	2419	3.38364	2464	3.39164	2509	3.39950
2375	3.37566	2420	3.38382	2465	3.39182	2510	3.39967
2376	3.37585	2421	3.38399	2466	3.39199	2511	3.39985
2377	3.37603	2422	3.38417	2467	3.39217	2512	3.40002
2378	3.37621	2423	3.38435	2468	3.39235	2513	3.40019
2379	3.37639	2424	3.38453	2469	3.39252	2514	3.40037
2380	3.37658	2425	3.38471	2470	3.39270	2515	3.40054
2381	3.37667	2426	3.38489	2471	3.39287	2516	3.40071
2382	3.37694	2427	3.38507	2472	3.39305	2517	3.40088
2383	3.37712	2428	3.38525	2473	3.39322	2518	3.40106
2384	3.37731	2429	3.38543	2474	3.39340	2519	3.40123
2385	3.37749	2430	3.38561	2475	3.39358	2520	3.40140

2521

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
2521	3.40157	2566	3.40926	2611	3.41681	2656	3.42423
2522	3.40175	2567	3.40943	2612	3.41697	2657	3.42439
2523	3.40192	2568	3.40960	2613	3.41714	2658	3.42456
2524	3.40209	2569	3.40976	2614	3.41731	2659	3.42472
2525	3.40226	2570	3.40993	2615	3.41747	2660	3.42488
2526	3.4[illegible]3	2571	3.41010	2616	3.41764	2661	3.42504
2527	3.4[illegible]61	2572	3.41027	2617	3.41780	2662	3.42521
2528	3.40[illegible]8	2573	3.41044	2618	3.41797	2663	3.42537
2529	3.4029[illegible]	2574	3.41061	2619	3.41814	2664	3.42553
2530	3.40312	2575	3.41078	2620	3.41830	2665	3.42570
2531	3.40329	2576	3.41095	2621	3.41847	2666	3.42586
2532	3.40346	2577	3.41111	2622	3.41863	2667	3.42602
2533	3.40364	2578	3.41128	2623	3.41880	2668	3.42619
2534	3.40381	2579	3.41145	2624	3.41896	2669	3.42635
2535	3.40398	2580	3.41162	2625	3.41913	2670	3.42651
2536	3.40415	2581	3.41179	2626	3.41929	2671	3.42667
2537	3.40432	2582	3.41196	2627	3.41946	2672	3.42684
[illegible]38	3.40449	25[illegible]	3.41212	2628	3.41963	2673	3.42700
2539	3.40466	2584	3.412[illegible]	2629	3.41979	2674	[illegible].42716
[illegible]540	3.40483	2585	3.41246	2630	3.41996	2675	3.42732
2541	3.40500	2586	3.41263	2631	3.42012	2676	3.42749
2542	3.40518	2587	3.41280	2632	3.42029	2677	3.42765
2543	3.40535	2588	3.41296	2633	3.42045	2678	3.42781
2544	3.40552	2589	3.41313	2634	3.42062	2679	3.42797
2545	3.40569	2590	3.41330	2635	3.42078	2680	3.42813
2546	3.40586	2591	3.41347	2636	3.42095	2681	3.42830
2547	3.40603	2592	3.41364	2637	3.42111	2682	3.42846
2548	3.40620	2593	3.41380	2638	3.42127	2683	3.42862
2549	3.40637	2594	3.41397	2639	3.42144	2684	3.42878
2550	3.40654	2595	3.41414	2640	3.42160	2685	3.42894
2551	3.40671	2596	3.41430	2641	3.42177	2686	3.42911
2552	3.40688	2597	3.41447	2642	3.42193	2687	3.42927
2553	3.40705	2598	3.41464	2643	3.42210	2688	3.42943
2554	3.40722	2599	3.41481	2644	3.42226	2689	3.42959
2555	3.40739	2600	3.41497	2645	3.42243	2690	3.42975
2556	3.40756	2601	3.41514	2646	3.42259	2691	3.42991
2557	3.40773	2602	3.41531	2647	3.42275	2692	3.43008
2558	3.40790	2603	3.41547	2648	3.42292	2693	3.4[illegible]024
2559	3.40807	2604	3.41564	2649	3.42308	2694	3.43040
2560	3.40824	2605	3.41581	2650	3.42325	2695	3.43056
2561	3.40841	2606	3.41597	2651	3.42341	2696	3.43072
2562	3.40858	2607	3.41614	2652	3.42357	2697	3.43088
2563	3.40875	2608	3.4163[illegible]	2653	3.42374	2698	3.43104
2564	3.40892	2609	3.41647	2654	3.42390	2699	3.43120
2565	3.40909	2610	3.41664	2655	3.42406	2700	3.43136

2701

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
2701	3.43152	2746	3.43870	2791	3.44576	2836	3.45271
2702	3.43169	2747	3.43886	2792	3.44592	2837	3.45286
2703	3.43185	2748	3.43902	2793	3.44607	2838	3.45301
2704	3.43201	2749	3.43917	2794	3.44623	2839	3.45317
2705	3.43217	2750	3.43933	2795	3.44638	2840	3.45332
2706	3.43233	2751	3.43949	2796	3.44654	2841	3.45347
2707	3.43249	2752	3.43965	2797	3.44669	2842	3.45362
2708	3.43265	2753	3.43981	2798	3.44685	2843	3.45378
2709	3.43281	2754	3.43996	2799	3.44700	2844	3.45393
2710	3.43297	2755	3.44012	2800	3.44716	2845	3.45408
2711	3.43313	2756	3.44028	2801	3.44731	2846	3.45423
2712	3.43329	2757	3.44044	2802	3.44747	2847	3.45439
2713	3.43345	2758	3.44059	2803	3.44762	2848	3.45454
2714	3.43361	2759	3.44075	2804	3.44778	2849	3.45469
2715	3.43377	2760	3.44091	2805	3.44793	2850	3.45484
2716	3.43393	2761	3.44107	2806	3.44809	2851	3.45500
2717	3.43409	2762	3.44122	2807	3.44824	2852	3.45515
2718	3.43425	2763	3.44138	2808	3.44840	2853	3.45530
2719	3.43441	2764	3.44154	2809	3.44855	2854	3.45545
2720	3.43457	2765	3.44170	2810	3.44871	2855	3.45561
2721	3.43473	2766	3.44185	2811	3.44886	2856	3.45576
2722	3.43489	2767	3.44201	2812	3.44902	2857	3.45591
2723	3.43505	2768	3.44217	2813	3.44917	2858	3.45606
2724	3.43521	2769	3.44232	2814	3.44932	2859	3.45621
2725	3.43537	2770	3.44248	2815	3.44948	2860	3.45637
2726	3.43553	2771	3.44264	2816	3.44963	2861	3.45652
2727	3.43569	2772	3.44279	2817	3.44979	2862	3.45667
2728	3.43584	2773	3.44295	2818	3.44994	2863	3.45682
2729	3.43600	2774	3.44311	2819	3.45010	2864	3.45697
2730	3.43616	2775	3.44326	2820	3.45025	2865	3.45712
2731	3.43632	2776	3.44342	2821	3.45040	2866	3.45728
2732	3.43648	2777	3.44358	2822	3.45056	2867	3.45743
2733	3.43664	2778	3.44373	2823	3.45071	2868	3.45758
2734	3.43680	2779	3.44389	2824	3.45086	2869	3.45773
2735	3.43696	2780	3.44404	2825	3.45102	2870	3.45788
2736	3.43712	2781	3.44420	2826	3.45117	2871	3.45803
2737	3.43727	2782	3.44436	2827	3.45133	2872	3.45818
2738	3.43743	2783	3.44451	2828	3.45148	2873	3.45834
2739	3.43759	2784	3.44467	2829	3.45163	2874	3.45849
2740	3.43775	2785	3.44483	2830	3.45179	2875	3.45864
2741	3.43791	2786	3.44498	2831	3.45194	2876	3.45879
2742	3.43807	2787	3.44514	2832	3.45209	2877	3.45894
2743	3.43823	2788	3.44529	2833	3.45225	2878	3.45909
2744	3.43838	2789	3.44545	2834	3.45240	2879	3.45924
2745	3.43854	2790	3.44560	2835	3.45255	2880	3.45939

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
2881	3.45954	2926	3.46627	2971	3.47290	3016	3.47943
2882	3.45969	2927	3.46642	2972	3.47305	3017	3.47958
2883	3.45984	2928	3.46657	2973	3.47319	3018	3.47972
2884	3.46000	2929	3.46672	2974	3.4733[illegible]	3019	3.47986
2885	3.46015	2930	3.46687	2975	3.47349	3020	3.48001
2886	3.4[illegible]	2931	3.46702	2976	3.47363	3021	3.48015
2887	3.[illegible]045	2932	3.46716	2977	3.47378	3022	3.48029
2888	3.46060	2933	3.46731	2978	3.47392	3023	3.48044
2889	3.46075	2934	3.46746	2979	3.47407	3024	3.48058
2890	3.46090	2935	3.46761	2980	3.47422	3025	3.48073
2891	3.46105	2936	3.46776	2981	3.47436	3026	3.48087
2892	3.46120	2937	3.46790	2982	3.47451	3027	3.48101
2893	3.46135	2938	3.46805	2983	3.47465	3028	3.48116
2894	3.46150	2939	3.46820	2984	3.47480	3029	3.48130
2895	3.46165	2940	3.46835	2985	3.47494	3030	3.48144
2896	3.46180	2941	3.46850	2986	3.47509	3031	3.48159
2897	3.46195	2942	3.46864	2987	3.47524	3032	3.48173
2898	3.46210	29[illegible]	3.46879	2988	3.47538	3033	3.48187
2899	3.46225	2944	3.46[illegible]4	2989	3.47553	3034	3.48202
2900	3.46240	2945	3.46909	2990	3.47567	3035	3.48216
2901	3.46255	2946	3.46923	2991	3.47582	3036	3.48230
2902	3.46270	2947	3.46938	2992	3.47596	3037	3.48244
2903	3.46285	2948	3.46953	2993	3.47611	3038	3.48259
2904	3.46300	2949	3.46967	2994	3.47625	3039	3.48273
2905	3.46315	2950	3.46982	2995	3.47640	3040	3.48287
2906	3.46330	2951	3.46997	2996	3.47654	3041	3.48302
2907	3.46345	2952	3.47012	2997	3.47669	3042	3.48316
2908	3.46360	2953	3.47026	2998	3.47683	3043	3.48330
2909	3.46374	2954	3.47041	2999	3.47698	3044	3.48344
2910	3.46389	2955	3.47056	3000	3.47712	3045	3.48359
2911	3.46404	2956	3.47070	3001	3.47727	3046	3.48373
2912	3.46419	2957	3.47085	3002	3.47741	3047	3.48387
2913	3.46434	2958	3.47100	3003	3.47756	3048	3.48402
2914	3.46449	2959	3.47115	3004	3.47770	3049	3.48416
2915	3.46464	2960	3.47129	3005	3.47784	3050	3.48430
2916	3.46479	2961	3.47144	3006	3.47799	3051	3.48444
2917	3.46494	2962	3.47159	3007	3.47813	3052	3.48458
2918	3.46509	2963	3.47173	3008	3.47828	3053	3.48473
2919	3.46523	2964	3.47188	3009	3.47842	3054	3.48487
2920	3.46538	2965	3.47202	3010	3.47857	3055	3.48501
2921	3.46553	2966	3.47217	3011	3.47871	3056	3.48515
2922	3.46568	2967	3.47232	3012	3.47886	3057	3.48530
2923	3.46583	2968	3.47246	3013	3.47900	3058	3.48544
2924	3.46598	2969	3.47261	3014	3.47914	3059	3.48558
2925	3.46613	2970	3.47276	3015	3.47929	3060	3.48572

3061

N.	Logar.	N.	Logar.	N	Logar.	N.	Logar.
3061	3.48586	3106	3.49220	3151	3.49845	3196	3.50461
3062	3.48601	3107	3.49234	3152	3.49859	3197	3.50474
3063	3.48615	3108	3.49248	3153	3.49872	3198	3.50488
3064	3.48629	3109	3.49262	3154	3.49886	3199	3.50501
3065	3.48643	3110	3.49276	3155	3.49900	3200	3.50515
3066	3.48657	3111	3.49290	3156	3.49914	3201	3.50529
3067	3.48671	3112	3.49304	3157	3.49927	3202	3.50542
3068	3.48686	3113	3.49318	3158	3.49941	3203	3.50556
3069	3.48700	3114	3.49332	3159	3.49955	3204	3.50569
3070	3.48714	3115	3.49346	3160	3.49969	3205	3.50583
3071	3.48728	3116	3.49360	3161	3.49982	3206	3.50596
3072	3.48742	3117	3.49374	3162	3.49996	3207	3.50610
3073	3.48756	3118	3.49388	3163	3.50010	3208	3.50623
3074	3.48770	3119	3.49402	3164	3.50024	3209	3.50637
3075	3.48785	3120	3.49415	3165	3.50037	3210	3.50651
3076	3.48799	3121	3.49429	3166	3.50051	3211	3.50664
3077	3.48813	3122	3.49443	3167	3.50065	3212	3.50678
3078	3.48827	3123	3.49457	3168	3.50079	3213	3.50691
3079	3.48841	3124	3.49471	3169	3.50092	3214	3.50705
3080	3.48855	3125	3.49485	3170	3.50106	3215	3.50718
3081	3.48869	3126	3.49499	3171	3.50120	3216	3.50732
3082	3.48883	3127	3.49513	3172	3.50133	3217	3.50745
3083	3.48897	3128	3.49527	3173	3.50147	3218	3.50759
3084	3.48911	3129	3.49541	3174	3.50161	3219	3.50772
3085	3.48926	3130	3.49554	3175	3.50174	3220	3.50786
3086	3.48940	3131	3.49568	3176	3.50188	3221	3.50799
3087	3.48954	3132	3.49582	3177	3.50202	3222	3.50813
3088	3.48968	3133	3.49596	3178	3.50215	3223	3.50826
3089	3.48982	3134	3.49610	3179	3.50229	3224	3.50840
3090	3.48996	3135	3.49624	3180	3.50243	3225	3.50853
3091	3.49010	3136	3.49638	3181	3.50256	3226	3.50866
3092	3.49024	3137	3.49651	3182	3.50270	3227	3.50880
3093	3.49038	3138	3.49665	3183	3.50284	3228	3.50893
3094	3.49052	3139	3.49679	3184	3.50297	3229	3.50907
3095	3.49066	3140	3.49693	3185	3.50311	3230	3.50920
3096	3.49080	3141	3.49707	3186	3.50325	3231	3.50934
3097	3.49094	3142	3.49721	3187	3.50338	3232	3.50947
3098	3.49108	3143	3.49734	3188	3.50352	3233	3.50961
3099	3.49122	3144	3.49748	3189	3.50365	3234	3.50974
3100	3.49136	3145	3.49762	3190	3.50379	3235	3.50987
3101	3.49150	3146	3.49776	3191	3.50393	3236	3.51001
3102	3.49164	3147	3.49790	3192	3.50406	3237	3.51014
3103	3.49178	3148	3.49803	3193	3.50420	3238	3.51028
3104	3.49192	3149	3.49817	3194	3.50433	3239	3.51041
3105	3.49206	3150	3.49831	3195	3.50447	3240	3.51055

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
3241	3.51068	3286	3.51667	3331	3.52257	3376	3.52840
3242	3.51081	3287	3.51680	3332	3.52271	3377	3.52853
3243	3.51095	3288	3.51693	3333	3.52284	3378	3.52866
3244	3.51108	3289	3.51706	3334	3.52297	3379	3.52879
3245	3.51121	3290	3.51720	3335	3.52310	3380	3.52892
3246	3.51135	3291	3.51733	3336	3.52323	3381	3.52905
3247	3.51148	3292	3.51746	3337	3.52336	3382	3.52917
3248	3.51162	3293	3.51759	3338	3.52349	3383	3.52930
3249	3.51175	3294	3.51772	3339	3.52362	3384	3.52943
3250	3.51188	3295	3.51786	3340	3.52375	3385	3.52956
3251	3.51202	3296	3.51799	3341	3.52388	3386	3.52969
3252	3.51215	3297	3.51812	3342	3.52401	3387	3.52982
3253	3.51228	3298	3.51825	3343	3.52414	3388	3.52994
3254	3.51242	3299	3.51838	3344	3.52427	3389	3.53007
3255	3.51255	3300	3.51851	3345	3.52440	3390	3.53020
3256	3.51268	3301	3.51865	3346	3.52453	3391	3.53033
3257	3.51282	3302	3.51878	3347	3.52466	3392	3.53046
3258	3.51295	3303	3.51891	3348	3.52479	3393	3.53058
3259	3.51308	3304	3.51904	3349	3.52492	3394	3.53071
3260	3.51322	3305	3.51917	3350	3.52504	3395	3.53084
3261	3.51335	3306	3.51930	3351	3.52517	3396	3.53097
3262	3.51348	3307	3.51943	3352	3.52530	3397	3.53110
3263	3.51362	3308	3.51957	3353	3.52543	3398	3.53122
3264	3.51375	3309	3.51970	3354	3.52556	3399	3.53135
3265	3.51388	3310	3.51983	3355	3.52569	3400	3.53148
3266	3.51402	3311	3.51996	3356	3.52582	3401	3.53161
3267	3.51415	3312	3.52009	3357	3.52595	3402	3.53173
3268	3.51428	3313	3.52022	3358	3.52608	3403	3.53186
3269	3.51441	3314	3.52035	3359	3.52621	3404	3.53199
3270	3.51455	3315	3.52048	3360	3.52634	3405	3.53212
3271	3.51468	3316	3.52061	3361	3.52647	3406	3.53224
3272	3.51481	3317	3.52075	3362	3.52660	3407	3.53237
3273	3.51495	3318	3.52088	3363	3.52673	3408	3.53250
3274	3.51508	3319	3.52101	3364	3.52686	3409	3.53263
3275	3.51521	3320	3.52114	3365	3.52699	3410	3.53275
3276	3.51534	3321	3.52127	3366	3.52711	3411	3.53288
3277	3.51548	3322	3.52140	3367	3.52724	3412	3.53301
3278	3.51561	3323	3.52153	3368	3.52737	3413	3.53314
3279	3.51574	3324	3.52166	3369	3.52750	3414	3.53326
3280	3.51587	3325	3.52179	3370	3.52763	3415	3.53339
3281	3.51601	3326	3.52192	3371	3.52776	3416	3.53352
3282	3.51614	3327	3.52205	3372	3.52789	3417	3.53365
3283	3.51627	3328	3.52218	3373	3.52802	3418	3.53377
3284	3.51640	3329	3.52231	3374	3.52815	3419	3.53390
3285	3.51654	3330	3.52244	3375	3.52827	3420	3.53403

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
3421	3.53415	3466	3.53983	3511	3.54543	3556	3.55096
3422	3.53428	3467	3.53995	3512	3.54555	3557	3.55108
3423	3.53441	3468	3.54008	3513	3.54568	3558	3.55121
3424	3.53453	3469	3.54020	3514	3.54580	3559	3.55133
3425	3.53466	3470	3.54033	3515	3.54593	3560	3.55145
3426	3.53479	3471	3.54045	3516	3.54605	3561	3.55157
3427	3.53491	3472	3.54058	3517	3.54617	3562	3.55169
3428	3.53504	3473	3.54070	3518	3.54630	3563	3.55182
3429	3.53517	3474	3.54083	3519	3.54642	3564	3.55194
3430	3.53529	3475	3.54095	3520	3.54654	3565	3.55206
3431	3.53542	3476	3.54108	3521	3.54667	3566	3.55218
3432	3.53555	3477	3.54120	3522	3.54679	3567	3.55230
3433	3.53567	3478	3.54133	3523	3.54691	3568	3.55242
3434	3.53580	3479	3.54145	3524	3.54704	3569	3.55255
3435	3.53593	3480	3.54158	3525	3.54716	3570	3.55267
3436	3.53605	3481	3.54170	3526	3.54728	3571	3.55279
3437	3.53618	3482	3.54183	3527	3.54741	3572	3.55291
3438	3.53631	3483	3.54195	3528	[illegible]	357[illegible]	3.55303
3439	3.53643	3484	3.54208	3529	3.54765	3574	3.55315
3440	3.53656	3485	3.54220	3530	3.54777	3575	3.55328
3441	3.53668	3486	3.54233	3531	3.54790	3576	3.55340
3442	3.53681	3487	3.54245	3532	3.54802	3577	3.55352
3443	3.53694	3488	3.54258	3533	3.54814	3578	3.55364
3444	3.53706	3489	3.54270	3534	3.54827	3579	3.55376
3445	3.53719	3490	3.54283	3535	3.54839	3580	3.55388
3446	3.53732	3491	3.54295	3536	3.54851	3581	3.55400
3447	3.53744	3492	3.54307	3537	3.54864	3582	3.55413
3448	3.53757	3493	3.54320	3538	3.54876	3583	3.55425
3449	3.53769	3494	3.54332	3539	3.54888	3584	3.55437
3450	3.53782	3495	3.54345	3540	3.54900	3585	3.55449
3451	3.53795	3496	3.54357	3541	3.54913	3586	3.55461
3452	3.53807	3497	3.54370	3542	3.54925	3587	3.55473
3453	3.53820	3498	3.54382	3543	3.54937	3588	3.55485
3454	3.53832	3499	3.54394	3544	3.54949	3589	3.55497
3455	3.53845	3500	3.54407	3545	3.54962	3590	3.55509
3456	3.53857	3501	3.54419	3546	3.54974	3591	3.55522
3457	3.53870	3502	3.54432	3547	3.54986	3592	3.55534
3458	3.53883	3503	3.54444	3548	3.54998	3593	3.55546
3459	3.53895	3504	3.54456	3549	3.55011	3594	3.55558
3460	3.53908	3505	3.54469	3550	3.55023	3595	3.55570
3461	3.53920	3506	3.54481	3551	3.55035	3596	3.55582
3462	3.53933	3507	3.54494	3552	3.55047	3597	3.55594
3463	3.53945	3508	3.54506	3553	3.55060	3598	3.55606
3464	3.53958	3509	3.54518	3554	3.55072	3599	3.55618
3465	3.53970	3510	3.54531	3555	3.55084	3600	3.55630

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
3601	3.55642	3646	3.56182	3691	3.56714	3736	3.57241
3602	3.55654	3647	3.56194	3692	3.56726	3737	3.57252
3603	3.55666	3648	3.56205	3693	3.56738	3738	3.57264
3604	3.55678	3649	3.56217	3694	3.56750	3739	3.57276
3605	3.55691	3650	3.56229	3695	3.56761	3740	3.57287
3606	3.55703	3651	3.56241	3696	3.56773	3741	3.57299
3607	3.55715	3652	3.56253	3697	3.56785	3742	3.57310
3608	3.55727	3653	3.56265	3698	3.56797	3743	3.57322
3609	3.557[illegible]9	3654	3.56277	3699	3.56808	3744	3.57334
3610	3.55751	3655	3.56289	3700	3.56820	3745	3.57345
3611	3.55763	3656	3.56301	3701	3.56832	3746	3.57357
3612	3.55775	3657	3.56313	3702	3.56844	3747	3.57368
3613	3.55787	3658	3.56324	3703	3.56855	3748	3.57380
3614	3.55799	3659	3.56336	3704	3.56867	3749	3.57392
3615	3.55811	3660	3.56348	3705	3.56879	3750	3.57403
3616	3.55823	3661	3.56360	3706	3.56891	3751	3.57415
3617	3.55835	3662	3.56372	3707	3.56902	3752	3.57426
3618	3.55847	366[illegible]	[illegible]56384	3708	3.56914	3753	3.57438
3619	3.55859	3664	3.5639[illegible]	3709	3.56926	3754	3.57449
3620	3.55874	3665	3.56407	3710	3.56937	3755	3.57461
3621	3.55882	3666	3.56419	3711	3.56949	3756	3.57473
3622	3.55895	3667	3.56431	3712	3.56961	3757	3.57484
3623	3.55907	3668	3.56443	3713	3.56972	3758	3.57496
3624	3.55919	3669	3.56455	3714	3.56984	3759	3.57507
3625	3.55931	3670	3.56467	3715	3.56996	3760	3.57519
3626	3.55943	3671	3.56478	3716	3.57008	3761	3.57530
3627	3.55955	3672	3.56490	3717	3.57019	3762	3.57542
3628	3.55967	3673	3.56502	3718	3.57031	3763	3.57553
3629	3.55979	3674	3.56514	3719	3.57043	3764	3.57565
3630	3.55991	3675	3.56526	3720	3.57054	3765	3.57577
3631	3.56003	3676	3.56538	3721	3.57066	3766	3.57588
3632	3.56015	3677	3.56549	3722	3.57078	3767	3.57600
3633	3.56026	3678	3.56561	3723	3.57089	3768	3.57611
3634	3.56038	3679	3.56573	3724	3.57101	3769	3.57623
3635	3.56050	3680	3.56585	3725	3.57113	3770	3.57634
3636	3.56062	3681	3.56597	3726	3.57124	3771	3.57646
3637	3.56074	3682	3.56608	3727	3.57136	3772	3.57657
3638	3.56086	3683	3.56620	3728	3.57148	3773	3.57669
3639	3.56098	3684	3.56632	3729	3.57159	3774	3.57680
3640	3.56110	3685	3.56644	3730	3.571[illegible]1	3775	3.57692
3641	3.56122	3686	3.56656	3731	3.57183	3776	3.57703
3642	3.56134	3687	3.56667	3732	3.57194	3777	3.57715
3643	3.56146	3688	3.56679	3733	3.57206	3778	3.57726
3644	3.56158	3689	3.56691	3734	3.57217	3779	3.57738
3645	3.56170	3690	3.56703	3735	3.57229	3780	3.57749

3781

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
3781	3.57761	3826	3.58275	3871	3.58782	3916	3.59284
3782	3.57772	3827	3.58286	3872	3.58796	3917	3.59295
3783	3.57784	3828	3.58297	3873	3.58805	3918	3.59306
3784	3.57795	3829	3.58309	3874	3.58816	3919	3.59318
3785	3.57807	3830	3.58320	3875	3.58827	3920	[illegible]
3786	3.57818	3831	3.58331	3876	3.58838	3921	3.59340
3787	3.57830	3832	3.58343	3877	3.58850	3922	3.59351
3788	3.57841	3833	3.58354	3878	3.58861	3923	3.59362
3789	3.57852	3834	3.58365	3879	3.58872	3924	3.59373
3790	3.57864	3835	3.58377	3880	3.58883	3925	3.59384
3791	3.57875	3836	3.58388	3881	3.58894	3926	3.59395
3792	3.57887	3837	3.58399	3882	3.58906	3927	3.59406
3793	3.57898	3838	3.58411	3883	3.58917	3928	3.59417
3794	3.57910	3839	3.58422	3884	3.58928	3929	3.59428
3795	3.57921	3840	3.58433	3885	3.58939	3930	3.59439
3796	3.57933	3841	3.58444	3886	3.58950	3931	3.59450
3797	3.57944	3842	3.58456	3887	3.58961	3932	3.59461
3798	3.57956	3843	3.58467	3888	[illegible]	3933	3.59472
3799	3.57967	3844	3.58478	3889	3.58984	3934	3.59483
3800	3.57978	3845	3.58490	3890	3.58995	3935	3.59494
3801	3.57990	3846	3.58501	3891	3.59006	3936	3.59506
3802	3.58001	3847	3.58512	3892	3.59017	3937	3.59517
3803	3.58013	3848	3.58524	3893	3.59028	3938	3.59528
3804	3.58024	3849	3.58535	3894	3.59040	3939	3.59539
3805	3.58035	3850	3.58546	3895	3.59051	3940	3.59550
3806	3.58047	3851	3.58557	3896	3.59062	3941	3.59561
3807	3.58058	3852	3.58569	3897	3.59073	3942	3.59572
3808	3.58070	3853	3.58580	3898	3.59084	3943	3.59583
3809	3.58081	3854	3.58591	3899	3.59095	3944	3.59594
3810	3.58093	3855	3.58602	3900	3.59106	3945	3.59605
3811	3.58104	3856	3.58614	3901	3.59118	3946	3.59616
3812	3.58115	3857	3.58625	3902	3.59129	3947	3.59627
3813	3.58127	3858	3.58636	3903	3.59140	3948	3.59638
3814	3.58138	3859	3.58647	3904	3.59151	3949	3.59649
3815	3.58149	3860	3.58659	3905	3.59162	3950	3.59660
3816	3.58161	3861	3.58670	3906	3.59173	3951	3.59671
3817	3.58172	3862	3.58681	3907	3.59184	3952	3.59682
3818	3.58184	3863	3.58692	3908	3.59195	3953	3.59693
3819	3.58195	3864	3.58704	3909	3.59207	3954	3.59704
3820	3.58206	3865	3.58715	3910	3.59218	3955	3.59715
3821	3.58218	3866	3.58726	3911	3.59229	3956	3.59726
3822	3.58229	3867	3.58737	3912	3.59240	3957	3.59737
3823	3.58240	3868	3.58749	3913	3.59251	3958	3.59748
3824	3.58252	3869	3.58760	3914	3.59262	3959	3.59759
3825	3.58263	3870	3.58771	3915	3.59273	3960	3.59770

N.	Logar.	N.	Logar.	N	Logar.	N.	Logar.
3961	3.59780	4006	3.60271	4051	3.60756	4096	3.61236
3962	3.59791	4007	3.60282	4052	3.60767	4097	3.61247
3963	3.59802	4008	3.60293	4053	3.60778	4098	3.61257
3964	3.59813	4009	3.60304	4054	3.6078[illegible]	4099	3.61268
3965	3.59824	4010	3.6031[illegible]	4055	3.60799	4100	3.61278
3966	3.59835	4011	3.60325	4056	3.60810	4101	3.61289
3967	3.59846	4012	3.60336	4057	3.60821	4102	3.61300
3968	3.59857	4013	3.60347	4058	3.60831	4103	3.61310
3969	3.59868	4014	3.60358	4059	3.60842	4104	3.61321
3970	3.59879	4015	3.60369	4060	3.60853	4105	3.61331
3971	3.59890	4016	3.60379	4061	3.60863	4106	3.61342
3972	3.59901	4017	3.60390	4062	3.60874	4107	3.61352
3973	3.59912	4018	3.60401	4063	3.60885	4108	3.61363
3974	3.59923	4019	3.60412	4064	3.60895	4109	3.61374
3975	3.59934	4020	3.60423	4065	3.60906	4110	3.61384
3976	3.59945	4021	3.60433	4066	3.60917	4111	3.61395
3977	3.59956	4022	3.60444	4067	3.60927	4112	3.61405
3978	3.5996[illegible]	40[illegible]	[illegible].60455	4068	3.60938	4113	3.61416
3979	3.59977	4024	3.60466	4069	3.60949	4114	3.61426
3980	3.59988	4025	3.60477	4070	3.60959	4115	3.61437
3981	3.59999	4026	3.60487	4071	3.60970	4116	3.61448
3982	3.60010	4027	3.60498	4072	3.60981	4117	3.61458
3983	3.60021	4028	3.60509	4073	3.60991	4118	3.61469
3984	3.60032	4029	3.60520	4074	3.61002	4119	3.61479
3985	3.6004	4030	3.60531	4075	3.61013	4120	3.61490
3986	3.60054	4031	3.60541	4076	3.61023	4121	3.61500
3987	3.60065	4032	3.60552	4077	3.61034	4122	3.61511
3988	3.60076	4033	3.60563	4078	3.61045	4123	3.61521
3989	3.60086	4034	3.60574	4079	3.61055	4124	3.61532
3990	3.60097	4035	3.60584	4080	3.61066	4125	3.61542
3991	3.60108	4036	3.60595	4081	3.61077	4126	3.61553
3992	3.60119	4037	3.60606	4082	3.61087	4127	3.61563
3993	3.60130	4038	3.60617	4083	3.61098	4128	3.61574
3994	3.60141	4039	3.60627	4084	3.61109	4129	3.61584
3995	3.60152	4040	3.60638	4085	3.61119	4130	3.61595
3996	3.6016	4041	3.60649	4086	3.61130	4131	3.61606
3997	3.60173	4042	3.60660	4087	3.61140	4132	3.61616
3998	3.60184	4043	3.60670	4088	3.61151	4133	3.61627
3999	3.60195	4044	3.60681	4089	3.61162	4134	3.61637
4000	3.60206	4045	3.60692	4090	3.61172	4135	3.61648
4001	3.60217	4046	3.60703	4091	3.61183	4136	3.61658
4002	3.60228	4047	3.60713	4092	3.61194	4137	3.61669
4003	3.60239	4048	3.60724	4093	3.61204	4138	3.61679
4004	3.60249	4049	3.60735	4094	3.61215	4139	3.61690
4005	3.60260	4050	3.60746	4095	3.61225	4140	3.61700

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
4141	3.61711	4186	3.62180	4231	3.62644	4276	3.63104
4142	3.61721	4187	3.62190	4232	3.62655	4277	3.63114
4143	3.61731	4188	3.62201	4233	3.62665	4278	3.63124
4144	3.61742	4189	3.62211	4234	3.62675	4279	3.63134
4145	3.61752	4190	3.62221	4235	3.62685	4280	3.63144
4146	3.61763	4191	3.62232	4236	3.62696	4281	3.63155
4147	3.61773	4192	3.62242	4237	3.62706	4282	3.63165
4148	3.61784	4193	3.62252	4238	3.62716	4283	3.63175
4149	3.61794	4194	3.62263	4239	3.62726	4284	3.63185
4150	3.61805	4195	3.62273	4240	3.62737	4285	3.63195
4151	3.61815	4196	3.62284	4241	3.62747	4286	3.63205
4152	3.61826	4197	3.62294	4242	3.62757	4287	3.63215
4153	3.61836	4198	3.62304	4243	3.62767	4288	3.63225
4154	3.61847	4199	3.62315	4244	3.62778	4289	3.63236
4155	3.61857	4200	3.62325	4245	3.62788	4290	3.63246
4156	3.61868	4201	3.62335	4246	3.62798	4291	3.63256
4157	3.61878	4202	3.62346	4247	3.62808	4292	3.63266
4158	3.61888	4203	3.62356	4248	3.62818	4293	3.63276
4159	3.61899	4204	3.62366	4249	3.62829	4294	3.63286
4160	3.61909	4205	3.62377	4250	3.62839	4295	3.63296
4161	3.61920	4206	3.62387	4251	3.62849	4296	3.63306
4162	3.61930	4207	3.62397	4252	3.62859	4297	3.63317
4163	3.61941	4208	3.62408	4253	3.62870	4298	3.63327
4164	3.61951	4209	3.62418	4254	3.62880	4299	3.63337
4165	3.61962	4210	3.62428	4255	3.62890	4300	3.63347
4166	3.61972	4211	3.62439	4256	3.62900	4301	3.63357
4167	3.61982	4212	3.62449	4257	3.62910	4302	3.63367
4168	3.61993	4213	3.62459	4258	3.62921	4303	3.63377
4169	3.62003	4214	3.62469	4259	3.62931	4304	3.63387
4170	3.62014	4215	3.62480	4260	3.62941	4305	3.63397
4171	3.62024	4216	3.62490	4261	3.62951	4306	3.63407
4172	3.62034	4217	3.62500	4262	3.62961	4307	3.63417
4173	3.62045	4218	3.62511	4263	3.62972	4308	3.63428
4174	3.62055	4219	3.62521	4264	3.62982	4309	3.63438
4175	3.62066	4220	3.62531	4265	3.62992	4310	3.63448
4176	3.62076	4221	3.62542	4266	3.63002	4311	3.63458
4177	3.62086	4222	3.62552	4267	3.63012	4312	3.63468
4178	3.62097	4223	3.62562	4268	3.63022	4313	3.63478
4179	3.62107	4224	3.62572	4269	3.63033	4314	3.63488
4180	3.62118	4225	3.62583	4270	3.63043	4315	3.63498
4181	3.62128	4226	3.62593	4271	3.63053	4316	3.63508
4182	3.62138	4227	3.62603	4272	3.63063	4317	3.63518
4183	3.62149	4228	3.62614	4273	3.63073	4318	3.63528
4184	3.62159	4229	3.62624	4274	3.63083	4319	3.63538
4185	3.62170	4230	3.62634	4275	3.63094	4320	3.63548

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
4321	3.63558	4366	3.64008	4411	3.64454	4456	3.64895
4322	3.63568	4367	3.64018	4412	3.64464	4457	3.64904
4323	3.63579	4368	3.64028	4413	3.64473	4458	3.64914
4324	3.63589	4369	3.64038	4414	3.64483	4459	3.64924
4325	3.63599	4370	3.64048	4415	3.64493	4460	3.64933
4326	3.63609	4371	3.64058	4416	3.64503	4461	3.64943
4327	3.63619	4372	3.64068	4417	3.64513	4462	3.64953
4328	3.63629	4373	3.64078	4418	3.64523	4463	3.64963
4329	3.63639	4374	3.64088	4419	3.64532	4464	3.64972
4330	3.63649	4375	3.64098	4420	3.64542	4465	3.64982
4331	3.63659	4376	3.64108	4421	3.64552	4466	3.64992
4332	3.63669	4377	3.64118	4422	3.64562	4467	3.65002
4333	3.63679	4378	3.64128	4423	3.64572	4468	3.65011
4334	3.63689	4379	3.64137	4424	3.64582	4469	3.65021
4335	3.63699	4380	3.64147	4425	3.64591	4470	3.65031
4336	3.63709	4381	3.64157	4426	3.64601	4471	3.65040
4337	3.63719	4382	3.64167	4427	3.64611	4472	3.65050
4338	3.637[illegible]9	43[illegible]	3.64177	4428	3.64621	4473	3.65060
4339	3.63739	4384	3.64187	4429	3.64631	4474	3.65070
4340	3.63749	4385	3.64197	4430	3.64640	4475	3.65079
4341	3.63759	4386	3.64207	4431	3.64650	4476	3.65089
4342	3.63769	4387	3.64217	4432	3.64660	4477	3.65099
4343	3.63779	4388	3.64227	4433	3.64670	4478	3.65108
4344	3.63789	4389	3.64237	4434	3.64680	4479	3.65118
4345	3.63799	4390	3.64246	4435	3.64689	4480	3.65128
4346	3.63809	4391	3.64256	4436	3.64699	4481	3.65137
4347	3.63819	4392	3.64266	4437	3.64709	4482	3.65147
4348	3.63829	4393	3.64276	4438	3.64719	4483	3.65157
4349	3.63839	4394	3.64286	4439	3.64729	4484	3.65167
4350	3.63849	4395	3.64296	4440	3.64738	4485	3.65176
4351	3.63859	4396	3.64306	4441	3.64748	4486	3.65186
4352	3.63869	4397	3.64316	4442	3.64758	4487	3.65196
4353	3.63879	4398	3.64326	4443	3.64768	4488	3.65205
4354	3.63889	4399	3.64335	4444	3.64777	4489	3.65215
4355	3.63899	4400	3.64345	4445	3.64787	4490	3.65225
4356	3.63909	4401	3.64355	4446	3.64797	4491	3.65234
4357	3.63919	4402	3.64365	4447	3.64807	4492	3.65244
4358	3.63929	4403	3.64375	4448	3.64816	4493	3.65254
4359	3.63939	4404	3.64385	4449	3.64826	4494	3.65263
4360	3.63949	4405	3.64395	4450	3.64836	4495	3.65273
4361	3.63959	4406	3.64404	4451	3.64846	4496	3.65283
4362	3.63969	4407	3.64414	4452	3.64856	4497	3.65292
4363	3.63979	4408	3.64424	4453	3.64865	4498	3.65302
4364	3.63988	4409	3.64434	4454	3.64875	4499	3.65312
4365	3.63998	4410	3.64444	4455	3.64885	4500	3.65321

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
4501	3.65331	4546	3.65763	4591	3.66191	4636	3.66614
4502	3.65341	4547	3.65773	4592	3.66200	4637	3.66624
4503	3.65350	4548	3.65782	4593	3.66210	4638	3.66633
4504	3.65360	4549	3.65792	4594	3.66219	4639	3.66642
4505	3.65369	4550	3.65801	4595	3.66229	4640	3.6665[illegible]
4506	3.65379	4551	3.65811	4596	3.66238	4641	3.66661
4507	3.65389	4552	3.65820	4597	3.66247	4642	3.66671
4508	3.65398	4553	3.65830	4598	3.66257	4643	3.66680
4509	3.65408	4554	3.65839	4599	3.66266	4644	3.66689
4510	3.65418	4555	3.65849	4600	3.66276	4645	3.66699
4511	3.65427	4556	3.65858	4601	3.66285	4646	3.66708
4512	3.65437	4557	3.65868	4602	3.66295	4647	3.66717
4513	3.65447	4558	3.65877	4603	3.66304	4648	3.66727
4514	3.65456	4559	3.65887	4604	3.66314	4649	3.66736
4515	3.65466	4560	3.65896	4605	3.66323	4650	3.66745
4516	3.65475	4561	3.65906	4606	3.66332	4651	3.66755
4517	3.65485	4562	3.65916	4607	3.66342	4652	3.66764
4518	3.65495	4563	3.65925	4608	3.66351	4653	3.66773
4519	3.65504	4564	3.65935	4609	3.66361	4654	3.66783
4520	3.65514	4565	3.65944	4610	3.66370	4655	3.66792
4521	3.65523	4566	3.65954	4611	3.66380	4656	3.66801
4522	3.65533	4567	3.65963	4612	3.66389	4657	3.66811
4523	3.65543	4568	3.65973	4613	3.66398	4658	3.66820
4524	3.65552	4569	3.65982	4614	3.66408	4659	3.66829
4525	3.65562	4570	3.65992	4615	3.66417	4660	3.66839
4526	3.65571	4571	3.66001	4616	3.66427	4661	3.66848
4527	3.65581	4572	3.66011	4617	3.66436	4662	3.66857
4528	3.65591	4573	3.66020	4618	3.66445	4663	3.66867
4529	3.65600	4574	3.66030	4619	3.66455	4664	3.66876
4530	3.65610	4575	3.66039	4620	3.66464	4665	3.66885
4531	3.65619	4576	3.66049	4621	3.66474	4666	3.66894
4532	3.65629	4577	3.66058	4622	3.66483	4667	3.66904
4533	3.65639	4578	3.66068	4623	3.66492	4668	3.66913
4534	3.65648	4579	3.66077	4624	3.66502	4669	3.66922
4535	3.65658	4580	3.66087	4625	3.66511	4670	3.66932
4536	3.65667	4581	3.66096	4626	3.66521	4671	3.66941
4537	3.65677	4582	3.66106	4627	3.66530	4672	3.66950
4538	3.65686	4583	3.66115	4628	3.66539	4673	3.66960
4539	3.65696	4584	3.66124	4629	3.66549	4674	3.66969
4540	3.65706	4585	3.66134	4630	3.66558	4675	3.66978
4541	3.65715	4586	3.66143	4631	3.66567	4676	3.66987
4542	3.65725	4587	3.66153	4632	3.66577	4677	3.66997
4543	3.65734	4588	3.66162	4633	3.66586	4678	3.67006
4544	3.65744	4589	3.66172	4634	3.66596	4679	3.67015
4545	3.65753	4590	3.66181	4635	3.66605	4680	3.67025

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
4681	3.67034	4726	3.67449	4771	3.67861	4816	3.68269
4682	3.67043	4727	3.67459	4772	3.67870	4817	3.68278
4683	3.67052	4728	3.67468	4773	3.67879	4818	3.68287
4684	3.67062	4729	3.67477	4774	3.67888	4819	3.68296
4685	3.67071	4730	3.67486	4775	3.67897	4820	3.68305
4686	3.67080	4731	3.67495	4776	3.67906	4821	3.68314
4687	3.67090	4732	3.67504	4777	3.67916	4822	3.68323
4688	3.67099	4733	3.67514	4778	3.67925	4823	3.68332
4689	3.67108	4734	3.67523	4779	3.67934	4824	3.68341
4690	3.67117	4735	3.67532	4780	3.67943	4825	3.68350
4691	3.67127	4736	3.67541	4781	3.67952	4826	3.68359
4692	3.67136	4737	3.67550	4782	3.67961	4827	3.68368
4693	3.67145	4738	3.67560	4783	3.67970	4828	3.68377
4694	3.67154	4739	3.67569	4784	3.67979	4829	3.68386
4695	3.67164	4740	3.67578	4785	3.67988	4830	3.68395
4696	3.67173	4741	3.67587	4786	3.67997	4831	3.68404
4697	3.67182	4742	3.67596	4787	3.68006	4832	3.68413
4698	3.67191	4743	[illegible]	4788	3.68015	4833	3.68422
4699	3.67201	4744	3.67614	4789	3.68024	4834	3.68431
4700	3.67210	4745	3.67624	4790	3.68034	4835	3.68440
4701	3.67219	4746	3.67633	4791	3.68043	4836	3.68449
4702	3.67228	4747	3.67642	4792	3.68052	4837	3.68458
4703	3.67238	4748	3.67651	4793	3.68061	4838	3.68467
4704	3.67247	4749	3.67660	4794	3.68070	4839	3.68476
4705	3.67256	4750	3.67669	4795	3.68079	4840	3.68485
4706	3.67265	4751	3.67679	4796	3.68088	4841	3.68494
4707	3.67274	4752	3.67688	4797	3.68097	4842	3.68502
4708	3.67284	4753	3.67697	4798	3.68106	4843	3.68511
4709	3.67293	4754	3.67706	4799	3.68115	4844	3.68520
4710	3.67302	4755	3.67715	4800	3.68124	4845	3.68529
4711	3.67311	4756	3.67724	4801	3.68133	4846	3.68538
4712	3.67321	4757	3.67733	4802	3.68142	4847	3.68547
4713	3.67330	4758	3.67742	4803	3.68151	4848	3.68556
4714	3.67339	4759	3.67752	4804	3.68160	4849	3.68565
4715	3.67348	4760	3.67761	4805	3.68169	4850	3.68574
4716	3.67357	4761	3.67770	4806	3.68178	4851	3.68583
4717	3.67367	4762	3.67778	4807	3.68187	4852	3.68592
4718	3.67376	4763	3.67788	4808	3.68196	4853	3.68601
4719	3.67385	4764	3.67797	4809	3.68205	4854	3.68610
4720	3.67394	4765	3.67806	4810	3.68215	4855	3.68619
4721	3.67403	4766	3.67815	4811	3.68224	4856	3.68628
4722	3.67413	4767	3.67825	4812	3.68233	4857	3.68637
4723	3.67422	4768	3.67834	4813	3.68242	4858	3.68646
4724	3.67431	4769	3.67843	4814	3.68251	4859	3.68655
4725	3.67440	4770	3.67852	4815	3.68260	4860	3.68664

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
4861	3.68673	4906	3.69073	4951	3.69469	4996	3.69862
4862	3.68681	4907	3.69082	4952	3.69478	4997	3.69871
4863	3.68690	4908	3.69090	4953	3.69487	4998	3.69880
4864	3.68699	4909	3.69099	4954	3.69496	4999	3.69888
4865	3.68708	4910	3.69108	4955	3.69504	5000	3.69897
4866	3.68717	4911	3.69117	4956	3.69513	5001	3.69906
4867	3.68726	4912	3.69126	4957	3.69522	5002	3.69914
4868	3.68735	4913	3.69135	4958	3.69531	5003	3.69923
4869	3.68744	4914	3.69144	4959	3.69539	5004	3.69932
4870	3.68753	4915	3.69152	4960	3.69548	5005	3.69940
4871	3.68762	4916	3.69161	4961	3.69557	5006	3.69949
4872	3.68771	4917	3.69170	4962	3.69566	5007	3.69958
4873	3.68780	4918	3.69179	4963	3.69574	5008	3.69966
4874	3.68789	4919	3.69188	4964	3.69583	5009	3.69975
4875	3.68797	4920	3.69197	4965	3.69592	5010	3.69984
4876	3.68806	4921	3.69205	4966	3.69601	5011	3.69992
4877	3.68815	4922	3.69214	4967	3.69609	5012	3.70001
4878	3.68824	4923	3.69223	4968	3.69618	5013	3.70010
4879	3.68833	4924	3.69232	4969	3.69627	5014	3.70018
4880	3.68842	4925	3.69241	4970	3.69636	5015	3.70027
4881	3.68851	4926	3.69249	4971	3.69644	5016	3.70036
4882	3.68860	4927	3.69258	4972	3.69653	5017	3.70044
4883	3.68869	4928	3.69267	4973	3.69662	5018	3.70053
4884	3.68878	4929	3.69276	4974	3.69671	5019	3.70062
4885	3.68886	4930	3.69285	4975	3.69679	5020	3.70070
4886	3.68895	4931	3.69294	4976	3.69688	5021	3.70079
4887	3.68904	4932	3.69302	4977	3.69697	5022	3.70088
4888	3.68913	4933	3.69311	4978	3.69705	5023	3.70096
4889	3.68922	4934	3.69320	4979	3.69714	5024	3.70105
4890	3.68931	4935	3.69329	4980	3.69723	5025	3.70114
4891	3.68940	4936	3.69338	4981	3.69732	5026	3.70122
4892	3.68949	4937	3.69346	4982	3.69740	5027	3.70131
4893	3.68958	4938	3.69355	4983	3.69749	5028	3.70140
4894	3.68966	4939	3.69364	4984	3.69758	5029	3.70148
4895	3.68975	4940	3.69373	4985	3.69767	5030	3.70157
4896	3.68984	4941	3.69381	4986	3.69775	5031	3.70165
4897	3.68993	4942	3.69390	4987	3.69784	5032	3.70174
4898	3.69002	4943	3.69399	4988	3.69793	5033	3.70183
4899	3.69011	4944	3.69408	4989	3.69801	5034	3.70191
4900	3.69020	4945	3.69417	4990	3.69810	5035	3.70200
4901	3.69028	4946	3.69425	4991	3.69819	5036	3.70209
4902	3.69037	4947	3.69434	4992	3.69827	5037	3.70217
4903	3.69046	4948	3.69443	4993	3.69836	5038	3.70226
4904	3.69055	4949	3.69452	4994	3.69845	5039	3.70234
4905	3.69064	4950	3.69461	4995	3.69854	5040	3.70243

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
5041	3.70252	5086	3.70638	5131	3.71020	5176	3.71399
5042	3.70260	5087	3.70646	5132	3.71028	5177	3.71408
5043	3.70269	5088	3.70655	5133	3.71037	5178	3.71416
5044	3.70278	5089	3.70663	5134	3.71046	5179	3.71425
5045	3.70286	5090	3.70672	5135	3.51054	5180	3.71433
5046	3.70295	5091	3.70680	5136	3.71163	5181	3.71441
5047	3.70303	5092	3.70689	5137	3.71171	5182	3.71450
5048	3.70312	5093	3.70697	5138	3.71179	5183	3.71458
5049	3.70321	5094	3.70706	5139	3.71188	5184	3.71467
5050	3.70329	5095	3.70714	5140	3.71196	5185	3.71475
5051	3.70338	5096	3.70723	5141	3.71105	5186	3.71483
5052	3.70346	5097	3.70731	5142	3.71113	5187	3.71492
5053	3.70355	5098	3.70740	5143	3.71122	5188	3.71500
5054	3.70364	5099	3.70748	5144	3.71130	5189	3.71508
5055	3.70372	5100	3.70757	5145	3.71139	5190	3.71517
5056	3.70381	5101	3.70766	5146	3.71147	5191	3.71525
5057	3.70389	5102	3.70774	5147	3.71155	5192	3.71533
5058	3.70398	5103	3.70782	5148	3.71164	5193	3.71542
5059	3.70406	5104	3.70791	5149	3.71172	5194	3.71550
5060	3.70415	5105	3.70800	5150	3.71181	5195	3.71559
5061	3.70424	5106	3.70808	5151	3.71189	5196	3.71567
5062	3.70432	5107	3.70817	5152	3.71198	5197	3.71575
5063	3.70441	5108	3.70825	5153	3.71206	5198	3.71584
5064	3.70449	5109	3.70834	5154	3.71214	5199	3.71592
5065	3.70458	5110	3.70842	5155	3.71223	5200	3.71600
5066	3.70466	5111	3.70851	5156	3.71231	5201	3.71609
5067	3.70475	5112	3.70859	5157	3.71240	5202	3.71617
5068	3.70484	5113	3.70868	5158	3.71248	5203	3.71625
5069	3.70492	5114	3.70876	5159	3.71257	5204	3.71634
5070	3.70501	5115	3.70885	5160	3.71265	5205	3.71642
5071	3.70509	5116	3.70893	5161	3.71273	5206	3.71650
5072	3.70518	5117	3.70902	5162	3.71282	5207	3.71659
5073	3.70526	5118	3.70910	5163	3.71290	5208	3.71667
5074	3.70535	5119	3.70919	5164	3.71299	5209	3.71675
5075	3.70544	5120	3.70927	5165	3.71307	5210	3.71684
5076	3.70552	5121	3.70935	5166	3.71315	5211	3.71692
5077	3.70561	5122	3.70944	5167	3.71324	5212	3.71700
5078	3.70569	5123	3.70952	5168	3.71332	5213	3.71709
5079	3.70578	5124	3.70961	5169	3.71341	5214	3.71717
5080	3.70586	5125	3.70969	5170	3.71349	5215	3.71725
5081	3.70595	5126	3.70978	5171	3.71357	5216	3.71734
5082	3.70603	5127	3.70986	5172	3.71366	5217	3.71742
5083	3.70612	5128	3.70995	5173	3.71374	5218	3.71750
5084	3.70621	5129	3.71003	5174	3.71383	5219	3.71759
5085	3.70629	5130	3.71012	5175	3.71391	5220	3.71767

N	Logar.	N	Logar.	N	Logar.	N	Logar.
5221	3.71775	5266	3.72148	5311	3.72518	5356	3.72884
5222	3.71784	5267	3.72156	5312	3.72526	5357	3.72892
5223	3.71792	5268	3.72165	5313	3.72534	5358	3.72900
5224	3.71800	5269	3.72173	5314	3.72542	5359	3.72908
5225	3.71809	5270	3.72181	5315	3.72550	5360	3.72916
5226	3.71817	5271	3.72189	5316	3.72559	5361	3.72925
5227	3.71825	5272	3.72198	5317	3.72567	5362	3.72933
5228	3.71834	5273	3.72206	5318	3.72575	5363	3.72941
5229	3.71842	5274	3.72214	5319	3.72583	5364	3.72949
5230	3.71850	5275	3.72222	5320	3.72591	5365	3.72957
5231	3.71858	5276	3.72230	5321	3.72599	5366	3.72965
5232	3.71867	5277	3.72239	5322	3.72607	5367	3.72973
5233	3.71875	5278	3.72247	5323	3.72616	5368	3.72981
5234	3.71883	5279	3.72255	5324	3.72624	5369	3.72989
5235	3.71892	5280	3.72263	5325	3.72632	5370	3.72997
5236	3.71900	5281	3.72272	5326	3.72640	5371	3.73006
5237	3.71908	5282	3.72280	5327	3.72648	5372	3.73014
5238	3.71917	5283	3.72288	5328	3.72656	5373	3.73022
5239	3.71925	5284	3.72296	5329	3.72665	5374	3.73030
5240	3.71933	5285	3.72305	5330	3.72673	5375	3.73038
5241	3.71941	5286	3.72313	5331	3.72681	5376	3.73046
5242	3.71950	5287	3.72321	5332	3.72689	5377	3.73054
5243	3.71958	5288	3.72329	5333	3.72697	5378	3.73062
5244	3.71966	5289	3.72337	5334	3.72705	5379	3.73070
5245	3.71975	5290	3.72346	5335	3.72713	5380	3.73078
5246	3.71983	5291	3.72354	5336	3.72722	5381	3.73086
5247	3.71991	5292	3.72362	5337	3.72730	5382	3.73094
5248	3.71999	5293	3.72370	5338	3.72738	5383	3.73102
5249	3.72008	5294	3.72378	5339	3.72746	5384	3.73111
5250	3.72016	5295	3.72387	5340	3.72754	5385	3.73119
5251	3.72024	5296	3.72395	5341	3.72762	5386	3.73127
5252	3.72032	5297	3.72403	5342	3.72770	5387	3.73135
5253	3.72041	5298	3.72411	5343	3.72779	5388	3.73143
5254	3.72049	5299	3.72419	5344	3.72787	5389	3.73151
5255	3.72057	5300	3.72428	5345	3.72795	5390	3.73159
5256	3.72066	5301	3.72436	5346	3.72803	5391	3.73167
5257	3.72074	5302	3.72444	5347	3.72811	5392	3.73175
5258	3.72082	5303	3.72452	5348	3.72819	5393	3.73183
5259	3.72090	5304	3.72460	5349	3.72827	5394	3.73191
5260	3.72099	5305	3.72469	5350	3.72835	5395	3.73199
5261	3.72107	5306	3.72477	5351	3.72843	5396	3.73207
5262	3.72115	5307	3.72485	5352	3.72852	5397	3.73215
5263	3.72123	5308	3.72493	5353	3.72860	5398	3.73223
5264	3.72132	5309	3.72501	5354	3.72868	5399	3.73231
5265	3.72140	5310	3.72509	5355	3.72876	5400	3.73239

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
5401	3.73247	5446	3.73608	5491	3.73965	5536	3.74320
5402	3.73255	5447	3.73616	5492	3.73973	5537	3.74327
5403	3.73264	5448	3.73624	5493	3.73981	5538	3.7433[illegible]
5404	3.73272	5449	3.73632	5494	3.73989	5539	[illegible]
5405	3.73280	5450	3.73640	5495	3.73997	5540	3.74351
5406	3.73288	5451	3.73648	5496	3.74005	5541	3.743[illegible]9
5407	3.73296	5452	3.73656	5497	3.74013	5542	3.743[illegible]7
5408	3.73304	5453	3.73664	5498	3.74020	5543	3.74[illegible]74
5409	3.73312	5454	3.73672	5499	3.74028	5544	3.74382
5410	3.73320	5455	3.73679	5500	3.74036	5545	3.74390
5411	3.73328	5456	3.73687	5501	3.74044	5546	3.74398
5412	3.73336	5457	3.73695	5502	3.74052	5547	3.74406
5413	3.73344	5458	3.73703	5503	3.74060	5548	3.74414
5414	3.73352	5459	3.73711	5504	3.74068	5549	3.74421
5415	3.73360	5460	3.73719	5505	3.74076	5550	3.74429
5416	3.73368	5461	3.73727	5506	3.74084	5551	3.74437
5417	3.73376	5462	3.73735	5507	3.74092	5552	3.74445
5418	3.73[illegible]84	5463	3.73743	5508	3.74099	5553	3.74453
5419	3.73392	5464	3.737[illegible]	5509	3.74107	5554	3.74461
5420	3.73400	5465	3.73759	5510	3.74115	5555	3.74468
5421	3.73408	5466	3.73767	5511	3.74123	5556	3.74476
5422	3.73416	5467	3.73775	5512	3.74131	5557	3.74484
5423	3.73424	5468	3.73783	5513	3.74139	5558	3.74492
5424	3.73432	5469	3.73791	5514	3.74147	5559	3.74500
5425	3.73440	5470	3.73799	5515	3.74156	5560	3.74507
5426	3.73448	5471	3.73807	5516	3.74162	5561	3.74515
5427	3.73456	5472	3.73815	5517	3.74170	5562	3.74523
5428	3.73464	5473	3.73823	5518	3.74178	5563	3.74531
5429	3.73472	5474	3.73830	5519	3.74186	5564	3.74539
5430	3.73480	5475	3.73838	5520	3.74194	5565	3.74547
5431	3.73488	5476	3.73846	5521	3.74202	5566	3.74554
5432	3.73496	5477	3.73854	5522	3.74210	5567	3.74562
5433	3.73504	5478	3.73862	5523	3.74218	5568	3.74570
5434	3.73512	5479	3.73870	5524	3.74225	5569	3.74578
5435	3.73520	5480	3.73878	5525	3.74233	5570	3.74586
5436	3.73528	5481	3.73886	5526	3.74241	5571	3.74593
5437	3.73536	5482	3.73894	5527	3.74249	5572	3.74601
5438	3.73544	5483	3.73902	5528	3.74257	5573	3.74609
5439	3.73552	5484	3.73909	5529	3.74265	5574	3.74617
5440	3.73560	5485	3.73918	5530	3.74273	5575	3.74624
5441	3.73568	5486	3.73926	5531	3.74280	5576	3.74632
5442	3.73576	5487	3.73934	5532	3.74288	5577	3.74640
5443	3.73584	5488	3.73941	5533	3.74296	5578	3.74648
5444	3.73592	5489	3.73949	5534	3.74304	5579	3.74656
5445	3.73600	5490	3.73957	5535	3.74312	5580	3.74663

N.	Logar.	N.	Logar.	N.	Logar.	N	Logar.
5581	3.74671	5626	3.75020	5671	3.75366	5716	3.75709
5582	3.74679	5627	3.75028	5672	3.75374	5717	3.75717
5583	3.74687	5628	3.75035	5673	3.75381	5718	3.75724
5584	3.74695	5629	3.75043	5674	3.75389	5719	3.75732
5585	3.74702	5630	3.75051	5975	3.75397	5720	3.75740
5586	3.74710	5631	3.75059	5676	3.75404	5721	3.75747
5587	3.74718	5632	3.75066	5677	3.75412	5722	3.75755
5588	3.74726	5633	3.75074	5678	3.75420	5723	3.75762
5589	3.74733	5634	3.75082	5679	3.75427	5724	3.75770
5590	3.74741	5635	3.75089	5680	3.75435	5725	3.75778
5591	3.74749	5636	3.75097	5681	3.75442	5726	3.75785
5592	3.74757	5637	3.75105	5682	3.75450	5727	3.75793
5593	3.74764	5638	3.75113	5683	3.75458	5728	3.75800
5594	3.74772	5639	3.75120	5684	3.75465	5729	3.75808
5595	3.74780	5640	3.75128	5685	3.75473	5730	3.75815
5596	3.74788	5641	3.75136	5686	3.75481	5731	3.75823
5597	3.74796	5642	3.75143	5687	3.75488	5732	3.75831
5598	3.74803	5643	3.75151	5688	3.75496	5733	3.75838
5599	3.74811	5644	3.75159	5689	3.75504	5734	3.75846
5600	3.74819	5645	3.75166	5690	3.75511	5735	3.75853
5601	3.74827	5646	3.75174	5691	3.75519	5736	3.75861
5602	3.74834	5647	3.75182	5692	3.75526	5737	3.75868
5603	3.74842	5648	3.75189	5693	3.75534	5738	3.75876
5604	3.74850	5649	3.75197	5694	3.75542	5739	3.75884
5605	3.74858	5650	3.75205	5695	3.75549	5740	3.75891
5606	3.74865	5651	3.75213	5696	3.75557	5741	3.75899
5607	3.74873	5652	3.75220	5697	3.75565	5742	3.75906
5608	3.74881	5653	3.75228	5698	3.75572	5743	3.75914
5609	3.74889	5654	3.75236	5699	3.75580	5744	3.75921
5610	3.74896	5655	3.75243	5700	3.75587	5745	3.75929
5611	3.74904	5656	3.75251	5701	3.75595	5746	3.75937
5612	3.74912	5657	3.75259	5702	3.75603	5747	3.75944
5613	3.74920	5658	3.75266	5703	3.75610	5748	3.75952
5614	3.74927	5659	3.75274	5704	3.75618	5749	3.75959
5615	3.74935	5660	3.75282	5705	3.75626	5750	3.75967
5616	3.74943	5661	3.75289	5706	3.75633	5751	3.75974
5617	3.74950	5662	3.75297	5707	3.75641	5752	3.75982
5618	3.74958	5663	3.75305	5708	3.75648	5753	3.75989
5619	3.74966	5664	3.75312	5709	3.75656	5754	3.75997
5620	3.74974	5665	3.75320	5710	3.75664	5755	3.76005
5621	3.74981	5666	3.75328	5711	3.75671	5756	3.76012
5622	3.74989	5667	3.75335	5712	3.75679	5757	3.76020
5623	3.74997	5668	3.75343	5713	3.75686	5758	3.76027
5624	3.75005	5669	3.75351	5714	3.75694	5759	3.76035
5625	3.75012	5670	3.75358	5715	3.75702	5760	3.76042

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
5761	3.76050	5806	3.76388	5851	3.76723	5896	3.77056
5762	3.76057	5807	3.76395	5852	3.76730	5897	3.77063
5763	3.76065	5808	3.76403	5853	3.76738	5898	3.770[illegible]0
5764	3.76072	5809	3.76410	5854	3.76745	58[illegible]	3.[illegible]78
5765	3.76080	5810	3,76418	5855	3.76753	5900	3.7708[illegible]
5766	3.76087	5811	3.76425	5856	3.76760	5901	3.77[illegible]93
5767	3.76095	5812	3.76[illegible]33	5857	3.76768	5902	3.77[illegible]00
5768	3.76103	5813	3.76440	5858	3.76775	5903	3.[illegible]107
5769	3.76110	5814	3.76448	5859	3.76782	5904	3.77115
5770	3.76118	5815	3.76455	5860	3.76790	5905	3.77122
5771	3.76125	5816	3.76462	5861	3.76797	5906	3.77129
5772	3.76133	5817	3.76470	5862	3.76805	5907	3.77137
5773	3.76140	5818	3.76477	5863	3.76812	5908	3.77144
5774	3.76148	5819	3.76485	5864	3.76819	5909	3.77151
5775	3.76155	5820	3.76492	5865	3.76827	5910	3.77159
5776	3.76163	5821	3.76500	5866	3.76834	5911	3.77166
5777	3.76170	5822	3.76507	5867	3.76842	5912	3.77173
5778	3.7[illegible]8	5823	3.765[illegible]5	5868	3.76849	5913	3.77181
5779	3.76185	5824	3.76522	5869	3.76856	591[illegible]	3.77188
5780	3.76193	5825	3.76530	5870	3.76864	5915	3.77195
5781	3.76200	5826	3.76537	5871	3.76871	5916	3.77203
5782	3.76208	5827	3.76545	5872	3.76879	5917	3.77210
5783	3.76215	5828	3.76552	5873	3.76886	5918	3.77218
5784	3.76223	5829	3.76558	5874	3.76893	5919	3.77225
5785	3.76230	5830	3.76567	5875	3.76901	5920	3.77232
5786	3.76238	5831	3.76574	5876	3.76908	5921	3.77240
5787	3.76245	5832	3.76582	5877	3.76916	5922	3.77247
5788	3.76253	5833	3.76589	5878	3.76923	5923	3.77254
5789	3.76260	5834	3.76597	5879	3.76930	5924	3.77262
5790	3.76268	5835	3.76604	5880	3.76938	5925	3.77269
5791	3.76275	5836	3.76612	5881	3.76945	5926	3.77276
5792	3.76283	5837	3.76619	5882	3.76953	5927	3.77283
5793	3.76290	5838	3.76626	5883	3.76960	5928	3.77291
5794	3.76298	5839	3.76634	5884	3.76967	5929	3.77298
5795	3.76305	5840	3.76641	5885	3.76975	5930	3.77305
5796	3.76313	5841	3.76649	5886	3.76982	5931	3.77313
5797	3.76320	5842	3.76656	5887	3.76989	5932	3.77320
5798	3.76328	5843	3.76664	5888	3.76997	5933	3.77327
5799	3.76335	5844	3.76671	5889	3.77004	5934	3.77335
5800	3.76343	5845	3.76678	5890	3.77012	5935	3.77342
5801	3.76350	5846	3.76686	5891	3.77019	5936	3.77349
5802	3.76358	5847	3.76693	5892	3.77026	5937	3.77357
5803	3.76365	5848	3.76701	5893	3.77034	5938	3.7736[illegible]
5804	3.76373	5849	3.76708	5894	3.77041	5939	3.7737[illegible]
5805	3.76380	5850	3.76716	5895	3.77048	5940	3.77379

N.	Logar.	N	Logar.	N.	Logar.	N.	Logar.
5941	3.77386	5986	3.77714	6031	3.78039	6076	3.78362
5942	3.77393	5987	3.77721	6032	3.78046	6077	3.78369
5943	3.77401	5988	3.77728	6033	3.78053	6078	3.78376
5944	3.774[illegible]	5989	3.77735	6034	3.78061	6079	3.78383
5945	3.77415	5990	3.77743	6035	3.78068	6080	3.78390
5946	3.77422	5991	3.77750	6036	3.78075	6081	3.78398
5947	3.77430	5992	3.77757	6037	3.78082	6082	3.78405
5948	3.77437	5993	3.77764	6038	3.78089	6083	3.78412
5949	3.77444	5994	3.77772	6039	3.78097	6084	3.78419
5950	3.77452	5995	3.77779	6040	3.78104	6085	3.78426
5951	3.77459	5996	3.77786	6041	3.78110	6086	3.78433
5952	3.77466	5997	3.77793	6042	3.78118	6087	3.78440
5953	3.77474	5998	3.77801	6043	3.78125	6088	3.78447
5954	3.77481	5999	3.77808	6044	3.78132	6089	3.78455
5955	3.77488	6000	3.77815	6045	3.78140	6090	3.78462
5956	3.77495	6001	3.77822	6046	3.78147	6091	3.78469
5957	3.77503	6002	3.77830	6047	3.78154	6092	3.78476
5958	3.77510	6003	3.77837	6048	3.78161	6093	3.78483
5959	3.77517	6004	3.77844	6049	3.78168	6094	3.78490
5960	3.77525	6005	3.77851	6050	3.78176	6095	3.78497
5961	3.77532	6006	3.77859	6051	3.78183	6096	3.78505
5962	3.77539	6007	3.77866	6052	3.78190	6097	3.78512
5963	3.77546	6008	3.77873	6053	3.78197	6098	3.785[illegible]
5964	3.77554	6009	3.77880	6054	3.78204	6099	3.78526
5965	3.77561	6010	3.77887	6055	3.78211	6100	3.78533
5966	3.77568	6011	3.77895	6056	3.78219	6101	3.78540
5967	3.77576	6012	3.77902	6057	3.78226	6102	3.78547
5968	3.77583	6013	3.77909	6058	3.78233	6103	3.78554
5969	3.77590	6014	3.77916	6059	3.78240	6104	3.78561
5970	3.77597	6015	3.77924	6060	3.78247	6105	3.78569
5971	3.77605	6016	3.77931	6061	3.78254	6106	3.78576
5972	3.77612	6017	3.77938	6062	3.78262	6107	3.78583
5973	3.77619	6018	3.77945	6063	3.78269	6108	3.78590
5974	3.77627	6019	3.77952	6064	3.78276	6109	3.78597
5975	3.77634	6020	3.77960	6065	3.78283	6110	3.78604
5976	3.77641	6021	3.77967	6066	3.78290	6111	3.78611
5977	3.77648	6022	3.77974	6067	3.78297	6112	3.78618
5978	3.77656	6023	3.77981	6068	3.78305	6113	3.78625
5979	3.77663	6024	3.77989	6069	3.78312	6114	3.78633
5980	3.77670	6025	3.77996	6070	3.78319	6115	3.78640
5981	3.77677	6026	3.78003	6071	3.78326	6116	3.78647
5982	3.77685	6027	3.78010	6072	3.78333	6117	3.78654
5983	3.77692	6028	3.78017	6073	3.78340	6118	3.78661
5984	3.77699	6029	3.78025	6074	3.78347	6119	3.78668
5985	3.77706	6030	3.78032	6075	3.78355	6120	3.78675

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
6121	3.78682	6166	3.79000	6211	3.79316	6256	3.79630
6122	3.78689	6167	3.79007	6212	3.79323	6257	3.7963[illegible]
6123	3.78696	6168	3.79014	6213	3.79330	6258	[illegible]
6124	3.78704	6169	3.79021	6214	3.7933[illegible]	[illegible]9	3.79651
6125	3.78711	6170	3.7902[illegible]	6215	3.79344	6260	3.796[illegible]
6126	3.78718	6171	3.79036	6216	3.79351	6261	3.796[illegible]4
6127	3.78725	6172	3.79043	6217	3.79358	6262	3.79[illegible]71
6128	3.78732	6173	3.79050	6218	3.79365	6263	3.79678
6129	3.78739	6174	3.79057	6219	3.79372	6264	3.79685
6130	3.78746	6175	3.79064	6220	3.79379	6265	3.79692
6131	3.78753	6176	3.79071	6221	3.79386	6266	3.79699
6132	3.78760	6177	3.79078	6222	3.79393	6267	3.79706
6133	3.78767	6178	3.79085	6223	3.79400	6268	3.79713
6134	3.78774	6179	3.79092	6224	3.79407	6269	3.79720
6135	3.78781	6180	3.79099	6225	3.79414	6270	3.79727
6136	3.78789	6181	3.79106	6226	3.79421	6271	3.79734
6137	3.[illegible]8796	6182	3.7911[illegible]	6227	3.79428	6272	3.79741
6138	3.78803	6183	3.791[illegible]0	6228	3.79435	6273	3.79748
6139	3.78810	6184	3.79127	6229	3.79442	6274	3.79754
6140	3.78817	6185	3.79134	6230	3.79449	6275	3.79761
6141	3.78824	6186	3.79141	6231	3.79456	6276	3.79768
6142	3.78831	6187	3.79148	6232	3.79463	6277	3.79775
6143	3.78838	6188	3.79155	6233	3.79470	6278	3.79782
6144	3.78845	6189	3.79162	6234	3.79477	6279	3.79789
6145	3.78852	6190	3.79169	6235	3.79484	6280	3.79796
6146	3.78859	6191	3.79176	6236	3.79491	6281	3.79803
6147	3.78866	6192	3.79183	6237	3.79498	6282	3.79810
6148	3.78873	6193	3.79190	6238	3.79505	6283	3.79817
6149	3.78880	6194	3.79197	6239	3.79512	6284	3.79824
6150	3.78888	6195	3.79204	6240	3.79518	6285	3.79831
6151	3.78895	6196	3.79211	6241	3.79525	6286	3.79837
6152	3.78902	6197	3.79218	6242	3.79532	6287	3.79844
6153	3.78909	6198	3.79225	6243	3.79539	6288	3.79851
6154	3.78916	6199	3.79232	6244	3.79546	6289	3.79858
6155	3.78923	6200	3.79239	6245	3.79553	6290	3.79865
6156	3.78930	6201	3.79246	6246	3.79560	6291	3.79872
6157	3.78937	6202	3.79253	6247	3.79567	6292	3.79879
6158	3.78944	6203	3.79260	6248	3.79574	6293	3.79886
6159	3.78951	6204	3.79267	6249	3.79581	6294	3.79893
6160	3.78958	6205	3.79274	6250	3.79588	6295	3.79900
6161	3.78965	6206	3.79281	6251	3.79595	6296	3.79906
6162	3.78972	6207	3.79288	6252	3.79602	6297	3.79913
6163	3.78979	6208	3.79295	6253	3.79609	6298	3.79920
6164	3.78986	6209	3.79302	6254	3.79616	6299	3.79927
6165	3.78993	6210	3.79309	6255	3.79623	6300	3.79934

N.	Logar.	N.	Logar.	N	Logar.	N.	Logar.
6301	3.79941	6346	3.80250	6391	3.80557	6436	3.80862
6302	3.79948	6347	3.80257	6392	3.80564	6437	3.80868
6303	3.79955	6348	3.80264	6393	3.80570	6438	3.80875
6304	3.7[illegible]	6349	3.80271	6394	3.80577	6439	3.80882
6305	3.79968	6350	3.80277	6395	3.80584	6440	3.80889
6306	3.79975	6351	3.80284	6396	3.80591	6441	3.80895
6307	3.79982	6352	3.80291	6397	3.80598	6442	3.80902
6308	3.79989	6353	3.80298	6398	3.80604	6443	3.80909
6309	3.79996	6354	3.80305	6399	3.80611	6444	3.80916
6310	3.80003	6355	3.80312	6400	3.80618	6445	3.80922
6311	3.80010	6356	3.80318	6401	3.80625	6446	3.80929
6312	3.80017	6357	3.80325	6402	3.80632	6447	3.80936
6313	3.80024	6358	3.80332	6403	3.80638	6448	3.80943
6314	3.80030	6359	3.80339	6404	3.80645	6449	3.80949
6315	3.80037	6360	3.80346	6405	3.80652	6450	3.80956
6316	3.80044	6361	3.80353	6406	3.80659	6451	3.80963
6317	3.80051	6362	3.80359	6407	3.80665	6452	3.80969
6318	3.80058	6363	3.80366	6408	3.80672	6453	3.80976
6319	3.80065	6364	3.80373	6409	3.80679	6454	3.80983
6320	3.80072	6365	3.80380	6410	3.80686	6455	3.80990
6321	3.80079	6366	3.80387	6411	3.80693	6456	3.80996
6322	3.80085	6367	3.80393	6412	3.80699	6457	3.81003
6323	3.80092	6368	3.80400	6413	3.80706	6458	3.810[illegible]
6324	3.80099	6369	3.80407	6414	3.80713	6459	3.81017
6325	3.80106	6370	3.80414	6415	3.80720	6460	3.81023
6326	3.80113	6371	3.80421	6416	3.80726	6461	3.81030
6327	3.80120	6372	3.80428	6417	3.80733	6462	3.81037
6328	3.80127	6373	3.80434	6418	3.80740	6463	3.81043
6329	3.80134	6374	3.80441	6419	3.80747	6464	3.81050
6330	3.80140	6375	3.80448	6420	3.80754	6465	3.81057
6331	3.80147	6376	3.80455	6421	3.80760	6466	3.81064
6332	3.80154	6377	3.80462	6422	3.80767	6467	3.81070
6333	3.80161	6378	3.80468	6423	3.80774	6468	3.81077
6334	3.80168	6379	3.80475	6424	3.80781	6469	3.81084
6335	3.80175	6380	3.80482	6425	3.80787	6470	3.81090
6336	3.80182	6381	3.80489	6426	3.80794	6471	3.81097
6337	3.80188	6382	3.80496	6427	3.80801	6472	3.81104
6338	3.80195	6383	3.80502	6428	3.80808	6473	3.81111
6339	3.80202	6384	3.80509	6429	3.80814	6474	3.81117
6340	3.80209	6385	3.80516	6430	3.80821	6475	3.81124
6341	3.80216	6386	3.80523	6431	3.80828	6476	3.81131
6342	3.80223	6387	3.80530	6432	3.80835	6477	3.81137
6343	3.80228	6388	3.80536	6433	3.80841	6478	3.81144
6344	3.80236	6389	3.80543	6434	3.80848	6479	3.81151
6345	3.80243	6390	3.80550	6435	3.80855	6480	3.81158

6481

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
6481	3.81164	6526	3.81465	6571	3.81763	6616	3.82060
6482	3.81171	6527	3.81471	6572	3.81770	6617	3.82066
6483	3.81178	6528	3.81478	6573	3.81776	6618	[illegible]
6484	3.81184	6529	3.81485	6574	3.81783	6619	3.82079
6485	3.81191	6530	3.81491	6575	3.81790	6620	3.82086
6486	3.81198	6531	3.81498	6576	3.81796	6621	[illegible]
6487	3.81204	6532	3.81505	6577	3.81803	6622	[illegible]
6488	3.81211	6533	3.81511	6578	3.81809	6623	3.82105
6489	3.81218	6534	3.81518	6579	3.81816	6624	3.82112
6490	3.81224	6535	3.81525	6580	3.81823	6625	3.82119
6491	3.81231	6536	3.81531	6581	3.81829	6626	3.82125
6492	3.81238	6537	3.81538	6582	3.81836	6627	3.82132
6493	3.81245	6538	3.81544	6583	3.81842	6628	3.82138
6494	3.81251	6539	3.81551	6584	3.81849	6629	3.82145
6495	3.81258	6540	3.81558	6585	3.81856	6630	3.82151
6496	3.81265	6541	3.81564	6586	3.81862	6631	3.82158
6497	3.81271	6542	3.81571	6587	3.81869	6632	3.82164
6498	3.81278	6543	3.81578	6588	3.81875	6633	3.82171
6499	3.81285	6544	3.81584	6589	3.81882	6634	3.82178
6500	3.81291	6545	3.81591	6590	3.81889	6635	3.82184
6501	3.81298	6546	3.81598	6591	3.81895	6636	3.82191
6502	3.81305	6547	3.81604	6592	3.81902	6637	3.82197
6503	3.81311	6548	3.81611	6593	3.81908	6638	3.82204
6504	3.81318	6549	3.81618	6594	3.81915	6639	3.82210
6505	3.81325	6550	3.81624	6595	3.81921	6640	3.82217
6506	3.81331	6551	3.81631	6596	3.81928	6641	3.82223
6507	3.81338	6552	3.81637	6597	3.81935	6642	3.82230
6508	3.81345	6553	3.81644	6598	3.81941	6643	3.82236
6509	3.81351	6554	3.81651	6599	3.81948	6644	3.82243
6510	3.81358	6555	3.81657	6600	3.81954	6645	3.82250
6511	3.81365	6556	3.81664	6601	3.81961	6646	3.82256
6512	3.81371	6557	3.81671	6602	3.81968	6647	3.82263
6513	3.81378	6558	3.81677	6603	3.81974	6648	3.82269
6514	3.81385	6559	3.81684	6604	3.81981	6649	3.82276
6515	3.81391	6560	3.81690	6605	3.81987	6650	3.82282
6516	3.81398	6561	3.81697	6606	3.81994	6651	3.82289
6517	3.81405	6562	3.81704	6607	3.82000	6652	3.82295
6518	3.81411	6563	3.81710	6608	3.82007	6653	3.82302
6519	3.81418	6564	3.81717	6609	3.82014	6654	3.82308
6520	3.81425	6565	3.81723	6610	3.82020	6655	3.82315
6521	3.81431	6566	3.81730	6611	3.82027	6656	3.82321
6522	3.81438	6567	3.81737	6612	3.82033	6657	3.82328
6523	3.81445	6568	3.81743	6613	3.82040	6658	3.82334
6524	3.81451	6569	3.81750	6614	3.82046	6659	3.82341
6525	3.81458	6570	3.81757	6615	3.82053	6660	3.82347

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
6661	3.82354	6706	3.82646	6751	3.82937	6796	3.83225
6662	3.82360	6707	3.82653	6752	3.82943	6797	3.83232
6663	3.82367	6708	3.82659	6753	3.82950	6798	3.83238
6664	3.82374	6709	3.82666	6754	3.82956	6799	3.83245
6665	3.82380	6710	3.82672	6755	3.82963	6800	3.83251
6666	3.82387	6711	3.82679	6756	3.82969	6801	3.83257
6667	3.82393	6712	3.82685	6757	3.82975	6802	3.83264
6668	3.82400	6713	3.82692	6758	3.82982	6803	3.83270
6669	3.82406	6714	3.82698	6759	3.82988	6804	3.83276
6670	3.82413	6715	3.82705	6760	3.82995	6805	3.83283
6671	3.82419	6716	3.82711	6761	3.83001	6806	3.83289
6672	3.82426	6717	3.82718	6762	3.83008	6807	3.83296
6673	3.82432	6718	3.82724	6763	3.83014	6808	3.83302
6674	3.82439	6719	3.82730	6764	3.83020	6809	3.83308
6675	3.82445	6720	3.82737	6765	3.83027	6810	3.83315
6676	3.82452	6721	3.82743	6766	3.83033	6811	3.83321
6677	3.82458	6722	3.82750	6767	3.83040	6812	3.83327
6678	3.82465	6723	3.82756	6768	3.83046	6813	3.83334
6679	3.82471	6724	3.82763	6769	3.83052	6814	3.83340
6680	3.82478	6725	3.82769	6770	3.83059	6815	3.83347
6681	3.82484	6726	3.82776	6771	3.83065	6816	3.83353
6682	3.82491	6727	3.82782	6772	3.83072	6817	3.83359
6683	3.82497	6728	3.82789	6773	3.83078	6818	3.83366
6684	3.82504	6729	3.82795	6774	3.83085	6819	3.83372
6685	3.82510	6730	3.82802	6775	3.83091	6820	3.83378
6686	3.82517	6731	3.82808	6776	3.83097	6821	3.83385
6687	3.82523	6732	3.82814	6777	3.83104	6822	3.83391
6688	3.82530	6733	3.82821	6778	3.83110	6823	3.83398
6689	3.82536	6734	3.82827	6779	3.83117	6824	3.83404
6690	3.82543	6735	3.82834	6780	3.83123	6825	3.83410
6691	3.82549	6736	3.82840	6781	3.83129	6826	3.83417
6692	3.82556	6737	3.82847	6782	3.83136	6827	3.83423
6693	3.82562	6738	3.82853	6783	3.83142	6828	3.83429
6694	3.82569	6739	3.82860	6784	3.83149	6829	3.83436
6695	3.82575	6740	3.82866	6785	3.83155	6830	3.83442
6696	3.82582	6741	3.82872	6786	3.83161	6831	3.83448
6697	3.82588	6742	3.82879	6787	3.83168	6832	3.83455
6698	3.82595	6743	3.82885	6788	3.83174	6833	3.83461
6699	3.82601	6744	3.82892	6789	3.83181	6834	3.83468
6700	3.82607	6745	3.82898	6790	3.83187	6835	3.83474
6701	3.82614	6746	3.82905	6791	3.83193	6836	3.83480
6702	3.82620	6747	3.82911	6792	3.83200	6837	3.83487
6703	3.82627	6748	3.82918	6793	3.83206	6838	3.83493
6704	3.82633	6749	3.82924	6794	3.83213	6839	3.83499
6705	3.82640	6750	3.82930	6795	3.83219	6840	3.83506

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
6841	3.83512	6886	3.83797	6931	3.84080	6976	3.84361
6842	3.83518	6887	3.83803	6932	3.84086	6977	3.84367
6843	3.83525	6888	3.83809	6933	3.84092	6978	3.84373
6844	3.83531	6889	3.83816	6934	3.84098	6979	3.84379
6845	3.83537	6890	3.83822	6935	3.84105	[illegible]	3.84386
6846	3.83544	6891	3.83828	6936	3.84111	6981	3.84392
6847	3.83550	6892	3.83835	6937	3.84117	6982	3.84398
6848	3.83556	6893	3.83841	6938	3.84123	6983	3.84404
6849	3.83563	6894	3.83847	6939	3.84130	6984	3.84410
6850	3.83569	6895	3.83853	6940	3.84136	6985	3.84417
6851	3.83575	6896	3.83860	6941	3.84142	6986	3.84423
6852	3.83582	6897	3.83866	6942	3.84148	6987	3.84429
6853	3.83588	6898	3.83872	6943	3.84155	6988	3.84435
6854	3.83594	6899	3.83879	6944	3.84161	6989	3.84442
6855	3.83601	6900	3.83885	6945	3.84167	6990	3.84448
6856	3.83607	6901	3.83891	6946	3.84173	6991	3.84454
6857	3.83613	6902	3.83898	6947	3.84180	6992	3.84460
6858	3.83620	6903	3.83904	6948	3.84186	6993	3.84466
6859	3.83626	6904	3.83910	6949	3.84192	6694	3.84473
6860	3.83632	6905	3.83916	6950	3.84198	6995	3.84479
6861	3.83639	6906	3.83923	6951	3.84205	6996	3.84485
6862	3.83645	6907	3.83929	6952	3.84211	6997	3.84491
6863	3.83651	6908	3.83935	6953	3.84217	6998	3.84497
6864	3.83658	6909	3.83942	6954	3.84223	6999	3.84504
6865	3.83664	6910	3.83948	6955	3.84230	7000	3.84510
6866	3.83670	6911	3.83954	6956	3.84236	7001	3.84516
6867	3.83677	6912	3.83960	6957	3.84242	7002	3.84522
6868	3.83683	6913	3.83967	6958	3.84248	7003	3.84528
6869	3.83689	6914	3.83973	6959	3.84255	7004	3.84535
6870	3.83696	6915	3.83979	6960	3.84261	7005	3.84541
6871	3.83702	6916	3.83986	6961	3.84267	7006	3.84547
6872	3.83708	6917	3.83992	6962	3.84273	7007	3.84553
6873	3.83715	6918	3.83998	6963	3.84280	7008	3.84559
6874	3.83721	6919	3.84004	6964	3.84286	7009	3.84566
6875	3.83727	6920	3.84011	6965	3.84292	7010	3.84572
6876	3.83734	6921	3.84017	6966	3.84298	7011	3.84578
6877	3.83740	6922	3.84023	6967	3.84305	7012	3.84584
6878	3.83746	6923	3.84029	6968	3.84311	7013	3.84590
6879	3.83753	6924	3.84036	6969	3.84317	7014	3.84597
6880	3.83759	6925	3.84042	6970	3.84323	7015	3.84603
6881	3.83765	6926	3.84048	6971	3.84330	7016	3.84609
6882	3.83771	6927	3.84055	6972	3.84336	7017	3.84615
6883	3.83778	6928	3.84061	6973	3.84342	7018	3.84621
6884	3.83784	6929	3.84067	6974	3.84348	7019	3.84628
6885	3.83790	6920	3.84073	6975	3.84354	7020	3.84634

7021

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
7021	3.84640	7066	3.84917	7111	3.85193	7156	3.85467
7022	3.84646	7067	3.84924	7112	3.85199	7157	3.85473
7023	3.84652	7068	3.84930	7113	3.85205	7158	3.85479
7024	3.84658	7069	3.84936	7114	3.85211	7159	3.85485
7025	3.84665	7070	3.84942	7115	3.85217	7160	3.85491
7026	3.84671	7071	3.84948	7116	3.85224	7161	3.85497
7027	3.84677	7072	3.84954	7117	3.85230	7162	3.85503
7028	3.84683	7073	3.84960	7118	3.85236	7163	3.85509
7029	3.84689	7074	3.84967	7119	3.85242	7164	3.85516
7030	3.84696	7075	3.84973	7120	3.85248	7165	3.85522
7031	3.84702	7076	3.84979	7121	3.85254	7166	3.85528
7032	3.84708	7077	3.84985	7122	3.85260	7167	3.85534
7033	3.84714	7078	3.84991	7123	3.85266	7168	3.85540
7034	3.84720	7079	3.84997	7124	3.85272	7169	3.85546
7035	3.84726	7080	3.85003	7125	3.85278	7170	3.85552
7036	3.84733	7081	3.85009	7126	3.85285	7171	3.85558
7037	3.84739	7082	3.85016	7127	3.85291	7172	3.85564
7038	3.84745	7083	3.85022	7128	3.85297	7173	3.85570
7039	3.84751	7084	3.85028	7129	3.85303	7174	3.85576
7040	3.84757	7085	3.85034	7130	3.85309	7175	3.85582
7041	3.84763	7086	3.85040	7131	3.85315	7176	3.85588
7042	3.84770	7087	3.85046	7132	3.85321	7177	3.85594
7043	3.84776	7088	3.85052	7133	3.85327	7178	3.85600
7044	3.84782	7089	3.85058	7134	3.85333	7179	3.85606
7045	3.84788	7090	3.85065	7135	3.85339	7180	3.85612
7046	3.84794	7091	3.85071	7136	3.85345	7181	3.85618
7047	3.84800	7092	3.85077	7137	3.85352	7182	3.85625
7048	3.84807	7093	3.85083	7138	3.85358	7183	3.85631
7049	3.84813	7094	3.85089	7139	3.85364	7184	3.85637
7050	3.84819	7095	3.85095	7140	3.85370	7185	3.85643
7051	3.84825	7096	3.85101	7141	3.85376	7186	3.85649
7052	3.84831	7097	3.85107	7142	3.85382	7187	3.85655
7053	3.84837	7098	3.85114	7143	3.85388	7188	3.85661
7054	3.84844	7099	3.85120	7144	3.85394	7189	3.85667
7055	3.84850	7100	3.85126	7145	3.85400	7190	3.85673
7056	3.84856	7101	3.85132	7146	3.85406	7191	3.85679
7057	3.84862	7102	3.85138	7147	3.85412	7192	3.85685
7058	3.84868	7103	3.85144	7148	3.85418	7193	3.85691
7059	3.84874	7104	3.85150	7149	3.85425	7194	3.85697
7060	3.84880	7105	3.85156	7150	3.85431	7195	3.85703
7061	3.84887	7106	3.85163	7151	3.85437	7196	3.85709
7062	3.84893	7107	3.85169	7152	3.85443	7197	3.85715
7063	3.84899	7108	3.85175	7153	3.85449	7198	3.85721
7064	3.84905	7109	3.85181	7154	3.85455	7199	3.85727
7065	3.84911	7110	3.85187	7155	3.85461	7200	3.85733

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
7201	3.85739	7246	3.86010	7291	3.86279	7336	3.86546
7202	3.85745	7247	3.86016	7292	3.86285	7337	3.86552
7203	3.85751	7248	3.86022	7293	3.86291	7338	3.86558
7204	3.85757	7249	3.86028	7294	3.86297	7339	3.86564
7205	3.85763	7250	3.86034	7295	3.86303	7340	3.86570
7206	3.85769	7251	3.86040	7296	3.86308	7341	3.86576
7207	3.85775	7252	3.86046	7297	3.86314	7342	3.86581
7208	3.85781	7253	3.86052	7298	3.86320	7343	3.86587
7209	3.85788	7254	3.86058	7299	3.86326	7344	3.86593
7210	3.85794	7255	3.86064	7300	3.86332	7345	3.86599
7211	3.85800	7256	3.86070	7301	3.86338	7346	3.86605
7212	3.85806	7257	3.86076	7302	3.86344	7347	3.86611
7213	3.85812	7258	3.86082	7303	3.86350	7348	3.86617
7214	3.85818	7259	3.86088	7304	3.86356	7349	3.86623
7215	3.85824	7260	3.86094	7305	3.86362	7350	3.86629
7216	3.85830	7261	3.86100	7306	3.86368	7351	3.86635
7217	3.85836	7262	3.86106	7307	3.86374	7352	3.86641
7218	3.85842	7263	3.86112	7308	3.86380	7353	3.86646
7219	3.85848	7264	3.86118	7309	3.86386	7354	3.86652
7220	3.85854	7265	3.86124	7310	3.86392	7355	3.86658
7221	3.85860	7266	3.86130	7311	3.86398	7356	3.86664
7222	3.85866	7267	3.86136	7312	3.86404	7357	3.86670
7223	3.85872	7268	3.86141	7313	3.86410	7358	3.86676
7224	3.85878	7269	3.86147	7314	3.86416	7359	3.86682
7225	3.85884	7270	3.86153	7315	3.86421	7360	3.86688
7226	3.85890	7271	3.86159	7316	3.86427	7361	3.86694
7227	3.85896	7272	3.86165	7317	3.86433	7362	3.86700
7228	3.85902	7273	3.86171	7318	3.86439	7363	3.86705
7229	3.85908	7274	3.86177	7319	3.86445	7364	3.86711
7230	3.85914	7275	3.86183	7320	3.86451	7365	3.86717
7231	3.85920	7276	3.86189	7321	3.86457	7366	3.86723
7232	3.85926	7277	3.86195	7322	3.86463	7367	3.86729
7233	3.85932	7278	3.86201	7323	3.86469	7368	3.86735
7234	3.85938	7279	3.86207	7324	3.86475	7369	3.86741
7235	3.85944	7280	3.86213	7325	3.86481	7370	3.86747
7236	3.85950	7281	3.86219	7326	3.86487	7371	3.86753
7237	3.85956	7282	3.86225	7327	3.86493	7372	3.86759
7238	3.85962	7283	3.86231	7328	3.86499	7373	3.86764
7239	3.85968	7284	3.86237	7329	3.86504	7374	3.86770
7240	3.85974	7285	3.86243	7330	3.86510	7375	3.86776
7241	3.85980	7286	3.86249	7331	3.86516	7376	3.86782
7242	3.85986	7287	3.86255	7332	3.86522	7377	3.86788
7243	3.85992	7288	3.86261	7333	3.86528	7378	3.86794
7244	3.85998	7289	3.86267	7334	3.86534	7379	3.86800
7245	3.86004	7290	3.86273	7335	3.86540	7380	3.86806

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
7381	3.86812	7426	3.87075	7471	3.87338	7516	3.87599
7382	3.86817	7427	3.87081	7472	3.87344	7517	3.87604
7383	3.86823	7428	3.87087	7473	3.87350	7518	3.87610
7384	3.86829	7429	3.87093	7474	3.87355	7519	3.87616
7385	3.86835	7430	3.87099	7475	3.87361	7520	3.87622
7386	3.86841	7431	3.87105	7476	3.87367	7521	3.87628
7387	3.86847	7432	3.87111	7477	3.87373	7522	3.87633
7388	3.86853	7433	3.87116	7478	3.87379	7523	3.87639
7389	3.86859	7434	3.87122	7479	3.87384	7524	3.87645
7390	3.86864	7435	3.87128	7480	3.87390	7525	3.87651
7391	3.86870	7436	3.87134	7481	3.87396	7526	3.87656
7392	3.86876	7437	3.87140	7482	3.87402	7527	3.87652
7393	3.86882	7438	3.87146	7483	3.87408	7528	3.87668
7394	3.86888	7439	3.87151	7484	3.87413	7529	3.87674
7395	3.86894	7440	3.87157	7485	3.87419	7530	3.87680
7396	3.86900	7441	3.87163	7486	3.87425	7531	3.87685
7397	3.86906	7442	3.87169	7487	3.87431	7532	3.87691
7398	3.86911	7443	3.87175	7488	3.87437	7533	3.87697
7399	3.86917	7444	3.87181	7489	3.87442	7534	3.87703
7400	3.86923	7445	3.87186	7490	3.87448	7535	3.87708
7401	3.86929	7446	3.87192	7491	3.87454	7536	3.87714
7402	3.86935	7447	3.87198	7492	3.87460	7537	3.87720
7403	3.86941	7448	3.87204	7493	3.87466	7538	3.87726
7404	3.86947	7449	3.87210	7494	3.87471	7539	3.87731
7405	3.86953	7450	3.87216	7495	3.87477	7540	3.87737
7406	3.86958	7451	3.87221	7496	3.87483	7541	3.87743
7407	3.86964	7452	3.87227	7497	3.87489	7542	3.87749
7408	3.86970	7453	3.87233	7498	3.87495	7543	3.87754
7409	3.86976	7454	3.87239	7499	3.87500	7544	3.87760
7410	3.86982	7455	3.87245	7500	3.87506	7545	3.87766
7411	3.86988	7456	3.87251	7501	3.87512	7546	3.87772
7412	3.86994	7457	3.87256	7502	3.87518	7547	3.87777
7413	3.86999	7458	3.87262	7503	3.87523	7548	3.87783
7414	3.87005	7459	3.87268	7504	3.87529	7549	3.87789
7415	3.87011	7460	3.87274	7505	3.87535	7550	3.87795
7416	3.87017	7461	3.87280	7506	3.87541	7551	3.87800
7417	3.87023	7462	3.87286	7507	3.87547	7552	3.87806
7418	3.87029	7463	3.87291	7508	3.87552	7553	3.87812
7419	3.87035	7464	3.87297	7509	3.87558	7554	3.87818
7420	3.87040	7465	[illegible]	7510	3.87564	7555	3.87823
7421	3.87046	7466	3.87309	7511	3.87570	7556	3.87829
7422	3.87052	7467	3.87315	7512	3.87576	7557	3.87835
7423	3.87058	7468	3.87320	7513	3.87581	7558	3.87841
7424	3.87064	7469	3.87326	7514	3.87587	7559	3.87846
7425	3.87070	7470	3.87332	7515	3.87593	7560	3.87852

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
7561	3.87858	7606	3.88116	7651	3.88372	7696	3.88627
7562	3.87864	7607	3.88121	7652	3.88378	7697	3.88632
7563	3.87869	7608	3.88127	7653	3.88383	7698	3.88638
7564	3.87875	7609	3.88133	7654	3.88389	7699	3.88643
7565	3.87881	7610	3.88138	7655	3.88395	7700	3.88649
7566	3.87887	7611	3.88144	7656	3.88400	7701	3.88655
7567	3.87892	7612	3.88150	7657	3.88406	7702	3.88660
7568	3.87898	7613	3.88156	7658	3.88412	7703	3.88666
7569	3.87904	7614	3.88161	7659	3.88417	7704	3.88672
7570	3.87910	7615	3.88167	7660	3.88423	7705	3.88677
7571	3.87915	7616	3.88173	7661	3.88429	7706	3.88683
7572	3.87921	7617	3.88178	7662	3.88434	7707	3.88689
7573	3.87927	7618	3.88184	7663	3.88440	7708	3.88694
7574	3.87933	7619	3.88190	7664	3.88446	7709	3.88700
7575	3.87938	7620	3.88196	7665	3.88451	7710	3.88705
7576	3.87944	7621	3.88201	7666	3.88457	7711	3.88711
7577	3.87950	7622	3.88207	7667	3.88463	7712	3.88717
7578	3.87955	7623	3.88213	7668	3.88468	7713	3.88722
7579	3.87961	7624	3.88218	7669	3.88474	7714	3.88728
7580	3.87967	7625	3.88224	7670	3.88480	7715	3.88734
7581	3.87973	7626	3.88230	7671	3.88485	7716	3.88739
7582	3.87978	7627	3.88235	7672	3.88491	7717	3.88745
7583	3.87984	7628	3.88241	7673	3.88497	7718	3.88750
7584	3.87990	7629	3.88247	7674	3.88502	7719	3.88756
7585	3.87996	7630	3.88252	7675	3.88508	7720	3.88762
7586	3.88001	7631	3.88258	7676	3.88514	7721	3.88767
7587	3.88007	7632	3.88264	7677	3.88519	7722	3.88773
7588	3.88013	7633	3.88270	7678	3.88525	7723	3.88779
7589	3.88018	7634	3.88275	7679	3.88530	7724	3.88784
7590	3.88024	7635	3.88281	7680	3.88536	7725	3.88790
7591	3.88030	7636	3.88287	7681	3.88542	7726	3.88795
7592	3.88036	7637	3.88292	7682	3.88547	7727	3.88801
7593	3.88041	7638	3.88298	7683	3.88553	7728	3.88807
7594	3.88047	7639	3.88304	7684	3.88559	7729	3.88812
7595	3.88053	7640	3.88309	7685	3.88564	7730	3.88818
7596	3.88059	7641	3.88315	7686	3.88570	7731	3.88824
7597	3.88064	7642	3.88321	7687	3.88576	7732	3.88829
7598	3.88070	7643	3.88326	7688	3.88581	7733	3.88835
7599	3.88076	7644	3.88332	7689	3.88587	7734	3.88840
7600	3.88081	7645	3.88338	76[illegible]	[illegible]593	7735	3.88846
7601	3.88087	7646	3.88343	7691	3.88598	7736	3.88852
7602	3.88093	7647	3.88349	7692	3.88604	7737	3.88857
7603	3.88099	7648	3.88355	7693	3.88610	7738	3.88863
7604	3.88104	7649	3.88360	7694	3.88615	7739	3.88868
7605	3.88110	7650	3.88366	7695	3.88621	7740	3.88874

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
7741	3.88880	7786	3.89131	7831	3.89382	7876	3.89631
7742	3.88885	7787	3.89137	7832	3.89387	7877	3.89636
7743	3.88891	7788	3.89143	7833	3.89393	7878	3.89642
7744	3.88897	7789	3.89148	7834	3.89398	7879	3.89647
7745	3.88902	7790	3.89154	7835	3.89404	7880	3.89653
7746	3.88908	7791	3.89159	7836	3.89409	7881	3.89658
7747	3.88913	7792	3.89165	7837	3.89415	7882	3.89664
7748	3.88919	7793	3.89170	7838	3.89421	7883	3.89669
7749	3.88925	7794	3.89176	7839	3.89426	7884	3.89675
7750	3.8893[illegible]	7795	3.89182	7840	3.89432	7885	3.89680
7751	3.88936	7796	3.89187	7841	3.89437	7886	3.89686
7752	3.88941	7797	3.89193	7842	3.89443	7887	3.89691
7753	3.88947	7798	3.89198	7843	3.89448	7888	3.89697
7754	3.88953	7799	3.89204	7844	3.89454	7889	3.89702
7755	3.88958	7800	3.89209	7845	3.89459	7890	3.89708
7756	3.88964	7801	3.89215	7846	3.89465	7891	3.89713
7757	3.88969	7802	3.89221	7847	3.89470	7892	3.89719
7758	3.88975	7803	3.89226	7848	3.89476	7893	3.89724
7759	3.88981	7804	3.89232	7849	3.89481	7894	3.89730
7760	3.88986	7805	3.89237	7850	3.89487	7895	3.89735
7761	3.88992	7806	3.89243	7851	3.89493	7896	3.89741
7762	3.88997	7807	3.89248	7852	3.89498	7897	3.89746
7763	3.89003	7808	3.89254	7853	3.89504	7898	3.89752
7764	3.89009	7809	3.89260	7854	3.89509	7899	3.89757
7765	3.89014	7810	3.89265	7855	3.89515	7900	3.89763
7766	3.89020	7811	3.89271	7856	3.89520	7901	3.89768
7767	3.89025	7812	3.89276	7857	3.89526	7902	3.89774
7768	3.89031	7813	3.89282	7858	3.89531	7903	3.89779
7769	3.89037	7814	3.89287	7859	3.89537	7904	3.89785
7770	3.89042	7815	3.89293	7860	3.89542	7905	3.89790
7771	3.89048	7816	3.89298	7861	3.89548	7906	3.89796
7772	3.89053	7817	3.89304	7862	3.89553	7907	3.89801
7773	3.89059	7818	3.89310	7863	3.89559	7908	3.89807
7774	3.89064	7819	3.89315	7864	3.89564	7909	3.89812
7775	3.89070	7820	3.89321	7865	3.89570	7910	3.89818
7776	3.89076	7821	3.89326	7866	3.89575	7911	3.89823
7777	3.89081	7822	3.89332	7867	3.89581	7912	3.89829
7778	3.89087	7823	3.89337	7868	3.89586	7913	3.89834
7779	3.89092	7824	3.89343	7869	3.89592	7914	3.89840
7780	3.89098	7825	3.89348	7870	3.89597	7915	3.89845
7781	3.89104	7826	3.89354	7871	3.89603	7916	3.89851
7782	3.89109	7827	3.89360	7872	3.89609	7917	3.89856
7783	3.89115	7828	3.89365	7873	3.89614	7918	3.89862
7784	3.89120	7829	3.89371	7874	3.89620	7919	3.89867
7785	3.89126	7830	3.89376	7875	3.89625	7920	3.89873

N.	Logar.	N.	Logar.	N	Logar	N.	Logar.
7921	3.89878	7966	3.90124	8011	3.90369	8056	3.90612
7922	3.89883	7967	3.90129	8012	3.90374	8057	3.90617
7923	3.89889	7968	3.90135	8013	3.90380	8058	3.90623
7924	3.89894	7969	3.90140	8014	3.90385	8059	3.90628
7925	3.89900	7970	3.90146	8015	3.90390	8060	3.90634
7926	3.89905	7971	3.90151	8016	3.90396	8061	3.90639
7927	3.89911	7972	3.90157	8017	3.90401	8062	3.90644
7928	3.89916	7973	3.90162	8018	3.90407	8063	3.90650
7929	3.89922	7974	3.90168	8019	3.90412	8064	3.90655
7930	3.89927	7975	3.90173	8020	3.90417	8065	3.90660
7931	3.89933	7976	3.90179	8021	3.90423	8066	3.90666
7932	3.89938	7977	3.90184	8022	3.90428	8067	3.90671
7933	3.89944	7978	3.90189	8023	3.90434	8068	3.90677
7934	3.89949	7979	3.90195	8024	3.90439	8069	3.90682
7935	3.89955	7980	3.90200	8025	3.90445	8070	3.90687
7936	3.89960	7981	3.90206	8026	3.90450	8071	3.90693
7937	3.89966	7982	3.90211	8027	3.90455	8072	3.90698
7938	3.89971	7983	3.90217	8028	3.90461	8073	3.90704
7939	3.89977	7984	3.90222	8029	3.90466	8074	3.90709
7940	3.89982	7985	3.90227	8030	3.90472	8075	3.90714
7941	3.89988	7986	3.90233	8031	3.90477	8076	3.90720
7942	3.89993	7987	3.90238	8032	3.90482	8077	3.90725
7943	3.89998	7988	3.90244	8033	3.90488	8078	3.90730
7944	3.90004	7989	3.90249	8034	3.90493	8079	3.90736
7945	3.90009	7990	3.90255	8035	3.90499	8080	3.90741
7946	3.90015	7991	3.90260	8036	3.90504	8081	3.90747
7947	3.90020	7992	3.90266	8037	3.90509	8082	3.90752
7948	3.90026	7993	3.90271	8038	3.90515	8083	3.90757
7949	3.90031	7994	3.90276	8039	3.90520	8084	3.90763
7950	3.90037	7995	3.90282	8040	3.90526	8085	3.90768
7951	3.90042	7996	3.90287	8041	3.90531	8086	3.90773
7952	3.90048	7997	3.90293	8042	3.90536	8087	3.90779
7953	3.90053	7998	3.90298	8043	3.90542	8088	3.90784
7954	3.90059	7999	3.90304	8044	3.90547	8089	3.90789
7955	3.90064	8000	3.90309	8045	3.90553	8090	3.90795
7956	3.90069	8001	3.90314	8046	3.90558	8091	3.90800
7957	3.90075	8002	3.90320	8047	3.90563	8092	3.90806
7958	3.90080	8003	3.90325	8048	3.90569	8093	3.90811
7959	3.90086	8004	3.90331	8049	3.90574	8094	3.90816
7960	3.90091	8005	3.90336	[illegible]	3.90580	8095	3.90822
7961	3.90097	8006	3.90342	8051	3.90585	8096	3.90827
7962	3.90 2	8007	3.90347	8052	3.90590	8097	3.90832
7963	3.90108	8008	3.90352	8053	3.90596	8098	3.90838
7964	3.9 113	8009	3.90358	8054	3.90601	8099	3.90843
7965	3.90119	8010	3.90363	8055	3.90607	8100	3.90849

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
8101	3.90854	8146	3.91094	8191	3.91334	8236	3.91572
8102	3.90859	8147	3.91100	8192	3.91339	8237	3.91577
8103	3.90865	8148	3.91105	8193	3.91344	8238	3.91582
8104	3.90870	8149	3.91110	8194	3.91350	8239	3.91587
8105	3.90875	8150	3.91116	8195	3.91355	8240	3.91593
8106	3.[illegible]0881	8151	3.91121	8196	3.91360	8241	3.91598
8107	3.[illegible]0886	8152	3.91126	8197	3.91365	8242	3.91603
8108	3.9[illegible]891	8153	3.91132	8198	3.91371	8243	3.91609
8109	3.90[illegible]97	8154	3.91137	8199	3.91376	8244	3.91614
8110	3.[illegible]090[illegible]	8155	3.91142	8200	3.91381	8245	3.91619
8111	3.9090[illegible]	8156	3.91148	8201	3.91387	8246	3.91624
8112	3.90913	8157	3.91153	8202	3.91392	8247	3.91630
8113	3.90918	8158	3.91158	8203	3.91397	8248	3.91635
8114	3.90924	8159	3.91164	8204	3.91403	8249	3.91640
8115	3.90929	8160	3.91169	8205	3.91408	8250	3.91645
8116	3.90934	8161	3.91174	8206	3.91413	8251	3.91651
8117	3.90940	8162	3.91180	8207	3.91418	8252	3.91656
8118	3.90945	8163	3.91185	8208	3.91424	8253	3.91661
8119	3.90950	8164	3.91190	8209	3.91429	8254	3.91666
8120	3.90956	8165	3.91196	8210	3.91434	8255	3.91672
8121	3.90961	8166	3.91201	8211	3.91440	8256	3.91677
8122	3.90966	8167	3.91206	8212	3.91445	8257	3.91682
8123	3.90972	8168	3.91212	8213	3.91450	8258	3.91687
8124	3.90977	8169	3.91217	8214	3.91455	8259	3.91693
8125	3.90982	8170	3.91222	8215	3.91461	8260	3.91698
8126	3.90988	8171	3.91227	8216	3.91466	8261	3.91703
8127	3.90993	8172	3.91232	8217	3.91471	8262	3.91709
8128	3.90998	8173	3.91238	8218	3.91477	8263	3.91714
8129	3.91004	8174	3.91243	8219	3.91482	8264	3.91719
8130	3.91009	8175	3.91249	8220	3.91487	8265	3.91724
8131	3.91014	8176	3.91254	8221	3.91492	8266	3.91730
8132	3.91020	8177	3.91259	8222	3.91498	8267	3.91735
8133	3.91025	8178	3.91265	8223	3.91503	8268	3.91740
8134	3.91030	8179	3.91270	8224	3.91508	8269	3.91745
8135	3.91036	8180	3.91275	8225	3.91514	8270	3.91751
8136	3.91041	8181	3.91281	8226	3.91519	8271	3.91756
8137	3.91046	8182	3.91286	8227	3.91524	8272	3.91761
8138	3.91052	8183	3.91291	8228	3.91529	8273	3.91766
8139	3.91057	8184	3.91297	8229	3.91535	8274	3.91772
8140	3.91062	8185	3.91302	8230	3.91540	8275	3.91777
8141	3.91068	8186	3.91307	8231	3.91545	8276	3.91782
8142	3.91073	8187	3.91312	8232	3.91551	8277	3.91787
8143	3.91078	8188	3.91318	8233	3.91556	8278	3.91793
8144	3.91084	8189	3.91323	8234	3.91561	8279	3.91798
8145	3.91089	8190	3.91328	8235	3.91566	8280	3.91803

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
8281	3.91808	8326	3.92044	8371	3.92278	8416	3.92511
8282	3.91814	8327	3.92049	8372	3.92283	8417	3.92516
8283	3.91819	8328	3.92054	8373	3.92288	8418	3.92521
8284	3.91824	8329	3.92059	8374	3.92293	8419	3.92526
8285	3.91829	8330	3.920[illegible]5	8375	3.92298	8420	3.92531
8286	3.91834	8331	3.92070	8376	3.92304	8421	3.92536
8287	3.91840	8332	3.92075	8377	3.92309	8422	3.92542
8288	3.91845	8333	3.92080	8378	3.92314	8423	3.92547
8289	3.91850	8334	3.92085	8379	3.92319	8424	3.92552
8290	3.91855	8335	3.92091	8380	3.92324	8425	3.92557
8291	3.91861	8336	3.92096	8381	3.92330	8426	3.92562
8292	3.91866	8337	3.92101	8382	3.9233[illegible]	8427	3.92567
8293	3.91871	8338	3.92106	8383	3.92340	8428	3.92572
8294	3.91876	8339	3.92111	8384	3.92345	8429	3.92578
8295	3.91882	8340	3.92117	8385	3.92350	8430	3.92583
8296	3.91887	8341	3.92122	8386	3.92355	8431	3.92588
8297	3.91892	8342	3.92127	8387	3.92361	8432	3.92593
8298	3.91897	8343	3.92132	8388	3.92366	8433	3.92598
8299	3.91903	8344	3.92137	8389	3.92371	8434	3.92603
8300	3.91908	8345	3.92143	8390	3.92376	8435	3.92609
8301	3.91913	8346	3.92148	8391	3.92381	8436	3.92614
8302	3.91918	8347	3.92153	8392	3.92387	8437	3.92619
8303	3.91924	8348	3.92158	8393	3.92392	8438	3.92624
8304	3.91929	8349	3.92163	8394	3.92397	8439	3.92629
8305	3.91934	8350	3.92169	8395	3.92402	8440	3.92634
8306	3.91939	8351	3.92174	8396	3.92407	8441	3.92639
8307	3.91944	8352	3.92179	8397	3.92412	8442	3.92645
8308	3.91950	8353	3.92184	8398	3.92418	8443	3.92650
8309	3.91955	8354	3.92189	8399	3.92423	8444	3.92655
8310	3.91960	8355	3.92195	8400	3.92428	8445	3.92660
8311	3.91965	8356	3.92200	8401	3.92433	8446	3.92665
8312	3.91971	8357	3.92205	8402	3.92438	8447	3.92670
8313	3.91976	8358	3.92210	8403	3.92443	8448	3.92675
8314	3.91981	8359	3.92215	8404	3.92449	8449	3.92681
8315	3.91986	8360	3.92221	8405	3.92454	8450	3.92686
8316	3.91991	8361	3.92226	8406	3.92459	8451	3.92691
8317	3.91997	8362	3.92231	8407	3.92464	8452	3.92696
8318	3.92002	8363	3.92236	8408	3.92469	8453	3.92701
8319	3.92007	8364	3.92241	8409	3.92474	8454	3.92706
8320	3.92012	8365	3.92247	8410	3.92480	8455	3.92711
8321	3.92018	8366	3.92252	8411	3.92485	8456	3.92717
8322	3.92023	8367	3.92257	8412	3.92490	8457	3.92722
8323	3.92028	8368	3.92262	8413	3.92495	8458	3.92727
8324	3.92033	8369	3.92267	8414	3.92500	8459	3.92732
8325	3.92038	8370	3.92273	8415	3.92505	8460	3.92737

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
8461	3.92742	8506	3.92973	8551	3.93201	8596	3.93430
8462	3.92747	8507	3.92978	8552	3.93207	8597	3.93435
8463	3.92752	8508	3.92983	8553	3.93212	8598	3.93440
8464	3.92758	8509	3.92988	8554	3.93217	8599	3.93445
8465	3.92763	8510	3.92993	8555	3.93222	8600	3.93450
8466	3.92768	8511	3.92998	8556	3.93227	8601	3.93455
8467	3.92773	8512	3.93003	8557	3.93232	8602	3.93460
8468	3.92778	8513	3.93008	8558	3.93237	8603	3.93465
8469	3.92783	8514	3.93013	8559	3.93242	8604	3.93470
8470	3.92788	8515	3.93018	8560	3.93247	8605	3.93475
8471	3.92793	8516	3.93024	8561	3.93252	8606	3.93480
8472	3.92799	8517	3.93029	8562	3.93258	8607	3.93485
8473	3.92804	8518	3.93034	8563	3.93263	8608	3.93490
8474	3.92809	8519	3.93039	8564	3.93268	8609	3.93495
8475	3.92814	8520	3.93044	8565	3.93273	8610	3.93500
8476	3.92819	8521	3.93049	8566	3.93278	8611	3.93505
8477	3.92824	8522	3.93054	8567	3.93283	8612	3.93510
8478	3.92829	8523	3.93059	8568	3.93288	8613	3.93515
8479	3.92834	8524	3.93064	8569	3.93293	8614	3.93520
8480	3.92840	8525	3.93069	8570	3.93298	8615	3.93526
8481	3.92845	8526	3.93075	8571	3.93303	8616	3.93531
8482	3.92850	8527	3.93080	8572	3.93308	8617	3.93536
8483	3.92855	8528	3.93085	8573	3.93313	8618	3.93541
8484	3.92860	8529	3.93090	8574	3.93318	8619	3.93546
8485	3.92865	8530	3.93095	8575	3.93323	8620	3.93551
8486	3.92870	8531	3.93100	8576	3.93328	8621	3.93556
8487	3.92875	8532	3.93105	8577	3.93334	8622	3.93561
8488	3.92881	8533	3.93110	8578	3.93339	8623	3.93566
8489	3.92886	8534	3.93115	8579	3.93344	8624	3.93571
8490	3.92891	8535	3.93120	8580	3.93349	8625	3.93576
8491	3.92896	8536	3.93125	8581	3.93354	8626	3.93581
8492	3.92901	8537	3.93131	8582	3.93359	8627	3.93586
8493	3.92906	8538	3.93136	8583	3.93364	8628	3.93591
8494	3.92911	8539	3.93141	8584	3.93369	8629	3.93596
8495	3.92916	8540	3.93146	8585	3.93374	8630	3.93601
8496	3.92921	8541	3.93151	8586	3.93379	8631	3.93606
8497	3.92927	8542	3.93156	8587	3.93384	8632	3.93611
8498	3.92932	8543	3.93161	8588	3.93389	8633	3.93616
8499	3.92937	8544	3.93166	8589	3.93394	8634	3.93621
8500	3.92942	8545	3.93171	8590	3.93399	8635	3.93626
8501	3.92947	8546	3.93176	8591	3.93404	8636	3.93631
8502	3.92952	8547	3.93181	8592	3.93409	8637	3.93636
8503	3.92957	8548	3.93186	8593	3.93414	8638	3.93641
8504	3.92962	8549	3.93192	8594	3.93420	8639	3.93646
8505	3.92967	8550	3.93197	8595	3.93425	8640	3.93651

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
8641	3.93656	8686	3.93882	8731	3.94106	8776	3.94330
8642	3.93661	8687	3.93887	8732	3.94111	8777	3.94335
8643	3.93666	8688	3.93892	8733	3.94116	8778	3.94340
8644	3.93671	8689	3.93897	8734	3.94121	8779	3.94345
8645	3.93677	8690	3.93902	8735	3.94126	8780	3.94349
8646	3.93682	8691	3.93907	8736	3.94131	8781	3.94354
8647	3.93687	8692	3.93912	8737	3.94136	8782	3.94359
8648	3.93692	8693	3.93917	8738	3.94141	8783	3.94364
8649	3.93697	8694	3.93922	8739	3.94146	8784	3.94369
8650	3.93702	8695	3.93927	8740	3.94151	8785	3.94374
8651	3.93707	8696	3.93932	8741	3.94156	8786	3.94379
8652	3.93712	8697	3.93937	8742	3.94[illegible]	8787	3.94384
8653	3.93717	8698	3.93942	8743	3.94166	8788	3.94389
8654	3.93722	8699	3.93947	8744	3.94171	8789	3.94394
8655	3.93727	8700	3.93952	8745	3.94176	8790	3.94399
8656	3.93732	8701	3.93957	8746	3.94181	8791	3.94404
8657	3.93737	8702	3.93962	8747	3.94186	8792	3.94409
8658	3.93742	8703	3.93967	8748	3.94191	8793	3.94414
8659	3.93747	8704	3.93972	8749	3.94196	8794	3.94419
8660	3.93752	8705	3.93977	8750	3.94201	8795	3.94424
8661	3.93757	8706	3.93982	8751	3.94206	8796	3.94429
8662	3.93762	8707	3.93987	8752	3.94211	8797	3.94433
8663	3.93767	8708	3.93992	8753	3.94216	8798	3.94438
8664	3.93772	8709	3.93997	8754	3.94221	8799	3.94443
8665	3.93777	8700	3.94002	8755	3.94226	8800	3.94448
8666	3.93782	8711	3.94007	8756	3.94231	8801	3.94453
8667	3.93787	8712	3.94012	8757	3.94236	8802	3.94458
8668	3.93792	8713	3.94017	8758	3.94240	8803	3.94463
8669	3.93797	8714	3.94022	8759	3.94245	8804	3.94468
8670	3.93802	8715	3.94027	8760	3.94250	8805	3.94473
8671	3.93807	8716	3.94032	8761	3.94255	8806	3.94478
8672	3.93812	8717	3.94037	8762	3.94260	8807	3.94483
8673	3.93817	8718	3.94042	8763	3.94265	8808	3.94488
8674	3.93822	8719	3.94047	8764	3.94270	8809	3.94493
8675	3.93827	8720	3.94052	8765	3.94275	8810	3.94498
8676	3.93832	8721	3.94057	8766	3.94280	8811	3.94503
8677	3.93837	8722	3.94062	8767	3.94285	8812	3.94507
8678	3.93842	8723	3.94067	8768	3.94290	8813	3.94512
8679	3.93847	8724	3.94072	8769	3.94295	8814	3.94517
8680	3.93852	8725	3.94077	8770	3.94300	8815	3.94522
8681	3.93857	8726	3.94082	8771	3.94305	8816	3.945[illegible]
8682	3.93862	8727	3.94087	8772	3.94310	8817	3.94532
8683	3.93867	8728	3.94091	8773	3.94315	8818	3.94537
8684	3.93872	8729	3.94096	8774	3.94320	8819	3.94542
8685	3.93877	8730	3.94101	8775	3.94325	8820	3.94547

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
8821	3.94552	8866	3.94773	8911	3.94993	8956	3.95211
8822	3.94557	8867	3.94778	8912	3.94998	8957	3.95211
8823	3.94562	8868	3.94783	8913	3.95002	8958	3.95226
8824	3.94567	8869	3.94787	8914	3.95007	8959	3.95226
8825	3.94571	8870	3.94792	8915	3.95012	8960	3.95231
8826	3.94576	8871	3.94797	8916	3.95017	8961	3.95236
8827	3.[illegible]4581	8872	3.94802	8917	3.95022	8962	3.95240
8828	3.9[illegible]586	8873	3.94807	8918	3.95027	8963	3.95245
8829	[illegible].94[illegible]91	8874	3.94812	8919	3.95032	8964	3.95250
8830	3.[illegible]45[illegible]6	8875	3.94817	8920	3.95036	8965	3.95255
8831	3.94[illegible]	8876	3.94822	8921	3.95041	8966	3.95260
8832	3.94606	8877	3.94827	8922	3.95046	8967	3.95265
8833	3.94611	88[illegible]	3.94832	8923	3.95051	8968	3.95270
8834	3.94616	8879	3.94836	8924	3.95056	8969	3.95274
8835	3.94621	8880	3.94841	8925	3.95061	8970	3.95279
8836	3.94626	8881	3.94846	8926	3.95066	8971	3.95284
8837	3.94630	8882	3.94851	8927	3.95071	8972	3.95289
8838	3.94635	8883	3.94856	8928	3.95075	8973	3.95294
8839	3.94640	8884	3.94861	8929	3.95080	8974	3.95299
8840	3.94645	8885	3.94866	8930	3.95085	8975	3.95303
8841	3.94650	8886	3.94871	8931	3.95090	8976	3.95308
8842	3.94655	8887	3.94876	8932	3.95095	8977	3.95313
8843	3.94660	8888	3.94880	8933	3.95100	8978	3.95318
8844	3.94665	8889	3.94885	8934	3.95105	8979	3.95323
8845	3.94670	8890	3.94890	8935	3.95109	8980	3.95328
8846	3.94675	8891	3.94895	8936	3.95114	8981	3.95332
8847	3.94680	8892	3.94900	8937	3.95119	8982	3.95337
8848	3.94685	8893	3.94905	8938	3.95124	8983	3.95342
8849	3.94689	8894	3.94910	8939	3.95129	8984	3.95347
8850	3.94694	8895	3.94915	8940	3.95134	8985	3.95352
8851	3.94699	8896	3.94919	8941	3.95139	8986	3.95357
8852	3.94704	8897	3.94924	8942	3.95143	8987	3.95361
8853	3.94709	8898	3.94929	8943	3.95148	8988	3.95366
8854	3.94714	8899	3.94934	8944	3.95153	8989	3.95371
8855	3.94719	8900	3.94939	8945	3.95158	8990	3.95376
8856	3.94724	8901	3.94944	8946	3.95163	8991	3.95381
8857	3.94729	8902	3.94949	8947	3.95168	8992	3.95386
8858	3.94734	8903	3.94954	8948	3.95173	8993	3.9[illegible]90
88[illegible]	3.94738	8904	3.94959	8949	3.95177	8994	3.95395
8860	3.94743	8905	3.94963	8950	3.95182	8995	3.95400
8861	3.94748	890[illegible]	[illegible].94968	8951	3.95187	8996	3.95405
8862	3.94753	8907	3.94973	8952	3.95192	8997	3.95410
8863	3.94758	8908	3.94978	8953	3.95197	8998	3.95415
8864	3.94763	8909	3.94983	8954	3.95202	8999	3.95419
8865	3.94768	8910	3.94988	8955	3.95207	9000	3.95424

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
9001	3.95429	9046	3.95646	9091	3.95861	9136	3.96076
9002	3.95434	9047	3.95650	9092	3.95866	9137	3.96080
9003	3.95439	9048	3.95655	9093	3.95871	9138	3.96085
9004	3.95444	9049	3.95660	9094	3.95875	9139	3.96090
9005	3.95448	9050	3.95665	9095	3.95880	9140	3.96095
9006	3.95453	9051	3.95670	9096	3.95885	9141	3.96099
9007	3.95458	9052	3.95675	9097	3.95890	9142	3.96104
9008	3.95463	9053	3.95679	9098	3.95895	9143	3.96109
9009	3.95468	9054	3.95684	9099	3.95899	9144	[illegible]
9010	3.95472	9055	3.95689	9100	3.95904	9145	3.96118
9011	3.95477	9056	3.95694	9101	3.95909	9146	3.96123
9012	3.95482	9057	3.95698	9102	[illegible]	9147	3.96128
9013	3.95487	9058	3.95703	9103	3.95918	9148	3.96133
9014	3.95492	9059	3.95708	9104	3.95923	9149	3.96137
9015	3.95497	9060	3.95713	9105	3.95928	9150	3.96142
9016	3.95501	9061	3.95718	9106	3.95933	9151	3.96147
9017	3.95506	9062	3.95722	9107	3.95938	9152	3.96152
9018	3.95511	9063	3.95727	9108	3.95942	9153	3.96156
9019	3.95516	9064	3.95732	9109	3.95947	9154	3.96161
9020	3.95521	9065	3.95737	9110	3.95952	9155	3.96166
9021	3.95525	9066	3.95742	9111	3.95957	9156	3.96171
9022	3.95530	9067	3.95746	9112	3.95961	9157	3.96175
9023	3.95535	9068	3.95751	9113	3.95966	9158	3.96180
9024	3.95540	9069	3.95756	9114	3.95971	9159	3.96185
9025	3.95545	9070	3.95761	9115	3.95976	9160	3.96190
9026	3.95550	9071	3.95766	9116	3.95980	9161	3.96194
9027	3.95554	9072	3.95770	9117	3.95985	9162	3.96199
9028	3.95559	9073	3.95775	9118	3.95990	9163	3.96204
9029	3.95564	9074	3.95780	9119	3.95995	9164	3.96209
9030	3.95569	9075	3.95785	9120	3.95999	9165	3.96213
9031	3.95574	9076	3.95789	9121	3.96004	9166	3.96218
9032	3.95578	9077	3.95794	9122	3.96009	9167	3.96223
9033	3.95583	9078	3.95799	9123	3.96014	9168	3.96227
9034	3.95588	9079	3.95804	9124	3.96019	9169	3.96232
9035	3.95593	9080	3.95809	9125	3.96023	9170	3.96237
9036	3.95598	9081	3.95813	9126	3.96028	9171	3.96242
9037	3.95602	9082	3.95818	9127	3.96033	9172	3.96246
9038	3.95607	9083	3.95823	9128	3.96038	9173	3.96251
9039	3.95612	9084	3.95828	9129	3.96042	9174	3.96256
9040	3.95617	9085	3.95832	9130	3.96047	9175	3.96261
9041	3.95622	9086	3.95837	9131	3.96052	9176	3.96265
9042	3.95626	9087	3.95842	9132	3.96057	9177	3.96270
9043	3.95631	9088	3.95847	9133	3.96061	9178	3.96275
9044	3.95636	9089	3.95852	9134	3.96066	9179	3.96280
9045	3.95641	9090	3.95856	9135	3.96071	9180	3.96284

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
9181	3.96289	9226	3.96501	9271	3.96713	931[illegible]	3.96923
9182	3.96294	9227	3.96506	9272	3.96717	9317	3.96928
9183	3.96298	9228	3.96511	9273	3.96722	9318	3.96932
9184	3.96303	9229	3.96515	9274	3.96727	9319	3.96937
9185	3.9[illegible]308	923[illegible]	3.96520	9275	[illegible].96731	9320	3.96942
9186	3.963[illegible]3	9231	3.96525	9276	[illegible].96736	9321	3.96946
9187	3.963[illegible]	9232	3.96530	9277	3.96741	9322	3.96951
9188	3.9632[illegible]	923[illegible]	3.96534	9278	3.96745	9323	3.96956
9189	[illegible]7	9234	3.96539	9279	3.96750	9324	3.96960
9190	3.963[illegible]	[illegible]35	3.96544	9280	3.96755	9325	3.96965
9191	3.96336	92[illegible]6	3.96548	9281	3.96759	9326	3.96970
9192	3.96341	9237	[illegible]553	9282	3.96764	9327	3.96974
9193	3.96346	9238	3.96558	9283	3.96769	9328	3.96979
9194	3.96350	9239	3.96563	9284	3.96774	9329	3.96984
9195	3.96355	9240	3.96567	9285	3.967[illegible]8	9330	3.96988
9196	3.96360	9241	3.96572	9286	3.96783	9331	3.96993
9197	3.96365	9242	3.96577	9287	3.96788	9332	3.96997
9198	3.96369	9243	3.96581	9288	3.96792	9333	3.97002
9199	3.96[illegible]74	9244	3.96586	9289	3.96797	9334	3.97007
9200	3.96379	9245	3.96591	9290	3.96802	9335	3.97011
9201	3.96384	9246	3.96595	9291	3.96806	9336	3.97016
9202	3.96388	9247	3.96600	9292	3.96811	9337	3.97021
9203	3.96393	9248	3.96605	9293	3.96816	9338	3.97025
9204	3.96398	9249	3.96609	9294	3.96820	9339	3.97030
9205	3.96402	9250	3.96614	9295	3.96825	9540	3.97035
9206	3.96407	9251	3.96619	9296	3.96830	9341	3.97039
9207	3.96412	9252	3.96624	9297	3.96834	9342	3.97044
9208	3.96417	9253	3.96628	9298	3.96839	9343	3.97049
9209	3.96421	9254	3.96633	6299	3.96844	9344	3.97053
9210	3.96426	9255	3.96638	9300	3.96848	9345	3.97058
9211	3.96431	9256	3.96642	9301	3.96853	9346	3.97063
9212	3.96435	9257	3.96647	9302	3.96858	9347	3.97067
9213	3.96440	9258	3.96652	9303	3.96862	9348	3.97072
9214	3.96445	9259	3.96656	9304	3.96867	9349	3.97077
9215	3.96450	9260	3.96661	9305	3.96872	9350	3.97081
9216	3.96454	9261	3.96666	9306	3.96876	9351	3.97086
9217	3.96459	9262	3.96670	9307	3.96881	9352	3.97090
9218	3.96464	9263	3.96675	9308	3.96886	9353	3.97095
9219	3.96468	9264	3.96680	9309	3.96890	9354	3.97100
9220	3.96473	9265	3.96[illegible]	9310	3.96895	9355	3.97104
9221	3.96478	9266	3.95689	9311	3.96900	9356	3.97109
9222	3.96483	9267	3.96694	9312	3.96904	9357	3.97114
9223	3.96487	9268	3.96699	9313	3.96909	9358	3.97118
9224	3.96492	9269	3.96703	9314	3.96914	9359	3.97123
9225	3.96497	9270	3.96708	9315	3.96918	9360	3.97128

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
9361	3.97132	9406	3.97341	9451	3.97548	9496	3.97754
9362	3.97137	9407	3.97345	9452	3.97552	9497	3.97759
9363	3.97142	9408	3.97350	9453	3.97557	9498	3.97763
9364	3.97146	9409	3.97354	9454	3.97562	9499	3.97768
9365	3.97151	9410	3.97359	9455	3.97566	9500	3.97772
9366	3.97155	9411	3.973[illegible]4	9456	3.9757[illegible]	9501	3.[illegible]7777
9367	3.97160	9412	3.97368	9457	3.97575	9502	[illegible].97782
9368	3.97165	9413	3.97373	9458	3.97580	9503	[illegible].97786
9369	3.97169	9414	3.97377	9459	3.97585	950[illegible]	3.97791
9370	3.97174	9415	3.97382	9460	3.97589	[illegible]05	[illegible]
9371	3.97179	9416	3.97387	9461	3.97594	[illegible]	[illegible].97800
9372	3.97183	9417	3.97391	9462	3.97598	9507	3.97804
9373	3.97188	9418	3.97396	9463	3.97[illegible]	9508	3.97809
9374	3.97192	9419	3.97400	9464	3.97607	9509	3.97813
9375	3.97197	9420	3.97405	9465	3.97612	9510	3.97818
9376	3.97202	9421	3.97410	9466	3.97617	9511	3.97823
9377	3.97206	9422	3.97414	9467	3.97621	9512	3.97827
9378	3.97211	9423	3.97419	9468	3.97626	9513	3.97832
9379	3.97216	9424	3.97424	9469	3.97630	9514	3.97836
9380	3.97220	9425	3.97428	9470	3.97635	9515	3.97841
9381	3.97225	9426	3.97453	9471	3.97640	9516	3.97845
9382	3.97230	9427	3.97437	9472	3.97644	9517	3.97850
9383	3.97234	9428	3.97442	9473	3.97649	9518	3.97855
9384	3.97239	9429	3.97447	9474	3.97653	9519	3.97859
9385	3.97243	9430	3.97451	9475	3.97658	9520	3.97864
9386	3.97248	9431	3.97456	9476	3.97663	9521	3.97868
9387	3.97253	9432	3.97460	9477	3.97667	9522	3.97873
9388	3.97257	9433	3.97465	9478	3.97672	9523	3.97877
9389	3.97262	9434	3.97470	9479	3.97676	9524	3.97882
9390	3.97267	9435	3.97474	9480	3.97681	9525	3.97887
9391	3.97271	9436	3.97479	9481	3.97685	9526	3.97891
9392	3.97276	9437	3.97483	9482	3.97690	9527	3.97896
9393	3.97280	9438	3.97488	9483	3.97695	9528	3.97900
9394	3.97285	9439	3.97493	9484	3.97699	9529	3.97905
9395	3.97290	9440	3.97497	9485	3.97704	9530	3.97909
9396	3.97294	9441	3.97502	9486	3.97708	9531	3.97914
9397	3.97299	9442	3.97506	9487	3.97713	9532	3.97918
9398	3.97304	9443	3.97511	9488	3.97717	9533	3.97923
9399	3.97308	9444	3.97516	9489	3.97722	9534	3.97928
9400	3.97313	9445	3.97520	9490	3.97727	9535	3.97932
9401	3.97317	9446	3.97525	9491	[illegible]	9536	3.97937
9402	3.97322	9447	3.97529	9492	3.97736	9537	3.97941
9403	3.97327	9448	3.97534	9493	3.97740	9538	3.97946
9404	3.97331	9449	3.97539	9494	3.97745	9539	3.97950
9405	3.97336	9450	3.97543	9495	3.97750	9540	3.97955

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
9541	3.97959	9586	3.98164	9631	[illegible]	9676	3.98570
9542	3.97964	9587	3.98168	9632	3.98372	[illegible]77	3.98574
9543	3.97968	9588	3.98173	9633	3.98376	9678	3.98579
9544	3.97973	9589	3.98177	9634	3.98381	9679	3.98583
9545	3.97978	9590	3.98182	9635	3.98385	9680	3.98588
9546	3.[illegible]7982	9591	3.98186	9636	3.98390	9681	3.98592
9547	3.9[illegible]987	9592	3.98191	9637	3.98394	9682	3.98597
9548	3.97[illegible]91	9593	3.98195	9638	3.98399	9683	3.98601
9549	3.979[illegible]6	9594	3.98200	9639	3.98403	9684	3.98605
95[illegible]	[illegible]	9595	3.98205	9640	3.98408	9685	3.98610
9551	3.980[illegible]	9596	3.98209	9641	3.98412	9686	3.98614
9552	3.98009	[illegible]7	3.98214	9642	3.98417	9687	3.98619
9553	3.98014	959[illegible]	[illegible]98218	9643	3.98421	9688	3.98623
9554	3.98019	9599	3.98223	9644	3.98426	9689	3.98628
9555	3.98023	9600	3.98227	9645	3.98430	9690	3.98632
9556	3.98028	9601	3.98232	9646	3.98435	9691	3.98637
9557	3.98032	9602	3.98236	9647	3.98439	9692	3.98641
9558	3.98037	9603	3.98241	9648	3.98444	9693	3.98646
9559	3.98041	9604	3.98245	9649	3.98448	9694	3.98650
9560	3.98046	9605	3.98250	9650	3.98453	9695	3.98655
9561	3.98050	9606	3.98254	9651	3.98457	9696	3.98659
9562	3.98055	9607	3.98259	9652	3.98462	9697	3.98664
9563	3.98059	9608	3.98263	9653	3.98466	9698	3.98668
9564	3.98064	9609	3.98268	9654	3.98471	9699	3.98673
9565	3.98069	9610	3.98272	9655	3.98475	9700	3.98677
9566	3.98073	9611	3.98277	9656	3.98480	9701	3.98682
9567	3.98078	9612	3.98281	9657	3.98484	9702	3.98686
9568	3.98082	9613	3.98286	9658	3.98489	9703	3.98691
9569	3.98087	9614	3.98290	9659	3.98493	9704	3.98695
9570	3.98091	9615	3.98295	9660	3.98498	9705	3.98700
9571	3.98096	9616	3.98299	9661	3.98502	9706	3.98704
9572	3.98100	9617	3.98304	9662	3.98507	9707	3.98709
9573	3.98105	9618	3.98308	9663	3.98511	9708	3.98713
9574	3.98109	9619	3.98313	9664	3.98516	9709	3.98717
9575	3.98114	9620	3.98318	9665	3.98520	9710	3.98722
9576	3.98118	9621	3.98322	9666	3.98525	9711	3.98726
9577	3.98123	9622	3.98327	9667	3.98529	9712	3.98731
9578	3.98127	9623	3.98331	9668	3.98534	9713	3.987[illegible]5
9579	3.98132	9624	3.98336	9669	3.98538	9714	3.98740
9580	3.98137	9625	3.98340	9670	3.98543	9715	3.98744
9581	3.98141	9626	3.98345	9671	3.98547	9716	3.98749
9582	3.98146	9627	3.98349	9672	3.98552	9717	3.98753
9583	3.98150	9628	3.98354	9673	3.98556	9718	3.98758
9584	3.98155	9629	3.98358	9674	3.98561	9719	3.98762
9585	3.98159	9630	3.98363	9675	3.98565	9720	3.98767

9721

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
9721	3.98771	9766	3.98972	9811	3.99171	9856	3.99370
9722	3.98776	9767	3.98976	9812	3.99176	9857	3.99374
9723	3.98780	9768	3.98981	9813	3.99180	9858	3.99379
9724	3.98784	9769	3.98985	9814	3.99185	9859	3.99383
9725	3.98789	9770	3.98989	9815	3.99189	9860	3.99388
9726	3.98793	9771	3.98994	9816	3.9919[illegible]	9861	3.99392
9727	3.98798	9772	3.98998	9817	3.99198	9862	3.99397
9728	3.98802	9773	3.99003	9818	3.99202	9863	3.99401
9729	3.98807	9774	3.99007	9819	3.99207	9864	3.99405
9730	3.98811	9775	3.99012	9820	3.99211	9865	3.99410
9731	3.98816	9776	3.99016	9821	3.99216	9866	3.99414
9732	3.98820	9777	3.99021	9822	3.992[illegible]	9867	3.99419
9733	3.98825	9778	3.99025	9823	3.99224	9868	3.99423
9734	3.98829	9779	3.99029	9824	3.99229	9869	3.99427
9735	3.98834	9780	3.99034	9825	3.99233	9870	3.99432
9736	3.98838	9781	3.99038	9826	3.99238	9871	3.99436
9737	3.98843	9782	3.99043	9827	3.99242	9872	3.99441
9738	3.98847	9783	3.99047	9828	3.99247	9873	3.99445
9739	3.98851	9784	3.99052	9829	3.99251	9874	3.99449
9740	3.98856	9785	3.99056	9830	3.99255	9875	3.99454
9741	3.98860	9786	3.99061	9831	3.99260	9876	3.99458
9742	3.98865	9787	3.99065	9832	3.99264	9877	3.99463
9743	3.98869	9788	3.99069	9833	3.99269	9878	3.99467
9744	3.98874	9789	3.99074	9834	3.99273	9879	3.99471
9745	3.98878	9790	3.99078	9835	3.99277	9880	3.99476
9746	3.98883	9791	3.99083	9836	3.99282	9881	3.99480
9747	3.9888[illegible]	9792	3.99087	9837	3.99286	9882	3.99484
9748	3.98892	9793	3.99092	9838	3.99291	9883	3.99489
9749	3.98896	9794	3.99096	9839	3.99295	9884	3.99493
9750	3.98900	9795	3.99100	9840	3.99300	9885	3.99498
9751	3.98905	9796	3.99105	9841	3.99304	9886	3.99502
9752	3.98909	9797	3.99109	9842	3.99308	9887	3.99506
9753	3.98914	9798	3.99114	9843	3.99313	9888	3.99511
9754	3.98918	9799	3.99118	9344	3.99317	9889	3.99515
9755	3.98922	9800	3.99123	9845	3.99322	9890	3.99520
9756	3.98927	9801	3.99127	9846	3.99326	9891	3.99524
9757	3.98932	9802	3.99131	9847	3.99330	9892	3.99528
9758	3.98936	9803	3.99136	9848	3.99335	9893	3.99533
9759	3.98941	9804	3.99140	9849	3.99339	9894	3.99537
9760	3.98945	9805	3.99145	9850	[illegible]	9895	3.99542
9761	3.98949	9806	3.99149	9851	3.99348	9896	3.99546
9762	3.98954	9807	3.99154	9852	3.99352	9897	3.99550
9763	3.98958	9808	3.99158	9853	3.99357	9898	3.99555
9764	3.98963	9809	3.99162	9854	3.99361	9899	3.99559
9765	3.98967	9810	3.99167	9855	3.99366	9900	3.99564

N.	Logar.	N.	Logar.	N.	Logar.	N.	Logar.
[illegible]	[illegible]	9926	3.99677	9951	3.99787	9976	3.99896
[illegible]	3.99572	9927	3.99682	9952	3.99791	9977	3.99900
9903	3.99577	9928	3.99686	9953	3.99795	9978	3.99904
9904	3.99581	9929	3.99691	9954	3.99800	9979	3.99909
9905	3.99585	9930	3.99695	9955	3.99804	9980	3.99913
9906	3.99590	9931	3.99699	9956	3.99808	9981	3.99917
9907	3.99594	9932	3.99704	9957	3.99813	9982	3.99922
9908	[illegible]	9933	3.99708	9958	3.99817	9983	3.99926
9909	3.99603	9934	3.99712	9959	3.99822	9984	3.99930
9910	3.99[illegible]	9935	3.99717	9960	3.99826	9985	3.99935
9911	3.99612	9936	3.99721	9961	3.99830	9986	3.99939
9912	3.99616	9937	3.99726	9962	3.99835	9987	3.99944
9913	3.99621	9938	3.99730	9963	3.99839	9988	3.99948
9914	3.99625	9939	3.99734	9964	3.99843	9989	3.99952
9915	3.99629	9940	3.99739	9965	3.99848	9990	3.99957
9916	3.99634	9941	3.99743	9966	3.99852	9991	3.99961
9917	3.99638	9942	3.99747	9967	3.99856	9992	3.99965
9918	3.99642	9943	3.99752	9968	3.99861	9993	3.99970
9919	3.99647	9944	3.99756	9969	3.99865	9994	3.99974
9920	3.99651	9945	3.99760	9970	3.99870	9995	3.99978
9921	3.99656	9946	3.99765	9971	3.99874	9996	3.99983
9922	3.99660	9947	3.99769	9972	3.99878	9997	3.99987
9923	3.99664	9948	3.99774	9973	3.99883	9998	3.99991
9924	3.99669	9949	3.99778	9974	3.99887	9999	3.99996
9925	3.99673	9950	3.99782	9975	3.99891	10000	4.00000

Th. Logarithm of a Fraction, being a Decimal, is the same wi... of an integer; only the Index is negative, and is so much less than o, as ... Place of the Decimal is removed from Unity, and these Indices may be dist... guish-ed from the Absol... ones, by setting a Negative Sign over them.

As for Ex...	Indices	3	2	$\bar{1}$	0	$\bar{9}$	...
	Numbers	7	6	7	6	2	7

Here the fi... Place of Decimal has for its Index $\bar{9}$, of the second ... of the third $\bar{7}$.

Another Exampl.	4568.	3.65973
	456.8	2.65973
	45.68	1.65973
	4.568	0.65973
	.4568	$\bar{9}$.65973
	.04568	$\bar{8}$.65973
	.004568	$\bar{7}$.65937

N. B. The Logarithm is the sa...e, only the Index d...ffers according to ...e V... of the left... and F...gure of the gi... Number.

To find the Logarithm of a Vulgar Fraction; Subtract the Logarithm of the Denominator out of the Logarithm of the Numerator, the Remainder is the Logarithm of a Decimal equivalent to the Vulgar-Fraction. *Example* $\frac{3}{4}$.

3	0.47712
4	0.60206
75	$\bar{9}$.87506

The Operation of Decimal Fractions is the same as of whole Numbers, both in Natural and Logarithmical Arithmetic, remembring these 3 Cautions. 1. If we are to substract a greater Logarithm out of a less we add 10 to the Index of the less, and 2. If the Logarithm which answers the Question (whether be Sum, Remainder, Half, Third, *&c.*) if the Index be Ten, Twenty, *&c.* neglect or cancel the said Figure in the Place of Tens in the Characteristic. Lastly, In extracting the Square Root of a Decimal, add 10 to its Index, and then halve it, and in extracting the Cube Root add 20 to its Index, and then take its third aud in finding a mean between two Numbers, (if one be a Decimal and the Sum of the Indices be 10) reject 10, and halve the rest; but if it be not 10, add 10 to it, and then halve it.

In Arithmetical Operations of Cases of *Trigonometry*, where Radius is not concerned, the Work may be abbreviated by taking the Arithmetical Complement of the Logarithm of the first term) which is found by taking the Remainder of each Figure to 9, only that on the right hand to 10) and adding it to the Logarithms of the second and third Terms, the Sum abating Radius is the fourth Term required.

To find 2 or more Proportionals between 2 Numbers: Subtract the Logarithm of the less Number out of the Logarithm of the greater, the Remainder divide by a Number greater by one, than the Number of Means sought as here by 4 for three Means.

Example 12. and 25.

The Quotient added to the Logarithm of the lesser Number, the Sum is the Logarithm of the first Mean, to which adding again the said Quotient the Sum is the Logarithm of the second Mean, and so forward for as many Means as the Quotient was at first order'd for.

	12	1.07918
	.25	$\bar{9}$.39794
		1.68124
	$\frac{1}{4}$ Diff.	$\bar{4}$2031
		$\bar{9}$.39794
1st. Mean	.658	$\bar{9}$.81825
		42031
2d. Mean	1.732	10.23856
		42031
3d. Mean	4.556	0.65887

A

TABLE

OF

Artificial SINES, TANGENTS and SECANTS, the Radius 10.00000; and to every Degree and Minute of the *Quadrant*.

A Table of Artificial Sines,

0 Degree.

Min.	Sine.		Tang.		Secant.		
0	0.00000	0.00000	0.00000	Infinite.	10.00000	Infinite	60
1	6.46373	9.99999	6.46373	13.53627	10.00001	13.53627	59
2	6.76476	9.99999	6.76476	13.23524	10.00001	13.23524	58
3	6.94085	9.99999	6.94085	13.05915	10.00001	13.05915	57
4	7.06579	9.99999	7.06579	12.93421	10.00001	12.93421	56
5	7.16270	9.99999	7.16270	12.83730	10.00001	12.83730	55
6	7.24188	9.99999	7.24188	12.75812	10.00001	12.75812	54
7	7.30882	9.99999	7.30883	12.69118	10.00001	12.69118	53
8	7.36682	9.99999	7.36682	12.63318	10.00001	12.63318	52
9	7.41797	9.99999	7.41797	12.58203	10.00001	12.58203	51
10	7.46373	9.99999	7.46373	12.53627	10.00001	12.53627	50
11	7.50512	9.99999	7.50512	12.49488	10.00001	12.49488	49
12	7.54291	9.99999	7.54291	12.45709	10.00001	12.45709	48
13	7.57767	9.99999	7.57767	12.42233	10.00001	12.42233	47
14	7.60985	9.99999	7.60986	12.39014	10.00001	12.39015	46
15	7.63982	9.99999	7.63982	12.36018	10.00001	12.36018	45
16	7.66784	9.99999	7.66785	12.33215	10.00001	12.33216	44
17	7.69417	9.99999	7.69418	12.30582	10.00001	12.30583	43
18	7.71900	9.99999	7.71900	12.28100	10.00001	12.28100	42
19	7.74248	9.99999	7.74248	12.25752	10.00001	12.25752	41
20	7.76475	9.99999	7.76476	12.23524	10.00001	12.23525	40
21	7.78594	9.99999	7.78595	12.21405	10.00001	12.21406	39
22	7.80615	9.99999	7.80616	12.19385	10.00001	12.19385	38
23	7.82545	9.99999	7.82546	12.17454	10.00001	12.17455	37
24	7.84393	9.99999	7.84394	12.15606	10.00001	12.15607	36
25	7.86166	9.99999	7.86167	12.13833	10.00001	12.13834	35
26	7.87870	9.99999	7.87871	12.12129	10.00001	12.12131	34
27	7.89509	9.99999	7.89510	12.10490	10.00001	12.10492	33
28	7.91088	9.99999	7.91089	12.08911	10.00001	12.08912	32
29	7.92612	9.99998	7.92613	12.07387	10.00002	12.07388	31
30	7.94084	9.99998	7.94086	12.05914	10.00002	12.05916	30
		Sine.		Tang.		Secant	Min.

89. Degrees.

0 Degree.

Min.	Si[ne]		Tang.		Secant.		
30	7.94084	9.99998	7.94086	12.05914	10.00002	12.05916	30
31	7.95508	9.99998	7.95510	12.04490	10.00002	12.04492	29
32	7.96887	9.99998	7.96889	12.03111	10.00002	12.03113	28
33	7.98223	9.99998	7.98225	12.01775	10.00002	12.01777	27
34	7.99520	9.99998	7.99522	12.00478	10.00002	12.00480	26
35	8.00779	9.99998	8.00781	11.99219	10.00002	11.99221	25
36	8.02002	9.99998	8.02004	11.97996	10.00002	11.97998	24
37	8.03192	9.99998	8.03195	11.96806	10.00002	11.96808	23
38	8.04350	9.99997	8.04353	11.95647	10.00003	11.95650	22
39	8.05478	9.99997	8.05481	11.94519	10.00003	11.94522	21
40	8.06578	9.99997	8.06581	11.93419	10.00003	11.93422	20
41	8.07650	9.99997	8.07653	11.92347	10.00003	11.92350	19
42	8.08697	9.99997	8.08700	11.91300	10.00003	11.91304	18
43	8.09718	9.99997	8.09722	11.90278	10.00003	11.90282	17
44	8.10717	9.99996	8.10720	11.89280	10.00004	11.89283	16
45	8.11693	9.99996	8.11696	11.88304	10.00004	11.88307	15
46	8.12647	9.99996	8.12651	11.87349	10.00004	11.87353	14
47	8.13581	9.99996	8.13585	11.86415	10.00004	11.86419	13
48	8.14495	9.99996	8.14500	11.85500	10.00004	11.85505	12
49	8.15391	9.99996	8.15395	11.84605	10.00004	11.84609	11
50	8.16268	9.99995	8.16273	11.83727	10.00005	11.83732	10
51	8.17128	9.99995	8.17133	11.82867	10.00005	11.82872	9
52	8.17971	9.99995	8.17976	11.82024	10.00005	11.82029	8
53	8.18799	9.99995	8.18804	11.81196	10.00005	11.81202	7
54	8.19610	9.99995	8.19616	11.80384	10.00005	11.80390	6
55	8.20407	9.99994	8.20413	11.79587	10.00006	11.79593	5
56	8.21190	9.99994	8.21195	11.78805	10.00006	11.78811	4
57	8.21958	9.99994	8.21964	11.78036	10.00006	11.78042	3
58	8.22713	9.99994	8.22720	11.77281	10.00006	11.77287	2
59	8.23456	9.99994	8.23462	11.76538	10.00006	11.76544	1
60	8.24186	9.99993	8.24192	11.75808	10.00007	11.75815	0
		Sine.		Tang.		Secant.	Min.

89 Degrees.

A Table of Artificial Sines

1 Degree.

Min.	Sine.		Tang.		Secant.		
0	8.24186	9.99993	8.24192	11.75808	10.00007	11.75815	60
1	8.24903	9.99993	8.24910	11.75090	10.00007	11.75097	59
2	8.25609	9.99993	8.25617	11.74384	10.00007	11.74391	58
3	8.26304	9.99993	8.26312	11.73689	10.00007	11.73696	57
4	8.26988	9.99993	8.26996	11.73004	10.00007	11.73012	56
5	8.27661	9.99992	8.27669	11.72331	10.00008	11.72339	55
6	8.28324	9.99992	8.28332	11.71668	10.00008	11.71676	54
7	8.28977	9.99992	8.28986	11.71014	10.00008	11.71023	53
8	8.29621	9.99992	8.29629	11.70371	10.00008	11.70379	52
9	8.30255	9.99991	8.30263	11.69737	10.00009	11.69745	51
10	8.30879	9.99991	8.30888	11.69112	10.00009	11.69121	50
11	8.31495	9.99991	8.31505	11.68495	10.00009	11.68505	49
12	8.32103	9.99991	8.32112	11.67888	10.00009	11.67897	48
13	8.32702	9.99990	8.32711	11.67289	10.00010	11.67298	47
14	8.33292	9.99990	8.33303	11.66698	10.00010	11.66708	46
15	8.33875	9.99990	8.33886	11.66114	10.00010	11.66125	45
16	8.34450	9.99989	8.34461	11.65539	10.00011	11.65550	44
17	8.35018	9.99989	8.35029	11.64971	10.00011	11.64982	43
18	8.35578	9.99989	8.35590	11.64411	10.00011	11.64422	42
19	8.36132	9.99989	8.36143	11.63857	10.00011	11.63869	41
20	8.36678	9.99988	8.36689	11.63311	10.00012	11.63322	40
21	8.37217	9.99988	8.37229	11.62771	10.00012	11.62783	39
22	8.37750	9.99988	8.37762	11.62238	10.00012	11.62250	38
23	8.38276	9.99987	8.38289	11.61711	10.00013	11.61724	37
24	8.38796	9.99987	8.38809	11.61191	10.00013	11.61204	36
25	8.39310	9.99987	8.39323	11.60677	10.00013	11.60690	35
26	8.39818	9.99986	8.39832	11.60169	10.00014	11.60182	34
27	8.40320	9.99986	8.40334	11.59666	10.00014	11.59680	33
28	8.40816	9.99986	8.40830	11.59170	10.00014	11.59184	32
29	8.41307	9.99985	8.41321	11.58679	10.00015	11.58693	31
30	8.41792	9.99985	8.41807	11.58193	10.00015	11.58208	30
		Sine.		Tang.		Secant.	Min.

88 Degrees.

1 Degrees.

Min.	Sine.		Tang.		Secant.		
30	8.41792	9.99985	8.41807	11.58193	10.00015	11.58208	30
31	8.42272	9.99985	8.42287	11.57713	10.00015	11.57728	29
32	8.42746	9.99984	8.42762	11.57238	10.00016	11.57254	28
33	8.43216	9.99984	8.43232	11.56769	10.00016	11.56784	27
34	8.43680	9.99984	8.43696	11.56304	10.00016	11.56320	26
35	8.44139	9.99983	8.44156	11.55844	10.00017	11.55861	25
36	8.44594	9.99983	8.44611	11.55389	10.00017	11.55406	24
37	8.45044	9.99983	8.45061	11.54939	10.00017	11.54956	23
38	8.45489	9.99982	8.45507	11.54493	10.00018	11.54511	22
39	8.45930	9.99982	8.45948	11.54052	10.00018	11.54070	21
40	8.46366	9.99982	8.46385	11.53615	10.00018	11.53634	20
41	8.46799	9.99981	8.46817	11.53183	10.00019	11.53202	19
42	8.47226	9.99981	8.47245	11.52755	10.00019	11.52774	18
43	8.47650	9.99981	8.47669	11.52331	10.00019	11.52350	17
44	8.48069	9.99980	8.48089	11.51911	10.00020	11.51931	16
45	8.48485	9.99980	8.48505	11.51495	10.00020	11.51515	15
46	8.48896	9.99979	8.48917	11.51083	10.00021	11.51104	14
47	8.49304	9.99979	8.49325	11.50675	10.00021	11.50696	13
48	8.49708	9.99979	8.49729	11.50271	10.00021	11.50292	12
49	8.50108	9.99978	8.50130	11.49870	10.00022	11.49892	11
50	8.50505	9.99978	8.50527	11.49473	10.00022	11.49496	10
51	8.50897	9.99977	8.50920	11.49080	10.00023	11.49103	9
52	8.51287	9.99977	8.51310	11.48690	10.00023	11.48713	8
53	8.51673	9.99977	8.51696	11.48304	10.00023	11.48327	7
54	8.52055	9.99976	8.52079	11.47921	10.00024	11.47945	6
55	8.52434	9.99976	8.52459	11.47541	10.00024	11.47566	5
56	8.52810	9.99975	8.52835	11.47165	10.00025	11.47190	4
57	8.53183	9.99975	8.53208	11.46792	10.00025	11.46817	3
58	8.53552	9.99974	8.53578	11.46422	10.00026	11.4644[illegible]	2
59	8.53919	9.99974	8.53945	11.46055	10.00026	11.46081	1
60	8.54282	9.99974	8.54308	11.45692	10.00026	11.45718	0
		Sine.	Tang.			Secant.	Min.

88 Degrees.

A Table of Artificial Sines.

2 Degrees.

Min.	Sine.		Tang		Secant.		
0	8.54282	9.99974	8.54308	11.45692	10.00026	11.45718	60
1	8.54642	9.99973	8.54669	11.45331	10.00027	11.45358	59
2	8.55000	9.99973	8.55027	11.44973	10.00027	11.45001	58
3	8.55354	9.99972	8.55382	11.44618	10.00028	11.44646	57
4	8.55705	9.99972	8.55734	11.44266	10.00028	11.44295	56
5	8.56054	9.99971	8.56083	11.43917	10.00029	11.43946	55
6	8.56400	9.99970	8.56429	11.43571	10.00030	11.43600	54
7	8.56743	9.99970	8.56773	11.43227	10.00030	11.43257	53
8	8.57084	9.99970	8.57114	11.42886	10.00030	11.42916	52
9	8.57421	9.99969	8.57452	11.42548	10.00031	11.42579	51
10	8.57757	9.99969	8.57788	11.42212	10.00031	11.42243	50
11	8.58089	9.99968	8.58121	11.41879	10.00032	11.41911	49
12	8.58419	9.99968	8.58451	11.41549	10.00032	11.41581	48
13	8.58747	9.99968	8.58779	11.41221	10.00032	11.41253	47
14	8.59072	9.99967	8.59105	11.40895	10.00033	11.40928	46
15	8.59395	9.99967	8.59428	11.40572	10.00033	11.40605	45
16	8.59715	9.99966	8.59749	11.40251	10.00034	11.40285	44
17	8.60033	9.99966	8.60068	11.39932	10.00034	11.39967	43
18	8.60349	9.99965	8.60384	11.39616	10.00035	11.39651	42
19	8.60662	9.99965	8.60698	11.39302	10.00035	11.39338	41
20	8.60973	9.99964	8.61009	11.38991	10.00036	11.39027	40
21	8.61282	9.99964	8.61319	11.38681	10.00036	11.38718	39
22	8.61589	9.99963	8.61626	11.38374	10.00037	11.38411	38
23	8.61894	9.99962	8.61931	11.38069	10.00038	11.38106	37
24	8.62196	9.99962	8.62234	11.37766	10.00038	11.37804	36
25	8.62497	9.99961	8.62535	11.37465	10.00039	11.37504	35
26	8.62795	9.99960	8.62834	11.37166	10.00040	11.37205	34
27	8.63091	9.99960	8.63131	11.36869	10.00040	11.36909	33
28	8.63385	9.99960	8.63426	11.36574	10.00040	11.36615	32
29	8.63678	9.99960	8.63718	11.36282	10.00040	11.36322	31
30	8.63968	9.99959	8.64009	11.35991	10.00041	11.36032	30
		Sine.		Tang.		Secant.	Min.

87 Degrees.

2 Degrees.

Min.	Sine.		Tang.		Secant.		
30	8.63968	9.99959	8.64009	11.35991	10.00041	11.36032	30
31	8.64256	9.99958	8.64298	11.35702	10.00042	11.35744	29
32	8.64543	9.99958	8.64585	11.35415	10.00043	11.35457	28
33	8.64827	9.99957	8.64870	11.35130	10.00043	11.35173	27
34	8.65110	9.99956	8.65154	11.34846	10.00044	11.34890	26
35	8.65391	9.99956	8.65435	11.34565	10.00044	11.34609	25
36	8.65670	9.99955	8.65715	11.34285	10.00045	11.34330	24
37	8.65948	9.99955	8.65993	11.34007	10.00045	11.34053	23
38	8.66223	9.99954	8.66269	11.33731	10.00046	11.33777	22
39	8.66497	9.99954	8.66543	11.33457	10.00047	11.33503	21
40	8.66769	9.99953	8.66816	11.33184	10.00047	11.33231	20
41	8.67039	9.99952	8.67087	11.32913	10.00048	11.32961	19
42	8.67308	9.99952	8.67356	11.32644	10.00048	11.32692	18
43	8.67575	9.99951	8.67624	11.32376	10.00049	11.32425	17
44	8.67841	9.99951	8.67890	11.32110	10.00049	11.32160	16
45	8.68104	9.99950	8.68154	11.31846	10.00050	11.31896	15
46	8.68367	9.99949	8.68417	11.31583	10.00051	11.31634	14
47	8.68627	9.99949	8.68678	11.31322	10.00051	11.31373	13
48	8.68886	9.99948	8.68938	11.31062	10.00052	11.31114	12
49	8.69144	9.99948	8.69169	11.30804	10.00053	11.30857	11
50	8.69400	9.99947	8.69453	11.30547	10.00053	11.30600	10
51	8.69654	9.99946	8.69708	11.30292	10.00054	11.30346	9
52	8.69907	9.99946	8.69962	11.30038	10.00054	11.30093	8
53	8.70159	9.99945	8.70214	11.29786	10.00055	11.29841	7
54	8.70409	9.99944	8.70465	11.29535	10.00056	11.29591	6
55	8.70658	9.99944	8.70714	11.29286	10.00056	11.29342	5
56	8.70905	9.99943	8.70962	11.29038	10.00057	11.29095	4
57	8.71151	9.99942	8.71208	11.28792	10.00058	11.28849	3
58	8.71395	9.99942	8.71453	11.28547	10.00058	11.28605	2
59	8.71638	9.99941	8.71697	11.28303	10.00059	11.28362	1
60	8.71880	9.99940	8.71940	11.28060	10.00060	11.28120	0
		Sine.		Tang.		Secant.	Min.

87 Degrees.

A Table of Artificial Sines,

3 Degrees.

Min.	Sine.		Tang.		Secant.		
0	8.71880	9.99940	8.71940	11.28060	10.00060	11.[illegible]120	60
1	8.72120	9.99940	8.72181	11.27819	10.00060	11.27880	59
2	8.72360	9.99939	8.72420	11.27580	10.00061	11.27641	58
3	8.72597	9.99938	8.72659	11.27341	10.00062	11.27403	57
4	8.72834	9.99938	8.72896	11.27104	10.00062	11.27166	56
5	8.73069	9.99937	8.73132	11.26868	10.00063	11.26931	55
6	8.73303	9.99936	8.73366	11.26634	10.00064	11.26697	54
7	8.73535	9.99936	8.73600	11.26400	10.00064	11.26465	53
8	8.73767	9.99935	8.73832	11.26168	10.00065	11.26233	52
9	8.73997	9.99934	8.74063	11.25937	10.00066	11.26003	51
10	8.74226	9.99934	8.74292	11.25708	10.00066	11.25774	50
11	8.74454	9.99933	8.74521	11.25479	10.00067	11.25546	49
12	8.74680	9.99932	8.74748	11.25252	10.00068	11.25320	48
13	8.74906	9.99932	8.74974	11.25026	10.00069	11.25095	47
14	8.75130	9.99931	8.75199	11.24801	10.00069	11.24870	46
15	8.75353	9.99930	8.75423	11.24577	10.00070	11.24647	45
16	8.75575	9.99929	8.75645	11.24355	10.00071	11.24425	44
17	8.75796	9.99929	8.75867	11.24133	10.00071	11.24205	43
18	8.76015	9.99928	8.76087	11.23913	10.00072	11.23985	42
19	8.76234	9.99927	8.76307	11.23694	10.00073	11.23766	41
20	8.76451	9.99927	8.76525	11.23475	10.00074	11.23549	40
21	8.76668	9.99926	8.76742	11.23258	10.00074	11.23333	39
22	8.76883	9.99925	8.76958	11.23042	10.00075	11.23117	38
23	8.77097	9.99924	8.77173	11.22827	10.00076	11.22903	37
24	8.77310	9.99924	8.77387	11.22613	10.00077	11.22690	36
25	8.77522	9.99923	8.77600	11.22401	10.00077	11.22478	35
26	8.77733	9.99922	8.77811	11.22189	10.00078	11.22267	34
27	8.77943	9.99921	8.78022	11.21978	10.00079	11.22057	33
28	8.78152	9.99921	8.78232	11.21768	10.00080	11.21848	32
29	8.78361	9.99920	8.78441	11.21559	10.00080	11.21640	31
30	8.78568	9.99919	8.78649	11.21351	10.00081	11.21433	30
		Sine.		Tang.		Secant.	Min.

86 Degrees.

Tangents and Secants.

3 *Degrees.*

Min.	Sine.		Tang.		Secant.		
30	8.78568	9.99919	8.78649	11.21351	10.00081	11.21433	30
31	8.78774	9.99918	8.78855	11.21145	10,00082	11.21226	29
32	8.78979	9.99917	8.79061	11.20939	10.00083	11.21021	28
33	8.79183	9.99917	8.79266	11.20734	10.00083	11.20817	27
34	8.79386	9.99916	8.79470	11.20530	10.00084	11.20614	26
35	8.79588	9.99915	8.79673	11.20327	10.00085	11.20412	25
36	8.79789	9.99914	8.79875	11.20125	10.00086	11.20211	24
37	8.79990	9.99913	8.80076	11.19924	10.00087	11.20010	23
38	8.80189	9.99913	8.80277	11.19724	10,00087	11.19811	22
39	8.80388	9.99912	8.80476	11.19524	10.00088	11.19612	21
40	8.80585	9.99911	8.80674	11.19326	10.00089	11.19415	20
41	8.80782	9.99910	8,80872	11.19128	10.00090	11.19218	19
42	8.80978	9.99909	8.81068	11.18932	10.00091	11.19022	18
43	8.81173	9.99909	8.81264	11.18736	10.00091	11.18827	17
44	8.81367	9.99908	8.81459	11.18541	10.00092	11.18633	16
45	8.81560	9.99907	8.81653	11.18347	10.00094	11.18440	15
46	8.81752	9.99906	8.81846	11.18154	10.00094	11.18248	14
47	8.81944	9.99905	8.82038	11.17962	10.00095	11.18056	13
48	8.82134	9.99904	8.82230	11.17770	10.00096	11.17866	12
49	8.82324	9.99904	8.82421	11.17580	10.00096	11.17676	11
50	8.82513	9.99903	8.82610	11.17390	10.00097	11.17487	10
51	8.82701	9.99902	8.82799	11.17201	10.00298	11.17299	9
52	8.82888	9.99901	8.82987	11.17013	10.00099	11.17112	8
53	8.83075	9.99900	8.83175	11.16825	10.00100	11.16925	7
54	8.83261	9.99899	8.83361	11.16630	10.00101	11.16739	6
55	8.83446	9.99898	8.83547	11.16453	10.00102	11.16554	5
56	8.83630	9.99898	8.83732	11.16268	10.00102	11.16370	4
57	8.83813	9.99897	8.83916	11.16084	10.00103	11.16187	3
58	8.83996	9.99896	8.84100	11.15900	10.00104	11.16004	2
59	8.84177	9.99895	8.84282	11.15718	10.00105	11.15823	1
60	8.84358	9.99894	8.84464	11.15536	10.00106	11.15642	0
		Sine.		Tang.		Secant.	Min.

86 *Degrees.*

A Table of Artificial Sines,

4 Degrees.

Min.	Sine.		Tang:		Secant.		
0	8.84358	9.99894	8.84464	11.15536	10.00106	11.[illegible]3642	60
1	8.84539	9.99893	8.84646	11.15355	10.00107	11.15461	59
2	8.84718	9.99892	8.84826	11.15174	10.00108	11.15282	58
3	8.84897	9.99891	8.85006	11.14994	10.00109	11.15103	57
4	8.85075	9.99891	8.85185	11.14815	10.00110	11 14925	56
5	8.85252	9.99890	8.85363	11.14637	10.00110	11.14748	55
6	8.85429	9.99889	8.8[illegible]540	11.14460	10.00111	11.14571	54
7	8.85605	9.998[illegible]	8.8[illegible]717	11.14283	10.00112	11.14395	53
8	8 85780	9.[illegible]9887	8.85893	11 14107	10.00113	11.14220	52
9	8.85995	9.9[illegible]886	8.86069	11.13931	10.00114	11.14055	51
10	8.86128	9.99885	8.8624[illegible]	11.13757	10.00115	11.13872	50
11	8 86301	9 99884	8.86417	11.13583	10.00116	11.13699	49
12	8.86474	9.99883	8.86591	11.13409	10.00117	11.13526	48
13	8.86645	9 99882	8.86763	11.13237	10.00118	11.13355	47
14	8.86815	9.99881	8.86935	11.13065	10.00119	11.13184	46
15	8.86987	9.99880	8.87106	11.12894	10.00120	11.13013	45
16	8.87157	9.99880	8.87277	11.12723	10.00121	11 12844	44
17	8.87326	9.99879	8.87447	11.12553	10.00122	11.12675	43
18	8.87494	9.99878	8.87616	11.12384	10.00122	11.12506	42
19	8.87662	9.99877	8.87785	11.12215	10.00123	11.12339	41
20	8.87829	9.99876	8.87953	11.12047	10.00124	11.12172	40
21	8.87995	9.99875	8.88120	11.11880	10.00125	11.12005	39
22	8.88161	9.99874	8.88287	11.11713	10.00126	11.11839	38
23	8.88326	9.99873	8.88453	11.11547	10.00127	11.11674	37
24	8.88490	9.99872	8.88619	11.11382	10.00128	11.11510	36
25	8.88654	9.99871	8.88783	11.11217	10.00129	11.11346	35
26	8.88817	9.99870	8.88948	11.11052	10.00130	11.11183	34
27	8.88980	9.99869	8.89111	11.10889	10.00131	11.11020	33
28	8.89142	9.99868	8.89274	11.10726	10.00132	11.10858	32
29	8.89304	9.99867	8.89437	11.10563	10.00133	11.10697	31
30	8.89464	9.99866	8.89598	11.1040[illegible]	10.00134	11.10536	30
		Sine.		Tang:		Secant.	Min.

85 Degrees.

Tangents and Secants.

4 Degrees.

Min.	Si[illegible]		Tang.		Secant.		
30	8.89[illegible]64	9.99866	8.89598	11.10402	10.00134	11.10536	30
31	8.89625	9.99865	8.89760	11.10240	10.00135	11.10375	29
32	8.89784	9.99864	8.89920	11.10080	10.00136	11.10216	28
33	8.89943	9.99863	8.90080	11.09920	10.00137	11.10057	27
34	8.90102	9.99862	8.90240	11.09760	10.00138	11.09898	26
35	8.90260	9.99861	8.90399	11.09601	10.00139	11.09740	25
36	8.90417	9.99860	8.90557	11.09443	10.00140	11.09583	24
37	8.90574	9.99859	8.90715	11.09285	10.00141	11.09426	23
38	8.90730	9.99858	8.90872	11.09128	10.00142	11.09270	22
39	8.90885	9.99857	8.91029	11.08972	10.00143	11.09115	21
40	8.91040	9.99856	8.91185	11.08815	10.00144	11.08960	20
41	8.91[illegible]95	9.99855	8.91340	11.08660	10.00145	11.08805	19
42	8.91349	9.99854	8.91495	11.08505	10.00146	11.08651	18
43	8.91502	9.99853	8.91650	11.08351	10.00147	11.08498	17
44	8.91655	9.99852	8.91803	11.08197	10.00148	11.08345	16
45	8.91807	9.99851	8.91957	11.08043	10.00149	11.08193	15
46	8.91959	9.99850	8.92110	11.07890	10.00151	11.08041	14
47	8.92110	9.99849	8.92262	11.07738	10.00152	11.07890	13
48	8.92261	9.99847	8.92414	11.07586	10.00153	11.07739	12
49	8.92411	9.99846	8.92565	11.07435	10.00154	11.07589	11
50	8.92561	9.99845	8.92716	11.07285	10.00155	11.07439	10
51	8.92710	9.99844	8.92866	11.07134	10.00156	11.07290	9
52	8.92859	9.99843	8.93016	11.06985	10.00157	11.07141	8
53	8.93007	9.99842	8.93165	11.06835	10.00158	11.06993	7
54	8.93154	9.99841	8.93313	11.06687	10.00159	11.06846	6
55	8.93302	9.99840	8.93462	11.06538	10.00160	11.06699	5
56	8.93448	9.99839	8.93609	11.06391	10.00161	11.06552	4
57	8.93594	9.99838	8.93757	11.06244	10.00162	11.06406	3
58	8.93740	9.99837	8.93903	11.06097	10.00163	11.06260	2
59	8.93885	9.99836	8.94049	11.05951	10.00165	11.06115	1
60	8.94030	9.99834	8.94195	11.05805	10.00166	11.05970	0
		Sine.		Tang.		Secant.	Min.

85 Degrees.

A Table of Artificial Sin[illegible]

5 Degrees.

Min.	Sine		Tang.		Secant.		
0	8.94030	9.99834	8.94195	11.05805	10.00166	11.[illegible]5970	60
1	8.94174	9.99833	8.94340	11.05660	10.00167	11.05826	59
2	8.94317	9.99832	8.94485	11.05515	10.00168	11.05683	58
3	8.94461	9.99831	8.94630	11.05370	10.00169	11.05539	57
4	8.94603	9.99830	8.94773	11.05227	10.00170	11.05397	56
5	8.94746	9.99829	8.94917	11.05083	10.00171	11.05254	55
6	8.94887	9.99828	8.95060	11.04940	10.00172	11.05113	54
7	8.95029	9.99827	8.95202	11.04798	10.00173	11.04971	53
8	8.95170	9.99826	8.95344	11.04656	10.00175	11.04830	52
9	8.95310	9.99824	8.95486	11.04514	10.00176	11.04690	51
10	8.95450	9.99823	8.95627	11.04373	10.00177	11.04550	50
11	8.95590	9.99822	8.95767	11.04233	10.00178	11.04411	49
12	8.95728	9.99821	8.95908	11.04093	10.00179	11.04272	48
13	8.95867	9.99820	8.96047	11.03953	10.00180	11.04133	47
14	8.96005	9.99819	8.96180	11.03863	10.00181	11.03995	46
15	8.96143	9.99817	8.96325	11.03675	10.00183	11.03857	45
16	8.96280	9.99816	8.96464	11.03536	10.00184	11.03720	44
17	8.96417	9.99815	8.96602	11.03398	10.00185	11.03583	43
18	8.96553	9.99814	8.96739	11.03261	10.00186	11.03447	42
19	8.96689	9.99813	8.96877	11.03123	10.00187	11.03311	41
20	8.96825	9.99812	8.97013	11.02987	10.00188	11.03175	40
21	8.96960	9.99810	8.97150	11.02850	10.00190	11.03040	39
22	8.97095	9.99809	8.97286	11.02715	10.00191	11.02905	38
23	8.97220	9.99808	8.97421	11.02579	10.00192	11.02771	37
24	8.97363	9.99807	8.97556	11.02444	10.00193	11.02637	36
25	8.9749[illegible]	9.99806	8.97691	11.02309	10.00194	11.02504	35
26	8.97629	9.99804	8.97825	11.02175	10.00196	11.02371	34
27	8.97762	9.99803	8.97959	11.02041	10.00197	11.02238	33
28	8.97894	9.99802	8.98092	11.01908	10.00198	11.02[illegible]06	32
29	8.98026	9.99801	8.98225	11.01775	10.00199	11.01974	31
30	8.98157	9.99800	8.98358	11.01642	10.00200	11.01843	30
		Sine.		Tang.		Secant.	Min.

84 Degrees,

Tangents and Secants.

5 Degrees.

Min.	Sine.		Tang.		Secant.		
30	8.981[illegible]	9.99800	8.98358	11.01642	10.00200	11.01843	30
31	8.98288	9.99798	8.98490	11.01510	10.00202	11.01712	29
32	8.98419	9.99797	8.98622	11.01378	10.00203	11.01581	28
33	8.98549	9.99796	8.98753	11.01247	10.00204	11.01451	27
34	8.98679	9.99795	8.98884	11.01116	10.00205	11.01321	26
35	8.98808	9.99794	8.99015	11.00985	10.00207	11.01192	25
36	8.98937	9.99792	8.99145	11.00855	10.00208	11.01063	24
37	8.99066	9.99791	8.99275	11.00725	10.00209	11.00934	23
38	8.99194	9.99790	8.99405	11.00596	10.00210	11.00806	22
39	8.99322	9.99789	8.99534	11.00466	10.00211	11.00678	21
40	8.99450	9.99787	8.99662	11.00338	10.00213	11.00550	20
41	8.99577	9.99786	8.99791	11.00209	10.00214	11.00423	19
42	8.99704	9.99785	8.99919	11.00081	10.00215	11.00296	18
43	8.99830	9.99784	9.00047	10.99954	10.00217	11.00170	17
44	8.99956	9.99782	9.00174	10.99826	10.00218	11.0004[illegible]	16
45	9.00082	9.99781	9.00301	10.99699	10.00220	10.99918	15
46	9.00207	9.99780	9.00427	10.99573	10.00220	10.99793	14
47	9.00332	9.99778	9.00553	10.99447	10.00222	10.99668	13
48	9.00456	9.99777	9.00679	10.99321	10.00223	10.99544	12
49	9.00581	9.99776	9.00805	10.99195	10.00224	10.99420	11
50	9.00704	9.99775	9.00930	10.99070	10.00226	10.99296	10
51	9.00828	9.99773	9.01055	10.98945	10.00227	10.99172	9
52	9.00951	9.99772	9.01179	10.98821	10.00228	10.99049	8
53	9.01074	9.99771	9.01303	10.98697	10.00229	10.98926	7
54	9.01196	9.99769	9.01427	10.98573	10.00231	10.98804	6
55	9.01318	9.99768	9.01550	10.98450	10.00232	10.98682	5
56	9.01440	9.99767	9.01673	10.98327	10.0023[illegible]	10.98560	4
57	9.01561	9.99765	9.01796	10.98204	10.00235	10.98439	3
58	9.0[illegible]682	9.99764	9.01918	10.98082	10.00236	10.98318	2
59	9.01803	9.99763	9.02040	10.97960	10.00237	10.98197	1
60	9.01923	9.99761	9.02162	10.97838	10.00239	10.98077	0
		Sine.		Tang.		Secant.	Min.

84 Degrees.

A Table of Artificial Sines,

6 Degrees.

Min.	Sine.		Tang.		Secant.		
0	9.01924	9.99761	9.02162	10.97838	10.00239	10.98076	60
1	9.02044	9.99760	9.02283	10.97717	10.00240	10.97957	59
2	9.02163	9.99759	9.02404	10.97596	10.00241	10.97837	58
3	9.02283	9.99757	9.02525	10.97475	10.00243	10.97718	57
4	9.02402	9.99756	9.02646	10.97355	10.00244	10.97598	56
5	9.02520	9.99755	9.02766	10.97235	10.00245	10.97480	55
6	9.02639	9.99753	9.02885	10.97115	10.00247	10.97361	54
7	9.02757	9.99752	9.03005	10.96995	10.00248	10.97243	53
8	9.02874	9.99751	9.03124	10.96876	10.00249	10.97126	52
9	9.02992	9.99749	9.03243	10.96758	10.00251	10.97008	51
10	9.03109	9.99748	9.03361	10.96639	10.00252	10.96891	50
11	9.03226	9.99747	9.03479	10.96521	10.00253	10.96774	49
12	9.03342	9.99745	9.03597	10.96403	10.00255	10.96658	48
13	9.03458	9.99744	9.03714	10.96286	10.00256	10.96542	47
14	9.03574	9.99743	9.03832	10.96168	10.00258	10.96426	46
15	9.03690	9.99741	9.03949	10.96052	10.00259	10.96310	45
16	9.03805	9.99740	9.04065	10.95935	10.00260	10.96195	44
17	9.03920	9.99738	9.04181	10.95819	10.00262	10.96080	43
18	9.04034	9.99737	9.04297	10.95703	10.00263	10.95966	42
19	9.04149	9.99736	9.04413	10.95587	10.00265	10.95852	41
20	9.04263	9.99734	9.04528	10.95472	10.00266	10.95738	40
21	9.04376	9.99733	9.04643	10.95357	10.00267	10.95624	39
22	9.04490	9.99731	9.04758	10.95242	10.00269	10.95511	38
23	9.04603	9.99730	9.04873	10.95127	10.00270	10.95397	37
24	9.04715	9.99729	9.04987	10.95013	10.00272	10.95285	36
25	9.04828	9.99727	9.05101	10.94899	10.00273	10.95172	35
26	9.04940	9.99726	9.05214	10.94786	10.00274	10.95060	34
27	9.05052	9.99724	9.05328	10.94672	10.00276	10.94948	33
28	9.05164	9.99723	9.05441	10.94559	10.00277	10.94837	32
29	9.05275	9.99721	9.05554	10.94447	10.00279	10.94725	31
30	9.05386	9.99720	9.05666	10.94334	10.00280	10.946 4	30
		Sine.		Tang.		Secant.	Min.

83 Degrees.

Tangents and Secants.

6 Degrees.

Min.	Sine.		Tang.		Secant.		
30	9.05386	9.99720	9.05666	10.94334	10.00280	10.94614	30
31	9.05497	9.99719	9.05778	10.94222	10.00282	10.94503	29
32	9.05607	9.99717	9.05890	10.94110	10.00283	10.94393	28
33	9.05717	9.99716	9.06002	10.93998	10.00284	10.94284	27
34	9.05827	9.99714	9.06113	10.93887	10.00286	10.94173	26
35	9.05937	9.99713	9.06224	10.93776	10.00287	10.94063	25
36	9.06046	9.99711	9.06335	10.93665	10.00289	10.93954	24
37	9.06155	9.99710	9.06445	10.93555	10.00290	10.93845	23
38	9.06264	9.99708	9.06556	10.93444	10.00292	10.93736	22
39	9.06372	9.99707	9.06666	10.93335	10.00293	10.93628	21
40	9.06481	9.99705	9.06775	10.93225	10.00295	10.93519	20
41	9.06589	9.99704	9.06885	10.93115	10.00296	10.93412	19
42	9.06696	9.99702	9.06994	10.93006	10.00298	10.93304	18
43	9.06804	9.99701	9.07103	10.92897	10.00299	10.93196	17
44	9.06911	9.99699	9.07211	10.92789	10.00301	10.93089	16
45	9.07018	9.99698	9.07320	10.92680	10.00302	10.92982	15
46	9.07124	9.99696	9.07428	10.92572	10.00304	10.92876	14
47	9.07231	9.99695	9.07536	10.92464	10.00305	10.92769	13
48	9.07337	9.99693	9.07643	10.92357	10.00307	10.92663	12
49	9.07442	9.99692	9.07751	10.92245	10.00308	10.92558	11
50	9.07548	9.99690	9.07858	10.92142	10.00310	10.92452	10
51	9.07653	9.99689	9.07964	10.92036	10.00311	10.92347	9
52	9.07758	9.99687	9.08071	10.91929	10.00313	10.92242	8
53	9.07863	9.99686	9.08177	10.91823	10.00314	10.92137	7
54	9.07968	9.99684	9.08283	10.91717	10.00316	10.92032	6
55	9.08072	9.99683	9.08389	10.91611	10.00317	10.91928	5
56	9.08176	9.99681	9.08495	10.91505	10.00319	10.91824	4
57	9.08280	9.99680	9.08600	10.91400	10.00320	10.91720	3
58	9.08383	9.99678	9.08705	10.91295	10.00322	10.91617	2
59	9.08486	9.99677	9.08810	10.91190	10.00323	10.91514	1
60	9.08589	9.99675	9.08914	10.91086	10.00325	10.91411	0
		Sine.		Tang.		Secant.	Min.

83 Degrees.

7 Degrees.

Min.	Sine.		Tang.		Secant.		
0	9.08589	9.99675	9.08914	10.91086	10.00325	10.91411	60
1	9.08692	9.99674	9.09019	10.90981	10.00327	10.91308	59
2	9.08795	9.99672	9.09123	10.90877	10.00328	10.91205	58
3	9.08897	9.99670	9.09227	10.90773	10.00330	10.91103	57
4	9.08999	9.99669	9.09330	10.90670	10.00331	10.91001	56
5	9.09101	9.99667	9.09434	10.90566	10.00333	10.90899	55
6	9.09202	9.99666	9.09537	10.90463	10.00334	10.90798	54
7	9.09304	9.99664	9.09640	10.90360	10.00336	10.90696	53
8	9.09405	9.99663	9.09740	10.90258	10.00338	10.90595	52
9	9.09506	9.99661	9.09845	10.90155	10.00339	10.90494	51
10	9.09606	9.99659	9.09947	10.90053	10.00341	10.90394	50
11	9.09707	9.99658	9.10049	10.89951	10.00342	10.90294	49
12	9.09807	9.99656	9.10150	10.89850	10.00344	10.90193	48
13	9.09907	9.99655	9.10252	10.89748	10.00345	10.90094	47
14	9.10006	9.99653	9.10353	10.89647	10.00347	10.89994	46
15	9.10106	9.99651	9.10454	10.89546	10.00349	10.89894	45
16	9.10205	9.99650	9.10555	10.89445	10.00350	10.89795	44
17	9.10304	9.99648	9.10656	10.89344	10.00352	10.89696	43
18	9.10403	9.99647	9.10756	10.89244	10.00353	10.89598	42
19	9.10501	9.99644	9.10856	10.89144	10.00355	10.89499	41
20	9.10599	9.99643	9.10956	10.89044	10.00357	10.89401	40
21	9.10697	9.99642	9.11056	10.88944	10.00358	10.89303	39
22	9.10795	9.99640	9.11155	10.88845	10.00360	10.89205	38
23	9.10893	9.99638	9.11254	10.88746	10.00362	10.89107	37
24	9.10990	9.99637	9.11353	10.88647	10.00363	10.89010	36
25	9.11087	9.99635	9.11452	10.88548	10.00365	10.88913	35
26	9.11184	9.99634	9.11551	10.88449	10.00367	10.88816	34
27	9.11281	9.99632	9.11649	10.88351	10.00368	10.88719	33
28	9.11377	9.99630	9.11747	10.88253	10.00370	10.88623	32
29	9.11474	9.99629	9.11845	10.88155	10.00372	10.88526	31
30	9.11570	9.99627	9.11943	10.88057	10.00373	10.88430	30
		Sine.		Tang.		Secant.	Min.

82 Degrees.

7 Degrees.

Min.	Sine		Tang.		Secant.		
30	9.11570	9.99627	9.11943	10.88057	10.00373	10.88430	30
31	9.11666	9.99625	9.12040	10.87960	10.00375	10.88334	29
32	9.11761	9.99624	9.12138	10.87862	10.00377	10.88239	28
33	9.11857	9.99622	9.12235	10.87765	10.00378	10.88143	27
34	9.11952	9.99620	9.12332	10.87668	10.00380	10.88948	26
35	9.12047	9.99619	9.12428	10.87572	10.00382	10.87953	25
36	9.12142	9.99617	9.12525	10.87475	10.00383	10.87858	24
37	9.12236	9.99615	9.12620	10.87379	10.00385	10.87764	23
38	9.12331	9.99613	9.12717	10.87283	10.00387	10.87669	22
39	9.12425	9.99612	9.12813	10.87187	10.00388	10.87575	21
40	9.12519	9.99610	9.12909	10.87091	[illegible]0.00390	10.87481	20
41	9.12613	9.99608	9.13004	10.86996	10.00392	10.87388	19
42	9.12706	9.99607	9.13099	10.86901	10.00393	10.87295	18
43	9.12799	9.99605	9.13194	10.86806	10.00395	10.872[illegible]1	17
44	9.12893	9.99603	9.13289	10.86711	10.00397	10.87108	16
45	9.12985	9.99602	9.13384	10.86616	10.00399	10.87015	15
46	9.13078	9.99600	9.13478	10.86522	10.00400	10.86922	14
47	9.13171	9.99598	9.13573	10.86427	10.00402	10.86829	13
48	9.13263	9.99596	9.13667	10.86333	10.00404	10.86737	12
49	9.13355	9.99595	9.13761	10.86240	10.00405	10.86645	11
50	9.13447	9.99593	9.13854	10.86146	10.00407	10.86553	10
51	9.13539	9.99591	9.13948	10.86052	10.00409	10.86461	9
52	9.13630	9.99589	9.14041	10.85959	10.00411	10.86370	8
53	9.13722	9.99588	9.14134	10.85866	10.00412	10.86278	7
54	9.13813	9.99586	9.14227	10.85773	10.00414	10.86187	6
55	9.13904	9.99584	9.14320	10.85680	10.00416	10.86096	5
56	9.13994	9.99582	9.14412	10.85588	10.00418	10.86006	4
57	9.14085	9.99581	9.14504	10.85496	10.00419	10.85915	3
58	9.14175	9.99579	9.14597	10.85403	10.00421	10.85825	2
59	9.14266	9.99577	9.14689	10.85312	10.00423	10.85734	1
60	9.14356	9.99575	9.14780	10.85220	10.00425	10.85645	0
		Sine.		Tang.		Secant.	Min.

82 Degrees.

A Table of Artificial Sines,

8 Degrees.

Min.	Sine.		Tang.		Secant.		
0	9.14356	9.99575	9.14780	10.85220	10.00425	10.85645	60
1	9.14445	9.99574	9.14872	10.85128	10.00427	10.85555	59
2	9.14535	9.9957[illegible]	9.14963	10.85037	10.00428	10.85465	58
3	9.14624	9.99570	9.15054	10.84946	10.00430	10.85376	57
4	9.14714	9.99568	9.15145	10.84855	10.00432	10.85286	56
5	9.14803	9.99566	9.15236	10.84764	10.00434	10.85197	55
6	9.14892	9.99565	9.15327	10.84673	10.00435	10.85109	54
7	9.14980	9.99563	9.15417	10.84583	10.00437	10.85020	53
8	9.15069	9.99561	9.15508	10.84492	10.00439	10.84931	52
9	9.15157	9.99559	9.15598	10.84402	10.00441	10.84843	51
10	9.15245	9.99557	9.[illegible]5689	10.84312	10.00443	10.84755	50
11	9.15333	9.99556	9.15778	10.84223	10.00445	10.84667	49
12	9.15421	9.99554	9.15867	10.84133	10.00446	10.84579	48
13	9.15508	9.99552	9.15957	10.84044	10.00448	10.84492	47
14	9.15596	9.99550	9.16046	10.83954	10.00450	10.84404	46
15	9.15683	9.99548	9.16135	10.83865	10.00452	10.84317	45
16	9.15770	9.99546	9.16224	10.83776	10.00454	10.84230	44
17	9.15857	9.99545	9.16312	10.83688	10.00455	10.84143	43
18	9.15944	9.99543	9.16401	10.83599	10.00457	10.84057	42
19	9.16030	9.99541	9.16489	10.83511	10.00459	10.83970	41
20	9.16116	9.99539	9.16577	10.83423	10.00461	10.83884	40
21	9.16203	9.99537	9.16665	10.83335	10.00463	10.83797	39
22	9.16289	9.99535	9.16753	10.83247	10.00465	10.83712	38
23	9.16374	9.99533	9.16850	10.83159	10.00467	10.83626	37
24	9.16460	9.99532	9.16928	10.83072	10.00468	10.83540	36
25	9.16545	9.99530	9.17016	10.82984	10.00470	10.82455	35
26	9.16631	9.99528	9.17103	10.82897	10.00472	10.83369	34
27	9.16716	9.99526	9.17190	10.82810	10.00474	10.83284	33
28	9.16801	9.99524	9.17277	10.82723	10.00476	10.83199	32
29	9.16886	9.99522	9.17363	10.82637	10.00478	10.83114	31
30	9.16970	9.99520	9.17450	10.82550	10.00480	10.83030	30
		Sine.		Tang.		Secant.	Min.

81 Degrees.

Tangents and Secants.

8 *Degrees.*

Min.	Sine.		Tang.		Secant.		
30	9.16970	9.99520	9.17450	10.82550	10.00480	10.83030	30
31	9.17055	9.99518	9.17536	10.82464	10.00482	10.82945	29
32	9.17139	9.99517	9.17622	10.82378	10.00484	10.82861	28
33	9.17223	9.99515	9.17708	10.82292	10.00485	10.82777	27
34	9.17307	9.99513	9.17794	10.82206	10.00487	10.82693	26
35	9.17391	9.99511	9.17880	10.82120	10.00489	10.82609	25
36	9.17474	9.99509	9.17966	10.82035	10.0049[illegible]	10.82526	24
37	9.17558	9.99507	9.18051	10.81949	10.00493	10.82442	23
38	9.17641	9.99505	9.18136	10.81864	10.00495	10.82359	22
39	9.17724	9.99503	9.18221	10.81779	10.00497	10.82276	21
40	9.17807	9.995[illegible]	9.18306	10.81694	10.00499	10.82193	20
41	9.17890	9.99499	9.18391	10.81609	10.0050[illegible]	10.82111	19
42	9.17973	9.99497	9.18475	10.81525	10.00503	10 82027	18
43	9.18055	9 99496	9.18560	10.81440	10.00505	10.81949	17
44	9.18137	9.99494	9.18644	10.81356	10.00507	10.81863	16
45	9.18220	9.99492	9.187[illegible]8	10.81272	10.00508	10.81780	15
46	9.18302	9.99490	9.18812	10.81188	10.00510	10.81698	14
47	9.18383	9.99488	9.18896	10.81104	10.00512	10.81617	13
48	9.18465	9.99486	9.18979	10.81021	10.00514	10.81535	12
49	9.18547	9.99484	9.19063	10.80937	10.00516	10.81453	11
50	9.18628	9.99482	9.19146	10.80854	10.00518	10.81372	10
51	9.18709	9.99480	9.19229	10.80771	10.00520	10.81291	9
52	9.18790	9 99478	9.19312	10.80688	10.00522	10.81210	8
53	9.18871	9.99476	9.19395	10.80605	10.00524	10.81129	7
54	9.18952	9.99474	9.19478	10.80522	10.00526	10.81048	6
55	9.19033	9.99473	9.19561	10 80439	10.00528	10.80968	5
56	9.19113	9.99470	9.19643	10 80357	10.00530	10.80887	4
57	9.19193	9 99468	9.19725	10.80275	10.00532	10.80807	3
58	9.[illegible]9273	9.99466	9.19807	10.80193	10.00534	10.80727	2
59	9.19353	9.99464	9.19889	10.80111	10.00536	10.80647	1
60	9.19433	9.99462	9.19971	10.80029	10.00538	10.80567	0
		Sine		Tang.		Secant	Min.

81 *Degrees.*

A Table of Artificial Sines,

9 Degrees.

Min.	Sine.		Tang.		Secant.		
0	9.19433	9.99462	9.19971	10.80029	10.00538	10.80567	60
1	9.19513	9.99460	9.20053	10.79947	10.00540	10.80488	59
2	9.19593	9.99458	9.20135	10.79866	10.00542	10.80408	58
3	9.19672	9.99456	9.20216	10.79784	10.00544	10.80328	57
4	9.19751	9.99454	9.20297	10.79703	10.00546	10.80249	56
5	9.19830	9.99452	9.20378	10.79622	10.00548	10.80170	55
6	9.19909	9.99450	9.20459	10.79541	10.00550	10.80091	54
7	9.19988	9.99448	9.20540	10.79460	10.00552	10.80012	53
8	9.20067	9.99446	9.20621	10.79379	10.00554	10.79933	52
9	9.20145	9.99444	9.20701	10.79299	10.00556	10.79855	51
10	9.20223	9.99442	9.20782	10.79218	10.00558	10.79777	50
11	9.20302	9.99440	9.20862	10.79138	10.00560	10.79698	49
12	9.20380	9.99438	9.20942	10.79058	10.00562	10.79620	48
13	9.20458	9.99436	9.21022	10.78978	10.00564	10.79542	47
14	9.20535	9.99434	9.21102	10.78898	10.00566	10.79465	46
15	9.20613	9.99432	9.21182	10.78819	10.00568	10.79387	45
16	9.20691	9.99430	9.21261	10.78739	10.00571	10.79309	44
17	9.20768	9.99427	9.21341	10.78660	10.00572	10.79232	43
18	9.20845	9.99425	9.21420	10.78580	10.00575	10.79155	42
19	9.20922	9.99423	9.21499	10.78501	10.00577	10.79078	41
20	9.20999	9.99421	9.21578	10.78422	10.00579	10.79001	40
21	9.21076	9.99419	9.21657	10.78343	10.00581	10.78924	39
22	9.21153	9.99417	9.21736	10.78264	10.00583	10.78847	38
23	9.21229	9.99415	9.21814	10.78186	10.00585	10.78771	37
24	9.21306	9.99413	9.21893	10.78107	10.00587	10.78695	36
25	9.21382	9.99411	9.21971	10.78029	10.00589	10.78618	35
26	9.21458	9.99409	9.22049	10.77951	10.00591	10.78542	34
27	9.21534	9.99407	9.22127	10.77873	10.00593	10.78466	33
28	9.21610	9.99405	9.22205	10.77795	10.00596	10.78390	32
29	9.21685	9.99402	9.22283	10.77717	10.00598	10.78315	31
30	9.21761	9.99400	9.22361	10.77639	10.00600	10.78239	30
		Sine.		Tang.		Secant.	Min.

80 Degrees.

Tangents and Secants.

9 Degrees.

Min.	Sine.		Tang.		Secant.		
30	9.21761	9.99400	9.22361	10.77639	10.00600	10.78239	30
31	9.21[illegible]	9.99398	9.22438	10.77562	10.00602	10.78164	29
32	9.21912	9.99396	9.22516	10.77484	10.00604	10.78088	28
33	9.21987	9.99394	9.22593	10.77407	10.00606	10.78013	27
34	9.22062	9.99392	9.22670	10.77330	10.00608	10.77938	26
35	9.22137	9.99390	9.22747	10.77253	10.00610	10.77863	25
36	9.22212	9.99388	9.22824	10.77176	10.00613	10.77789	24
37	9.22286	9.99385	9.22901	10.77099	10.00615	10.77714	23
38	9.22361	9.99383	9.22977	10.77023	10.00617	10.77639	22
39	9.22435	9.99381	9.23054	10.76946	10.00619	10.77565	21
40	9.22509	9.99379	9.23131	10.768[illegible]	10.00621	10.77491	20
41	9.22583	9.99377	9.23207	10.76794	10.00623	10.77417	19
42	9.22657	9.99375	9.23283	10.76717	10.00625	10.77343	18
43	9.22731	9.99373	9.23359	10.76641	10.00628	10.77269	17
44	9.22805	9.99370	9.23435	10.76566	10.00630	10.77195	16
45	9.22878	9.99368	9.23510	10.76490	10.00632	10.77122	15
46	9.22952	9.99366	9.23586	10.76414	10.00634	10.77048	14
47	9.23025	9.99364	9.23661	10.76339	10.00636	10.76975	13
48	9.23098	9.99362	9.23737	10.76263	10.00638	10.76902	12
49	9.23171	9.99359	9.23812	10.76188	10.00641	10.76829	11
50	9.23244	9.99357	9.23887	10.76113	10.00643	10.76756	10
51	9.23317	9.99355	9.23962	10.76038	10.00645	10.76683	9
52	9.23390	9.99353	9.24037	10.75963	10.00647	10.76610	8
53	9.23463	9.99351	9.24112	10.75888	10.00649	10.76538	7
54	9.23535	9.99348	9.24187	10.75814	10.00652	10.76465	6
55	9.23607	9.99346	9.24261	10.75739	10.00654	10.76393	5
56	9.23680	9.99344	9.24335	10.75665	10.00656	10.76321	4
57	9.23752	9.99342	9.24410	10.75590	10.00658	10.76249	3
58	9.23824	9.99340	9.24484	10.75516	10.00660	10.76177	2
59	9.23895	9.99337	9.24558	10.75442	10.00663	10.76105	1
60	9.23967	9.99335	9.24632	10.75368	10.00665	10.76033	0
		Sine.		Tang.		Secant.	Min.

80 Degrees.

A Table of Artificial Sines,

10 Degrees.

Min.	Sine.		Tang.		Secant.		
0	9.23967	9.99335	9.24632	10.75368	10.00665	10.76[illegible]33	60
1	9.24039	9.99333	9.24706	10.75294	10.00667	1[illegible]5961	59
2	9.24110	9.9933[illegible]	9.24779	10.75221	10.00669	10.75890	58
3	9.24181	9.99328	9.24853	10.75147	10.00672	10.75819	57
4	9.24253	9.99326	9.24926	10.75074	10.00674	10.75747	56
5	9.24324	9.99324	9.25000	10.75000	10.00676	10.75676	55
6	9.24395	9.99322	9.25073	10.74927	10.00678	10.75605	54
7	9.24466	9.99320	9.25146	10.74854	10.00681	10.75534	53
8	9.24536	9.99317	9.25219	10.74781	10.00683	10.75464	52
9	9.24607	9.99315	9.25292	10.74708	10.00685	10.75393	51
10	9.24678	9.99313	9.25365	10.74635	10.00687	10.75323	50
11	9.24748	9.99310	9.25437	10.74563	10.00690	10.75252	49
12	9.24818	9.99308	9.25510	10.74490	10.00692	10.75182	48
13	9.24888	9.99306	9.25582	10.74418	10.00694	10.75112	47
14	9.24958	9.99304	9.25655	10.74345	10.00696	10.75042	46
15	9.25028	9.99301	9.25727	10.74273	10.00699	10.74972	45
16	9.25098	9.99299	9.25799	10.74201	10.00701	10.74902	44
17	9.25168	9.99297	9.25871	10.74129	10.00703	10.74832	43
18	9.25237	9.99294	9.25943	10.74057	10.00706	10.74763	42
19	9.25307	9.99292	9.26015	10.73985	10.00708	10.74693	41
20	9.25376	9.99290	9.26086	10.73914	10.00710	10.74624	40
21	9.25445	9.99288	9.26158	10.73842	10.00713	10.74555	39
22	9.25514	9.99285	9.26229	10.73771	10.00715	10.74486	38
23	9.25583	9.99283	9.26301	10.73700	10.00717	10.74417	37
24	9.25652	9.99281	9.26372	10.73628	10.00719	10.74348	36
25	9.25721	9.99278	9.26443	10.73557	10.00722	10.74279	35
26	9.25790	9.99276	9.26514	10.73486	10.00724	10.74210	34
27	9.25858	9.99274	9.26585	10.73415	10.00726	10.74142	33
28	9.25927	9.99271	9.26656	10.73345	10.00729	10.740[illegible]3	32
29	9.25995	9.99270	9.26726	10.73274	10.00731	10.74005	31
30	9.26063	9.99267	9.2679	10.73203	10.00733	10.73937	30
		Sine.		Tang.		Secant.	Min.

79 Degrees.

10 *Degrees*.

Min.	Sine.		Tang.		Secant.		
30	9.260[illegible]	9.99267	9.26797	10.73203	10.00733	10.73937	30
31	9.26131	9.99264	9.26867	10.73133	10.00736	10.73869	29
32	9.26199	9.99262	9.26938	10.73063	10.00738	10.73801	28
33	9.26267	9.99260	9.27008	10.72992	10.00740	10.73733	27
34	9.26335	9.99257	9.27078	10.72922	10.00743	10.73665	26
35	9.26403	9.99255	9.27148	10.72852	10.00745	10.73597	25
36	9.26470	9.99253	9.27218	10.72782	10.00748	10.73530	24
37	9.26538	9.99250	9.27288	10.72712	10.00750	10.73462	23
38	9.26605	9.99248	9.27357	10.72643	10.00752	10.73395	22
39	9.26672	9.99245	9.27427	10.72573	10.00755	10.73328	21
40	9.26739	9.99243	9.27496	10.72504	10.00757	10.73261	20
41	9.26807	9.99241	9.27566	10.72434	10.00759	10.73194	19
42	9.26873	9.99238	9.27635	10.72365	10.00762	10.73127	18
43	9.26940	9.99236	9.27704	10.72296	10.00764	10.73060	17
44	9.27007	9.99234	9.27773	10.72227	10.00767	10.72993	16
45	9.27074	9.99231	9.27842	10.72158	10.00769	10.72927	15
46	9.27140	9.99229	9.27911	10.72089	10.00771	10.72860	14
47	9.27206	9.99226	9.27980	10.72020	10.00774	10.72794	13
48	9.27273	9.99224	9.28049	10.71951	10.00776	10.72727	12
49	9.27339	9.99221	9.28117	10.71883	10.00779	10.7266[illegible]	11
50	9.27405	9.99219	9.28186	10.71814	10.00781	10.72595	10
51	9.27471	9.99217	9.28254	10.71746	10.00783	10.72529	9
52	9.27537	9.99214	9.28323	10.71678	10.00786	10.72463	8
53	9.27602	9.99212	9.28391	10.71609	10.00788	10.72398	7
54	9.27668	9.99209	9.28459	10.71541	10.00791	10.72332	6
55	9.27734	9.99207	9.28527	10.71473	10.00793	10.72266	5
56	9.27799	9.99204	9.28595	10.71405	10.00796	10.72201	4
57	9.27864	9.99202	9.28662	10.71338	10.00798	10.72136	3
58	9.279[illegible]	9.99200	9.28730	10.71270	10.00800	10.72070	2
59	9.27995	9.99197	9.28798	10.71202	10.00803	10.72005	1
60	9.28060	9.99195	9.28865	10.71135	10.00805	10.71940	0
		Sine.		Tang.		Secant.	Min.

79 *Degrees*.

A Table of Artificial Sines,

XI Degrees.

Min.	Sine.		Tang.		Secant.		
0	9.28060	9.99195	9.28865	10.71135	10.00805	10.71940	60
1	9.28125	9.99192	9.28924	10.71067	10.008[illegible]	10.71875	59
2	9.28190	9.99190	9.29000	10.71000	10.00810	10.71810	58
3	9.28254	9.99187	9.29067	10.70933	10.00813	10.71746	57
4	9.28319	9.99185	9.29134	10.70866	10.00815	10.71681	56
5	9.28384	9.99182	9.29201	10.70799	10.00818	10.71616	55
6	9.2844[illegible]	9.99180	9.29268	10.70732	10.00820	10.71552	54
7	9.28512	9.99177	9.29335	10.70665	10.00823	10.71488	53
8	9.28577	9.99175	9.29402	10.70598	10.00825	10.71423	52
9	9.28641	9.99172	9.29468	10.70532	10.00828	10.71359	51
10	9.28705	9.99170	9.29535	10.70465	10.00830	10.71295	50
11	9.28769	9.99167	9.29601	10.70399	10.00833	10.71231	49
12	9.28833	9.99165	9.29668	10.70332	10.00835	10.71167	48
13	9.28896	9.99162	9.29734	10.70266	10.00838	10.71104	47
14	9.28960	9.99160	9.29800	10.70200	10.00840	10.71040	46
15	9.29024	9.99157	9.29866	10.70134	10.00843	10.70976	45
16	9.29087	9.99155	9.29932	10.70068	10.00845	10.70913	44
17	9.29150	9.99152	9.29998	10.70002	10.00848	10.70850	43
18	9.29214	9.99150	9.30064	10.69936	10.00850	10.70786	42
19	9.29277	9.99147	9.30130	10.69871	10.00853	10.70723	41
20	9.29340	9.99145	9.30195	10.69805	10.00855	10.70660	40
21	9.29403	9.99142	9.30261	10.69739	10.00858	10.70597	39
22	9.29466	9.99140	9.30326	10.69674	10.00860	10.70534	38
23	9.29529	9.99137	9.30391	10.69609	10.00863	10.70471	37
24	9.29591	9.99135	9.30457	10.69543	10.00865	10.70409	36
25	9.29654	9.99132	9.30522	10.69478	10.00868	10.70346	35
26	9.29716	9.99130	9.30587	10.69413	10.00871	10.70284	34
27	9.29779	9.99127	9.30652	10.69348	10.00873	10.70221	33
28	9.29841	9.99124	9.30717	10.69283	10.00876	10.70159	32
29	9.29903	9.99122	9.30782	10.69218	10.00878	10.70097	31
30	9.29966	9.99119	9.30846	10.69154	10.00881	10.70035	30
		Sine.		Tang.		Secant.	Min.

78 Degrees.

11 Degrees.

Min.	Sine.		Tang		Secant.		
30	9.2[illegible]66	9.99119	9.30846	10.69154	10.00881	10.70035	30
31	9.300[illegible]	9.99117	9.309[illegible]	10.69089	10.00883	10.69972	29
32	9.30090	9.99114	9.30975	10.69025	10.00886	10.69911	28
33	9.30151	9.99112	9.31040	10.68960	10.00889	10.69849	27
34	9.30213	9.99109	9.31104	10.68896	10.00891	10.69787	26
35	9.30275	9.99106	9.31169	10.68832	10.00894	10.69725	25
36	9.30336	9.99104	9.31233	10.68767	10.00896	10.69664	24
37	9.30398	9.99101	9.31297	10.68703	10.0089[illegible]	10.69602	23
38	9.30459	9.99099	9.31361	10.68639	10.00[illegible]01	10.69541	22
39	9.30521	9.99096	9.31425	10.68575	10.00904	10.69479	21
40	9.30582	9.99093	9.31489	10.68512	10.00907	10.69418	20
41	9.30643	9.99091	9.31552	10.68448	10.00909	10.69357	19
42	9.30704	9.99088	9.31616	10.68384	10.00912	10.69296	18
43	9.30765	9.99086	9.31680	10.68321	10.00915	10.69235	17
44	9.30826	9.99083	9.31743	10.68257	10.00917	10.69174	16
45	9.30887	9.99080	9.31806	10.68194	10.00920	10.69113	15
46	9.30947	9.99078	9.31870	10.68130	10.00922	10.69053	14
47	9.31008	9.99075	9.31933	10.68067	10.00925	10.68992	13
48	9.31069	9.99072	9.31996	10.68004	10.00928	10.68932	12
49	9.31129	9.99070	9.32059	10.67941	10.00930	10.68871	11
50	9.31189	9.99067	9.32122	10.67878	10.00933	10.68811	10
51	9.31250	9.99064	9.32185	10.67815	10.00936	10.63751	9
52	9.31310	9.99062	9.32248	10.67752	10.00938	10.68690	8
53	9.31370	9.99059	9.32311	10.67689	10.00941	10.68630	7
54	9.31430	9.99057	9.32373	10.67627	10.00944	10.68570	6
55	9.31490	9.99054	9.32436	10.67564	10.00946	10.68510	5
56	9.31550	9.99051	9.32498	10.67502	10.00949	10.68451	4
57	9.31609	9.99049	9.32561	10.67439	10.00952	10.68391	3
58	9.31669	9.99046	9.32623	10.67377	10.00954	10.68331	2
59	9.31728	9.99043	9.32685	10.67315	10.00957	10.68272	1
60	9.31788	9.99040	9.32747	10.67253	10.00960	10.68212	0
		Sine.		Tang.		Secant.	Min.

78 Degrees.

A Table of Artificial Sines,

12 Degrees.

Min.	Sine.		Tang.		Secant.		
0	9.31788	9.99046	9.32747	10.67253	10.00960	[illegible]	60
1	9.31847	9.99038	9.32810	10.67191	10.00962	[illegible]	59
2	9.31907	9.99035	9.32872	10.67129	10.00965	10.68093	58
3	9.31966	9.99032	9.32933	10.67067	10.00968	10.68034	57
4	9.32025	9.99030	9.32995	10.67005	10.00970	10.67974	56
5	[illegible]	9.99027	9.33057	10.66994	10.00973	10.67916	55
6	9.32143	9.99024	9.33119	10.66881	10.00976	10.67857	54
7	9.32202	9.99022	9.33180	10.66820	10.00978	10.67798	53
8	9.32261	9.99019	9.33242	10.66758	10.00981	10.67739	52
9	9.32319	9.99016	9.33303	10.66697	10.00984	10.67681	51
10	9.32378	9.99013	9.33365	10.66635	10.00987	10.67622	50
11	9.32437	9.99011	9.33426	10.66574	10.00989	10.67563	49
12	9.32495	9.99008	9.33487	10.66513	10.00992	10.67505	48
13	9.32553	9.99005	9.33548	10.66452	10.00995	10.67447	47
14	9.32612	9.99003	9.33609	10.66391	10.00998	10.67388	46
15	9.32670	9.99000	9.33670	10.66330	10.01000	10.67330	45
16	9.32728	9.98997	9.33731	10.66269	10.01003	10.67272	44
17	9.32786	9.98994	9.33792	10.66208	10.01006	10.67214	43
18	9.32844	9.98992	9.33853	10.66147	10.01009	10.67156	42
19	9.32902	9.98989	9.33913	10.66087	10.01011	10.67098	41
20	9.32960	9.98986	9.33974	10.66026	10.01014	10.67040	40
21	9.33018	9.98983	9.34034	10.65966	10.01017	10.66982	39
22	9.33075	9.98980	9.34095	10.65905	10.01020	10.66925	38
23	9.33133	9.98978	9.34155	10.65845	10.01022	10.66867	37
24	9.33190	9.98975	9.34216	10.65785	10.01025	10.66810	36
25	9.33248	9.98972	9.34276	10.65724	10.01028	10.66752	35
26	9.33305	9.98969	9.34336	10.65664	10.01031	10.66695	34
27	9.33362	9.98967	9.34396	10.65604	10.01034	10.66638	33
28	9.33420	9.98964	9.34456	10.65544	10.01036	10.66580	32
29	9.33477	9.98961	9.34516	10.65484	10.01039	10.66523	31
30	9.33534	9.98958	9.34576	10.65425	10.01042	10.66466	30
		Sine.		Tang.		Secant.	Min.

77 Degrees,

Tangents and Secants.

12 Degrees.

Min.	Sine.		Tang.		Secant.		
30	9.[illegible]534	9.98958	9.34576	10.65425	10.0104[illegible]	10.66466	30
31	9.33[illegible]	9.98955	9.34635	10.65365	10.01045	10.66409	29
32	9.33648	9.98953	9.34695	10.65305	10.0104[illegible]	10.66353	28
33	9.33704	9.98950	9.34755	10.65246	10.01050	10.66296	27
34	9.33761	9.98947	9.34814	10.65186	10.01053	10.66239	26
35	9.33818	9.98944	9.34874	10.65127	10.01056	10.66183	25
36	9.33874	9.98941	9.34933	10.65[illegible]67	10.010[illegible]	10.66126	24
37	9.33931	9.98938	9.34992	10.65008	10.01062	10.66069	23
38	9.33987	9.98936	9.35051	10.64949	10.[illegible]1064	10.66013	22
39	9.34043	9.98933	9.35111	10.64889	10.01067	10.65957	21
40	9.34100	9.98930	9.35170	10.64830	10.01070	10.65900	20
41	9.34156	9.98927	9.35229	10.64771	10.01073	10.65844	19
42	9.34212	9.98924	9.35288	10.64712	10.01076	10.65788	18
43	9.34268	9.98921	9.35347	10.64654	10.01079	10.65732	17
44	9.34324	9.98919	9.35405	10.64595	10.01081	10.65676	16
45	9.34380	9.98916	9.35464	10.64536	10.01084	10.65620	15
46	9.34436	9.98913	9.35525	10.64478	10.01087	10.65565	14
47	9.34491	9.98910	9.35581	10.64419	10.01090	10.65509	13
48	9.34547	9.98907	9.35640	10.64360	10.01093	10.65453	12
49	9.34602	9.98904	9.35698	10.64302	10.01096	10.65398	11
50	9.34658	9.98901	9.35757	10.64243	10.01099	10.65342	10
51	9.34713	9.98899	9.35815	10.64185	10.01102	10.65287	9
52	9.34769	9.98896	9.35873	10.64127	10.01104	10.65231	8
53	9.34824	9.98893	9.35931	10.64069	10.01107	10.65176	7
54	9.34879	9.98890	9.35989	10.64011	10.01110	10.65121	6
55	9.34934	9.98887	9.36047	10.63953	10.01113	10.65066	5
56	9.34989	9.98884	9.36105	10.63895	10.01116	10.65011	4
57	9.35044	9.98881	9.36163	10.63837	10.01119	10.64956	3
58	9.35099	9.98878	9.36221	10.63779	10.01122	10.64901	2
59	9.35154	9.98875	9.36279	10.63721	10.01125	10.64846	1
60	9.35209	9.98872	9.36336	10.63664	10.01128	10.64791	0
		Sine		Tang.		Secant.	Min.

77 Degrees.

A Table of Artificial Sines,

1[illegible] Degrees.

Min.	Sine.		Tang		Secant.		
0	9.35209	9.98872	9.36336	10.63664	10.01128	10.647[illegible]	60
1	9.35264	9.98869	9.36394	10.63606	10.01131	10.[illegible]37	59
2	9.35318	9.98867	9.36452	10.63548	10.01133	10.64682	58
3	9.35373	9.98864	9.36509	10.63491	10.01136	10.64627	57
4	9.35427	9.98861	9.36566	10.63434	10.01139	10.64573	56
5	9.35482	9.98858	9.36624	10.63376	10.01142	10.64519	55
6	9.35536	9.98855	9.36681	10.63319	10.01145	10.64464	54
7	9.35590	9.98852	9.36728	10.63262	10.01148	10.64410	53
8	9.35644	9.98849	9.36795	10.63205	10.01151	10.64356	52
9	9.35698	9.98846	9.36852	10.63148	10.01154	10.64302	51
10	9.35752	9.98843	9.36909	10.63091	10.01157	10.64248	50
11	9.35806	9.98840	9.36966	10.63034	10.01160	10.64194	49
12	9.35860	9.98837	9.37023	10.62977	10.01163	10.64140	48
13	9.35914	9.98834	9.37080	10.62920	10.01166	10.64086	47
14	9.35968	9.98831	9.37137	10.62863	10.01169	10.64032	46
15	9.36022	9.98828	9.37193	10.62807	10.01172	10.63979	45
16	9.36075	9.98825	9.37250	10.62750	10.01175	10.63925	44
17	9.36129	9.98822	9.37306	10.62694	10.01178	10.63871	43
18	9.36182	9.98819	9.37363	10.62037	10.01181	10.63818	42
19	9.36236	9.98816	9.37419	10.62581	10.01184	10.63764	41
20	9.36289	9.98813	9.37476	10.62524	10.01187	10.63711	40
21	9.36342	9.98810	9.37532	10.62468	10.01190	10.63658	39
22	9.36395	9.98807	9.37588	10.62412	10.01193	10.63605	38
23	9.36449	9.98804	9.37644	10.62356	10.01196	10.63552	37
24	9.36502	9.98801	9.37700	10.62300	10.01199	10.63498	36
25	9.36555	9.98798	9.37756	10.62244	10.01202	10.63445	35
26	9.36608	9.98795	9.37812	10.62188	10.01205	10.63393	34
27	9.36660	9.98792	9.37868	10.62132	10.01208	10.63340	33
28	9.36713	9.98789	9.37924	10.62076	10.01211	10.63287	32
29	9.36766	9.98786	9.37980	10.62020	10.01214	10.63234	31
30	9.36819	9.98783	9.38035	10.61965	10.01217	10.63182	30
		Sine.		Tang.		Secant.	Min.

76 Degrees.

Tangents and Secants

13 Degrees

Min.	Sine.		Tang.		Secant.		
30	[illegible]6819	9.98783	9.38035	10.61965	10.012[illegible]7	10.63182	30
31	9.3[illegible]1	9.98780	9.38091	10.61909	10.01220	10.63129	29
32	9.36924	9.98777	9.38147	10.61853	10.01223	10.63076	28
33	9.36976	9.98774	9.38202	10.61798	10.01226	10.63024	27
34	9.37029	9.98771	9.38258	10.61743	10.01229	10.62972	26
35	9.37081	9.98768	9.38313	10.61687	10.01232	10.62919	25
36	9.37133	9.98765	9.38368	10.61632	10.01235	10.62867	24
37	9.37185	9.98762	9.38423	10.61577	10.01238	10.62815	23
38	9.37237	9.98759	9.38479	10.61521	10.01241	10.62763	22
39	9.37289	9.98756	9.38534	10.61466	10.01244	10.62711	21
40	9.37341	9.98753	9.38589	10.61411	10.01247	10.62659	20
41	9.37393	9.98750	9.38644	10.61356	10.01250	10.62607	19
42	9.37445	9.98747	9.38699	10.61301	10.01254	10.62555	18
43	9.37497	9.98743	9.38754	10.61246	10.01257	10.62503	17
44	9.37549	9.98740	9.38808	10.61192	10.01260	10.62451	16
45	9.37600	9.98737	9.38863	10.61137	10.01263	10.62400	15
46	9.37652	9.98734	9.38918	10.61082	10.01266	10.62348	14
47	9.37704	9.98731	9.38972	10.61028	10.01269	10.62297	13
48	9.37755	9.98728	9.39027	10.60973	10.01272	10.62245	12
49	9.37806	9.98725	9.39082	10.60919	10.01275	10.62194	11
50	9.37858	9.98722	9.39136	10.60864	10.01278	10.62142	10
51	9.37909	9.98719	9.39190	10.60810	10.01281	10.62091	9
52	9.37960	9.98716	9.39245	10.60755	10.01285	10.62040	8
53	9.38011	9.98712	9.39299	10.60701	10.01288	10.61989	7
54	9.38062	9.98709	9.39353	10.60645	10.01291	10.61938	6
55	9.38113	9.98706	9.39407	10.60593	10.01294	10.61887	5
56	9.38164	9.98703	9.39461	10.60539	10.01297	10.61836	4
57	9.38216	9.98700	9.39515	10.60485	10.01300	10.61785	3
58	9.38266	9.98697	9.39569	10.60431	10.01303	10.61734	2
59	9.38317	9.98694	9.39623	10.60377	10.01306	10.61683	1
60	9.38368	9.98690	9.39677	10.60323	10.01310	10.61633	0
		Sine.		Tang.		Secant.	Min.

76 Degrees.

A [illegible]ble of Artificial Sines,

1[illegible] Degrees.

Min.	Sine.		Tang.		Secant.		
0	9.38368	9.98690	9.39677	10.60323	10.01310	10.616[illegible]	60
1	9.38418	9.98687	9.36731	10.60269	10.01313	10.[illegible]62	59
2	9.38469	9.98684	9.39785	10.60215	10.01316	10.61531	58
3	9.38519	9.98681	9.39838	10.60162	10.01319	10.61481	57
4	9.38570	9.98678	9.39892	10.60108	10.01322	10.61430	56
5	9.38620	9.98675	9.39946	10.60055	10.01325	10.61380	55
6	9.38670	9.98671	9.39999	10.60001	10.01329	10.61330	54
7	9.38721	9.98668	9.40052	10.59948	10.01332	10.61279	53
8	9.38771	9.98665	9.40106	10.59894	10.01335	10.61229	52
9	9.38821	9.98662	9.40159	10.59841	10.01338	10.61179	51
10	9.38871	9.98659	9.40212	10.59788	10.01341	10.61129	50
11	9.38921	9.98656	9.40266	10.59734	10.01345	10.61079	49
12	9.38971	9.98652	9.40319	10.59681	10.01348	10.61029	48
13	9.39021	9.98649	9.40372	10.59628	10.01351	10.60979	47
14	9.39071	9.98646	9.40425	10.59575	10.01354	10.60929	46
15	9.39121	9.98643	9.40478	10.59522	10.01357	10.60876	45
16	9.39170	9.98640	9.40531	10.59469	10.01361	10.60830	44
17	9.39220	9.98636	9.40584	10.59416	10.01364	10.60780	43
18	9.39270	9.98633	9.40636	10.59364	10.01367	10.60731	42
19	9.39319	9.98630	9.40689	10.59311	10.01370	10.60681	41
20	9.39369	9.98627	9.40742	10.59258	10.01373	10.60632	40
21	9.39418	9.98623	9.40795	10.59206	10.01377	10.60582	39
22	9.39467	9.98620	9.40847	10.59153	10.01380	10.60533	38
23	9.39517	9.98617	9.40900	10.59100	10.01383	10.60483	37
24	9.39566	9.98614	9.40952	10.59048	10.01386	10.60434	36
25	9.39615	9.98610	9.41005	10.58996	10.01390	10.60385	35
26	9.39664	9.98607	9.41057	10.58943	10.01393	10.60336	34
27	9.39713	9.98604	9.41109	10.58891	10.01396	10.60287	33
28	9.39762	9.98601	9.41162	10.58839	10.01399	10.60238	32
29	9.39811	9.98597	9.41214	10.58786	10.01403	10.60189	31
30	9.39860	9.98594	9.41266	10.58734	10.01406	10.60140	30
		Sine.		Tang.		Secant.	Min.

75 Degrees.

Tangents and Secants

14 Degrees

Min.	Sine.		Tang.		Secant.		
30	9.3[illegible]60	9.98594	9.41266	10.58734	10.01406	10.60140	30
31	9.399[illegible]	[illegible]98591	9.41318	10.58682	10.01409	10.60091	29
32	9.39958	9.98588	9.41370	10.58630	10.01412	10.60043	28
33	9.40006	9.98584	9.41422	10.58578	10.01416	10.59994	27
34	9.40055	9.98581	9.41474	10.58526	10.01419	10.59945	26
35	9.40104	9.98578	9.41526	10.58474	10.01422	10.59897	25
36	9.40152	9.98575	9.41578	10.58423	10.01426	10.59848	24
37	9.40201	9.98571	9.41629	10.58371	10.01429	10.59800	23
38	9.40249	9.98568	9.41681	10.58319	10.01432	10.59751	22
39	9.40297	9.98565	9.41733	10.58267	10.01435	10.59703	21
40	9.40346	9.98561	9.41784	10.58216	10.01439	10.59655	20
41	9.40394	9.98558	9.41836	10.58164	10.01442	10.59606	19
42	9.40442	9.98555	9.41887	10.58113	10.01445	10.59558	18
43	9.40490	9.98551	9.41939	10.58061	10.01449	10.59510	17
44	9.40538	9.98548	9.41990	10.58010	10.01452	10.59462	16
45	9.40586	9.98545	9.42042	10.57959	10.01455	10.59414	15
46	9.40634	9.98541	9.42093	10.57907	10.01459	10.59366	14
47	9.40682	9.98538	9.42144	10.57856	10.01462	10.59318	13
48	9.40730	9.98535	9.42195	10.57805	10.01465	10.59270	12
49	9.40778	9.98531	9.42246	10.57754	10.01469	10.59222	11
50	9.40825	9.98528	9.42297	10.57703	10.01472	10.59175	10
51	9.40873	9.98525	9.42348	10.57652	10.01475	10.59127	9
52	9.40921	9.98521	9.42399	10.57601	10.01479	10.59079	8
53	9.40968	9.98518	9.42450	10.57550	10.01582	10.59032	7
54	9.41016	9.98515	9.42501	10.57499	10.01485	10.58984	6
55	9.41063	9.98511	9.42552	10.57448	10.01489	10.58937	5
56	9.41111	9.98508	9.42603	10.57397	10.01492	10.58889	4
57	9.41158	9.98505	9.42653	10.57347	10.01496	10.58842	3
58	9.41205	9.98501	9.42704	10.57296	10.01499	10.58795	2
59	9.41252	9.98498	9.42755	10.57245	10.01502	10.58748	1
60	9.41300	9.98494	9.4280[illegible]	10.57195	10.01506	10.58700	0
		Sine.		Tang.		Secant.	Min.

75 Degrees.

A Table of Artificial Sines,

[illegible] Degrees.

Min.	Sine.		Tang.		Secant.		
0	9.41300	9.98494	9.42805	10.57195	10.01506	10.[illegible]700	60
1	9.41347	9.98491	9.42856	10.57144	10.01509	10.58653	59
2	9.41394	9.98488	9.42906	10.57094	10.01512	10.58606	58
3	9.41441	9.98484	9.42957	10.57043	10.01516	10.58559	57
4	9.41488	9.98481	9.43007	10.56993	10.01519	10.58512	56
5	9.41535	9.98477	9.43057	10.56943	10.01523	10.58465	55
6	9.41582	9.98474	9.43108	10.56893	10.01526	10.58419	54
7	9.41628	9.98471	9.43158	10.56842	10.01529	10.58372	53
8	9.41675	9.98467	9.43208	10.56792	10.01533	10.58325	52
9	9.41722	9.98464	9.43258	10.56742	10.01536	10.58278	51
10	9.41768	9.98460	9.43308	10.[illegible]6692	10.01540	10.58232	50
11	9.41815	9.98457	9.43358	10.56642	10.01543	10.58185	49
12	9.41862	9.98454	9.43408	10.56592	10.01547	10.58139	48
13	9.41908	9.98450	9.43458	10.56542	10.01550	10.58092	47
14	9.41954	9.98447	9.43508	10.56492	10.01553	10.58046	46
15	9.42001	9.98443	9.43558	10.56442	10.01557	10.57999	45
16	9.42047	9.98440	9.43607	10.56393	10.01560	10.57953	44
17	9.42093	9.98436	9.43657	10.56343	10.01564	10.57907	43
18	9.42140	9.98433	9.43707	10.56293	10.01567	10.57861	42
19	9.42186	9.98429	9.43756	10.56244	10.01571	10.57814	41
20	9.42232	9.98426	9.43806	10.56194	10.01574	10.57768	40
21	9.42278	9.98422	9.43855	10.56145	10.01578	10.57722	39
22	9.42324	9.98419	9.43905	10.56095	10.01581	10.57676	38
23	9.42370	9.98416	9.43954	10.56046	10.01584	10.57630	37
24	9.42416	9.98412	9.44004	10.55996	10.01588	10.57584	36
25	9.42462	9.98409	9.44053	10.55947	10.01592	10.57539	35
26	9.42507	9.98405	9.44102	10.55898	10.01595	10.57493	34
27	9.42553	9.98402	9.44151	10.55849	10.01599	10.57447	33
28	9.42599	9.98398	9.44201	10.55799	10.01602	10.57401	32
29	9.42644	9.98395	9.44250	10.55750	10.01605	10.57356	31
30	9.42690	9.98391	9.44299	10.55701	10.01609	10.57310	30
		Sine.		Tang.		Secant.	Min.

74 Degrees.

15 Degrees.

Min.	Sine.		Tang.		Secant.		
30	9.42690	9.98391	9.44299	10.55701	10.01609	10.57310	30
31	9.4[illegible]	9.98388	9.44348	10.55652	10.01612	10.57265	29
32	9.42781	9.98384	9.44397	10.55603	10.01616	10.57219	28
33	9.42826	9.98381	9.44446	10.55554	10.01620	10.57174	27
34	9.42872	9.98377	9.44495	10.55505	10.01623	10.57128	26
35	9.42917	9.983[illegible]4	9.44544	10.55457	10.01627	10.57083	25
36	9.42962	9.98370	9.44592	10.55408	10.01630	10.57038	24
37	9.43008	9.98366	9.44641	10.55359	10.01634	10.56992	23
38	9.43053	9.98363	9.44690	10.55310	10.01637	10.56947	22
39	9.43098	9.98359	9.44738	10.55262	10.01641	10.56902	21
40	9.43143	9.98356	9.44787	10.55213	10.01644	10.56857	20
41	9.43188	9.98352	9.44836	10.55164	10.01648	10.56812	19
42	9.43233	9.98349	9.44884	10.55116	10.01651	10.56767	18
43	9.43278	9.98345	9.44833	10.55067	10.01655	10.56722	17
44	9.43323	9.98342	9.44981	10.55019	10.01658	10.56677	16
45	9.43368	9.98338	9.45029	10.54971	10.01662	10.56633	15
46	9.43412	9.98335	9.45078	10.54922	10.01666	10.56588	14
47	9.43457	9.98331	9.45126	10.54874	10.01669	10.56543	13
48	9.43502	9.98327	9.45174	10.54826	10.01672	10.56498	12
49	9.43546	9.98324	9.45223	10.54778	10.01676	10.56454	11
50	9.43591	9.98320	9.45271	10.54729	10.01680	10.56409	10
51	9.43635	9.98317	9.45319	10.54681	10.01683	10.56365	9
52	9.43680	9.98313	9.45367	10.54633	10.01687	10.56320	8
53	9.43724	9.98309	9.45415	10.54585	10.01691	10.56276	7
54	9.43769	9.98306	9.45463	10.54537	10.01694	10.56231	6
55	9.43813	9.98302	9.45511	10.54489	10.01698	10.56187	5
56	9.43857	9.98299	9.45559	10.54441	10.01701	10.56143	4
57	9.43901	9.98295	9.45606	10.54394	10.01705	10.56099	3
58	9.43946	9.98291	9.45654	10.54346	10.01709	10.56054	2
59	9.43990	9.98288	9.45702	10.54298	10.01712	10.56010	1
60	9.44034	9.98284	9.45750	10.54250	10.01716	10.56966	0
		Sine.		Tang.		Secant.	Min.

74 Degrees.

A Table of Artificial Sines,

16 Degrees.

Min.	Sine.		Tang.		Secant.		
0	9.44034	9.98284	9.45750	10.54250	10.01716	10.55[illegible]6	60
1	9.44078	9.98281	9.45797	10.54203	10.01720	1[illegible]922	59
2	9.44122	9.98277	9.45845	10.54155	10.01723	10.55878	58
3	9.44166	9.98273	9.45893	10.54108	10.01727	10.55834	57
4	9.44210	9.98270	9.45940	10.54060	10.01730	10.55790	56
5	9.44254	9.98266	9.45988	10.54013	10.01734	10.55747	55
6	9.44297	9.98262	9.46035	10.53965	10.01738	10.55703	54
7	9.44341	9.98259	9.46082	10.53918	10.01741	10.55659	53
8	9.44385	9.98255	9.46130	10.53870	10.01745	10.55615	52
9	9.44428	9.98251	9.46177	10.53823	10.01749	10.55573	51
10	9.44472	9.98248	9.46224	10.53776	10.01752	10.55528	50
11	9.44516	9.98244	9.46271	10.53729	10.01756	10.55485	49
12	9.44559	9.98240	9.46319	10.53681	10.01760	10.55441	48
13	9.44603	9.98237	9.46366	10.53634	10.01763	10.55398	47
14	9.44646	9.98233	9.46413	10.53587	10.01767	10.55354	46
15	9.44689	9.98229	9.46460	10.53540	10.01771	10.55311	45
16	9.44733	9.98226	9.46507	10.53493	10.01774	10.55267	44
17	9.44776	9.98222	9.46554	10.53446	10.01778	10.55224	43
18	9.44819	9.98218	9.46601	10.53399	10.01782	10.55181	42
19	9.44862	9.98215	9.46648	10.53352	10.01785	10.55138	41
20	9.44905	9.98211	9.46695	10.53306	10.01789	10.55095	40
21	9.44949	9.98207	9.46741	10.53259	10.01793	10.55052	39
22	9.44992	9.98204	9.46788	10.53212	10.01797	10.55009	38
23	9.45035	9.98200	9.46835	10.53165	10.01800	10.54966	37
24	9.45078	9.98196	9.46881	10.53119	10.01804	10.54923	36
25	9.45120	9.98193	9.46928	10.53072	10.01808	10.54880	35
26	9.45163	9.98189	9.46975	10.53025	10.01811	10.54837	34
27	9.45206	9.98185	9.47021	10.52979	10.01815	10.54794	33
28	9.45249	9.98181	9.47068	10.52932	10.01819	10.54751	32
29	9.45292	9.98177	9.47114	10.52886	10.01823	10.54709	31
30	9.45334	9.98174	9.47161	10.52840	10.01826	10.54666	30
		Sine.		Tang.		Secant.	Min.

73 Degrees,

16 Degrees.

Min.	Sine.		Tang.		Secant.		
30	9.4[illegible]34	9.98174	9.47161	10.52840	10.01826	10.54666	30
31	9.45377	9.98170	9.[illegible]7207	10.52793	10.01830	10.54623	29
32	9.45419	9.98166	9.47253	10.52747	10.01834	10.54581	28
33	9.45462	9.98162	9.47300	10.52701	10.01838	10.54538	27
34	9.45504	9.98159	9.47346	10.52654	10.01841	10.54496	26
35	9.45547	9.98155	9.47392	10.52608	10.01845	10.54453	25
36	9.45589	9.98151	9.47438	10.52562	10.01849	10.54411	24
37	9.45632	9.98147	9.47484	10.525[illegible]6	10.01853	10.54368	23
38	9.45674	9.98144	9.47530	10.52470	10.01856	10.54326	22
39	9.45716	9.98140	9.47576	10.52424	10.01860	10.54284	21
40	9.45758	9.98136	9.47622	10.52378	10.01864	10.54242	20
41	9.45791	9.98132	9.47668	10.52332	10.01868	10.54199	19
42	9.45843	9.98129	9.47714	10.52286	10.01872	10.54157	18
43	9.45885	9.98125	9.47760	10.52240	10.01875	10.54115	17
44	9.45927	9.98121	9.47806	10.52194	10.01879	10.54073	16
45	9.45969	9.98117	9.4785[illegible]	10.52148	10.01883	10.54031	15
46	9.46011	9.98113	9.47898	10.52103	10.01887	10.53989	14
47	9.46053	9.98110	9.47943	10.52057	10.01891	10.53947	13
48	9.46095	9.98106	9.47989	10.52011	10.01894	10.53905	12
49	9.46136	9.98102	9.48[illegible]35	10.51966	10.01898	10.53864	11
50	9.46178	9.98098	9.48080	10.51920	10.01902	10.53822	10
51	9.46220	9.98094	9.48126	10.51874	10.01906	10.53780	9
52	9.46266	9.98090	9.48171	10.51829	10.01910	10.53738	8
53	9.46303	9.98087	9.48217	10.51783	10.01913	10.53697	7
54	9.46345	9.98083	9.48262	10.51738	10.01917	10.53655	6
55	9.46386	9.98079	9.48308	10.51693	10.01921	10.53614	5
56	9.46428	9.98075	9.48353	10.51647	10.01925	10.53572	4
57	9.46469	9.98071	9.48398	10.51602	10.01929	10.53531	3
58	9.4[illegible]11	9.98067	9.48444	10.51557	10.01933	10.53489	2
59	9.46555	9.98064	9.48489	10.51511	10.01937	10.53448	1
60	9.46594	9.98060	9.48534	10.51466	10.01940	10.53407	0
		Sine		Tang.		Secant.	Min.

73 *Degrees.*

A Table of Artificial Sines,

17 Degrees.

Min.	Sine.		Tang.		Secant.		
0	9.46594	9.98060	9.48534	10.51466	10.01940	10.53407	60
1	9.46635	9.98056	9.48579	10.51421	10.01944	10.53365	59
2	9.46676	9.98052	9.48624	10.51376	10.01948	10.53324	58
3	9.46717	9.98048	9.48669	10.51331	10.01952	10.53283	57
4	9.46759	9.98044	9.48714	10.51286	10.01956	10.53242	56
5	9.46800	9.98040	9.48759	10.51241	10.01960	10.53200	55
6	9.46841	9.98036	9.48804	10.51196	10.01964	10.53159	54
7	9.46882	9.98033	9.48849	10.51151	10.01968	10.53118	53
8	9.46923	9.98029	9.48894	10.51106	10.01971	10.53077	52
9	9.46964	9.98025	9.48939	10.51061	10.01975	10.53030	51
10	9.47004	9.98021	9.48984	10.51016	10.01979	10.52995	50
11	9.47046	9.98017	9.49029	10.50971	10.01983	10.52955	49
12	9.47086	9.98013	9.49073	10.50927	10.01987	10.52914	48
13	9.47127	9.98009	9.49118	10.50882	10.01991	10.52873	47
14	9.47168	9.98005	9.49163	10.50837	10.01995	10.52823	46
15	9.47209	9.98001	9.49207	10.50793	10.01999	10.52791	45
16	9.47249	9.97997	9.49252	10.50748	10.02003	10.52751	44
17	9.47290	9.97993	9.49297	10.50704	10.02007	10.52710	43
18	9.47330	9.97990	9.49341	10.50659	10.02011	10.52670	42
19	9.47371	9.97986	9.49385	10.50615	10.02[illegible]	10.52629	41
20	9.47412	9.97982	9.49430	10.50570	[illegible]	10.52589	40
21	9.47452	9.97978	9.49474	10.50526	10.02022	10.52548	39
22	9.47492	9.97974	9.49519	10.50481	10.02026	10.52508	38
23	9.47533	9.97970	9.49563	10.50437	10.02030	10.52467	37
24	9.47573	9.97966	9.49607	10.50393	10.02034	10.52427	36
25	9.47613	9.97962	9.49552	10.50349	10.02038	10.52387	35
26	9.47654	9.97958	9.49696	10.50304	10.02042	10.52346	34
27	9.47694	9.97954	9.49740	10.50260	10.02046	10.52306	33
28	9.47734	9.97950	9.49784	10.50216	10.02050	10.52266	32
29	9.47774	9.97946	9.49828	10.50172	10.02054	10.52226	31
30	9.47814	9.97942	9.49872	10.50128	10.02058	10.52186	30
		Sine.		Tang.		Secant.	Min.

72 Degrees.

Tangents and Secants.

17 Degrees.

Min.	Sine.		Tang.		Secant.		
30	9.47814	9.97942	9.49872	10.50128	10.02058	10.52186	30
31	9.47854	9.97938	9.49916	10.50084	10.02062	10.52146	29
32	9.47894	9.97934	9.49960	10.50040	10.02066	10.52106	28
33	9.47934	9.97930	9.50004	10.49996	10.02070	10.52066	27
34	9.47974	9.97926	9.50048	10.49952	10.02074	10.52026	26
35	9.48014	9.97922	9.50092	10.49908	10.02078	10.51986	25
36	9.48054	9.97918	9.50136	10.49864	10.02082	10.51946	24
37	9.48094	9.97914	9.50180	10.49820	10.02086	10.51906	23
38	9.48133	9.97910	9.50224	10.49777	10.02090	10.51867	22
39	9.48173	9.97906	9.50267	10.49733	10.02094	10.51827	21
40	9.48213	9.97902	9.50311	10.49689	10.02098	10.51787	20
41	9.48253	9.97898	9.50355	10.49645	10.02102	10.51748	19
42	9.48292	9.97894	9.50398	10.49602	10.02106	10.51708	18
43	9.48332	9.97890	9.50442	10.49558	10.02110	10.51668	17
44	9.48371	9.97886	9.50485	10.49515	10.02114	10.51629	16
45	9.48411	9.97882	9.50529	10.49471	10.02118	10.51589	15
46	9.48450	9.97878	9.50572	10.49428	10.02122	10.51550	14
47	9.48490	9.97874	9.50616	10.49384	10.02126	10.51511	13
48	[illegible]	9.97870	9.50659	10.49341	10.02130	10.51471	12
49	[illegible]	9.97866	9.50703	10.49297	10.02135	10.51432	11
50	9.48608	[illegible]	9.50746	10.49254	10.02139	10.51393	10
51	9.48647	[illegible]	9.50789	10.49211	10.02143	10.51353	9
52	9.48686	[illegible]	9.50833	10.49167	10.02147	10.51314	8
53	9.48725	[illegible]	9.50876	10.49124	10.02151	10.51275	7
54	9.48764	[illegible]	9.50919	10.49081	10.02155	10.51236	6
55	9.48803	9.97841	9.50962	10.49038	10.02159	10.51197	5
56	9.48842	9.97837	9.51005	10.48995	10.02163	10.51158	4
57	9.48881	9.97833	9.51049	10.48952	10.02167	10.51119	3
58	9.48920	9.97829	9.51092	10.48908	10.02172	10.51080	2
59	9.48959	9.97825	9.51135	10.48865	10.02175	10.51041	1
60	9.48998	9.97821	9.51178	10.48822	10.02179	10.51002	0
		Sine.		Tang.		Secant.	Min.

72 Degrees.

A Table of Artificial Sines,

18 Degrees.

Min.	Sine.		Tang.		Secant.		
0	9.48998	9.97821	9.52178	10.48822	10.02179	10.51002	60
1	9.49037	9.97817	9.51221	10.48779	10.02184	10.50963	59
2	9.49076	9.97812	9.51264	10.48737	10.02188	10.50924	58
3	9.49115	9.97808	9.51306	10.48690	10.02192	10.50885	57
4	9.49153	9.97804	9.51349	10.48651	10.02196	10.50847	56
5	9.49192	9.97800	9.51392	10.48608	10.02200	10.50807	55
6	9.49231	9.97796	9.51435	10.48565	10.02204	10.50769	54
7	9.49270	9.97792	9.51478	10.48522	10.02208	10.50731	53
8	9.49308	9.97788	9.51520	10.48480	10.02212	10.50692	52
9	9.49347	9.97784	9.51563	10.48437	10.02217	10.50653	51
10	9.49385	9.97779	9.51606	10.48394	10.02221	10.50615	50
11	9.49424	9.97775	9.51648	10.48352	10.02225	10.50576	49
12	9.49462	9.97771	9.51691	10.48309	10.02229	10.50538	48
13	9.49501	9.97767	9.51734	10.48267	10.02233	10.50500	47
14	9.49539	9.97763	9.51779	10.48224	10.02237	10.50461	46
15	9.49577	9.97759	9.51819	10.48181	10.02241	10.50423	45
16	9.49615	9.97754	9.51861	10.48139	10.02246	10.50385	44
17	9.49654	9.97750	9.51903	10.48097	10.02250	10.50346	43
18	9.49692	9.97746	9.51946	10.48054	10.02254	10.50308	42
19	9.49730	9.97742	9.51988	10.48012	10.02258	10.50270	41
20	9.49768	9.97738	9.52031	10.47970	10.02262	10.50232	40
21	9.49806	9.97734	9.52073	10.47927	10.02267	10.50194	39
22	9.49844	9.97729	9.52115	10.47885	10.02271	10.50156	38
23	9.49882	9.97725	9.52157	10.47843	10.02275	10.50118	37
24	9.49920	9.97721	9.52200	10.47801	10.02279	10.50080	36
25	9.49958	9.97717	9.52242	10.47758	10.02283	10.50042	35
26	9.49996	9.97713	9.52284	10.47716	10.02288	10.50004	34
27	9.50034	9.97708	9.52326	10.47674	10.02292	10.49966	33
28	9.50072	9.97704	9.52368	10.47632	10.02296	10.49928	32
29	9.50110	9.97700	9.52410	10.47590	10.02300	10.49890	31
30	9.50158	9.97696	9.52452	10.47548	10.02304	10.49852	30
		Sine.		Tang.		Secant	Min.

71 Degrees.

18 *Degrees.*

Min.	Sine.		Tang.		Secant.		
30	9.50148	9.97696	9.52452	10.47548	10.02304	10.49852	30
31	9.50185	9.97691	9.52494	10.47506	10.02309	10.49815	29
32	9.50223	9.97687	9.52536	10.47464	10.02313	10.49777	28
33	9.50261	9.97683	9.52578	10.47422	10.02317	10.49739	27
34	9.50298	9.97679	9.52620	10.47380	10.02321	10.49702	26
35	9.50336	9.97675	9.52662	10.47335	10.02326	10.49664	25
36	9.50374	9.97670	9.52703	10.47297	10.02330	10.49627	24
37	9.50411	9.97666	9.52745	10.47255	10.02334	10.49589	23
38	9.50449	9.97662	9.52787	10.47213	10.02338	10.49552	22
39	9.50486	9.97657	9.52829	10.47172	10.02343	10.49514	21
40	9.50523	9.97653	9.52870	10.47130	10.02347	10.49477	20
41	9.50561	9.97649	9.52912	10.47088	10.02351	10.49439	19
42	9.50598	9.97645	9.52954	10.47047	10.02355	10.49402	18
43	9.50635	9.97640	9.52996	10.47005	10.02360	10.49365	17
44	9.50673	9.97636	9.53037	10.46963	10.02364	10.49327	16
45	9.50710	9.97632	9.53078	10.46922	10.02368	10.49290	15
46	9.50747	9.97628	9.53120	10.46880	10.02373	10.49253	14
47	9.50784	9.97623	9.53161	10.46839	10.02377	10.49216	13
48	9.50821	9.97619	9.53203	10.46798	10.02381	10.49179	12
49	9.50859	9.97615	9.53244	10.46756	10.02385	10.49142	11
50	9.50896	9.97610	9.53285	10.46715	10.02390	10.49104	10
51	9.50933	9.97606	9.53327	10.46673	10.02394	10.49067	9
52	9.50970	9.97602	9.53368	10.46632	10.02398	10.49030	8
53	9.51007	9.97597	9.53409	10.46591	10.02403	10.48994	7
54	9.51043	9.97593	9.53450	10.46550	10.02407	10.48957	6
55	9.51080	9.97589	9.53492	10.46508	10.02411	10.48920	5
56	9.51117	9.97584	9.53533	10.46467	10.02416	10.48883	4
57	9.51154	9.97580	9.53574	10.46426	10.02420	10.48846	3
58	9.51191	9.97576	9.53615	10.46385	10.02424	10.48809	2
59	9.51228	9.97571	9.53656	10.46344	10.02429	10.48773	1
60	9.51264	9.97567	9.53698	10.46303	10.02433	10.48736	0
		Sine.		Tang.		Secant.	Min.

71 *Degrees.*

A Table of Artificial Sines,

19 Degrees.

Min.	Sine.		Tang.		Secant.		
0	9.51264	9.97567	9.53697	10.4630[illegible]	10.02433	10.48736	60
1	9.51301	9.97563	9.53738	10.462[illegible]2	10.02437	10.48699	59
2	9.51338	9.97558	9.53779	10.46[illegible]21	10.02442	10.48663	58
3	9.51374	9.97554	9.53820	10.46[illegible]80	10.02446	10.48626	57
4	9.51411	9.97550	9.53861	10.46[illegible]39	10.02450	10.48589	56
5	9.51447	9.97545	9.53902	10.46098	10.02455	10.48553	55
6	9.51484	9.97541	9.53943	10.46057	10.02459	10.48516	54
7	9.51520	9.97537	9.53984	10.46016	10.02464	10.48480	53
8	9.51557	9.97532	9.54025	10.45976	10.02468	10.48443	52
9	9.51593	9.97528	9.54065	10.45935	10.02472	10.48407	51
10	9.51629	9.97523	9.54106	10.45894	10.02477	10.48371	50
11	9.51666	9.97519	9.54147	10.45853	10.02481	10.48334	49
12	9.51702	9.97515	9.54188	10.45813	10.02486	10.48298	48
13	9.51738	9.97510	9.54228	10.45772	10.02490	10.48262	47
14	9.51775	9.97506	9.54269	10.45731	10.02494	10.48226	46
15	9.51811	9.97501	9.54309	10.45691	10.02499	10.48189	45
16	9.51847	9.97497	9.54350	10.45650	10.02503	10.48153	44
17	9.51883	9.97493	9.54391	10.45610	10.02508	10.48117	43
18	9.51919	9.97488	9.54431	10.45569	10.02512	10.48081	42
19	9.51955	9.97484	9.54472	10.45528	10.02516	10.48045	41
20	9.51991	9.97479	9.54512	10.45488	10.02521	10.48009	40
21	9.52027	9.97475	9.54552	10.45448	10.02525	10.47973	39
22	9.52063	9.97470	9.54593	10.45407	10.02530	10.47937	38
23	9.52099	9.97466	9.54633	10.45367	10.02534	10.47901	37
24	9.52135	9.97461	9.54673	10.45327	10.02539	10.47865	36
25	9.52171	9.97457	9.54714	10.45286	10.02543	10.47829	35
26	9.52207	9.9745	9.54754	10.45246	10.02548	10.47793	34
27	9.52242	9.97448	9.54794	10.45206	10.02551	10.47758	33
28	9.52278	9.97444	9.54835	10.45166	10.02556	10.47722	32
29	9.52314	9.97439	9.54875	10.45125	10.02561	10.47686	31
30	9.52350	9.97435	9.54915	10.45085	10.02565	10.47651	30
		Sine.		Tang.		Secant.	Min.

70 Degrees.

Tangents and Secants.

19 Degrees.

Min.	Sine.		Tang.		Secant.		
30	9.52350	9.97435	9.54915	10.45085	10.02565	10.47651	30
31	9.52385	9.97430	9.54955	10.45045	10.02570	10.47615	29
32	9.52421	9.97426	9.54995	10.45005	10.02574	10.47579	28
33	9.52456	9.97421	9.55035	10.44965	10.02579	10.47544	27
34	9.52492	9.97417	9.55075	10.44925	10.02583	10.47508	26
35	9.52528	9.97412	9.55115	10.44885	10.02587	10.47473	25
36	9.52563	9.97408	9.55155	10.44845	10.02592	10.47437	24
37	9.52598	9.97403	9.55195	10.44805	10.02597	10.47402	23
38	9.52634	9.97399	9.55235	10.44765	10.02601	10.47366	22
39	9.52669	9.97394	9.55275	10.44725	10.02606	10.47331	21
40	9.52705	9.97390	9.55315	10.44685	10.02610	10.47295	20
41	9.52740	9.97385	9.55355	10.44645	10.02615	10.47260	19
42	9.52775	9.97381	9.55395	10.44605	10.02619	10.47225	18
43	9.52811	9.97376	9.55434	10.44566	10.02624	10.47190	17
44	9.52846	9.97372	9.55474	10.44526	10.02628	10.47154	16
45	9.52881	9.97367	9.55514	10.44486	10.02633	10.47119	15
46	9.52916	9.97363	9.55554	10.44446	10.02637	10.47084	14
47	9.52951	9.97358	9.55593	10.44407	10.02642	10.47049	13
48	9.52986	9.97354	9.55633	10.44367	10.02647	10.47014	12
49	9.53022	9.97349	9.55673	10.44327	10.02651	10.46979	11
50	9.53057	9.97344	9.55712	10.44288	10.02656	10.46944	10
51	9.53092	9.97340	9.55752	10.44248	10.02660	10.46909	9
52	9.53127	9.97335	9.55791	10.44209	10.02665	10.46874	8
53	9.53161	9.97331	9.55831	10.44169	10.02669	10.46839	7
54	9.53196	9.97326	9.55870	10.44130	10.02674	10.46804	6
55	9.53231	9.97322	9.55910	10.44090	10.02679	10.46769	5
56	9.53266	9.97317	9.55949	10.44051	10.02683	10.46734	4
57	9.53301	9.97312	9.55989	10.44012	10.02688	10.46699	3
58	9.53336	9.97308	9.56028	10.43972	10.02692	10.46664	2
59	9.53370	9.97303	9.56067	10.43933	10.02697	10.46630	1
60	9.53405	9.97299	9.56107	10.43893	10.02701	10.46595	0
		Sine		Tang.		Secant.	Min.

70 Degrees.

A Table of Artificial Sines,

20 Degrees.

Min.	Sine.		Tang		Secant.		
0	9.53405	9.97299	9.56107	10.438[illegible]	10.02701	10.46595	60
1	9.53440	9.97294	9.56146	10.43[illegible]4	10.02706	10.46560	59
2	9.53475	9.97289	9.56185	10.43[illegible]18	10.02711	10.46526	58
3	9.535[illegible]9	9.97285	9.56224	10.43[illegible]76	10.02715	10.46491	57
4	9.53544	9.97280	9.56264	10.43[illegible]36	10.02720	10.46456	56
5	9.53578	9.97276	9.56303	10.43[illegible]97	10.02725	10.46422	55
6	9.53613	9.97271	9.56342	10.43658	10.02729	10.46387	54
7	9.53647	9.97266	9.56[illegible]81	10.43619	10.02734	10.46353	53
8	9.53682	9.97262	9.56420	10.43580	10.02738	10.46318	52
9	9.53716	9.97257	9.56459	10.43541	10.02743	10.46284	51
10	9.53751	9.97252	9.56498	10.43502	10.02748	10.[illegible]6249	50
11	9.53785	9.97248	9.56537	10.43463	10.02752	10.46215	49
12	9.53819	9.97243	9.56576	10.43424	10.02757	10.46181	48
13	9.53854	9.97238	9.56615	10.43385	10.02762	10.46146	47
14	9.53888	9.97234	9.56654	10.43346	10.02766	10.46112	46
15	9.53922	9.97229	9.56693	10.43307	10.02771	10.46078	45
16	9.53957	9.97225	9.56732	10.43268	10.02776	10.46044	44
17	9.53991	9.97220	9.56771	10.43229	10.02780	10.46009	43
18	9.54025	9.97215	9.56810	10.43190	10.02785	10.45975	42
19	9.5405[illegible]	9.97211	9.56849	10.43151	10.02790	10.45941	41
20	9.54093	9.97206	9.56887	10.43113	10.02794	10.45907	40
21	9.54127	9.97201	9.56925	10.43074	10.02799	10.45873	39
22	9.54161	9.97196	9.56965	10.43035	10.02804	10.45839	38
23	9.54195	9.97192	9.57004	10.42996	10.02808	10.45805	37
24	9.54229	9.97187	9.57042	10.42958	10.02813	10.45771	36
25	9.54263	9.97182	9.57081	10.42919	10.02818	10.45737	35
26	9.54297	9.97178	9.57120	10.42881	10.02822	10.45703	34
27	9.54331	9.97173	9.57158	10.42842	10.02827	10.45669	33
28	9.5436[illegible]	9.97168	9.57197	10.42803	10.02832	10.45635	32
29	9.54399	9.97164	9.57235	10.42765	10.02837	10.45601	31
30	9.54433	9.9715[illegible]	9.57274	10.42726	10.02843	10.45568	30
		Sine.		Tang.		Secant.	Min.

69 Degrees.

Tangents and Secants.

20 Degrees.

Min.	Sine.		Tang.		Secant.		
30	9.54433	9.97159	9.5[illegible]274	10.42726	10.02841	10.45568	30
31	9.54466	9.97154	9.57[illegible]12	10.42688	10.02846	10.45534	29
32	9.54500	9.97149	9.573[illegible]1	10.42649	10.02851	10.45500	28
33	9.54534	9.97145	9.573[illegible]9	10.42611	10.02855	10.45466	27
34	9.54567	9.97140	9.57[illegible]28	10.42572	10.02860	10.45433	26
35	9.54601	9.97135	9.57[illegible]66	10.42534	10.02865	10.45399	25
36	9.54635	9.97130	9.57[illegible]04	10.42496	10.02870	10.45365	24
37	9.54668	9.97126	9.57543	10.42457	10.02874	10.45332	23
38	9.54702	9.97121	9.57581	10.42419	10.02879	10.45298	22
39	9.54735	9.97116	9.57619	10.42381	10.02884	10.45265	21
40	9.54769	9.97111	9.57658	10.42342	10.02889	10.45231	20
41	9.54802	9.97107	9.57696	10.42304	10.02893	10.45198	19
42	9.54836	9.97102	9.57734	10.42266	10.02898	10.45164	18
43	9.54869	9.97097	9.57772	10.42228	10.02903	10.45131	17
44	9.54903	9.97092	9.57810	10.42190	10.02908	10.45097	16
45	9.54936	9.97087	9.57849	10.42151	10.02913	10.45064	15
46	9.54969	9.97083	9.57887	10.42113	10.02917	10.45031	14
47	9.55003	9.97078	9.57925	10.42075	10.02922	10.44997	13
48	9.55036	9.97073	9.57963	10.42037	10.02927	10.44964	12
49	9.55069	9.97068	9.58001	10.41999	10.02932	10.44931	11
50	9.55102	9.97064	9.58039	10.41961	10.02937	10.44898	10
51	9.55136	9.97059	9.58077	10.41923	10.02941	10.44864	9
52	9.55169	9.97054	9.58115	10.41885	10.02946	10.44831	8
53	9.55202	9.97049	9.58153	10.41847	10.02951	10.44798	7
54	9.55235	9.97044	9.58191	10.41809	10.02956	10.44765	6
55	9.55268	9.97039	9.58229	10.41771	10.02961	10.44732	5
56	9.55301	9.97035	9.58267	10.41734	10.02966	10.44699	4
57	9.55334	9.97030	9.58304	10.41696	10.02970	10.44666	3
58	9.55367	9.97025	9.58342	10.41658	10.02975	10.44633	2
59	9.55400	9.97020	9.58380	10.41620	10.02980	10.44600	1
60	9.55433	9.97015	9.58418	10.41582	10.02985	10.44567	0
		Sine		Tang.		Secant.	Min.

69 Degrees.

A Table of Artificial Sines,

21 *Degrees.*

Min.	Sine.		Tang.		Secant.		
0	9.55433	9.97015	9.58418	[illegible]	10.02985	10.44567	60
1	9.55466	9.97010	9.58456	[illegible]	10.02990	10.44534	59
2	9.55499	9.97006	9.58493	[illegible]	10.02995	10.44501	58
3	9.55532	9.97001	9.58531	[illegible]	10.02999	10.44468	57
4	9.55564	9.96996	9.58569	[illegible]	10.03004	10.44436	56
5	9.55597	9.96991	9.58606	[illegible]	10.03009	10.44401	55
6	9.55630	9.96986	9.58644	[illegible]	10.03014	10.44370	54
7	9.55663	9.96981	9.58682	10.41319	10.03019	10.44337	53
8	9.55695	9.96976	9.58719	[illegible]	10.03024	10.44305	52
9	9.55728	9.96971	9.58757	10.41243	10.03029	10.44272	51
10	9.55761	9.96967	9.58794	10.41206	10.03034	10.44239	50
11	9.55793	9.96962	9.58832	10.41168	10.03038	10.44207	49
12	9.55826	9.96957	9.58869	10.41131	10.03043	10.44174	48
13	9.55858	9.96952	9.58907	10.41093	10.03048	10.44142	47
14	9.55891	9.96947	9.58944	10.41056	10.03053	10.44109	46
15	9.55923	9.96942	9.58981	10.41019	10.03058	10.44076	45
16	9.55956	9.96937	9.59016	10.40981	10.03063	10.44044	44
17	9.55988	9.96932	9.59056	10.40944	10.03068	10.44012	43
18	9.56021	9.96927	9.59094	10.40907	10.03073	10.43979	42
19	9.56053	9.96922	9.59131	10.40869	10.03078	10.43947	41
20	9.56086	9.96917	9.59168	10.40832	10.03083	10.43915	40
21	9.56118	9.96912	9.59205	10.40795	10.03088	10.43882	39
22	9.56150	9.96908	9.59243	10.40757	10.03093	10.43850	38
23	9.56182	9.96903	9.59280	10.40720	10.03098	10.43818	37
24	9.56215	9.96898	9.59317	10.40683	10.03102	10.43785	36
25	9.56247	9.96893	9.59354	10.40646	10.03107	10.43753	35
26	9.56280	9.96888	9.59391	[illegible]	10.03112	10.43721	34
27	9.56311	9.96883	9.59429	10.40572	10.03118	10.43689	33
28	9.56343	9.96878	9.59466	10.40534	10.03122	[illegible]	32
29	9.56376	9.96873	9.59503	10.40497	10.03127	10.43625	31
30	9.56408	9.96868	9.59540	10.40460	[illegible]	10.43592	30
		Sine.		Tang.		Secant.	Min.

68 *Degrees.*

21 *Degrees.*

Min.	Sine.		Tang.		Secant.		
30	9.56408	9.96868	9.5[illegible]540	10.40460	10.03132	10.43[illegible]93	30
31	9.56440	9.96863	9.59[illegible]77	10.40423	10.03137	10.43561	29
32	9.56472	9.96858	9.596[illegible]4	10.40386	10.03142	10.43528	28
33	9.56504	9.96853	9.596[illegible]1	10.40349	10.03147	10.43496	27
34	9.56536	9.96848	9.596[illegible]8	10.40312	10.03152	10.43464	26
35	9.56568	9.96843	9.597[illegible]5	10.40275	10.03157	10.43432	25
36	9.56600	9.96838	9.59[illegible]62	10.40238	10.03162	10.43401	24
37	9.56631	9.96833	9.59[illegible]99	10.40202	10.03167	10.43369	23
38	9.56663	9.96828	9.598[illegible]5	10.40165	10.03172	10.43337	22
39	9.56695	9.96823	9.5987[illegible]	10.40128	10.03177	10.43305	21
40	9.56727	9.96818	9.59909	10.40091	10.03182	10.43273	20
41	9.56759	9.96813	9.59946	10.40054	10.03187	10.43241	19
42	9.56790	9.96808	9.59983	10.40017	10.03192	10.43210	18
43	9.56822	9.96803	9.60019	10.39981	10.03197	10.43178	17
44	9.56854	9.96798	9.60056	1[illegible].39944	10.03202	10.43146	16
45	9.56884	9.96793	9.60093	10.39907	10.03207	10.43114	15
46	9.56917	9.96788	9.60130	10.39870	10.03212	10.43083	14
47	9.56949	9.96783	9.60166	10.39834	10.03217	10.43051	13
48	9.56980	9.96778	9.60203	10.39797	10.03223	10.43020	12
49	9.57012	9.96773	9.60240	10.39761	10.03228	10.42988	11
50	9.57044	9.96767	9.60276	10.39724	10.03233	10.42956	10
51	9.57075	9.96762	9.60313	10.39687	10.03238	10.42925	9
52	9.57107	9.96757	9.60349	10.39651	10.03243	10.42893	8
53	9.57138	9.96752	9.60386	10.39614	10.03248	10.42862	7
54	9.57170	9.96747	9.60422	10.39578	10.03253	10.42831	6
55	9.57201	9.96742	9.60459	10.39541	10.03258	10.42799	5
56	9.57232	9.96737	9.60495	10.39505	10.03263	10.42768	4
57	9.57264	9.96732	9.60532	10.39468	10.03268	10.42736	3
58	9.57295	9.96727	9.60568	10.39432	10.03273	10.42705	2
59	9.5732[illegible]	9.96722	9.60605	10.39395	10.03278	10.42674	1
60	9.57358	[illegible].96717	[illegible].60641	10.39359	10.03283	10.42643	0
		Sine.		Tang.		Secant.	Min.

68 *Degrees.*

A Table of Artificial Sines,

22 *Degrees.*

Min.	Sine.		Tang.		Secant.		
0	9.57358	9.96717	9.60641	10.3935[illegible]	10.03283	10.42643	60
1	9.57389	9.96712	9.60677	10.392[illegible]3	10.03289	10.42611	59
2	9.57420	9.96706	9.60714	10.39[illegible]86	10.03294	10.42580	58
3	9.57451	9.96701	9.60750	10.39[illegible]50	10.03299	10.42549	57
4	9.57482	9.96696	9.60786	10.39[illegible]14	10.03304	10.42518	56
5	9.57514	9.96691	9.608[illegible]3	10.391[illegible]	10.03309	10.42487	55
6	9.57545	9.96686	9.60859	10.391[illegible]1	10.03314	10.42455	54
7	9.57576	9.96681	9.60895	10.391[illegible]5	10.03319	10.42424	53
8	9.57607	9.96676	9.60931	10.390[illegible]	10.03324	10.42393	52
9	9.57638	9.96671	9.60967	10.[illegible]033	10.03330	10.42362	51
10	9.57669	9.96665	9.61004	10.38996	10.03335	10.42331	50
11	9.57700	9.96660	9.61040	10.38960	10.03340	10.42300	49
12	9.57731	9.96655	9.61076	10.38924	10.03345	10.42269	48
13	9.57762	9.96650	9.61112	10.38888	10.03350	10.42238	47
14	9.57793	9.96645	9.61148	10.38852	10.03355	10.42207	46
15	9.57824	9.96640	9.61184	10.38816	10.03361	10.42176	45
16	9.57855	9.96634	9.61200	10.38780	10.03366	10.42146	44
17	9.57885	9.96629	9.61256	10.38744	10.03371	10.42115	43
18	9.57916	9.96624	9.61292	10.38708	10.03376	10.42084	42
19	9.57947	9.96619	9.61328	10.38672	10.03381	10.42053	41
20	9.57978	9.96614	9.61364	10.38636	10.03386	10.42023	40
21	9.58008	9.96609	9.61400	10.38600	10.03392	10.41992	39
22	9.58039	9.96603	9.61436	10.38564	10.03397	10.41961	38
23	9.58070	9.96598	9.61472	10.38528	10.03402	10.41930	37
24	9.58101	9.96593	9.61508	10.38492	10.03407	10.41900	36
25	9.58131	9.96588	9.61544	10.38457	10.03412	10.41869	35
26	9.58162	9.96582	9.61579	10.38421	10.03418	10.41838	34
27	9.58192	9.96577	9.61615	10.38385	10.03423	10.41808	33
28	9.58223	9.96572	9.61651	10.38349	10.03428	10.41777	32
29	9.58253	9.96567	9.61687	10.38313	10.03433	10.41747	31
30	9.58284	9.96562	9.61722	10.38278	10.03439	10.41716	30
		Sine.		Tang.		Secant.	Min.

67 *Degrees.*

22 Degrees.

Min.	Sine.		Tang.		Secant.		
30	9.58284	9.96562	9.[illegible]722	10.38278	10.03439	10.41716	30
31	9.58314	9.96556	9.61[illegible]58	10.38242	10.03444	10.41686	29
32	9.58345	9.96551	9.617[illegible]4	10.38206	10.03449	10.41655	28
33	9.58375	9.96546	9.618[illegible]0	10.38171	10.03454	10.41625	27
34	9.58406	9.96541	9.618[illegible]5	10.38135	10.03459	10.41594	26
35	9.58436	9.96535	9.619[illegible]1	10.38099	10.03465	10.41564	25
36	9.58467	9.96530	9.61[illegible]36	10.3806[illegible]	10.03470	10.41534	24
37	9.58497	9.96525	9.61[illegible]72	10.380[illegible]8	10.03475	10.41503	23
38	9.58527	9.96520	9.620[illegible]8	10.37992	10.03481	10.41473	22
39	9.58557	9.96514	9.62043	10.37957	10.03486	10.41443	21
40	9.58588	9.96509	9.62079	10.[illegible]7921	10.03491	10.41412	20
41	9.58618	9.96504	9.62114	10.[illegible]7886	10.03496	10.41382	19
42	9.58648	9.96498	9.62150	10.37850	10.03502	10.41352	18
43	9.58678	9.96493	9.62185	10.3[illegible]815	10.03507	10.41322	17
44	9.58709	9.96488	9.62221	10.[illegible]7779	10.03512	10.41292	16
45	9.58739	9.96483	9.62256	10.3[illegible]744	10.03517	10.41261	15
46	9.58769	9.96477	9.62292	10.377[illegible]	10.03523	10.41231	14
47	9.58799	9.96472	9.62327	10.37673	10.03528	10.41201	13
48	9.58829	9.96467	9.62362	10.37638	10.03533	10.41171	12
49	9.58859	9.96461	9.62398	10.37602	10.03539	10.41141	11
50	9.58889	9.96456	9.62433	10.37567	10.03544	10.41111	10
51	9.58919	9.96451	9.62468	10.37532	10.03549	10.41081	9
52	9.58949	9.96445	9.62504	10.37496	10.03555	10.41051	8
53	9.58979	9.96440	9.62539	10.37461	10.03560	10.41021	7
54	9.59009	9.96435	9.62574	10.37426	10.03566	10.40991	6
55	9.59039	9.96429	9.62609	10.37391	10.03571	10.40961	5
56	9.59069	9.96424	9.62645	10.37356	10.03576	10.40931	4
57	9.59098	9.96419	9.62680	10.37320	10.03581	10.40902	3
58	9.59128	9.96413	9.62715	10.37285	10.03587	10.40872	2
59	9.591[illegible]8	9.96408	9.62750	10.37250	10.03592	10.40842	1
60	9.59188	9.[illegible]6403	9.62785	10.37215	10.03597	10.40812	0
		Sine.		Tang.		Secant.	Min.

67 Degrees.

A Table of Artificial Sines,

23 Degrees.

Min.	Sine.		Tang.		Secant.		
0	9.59188	9.96403	9.62785	10.37[illegible]15	10.03597	10.40812	60
1	9.59218	9.96397	9.62820	10.3[illegible]180	10.03603	10.40782	59
2	9.59247	9.96392	9.62855	10.3[illegible]145	10.03608	10.40753	58
3	9.59278	9.96387	9.62891	10.3[illegible]110	10.03614	10.40723	57
4	9.59307	9.96381	9.62926	10.3[illegible]075	10.03619	10.40693	56
5	9.59336	9.96376	9.6[illegible]961	10.37[illegible]39	10.03624	10.40664	55
6	9.59366	9.96370	9.62996	10.37[illegible]04	10.03630	10.40634	54
7	9.59396	9.96365	9.63031	10.3[illegible]969	10.03635	10.40604	53
8	9.59425	9.96360	9.63066	10.[illegible]6934	10.03640	10.40575	52
9	9.59455	9.96354	9.63101	1[illegible].36900	10.03646	10.40545	51
10	9.59484	9.96349	9.63135	10.36865	10.03651	10.40516	50
11	9.59514	9.96343	9.63170	[illegible]0.36830	10.03657	10.40486	49
12	9.59543	9.96338	9.632[illegible]5	[illegible].36795	10.03662	10.40457	48
13	9.59573	9.96333	9.632[illegible]	[illegible].36760	10.03668	10.40427	47
14	9.59602	9.96327	9.63275	10.36725	10.03673	10.40398	46
15	9.59632	9.96322	9.6[illegible]310	10.36690	10.03678	10.40369	45
16	9.59661	9.96316	9.63345	10.36655	10.03684	10.40339	44
17	9.59690	9.96311	9.63380	10.36621	10.03689	10.40310	43
18	9.59720	9.96305	9.63414	10.36586	10.03695	10.40280	42
19	9.59749	9.96300	9.63449	10.36551	10.03700	10.40251	41
20	9.59778	9.96295	9.63484	10.36516	10.03706	10.40222	40
21	9.59808	9.96289	9.63519	10.36482	10.03711	10.40193	39
22	9.59837	9.96284	9.63553	10.36447	10.03716	10.40163	38
23	9.59866	9.96278	9.63588	10.36412	10.03722	10.40134	37
24	9.59895	9.96273	9.63623	10.36377	10.03727	10.40105	36
25	9.59924	9.96267	9.63657	10.36343	10.03733	10.40076	35
26	9.59954	9.96262	9.63692	10.36308	10.03738	10.40046	34
27	9.59983	9.96256	9.63727	10.36274	10.03744	10.40017	33
28	9.60012	9.96251	9.63761	10.36239	10.03749	10.[illegible]0988	32
29	9.60041	9.96245	9.63796	10.36204	10.037[illegible]	10.40959	31
30	9.60070	9.96240	9.63830	10.36170	10.037[illegible]0	10.40930	30
		Sine.		Tang.		Secant.	Min.

66 Degrees.

23 *Degrees.*

Min.	Sine.		Tang.		Secant.		
30	9.60070	9.96240	9.[illegible]3830	10.36170	10.03760	10.39930	30
31	9.60099	9.96234	9.[illegible]865	10.36135	10.03766	10.39901	29
32	9.60128	9.96229	9.63[illegible]99	10.36101	10.03771	10.39872	28
33	9.60157	9.96223	9.63[illegible]34	10.36066	10.03777	10.39843	27
34	9.60186	9.96218	9.63[illegible]68	10.36032	10.03782	10.39814	26
35	9.60215	9.96212	9.64[illegible]03	10.35997	10.03780	10.39785	25
36	9.60244	9.96207	9.6[illegible]37	10.35963	10.03793	10.39756	24
37	9.60273	9.96201	9.6[illegible]72	10.35928	10.03799	10.39727	23
38	9.60302	9.96196	9.64[illegible]06	10.35894	10.03804	10.39698	22
39	9.60331	9.96190	9.64[illegible]	10.35860	10.03810	10.39670	21
40	9.60359	9.96185	9.64175	[illegible]35825	10.03815	10.39641	20
41	9.60[illegible]88	9.96179	9.64209	1[illegible].35791	10.03821	10.39612	19
42	9.60417	9.96174	9.64243	1[illegible].35757	10.03826	10.39583	18
43	9.60446	9.96168	9.64278	[illegible]722	10.03832	10.39554	17
44	9.60475	9.96162	9.64312	[illegible]5688	10.03838	10.39526	16
45	9.60503	9.96157	9.64346	10.[illegible]5654	10.03843	10.39497	15
46	9.60532	9.96151	9.6438[illegible]	10.3[illegible]619	10.03849	10.39468	14
47	9.60561	9.96146	9.64415	10.35[illegible]85	10.03854	10.39439	13
48	9.60589	9.96140	9.64449	10.355[illegible]	10.03860	10.39411	12
49	9.60618	9.96135	9.64483	10.35517	10.03865	10.39382	11
50	9.60647	9.96129	9.64517	10.35483	10.03871	10.39354	10
51	9.60675	9.96124	9.64552	10.35448	10.03877	10.39325	9
52	9.60704	9.96118	9.64586	10.35414	10.03882	10.39296	8
53	9.60732	9.96112	9.64620	10.35380	10.03888	10.39268	7
54	9.60761	9.96107	9.64654	10.35346	10.03893	10.39239	6
55	9.60789	9.96101	9.64688	10.35312	10.03899	10.39211	5
56	9.60818	9.96096	9.64722	10.35278	10.03905	10.39182	4
57	9.60846	9.96090	9.64756	10.35244	10.03910	10.39153	3
58	9.60875	9.96084	9.64790	10.35210	10.03916	10.39126	2
59	9.6[illegible]03	9.96079	9.64824	10.35176	10.03921	10.39097	1
60	9.6093[illegible]	[illegible].96073	9.64858	10.35142	10.03927	10.39069	0
		Sine.		Tang.		Secant.	Min.

66 *Degrees.*

A Table of Artificial Sines,

24 *Degrees.*

Min.	Sine		Tang		Secant.		
0	9.60931	9.96073	9.64858	10.351[illegible]2	10.03927	10.39069	60
1	9.60960	9.96067	9.64892	10.35[illegible]08	10.03933	10.39040	59
2	9.60988	[illegible]96062	9.64926	10.35[illegible]74	10.03938	10.39012	58
3	9.61016	9.96056	9.64960	10.35[illegible]40	10.03944	10.38984	57
4	9.61045	9.96051	9.64994	10.35[illegible]06	10.03950	10.38955	56
5	9.61073	9.96045	9.65028	10.34[illegible]72	10.03955	10.38927	55
6	9.61101	9.96039	9.65062	10.34[illegible]8	10.03961	10.38899	54
7	9.61129	9.96034	9.65096	10.34[illegible]04	10.03967	10.38871	53
8	9.61158	9.96028	9.65130	10.[illegible]4870	10.03972	10.38842	52
9	9.61186	9.96022	9.6516[illegible]	[illegible]34836	10.03978	10.38814	51
10	9.61214	9.96017	9.65197	[illegible]0.34803	10.03983	10.[illegible]8786	50
11	9.61242	9.96011	9.65231	[illegible].34769	10.03989	10.38758	49
12	9.61270	9.96005	9.652[illegible]	[illegible].34735	10.03995	10.38730	48
13	9.61298	9.96000	9.652[illegible]	[illegible].34701	10.04001	10.38702	47
14	9.61326	9.95994	9.6533[illegible]	10.34667	10.04006	10.38674	46
15	9.61355	9.95988	9.65[illegible]66	10.34634	10.04012	10.38646	45
16	9.6138[illegible]	9.95983	9.6[illegible]400	10.34600	10.04018	10.38618	44
17	9.61411	9.95977	9.65434	10.34566	10.04023	10.38590	43
18	9.61439	9.95971	9.65467	10.34533	10.04029	10.38562	42
19	9.61467	9.9596[illegible]	9.65501	10.34499	10.04035	10.38534	41
20	9.61494	9.95960	9.65535	10.34465	10.04040	10.38506	40
21	9.61522	9.95954	9.65568	10.34432	10.04046	10.38478	39
22	9.61550	9.95944	9.65602	10.34398	10.04052	10.38450	38
23	9.61578	9.95943	9.65636	10.34364	10.04058	10.38422	37
24	9.61606	9.95937	9.65669	10.34331	10.04063	10.38394	36
25	9.61634	9.95931	9.65702	10.34297	10.04069	10.38366	35
26	9.61662	9.95925	9.65736	10.34264	10.04075	10.38338	34
27	9.61689	9.95920	9.65770	10.34230	10.04081	10.38311	33
28	9.61717	9.95914	9.65803	10.34197	10.04086	10.[illegible]8283	32
29	9.61745	9.95908	9.65837	10.34163	10.0409[illegible]	[illegible]0.38255	31
30	9.61773	9.95902	9.65870	10.34130	10.040[illegible]8	10.38227	30
		Sine		Tang.		Secant.	Min.

65 *Degrees.*

Tangents and Secants.

24 Degrees.

Min.	Sine.		Tang.		Secant.		
30	9.61773	9.95902	9.65870	10.34130	10.04098	10.38227	30
31	9.61800	9.95897	9.65904	10.34096	10.04104	10.38200	29
32	9.61828	9.95891	9.65937	10.34063	10.04[illegible]	[illegible]8172	28
33	9.61856	9.95885	9.65971	10.34029	10.04115	10.38144	27
34	9.61883	9.95879	9.66[illegible]04	10.33996	10.04121	10.38117	26
35	9.61911	9.9587[illegible]	9.66[illegible]38	10.33962	10.04127	10.38089	25
36	9.61939	9.95868	9.66[illegible]71	10.33929	10.04132	10.38061	24
37	9.61966	9.95862	9.661[illegible]4	10.33896	10.04138	10.38034	23
38	9.61994	9.95856	9.661[illegible]	10.33862	10.04144	10.38006	22
39	9.62021	9.95850	9.66171	[illegible].33829	10.04150	10.37979	21
40	9.62[illegible]49	9.95845	9.66204	10[illegible]33796	10.04156	10.37951	20
41	9.62076	9.95839	9.66238	1[illegible]33762	10.04161	10.37924	19
42	9.62104	9.95833	9.66271	[illegible]729	10.04167	10.37896	18
43	9.62131	9.95827	9.66304	[illegible]696	10.04173	10.37869	17
44	9.62159	9.95821	9.66337	10.[illegible]3663	10.04179	10.37841	16
45	9.62186	9.95815	9.66371	10.33[illegible]29	10.04185	10.37814	15
46	9.62214	9.9581[illegible]	9.66404	10.335[illegible]6	10.04190	10.37787	14
47	9.62241	9.95804	9.66437	10.33563	10.04196	10.37759	13
48	9.62268	9.95798	9.66470	10.33530	10.04202	10.37732	12
49	9.62296	9.95792	9.66504	10.33497	10.04208	10.37704	11
50	9.62323	9.95786	9.66537	10.33463	10.04214	10.37677	10
51	9.62350	9.95780	9.66570	10.33430	10.04220	10.37650	9
52	9.62377	9.95775	9.66603	10.33397	10.04225	10.37623	8
53	9.62405	9.95769	9.66636	10.33364	10.04231	10.37595	7
54	9.62432	9.9576[illegible]	9.66669	10.33331	10.04237	10.37568	6
55	9.62459	9.95757	9.66702	10.33298	10.04243	10.37541	5
56	9.62486	9.95751	9.66735	10.33265	10.04249	10.37514	4
57	9.62514	9.95745	9.66768	10.33232	10.04255	10.37487	3
58	9.62[illegible]	9.95739	9.66801	10.33199	10.04261	10.37459	2
59	9.62568	9.95734	9.66834	10.33166	10.04267	10.37432	1
60	9.62595	9.95728	9.66867	10.33133	10.04272	10.37405	0
		Sine		Tang.		Secant.	Min.

65 Degrees.

A Table of Artificial Sines,

25 *Degrees.*

Min.	Sine.		Tang.		Secant.		
0	9.62595	9.95728	9.66867	10.33133	10.04272	10.37405	60
1	9.626[illegible]2	9.95722	9.66900	10.33100	10.04278	10.37378	59
2	9.62649	9.95716	9.66933	10.33067	10.04284	10.37351	58
3	9.626[illegible]	[illegible]0	9.66966	10.33034	10.04290	10.37324	57
4	9.62703	9.95704	9.66999	10.33001	10.04296	10.37297	56
5	9.62730	9.95698	9.67032	10.32958	10.04302	10.37270	55
6	9.62757	9.95692	9.67065	10.329[illegible]5	10.04308	10.37243	54
7	9.62784	9.95686	9.67098	10.329[illegible]2	10.04314	10.37216	53
8	9.62811	9.95680	9.67131	10.328[illegible]9	10.04320	10.37189	52
9	9.62838	9.95674	9.67103	10.[illegible]837	10.04326	10.37162	51
10	9.62865	9.95668	9.67196	[illegible].32804	10.04332	10.37135	50
11	9.62892	9.95663	9.67229	[illegible].32771	10.04338	10.37108	49
12	9.62918	9.95657	9.67262	[illegible].32738	10.04343	10.37082	48
13	9.62945	9.95651	9.6729[illegible]	[illegible]32705	10.04349	10.37055	47
14	9.62972	9.95645	9.6732[illegible]	[illegible]2673	10.04355	10.37028	46
15	9.62999	9.95639	9.6736[illegible]	10.32640	10.04361	10.37001	45
16	9.63025	9.95633	9.673[illegible]3	10.32607	10.04367	10.36974	44
17	9.63052	9.95627	9.67[illegible]26	10.32574	10.04373	10.36948	43
18	9.63079	9.95621	9.67458	10.32542	10.04379	10.36921	42
19	9.63106	9.95615	9.67491	10.32509	10.04385	10.36894	41
20	9.63133	9.95609	9.67524	10.32476	10.04391	10.36867	40
21	9.63159	9.95603	9.67556	10.32444	10.04397	10.36841	39
22	9.63186	9.95597	9.67589	10.32411	10.04403	10.36814	38
23	9.63213	9.95591	9.67622	10.32378	10.04409	10.36787	37
24	9.63239	9.95585	9.67654	10.32346	10.04415	10.36761	36
25	9.63266	9.95579	9.67687	10.32313	10.04421	10.36734	35
26	9.63292	9.95573	9.67719	10.32281	10.04427	10.36708	34
27	9.63319	9.95567	9.67752	10.32248	10.04433	10.36681	33
28	9.63345	9.95561	9.67785	10.32215	10.04439	10.36655	32
29	9.63372	9.95555	9.67817	10.32183	10.04445	10.[illegible]628	31
30	9.63398	9.95549	9.67850	10.32150	10.04451	[illegible].36602	30
		Sine.		Tang.		Secant.	Min.

64 *Degrees.*

Tangents and Secants.

25 Degrees.

Min.	Sine.		Tang.		Secant.		
30	9.63398	9.95549	9.67850	10.32150	10.04451	10.36602	30
31	9.63425	9.95543	9.67882	10.32118	10.04457	10.36575	29
32	9.63451	9.95537	9.67915	10.32085	10.0[illegible]	[illegible]36549	28
33	9.63478	9.95531	9.67947	10.32053	10.04469	10.36522	27
34	9.63504	9.95525	9.67980	10.32021	10.04475	10.36496	26
35	9.63531	9.95519	9.68[illegible]12	10.31988	10.04481	10.36469	25
36	9.63567	9.95513	9.6[illegible]044	10.31956	10.04487	10.36443	24
37	9.63583	9.95507	9.68[illegible]77	10.31923	10.04494	10.36417	23
38	9.63610	9.95501	9.681[illegible]	10.31891	10.04500	10.36390	22
39	9.63636	9.95494	9.68142	10.31858	10.04506	10.36364	21
40	9.63[illegible]62	9.95488	9.68174	1[illegible]31826	10.04512	10.36338	20
41	9.63689	9.95482	9.68206	1[illegible]31794	10.04518	10.36311	19
42	9.63715	9.95476	9.68239	[illegible]761	10.04524	10.36285	18
43	9.63741	9.95470	9.68271	[illegible]1729	10.04530	10.36259	17
44	9.63767	9.95464	9.68303	10[illegible]1697	10.04536	10.362[illegible]3	16
45	9.63794	9.95458	9.68336	10.3[illegible]664	10.04542	10.36207	15
46	9.63820	9.95452	9.68368	10.31[illegible]32	10.04548	10.36180	14
47	9.63846	9.95446	9.68400	10.31600	10.04554	10.36154	13
48	9.63872	9.95440	9.68432	10.31568	10.04560	10.36128	12
49	9.63898	9.95434	9.68465	10.31535	10.04567	10.36102	11
50	9.63924	9.95427	9.68497	10.31503	10.04573	10.36076	10
51	9.63950	9.95421	9.68529	10.31471	10.04579	10.36050	9
52	9.63976	9.95415	9.68561	10.31439	10.04585	10.36024	8
53	9.64002	9.95409	9.68593	10.31407	10.04591	10.35998	7
54	9.64028	9.95403	9.68626	10.31375	10.04597	10.35972	6
55	9.64054	9.95397	9.68658	10.31342	10.04603	10.35946	5
56	9.64080	9.95391	9.68690	10.31310	10.04609	10.35920	4
57	9.64106	9.95385	9.68722	10.31278	10.04616	10.35894	3
58	9.6[illegible]32	9.95378	9.68754	10.31246	10.04622	10.35868	2
59	9.6415[illegible]	[illegible].95372	[illegible].68786	10.31214	10.04628	10.35842	1
60	9.64184	[illegible]95366	9.68818	10.31182	10.04634	10.35816	0
		Sine.		Tang.		Secant.	Min.

64 Degrees.

A Table of Artificial Sines,

26 Degrees.

Min.	Sine.		Tang.		Secant.		
0	9.64184	9.95366	9.68818	10.31182	10.04634	10.35816	60
1	[illegible]	9.95360	9.68850	10.31150	10.04640	10.35790	59
2	9.64236	[illegible]	9.68882	10.31118	10.04646	10.35764	58
3	[illegible]	[illegible]	9.68914	10.31086	10.04653	10.35738	57
4	9.64288	9.95341	9.68946	10.31054	10.04659	10.35712	56
5	9.64314	9.95335	9.68978	10.31022	10.04665	10.35687	55
6	9.64339	9.95329	[illegible]	[illegible]	10.04671	10.35661	54
7	9.64365	9.95323	9.69042	[illegible]	10.04677	10.35635	53
8	9.64391	9.95317	9.69074	[illegible]	10.04683	10.35609	52
9	[illegible]	9.95310	9.69106	[illegible]	10.04690	10.35584	51
10	9.64442	9.95304	[illegible]	[illegible]	10.04696	10.35558	50
11	9.64468	9.95298	[illegible]	[illegible]	10.04702	10.35532	49
12	9.64494	9.95292	9.69202	[illegible]	10.04708	10.35506	48
13	9.64519	9.95286	[illegible]	[illegible]	10.04715	10.35481	47
14	9.64545	9.95279	[illegible]	[illegible]	10.04721	10.35455	46
15	9.64571	9.95273	[illegible]	10.20703	10.04727	10.35429	45
16	9.64596	9.95267	[illegible]	10.30671	10.04733	10.35404	44
17	9.64622	9.95261	[illegible]	10.30639	10.04739	10.35378	43
18	9.64647	9.95254	9.69393	10.30607	10.04746	10.35353	42
19	9.64673	9.95248	9.69425	10.30575	10.04752	10.35327	41
20	9.64698	9.95242	9.69457	10.30543	10.04758	10.35302	40
21	9.64724	9.95236	9.69488	10.30512	10.04764	10.35276	39
22	9.64749	9.95229	9.69520	10.30480	10.04771	10.35251	38
23	9.64775	9.95223	9.69552	10.30448	10.04777	10.35225	37
24	9.64800	9.95217	9.69584	10.30416	10.04783	10.35200	36
25	9.64826	9.95211	9.69615	10.30385	10.04789	10.35174	35
26	9.64851	9.95204	9.69647	10.30353	10.04796	10.35149	34
27	9.64877	9.95198	9.69679	10.30321	10.04802	10.35123	33
28	9.64902	9.95192	9 69710	10.30290	10.04808	10.35098	32
29	9.64927	9.95185	9.69742	10 30258	10.04815	[illegible]	31
30	9.64953	9.95179	9.69774	10.30226	[illegible]	10.35047	30
		Sine.		Tang.		Secant.	Min.

63 Degrees.

26 Degrees.

Min.	Sine.		Tang.		Secant.		
30	9.64953	9.95179	9.69774	10.30[illegible]26	10.04821	10.35047	30
31	9.64978	9.95173	9.69805	10.30195	10.04827	1[illegible].35022	29
32	9.65003	9.95167	9.69837	10.30163	10.04834	10.34997	28
33	9.65029	9.95160	9.69869	10.30132	10.[illegible]48[illegible]	[illegible].34971	27
34	9.65054	9.95154	9.69900	10.30100	10.04846	10.34946	26
35	9.65079	9.95148	9.69932	10.30068	10.04852	10.34921	25
36	9.65104	9.95141	9.69963	10.30[illegible]37	10.04859	10.34896	24
37	9.65130	9.95135	9.69995	10.30005	10.04865	10.34870	23
38	9.65155	9.95129	9.70[illegible]26	10.29974	10.04871	10.34845	22
39	9.65180	9.95122	9.700[illegible]8	10.29942	10.04878	10.34820	21
40	9.65205	9.95116	9.70089	1[illegible].29911	10.04884	10.34795	20
41	9.65230	9.95110	9.70121	1[illegible].29879	10.04890	10.34770	19
42	9.65256	9.95103	9.70152	[illegible].29848	10.04897	10.34745	18
43	9.65281	9.95097	9.70184	[illegible]9816	10.04903	10.347[illegible]9	17
44	9.65306	9.95091	9.7021[illegible]	[illegible]9785	10.04910	10.34694	16
45	9.65331	9.95084	9.70247	10.[illegible]9753	10.04916	10.34669	15
46	9.65356	9.95078	9.70278	10.2[illegible]22	10.04922	10.34644	14
47	9.65381	9.95071	9.70310	10.29[illegible]91	10.04929	10.34619	13
48	9.65406	9.95065	9.70341	10.29659	10.04935	10.34594	12
49	9.65431	9.95059	9.70372	10.29628	10.04941	10.34569	11
50	9.65456	9.95052	9.70404	10.29596	10.04948	10.34544	10
51	9.65481	9.95046	9.70435	10.29565	10.04954	10.34519	9
52	9.65506	9.95039	9.70466	10.29534	10.04961	10.34494	8
53	9.65531	9.95033	9.70498	10.29502	10.04967	10.34469	7
54	9.65556	9.95027	9.70529	10.29471	10.04973	10.34444	6
55	9.65581	9.95020	9.70560	10.29440	10.04980	10.34420	5
56	9.65605	9.95014	9.70592	10.29408	10.04986	10.34395	4
57	9.65630	9.95007	9.70623	10.29377	10.04993	10.34370	3
58	9.65655	9.95000	9.70654	10.29346	10.04999	10.34345	2
59	9.6[illegible]80	9.95995	9.70685	10.29315	10.05006	10.34320	1
60	9.65704	[illegible].95988	[illegible].70717	10.29283	10.05012	10.34295	0
		Sine.		Tang.		Secant.	Min.

63 Degrees.

A Table of Artificial Sines,

27 Degrees.

Min.	Sine.		Tang.		Secant.		
0	[illegible]	9.94988	9.70717	10.29283	10.05012	10.34295	60
1	[illegible]	9.94982	9.70748	10.29252	10.05018	10.34271	59
2	9.65754	9.94975	9.70779	10.29221	10.05025	10.34246	58
3	9.65779	9.94969	9.70810	10.29190	10.05031	10.34221	57
4	9.65804	9.94962	9.70841	10.29159	10.05038	10.34196	56
5	9.65828	9.94956	9.70873	10.29127	10.05044	10.34172	55
6	9.65853	9.94949	9.70904	10.29096	10.05051	10.34147	54
7	9.65878	9.94943	9.70935	10.29065	10.05057	10.34122	53
8	9.65903	9.94936	9.70966	[illegible]	10.05064	10.34098	52
9	9.65927	9.94930	9.70997	[illegible]	10.05070	10.34073	51
10	9.65952	9.94924	9.71028	10.28972	10.05077	10.34048	50
11	9.65976	9.94917	9.71059	10.28941	10.05083	10.34024	49
12	9.66001	9.94911	[illegible]	10.28910	10.05090	10.33999	48
13	9.66026	9.94904	[illegible]	[illegible]	10.05096	10.33975	47
14	9.66050	9.94898	[illegible]	10.28848	10.05103	10.33950	46
15	9.66075	9.94891	[illegible]	[illegible]	10.05109	10.33925	45
16	9.66099	9.94885	[illegible]	10.28785	10.05116	10.33901	44
17	9.66124	9.94878	9.71246	10.28754	10.05122	10.33876	43
18	9.66148	9.94872	9.71277	10.28723	10.05129	10.33852	42
19	9.66173	9.94865	9.71308	10.28692	10.05135	10.33827	41
20	9.66197	9.94858	9.71339	10.28661	10.05142	10.33803	40
21	9.66221	9.94852	9.71370	10.28630	10.05148	10.33779	39
22	9.66246	9.94845	9.71401	10.28600	10.05155	10.33754	38
23	9.66270	9.94839	9.71431	10.28569	10.05161	10.33730	37
24	9.66295	9.94832	9.71462	10.28538	10.05168	10.33705	36
25	9.66319	9.94826	9.71493	10.28507	10.05174	10.33681	35
26	9.66343	9.94819	9.71524	10.28476	10.05181	10.33657	34
27	9.66368	9.94813	9.71555	10.28445	10.05187	10.33632	33
28	9.66392	9.94806	9.71586	10.28414	10.05194	10.33608	32
29	9.66416	9.94800	9.71617	10.28383	10.05201	10.33584	31
30	9.66441	9.94793	9.71648	10.28352	[illegible]	10.33559	30
		Sine.		Tang.		Secant.	Min.

62 Degrees.

27 Degrees.

Min.	Sine.		Tang.		Secant.		
30	9.66441	9.94793	9.71648	10.28352	10.0520[illegible]	10.33559	30
31	9.66465	9.94786	9.71679	10.28322	10.05214	10.33535	29
32	9.66489	9.94780	9.71709	10.28291	10.05220	10.[illegible]511	28
33	9.66513	9.94773	9.71740	10.28260	10.05227	10.33487	27
34	9.66538	9.94767	9.71771	10.28229	10.05233	10.33463	26
35	9.66562	9.94760	9.71802	10.28198	10.05240	10.33438	25
36	9.66586	9.94753	9.71833	10.28168	10.05247	10.33414	24
37	9.66610	9.94747	9.71863	10.28137	10.05253	10.33390	23
38	9.66634	9.94740	9.71894	10.28106	10.05260	10.33366	22
39	9.66658	9.94734	9.71925	10.28075	10.05267	10.33342	21
40	9.66682	9.94727	9.71956	10.28045	10.05273	10.33318	20
41	9.66707	9.94720	9.71986	10.28014	10.05280	10.33294	19
42	9.66731	9.94714	9.72017	10.27[illegible]83	10.05286	10.33270	18
43	9.66755	9.94707	9.72048	10.[illegible]7952	10.05293	10.33245	17
44	9.66779	9.94700	9.72078	10.27922	10.05300	10.33221	16
45	9.66803	9.94694	9.72109	10.27891	10.05306	10.33197	15
46	9.66827	9.94687	9.72139	10.27860	10.05313	10.33173	14
47	9.66851	9.94680	9.72170	10.278[illegible]0	10.05320	10.33149	13
48	9.66875	9.94674	9.72201	10.27799	10.05326	10.33125	12
49	9.66899	9.94667	9.72232	10.27769	10.05333	10.33101	11
50	9.66923	9.94660	9.72262	10.27738	10.05340	10.33078	10
51	9.66946	9.94654	9.72293	10.27707	10.05346	10.33054	9
52	9.66970	9.94647	9.72323	10.27677	10.05353	10.3303	8
53	9.66994	9.94640	9.72354	10.27646	10.05360	10.33006	7
54	9.67018	9.94634	9.72384	10.27616	10.05366	10.32982	6
55	9.67042	9.94627	9.72415	10.27585	10.05373	10.32958	5
56	9.67066	9.94620	9.72445	10.27555	10.05380	10.32934	4
57	9.67090	9.94614	9.72476	10.27524	10.05386	10.32910	3
58	9.67113	9.94607	9.72507	10.27494	10.05393	10.32887	2
59	9.67137	[illegible].94600	9.72537	10.27463	10.05400	10.32863	1
60	9.67161	9.[illegible]4594	9.72567	10.27433	10.05407	10.32839	0
		Sine.		Tang.		Secant.	Min.

62 Degrees.

A Table of Artificial Sines,

28 Degrees.

Min.	Sine.		Tang.		Secant.		
0	9.67161	9.94594	9.72567	10.27433	10.05407	10.32839	60
1	9.67185	9.94587	9.72598	10.27402	10.05413	10.32815	59
2	9.67208	9.94580	9.72628	10.27372	10.05420	10.32792	58
3	9.67232	9.94573	9.72659	10.27341	10.05427	10.32768	57
4	9.67256	9.94567	9.72689	10.27311	10.05433	10.32744	56
5	9.67280	9.94560	9.72720	10.27280	10.05440	10.32721	55
6	9.67303	9.94553	9.72750	10.27250	10.05447	10.32697	54
7	9.67327	9.94546	9.72781	10.27220	10.05454	10.32673	53
8	9.67351	9.94540	9.72811	10.27189	10.05460	10.32650	52
9	9.67374	9.94533	9.72841	10.27159	10.05467	10.32626	51
10	9.67398	9.94526	9.72872	[illegible]0.27128	10.05474	10.32602	50
11	9.67421	9.94519	9.72902	[illegible].27098	10.05481	10.32579	49
12	9.67445	9.94513	9.7293[illegible]	[illegible].27068	10.05487	10.32555	48
13	9.67468	9.94506	9.7296[illegible]	[illegible]27037	10.05494	10.32532	47
14	9.67492	9.94499	9.72993	10.27007	10.05501	10.32508	46
15	9.67516	9.94492	9.73023	10.26977	10.05508	10.32485	45
16	9.67539	9.94485	9.73054	10.26947	10.05515	10.32461	44
17	9.67562	9.94479	9.73084	10.26916	10.05521	10.32438	43
18	9.67586	9.94472	9.73114	10.26886	10.05528	10.32414	42
19	9.67609	9.94465	9.73144	10.26856	10.05535	10.32391	41
20	9.67633	9.94458	9.73175	10.26825	10.05542	10.32367	40
21	9.67656	9.94451	9.73205	10.26795	10.05549	10.32344	39
22	9.67680	9.94445	9.73235	10.26765	10.05555	10.32320	38
23	9.67703	9.94438	9.73265	10.26735	10.05562	10.32297	37
24	9.67726	9.94431	9.73296	10.26705	10.05569	10.32274	36
25	9.67750	9.94424	9.73326	10.26674	10.05576	10.32250	35
26	9.67773	9.94417	9.73356	10.26644	10.05583	10.32227	34
27	9.67796	9.94410	9.73386	10.26614	10.05590	10.32204	33
28	9.67820	9.94404	9.73416	10.26584	10.05596	10.32180	32
29	9.67843	9.94397	9.73446	10.26554	10.05603	[illegible].32157	31
30	9.67866	9.94390	9.73476	10.26524	10.0561[illegible]	10.32134	30
		Sine.		Tang.		Secant.	Min.

61 Degrees.

Tangents and Secants.

28 Degrees.

Min.	Sin[illegible]		Tang.		Secant.		
30	9.67866	9.94390	9.73476	10.26524	10.05[illegible]	10.32134	30
31	9.67890	9.94383	9.73507	10.26493	10.05617	10.32110	29
32	9.67913	9.94376	9.73537	10.26463	10.05624	10.[illegible]7	28
33	9.67936	9.94369	9.73567	10.26433	10.05631	10.32064	27
34	9.67959	9.94362	9.73597	10.26403	10.05638	10.32041	26
35	9.67982	9.94356	9.73627	10.26373	10.05645	10.32018	25
36	9.68006	9.94349	9.73657	10.26343	10.05651	10.31994	24
37	9.68029	9.94342	9.73687	10.26313	10.05658	10.31971	23
38	9.68052	9.94335	9.73717	10.26283	10.05665	10.31948	22
39	9.68075	9.94328	9.73747	10.26253	10.05672	10.31925	21
40	9.68098	9.94321	9.73777	10.26223	10.05679	10.31902	20
41	9.68121	9.94314	9.73807	10.26193	10.05686	10.31879	19
42	9.68144	9.94307	9.73837	10.2[illegible]63	10.05693	10.31856	18
43	9.68167	9.94300	9.73867	10.26133	10.05700	10.31833	17
44	9.68191	9.94293	9.73897	10.26103	10.05707	10.31810	16
45	9.68214	9.94286	9.73927	10.26073	10.05714	10.31787	15
46	9.68237	9.94280	9.73957	10.26043	10.05721	10.31763	14
47	9.68260	9.94273	9.73987	10.26013	10.05727	10.31741	13
48	9.68283	9.94266	9.74017	10.25983	10.05734	10.31718	12
49	9.68306	9.94259	9.74047	10.25953	10.05741	10.31695	11
50	9.68328	9.94252	9.74077	10.25923	10 05748	10.31672	10
51	9.68351	9.94245	9.74107	10.25893	10.05755	10.31649	9
52	9.68374	9.94238	9.74137	10.25864	10.05762	10.31626	8
53	9.68397	9.94231	9.74166	10.25834	10.05769	10.31603	7
54	9.68420	9.94224	9.74196	10.25804	10.05776	10.31580	6
55	9.68443	9.94217	9.74226	10.25774	10.05783	10.31557	5
56	9.68466	9.94210	9.74256	10.25744	10.05790	10.31534	4
57	9.68489	9.94203	9.74286	10.25714	10.05797	10.31511	3
58	9.68512	9.94196	9.74316	10.25684	10.05804	10.31489	2
59	9.68534	9.94189	9.74345	10.25655	10.05811	10.31466	1
60	9.68557	9.94182	9.74375	10.25625	10.05818	10.31443	0
		Sine		Tang.		Secant.	Min.

61 Degrees.

A Table of Artificial Sines,

29 Degrees.

Min.	Sine.		Tang.		Secant.		
0	9.68557	9.94182	9.74375	10.25625	10.05818	10.31443	60
1	9.68580	9.94175	9.74405	10.25595	10.05825	10.31420	59
2	9.[illegible]03	9.94168	9.74435	10.25565	10.05832	10.31397	58
3	9.68625	9.94161	9.74465	10.25536	10.05839	10.31375	57
4	9.68648	9.94154	9.74494	10.25506	10.05846	10.31352	56
5	9.68671	9.94147	9.74524	10.25476	10.05853	10.31329	55
6	9.68694	9.94140	9.74554	10.25446	10.05860	10.31306	54
7	9.68716	9.94133	9.74584	10.25417	10.05867	10.31284	53
8	9.68739	9.94126	9.74613	10.25387	10.05874	10.31261	52
9	9.68762	9.94119	9.74643	10.25357	10.05881	10.31238	51
10	9.68784	9.94112	9.74673	10.25327	10.05888	10.31216	50
11	9.68807	9.94105	9.74702	10.25298	10.05895	10.31193	49
12	9.68830	9.94098	9.747[illegible]	10.25268	10.05902	10.31171	48
13	9.68852	9.94091	9.74762	10.[illegible]5238	10.05910	10.31148	47
14	9.68875	9.94083	9.74791	10.25209	10.05917	10.31125	46
15	9.68897	9.94076	9.74821	10.25179	10.05924	10.31103	45
16	9.68920	9.94069	9.74851	10.25150	10.05931	10.31080	44
17	9.68942	9.94062	9.74880	10.25120	10.05938	10.31058	43
18	9.68965	9.94055	9.74910	10.25090	10.05945	10.31035	42
19	9.68987	9.94048	9.74939	10.25061	10.05952	10.31013	41
20	9.69010	9.94041	9.74969	10.25031	10.05959	10.30990	40
21	9.69032	9.94034	9.74997	10.25002	10.05966	10.30968	39
22	9.69055	9.94027	9.75028	10.24972	10.05973	10.30945	38
23	9.69077	9.94020	9.75058	10.24942	10.05980	10.30923	37
24	9.69100	9.94013	9.75087	10.24913	10.05988	10.30900	36
25	9.69122	9.94005	9.75117	10.24883	10.05995	10.30878	35
26	9.69144	9.93998	9.75146	10.24854	10.06002	10.30856	34
27	9.69167	9.93991	9.75176	10.24824	10.06009	10.30833	33
28	9.69190	9.93984	9.75205	10.24795	10.06016	10.30811	32
29	9.69212	9.93977	9.75235	10.24765	10.06023	10.[illegible]0788	31
30	9.69234	9.93970	9.75264	10.24736	10.06030	10.30766	30
		Sine.		Tang.		Secant.	Min.

60 Degrees.

Tangents and Secants.

29 Degrees.

Min.	Si[illegible]		Tang.		Secant.		
30	9.69234	9.93970	9.75264	10.247[illegible]6	10.0603[illegible]	10.3[illegible]766	30
31	9.69256	9.93963	9.75294	10.24706	10.06038	10.3[illegible]735	29
32	9.69279	9.93955	9.75323	10.24677	10.06045	10.3[illegible]22	28
33	9.69301	9.93948	9.75353	10.24647	10.06052	10.30699	27
34	9.69323	9.93941	9.75382	10.24618	10.06059	10.30677	26
35	9.69345	9.93934	9.75412	10.24589	10.06066	10.30655	25
36	9.69368	9.93927	9.75441	10.24559	10.06073	10.30632	24
37	9.69390	9.93919	9.75470	10.245[illegible]0	10.06081	10.30610	23
38	9.69412	9.93912	9.75500	10.24500	10.06088	10.30589	22
39	9.69434	9.93905	9.75529	10.24471	10.06095	10.30566	21
40	9.69456	9.93898	9.75559	10.24442	10.06102	10.30544	20
41	9.69479	9.93891	9.75588	10.24412	10.06109	10.30521	19
42	9.69501	9.93884	9.75617	10.24383	10.06116	10.30499	18
43	9.69523	9.93876	9.75647	10.24354	10.06124	10.30477	17
44	9.69545	9.93869	9.75676	10.24324	10.06131	10.30455	16
45	9.69567	9.93862	9.7570[illegible]	10.24295	10.06138	10.30433	15
46	9.69589	9.93855	9.75735	10.24266	10.06145	10.30411	14
47	9.69611	9.93848	9.75764	10.24236	10.06153	10.30389	13
48	9.69633	9.93840	9.75793	10.24207	10.06160	10.30367	12
49	9.69655	9.93833	9.75822	10.24178	10.06167	10.30345	11
50	9.69677	9.93826	9.75852	10.24148	10.06174	10.30323	10
51	9.69700	9.93819	9.75881	10.24119	10.06182	10.30301	9
52	9.69722	9.93811	9.75901	10.24090	10.06189	10.30279	8
53	9.69744	9.93804	9.75940	10.24061	10.06196	10.30257	7
54	9.69765	9.93797	9.75969	10.24031	10.06203	10.30235	6
55	9.69787	9.93790	9.75998	10.24002	10.06211	10.30213	5
56	9.69809	9.93782	9.76027	10.23973	10.06218	10.30191	4
57	9.69831	9.93775	9.76056	10.23944	10.06225	10.30169	3
58	9.69853	9.93768	9.76086	10.23914	10.06232	10.30147	2
59	9.698[illegible]	9.93760	9.76115	10.23885	10.06240	10.30125	1
60	9.69897	9.93753	9.76144	10.23856	10.06247	10.30103	0
		Sine.		Tang.		Secant.	Min.

60 Degrees.

A Table of Artificial Sines,

30 Degrees.

Min.	Sine.		Tang.		Secant.		
0	9.69[illegible]97	[illegible]93753	9.7[illegible]144	10.23856	10.06247	10.30103	60
1	9.6[illegible]919	9.93746	9.76173	10.23827	10.06254	10.30081	59
2	[illegible]941	9.93739	9.76202	10.23798	10.06262	10.30059	58
3	9.69963	9.93731	9.76231	10.23769	10.06269	10.30037	57
4	9.69984	9.93724	9.76261	10.23739	10.06276	10.30016	56
5	9.70006	9.93717	9.76290	10.23710	10.06284	10.29994	55
6	9.70028	9.93709	9.76319	10.23681	10.06291	10.29972	54
7	9.70050	9.93702	9.76348	10.23652	10.06298	10.29950	53
8	9.70072	9.93695	9.76377	10.23623	10.06305	10.29928	52
9	9.70093	9.93687	9.76406	10.23594	10.06313	10.29907	51
10	9.70115	9.93680	9.76435	10.23565	10.06320	10.29885	50
11	9.70137	9.93673	9.76464	10.23536	10.06328	10.29863	49
12	9.70159	9.93665	9.76493	10.23507	10.06335	10.29842	48
13	9.70180	9.93658	9.76522	10.23478	10.06342	10.29820	47
14	9.70202	9.93651	9.76551	10.23449	10.06350	10.29798	46
15	9.70224	9.93643	9.76581	10.23420	10.06357	10.29776	45
16	9.70245	9.93636	9.76610	10.23391	10.06364	10.29755	44
17	9.70267	9.93628	9.76639	10.23362	10.06372	10.29733	43
18	9.70289	9.93621	9.76668	10.23333	10.06379	10.29712	42
19	9.70310	9.93614	9.76697	10.23304	10.06386	10.29690	41
20	9.70332	9.93606	9.76726	10.23275	10.06394	10.29668	40
21	9.70353	9.93599	9.76755	10.23246	10.06401	10.29647	39
22	9.70375	9.93591	9.76783	10.23217	10.06409	10.29625	38
23	9.70396	9.93584	9.76812	10.23188	10.06416	10.29604	37
24	9.70418	9.93577	9.76841	10.23159	10.06423	10.29582	36
25	9.70440	9.93569	9.76870	10.23130	10.06431	10.29561	35
26	9.70461	9.93562	9.76899	10.23101	10.06438	10.29539	34
27	9.70483	9.93554	9.76928	10.23072	10.06446	10.29518	33
28	9.70504	9.93547	9.76957	10.23043	10.06453	10.29496	32
29	9.70525	9.93540	9.76986	10.23014	10.06461	[illegible]29475	31
30	9.70547	9.93532	9.77015	10.22985	10.06468	10.29453	30
		Sine.		Tang.		Secant.	Min.

59 Degrees.

30 Degrees.

Min.	Si[illegible]		Tang.		Secant.		
30	9.70547	9.93532	9.77015	10.22985	10.06468	10.[illegible]9453	30
31	9.70568	9.93525	9.77044	10.22956	10.06475	10.[illegible]432	29
32	9.70590	9.93517	9.77073	10.22927	10.06483	10.[illegible]10	28
33	9.70611	9.93510	9.77102	10.22899	10.06490	10.29389	27
34	9.70633	9.93502	9.77130	10.22870	10.06498	10.29367	26
35	9.70654	9.93495	9.77159	10.22841	10.06505	10.29346	25
36	9.70675	9.93487	9.77188	10.22812	10.06513	10.29325	24
37	9.70697	9.93480	9.77217	10.22783	10.06520	10.29303	23
38	9.70718	9.93472	9.77246	10.22754	10.06528	10.29282	22
39	9.70739	9.93465	9.77275	10.22726	10.06535	10.29261	21
40	9.70761	9.93457	9.77303	10.22697	10.06543	10.29239	20
41	9.70782	9.93450	9.77332	10.22668	10.06550	10.29218	19
42	9.70803	9.93442	9.77361	10.22[illegible]9	10.06558	10.29197	18
43	9.70825	9.93435	9.77390	10.22610	10.06565	10.29176	17
44	9.70846	9.93427	9.77418	10.22582	10.06573	10.2915[illegible]	16
45	9.70867	9.93420	9.7744[illegible]	10.22553	10.06580	10.29133	15
46	9.70888	9.93412	9.77476	10.22524	10.06588	10.29112	14
47	9.70909	9.93405	9.77505	10.22495	10.06595	10.29091	13
48	9.70931	9.93397	9.77533	10.22467	10.06603	10.29069	12
49	9.70952	9.93390	9.77562	10.22438	10.06610	10.29048	11
50	9.70973	9.93382	9.77591	10.22409	10.06618	10.29027	10
51	9.70994	9.93375	9.77620	10.22381	10.06625	10.29006	9
52	9.71015	9.93367	9.77648	10.22352	10.06633	10.28985	8
53	9.71036	9.93360	9.77677	10.22323	10.06640	10.28964	7
54	9.71058	9.93352	9.77706	10.222[illegible]5	10.06648	10.28943	6
55	9.71079	9.93344	9.77734	10.22266	10.06656	10.28921	5
56	9.71100	9.93337	9.77763	10.22237	10.06663	10.28900	4
57	9.71121	9.93329	9.77792	10.22209	10.06671	10.28879	3
58	9.71142	9.93322	9.77820	10.22180	10.06678	10.28858	2
59	9.7116[illegible]	9.93314	9.77849	10.22151	10.06686	10.28837	1
60	9.71184	9.93307	9.77877	10.22122	10.06693	10.28816	0
		Sine.		Tang.		Secant.	Min.

59 Degrees.

A Table of Artificial Sines,

31 Degrees.

Min.	Sine.		Tang.		Secant.		
0	9.71184	9.93307	9.77877	10.22123	10.06693	10.28816	60
1	9.71205	9.93299	9.77906	10.22094	10.06701	10.28795	59
2	9.71226	9.93291	9.77935	10.22065	10.06709	10.28774	58
3	9.71247	9.93284	9.77963	10.22037	10.06716	10.28753	57
4	9.71268	9.93276	9.77992	10.22008	10.06727	10.28732	56
5	9.71289	9.93269	9.78020	10.21980	10.06732	10.28711	55
6	9.71310	9.93261	9.78049	10.21951	10.06739	10.28690	54
7	9.71331	9.93253	9.78078	10.21923	10.06747	10.28669	53
8	9.71352	9.93246	9.78106	10.21894	10.06754	10.28648	52
9	9.71373	9.93238	9.78135	10.21865	10.06762	10.28627	51
10	9.71394	9.93230	9.78163	10.21837	10.06770	10.28607	50
11	9.71414	9.93223	9.78192	10.21808	10.06777	10.28586	49
12	9.71435	9.93215	9.78220	10.21780	10.06785	10.28565	48
13	9.71456	9.93208	9.78249	10.21751	10.06793	10.28544	47
14	9.71477	9.93200	9.78277	10.21723	10.06800	10.28523	46
15	9.71498	9.93192	9.78306	10.21695	10.06808	10.28502	45
16	9.71519	9.93185	9.78334	10.21666	10.06816	10.28481	44
17	9.71539	9.93177	9.78363	10.21637	10.06823	10.28461	43
18	9.71560	9.93169	9.78391	10.21609	10.06831	10.28440	42
19	9.71581	9.93161	9.78419	10.21581	10.06839	10.28419	41
20	9.71602	9.93154	9.78448	10.21552	10.06846	10.28398	40
21	9.71622	9.93146	9.78479	10.21524	10.06854	10.28378	39
22	9.71643	9.93138	9.78505	10.21495	10.06862	10.28357	38
23	9.71664	9.93131	9.78533	10.21467	10.06869	10.28336	37
24	9.71685	9.93123	9.78562	10.21438	10.06877	10.28315	36
25	9.71705	9.93115	9.78590	10.21410	10.06885	10.28295	35
26	9.71726	9.93108	9.786[illegible]	10.21382	10.06893	10.28274	34
27	9.71747	9.93100	9.78647	10.21353	10.06900	10.28253	33
28	9.71767	9.93092	9.78675	10.21325	10.06908	10.28233	32
29	9.71788	9.93084	9.78704	10.21296	10.06916	10.28212	31
30	9.71809	9.93077	9.78732	10.21265	10.06923	10.28192	30
		Sine		Tang.		Secant.	Min.

58 Degrees.

Tangents and Secants.

31 Degrees.

Min.	Sine.		Tang.		Secant.		
30	9.71809	9.93077	9.78732	10.212[illegible]	10.06923	10[illegible]8192	30
31	9.71829	9.93069	9.78760	10.21240	10.06931	10.[illegible]8171	29
32	9.71850	9.93061	9.78789	10.21211	10.06939	10.[illegible]150	28
33	9.71870	9.93053	9.78817	10.21183	10.06947	10.28130	27
34	9.71891	9.93046	9.78845	10.21155	10.06954	10.28109	26
35	9.71911	9.93038	9.78874	10.21126	10.06961	10.28089	25
36	9.71932	9.93030	9.78902	10.21098	10.06970	10.28068	24
37	9.71953	9.93022	9.78930	10.21070	10.06978	10.28048	23
38	9.71973	9.93015	9.78959	10.21042	10.06986	10.28027	22
39	9.71994	9.93007	9.78987	10.21013	10.06993	10.28007	21
40	9.72014	9.92999	9.79015	10.20985	10.07001	10.27986	20
41	9.7[illegible]035	9.92991	9.79043	10.20957	10.07009	10.27966	19
42	9.72055	9.92983	9.79072	10.20928	10.07017	10.27945	18
43	9.72075	9.92976	9.79100	10.2[illegible]900	10.07025	10.27925	17
44	9.72096	9.92968	9.79128	10.20872	10.0703	10.27904	16
45	9.72116	9.92960	9.79156	10.20844	10.07040	10.27884	15
46	9.72137	9.92952	9.79185	10.20815	10.07048	10.27863	14
47	9.72157	9.92944	9.79213	10.20787	10.07056	10.27843	13
48	9.72177	9.92936	9.79241	10.20759	10.07064	10.27823	12
49	9.72198	9.92929	9.79269	10.20731	10.07071	10.27802	11
50	9.72218	9.92921	9.79297	10.20703	10.07079	10.27782	10
51	9.72239	9.92913	9.79326	10.20674	10.07087	10.27762	9
52	9.72259	9.92905	9.79354	10.20646	10.07095	10.27741	8
53	9.72279	9.92897	9.79382	10.20618	10.07103	10.27721	7
54	9.72299	9.92889	9.79410	10.20590	10.07111	10.27701	6
55	9.72320	9.92881	9.79438	10.20562	10.07118	10.27681	5
56	9.72340	9.92874	9.79466	10.20534	10.07126	10.27660	4
57	9.72360	9.92866	9.79495	10.20505	10.07134	10.27640	3
58	9.72381	9.92858	9.79523	10.20477	10.07142	10.27620	2
59	9.72[illegible]01	9.92850	9.79551	10.20449	10.07150	10.27599	1
60	9.72421	9.92842	9.79579	10.20421	10.07158	10.27579	0
		Sine.		Tang.		Secant.	Min.

58 Degrees.

A Table of A[illegible]tificial Sines.

32 Degrees.

Min.	Sine.		Tang		Sec[illegible]nt.		
0	9.724[illegible]1	9.92842	9.[illegible]9579	10.20421	10.07158	10.27579	60
1	9.72[illegible]41	9.92834	9.79607	10.20393	10.07166	10.27559	59
2	9.7[illegible]461	9.92826	9.[illegible]9635	10.20365	10.07174	10.27539	58
3	9.72482	9.92818	9.79663	10.20337	10.07182	10.27518	57
4	9.72502	9.92810	9.79091	10.20309	10.07190	10.27498	56
5	9.72522	9.92803	9.79719	10.20281	10.07198	10.27478	55
6	9.72542	9.92795	9.79747	10.20253	10.07205	10.27458	54
7	9.72562	9.92787	9.79776	10.20225	10.07213	10.27438	53
8	9.72582	9.92779	9.79804	10.20196	10.07221	10.27418	52
9	9.72602	9.92770	9.79832	10.20168	10.07229	10.27398	51
10	9.72623	9.92763	9.79860	10.20140	10.07237	10.27378	50
11	9.72643	9.92755	9.79888	10.20112	10.07245	10.27357	49
12	9.72663	9.92747	9.79[illegible]	10.20084	10.07253	10.27337	48
13	9.72683	9.92739	9.79944	10.20056	10.07261	10.27317	47
14	9.72703	9.92731	9.79972	10.20028	10.07269	10.27297	46
15	9.72723	9.92723	9.80000	10.20[illegible]00	10.07277	10.27277	45
16	9.72743	9.92715	9.80028	10.19972	10.07285	10.27257	44
17	9.72763	9.92707	9.80056	10.19944	10.07293	10.27237	43
18	9.72783	9.92699	9.80084	10.19916	10.07301	10.27217	42
19	9.72803	9.9269[illegible]	9.80112	10.19888	10.07309	10.27197	41
20	9.72823	9.92683	9.80140	10.19860	10.07317	10.27177	40
21	9.72843	9.92675	9.80168	10.19833	10.07325	10.27157	39
22	9.72863	9.92667	9.80196	10.19805	10.07333	10.27137	38
23	9.72883	9.92659	9.80223	10.19777	10.07341	10.27118	37
24	9.72902	9.92651	9.80251	10.19749	10.07349	10.27098	36
25	9.72922	9.92643	9.80279	10.19721	10.07357	10.27078	35
26	9.72942	9.92635	9.80307	10.19693	10.07365	10.27058	34
27	9.72962	9.92627	9.80335	10.19665	10.07373	10.27038	33
28	9.72982	9.92619	9.80363	10.19637	10.07381	10.27018	32
29	9.73002	9.92611	9.80391	10.19609	10.07389	10.[illegible]998	31
30	9.73022	9.92603	9.80419	10.19581	10.07397	10.26978	30
		Sine.		Tang.		Secant.	Min.

57 Degrees.

32 Degrees.

Min.	S[illegible]		Tang.		Secant.		
30	9.73022	9.92603	9.80419	10.19581	10.07397	10.[illegible]6978	30
31	9.73042	9.92595	9.80447	10.19555	10.07405	10.[illegible]5959	29
32	9.73061	9.92587	9.80475	10.19526	10.07413	10.26939	28
33	9.73081	9.92579	9.80502	10.19498	10.07421	10.26919	27
34	9.73101	9.92571	9.80530	10.19470	10.07429	10.26899	26
35	9.73121	9.92563	9.80558	10.19442	10.07437	10.26879	25
36	9.73140	9.92555	9.80586	10.19414	10.07446	10.26860	24
37	9.73160	9.92547	9.80614	10.19386	10.07454	10.26840	23
38	9.73180	9.92538	9.80642	10.19359	10.07402	10.26820	22
39	9.73200	9.92530	9.80669	10.19331	10.07470	10.26800	21
40	9.73219	9.92522	9.80697	10.19303	10.07478	10.26781	20
41	9.73239	9.92514	9.80725	10.19275	10.07486	10.26760	19
42	9.73259	9.92505	9.80753	10.19[illegible]7	10.07494	10.26741	18
43	9.73278	9.92498	9.80781	10.19220	10.07502	10.26722	17
44	9.73298	9.92490	9.80808	10.19192	10.07510	10.26702	16
45	9.73318	9.92482	9.80836	10.19164	10.07518	10.26682	15
46	9.73337	9.92474	9.80864	10.19136	10.07527	10.26663	14
47	9.73357	9.92465	9.80892	10.19108	10.07534	10.26643	13
48	9.73377	9.92457	9.80919	10.19081	10.07543	10.26624	12
49	9.73396	9.92449	9.80947	10.19053	10.07551	10.26604	11
50	9.73416	9.92441	9.80975	10.19025	10.07559	10.26584	10
51	9.73435	9.92433	9.80003	10.18998	10.07567	10.26565	9
52	9.73455	9.92425	9.81030	10.18970	10.07575	10.26545	8
53	9.73474	9.92416	9.81058	10.18942	10.07584	10.26526	7
54	9.73494	9.92408	9.81086	10.18914	10.07592	10.26506	6
55	9.73513	9.92401	9.81113	10.18887	10.07600	10.26487	5
56	9.73533	9.92392	9.81141	10.18859	10.07608	10.26467	4
57	9.73553	9.92384	9.81169	10.18831	10.07616	10.26448	3
58	9.73572	9.92376	9.81196	10.18804	10.07625	10.26428	2
59	9.73591	9.92367	9.81224	10.18775	10.07633	10.26409	1
60	9.73611	9.92359	9.81252	10.18748	10.07641	10.26389	0
		Sine		Tang.		Secant.	Min.

57 Degrees.

A Table of Artificial Sines,

33 Degrees.

Min.	Sine.		Tang.		Secant.		
0	9.73[illegible]10	9.92359	9.[illegible]1252	10.18748	10.07641	10.26389	60
1	9.7[illegible]630	9.9235[illegible]	9.[illegible]1279	10.18721	10.07649	10.26370	59
2	9.73650	9.92343	9.81307	10.18693	10.07657	10.26350	58
3	9.73669	9.92335	9.81335	10.18665	10.07666	10.26331	57
4	9.73689	9.92326	9.81362	10.18638	10.07674	10.26311	56
5	9.73708	9.92318	9.81[illegible]90	10.18610	10.07682	10.2629[illegible]	55
6	9.73727	9.92310	9.81418	10.18582	10.07690	10.26273	54
7	9.73747	9.92302	9.81445	10.18555	10.07698	10.26253	53
8	9.73766	9.92293	9.81473	10.18527	10.07706	10.26234	52
9	9.73786	9.92285	9.81500	10.18500	10.07715	10.26215	51
10	9.73805	9.92277	9.81528	10.18472	10.07723	10.2[illegible]195	50
11	9.73824	9.92269	9.81556	10.18445	10.07731	10.26176	49
12	9.73843	9.92260	9.8[illegible]583	10.18417	10.07740	10.26157	48
13	9.73863	9.92252	9.81611	10.18389	10.07748	10.26137	47
14	9.73882	9.92244	9.81638	10.18362	10.07756	10.26118	46
15	9.73901	9.92236	9.81666	10.18334	10.07765	10.26099	45
16	9.73921	9.92227	9.81693	10.18307	10.07773	10.26079	44
17	9.73940	9.92219	9.[illegible]1721	10.18279	10.07781	10.26060	43
18	9.73959	9.92211	9.81748	10.18252	10.07789	10.26041	42
19	9.73978	9.92202	9.81776	10.18224	10.07798	10.26022	41
20	9.73998	9.92194	9.81804	10.18197	10.07806	10.26003	40
21	9.74017	9.92186	9.81831	10.18169	10.07814	10.25983	39
22	9.74036	9.92177	9.81859	10.18142	10.07823	10.25964	38
23	9.74057	9.92169	9.81886	10.18114	10.07831	10.25945	37
24	9.74074	9.92161	9.81913	10.18087	10.07839	10.25926	36
25	9.74093	9.92152	9.81941	10.18059	10.07848	10.25907	35
26	9.74113	9.92144	9.81968	10.18032	10.07856	10.25888	34
27	9.74132	9.92136	9.81996	10.18004	10.07864	10.25868	33
28	9.74151	9.92127	9.82023	10.17977	10.07873	10.[illegible]5849	32
29	9.74170	9.92119	9.82051	10.17949	10.07881	10.25830	31
30	9.74189	9.92111	9.82078	10.17922	10.07889	10.25811	30
		Sine.		Tang.		Secant.	Min.

56 Degrees.

Tangents and Secants.

33 *Degrees.*

Min.	Sine.		Tang.		Secant.		
30	9.74189	9.92111	9.82078	10.17922	10.07889	10.25811	30
31	9.74208	9.92102	9.82106	10.17894	10.07898	10.25792	29
32	9.74227	9.92094	9.82133	10.17867	10.07906	10.25773	28
33	9.74246	9.92086	9.82161	10.17839	10.07914	10.25754	27
34	9.74265	9.92077	9.82188	10.17812	10.07923	10.25735	26
35	9.74284	9.92069	9.82215	10.17785	10.07931	10.25716	25
36	9.74303	9.92060	9.82243	10.17757	10.07940	10.25697	24
37	9.74322	9.92052	9.82270	10.17730	10.07948	10.25678	23
38	9.74341	9.92044	9.82298	10.17702	10.07956	10.25659	22
39	9.74360	9.92035	9.82325	10.17675	10.07965	10.25640	21
40	9.74379	9.92027	9.82352	10.17648	10.07973	10.25621	20
41	9.74398	9.92018	9.82380	10.17620	10.07982	10.25602	19
42	9.74417	9.92010	9.82407	10.17593	10.07990	10.25583	18
43	9.74436	9.92001	9.82435	10.17565	10.07999	10.25564	17
44	9.74455	9.91993	9.82462	10.17538	10.08007	10.25554	16
45	9.74474	9.91985	9.82489	10.17511	10.08015	10.25526	15
46	9.74493	9.91976	9.82517	10.17483	10.08024	10.25507	14
47	9.74512	9.91968	9.82544	10.17456	10.08032	10.25488	13
48	9.74531	9.91959	9.82571	10.17429	10.08041	10.25469	12
49	9.74549	9.91951	9.82599	10.17401	10.08049	10.25451	11
50	9.74568	9.91942	9.82626	10.17374	10.08058	10.25432	10
51	9.74587	9.91934	9.82653	10.17347	10.08066	10.25413	9
52	9.74606	9.91925	9.82681	10.17320	10.08075	10.25394	8
53	9.74625	9.91917	9.82708	10.17292	10.08083	10.25375	7
54	9.74644	9.91908	9.82735	10.17265	10.08092	10.25356	6
55	9.74662	9.91900	9.82762	10.17238	10.08100	10.25338	5
56	9.74681	9.91892	9.82790	10.17210	10.08109	10.25319	4
57	9.74700	9.91883	9.82817	10.17183	10.08117	10.25300	3
58	9.74719	9.91874	9.82844	10.17156	10.08126	10.25281	2
59	9.74737	9.91866	9.82872	10.17129	10.08134	10.25263	1
60	9.74756	9.91857	9.82899	10.17101	10.08143	10.25244	0
		Sine.		Tang.		Secant.	Min.

56 *Degrees.*

A Table of Artificial Sines,

34 *Degrees.*

Min.	Sine.		Tang.		Secant.		
0	9.747[illegible]6	9.918[illegible]	9.[illegible]2899	10.17101	10.08143	10.25244	60
1	9.74[illegible]75	9.91849	9.[illegible]2926	10.17074	10.08151	10.25225	59
2	9.74794	9.91840	9.82953	10.17047	10.08160	10.25206	58
3	9.74812	9.91832	9.82981	10.17020	10.08168	10.25188	57
4	9.74831	9.91823	9.83008	10.16992	10.08177	10.25169	56
[illegible]	9.74850	9.91815	9.83025	10.16965	10.08185	10.25150	55
6	9.74868	9.91806	9.83062	10.16938	10.08194	10.25132	54
7	9.74887	9.91798	9.83089	10.16911	10.08202	10.25113	53
8	9.74906	9.91789	9.83117	10.16884	10.08211	10.25094	52
9	9.74924	9.91781	9.83144	10.16856	10.08220	10.25076	51
10	9.74943	9.91772	9.83171	10.16829	10.08228	10.25057	50
11	9.74962	9.91763	9.83198	10.16802	10.08237	10.25039	49
12	9.74980	9.91755	9.83[illegible]5	10.16775	10.08245	10.25020	48
13	9.74999	9.91746	9.83253	10.16748	10.08254	10.25001	47
14	9.75017	9.91738	9.83280	10.16720	10.08262	10.24983	46
15	9.75036	9.91729	9.83307	10.1[illegible]693	10.08271	10.24964	45
16	9.75054	9.91720	9.83334	10.16666	10.08280	10.24946	44
17	9.75073	9.91712	9.83361	10.16639	10.08288	10.24927	43
18	9.75091	9.91703	9.83388	10.16612	10.08297	10.24908	42
19	9.75110	9.91695	9.83415	10.16585	10.08305	10.24890	41
20	9.75128	9.91686	9.83443	10.16558	10.08314	10.24872	40
21	9.75147	9.91677	9.83470	10.16530	10.08322	10.24853	39
22	9.75165	9.91669	9.83497	10.16503	10.08331	10.24835	38
23	9.75184	9.91660	9.83524	10.16476	10.08340	10.24816	37
24	9.75202	9.91651	9.83551	10.16449	10.08349	10.24798	36
25	9.75221	9.91643	9.83578	10.16422	10.08357	10.24779	35
26	9.75239	9.91634	9.83605	10.16395	10.08366	10.24761	34
27	9.75258	9.91625	9.83632	10.16368	10.08375	10.24742	33
28	9.75276	9.91617	9.83659	10.16341	10.08383	10.24724	32
29	9.75294	9.91608	9.83686	10.16314	10.08392	10.24706	31
30	9.75313	9.91599	9.83713	10.16287	10.08401	10.24687	30
		Sine.		Tang.		Secant.	Min.

55 *Degrees.*

34 Degrees.

Min.	Sine.		Tang.		Secant.		
30	9.75313	9.91599	9.83713	10.16287	10.08401	10.24687	30
31	9.75331	9.91591	9.83741	10.16260	10.08409	10.24669	29
32	9.75350	9.91582	9.83768	10.16232	10.08418	10.24651	28
33	9.75368	9.91573	9.83795	10.16205	10.08427	10.24632	27
34	9.75386	9.91565	9.83822	10.16178	10.08435	10.24614	26
35	9.75405	9.91556	9.83849	10.16151	10.08444	10.24595	[illegible]
36	9.75423	9.91547	9.83876	10.16124	10.08453	10.24577	24
37	9.75441	9.91539	9.83903	10.16097	10.08462	10.24559	23
38	9.75460	9.91530	9.83930	10.16070	10.08470	10.24541	22
39	9.75478	9.91521	9.83957	10.16043	10.08479	10.24522	21
40	9.75496	9.91512	9.83984	10.16016	10.08488	10.24504	20
41	9.75514	9.91504	9.84011	10.15989	10.08497	10.24486	19
42	9.75533	9.91495	9.84038	10.15962	10.08505	10.24467	18
43	9.75551	9.91486	9.84065	10.15935	10.08514	10.24449	17
44	9.75569	9.91477	9.84092	10.15908	10.08523	10.24431	16
45	9.75587	9.91469	9.84119	10.15881	10.08532	10.24413	15
46	9.75605	9.91466	9.84146	10.15854	10.08540	10.24394	14
47	9.75624	9.91451	9.84173	10.15827	10.08549	10.24376	13
48	9.75642	9.91442	9.84200	10.15800	10.08558	10.24358	12
49	9.75660	9.91433	9.84227	10.15773	10.08567	10.24340	11
50	9.75678	9.91425	9.84254	10.15747	10.08575	10.24322	10
51	9.75696	9.91416	9.84281	10.15720	10.08584	10.24304	9
52	9.75714	9.91407	9.84307	10.15693	10.08593	10.24286	8
53	9.75733	9.91398	9.84334	10.15666	10.08602	10.24267	7
54	9.75751	9.91389	9.84361	10.15639	10.08611	10.24249	6
55	9.75769	9.91381	9.84388	10.15612	10.08619	10.24231	5
56	9.75787	9.91372	9.84415	10.15585	10.08628	10.24213	4
57	9.75805	9.91363	9.84442	10.15558	10.08637	10.24195	3
58	9.75823	9.91354	9.84469	10.15531	10.08646	10.24177	2
59	9.75841	9.91345	9.84496	10.15504	10.08655	10.24159	[illegible]
60	9.75859	9.91336	9.84523	10.15477	10.08664	10.24141	[illegible]
		Sine.		Tang.		Secant.	Min.

55 Degrees.

A Table of Artificial Sines,

35 Degrees.

Min.	Sine.		Tang.		Secant.		
0	9.75859	9.91336	9.84523	10.15477	10.08665	10.24141	60
1	9.75877	9.91328	9.84550	10.15450	10.08672	10.24123	59
2	9.75895	9.91319	9.84576	10.15424	10.08681	10.24105	58
3	9.75913	9.91310	9.84603	10.15397	10.08690	10.24087	57
4	9.75931	9.91301	9.84630	10.15370	10.08699	10.24069	56
5	9.75949	9.91292	9.84657	10.15343	10.08708	10.24051	55
6	9.75967	9.91283	9.84684	10.15316	10.08717	10.24033	54
7	9.75985	9.91274	9.84711	10.15289	10.08726	10.24015	53
8	9.76003	9.91266	9.84738	10.15262	10.08735	10.23997	52
9	9.76021	9.91257	9.84764	10.15236	10.08743	10.23979	51
10	9.76039	9.91248	9.84791	10.15209	10.08752	10.23961	50
11	9.76057	9.91239	9.84818	10.15182	10.08761	10.23943	49
12	9.76075	9.91230	9.84845	10.15155	10.08770	10.23925	48
13	9.76093	9.91221	9.84872	10.15128	10.08779	10.23907	47
14	9.76111	9.91212	9.84899	10.15101	10.08788	10.23889	46
15	9.76129	9.91203	9.84925	10.15075	10.08797	10.23872	45
16	9.76146	9.91194	9.84952	10.15048	10.08806	10.23854	44
17	9.76164	9.91185	9.84979	10.15021	10.08815	10.23836	43
18	9.76182	9.91176	9.85006	10.14994	10.08824	10.23818	42
19	9.76200	9.91167	9.85033	10.14968	10.08833	10.23800	41
20	9.76218	9.91158	9.85059	10.14941	10.08842	10.23782	40
21	9.76236	9.91150	9.85086	10.14914	10.08851	10.23764	39
22	9.76253	9.91141	9.85113	10.14887	10.08860	10.23747	38
23	9.76271	9.91132	9.85140	10.14860	10.08868	10.23729	37
24	9.76289	9.91123	9.85166	10.14834	10.08877	10.23711	36
25	9.76307	9.91114	9.85193	10.14807	10.08886	10.23693	35
26	9.76325	9.91105	9.85220	10.14780	10.08895	10.23676	34
27	9.76342	9.91096	9.85247	10.14753	10.08906	10.23658	33
28	9.76360	9.91087	9.85273	10.14727	10.08913	10.23640	32
29	9.76378	9.91078	9.85300	10.14700	10.08922	10.23622	31
30	9.76395	9.91069	9.85327	10.14673	10.08931	10.23605	30
		Sine.		Tang.		Secant.	Min.

54 Degrees.

35 Degrees.

Min.	Sine.		Tang.		Secant		
30	9.76395	9.91069	9.85327	10.1467[illegible]	10.0[illegible]931	10.23605	30
31	9.76413	9.91060	9.85354	10.14647	10.08[illegible]	10.23587	29
32	9.76431	9.91051	9.85380	10.14620	10.089[illegible]9	10.23569	28
33	9.76449	9.91042	9.85407	10.14593	10.08959	10.23552	27
34	9.76466	9.91033	9.85434	10.14566	10.08968	10.23534	26
35	9.76484	9.91024	9.85460	10.14540	10.08977	10.23516	25
36	9.76502	9.91014	9.85487	10.14513	10.08986	10.23499	24
37	9.76519	9.91005	9.85514	10.14486	10.08995	10.23481	23
38	9.76537	9.90996	9.85540	10.14460	10.09004	10.23463	22
39	9.76554	9.90987	9.85567	10.14433	10.09013	10.23446	21
40	9.76572	9.90978	9.85594	10.14406	10.09022	10.23428	20
41	9.76590	9.90969	9.85620	10.14380	10.09031	10.23410	19
42	9.76607	9.90960	9.85647	10.1435[illegible]	10.09040	10.23393	18
43	9.76625	9.90951	9.85674	10.14326	10.09049	10.23375	17
44	9.76642	9.90942	9.85700	10.14300	10.09058	10.23358	16
45	9.76660	9.90933	9.85727	10.14273	10.09067	10.23340	15
46	9.76677	9.90924	9.85754	10.14246	10.09076	10.23323	14
47	9.76695	9.90915	9.85780	10.14220	10.09085	10.23305	13
48	9.76712	9.90906	9.85807	10.14193	10.09095	10.23288	12
49	9.76729	9.90896	9.85834	10.14166	10.09104	10.23270	11
50	9.76748	9.90887	9.85860	10.14140	10.09113	10.23253	10
51	9.76765	9.90878	9.85887	10.14113	10.09122	10.23235	9
52	9.76782	9.90869	9.85913	10.14087	10.09131	10.23218	8
53	9.76800	9.90860	9.85940	10.14060	10.09140	10.23200	7
54	9.76817	9.90851	9.85967	10.14033	10.09149	10.23183	6
55	9.76835	9.90842	9.85993	10.14007	10.09158	10.23165	5
56	9.76852	9.9083[illegible]	9.86020	10.13980	10.09168	10.23148	4
57	9.76870	9.90825	9.86046	10.13954	10.09177	10.23130	3
58	9.76887	9.90814	9.86073	10.139[illegible]7	10.09186	10.23113	2
59	9.76904	9.90805	9.86100	10.13901	10.09195	10.23096	1
60	9.7692[illegible]	9.90796	9.86126	10.13874	10.09204	10.23078	0
		Sine.		Tang.		Secant.	Min.

54 Degrees.

A Table of Artificial Sines,

36 Degrees.

Min.	Sine.		Tang.		Secant.		
0	9.76922	9.90796	9.86126	10.13874	10.09204	10.23078	60
1	9.76939	9.90787	9.86153	10.13847	10.09213	10.23061	59
2	9.76957	9.90777	9.86179	10.13821	10.09223	10.23043	58
3	9.76974	9.90768	9.86206	10.13704	10.09232	10.23026	57
4	9.76991	9.90759	9.86232	10.13768	10.09241	10.23009	56
5	9.77009	9.90750	9.86[illegible]	10.13741	10.09250	10.22991	55
6	9.77026	9.90741	9.86285	10.13715	10.09259	10.22974	54
7	9.77043	9.90731	9.86312	10.13688	10.09269	10.22957	53
8	9.77061	9.90722	9.86339	10.13662	10.09278	10.22939	52
9	9.77078	9.90713	9.86365	10.13635	10.09287	10.22922	51
10	9.77095	9.90704	9.86392	10.13609	10.09296	10.22905	50
11	9.77113	9.90695	9.86418	10.13582	10.09306	10.22888	49
12	9.77130	9.90685	9.86445	10.13556	10.09315	10.22870	48
13	9.77147	9.90[illegible]	9.86471	10.13529	10.09324	10.22852	47
14	9.77164	9.90667	9.86498	10.13502	10.09333	10.22836	46
15	9.77182	9.90657	9.86524	10.13476	10.09343	10.22819	45
16	9.77199	9.90648	9.86551	10.13450	10.09352	10.2280	44
17	9.77216	9.90639	9.86577	10.13423	10.09361	10.22784	43
18	9.77233	9.90630	9.86604	10.13397	10.09370	10.22767	42
19	9.77250	9.90620	9.86630	10.13370	10.09380	10.22750	41
20	9.77268	9.90611	9.86656	10.13344	10.09389	10.22733	40
21	9.77285	9.90602	9.86683	10.13317	10.09398	10.22715	39
22	9.77302	9.90593	9.86709	10.13291	10.09408	10.22698	38
23	9.77319	9.90583	9.86736	10.13264	10.09417	10.22681	37
24	9.77336	9.90574	9.86762	10.13238	10.09426	10.22664	36
25	9.77353	9.90565	9.86789	10.13211	10.09436	10.22647	35
26	9.77370	9.90555	9.86815	10.13185	10.09445	10.22630	34
27	9.77388	9.90546	9.86842	10.13158	10.09454	10.22613	33
28	9.77405	9.90537	9.86868	10.13132	10.09463	10.22595	32
29	9.77422	9.90527	9.86895	10.13106	10.09473	10.22578	31
30	9.77439	9.90518	9.86921	10.13079	10.09482	10.22561	30
		Sine.		Tang.		Secant.	Min.

53 Degrees.

36 Degrees.

Min.	Sine.		Tang.		Secant.		
30	9.77439	9.90518	9.86921	10.13079	[illegible]	10.22561	30
31	9.77456	9.90509	[illegible]	10.13053	[illegible]	10.22544	29
32	9.77473	9.90499	9.86974	10.13026	[illegible]	10.22527	28
33	9.77490	9.90490	9.87000	10.13000	10.09510	[illegible]	27
34	9.77507	9.90480	9.87027	10.12974	[illegible]	10.22493	26
35	9.77524	9.90471	9.87053	[illegible]	10.09529	10.22470	[illegible]
36	9.77541	9.90462	9.87079	10.12921	10.09538	10.22459	24
37	9.77558	9.90453	9.87106	10.12894	10.09548	10.22442	23
38	9.77575	9.90443	9.8713	10.12868	10.09557	10.22425	22
39	9.77592	9.90434	9.87159	10.12842	10.09567	10.22408	21
40	9.77609	9.90424	9.87185	10.12815	10.09576	10.22391	20
41	9.77626	9.90415	9.87211	10.12789	10.09585	10.22374	19
42	9.7764	9.90405	9.87238	[illegible]	10.09595	10.22357	18
43	9.77660	9.90396	9.87264	10.12736	[illegible]	10.22340	17
44	9.77677	9.90386	9.87290	10.12710	10.09614	10.22323	16
45	9.77694	9.90377	9.87317	10.12683	10.09623	10.22306	15
46	9.77711	9.90368	9.87343	10.12657	10.09632	10.22289	14
47	9.77728	9.90358	9.87369	10.12630	10.09642	10.22273	13
48	9.77744	9.90349	9.87396	10.12604	10.09651	10.22256	12
49	9.77761	9.90339	9.87422	10.12578	10.09661	10.22239	11
50	9.77778	9.90330	9.87448	10.12552	[illegible]	10.22222	10
51	9.77795	9.90320	9.87475	10.12525	10.09680	10.22205	9
52	9.77812	9.90311	9.87501	10.12499	10.09689	10.22188	8
53	9.77829	9.90301	9.87527	10.12473	10.09699	10.22171	7
54	9.77846	9.90293	9.87554	10.12446	10.09708	10.22155	6
55	9.77862	9.90282	9.8758	10.12420	10.09718	10.22138	5
56	9.77879	9.90273	9.87606	10.12394	10.09727	10.22121	4
57	9.77896	9.90263	9.87633	10.12367	10.09737	10.22104	3
58	9.77913	9.90254	9.87659	10.12341	10.09746	10.22087	2
59	9.77930	9.90244	9.87685	10.12315	10.09756	10.22071	1
60	9.77946	9.90235	9.87711	10.12289	10.09765	10.22054	0
		Sine		Tang.		Secant.	Min.

53 Degrees.

A Table of A[illegible]ificial Sines,

37 *Degrees.*

Min.	Sine.		Tang.		Secant.		
0	9.77946	9.90[illegible]5	9.[illegible]7711	10.1228[illegible]	10.09765	10.22054	60
1	9.77963	9.9[illegible]225	9.[illegible]7738	10.122[illegible]2	10.09775	10.22037	59
2	9.77980	9.9[illegible]216	9.87764	10.12236	10.09784	10.22020	58
3	9.77997	9.90206	9.87790	10.1[illegible]1[illegible]	10.09794	10.22003	57
4	9.78013	9.90197	9.87817	10.[illegible]2184	10.09803	10.21987	56
[illegible]	9.78030	9.90187	9.878[illegible]	[illegible]0.12157	10.09813	10.21970	55
6	9.78047	9.90178	9.87869	10.12131	10.09822	10.21953	54
7	9.78063	9.90168	9.87895	10.12105	10.09832	10.21937	53
8	9.78080	9.90159	9.87922	10.12078	10.09842	10.21920	52
9	9.78097	9.90149	9.87948	10.12052	10.09851	10.21903	51
10	9.78113	9.90139	9.87974	10.12026	10.09861	10.2[illegible]887	50
11	9.78130	9.90130	9.88000	10.12000	10.09870	10.21870	49
12	9.78147	9.90120	9.88[illegible]27	10.11974	10.09880	10.21853	48
13	9.78163	9.901[illegible]	[illegible]8053	10.11947	10.09889	10.21837	47
14	9.78180	9.90101	9.88080	10.11921	10.09899	10.21819	46
15	9.78197	9.90091	9.88105	10.11895	10.09909	10.21803	45
16	9.78213	9.90082	9.88131	10.11869	10.09918	10.21787	44
17	9.78230	9.90072	9.88158	10.11842	10.09928	10.21770	43
18	9.78246	9.90063	9.88184	10.11816	10.09937	10.21754	42
19	9.78263	9.90053	9.88210	10.11790	10.09947	10.21737	41
20	9.78280	9.90043	9.88236	10.11764	10.09957	10.21720	40
21	9.78296	9.90034	9.88263	10.11736	10.09966	10.21704	39
22	9.78313	9.90024	9.88289	10.11711	10.09976	10.21687	38
23	9.78329	9.90014	9.88315	10.11685	10.09986	10.21671	37
24	9.78346	9.90005	9.88341	10.11659	10.09995	10.21654	36
25	9.78362	9.89995	9.88367	10.11633	10.10005	10.21638	35
26	9.78379	9.89985	9.88393	10.11607	10.10015	10.21621	34
27	9.78395	9.89976	9.88420	10.11580	10.10024	10.21605	33
28	9.78412	9.89966	9.88446	10.11554	10.10034	10.21588	32
29	9.78428	9.89956	9.88472	10.11528	10.10044	10.21572	31
30	9.78445	9.89947	9.88498	10.11502	10.10053	10.21555	30
		Sine.		Tang.		Secant.	Min.

52 *Degrees.*

37 Degrees.

Min.	Sine.		Tang.		Secant.		
30	9.78445	9.89947	[illegible].88498	10.11502	10.10053	10.21[illegible]55	30
31	9.78461	9.89937	9.[illegible]24	10.11476	10.1[illegible]63	10.21[illegible]39	29
32	9.78478	9.89927	9.88[illegible]	10.11450	10.100[illegible]3	10.21522	28
33	9.78494	9.89918	9.885[illegible]7	10.11424	10.1008[illegible]	10.21506	27
34	9.78511	9.89908	9.8860[illegible]	10.11397	10.10092	10.21490	26
35	9.78527	9.89898	9.88629	10.11372	10.10102	10.2[illegible]	25
36	9.78543	9.89888	9.88655	10.11345	10.10112	10.21457	24
37	9.78560	9.89879	9.88681	10.11319	10.10121	10.21440	23
38	9.78576	9.89869	9.88707	10.11293	10.10131	10.21424	22
39	9.78593	9.89858	9.88733	10.11267	10.10141	10.21408	21
40	9.78609	9.89849	9.88759	10.11241	10.10151	10.21391	20
41	9.78625	9.89840	9.88786	10.11215	10.10160	10.21375	19
42	9.78642	9.89830	9.88812	10.11188	10.10170	10.21358	18
43	9.78658	9.89820	9.88838	10.111[illegible]	10.10180	10.21342	17
44	9.78674	9.89810	9.88864	10.11136	[illegible]190	10.21326	16
45	9.78691	9.89801	9.8889[illegible]	10.11110	10.10199	10.21309	15
46	9.78707	9.89791	9.88916	10.11084	10.10209	10.21293	14
47	9.78723	9.89781	9.88942	10.11058	10.10216	10.21277	13
48	9.78740	9.89771	9.88968	10.11032	10.10229	10.21261	12
49	9.78756	9.89761	9.88994	10.11006	10.10239	10.21244	11
50	9.78772	9.89752	9.89020	10.10980	10.102[illegible]	10.21228	10
51	9.78788	9.89742	9.89047	10.10954	10.10258	10.21212	9
52	9.78805	9.89732	9.89073	10.10928	10.10268	10.21196	8
53	9.78821	9.89722	9.89099	10.10901	10.10278	10.21179	7
54	9.78837	9.89712	9.89125	10.10875	10.10288	10.21163	6
55	9.78853	9.89703	9.89151	10.10849	10.10298	10.21147	5
56	9.78869	9.89693	9.89177	10.10823	10.10307	10.21131	4
57	9.78886	9.89683	9.89203	10.10797	10.10317	10.21114	3
58	9.78902	9.89673	9.89229	10.10771	10.10327	10.21098	2
59	9.78918	9.89663	9.89255	10.10745	10.10337	10.21082	1
60	9.78934	9.89653	9.89281	10.10719	10.10347	10.21066	0
		Sine.		Tang.		Secant.	Min.

52 Degrees.

A Table of Artificial Sines,

38 Degrees.

Min.	Sine.		Tang.		Secant.		
0	9.7[illegible]934	9.896[illegible]3	9.89[illegible]81	10.10719	[illegible].10347	10.21066	60
1	9.78950	9.8[illegible]43	9.89307	10.106[illegible]3	10.10357	10.21050	59
2	9.78967	9.8[illegible]634	9.89333	10.10[illegible]67	10.10367	10.2[illegible]34	58
3	9.78983	9.89624	9.89359	10.1[illegible]641	10.10376	10.21017	57
4	9.78999	9.89614	9.89385	10.[illegible]0615	10.10386	10.21001	56
5	9.79015	9.89604	9.8941[illegible]	[illegible]0.10589	10.10396	10.20985	55
6	9.79031	9.89594	9.89437	10.10563	10.10406	10.20969	54
7	9.79047	9.89584	9.89[illegible]63	10.10537	10.10416	10.20953	53
8	9.79063	9.89574	9.89489	10.10511	10.10426	10.20937	52
9	9.79079	9.89564	9.8951[illegible]	10.10485	10.10436	10.20921	51
10	9.79095	9.89554	9.89541	10.10459	10.10446	10.20905	50
11	9.79112	9.89544	9.89567	10.10433	10.10456	10.20889	49
[illegible]	9.79128	9.89534	9.8[illegible]593	10.10407	10.10466	10.20873	48
13	9.79144	9.895[illegible]	[illegible]9619	10.10381	10.10476	10.20856	47
14	9.79160	9.89514	9.89645	1[illegible].10355	10.10486	10.20840	46
15	9.79176	9.89505	9.89671	10.1[illegible]329	10.10496	10.20824	45
16	9.79192	9.89495	9.89697	10.10303	10.10506	10.20808	44
17	9.79208	9.89485	9.89723	10.10277	10.10515	10.20792	43
18	9.79224	9.89475	9.89749	10.10250	10.10525	10.20776	42
19	9.79240	9.89465	9.89775	10.10225	10.10535	10.20760	41
20	9.7[illegible]	[illegible]945[illegible]	[illegible]9801	10.10199	10.10545	10.20744	40
21	9.79272	9.89445	9.89827	10.10173	10.10555	10.20728	39
22	9.79288	9.89435	9.89853	10.10147	10.10565	10.20712	38
23	9.79304	9.89425	9.89879	10.10121	10.10575	10.20696	37
24	9.79320	9.89415	9.89905	10.10095	10.10585	10.20681	36
25	9.79335	9.89405	9.89931	10.10069	10.10595	10.20665	35
26	9.79351	9.89395	9.89957	10.10043	10.10605	10.20649	34
27	9.79367	9.89385	9.89983	10.10017	10.10615	10.20633	33
28	9.79383	9.89375	9.90009	10.09991	10.10626	10.20617	32
29	9.79399	9.89365	9.90035	10.09965	10.10636	10.20601	31
30	9.79415	9.89354	9.90061	10.09940	10.10646	10.20585	30
		Sine.		Tang.		Secant.	Min.

51 Degrees.

38 Degrees.

Min.	Sine.		Tang.		Secant.		
30	9.79415	9.89354	9.90061	10.09940	10.10640	10.20585	30
31	9.79431	9.89344	9.9[illegible]86	10.09914	10.10656	10.20569	29
32	9.79447	9.89334	9.90112	10.09888	10.10660	10.20553	28
33	9.79463	9.89324	9.901[illegible]8	10.09862	10.106[illegible]0	10.20537	27
34	9.79478	9.89314	9.9016[illegible]	10.09836	10.1068[illegible]	10.20522	26
35	9.79494	9.89304	9.90190	10.09810	10.10696	10.205[illegible]	25
36	9.79510	9.89294	9.90216	10.09784	10.10706	10.20490	24
37	9.79526	9.89284	9.90242	10.09758	10.10716	10.20474	23
38	9.79542	9.89274	9.90268	10.09732	10.10726	10.20458	22
39	9.79558	9.89264	9.90294	10.09706	10.10736	10.20443	21
40	9.79573	9.89254	9.90320	10.09680	10.10746	10.20427	20
41	9.79589	9.89244	9.90346	10.09654	10.10757	10.20411	19
42	9.79605	9.89233	9.90371	10.09629	10.10767	10.20395	18
43	9.79621	9.89223	9.90397	10.09[illegible]	10.10777	10.20379	17
44	9.79636	9.89213	9.90423	10.09577	10.10787	10.20364	16
45	9.79652	9.89203	9.90449	10.09551	10.10797	10.20348	15
46	9.79668	9.89193	9.90475	10.09525	10.10807	10.20332	14
47	9.79684	9.89183	9.905[illegible]	10.09499	10.10817	10.20316	13
48	9.79699	9.89173	9.90527	10.09473	10.10827	10.20301	12
49	9.79715	9.89162	9.90553	10.09447	10.10838	10.20285	11
50	9.79731	9.89152	9.90578	10.[illegible]	[illegible]	[illegible]269	10
51	9.79746	9.89142	9.90604	10.09396	10.10858	10.20254	9
52	9.79762	9.89132	9.90630	10.09370	10.10868	10.20238	8
53	9.79778	9.89122	9.90656	10.09344	10.10878	10.20222	7
54	9.79795	9.89112	9.90682	10.09318	10.10889	10.20207	6
55	9.79809	9.89101	9.90708	10.09292	10.10899	10.20191	5
56	9.79825	9.89091	9.90734	10.09266	10.10909	10.20175	4
57	9.79840	9.89081	9.90759	10.09241	10.10919	10.20160	3
58	9.79856	9.89071	9.90785	10.09215	10.10929	10.20144	2
59	9.79872	9.89061	9.90811	10.09189	10.10940	10.20128	1
60	9.79887	9.89050	9.90837	10.09163	10.10950	10.20113	0
		Sine.		Tang.		Secant.	Min.

51 Degrees.

A Table of Artificial Sines

39 Degrees.

Min.	Sine.		Tang.		Secant.		
0	9.79887	9.89050	9.90837	10.09163	10.10950	10.20113	60
1	9.79903	9.8[illegible]040	9.90863	10.091[illegible]7	10.1096[illegible]	10.20097	59
2	9.79918	9.[illegible]9030	9.90889	10.09[illegible]11	10.1097[illegible]	10.[illegible]082	58
3	9.79934	9.[illegible]9020	9.90914	10.0[illegible]086	10.[illegible]98	10.2000[illegible]	57
4	9.79950	9.[illegible]9009	9.90940	10.[illegible]9060	10.1[illegible]99[illegible]	10.20051	56
5	[illegible]79965	9.88999	9.[illegible]0966	10.09034	10.11001	10.20035	55
6	9.79981	9.[illegible]8989	[illegible]90992	10.09008	10.11011	10.20019	54
7	9.79996	9.[illegible]8979	9.91018	10.08982	10.11022	10.20004	53
8	9.80012	9.88968	9.[illegible]044	10.[illegible]8957	10.11032	10.19988	52
9	9.80027	9.[illegible]8958	9.910[illegible]9	10.[illegible]8931	10.11042	10.19973	51
10	9.80043	9.88[illegible]48	9.91095	10.[illegible]8905	10.11052	10.19957	50
11	9.80058	9.889[illegible]7	9.91121	10.08879	10.11063	10.[illegible]9942	49
12	9.80074	9.8892[illegible]	[illegible]91147	10.08853	10.11073	10.19926	48
13	9.80089	9.88917	[illegible]172	10.08828	10.11083	10.19911	47
14	9.80105	9.[illegible]890[illegible]	9.9119[illegible]	10.08802	[illegible].11094	10.19895	46
15	9.8012[illegible]	9.88896	9.91224	10.0[illegible]776	10.11104	10.19880	45
16	9.80136	9.[illegible]88[illegible]6	9.91250	10.08750	10.11114	10.19864	44
17	9.80[illegible]	9.88876	9.91276	10.08724	10.11125	10.19849	43
18	9.80167	9.88865	9.91301	10.08699	10.11135	10.19834	42
19	9.8018	9.[illegible]8875	9.91327	10.08673	10.11145	10.19818	41
20	9.8019[illegible]	9.[illegible]844	[illegible]1[illegible]53	10.08647	10.11156	10.19803	40
21	9.80213	[illegible].88834	9.91379	10.08621	10.11166	10.19787	39
22	9.80228	9.88824	9.91404	10.08596	10.11176	10.19772	38
23	9.80244	9.88813	9.91430	10.08570	10.11187	10.19756	37
24	9.80259	9.88803	9.91456	10.08544	10.11197	10.19741	36
25	9.80274	9.88793	9.91482	10.08518	10.11207	10.19726	35
26	9.80290	9.88782	9.91508	10.08493	10.11218	10.19710	34
27	9.80305	9.88772	9.91533	10.08467	10.11228	10.19695	33
28	9.80320	9.88761	9.91559	10.08441	10.11239	10.19680	32
29	9.80336	9.88751	9.91585	10.08415	10.11249	10.19664	31
30	9.80351	9.88741	9.91610	10.08390	10.11259	10.19649	30
		Sine.		Tang.		Secant.	Min.

50 Degrees.

39 Degrees.

Min.	Sine.		Tang.		Secant.		
30	9.80351	9.8[illegible]741	9.9[illegible]610	10.08390	10.11[illegible]59	[illegible]0.196[illegible]9	30
31	9.80366	9.8[illegible]730	9.916[illegible]6	10.08364	10.1127[illegible]	[illegible]0.19634	[illegible]9
[illegible]	[illegible]038[illegible]	9.[illegible]87[illegible]0	9.9166[illegible]	10.08338	10.1128[illegible]	[illegible].19618	28
33	9.80397	9.[illegible]8709	[illegible]9168[illegible]	[illegible]0.08312	10.1129[illegible]	10.19603	27
34	9.80412	9.88699	9.[illegible]713	[illegible]0.08287	10.113[illegible]	[illegible].19588	26
35	9.80428	9.88689	9.9173[illegible]	10.[illegible]261	[illegible].11312	10.19572	25
36	9.80443	9.88678	9.91765	[illegible]0.08235	[illegible].11322	10.19557	24
37	9.80458	9.88668	9.91791	[illegible]0.0820[illegible]	[illegible].11332	10.19542	23
38	9.80473	9.88657	9.91816	[illegible]0.081[illegible]	10.1134[illegible]	10.19527	22
39	9.80489	9.88647	9.91842	[illegible].0[illegible]158	10.113[illegible]	10.19511	21
40	9.805[illegible]4	9.88636	9.9186[illegible]	[illegible].08132	10.11364	10.19496	20
41	9.80519	9.88626	9.91893	10.08107	10.[illegible]1374	10.19481	19
42	9.80534	9.88615	9.91919	10.0808[illegible]	[illegible]385	10.1946[illegible]	18
43	9.80550	9.88605	9.91945	10.08[illegible]55	[illegible]95	10.19451	17
44	9.80565	9.88594	9.91971	10[illegible]029	10.11406	10.19435	16
45	9.80580	9.88584	9.91996	10.08004	10.11416	10.19420	15
46	9.80595	9.88573	9.92022	10.07978	10.11427	10.19405	14
47	9.80610	9.88563	9.92048	10.07952	10.11437	10.19390	13
48	9.80625	9.88552	9.92073	10.07927	10.11448	10.19375	12
49	9.80641	9.88542	9.92099	10.07901	10.11458	10.19359	11
50	9.80656	9.88531	9.92125	10.0787[illegible]	[illegible]9	[illegible]44	10
51	9.80671	9.88520	9.92150	10.07850	10.11479	10.19329	9
52	9.80686	9.88510	9.92176	10.07824	10.11490	10.19314	8
53	9.80701	9.88499	9.92202	10.07798	10.11501	10.19299	7
54	9.80716	9.88489	9.92227	10.07773	10.11511	10.19284	6
55	9.80731	9.88478	9.92253	10.07747	10.11522	10.19269	5
56	9.80746	9.88468	9.92279	10.07721	10.11532	10.19254	4
57	9.80762	9.88457	9.92304	10.07696	10.11543	10.19239	3
58	9.80777	9.88447	9.92330	10.07670	10.11553	10.19223	2
59	9.80792	9.88436	9.92356	10.07644	10.11564	10.19208	1
60	9.80807	9.88425	9.92381	10.07619	10.11575	10.19193	0
		Sine.		Tang.		Secant.	Min.

50 Degrees.

Table of Artificial Sines

40 Degrees

Min.	Sine		Tang		Secant.		
0	9.80807	[illegible].88425	9.92381	10.0761[illegible]	10.115[illegible]5	10.19193	60
1	[illegible]80822	[illegible]78415	9.92407	10.07[illegible]93	10.11[illegible]65	10.19178	59
2	9.8083[illegible]	[illegible]88404	9.92433	10.0[illegible]567	10.1[illegible]6	[illegible]62	58
3	9.80852	9.88394	9.92458	10.[illegible]7542	1[illegible].1160[illegible]	10.19148	57
4	9.80867	[illegible]88383	9.92484	10.07516	[illegible].11617	10.19133	56
5	9.80882	9.88372	[illegible].925[illegible]	[illegible]07490	10.11628	10.1911[illegible]	55
6	9.80897	9.88362	[illegible].92535	10.[illegible]7465	10.11638	10.19103	54
7	9.80912	[illegible].88351	[illegible]92551	10.07439	10.11649	10.19088	53
8	9.80927	9.88340	9.9[illegible]587	1[illegible]07414	10.11660	10.19073	52
9	9.80942	9.[illegible]8330	9.92[illegible]	1[illegible]07388	10.11670	10.19058	51
10	9.80957	9.88[illegible]19	9.92638	[illegible]362	10.11681	10.19043	50
11	9.80972	9.883[illegible]8	9.92663	[illegible].07337	10.11692	10.19028	49
12	9.809 7	9.88298	[illegible].92689	10.07311	10.11702	10.19013	48
13	9.81002	9.88[illegible]	[illegible]15	10.07285	10.11713	10.18998	47
14	9.81017	9.88276	9.9274[illegible]	[illegible]0.07260	10.11724	10.18983	46
15	9.81032	9.88266	9.92766	10.[illegible]7234	10.11734	10.18968	45
16	9.81047	9.88255	9.92792	10.07209	10.11745	10.18954	44
17	9.81061	9.88244	9.92817	10.07183	10.11754	10.18939	43
18	9.81076	9.88234	9.92843	10.07157	10.11766	10.18924	42
19	9.81091	9.88223	9.92868	10.07132	10.11777	10.18909	41
20	9.8[illegible]	[illegible]	[illegible]94	10.07106	10.11788	10.18894	40
21	9.81121	9.88201	9.92920	10.07080	10.11799	10.18879	39
22	9.81136	9.88191	9.92945	10.07055	10.11809	10.18864	38
23	9.81151	9.88180	9.92971	10.07029	10.11820	10.18849	37
24	9.81166	9.88169	9.92996	10.07004	10.11831	10.18835	36
25	9.81180	9.88158	9.93022	10.06978	10.11842	10.18820	35
26	9.81195	9.88148	9.93048	10.06952	10.11852	10.18805	34
27	9.81210	9.88137	9.93073	10.06927	10.11863	10.18790	33
28	9.81225	9.88126	9.93099	10.06901	10.11874	10.18775	32
29	9.81240	9.88115	9.93124	10.06876	10.11885	10.18760	31
30	9.81254	9.88105	9.93150	10.06850	10.11895	10.18746	30
		Sine.		Tang.		Secant.	Min.

49 Degrees.

40 Degrees.

Min.	Sine.		Tang.		Secant.		
30	9.81254	[illegible].88106	9.93150	10.06850	10.118[illegible]5	10.18746	30
31	9.81269	9[illegible]88094	9.9[illegible]176	10.06825	10.11906	10.18731	29
32	9.8[illegible]84	[illegible]88083	9.93201	10.06799	10.11917	10.1871[illegible]	28
33	9.81299	[illegible]	9.93[illegible]27	10.06773	10.11[illegible]28	10.18701	27
34	9.81314	[illegible]	9.93[illegible]	10.06748	10.1[illegible]9[illegible]9	10.18687	26
35	9.81328	9.88051	[illegible]	[illegible]0672[illegible]	10.1[illegible]950	10.1867[illegible]	25
36	9.81343	9.88040	9.933[illegible]3	10.0669[illegible]	10.11[illegible]60	10.18657	24
37	9.81358	9.88029	9.933[illegible]9	10.0667[illegible]	10.119[illegible]1	10.18642	23
38	9.81373	9.88018	9.933[illegible]5	10.06[illegible]46	10.11[illegible]82	10.18628	22
39	9.81387	9.88007	9.93[illegible]	10.[illegible]6620	10.1[illegible]993	10.18613	21
40	9.81402	9.87996	9.93[illegible]	10.06594	10.[illegible]2004	10.18598	20
41	9.81417	9.87986	9.9343[illegible]	10.06569	[illegible].12015	10.18583	19
42	9.81431	9.87975	9.93457	10.0654[illegible]	10.12025	10.18569	18
43	9.81446	9.87964	9.93482	10.0[illegible]	10.12036	10.18554	17
44	9.81461	9.87953	9.93508	[illegible].06492	10.12047	10.18539	16
45	9.81475	9.87942	9.93533	10.06467	10.12058	10.18525	15
46	9.81490	9.87931	9.93559	10.06441	10.12069	10.18510	14
47	9.81505	9.87920	9.93584	10.06416	10.12080	10.18495	13
48	9.81519	9.87909	9.93610	10.06390	10.12091	10.18481	12
49	9.81534	9.87898	9.93636	10.06365	10.12102	10.18466	11
50	9.81549	9.87888	9.93661	10.[illegible]	[illegible]	[illegible]8452	10
51	9.81563	9.87877	9.93687	10.06313	10.12123	10.18437	9
52	9.81578	9.87866	9.93712	10.06288	10.12134	10.18422	8
53	9.81592	9.87855	9.93738	10.06262	10.12145	10.18408	7
54	9.81607	9.87844	9.93763	10.06237	10.12156	10.18393	6
55	9.81622	9.87833	9.93789	10.06211	10.12167	10.18379	5
56	9.81636	9.87822	9.93814	10.06186	10.12178	10.18364	4
57	9.81651	9.87811	9.93840	10.06160	10.12189	10.18349	3
58	9.81665	9.87800	9.93865	10.06135	10.12200	10.18335	2
59	9.81680	9.87789	9.93891	10.06109	10.12211	10.18320	1
60	9.81694	9.87778	9.93916	10.06084	10.12222	10.18306	0
		Sine.		Tang.		Secant.	Min.

49 Degrees.

A [illegible]ble of Artificial Sines,

41 *Degrees.*

Min.	Sine.		Tang.		Secant.		
0	9.81[illegible]94	9.8[illegible]778	9.93916	10.06084	10.12222	[illegible].18306	60
1	9.81[illegible]09	9.8[illegible]767	9.93942	10.0605[illegible]	10.12233	[illegible].18292	59
2	[illegible].81723	9.87756	9.93967	10.0603[illegible]	10.122[illegible]	[illegible]277	[illegible]
3	9.81738	9.8[illegible]45	9.93993	10.060[illegible]7	10.1[illegible]255	[illegible].18262	57
4	9.81752	9.8[illegible]4	9.94018	10.05[illegible]82	[illegible]2266	10.18248	56
5	9.81767	9.877[illegible]3	9.9[illegible]044	[illegible]	10.12277	10.18233	55
6	9.81781	9.87[illegible]12	9.9[illegible]9	10.05[illegible]31	10.12288	10.18219	54
7	9.81796	9.8[illegible]701	9.9[illegible]95	10.05[illegible]05	10.12299	10.18204	53
8	9.81810	9.87[illegible]90	9.941[illegible]	10.05[illegible]80	10.12310	10.18190	52
9	9.81825	9.876[illegible]9	9.94146	[illegible]54	10.12321	10.18175	51
10	9.81839	9.8766[illegible]	9.94171	10.0[illegible]	10.12332	10.18161	50
11	9.81854	9.87657	[illegible]94197	10.0[illegible]803	10.12343	10.18146	49
12	9.81868	9.87646	9.9[illegible]222	10.05778	10.12354	10.18132	48
13	9.81883	9.8763[illegible]	[illegible]248	10.05752	10.12365	10.18118	47
14	9.81897	9.87624	9.94273	[illegible]727	10.12376	10.18103	46
15	9.81911	9.87613	9.94299	10.057[illegible]1	10.12388	10.18089	45
16	9.81926	9.87601	9.94324	10.05676	10.12399	10.18074	44
17	9.81940	9.87590	9.94350	10.05650	10.12410	10.18060	43
18	9.81955	9.87579	9.94375	10.05625	10.12421	10.18046	42
19	9.81969	9.87568	9.94401	10.05599	10.12432	10.18031	41
20	9.8198[illegible]	[illegible]	[illegible]	[illegible].05574	10.12443	10.18017	40
21	9.81998	9.87546	9.94452	10.05548	10.12454	10.18002	39
22	9.82012	9.87535	9.94477	10.05523	10.12465	10.17988	38
23	9.82026	9.87524	9.94503	10.05497	10.12476	10.17974	37
24	9.82041	9.87513	9.94528	10.05472	10.12487	10.17959	36
25	9.82055	9.87501	9.94554	10.05447	10.12499	10.17945	35
26	9.82069	9.87490	9.94579	10.05421	10.12510	10.17931	34
27	9.82084	9.87479	9.94605	10.05396	10.12521	10.17916	33
28	9.82098	9.87468	9.94630	10.05370	10.12532	10.17902	32
29	9.82112	9.87457	9.94655	10.05345	10.12543	10.17888	31
30	9.82127	9.87446	9.94681	10.05319	10.12554	10.17874	30
		Sine.		Tang.		Secan	Min.

48 *Degrees.*

41 Degrees.

Min.	Sine.		Tang.		Secant.		
30	9.82127	9.87446	9.94681	10.05319	10.1255[illegible]	10.1[illegible]874	30
31	9.82141	9.87434	9.94706	10.05294	10.1256[illegible]	10.1[illegible]859	29
32	9.82155	9.87423	9.94732	10.05268	10.12577	10.1784[illegible]	[illegible]8
3[illegible]	[illegible].821[illegible]9	[illegible].87[illegible]2	9.94757	10.05243	10.125[illegible]	10.17831	2[illegible]
34	9.82184	[illegible]	9.94783	10.05217	10.12[illegible]9	10.17817	26
35	9.82198	9.87390	9.9[illegible]	[illegible].0519[illegible]	10.12[illegible]10	10.17802	25
36	9.82212	9.87378	9.948[illegible]4	10.05160	10.12[illegible]22	10.17788	24
37	9.82226	9.87367	9.948[illegible]	10.0514[illegible]	10.126[illegible]3	10.17774	23
38	9.82240	9.87356	9.948[illegible]	10.05[illegible]6	10.126[illegible]4	10.17760	22
39	9.82255	9.87345	9.949[illegible]	10.0[illegible]090	10.12[illegible]55	10.17745	21
40	9.82269	9.87334	9.94[illegible]	10.05065	10.[illegible]667	10.17731	20
41	9.82283	9.87322	9.9496[illegible]	10.05039	10[illegible]12678	10.17717	19
42	9.82297	9.87311	9.94986	10.05014	[illegible].12690	10.17703	18
43	9.82311	9.87300	9.95012	10.04[illegible]	10.12700	10.17689	17
44	9.82326	9.87289	9.95037	10[illegible]4963	[illegible].12712	10.17674	16
45	9.82340	9.87277	9.95063	10.04938	10.12723	10.17660	15
46	9.82354	9.87266	9.95088	10.04912	10.12734	10.17646	14
47	9.82368	9.87255	9.95113	10.04887	10.12745	10.17632	13
48	9.82382	9.87243	9.95139	10.04861	10.12757	10.17618	12
49	9.82396	9.87232	9.95164	10.04836	10.12768	10.17604	11
50	9.82410	9.87221	9.95190	10.048[illegible]	10.1[illegible]9	10.17590	10
51	9.82425	9.87209	9.95215	10.04785	10.1279[illegible]	10.17576	9
52	9.82439	9.87198	9.95240	10.04760	10.12802	10.17561	8
53	9.82453	9.87187	9.95266	10.04734	10.12813	10.17547	7
54	9.82467	9.87176	9.95291	10.04709	10.12825	10.17533	6
55	9.82481	9.87164	9.95317	10.04683	10.12836	10.17519	5
56	9.82495	9.87153	9.95342	10.04658	10.12847	10.17505	4
57	9.82509	9.87148	9.95368	10.04633	10.12859	10.17491	3
58	9.82523	9.87130	9.95393	10.04607	10.12870	10.17477	2
59	9.82537	9.87119	9.95418	10.04582	10.12881	10.17463	1
60	9.82551	9.87107	9.95444	10.04556	10.12893	10.17449	0
		Sine.		Tang.		Secant.	Min.

48 Degrees.

A Table of Artificial Sines,

42 *Degrees.*

Min.	Sine.		Tang.		Secant.		
0	[illegible]	[illegible]	9.95444	10.04556	[illegible]	10.17449	60
1	[illegible]	[illegible]	9.95469	10.04531	[illegible]	10.17435	59
2	9.82579	[illegible]	9.95495	10.04505	[illegible]	[illegible]	58
3	9.82593	[illegible]	9.95520	10.04480	[illegible]	[illegible]	57
4	9.82607	[illegible]	9.95545	10.04455	[illegible]	10.17393	56
5	9.82621	[illegible]	[illegible]	[illegible]	10.12950	10.17379	55
6	9.82635	[illegible]	[illegible]	[illegible]	10.12961	10.17365	54
7	9.82649	[illegible]	[illegible]	[illegible]	10.12972	10.17351	53
8	9.82663	[illegible]	[illegible]	[illegible]	10.12984	10.17337	52
9	9.82677	[illegible]	[illegible]	[illegible]	10.12995	10.17323	51
10	9.82691	[illegible]	9.95698	[illegible]	10.13007	10.17309	50
11	9.82705	9.86982	[illegible]	10.04277	10.13018	10.17295	49
12	9.82719	9.86970	[illegible]	10.04252	10.13030	10.17281	48
13	9.82733	9.86959	[illegible]	10.04226	10.13041	10.17267	47
14	9.82747	9.86947	9.95799	[illegible]	10.13053	10.17253	46
15	9.82761	9.86936	9.95825	10.04175	10.13064	10.17239	45
16	9.82775	9.86925	9.95850	10.04150	10.13076	10.17226	44
17	9.82788	9.86913	9.95875	10.04125	10.13087	10.17212	43
18	9.82802	9.86902	9.95901	10.04099	10.13099	10.17198	42
19	9.82816	9.86890	9.95926	10.04074	10.13110	10.17184	41
20	[illegible]	[illegible]	[illegible]	10.04048	10.13122	10.17170	40
21	9.82844	9.86867	9.95977	10.04023	10.13133	10.17156	39
22	9.82858	9.86856	9.96002	10.03998	10.13145	10.17142	38
23	9.82872	9.86844	9.96028	10.03972	10.13156	10.17128	37
24	9.82886	9.86832	9.96053	10.03947	10.13168	10.17115	36
25	9.82899	9.86821	9.96078	10.03922	10.13179	10.17101	35
26	9.82913	9.86809	9.96104	10.03896	10.13191	10.17087	34
27	9.82927	9.86798	9.96129	10.03871	10.13202	10.17073	33
28	9.82941	9.86786	9.96155	10.03846	10.13214	10.17059	32
29	9.82955	9.86775	9.96180	10.03820	10.13225	10.17046	31
30	9.82968	9.86763	9.96205	10.03795	10.13237	10.17032	30
		Sine.		Tang.		Secant	Min.

47 *Degrees.*

Tangents and Secants.

42 Degrees.

Min.	Sine.		Tang.		Secant.		
30	9.82968	9.86763	9.96205	10.03795	10.13237	10.17032	30
31	9.82982	9.86752	9.96231	10.03769	10.13249	[illegible]	29
[illegible]	[illegible]	[illegible]	9.96256	10.03744	10.13260	10.17004	28
33	9.83010	[illegible]	9.96281	10.03719	[illegible]	10.16990	27
34	9.83023	9.86717	[illegible]	10.03693	10.13283	10.16977	26
35	9.83037	9.86705	[illegible]	[illegible]	[illegible]	10.16963	25
36	9.83051	9.86694	[illegible]	10.03643	[illegible]	10.16949	24
37	9.83065	9.86682	[illegible]	[illegible]	[illegible]	10.16935	23
38	9.83078	9.86670	[illegible]	[illegible]	[illegible]	10.16922	22
39	9.83092	9.86659	[illegible]	[illegible]	[illegible]	10.16908	21
40	9.83106	9.86647	[illegible]	[illegible]	[illegible]	10.16894	20
41	9.83120	9.86635	9.96484	10.03516	[illegible]	10.16881	19
42	9.83133	9.86624	9.96510	10.03491	[illegible]	10.16867	18
43	9.83147	9.86612	9.96535	[illegible]	[illegible]	10.16853	17
44	9.83161	9.86600	9.96560	[illegible]	10.13400	10.16839	16
45	9.83174	9.86589	9.96586	10.03414	10.13411	10.16826	15
46	9.83188	9.86577	9.96611	10.03389	10.13423	10.16812	14
47	9.83202	9.86565	9.96636	10.03364	10.13435	10.16798	13
48	9.83215	9.86554	9.96662	10.03338	10.13446	10.16785	12
49	9.83229	9.86542	9.96687	10.03313	10.13458	10.16771	11
50	9.83243	9.86530	9.96712	[illegible]	[illegible]	[illegible]	10
51	9.83256	9.86519	9.96738	10.03262	10.13482	10.16744	9
52	9.83270	9.86507	9.96763	10.03237	10.13493	10.16730	8
53	9.83283	9.86495	9.96788	10.03212	10.13505	10.16717	7
54	9.83297	9.86483	9.96814	10.03186	10.13517	10.16703	6
55	9.83311	9.86472	9.96839	10.03161	10.13528	10.16690	5
56	9.83324	9.86460	9.96864	10.03136	10.13540	10.16676	4
57	9.83338	9.86448	9.96890	10.03110	10.13552	10.16662	3
58	9.83351	9.86436	9.96915	10.03085	10.13564	10.16649	2
59	9.83365	9.86425	9.96940	10.03060	10.13576	10.16635	1
60	9.83378	9.86413	9.96966	10.03034	10.13587	10.16622	0
		Sine.		Tang.		Secant.	Min.

47 Degrees.

A Table of Artificial Sines,

43 Degrees.

Min.	Sine.		Tang.		Secant.		
0	9.83378	9.[illegible]6413	9.96[illegible]66	10.03034	10.13587	10.16622	60
1	9.8[illegible]392	9.[illegible]6401	9.9[illegible]991	10.03009	10.13599	10.16608	59
[illegible]	9.83405	9.86389	9.97016	10.02984	10.136[illegible]	10.1[illegible]	58
3	9.83419	9.8[illegible]377	9.97042	10.02958	10.[illegible]623	10.1658[illegible]	57
4	9.83433	9.[illegible]66	9.97067	10.02953	[illegible]	10.16568	56
5	9.83446	9.86[illegible]54	9.[illegible]7092	[illegible]	10.13646	10.16554	55
6	9.83460	9.86342	9.[illegible]7118	10.0[illegible]883	10.13658	10.16541	54
7	9.8347[illegible]	9.[illegible]6330	9.[illegible]7143	10.0[illegible]2857	10.1367[illegible]	10.16527	53
8	9.83487	9.[illegible]6318	9.97[illegible]68	10.0[illegible]832	10.13682	10.16514	52
9	9.83500	9.8[illegible]306	9.9719[illegible]	10.[illegible]807	10.13694	10.16500	51
10	9.83513	9.862[illegible]	9.97219	10.[illegible]81	10.13705	10.16487	50
11	9.83527	9.8628[illegible]	9.97244	10.02756	10.13717	10.16473	49
12	9.83540	9.86271	9.97269	10.02731	10.13729	10.16460	48
13	9.83554	9.86259	9.[illegible]72[illegible]	10.02705	10.13741	10.16446	47
14	9.83567	9.86247	9.97320	[illegible]02680	10.13753	10.16433	46
15	9.83581	9.86235	9.97345	10.02655	10.13765	10.16419	45
16	9.83594	9.86223	9.97371	10.02629	10.13777	10.16406	44
17	9.83608	9.86212	9.97396	10.02604	10.13789	10.16393	43
18	9.83621	9.86200	9.97421	10.02579	10.13800	10.16379	42
19	9.83634	9.86188	9.97447	10.02553	10.13812	10.16366	41
20	9.83[illegible]	[illegible]	[illegible]72	10.02528	10.13824	10.16352	40
21	9.83661	9.86164	9.97497	1[illegible]02503	10.13836	10.16339	39
22	9.83675	9.86152	9.97523	10.02477	10.13848	10.16326	38
23	9.83688	9.86140	9.97548	10.02452	10.13860	10.16312	37
24	9.83701	9.86128	9.97573	10.02427	10.13872	10.16299	36
25	9.83715	9.86116	9.97599	10.02402	10.13884	10.16285	35
26	9.83738	9.86104	9.97624	10.02376	10.13896	10.16272	34
27	9.83741	9.86092	9.97649	10.02351	10.13908	10.16259	33
28	9.83755	9.86080	9.97674	10.02326	10.13920	10.16245	32
29	9.83768	9.86068	9.97700	10.02300	10.13932	10.16232	31
30	983781	9.86056	9.97725	10.02275	10.13944	10.16219	30
	[illegible]	Sine.		Tang.		Secant.	Min.

46 Degrees.

43 *Degrees.*

Min.	Sine.		Tang.		Secant.		
30	9.83781	9.86056	9.97725	10.02275	10.1394[illegible]	10.16219	30
31	9.83795	9.86044	9.97750	10.02250	10.1395[illegible]	10.16[illegible]	29
[illegible]	[illegible]	9.86032	9.97776	10.02224	10.13968	10.16192	2[illegible]
33	9.83821	9.860[illegible]	9.97801	10.02199	10.139[illegible]0	10.16179	27
34	9.83834	9.86008	[illegible]97816	10.02174	10.1399[illegible]	10.16166	26
35	9.83848	9.85996	9.97852	[illegible]02149	10.14004	10.16152	25
36	9.83861	9.85984	9.9787[illegible]	10.02123	10.14016	10.16139	24
37	9.83874	9.85972	9.97902	10.020[illegible]	10.14028	10.16126	23
38	9.8388[illegible]	9.85960	9.9792[illegible]	10.0[illegible]73	10.140[illegible]0	10.16113	22
39	9.83901	9.85948	9.9795[illegible]	10.02047	10.14[illegible]52	10.16099	21
40	9.83[illegible]14	9.85936	9.979[illegible]	[illegible]0.02022	10.[illegible]4064	10.16086	20
41	9.83927	9.85924	9.98003	10.01997	[illegible]14076	10.16073	19
42	9.83940	9.85912	9.98029	10.01971	[illegible]0.14088	10.16060	18
43	9.83954	9.85900	9.98054	10.0[illegible]946	[illegible]0.14100	10.16046	17
44	9.83967	9.85888	9.98079	[illegible]01921	10.14112	10.16033	16
45	9.83980	9.85876	9.98104	10.01896	10.14124	10.16020	15
46	9.83993	9.85864	9.98130	10.01870	10.14137	10.16007	14
47	9.84006	9.85851	9.98155	10.01845	10.14149	10.15994	13
48	9.84020	9.85839	9.98180	10.01820	10.14161	10.15980	12
49	9.84033	9.85827	9.98206	10.01794	10.14173	10.15967	11
50	9.84046	9.85815	9.98231	10.01769	[illegible]	10.15954	10
51	9.84059	9.85803	9.98256	10.01744	10.14197	10.15941	9
52	9.84072	9.85791	9.98281	10.01719	10.14209	10.15928	8
53	9.84085	9.85779	9.98307	10.01693	10.14221	10.15915	7
54	9.84099	9.85767	9.98332	10.01668	10.14234	10.15902	6
55	9.84112	9.85754	9.98367	10.01643	10.14246	10.15888	5
56	9.84125	9.85742	9.98383	10.01617	10.14258	10.15875	4
57	9.84138	9.85730	9.98408	10.01592	10.14270	10.15862	3
58	9.84151	9.85718	9.98433	10.01567	10.14282	10.15849	2
59	9.84164	9.85706	9.98458	10.01542	10.14294	10.15836	1
60	9.84177	9.85693	9.98484	10.01516	10.14307	10.15823	0
		Sine.		Tang.		Secant.	Min.

46 *Degrees.*

A Table of Artificial Sines,

44 *Degrees.*

Min.	Sine		Tang		Secant		
0	9.84177	9.85693	9.98484	10.01516	10.14307	10.15823	60
1	9.84190	9.85681	9.98509	10.01491	10.14319	10.15810	59
2	9.84203	9.85669	9.98534	10.01466	10.14331	10.15797	58
3	9.84216	9.85657	9.98560	10.01440	10.14333	[illegible]	57
4	9.84220	9.85645	9.98585	10.01415	[illegible]	10.15771	56
5	9.84242	9.85632	9.98610	[illegible]	10.14368	10.15758	55
6	9.84256	9.85620	9.98635	10.01365	10.14380	10.15745	54
7	9.84261	9.85608	9.98661	10.01339	10.14392	10.15732	53
8	9.84282	9.85596	9.98686	10.01314	10.14404	10.15719	52
9	9.84295	9.85583	[illegible]	10.01289	10.14417	10.15705	51
10	9.84308	9.85571	9.98737	[illegible]	10.14429	10.15692	50
11	9.84321	[illegible]	9.98762	10.01238	10.14441	10.15679	49
12	9.84334	9.85547	9.98787	10.01213	10.14454	10.15666	48
13	9.84347	9.85534	9.98812	10.01188	10.14460	10.15653	47
14	9.84360	9.85522	[illegible]	10.01162	10.14478	10.15641	46
15	9.84373	9.85510	9.98863	10.01137	10.14490	10.15628	45
16	9.84386	9.85497	9.98888	10.01112	10.14503	10.15615	44
17	9.84398	9.85485	9.98913	10.01087	10.14515	10.15602	43
18	9.84411	9.85473	9.98939	10.01061	10.14527	10.15589	42
19	9.84424	9.85460	9.98964	10.01036	10.14540	10.15576	41
20	[illegible]	9.85448	9.98989	10.01011	10.14552	10.15563	40
21	9.84450	9.85436	9.99014	10.00986	10.14564	10.15550	39
22	9.84463	9.85423	9.99040	10.00960	10.14577	10.15537	38
23	9.84476	9.85411	9.99065	10.00935	10.14589	10.15524	37
24	9.84489	9.85399	9.99090	10.00910	10.14601	10.15511	36
25	9.84502	9.85386	9.99116	10.00884	10.14614	10.15498	35
26	9.84515	9.85374	9.99141	10.00859	10.14626	10.15485	34
27	9.84528	9.85361	9.99166	10.00834	10.14639	10.15472	33
28	9.84540	9.85349	9.99191	10.00809	10.14651	10.15460	32
29	9.84553	9.85337	9.99217	10.00783	10.14663	10.15447	31
30	9.84566	9.85324	9.99242	10.00758	10.14676	10.15434	30
		Sine.		Tang.		Secant.	Min.

45 *Degrees,*

44 Degrees.

Min.	Sine.		Tang.		Secant.		
30	9.84566	9.85324	9.99242	10.00758	10.14676	10.15434	30
31	9.84579	9.85312	9.99267	10.00733	10.14688	10.15421	29
32	9.84592	9.85299	9.99293	10.00708	10.14701	10.15408	28
33	9.84605	9.85287	9.99318	10.00682	10.14713	10.15395	27
34	9.84618	9.85275	9.99343	10.00657	10.14726	10.15383	26
35	9.84630	9.85262	9.99368	10.00632	10.14738	10.15370	25
36	9.84643	9.85250	9.99394	10.00606	10.14750	10.15357	24
37	9.84655	9.85237	9.99419	10.00581	10.14763	10.15344	23
38	9.84669	9.85225	9.99444	10.00556	10.14775	10.15331	22
39	9.84682	9.85212	9.99469	10.00531	10.14788	10.15318	21
40	9.84694	9.85200	9.99495	10.00505	10.14800	10.15306	20
41	9.84707	9.85187	9.99520	10.00480	10.14813	10.15293	19
42	9.84720	9.85175	9.99545	10.00455	10.14825	10.15280	18
43	9.84733	9.85162	9.99571	10.00430	10.14838	10.15267	17
44	9.84745	9.85150	9.99596	10.00404	10.14850	10.15255	16
45	9.84758	9.85137	9.99621	10.00379	10.14863	10.15242	15
46	9.84771	9.85125	9.99646	10.00354	10.14875	10.15229	14
47	9.84784	9.85112	9.99672	10.00329	10.14888	10.15216	13
48	9.84796	9.85100	9.99697	10.00303	10.14900	10.15204	12
49	9.84809	9.85087	9.99722	10.00278	10.14913	10.15191	11
50	9.84822	9.85075	9.99747	10.00253	10.14926	10.15178	10
51	9.84835	9.85062	9.99773	10.00227	10.14938	10.15166	9
52	9.84847	9.85049	9.99798	10.00202	10.14951	10.15153	8
53	9.84860	9.85037	9.99823	10.00177	10.14963	10.15140	7
54	9.84873	9.85024	9.99848	10.00152	10.14976	10.15127	6
55	9.84885	9.85012	9.99874	10.00126	10.14988	10.15115	5
56	9.84898	9.84999	9.99899	10.00101	10.15001	10.15102	4
57	9.84911	9.84986	9.99924	10.00076	10.15014	10.15089	3
58	9.84923	9.84974	9.99950	10.00051	10.15026	10.15077	2
59	9.84936	9.84961	9.99975	10.00025	10.15039	10.15064	1
60	9.84949	9.84949	10.0000	10.00000	10.15052	10.15052	0
		Sine.		Tang.		Secant.	Min.

45 Degrees.

A TABLE *of the* SUN'S *Declination for the Years*.

Days.	Jan. S. °	′	Feb S. °	′	March. S. * °	′	April. N. °	′	May. N. °	′	June. N. °	′	Days.
1	21	37	13	36	03	12	08	47	18	12	23	12	1
2	21	27	13	16	02	49	09	08	18	27	23	15	2
3	21	16	12	56	02	25	09	30	18	42	23	18	3
4	21	05	1[illegible]	35	02	01	09	51	18	56	23	21	4
5	20	54	12	14	01	37	10	13	19	10	23	23	5
6	20	42	11	53	01	14	10	34	19	23	23	25	6
7	20	30	11	32	00	50	10	55	19	37	23	27	7
8	20	17	11	11	00	26	11	16	19	50	23	28	8
9	20	04	10	49	00	03	11	36	20	03	23	29	9
10	19	51	10	27	N	21	11	[illegible]	20	15	23	29	10
11	19	37	10	05	00	44	12	17	20	27	23	29	11
12	19	23	09	43	01	08	12	37	20	38	23	28	12
13	19	09	09	21	01	32	12	57	20	49	23	27	13
14	18	54	08	59	01	55	13	16	21	01	23	26	14
15	18	39	08	37	02	19	13	36	21	11	23	24	15
16	18	24	08	[illegible]	02	42	13	55	21	21	23	22	16
17	18	08	07	51	03	06	14	14	21	30	23	19	17
18	17	52	07	28	03	29	14	33	21	40	23	16	18
19	17	35	07	05	03	[illegible]	14	51	21	49	23	13	19
20	17	18	06	42	04	16	15	09	21	58	23	09	20
21	17	01	06	19	04	39	15	27	22	06	23	05	21
22	16	44	05	56	05	02	15	45	22	14	23	00	22
23	16	26	05	33	05	25	16	03	22	22	22	55	23
24	16	08	05	10	05	48	16	20	22	29	22	50	24
25	15	50	04	46	06	11	16	37	22	36	22	44	25
26	15	32	04	23	06	33	16	53	22	42	22	37	26
27	15	13	03	59	06	56	17	10	22	48	22	30	27
28	14	54	03	36	07	18	17	26	22	54	22	23	28
29	14	35			07	41	17	41	22	59	22	16	29
30	14	16			08	03	17	57	23	04	22	08	30
31	13	56			08	25			23	08			31

1733, 1737, 1741, 1745, (each being the first after Leap-Year.

Days.	July. N.		Aug. N.		Sept. N. *		Octob. S.		Nov. S.		Decem. S.		Days.
	°	'	°	'	°	'	°	'	°	'	°	'	
1	22	00	14	58	04	[illegible]	07	30	17	[illegible]	23	09	1
2	21	51	14	40	03	45	07	52	18	[illegible]	23	13	2
3	21	[illegible]	14	[illegible]	03	22	08	15	18	[illegible]	23	17	3
4	[illegible]	33	14	03	02	58	08	37	18	[illegible]	23	[illegible]	4
5	21	23	13	44	02	35	08	59	18	[illegible]	23	24	5
6	21	13	13	25	02	12	09	21	19	06	23	25	6
7	21	03	13	05	01	49	09	43	19	[illegible]	23	27	7
8	20	[illegible]	12	46	01	25	10	05	19	34	23	28	8
9	20	41	12	26	01	02	10	27	19	48	23	29	9
10	20	29	12	06	[illegible]	39	10	48	20	01	23	29	10
11	20	17	11	46	00	[illegible]	11	[illegible]	20	14	23	29	11
12	20	05	11	26	S	08	11	[illegible]	20	27	23	28	12
13	19	53	11	05	00	32	11	52	20	39	23	27	13
14	19	40	10	44	00	55	12	13	20	51	23	26	14
15	19	27	10	24	01	19	12	33	21	02	23	24	15
16	19	14	10	03	01	42	12	54	21	13	23	21	16
17	19	00	09	41	02	06	13	14	21	24	23	18	17
18	18	46	09	20	02	29	13	34	21	34	23	15	18
19	18	31	08	58	02	53	13	54	21	44	23	11	19
20	18	17	08	37	03	16	14	13	21	54	23	07	20
21	18	02	08	15	03	39	14	33	22	03	23	02	21
22	17	46	07	53	04	03	14	52	22	11	22	57	22
23	17	31	07	31	04	26	15	11	22	20	22	51	23
24	17	15	07	09	04	49	15	29	22	27	22	45	24
25	16	59	06	47	05	12	15	48	22	34	22	33	25
26	16	42	06	24	05	35	16	06	22	41	22	31	26
27	16	26	06	02	05	58	16	24	22	48	22	24	27
28	16	09	05	39	06	21	16	41	22	54	22	16	28
29	15	51	05	16	06	44	16	58	22	59	22	07	29
30	15	34	04	54	07	07	17	15	23	04	21	58	30
31	15	16	04	31			17	32			21	49	31

A TABLE of the Sun's Declination for the Years

Days.	Jan. S. °	'	Feb. S. °	'	March. S. °	'	April. N. °	'	May. N. °	'	June. N. °	'	Days.
1	21	39	13	49	03	18	08	[illegible]	18	08	23	11	1
2	21	29	[illegible]	20	02	54	09	03	18	23	23	[illegible]	2
3	21	19	[illegible]	00	02	31	09	25	18	38	23	18	3
4	21	08	12	39	02	07	09	46	18	92	23	21	4
5	20	57	12	19	01	43	10	08	19	06	23	23	5
6	20	45	11	58	01	20	10	29	19	20	23	25	6
7	20	33	11	37	00	56	10	50	19	34	23	27	7
8	20	20	11	15	00	32	11	11	19	47	[illegible]	28	8
9	20	07	10	54	00	09	11	31	19	59	23	29	9
10	19	54	10	32	N	14	11	[illegible]	20	12	23	29	10
11	19	41	10	10	00	38	12	12	20	24	23	29	11
12	19	27	09	48	01	02	12	32	20	36	23	28	12
13	19	12	09	26	01	26	12	52	20	47	23	27	13
14	18	58	09	04	01	49	13	12	20	58	23	26	14
15	18	43	08	42	02	13	13	31	21	08	23	24	15
16	18	27	08	19	02	36	13	50	21	19	23	22	16
17	18	11	07	57	03	00	14	09	21	29	23	20	17
18	17	55	07	34	03	23	14	28	21	38	23	17	18
19	17	39	07	11	03	47	14	47	21	47	23	13	19
20	17	22	06	48	04	[illegible]	15	05	21	56	23	10	20
21	17	05	06	25	04	33	15	23	22	05	23	06	21
22	16	48	06	02	04	56	15	41	22	13	23	01	22
23	16	31	05	39	05	19	15	58	22	20	22	56	23
24	16	13	05	15	05	42	16	15	22	27	22	51	24
25	15	55	04	52	06	05	16	32	22	34	22	45	25
26	15	36	04	29	06	28	16	49	22	41	22	39	26
27	15	18	04	05	06	50	17	05	22	47	22	32	27
28	13	58	03	42	07	13	17	22	22	53	22	25	28
29	14	29			07	35	17	38	22	58	22	18	29
30	14	20			07	57	17	53	23	03	22	10	30
31	14	00			08	19			23	07			31

1730, 1734, 1738, 1742, (each being the second after Leap-year.)

Days	July. N. °	July. N. '	Aug. N. °	Aug. N. '	Sept. N. * °	Sept. N. * '	Octob. S. °	Octob. S. '	Nov. S. °	Nov. S. '	Decem. S. °	Decem. S. '	Days
1	22	02	15	02	[illegible]	13	07	24	17	44	23	08	1
2	[illegible]	53	14	44	03	50	07	47	18	[illegible]	[illegible]	12	2
3	[illegible]	44	14	26	03	27	08	09	18	[illegible]	[illegible]	16	3
4	21	35	14	07	03	04	08	32	18	[illegible]	23	19	4
5	21	26	13	48	02	41	08	54	18	47	23	22	5
6	21	16	13	29	02	17	09	16	19	[illegible]	23	24	6
7	21	06	13	10	01	54	09	38	19	17	23	26	7
8	20	[illegible]	12	51	01	31	10	00	19	31	23	27	8
9	20	44	12	31	01	07	10	21	19	45	23	28	9
10	20	33	12	11	00	44	10	43	19	58	23	29	10
11	20	21	11	51	00	21	11	04	20	11	23	29	11
12	20	09	11	31	S	03	11	26	20	24	23	28	12
13	19	57	11	10	00	26	11	47	20	36	23	27	13
14	19	44	10	49	00	50	12	08	20	48	23	26	14
15	19	31	10	28	01	13	12	28	21	00	23	24	15
16	19	18	10	07	01	37	12	49	21	11	23	22	16
17	19	04	09	46	02	00	13	09	21	22	23	19	17
18	18	50	09	25	02	23	13	29	21	32	23	16	18
19	18	35	09	04	02	47	13	49	21	42	23	12	19
20	18	20	08	42	03	10	14	09	21	51	23	08	20
21	18	05	08	20	03	34	14	28	22	00	23	03	21
22	17	51	07	58	03	57	14	47	22	09	22	58	22
23	17	35	07	36	04	20	15	06	22	17	22	52	23
24	17	19	07	14	04	44	15	25	22	25	22	46	24
25	17	03	06	52	05	07	15	43	22	33	22	40	25
26	16	46	06	30	05	30	16	01	22	40	22	33	26
27	16	30	06	07	05	53	16	19	22	46	22	25	27
28	16	13	05	44	06	16	16	37	22	52	22	17	28
29	15	56	05	22	06	39	16	54	22	58	22	09	29
30	15	39	04	[illegible]	07	02	17	11	23	03	22	00	30
31	15	21	04	36			17	28			21	51	31

A Table of the Sun's Declination for the Years

Days.	Jan. S. °	'	Feb. S. °	'	March. S. * °	'	April. N. °	'	May. N. °	'	June. N. °	'	Days.
1	21	42	13	45	03	24	08	36	18	05	23	10	1
2	21	32	13	25	03	00	08	58	18	20	23	14	2
3	21	21	13	05	02	36	09	17	18	35	23	17	3
4	21	10	1[illegible]	44	02	13	09	39	18	49	23	20	4
5	20	59	12	24	01	49	10	03	19	03	23	23	5
6	20	48	1[illegible]	03	01	25	10	24	19	15	23	25	6
7	20	36	11	42	01	02	10	45	19	29	23	26	7
8	20	23	11	21	00	38	11	06	19	43	23	27	8
9	20	10	10	59	00	14	11	27	19	56	23	28	9
10	19	57	10	38	N	09	11	47	20	09	23	29	10
11	19	44	10	16	00	33	12	07	20	21	23	29	11
12	19	30	09	54	00	56	12	27	20	33	23	29	12
13	19	16	09	32	01	20	12	47	20	44	23	28	13
14	19	01	09	10	01	44	13	07	20	55	23	27	14
15	18	46	08	47	02	07	13	26	21	06	23	25	15
16	18	31	08	25	02	31	13	46	21	16	23	23	16
17	18	15	08	02	02	54	14	05	21	26	23	21	17
17	17	59	07	39	03	18	14	24	21	36	23	18	18
18	17	43	07	17	03	41	14	42	21	45	23	14	19
20	17	26	06	51	04	04	14	59	21	54	23	11	20
21	17	09	06	31	04	27	15	19	22	03	23	07	21
22	16	52	06	08	04	51	15	37	22	11	23	02	22
23	16	35	05	44	05	14	15	54	22	18	22	57	23
24	16	10	05	21	05	37	16	11	22	26	22	52	24
25	15	59	04	5[illegible]	05	59	16	28	22	33	22	46	25
26	15	41	04	3[illegible]	06	22	16	45	22	39	22	40	26
27	15	22	04	1[illegible]	06	45	17	02	22	45	22	34	27
28	15	03	03	47	07	07	17	17	22	51	22	27	28
29	14	44			07	30	17	34	22	56	22	20	29
30	14	25			07	52	17	50	23	01	22	12	30
31	14	05			08	14			2[illegible]	06			31

1731, 1735, 1739, 1743, (each being the third after Leap-Year.)													
Days.	July. N.		Aug. N.		Sept. N.		Octob. S.		Nov. S.		Decem. S.		Days.
	°	′	°	′	°	′	°	′	°	′	°	′	
1	22	04	15	07	04	19	07	19	1[illegible]	41	23	07	1
2	2[illegible]	55	14	4[illegible]	03	56	07	41	17	5[illegible]	23	11	2
3	21	47	14	30	03	33	08	04	18	1[illegible]	23	1[illegible]	3
4	21	38	14	12	03	10	08	26	18	28	23	18	4
5	21	28	13	53	02	46	08	48	18	43	23	21	5
6	21	18	13	34	02	23	09	11	18	[illegible]8	23	2[illegible]	6
7	21	08	13	15	02	00	09	33	19	13	23	26	7
8	20	5[illegible]	12	55	01	36	09	54	19	27	23	27	8
9	20	46	12	36	01	13	10	16	19	41	23	28	9
10	20	25	12	16	00	50	10	38	19	55	23	29	10
11	20	23	11	56	00	26	10	59	20	08	23	29	11
12	20	13	11	35	00	03	11	20	20	21	23	29	12
23	20	01	11	15	S	20	11	42	20	33	23	28	13
14	19	47	10	54	00	44	12	03	20	45	23	27	14
15	19	34	10	34	01	07	12	23	20	57	23	25	15
16	19	20	10	13	01	31	12	44	21	08	23	23	16
17	19	07	09	51	01	54	13	04	21	19	23	20	17
18	18	53	09	30	02	18	13	24	21	30	23	17	18
19	18	38	09	09	02	41	13	44	21	40	23	13	19
20	18	24	08	47	03	05	14	04	21	49	23	09	20
21	18	09	08	25	03	28	14	23	21	58	23	04	21
22	17	54	08	04	03	51	14	41	22	07	22	59	22
23	17	38	07	42	04	15	15	01	22	16	22	54	23
24	17	23	07	20	04	38	15	20	22	24	22	48	24
25	17	07	06	57	05	01	15	39	22	31	22	42	25
26	16	50	06	35	05	24	15	57	22	38	22	35	26
27	16	34	06	12	05	47	16	15	22	45	22	27	27
28	16	17	05	50	06	10	16	33	22	51	22	20	28
29	16	00	05	27	06	33	16	50	22	57	22	12	29
30	15	42	05	05	06	56	17	07	23	02	22	03	30
31	15	25	04	42			17	24			21	54	31

A TABLE *of the Sun's Declination for the Years*

Days	Jan. S. °	Jan. S. '	Feb. S. °	Feb. S. '	March. S. °	March. S. '	April. N. °	April. N. '	May. N. °	May. N. '	June N. °	June N. '	Days
1	21	44	13	50	03	06	08	[illegible]	18	16	23	13	1
2	21	34	13	30	02	42	09	14	18	31	23	16	2
3	21	24	13	10	02	19	09	36	18	46	23	19	3
4	21	13	12	49	01	55	09	57	19	00	23	22	4
5	21	02	12	29	01	31	10	19	19	14	23	24	5
6	20	51	12	08	01	08	10	40	19	27	23	26	6
7	20	39	11	47	00	44	11	01	19	40	23	27	7
8	20	27	11	26	00	20	11	21	19	53	23	28	8
9	20	14	11	04	N	03	11	42	20	06	23	29	9
10	20	01	10	43	00	27	12	02	20	18	23	29	10
11	19	47	10	21	00	51	12	23	20	30	23	29	11
12	19	35	09	59	01	14	12	40	20	41	23	28	12
13	19	19	09	37	01	38	13	02	20	52	23	27	13
14	19	05	09	15	02	02	13	22	21	03	23	25	14
15	18	50	08	53	02	25	13	41	21	14	23	23	15
16	18	35	08	30	02	49	14	00	21	24	23	21	16
17	18	19	08	08	03	12	14	19	21	34	23	18	17
18	18	03	07	45	03	35	14	38	21	43	23	15	18
19	17	47	07	22	03	59	14	56	21	52	23	12	19
20	17	30	06	59	04	22	15	14	22	00	23	08	20
21	17	13	06	36	04	45	15	32	22	09	23	04	21
22	16	56	06	13	05	08	15	50	22	17	22	59	22
23	16	39	05	50	05	31	16	07	22	25	22	54	23
24	16	21	05	27	05	54	16	25	22	31	22	48	24
25	16	03	05	03	06	17	16	41	22	38	22	42	25
26	15	45	04	40	06	39	16	58	22	44	22	35	26
27	15	27	04	17	07	02	17	14	22	50	22	29	27
28	15	08	03	53	07	24	17	30	22	55	22	22	28
29	14	49	03	29	07	47	17	46	23	00	22	14	29
30	14	29			08	09	18	01	23	05	22	06	30
31	14	10			08	31			23	09			31

1732, 1736, 1740, 1744, (*being Leap-Year.*)

Days.	July. N. °	'	Aug. N. °	'	Sept. N. °	'	Octob. S. °	'	Nov. S. °	'	Decem. S. °	'	Days.
1	21	58	14	53	04	01	07	36	17	53	23	10	1
2	21	49	14	[illegible]	[illegible]	38	07	58	18	09	23	14	2
3	21	[illegible]	14	16	03	15	08	21	18	25	[illegible]	[illegible]	4
4	21	31	13	58	02	52	08	43	18	[illegible]	23	20	[illegible]
5	21	[illegible]	13	39	02	29	09	05	18	55	23	23	[illegible]
6	21	11	13	19	02	05	09	27	19	[illegible]	23	[illegible]	6
7	21	00	[illegible]	[illegible]	01	42	09	49	19	24	23	27	7
8	20	[illegible]	[illegible]	40	01	19	10	11	19	38	23	28	8
9	20	38	12	21	00	55	10	33	19	52	23	29	9
10	20	27	12	01	00	32	10	54	20	05	23	29	10
11	20	15	11	40	00	08	11	15	20	18	23	29	11
12	20	02	11	20	S	15	11	37	20	30	23	28	12
13	19	50	10	59	00	38	11	58	20	42	23	27	13
14	19	37	10	39	01	02	12	18	20	54	23	28	14
15	19	24	10	18	01	25	12	39	21	05	23	23	15
16	19	10	09	57	01	49	12	59	21	16	23	20	16
17	18	56	09	35	02	12	13	19	21	27	23	17	17
18	18	42	09	14	02	36	13	39	21	37	23	14	18
19	18	27	08	52	02	59	13	59	21	47	23	10	19
20	18	12	08	31	03	22	14	19	21	56	23	05	20
21	17	57	08	09	03	46	14	38	22	05	23	00	21
22	17	42	07	47	04	09	14	57	22	14	22	55	22
23	17	26	07	25	04	32	15	16	22	22	22	49	23
24	17	10	07	03	04	56	15	34	22	29	22	43	24
25	16	54	06	40	05	19	15	53	22	36	22	36	25
26	16	38	06	18	05	42	16	11	22	43	22	[illegible]	26
27	16	21	05	55	06	05	16	29	22	49	22	21	27
28	16	04	05	33	06	28	16	46	22	55	22	13	28
29	15	47	05	10	06	51	17	03	23	01	22	05	29
30	15	29	04	47	07	13	17	20	23	06	21	56	30
31	15	11	04	24			17	37			21	46	31

A TABLE *of the Variation of the Sun's Declination to every* 15 *Degrees of Longitude from the Meridian of* London.

Degrees of Longitude from the Meridian of London.

Daily Variat. Min.	*D.* 15 *M.*	*D.* 30 *M.*	*D.* 45 *M.*	*D.* 60 *M*	*D.* 75 *M.*	*D.* 90 *M.*	*Deg.* 105 *Min.*	*Deg.* 120 *Min.*	*Deg.* 135 *Min.*	*Deg.* 150 *Min.*	*Deg.* 165 *Min.*	*Deg.* 180 *Min.*
2	00	00	00	00	00	00	01	01	01	[illegible]	01	01
3	00	00	00	00	01	01	01	01	01	01	01	01
4	00	00	00	01	01	01	01	02	02	02	02	02
5	00	00	01	01	01	01	01	02	02	02	02	02
6	00	00	01	01	01	01	02	02	02	02	03	03
7	00	01	01	01	01	02	02	03	03	03	03	03
8	00	01	01	01	02	02	02	03	03	03	04	04
9	00	01	01	01	02	02	03	03	03	04	04	04
10	00	01	01	02	02	02	03	03	04	04	05	05
11	00	01	01	02	02	03	03	04	04	05	05	05
12	00	01	01	02	02	03	03	04	04	05	05	06
13	01	01	02	02	03	03	04	04	05	05	06	06
14	01	01	02	02	03	03	04	05	05	06	06	06
15	01	01	02	02	03	04	04	05	06	06	07	07
16	01	01	02	03	03	04	05	05	06	07	07	07
17	01	01	02	03	04	04	05	06	06	07	08	08
18	01	01	02	03	04	04	05	06	07	07	08	09
19	01	02	02	03	04	05	06	06	07	08	09	09
20	01	02	02	03	04	05	06	06	07	08	09	10
21	01	02	03	03	04	05	06	07	08	09	10	10
22	01	02	03	04	05	05	06	07	08	09	10	11
23	01	02	03	04	05	06	07	08	09	10	11	11
24	01	02	03	04	05	06	07	08	09	10	11	12

A

SUPPLEMENT

TO THIS

NEW EDITION:

CONTAINING

1. The *easy* Construction of the Tables of *Sines, Tangents* and *Secants.*
2. Two new Methods of Sailing without Tables or Instruments, by only Vulgar Arithmetick: *mentioned in Wilsons Navigation.*
3. Four Ways of Laying down Traverses on Paper.
4. The Disagreement in the sundry Kinds of *Sailing* exemplified, in Plain, Mercator, Middle Latitude, Circle, and Sailing by Parallel Parts a Method taught by *John Ward* in his *Posthumous*-Works.
5. To find the Meridional Parts without a Table of them.
6. To estimate Distances by Sound, *&c.*
7. A Table of New and Full Moons, with all the visible Eclipses for 21 Years to come, from 1736 to 1757.
8. A ready Method to calculate the Lunations throughout the whole Year, with a Table of Stars corrected to the Year 1726.
9. Sundry Errors and Defects in Chards, Compasses, Quadrant, Cross-Staff, Nocturnal and Nautical Tables, specified with proper Helps, *&c.*
10. A Synopsis of all the possible Varieties in working an Observation.

By SAMUEL FULLER.

DUBLIN:

Printed by and for SAM. FULLER, at the *Globe* in *Meath-street.* MDCC.XXXV.

SECT. I.

To make the Table of Natural Sines, Tangents and Secants easily.

Seeing the Periphery of a Circle whose Radius is 1, is 6.283185, and the Natural Sine of one Minute insensibly differs from the Length of the Arch of one Minute, say,

As the Periphery in Minutes - - - - 21600
is to the Periphery in equal Parts - - 6283185
so is one Minute - - - - - - - - - - 1
to the Parts agreeing to that Minute 0.000290888, equal to the Natural Sine of one Minute, which agrees with the largest Table of Natural Sines I ever saw.

Next to find its COSINE.

From the Square of Radius - - - - 100000000, &c.
deduct the Sq. of Sine of one Min. 000000084612
the remains is - - - - - - - - - - - 0.99999915388 whose Sq. R. is 99999995
the Cosine required or Sine of 89°. 59′
Then in a rank of Arches Equidistant say
As the Sine of any Arch in that Rank
is to the Sum of the Sines of any 2 Arches equally remote from it on each Side
so is the Sine of any other Arch in the said Rank to the Sum of the Sines of 2 Arches next it on each side having the same common Distance.

Let the Radius be made the mean or middle Term between these Extremes and the Proportion will run thus

As the Radius is to the double Cosine of one Minute:
so is the Sine of one Minute to the Sine of 2′ and 0′.
and,
So is the Sine of 2′ to the Sum of 3′ and 1′.
and,
So is the Sine of 3′ to the Sum of the Sines of 4′ and 2′, and so on in a successive Order from Minute to Minute

And then if from the Sum of the Sines of 3′ and 1′ be taken, the Sine of 1, the Remainder will be the Sine of 3′, and the like, if from the Sum of 4′ and 2′ be taken the Sine of 2′, the Remainder will be the Sine of 4′.

Proceeding thus all the Natural Sines in the Quadrant may be calculated by Addition and Subtraction only.

Having made the Table of Sines to form the Table of Natural Tangents, Say,

As the Cosine of any Arch is to its Sine: So is Radius to its Tangent sought, or for the Table of Natural Secants, Say,

As the Cosine to Radius, so is Radius to the Secant sought, or divide the Square of Radius by the Natural Cosine, the Quotient is the Natural Secant

The Tables of Artificial Sines, Tangents and Secants are only the respective Logarithms of their Natural Sines, Tangents and Secants, and have this Property that

the Artificial { Sine and Cosecant / Tangent and Cotangent / Secant and Cosine } do always make up 20.00000 &c. or double Radius

wherefore one is the Complement of the other to Double Radius

SECT. II.

PLAIN-SAILING *Arithmetical.*

A TABLE of Given Numbers.

Points	Latitude.	Depart.	Points
0 $\frac{1}{4}$	99 : 88	04 : 88	7 $\frac{3}{4}$
0 $\frac{1}{2}$	99 : 52	09 : 76	7 $\frac{1}{2}$
0 $\frac{3}{4}$	98 : 92	14 : 66	7 $\frac{1}{4}$
1	98 : 08	19 : 51	7
1 $\frac{1}{4}$	97 : 01	24 : 27	6 $\frac{3}{4}$
1 $\frac{1}{2}$	95 : 71	28 : 99	6 $\frac{1}{2}$
1 $\frac{3}{4}$	94 : 15	33 : 71	6 $\frac{1}{4}$
2	92 : 39	38 : 27	6
2 $\frac{1}{4}$	90 : 40	42 : 77	5 $\frac{3}{4}$
2 $\frac{1}{2}$	88 : 20	47 : 13	5 $\frac{1}{2}$
2 $\frac{3}{4}$	85 : 79	51 : 38	5 $\frac{1}{4}$
3	83 : 15	55 : 56	5
3 $\frac{1}{4}$	80 : 33	59 : 55	4 $\frac{3}{4}$
3 $\frac{1}{2}$	77 : 29	63 : 45	4 $\frac{1}{2}$
3 $\frac{3}{4}$	74 : 10	67 : 15	4 $\frac{1}{4}$
4	70 : 71	70 : 71	4
Points	*Depart.*	*Latitude.*	*Points*

The Ufe of this Table is for working the fix Cafes of *Plain Sailing*; in which obferve, that in the firft and laft Columns you have the Rumbs or Points of the Compafs, with the half Points, and quarter Points, number'd from the Meridian or North and South Line, either Eaft or Weft, according as they ftand in order; thus S. S. W. is two Points, becaufe South is upon the Meridian, then S. by W. is one Point, and S. S. W. two Points, *&c.* So likewife N. N. E. and N. N. W. is two Points from the North. Again, fuppofe a Ship fails S. W. $\frac{1}{2}$ S. that is, three Points and an half, and N. N. E. $\frac{1}{4}$ E. is two Points and a Quarter; which being a Thing fo commonly known, I fhall not need to add any more Examples.

The Number of Points thus found, obferve on which Side of the Table it is found, for if you find the Courfe at the left Hand, then find the Denomination of Latitude and Departure at the Top: But if the Courfe be on the right Hand, find the Denomination of Latitude and Departure at the Bottom; for the left Hand Column contains all the Points under four Points, and the right Hand Column contains all the reft of the Points to 8. Now if the Courfe be found in the firft Column, (*viz.* lefs than four Points) then in the fecond Column is the given Numbers for Difference of Latitude, and in the third Column is the given Numbers to find Departure: But if the Courfe be in the laft Column, (*viz.* above four Points) then in the third Column is the given Numbers to find Difference of Latitude, and the fecond is for the Departure, *&c.* And the Ufe of the Table being thus known for the firft Cafe, the reft is eafily found by Confequence, as we have hinted and fhall make it evident and intelligible to the meaneft Capacity, by the following Examples.

Note, If you have a given Number, with a Cypher on the left hand, (as in 7 $\frac{1}{2}$ and 7 $\frac{1}{4}$ Points) although a Cypher adds nothing to the Product (being on the left Hand) yet it caufeth a Figure more to be cut off for the Decimal Fraction; and having cut off as many Figures towards the right Hand as you multiply by, the reft is the Latitude or Departure fought, and thofe cut off are a Numerator of a Decimal Fraction to a Denominator confifting of as many Cyphers as you cut off Figures, with a 1 at the left Hand; fo if you cut off 97, it is $\frac{97}{100}$ or if you cut off 342, it is $\frac{342}{1000}$. and fo of the reft.

Note, When you have found the given Number in the Table, you need not always uſe all the 4 Figures, eſpecially, if the third or fourth be a ſmall Digit, as 1 or 2, as ſuppoſe your given Number be 8315, here the third Figure being a 1, you may cut off the two laſt Figures, and uſe only 83, to work with. Again, if the third Figure be one of the higheſt Digits, as 8 or 9, you may cut off the two laſt, only add one to the ſecond Figure and ſo work as before; as ſuppoſe your Number be 2895, you may add 1 to the ſecond Figure *viz.* 8, and then cut off the two laſt, and then your Number to work will be 29, the Reaſon of all which is very evident to any that underſtands the Nature of Decimals, and will by a little Practice become eaſy to the meaneſt Capacity.

PLAIN SAILING.

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

The Rule.

Multiply the Diſtance by the given Numbers for the Courſe, and from the Product cut off as many Figures as you multiply by, and the reſt is the Difference of Latitude and Departure required.

Queſtion. A Ship ſails N. W. by N. 123 Miles; I demand her Diff. of Latitude and Departure.

The given Number for Diff. Latitude being 8315, we ſhall only uſe 83, and cut off the other two Figures (towards the right hand) and multiplying the Diſtance 123, by the given Number 83, and from the Product cut off two Figures, (becauſe you multiply by two Figures) you have the Difference of Latitude; but for Departure the given Number is 5556, the third Figure being a 5, we ſhall for more Exactneſs uſe three Figures, *viz.* 555, and work as before. The Operation for the Difference of Latitude and Departure will ſtand thus:

For Difference of Latitude.	*For Departure.*
123	123
83	555
369	615
984	615
	615
102|09	681|265

The Difference of Latitude is 102 $\frac{09}{100}$ the Departure is 68 $\frac{265}{1000}$; but you need not regard the Fractions, only if a Fraction be conſiderably above half of one Mile, or Minute, you may add 1 to the whole Number; as ſuppoſe your Fraction be 78, *viz.* $\frac{78}{100}$ you may add 1 to the whole Number, and reject the Fraction, &c.

Another Example in Caſe I.

A Ship ſails N. N.W. $\frac{1}{2}$ W. 165 Miles; I demand the Difference of Latitude and Departure.

N. N. W. $\frac{1}{2}$ W. is 2 $\frac{1}{2}$ Points.

For Difference of Latitude.	For Departure.
165	165
88	47
1320	1155
1320	660
145|20 Diff. of Latitude 145.	77|55

Dep. 77, or rather 78, because the Fraction is $\frac{55}{100}$.

CASE II. *Course and Difference of Latitude given, to find Distance and Departure.*

The RULE.

For the Distance, add as many Cyphers to the Difference of Latitude as the Number of Figures you think to make use of in the given Number, and then divide it by the given Number, and the Quotient is the Distance which being found, find the Departure as in *Case* I.

Question. A Ship sails S. W. by S. till her Difference of Latitude be 174; I demand the Distance and Departure.

The Course is 3 Points, the given Numbers 8315 and 5556.

For the Distance.	For Departure.
83)17400(209 *Dist.*	209
..800	555
53	1045
	1045
	1045
	115|995

The Distance 209, and Departure 115, or rather 116, because the Fraction is so great, *viz.* above $\frac{500}{100}$.

CASE III. *Course and Departure given, to find Distance and Difference of Latitude.*

The RULE.

Add so many Cyphers to the Departure as you think to use Figures in the given Number; and then divide by the given Number answering to Departure, and the Quotient is the Distance, which being found, find the Difference of Latitude, as in *Case* I.

Question. A Ship sails N. by E. ¾ E. till her Departure be 72; her Distance and Difference of Latitude is required.

For the Distance.	For Diff. Lat.
337)72000(213	214
.460	49
1230	856
219	1926
	201|16

The

The Distance is 214, (being so large a Fraction) the Difference of Latitude is 201.

CASE IV. *Distance and Difference of Latitude given to find the Course and Departure.*

The RULE.

Square the Distance (that is multiply it by it self) and likewise the Difference of Latitude, and subtract the lesser Number from the greater, the square Root of the Remainder is the Departure required, and then for the Course, add two or three Cyphers to the Difference of Latitude, and divide that Sum by the Distance, the Quotient is the given Number for the Course, which being found in the Table, you have again the Course required.

Note, If you cannot find exactly the same Numbers (which seldom happens) find the nearest to it, which is sufficient, and finds the Course to the nearest Quarter Point.

Question. A Ship sails between the North and East 110 Miles; and then finds by Observation, that she hath rais'd the Pole 1 Degree, or 60 Min. or Miles; I demand the Course and Departure.

For the Course.

```
100)60000(545        110        60
     .50             110        60
     .600           -----      ----
    -----            1100      3600
     .50             110
                    -----
                    12100
```

For the Departure

```
Sq. of Dist.        12100
Sq. of Diff. Lat.    3600
                    -----
Diff. of Sq.         8500

  8500(92
  81
 -----
182)400
    364
   -----
     36
```

The Quotient 545 sought in the Table, the nearest given Number is 555, and against that, for the Course, you have five Points, which is N. E. by E. because the Course is between North and East, and the Departure is 92, for you need not regard the Fraction in the Square Root, it being but a small Part of a Mile or Minute in the Departure.

CASE V. *Distance and Departure given, to find Course and Difference of Latitude.*

The RULE.

Subtract the Square of the Departure from the Square of the Distance, the Square Root of the Remainder is the Difference of Latitude; and then find the Course as in *Case* IV; only mind to find the Quotient in the Departure Column.

Question. A Ship sails in the S. W. Quarter 124 Miles, her Departure 95? I demand the Course and Difference of Latitude.

For the Course.

124)95000(766
.82
.760
16

124
124
496
248
124
15376

95
95
475
855
9025

For the Diff. of Lat.

Square of Dist. 15376
Sq. of Diff. Lat. 9025
Diff. of Squares 6351

6351(79
49
149)1451
1341
110

The Course is S. W. $\frac{1}{2}$ W. nearest; for the nearest given Number to the Quotient 766 is 772, which is the Number for four $\frac{1}{2}$ Points, or S. W. $\frac{1}{2}$ W. and the Difference of Latitude is 79, or rather 80, because the Remainder of the square Root is so great: And here observe for a general Rule, that because the last Remainder in the Extraction is a Numerator to twice the Root for a Denominator? therefore if the last Remainder be more than the Root, add one to the Root, and that will be the Root exact enough in this Case; but if the Remainder be less than the Root found, the Root is nearest whole Number that answers the Question, and you need not regard the Fraction at all; Thus in the Example, *Case* IV. the Root is 92, and the Remainder is but 36, and therefore I keep 92 for the Departure, and reject the Fraction. But in the Example in *Case* V, the Root is 79, and the Remainder is more than the Root, *viz.* 110; and therefore I add 1 to 79, and the Sum 80 is the Difference of Latitude required, and so in others.

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

The RULE.

Square the Difference of Latitude, and also the Departure, and add the two Squares together; the Square Root of the Sum is the Distance required; and then find the Course, as in *Case* IV, or *Case* V.

Question. A Ship sails in the N. W. Quarter, till her Difference of Latitude be 220, and her Departure 108; I demand the Course and Distance.

For the Distance.

220
220
44
44
48400

108
108
864
1080
11664

Square of Diff. Lat. 48400
Square of Departure. 11664
Sum of the Squares 60064

60064(245
4
44)200
176
485)2464
2425
39

For the Course.

245)220000(897
2400
1950
235

The

The Courſe is 2 Points and a Quarter, or N. N. W. $\frac{1}{4}$ W the Diſtance [illegible] Miles.

Although the Operation in this Caſe ſeems the moſt tedious of all the reſt, becauſe we have aſſumed greater Numbers for the *Data* of the Queſtion, yet even in the greateſt Number this Way is much more expeditious than working by a Canon, as a little Practice will make manifeſt.

NAVIGATION *New Modell'd*;

OR,

The Whole Art Perform'd by a NEW METHOD.

PART II.

Rules and Grounds of this Method.

IN Order to the right Underſtanding of this new Method of *Trigonometry*, I ſhall proceed, according to the uſual Method, and ſhall, for the Help of Memory, lay down ſome fundamental Rules or Axioms, upon which the whole Operation depends, and by which all the Caſes in *Plain Trigonometry*, both Right and Oblique, may be ſolved, *without any Book, Table or Inſtrument* whatſoever. But before I come to the Axioms, I ſhall premiſe, that whenever a Side and an Angle is given, to find another Side, (which is the firſt and moſt uſeful Caſe in Navigation) there muſt firſt be a Number found, which I call the Natural Radius, not only becauſe it is the Original, from whence the Solutions are deduced, but alſo becauſe being found, it produces the ſame Anſwer in Natural Numbers, that the Radius, or Sine of 90, produces in a Sinical Proportion; and this Natural Radius is thus found.

METHOD the Firſt.

Take the Angle whoſe oppoſite Side is either given or ſought, and divide four times the Square of its Complement to 90 Degrees by 300 added to three times the ſaid Complement, and then the Quotient added to the ſaid Angle is the Natural Radius required; and this Rule is univerſally true in all Angles from 0 to 90.

METHOD

Method the Second.

But because in Angles under 45, the Complements are above 45, and their Squares amount to greater Numbers than the Squares of the Complements of the Angles above 45; therefore to render the Work as easy, and the Contrivance as useful as possible, I shall shew another Way to find the Natural Radius for all Angles under 45, and the Rule is,

Divide ... times the Square of the Angle (whose opposite Side is given or sought) by ...000, the Quotient added to 57 . 3, that is 57 ... the Sum is the Natural Radius required.

This being premised, the Rules are these.

RULE the First. In Right-angled Triangles.

An Angle and a Side given, to find another Side.

The Natural Radius bears always the same Proportion to the Hypothenuse that the Angle (by which the Natural Radius was found) bears to its opposite Side.

Therefore if the Angles and Hypothenuse be given, it is; As Natural Radius to Hypothenuse, so the Angle to its opposite Side. But if the Angles and a Leg be given, then it is, As the Angle to its opposite Side, so is the Natural Radius to the Hypothenuse.

RULE the Second. In Right-angled Triangles.

Two Sides given, to find a Third.

The Hypothenuse is equal in Power to the two Legs: that is, the Square of the Hypothenuse is equal to the Square of both Legs added together; of which see more in p. 6. 7.

RULE the Third. In Right-angled Triangles.

The Hypothenuse and a Leg given, to find the other Leg.

Multiply the Sum of the Hypothenuse, and given Leg, by their Difference: The Square Root of the Product is the other Leg required.

RULE the Fourth. In Right-angled Triangles.

Three Sides given, to find an Angle.

Add half the longer Leg to the Hypothenuse: Then, As that Sum to 86, so is the shorter Leg to its opposite Angle.

RULE the Fifth. In Oblique Triangles.

Three Sides given, to find where the Perpendicular must fall.

Multiply the Sum of the two shortest Sides by their Difference, and divide the Product by the third Side, which is the greatest, and upon which the Perpendicular is to fall: The Quotient added to the greatest Side, or subtracted from it, shall be double the greater or lesser Segment, on each Side, of the Perpendicular.

Another Way.

Add the Squares of the biggeſt and leaſt Sides together, and from their Sum ſubtract the Square of the middlemoſt; Half the Remainder, divide by the biggeſt Side, the Quotient is the leſſer Segment, which ſubtracted from the whole Baſe, leaves the bigger Segment.

Plain Sailing by a New Method.

I Shall now proceed to ſome Examples in Right-angled Triangles, applied to *Plain-Sailing*; and here note, That to avoid Fractions, I ſhall propoſe the given Angle always in whole Degrees, that being ſufficiently exact in all Uſes in Navigation; yea, and a far more exact Way, than reckoning by Points; one Degree being a much ſmaller Part of a great Circle than a Quarter Point of the Compaſs. And I ſhall make uſe of Degrees rather than Quarter Points, not only for its Exactneſs, but alſo becauſe it is a Method much in Uſe aboard of the Men of War, to reckon the Courſe in Degrees, and not in Points and Quarter-Points.

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

A Ship ſails South 25 Degrees Eaſterly 96 Miles; I demand as above.

The Operation at large.

Note, Where both Legs are required, chooſe always to find the leſſer firſt; becauſe the Natural Radius is more eaſily found, and then find the longer Leg by *Rule the Third.*

For the Departure.

The Angle - - - - - - - - - -	25
Multiplied by it ſelf - - - -	25

	125
	50

Square of the Angle - - -	625
Multiplied by - - - - - - -	3

The Product - - - - - -	1875
1875 divided by 1000 is	1.875
To which add - - - -	57.3
	--- ---
Sum is Natural Rad.	59.175
Or rather briefer - - -	59.2
Which is exact enough.	

The RULE I.

As Natural Rad. 59. 2. to the Diſtance 96 : So the leſſer Angle 25, to its oppoſite Side the Departure.

```
 96    592)24000(40½
 25        *320
----      -------
480        320
192   Neareſt which 40½
----- is the Departure
2400  req.
```

Then

Then for the Difference of Longitude by RULE III.

Hypothenuſe or Diſtance	96. 0	7575(87	The Diff. of Latit.
The Dep. in Decimals - -	40. 5	64	
The Sum - - - - - - - -	136. 5	167)1175	
The Difference - - - - -	55. 5	1169	
	6825	(6)	
	6825		
	6825		
The Product - - -	7575.75		

The Depart. is $40\frac{1}{2}$ (or in Decimals 40. 5.) The Diff. of Lat. 87.

CASE II. *Courſe and Difference of Latitude given, to find the reſt.*

A Ship ſails North 38 Degrees Weſt, her Difference of Latitude 120; her Diſtance and Departure is required.

Here the Side oppoſite to the bigger Angle is given, therefore we muſt make Uſe of *Method* I. to find the Natural Radius, becauſe *Method* II. ſerves only to Degrees under 45.

38 38	414)5776(13$\frac{394}{414}$.	
38 3	1636	
304 114	394	
114 300		
1444 434		
4		
5776		

Becauſe the Fraction is ſo great, I ſhall call the Quotient 14, which added to the bigger Angle 52, the Sum 66 is the Natural Radius.

Then by RULE I.

As 52, the greater Angle to 120 its oppoſite Side: ſo is Natural Radius, 66, to the Diſtance required.

Then for Departure, by RULE III.

120	Diſtance	152	
66	Diff. Latit.	120	8704(93 Departure
	Sum - - - -	272	81
720	Difference	32	183)604
720		544	549
		816	(55)
7920	Product	8704	
52)7920(152			
272			
120			
16			

The Diſtance 152. The Departure 93.

CASE

CASE III. *Course and Departure given, to find Distance and Difference of Latitude.*

A Ship sails North 19 Degrees Easterly, her Departure 72 Miles; I demand as above.

Here the shorter Leg is given; therefore I shall find the Natural Radius by *Method* II.

Three Times the Square of the given Angle is 1083, this divided by 1000, which is done by cutting off three Figures to the right Hand, the Quotient is 1.083; which because the second Figure in the Fraction is above 5, I add one to the first Figure, which is a Cypher, and then call the Quotient 1.1, which added to 57.3, the Sum 58.4 is the Natural Radius required.

```
   19
   19
  ---
  171
  19
  ---
  361
    3
  ---
1.083
```

Then for the Distance by RULE I.

As the Angle 19, to its opposite Side 72: So is the Natural Radius 58.4, to the Distance

```
  58.4        19)4204(221      The Distance
  72             40              required.
  ----            24
  1168           ---
 4088              5
 ------
 4204.8
```

Then find Difference of Latitude by RULE III.

```
Distance - - - - 221                 . . .
Departure - - -   72              43657(208
                 ---               4
Sum - - - -      293            ----------
Difference - -   149            40)03657
                ----           408) 3264
                2637                (393)
               1172
               293
              ------
              43657
```

The Root 208, but the Fraction being so large, I rather call it 209, the Difference of Lat. required.

CASE IV. *Distance and Difference of Latitude given to find the Course and Departure.*

A Ship sails between the North and East 117 Miles, her Difference of Latitude 102 Miles; I demand her Course and Departure.

For the Departure, by RULE III.

```
Distance - - - 117                 . .
Diff. of Lat. - 103              3080(55
               ---                25
Sum - - - -     220             -----
Difference - -   14          105)580
                ---              525
                880              (55)
               220
              -----
Product - -   3080
```

The Departure $55\frac{1}{2}$.

Then

Then for the Course, by RULE I[illegible].

Hypothenuse or Distance . 7[illegible]
Half the longest L[illegible] - 51.5

Sum - - - - - - - 168.5

As 168. to 86: so shortest Leg or Departure, 55.5, to its opposite Angle, the Course.

55.5 | 168.5)4773.0(28
86 | 1403.0
3330 | 559
4440 |
47730 |

The Course $28\frac{559}{1685}$ Degrees, which is almost $\frac{1}{3}$ *viz.* 28 Degrees, 19 Minutes.

CASE V. *Distance and Departure given, to find the rest.*

A Ship sails in the South-West Quarter, 124 Miles, her Departure 95 Miles; I demand her Course and Difference of Latitude.

For the Difference of Latitude, by RULE III.

Distance	- -	124	6351(79
Departure	- -	95	49
Sum	- - -	219	149)1451
Difference	- -	29	1341
		1971	110
		438	
Product	- -	6351	

The Square Root of 6351 is 79 or rather 80 (because the Remainder 110 is more than the Root) the Difference of Latitude required.

Then for the Course, by RULE IV.

Hypothenuse or Distance - - - 124 - - - 124
Longest Leg, which here is Dep. 95 it half 47.5

Sum - - - 171.5

As 171.5, to 86: So the shorter Leg (which here is the Difference of Latitude) 80, to its opposite Angle, the Complement of the Course.

86 | 171.5)6880.0(40 Degrees
80 | .0200
6880 | 20.0

The Complement of the Course is 40 Degrees, and consequently the Course is 50 Degrees, from the South Westerly, and the Difference of Latitude is 80 Miles *fere.*

CASE

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

A Ship sails in the North-West Quarter, till her Difference of Latitude be 220 Miles, and her Departure 108; I demand the rest.

For the Distance, by RULE II.

220	108	Square of Diff. of Lat. -	48400
220	108	Square of Departure - -	11664
440	864		
44	1080	Sum of the Squares - -	60064(245
48400	11664		4

Then for the Course by RULE IV.

As 355, to 86: So 108 to the Angle of the Course.

108	355)9288(26	44)200
86	2188	176
648	..58	485)1464
864		2425
9288		(39)

The Distance is 245, and the Course $26\frac{58}{355}$ Degrees, or 26*d* 9*m*, or N. N. W. somewhat more than $\frac{1}{4}$ W.

Oblique Triangles *by a New* Method.

How to solve all the Cases in Oblique Plain Triangles, by this New Method, without any Canon, Book, Instrument, &c.

IN the Solution of *Oblique Triangles*, by this New Method, it is necessary that they be first divided into two right-angled Triangles by a Perpendicular let fall, in which observe:

Let it fall from the End of a given Side, and opposite to the given Angle.

By this Means the Perpendicular will sometimes fall within, and sometimes without; when it falls within, it falls upon some intermediate Part of the Base, or longest Side; but when it falls without, it falls upon one of the shortest Sides continued; in either Case, there are two right-angled Triangles produced, and then the Angles or Sides sought are found as if they were Parts of a right-angled Triangle.

CASE

CASE I.

Given { The Angle at *A* 3[illegible].0 / The Angle at *B* 4[illegible].0 / The Side *B C* 29[illegible] } Req[illegible] Sides *AC*.

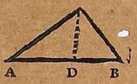
Here t[illegible] Perpendicular falls from the End of the given Side *B C*, and opposi[illegible] the given Angle at *B*; then in the Triangle *B D C* is given the Angle at *B*, and the Side *B C*, to find the Side *C D*, which being found, there is given in the Triangle *A D C*, the Angle at *A* and the Side *D C*, to find *A C*, the Side required. Fig. 1.

I shall not trouble the Reader with the Operation for finding Natural Radius, it having been often enough repeated in the foregoing Pages; but being found by *Method* I, the natural Radius for the Angle 45 is 63.62; therefore, As 63. 62, to Side *CB*, 290; So 45, the Angle at *B*, to the Side opposite *C D*..

45
290
—
4050
90
—
13050

63.62)13050.00(205 The Side *C D* 205.
: 326.00
—
. . 7,90

Fig. 1.



Now in the Triangle *A D C*, is given the Angle at *A* 30 *d* 0 *m*, and the Side *D C* 205, to find *A C*.

The Natural Radius therefore found by *Method* II, f[illegible]r the Angle 30 is 60. Therefore,

As the Angle at *A* 30, to Side opposite *D C*, 205: So 60 to the Hypotenuse *A C* Required.

205
60
—
12300

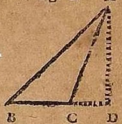
30)12300(410. The Side *A C* required.
. 3 .
.00
. .

CASE II.

Given { The Side *A B* 560 / The Side *A C* 410 / The Angle *B* 45.0 } Required the Angle at *C*.

Here the Perpendicular falls without, upon the Side *B C* continued, and in the Triangle *B D A* there is given the Angle at *B* 45, and the Hypothenuse *A B* 560, to find *A D*, which being found you have in the Triangle *C A D*, the Hypothenuse *C A*, and the Leg *A D*, to find the Leg *CD*, and the Angle *DAC*, and by Subtraction, the Angle *DCA*, and the Angle *BCA*, its Supplement in their proper Case of right-angled Triangles. Fig. 2.

Fig. 2.



The

The Operation.

The Natural Radius for the given Angle 45, is 63.62, as found by *Method* I: Therefore, as 63.62 … the Hypothenuse 560; So the Angle at *B* 45, to the Side …

560	63.62)25100.00(396 the Side *AD*
45	61140
	38820
2800	
2240	..6.480
25200	

Then you have *AD* 396, and *AC* 410, to find *CD* by *Rule* III, thus:

Side *AC* - - -	410	
Side *AD* - - -	396	11284)106, the Leg *CD*.
Sum - - - - -	806	
Difference - - -	14	20)012
		00
	3224	
	806	206)1284
		1236
Product - -	11284	(48

Then for the Angle *CAD*, by RULE IV.

Hypothenuse *AC* - -	410	As 608 to 86, so is 106 to the Angle *CAD*.	
Half the Leg *AD* -	198		
Sum - - - - - -	608	106	608)9116(14$\frac{604}{608}$
		86	3036
		636	604
		848	
		9116	

The Angle *CAD* is 14$\frac{604}{608}$, or rather 15 Degrees; which subtracted from 90, leaves *ACD*, 75 Degrees; and that subtracted from 180, leaves 105 Degrees, the Angle *ACB* required.

CASE III. *Given as in* CASE II, *to find the Third Side BC.*

In the whole Triangle *BDA*, you have given the Angle *ABD* 45, and the Hypothenuse *BA* 560; also by Consequence, the Angle *BAD*, which is also 45, to find the whole Side *BD*; but in this Case the acute Angles being equal, *viz.* 45 Degrees, the Leg *BD* is equal to *AD*, *viz.* 396; then having found *CD* 106 by the second Operation in *Case* II, subtract it from the whole Side *BD* 396, the Remainder 290, is the Side *BC* required.

CASE

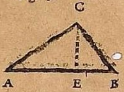
CASE IV.

Given { *The Side* A C 410 ; *The Side* A B 560 ; *The Angle at* A 30.0 } R[illegible] *Angle at* B.

In the Triangle *A E C*, is given the Angle at *A* 30, and the Hypothenuse *A C* 410, to find *C E*, which by the first Case hereof is found to be 205, and therefore I need not repeat the Operation. Then in the same Triangle *A C E*, there is given the Sides *A C* 410, and *C E* 205, to find the Side *A E* by *Rule* III. *Fig.* 3.

A C - - - - - -	410	126075(355, the Leg *A E*.	
C E - - - - - -	205	9	
Sum - - - - - -	615	65)360	
Difference - - - -	205	325	
	3075	705)3575	
	12300	3525	
Product - - - -	126075	50	

Fig. 3.



The Leg *A E* 355 subtracted from the whole Side *A B* 560, rests *E B* 205; then in the Triangle *B E C*, you have given *B E* 205, and *E C* 205, to find *C B* by *Rule* II, and the Angle *B* by *Rule* IV, but in this Case, *E C* and *E B* being equal, the Angle at *B* is proved to be 45 Degrees without Calculation.

CASE V.

Given as in CASE IV, *to find the third Side*, BC.

Although this is the Fifth *Case* in the *Trigonometrical* Operation, yet the Side *B C* is necessarily found in *Case* IV, before the Angle at *B* can be found; and therefore altho' the Operation in *Case* IV be somewhat tedious, yet both the Fourth and Fifth *Cases*, are included in it.

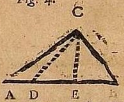
CASE VI.

Given { AB - - - - 560 ; AC - - - - - 410 ; BC - - - - - 290 } *Required the Angle at* A.

Find *A E* by the Rule laid down in *Axiom* IV. of *Plain Triangles*. As the Base *A B* 560, to the Sum of the other two Sides, 700: So the Difference of the said Sides 120, to the Difference of the Segments of the Base *A D* 150, as by the Operation below. *Fig.* 4.

120	56.0)8400.0(150
700	280
84000	..000

Fig. 4.



To the half Diff. 75 add the half Base 280, the Sum 355 is the greater Base *A E*; but subtracted, the Difference is the lesser Base *E B* 205.

Then in the Triangle *AEC*, there is given *AC* 410, and *AE* 355, to find *CE* by *Rule* III. and the Angle at *A* by *Rule* IV.

The Side *AC* - - 410
The Side *AE* - - 355

Their Sum - - - 765
Their Difference - 55

3825
3825

Product - - - 42075

42075(205
405)02075
2025

50

The ſquare Root of 42075, *viz.* 205 is the Side *CE* required.

Then, by *RULE* IV, find the Angles at *A*.

Hypothenuſe - - - 410
Half the longeſt Leg - - 177.5

Their Sum- - - - - 587.5

As 587.5, to 86: So *CE* 205, to the Angle oppoſite at *A* 30.

205
86

1230
1640

17630

587.5)17630.2(30 The Angle at *A* Req.
...5

50

Although this Method be not altogether ſo expeditious for oblique Triangles as the Calculation by Logarithms, becauſe you are obliged to divide every oblique Triangle into two right-angled ones, which ſometimes requires two Operations; yet I thought fit to inſert it to make the Method complete, it being of great Uſe when Tables are wanting, and of ſufficient Exactneſs for moſt Uſes in Navigation; but the right-angled Caſes, as perform'd hereby, I ſhall recommend to the Reader, as a Thing very uſeful, ſufficiently exact, and as expeditious as any Method commonly in Uſe.

To help the Memory, and ſhun the former Operations of finding the Natural Radius, ſome uſe the following Approximation.

	Deg. Deg.		
If the Degrees of the Angle be between	00 and 10	The Natural Radius is	57
	10 and 20		58
	20 and 30		59
	30 and 40		60
	40 and 50		61

And for every intermediate Degree they add $\frac{1}{10}$ or .1 to the proper Natural Radius aforegoing, ſo 35° will have 60.5 for its Natural Radius.

SECT.

SECT. III.

Four Ways of laying down Traverses on Paper.

A Traverse may be protracted four different Ways, *viz.*

I. By drawing new Meridians thro' the Extremity of every Course parallel to the first Meridian: then laying off the Course and Distance.

II. By laying down the Quantity of the Angle (after the first Course is protracted) between the Point next to be laid down, and the Point opposite to the Course last protracted; and so proceeding till the whole is finished.

III. Having a Circle described and divided like the *Mariner's Compass*, draw the several Courses parallel to the Rumbs in the Compass, and lay off the Distances as usual, which being done, a Line drawn from the Port left to the Place last laid down is the Distance and the Angle, which this Line makes with the Meridian, is the direct Course in all the Methods.

IV. Some have a Brass Circle cut into 32 Points of the Compass like Teeth, about the Center of which underneath a thin Brass Scale of equal Parts is made to play all round; then draw a Meridian Line on the Paper, on it set the North and South Points of the Brass Compass, and prick off the first Course and Distance by turning the Scale to the given Course, and against the Distance on the Scale make a Prick, and so draw the first Course, on which Line lay its opposite Rumb of the Brass Compass, and then turn the Scale to the second Course, and by the Scale set off its proper Distance, and so do with the rest of the Courses, still remembring to place the Compass on the last Line with that Rumb opposite to the Course last laid down.

SECT. IV.

The Disagreement in the sundry Kinds of Sailing *exemplified in Plain, Mercator,* &c.

MIDDLE Latitude Sailing is at best but an Approximation, and Approximations are to be used either when we have no direct Rule for solving the Proposition, or that by such an Approximation we save the Expence of some Trouble, neither of which is the Case before us; tis absurd to use a Multiplicity of Rules approximate, when a few direct ones will adequately and truly solve all the Cases: But some say in Voyages near the Equator, and in very short Runs, the Error is but small, which is granted; but inasmuch as its Rules are every where more or less Erroneous, it is certainly very absurd to use them, and the more so because neither Time nor Trouble is saved, the Multiplicity of Rules making more Variety of Cases than all the true ones put together, why should People burthen their Memories with such an Heap of Falsities.

Great Circle Sailing can be but of little Use in Navigation so long as Ships are steer'd by the Compass, and therefore our Author did well to omit it.

To exemplify the Disagreements of the sundry Sorts of Sailing, I shall instance the following Example: From *Iceland*, Lat. 66.26 to the River of of the *Amazons* on the Equinoctial, whose Difference of Longitude suppose to be 36° W.

Given	The Diff. of Lat.	66°.26′	= 3986 Miles.		
	The Diff. Long.	36 . . .	= 2160		
			According to		
		Plain Sailing	Middle Lat.	Mercator	Paral. Parts.
Sought	Course	28°.27′	[illegible]4.23	21.25	20.47
	Dist.	4533	4376	4294	4263

By the Arch of a great Circle Distance is 4268

Diff. in Dist. from which is	265 +	108 +	26 +	5 —

Wherefore whatsoever Method will not hold pretty near to the Truth, *viz.* to that by the Arch of a great Circle in long Distances, is proportionably false in short ones; and altho' the Errors are not so evident in short Voyages, yet the Aggregate or Sum of those Errors, will amount to that of a long Voyage; and therefore it is my Opinion, that neither Plain-Sailing, nor that by the Middle Latitude ought to be depended upon in any Voyage.

SECT. V.

To supply the Absence of (or to form) a Table of Meridional Parts by the 3 following PROBLEMS.

PROB. I. *To find the Meridional Parts to any given Latitude.*

RULE.

TO the given Latitude add 90, then find the Tangent of half that Sum, from which subtract the Radius, and divide the Remainder by 1263.3, the Quotient is the true Meridional Parts contain'd between the Equator and that Latitude.

Example. Given the Lat. 48.30.

Here 90°+48°.30=138.30 and the half is 69.15, whose Tan. is 10.4125142, deduct Radius, the Dividend is 4125142, and being divided by 1263.3 the Quotient is 3336.6, the Meridional Parts answering the Lat. 48.30.

PROB. II. *To find the Meridional Parts contain'd between the Latitude of any two Places in one Hemisphere*

RULE.

To each of the given Latitudes add 90, then find the Tangent of their half Sums as above, the Difference of these two Tangents being divided by

By 1263.3 the Quotient will be the true Meridional Parts contain'd between those two Latitudes.

Example. Given the Lat. 30. } both N°.
And Lat. 12.14 }

Here 90 + 50 = 140, whose half is 70°, its Tangent is 10.4389341
And 90 + 12.14 = 102.14 whose half is 51° 7′ its Tang. is 10.0934397

Difference of the Tangents 3454944

Which being divided by 1263.3 the Quotient is 2734.8 the Meridional Parts sought.

PROB. III. *To find the Meridional Parts contain'd between the Latitudes of two Places that are in different Hemispheres.*

RULE.

To each of the given Latitudes add 90, and find the Tangent to each of their half Sums, then add these two Tangents together and their Sum made less by twice the Radius 20.000, *&c.* divide the Remainder by 1263.3 the Quotient is the true Meridional Parts between the two Latitudes.

Example. Given the Lat. 14.24 N°.
And Lat. 16.3 S°.

Here 90° + 16°.3 = 106° 3′ its half is 51°. 1′. 30″ and its Tangent is — — — — —	10.1232799
And 90 + 14.24 = 104.24 its half is 52.12 and its Tangent is — — — — — — —	10.1103177
Total	20| 2335976

Which divide by 1263.3 the Quotient is 1849.1 the meridional Parts contain'd between the 2 Latitudes.

SECT. VI.

To Estimate the Distances of Places by Sound *and* Lightning.

FROM sundry Experiments it has been determin'd that Sound travels at the Rate of 1142 Feet in one Second of Time; but the Motion of Light is in a Manner instantaneous, moving 10000 Miles in a Second, wherefore, if the Difference between the Time an Explosion is first seen, and the Time that the Sound reaches the Ear be given, the Distance may easily be found.

For an *English* Mile contains 5280 Feet, consequently Sound requires 4″.623 to travel a Mile; but a Geographical Mile according to *Norwood's* Experiment contains 6120 Feet. Wherefore, As 5280 : 6120 : : 4.623 Seconds : 5.358 Seconds Sound takes to travel a Geographical Mile. Then,

As 1 is to	4.623 5.358	So is any given Distance in	*English* Geog.	Miles	to the Time that Sound requires to travel over that Dist.

And on the Contrary,

As	4.623 5.358	is to 1, so is the Number of Seconds between the Time a Sound is generated, and the Time it arrives at any Place to the Dist. between those two Places in	*English* Geog.	Miles.

So if I counted 70 Seconds between the Sight of the Lightning and hearing the Clap of Thunder, the Distance of said Thunder was 15.14 *English* Miles.

The best Way of measuring Seconds is by a Watch or Clock that shews Seconds, or by the Vibration of a Plummet of 39.2 Inches betwixt the Center of the Plummet and Pin whereon it hangs; then give it a small Swing, and the Number of Vibrations equal the Number of Seconds of Time during the Experiment: if the Plummet be but 9.8 Inches, each Vibration will be but half a Second of Time.

By this may an half Minute Glass be examined

SECT VIII.

By having the Time of the first New ☽ *in* January, *all other Aspects of the* ☽ *and* ☉ *may be collected throughout the whole Year by adding to.*

	D.	H.	′	″
Jan. 1, the ☽ being New or in ☌ her Age - - - -	00	00	00	00
For the Sextile Aspect ✱ take	4	22	7	20
First Square □ - - - - - - - -	7	9	11	1
Triangle Aspect △ - - - - - -	9	20	14	41
Full ☽ or ☍ Opposition - - -	14	18	22	2
Full ☽'s △ Triangle last - - -	19	18	22	2
Second □ Square - - - - - -	22	3	33	2
Second ✱ Sextile - - - - -	24	14	26	42
Other New ☽ or ☌ - - - -	29	12	44	3

SECT. IX.

SECT. IX.

Sundry Errors and Defects in Chards, Compasses, Quadrant, Cross-Staff, Nocturnal *and* Nautical Tables, *specified with proper Helps*, &c.

'TIS now above one Hundred and Fifty Years since the Errors of the plain Chard have been detected and corrected by *E. Wright*, the famous Author of what is falsly called *Mercator*'s Chard, and *Mercator*'s Sailing; and yet because of its Ease and Antiquity, the Plain Chard is too much in Use and Vogue among the Ignorant, tho' its very Foundation is Erroneous, supposing the Earth to be a Plane, and not a Globe, which may cause the Mariner in far northerly Voyages to err sometimes one, two, or three Points in his Course, and make his Distance double or triple the true Distance: Also by it the Proportion of the Length of Places far distant from the Equator to their Breadth is so much the more faulty, by how much the more distant they are from the Equator: the Longitude of Places on the common Sea Chard, is only true on or near the Line, because there only the Meridians and Parallels are equal; but the Parallels decrease and grow less and less towards the Poles, where all the Meridians unite and meet in a Point; wherefore, 'tis not safe to trust to these common Sea-Chards neither for Longitude, Course nor Distance of Places: much less to transfer Places from them to the Globes: All these Errors are excellently corrected by the true Chard commonly called *Mercator's*, whose Latitude, Longitude, Course and Distance of Places agree with the Globe, and ought only to be used by the expert Sailor, who desires to hit his Port and sail thither the shortest, surest and safest Way.

The Custom of drawing Rumb Lines for every Point of the Compass from several Places in the Chart, is very absurd; for these Rumbs do very much deface and obscure the Chart, so that the Places laid thereon are not so readily discern'd as otherwise they would; besides, these Rumbs are but of little or no Use, and the common Way of using them is mostly Guess-work at best; but to find the Bearing of Places without such Perplexity and Confusion of Rumb-Lines, lay the Meridian of a Protractor on the Meridian of the Chart, the Center thereof being on one Place, from which stretch a fine Thread to cut the Protractor, and the other Place; that Degree of the Protractor so cut by the Thread, gives the Bearing of said Place, in the Absence of a Brass or Horn Protractor; get one of Velom or Pastboard, having the Points of the Compass corresponding, which ought to go along with the Charts.

Tho' it can't be expected that a Chart should be more exact than the Discoveries of the Times will admit, yet it might be expected as exact and complete as those Discoveries would make it; therefore they are to blame, who let Errors pass, which they might with a little Pains have corrected; but we can expect no better, when Men that are capable decline the Task, and leave it to those to perform who know little or nothing of the Matter.

As to the Compass, the chiefest Instrument for keeping the Course; if its Variation be neglected, and no Allowance for Lee-Way be made, how many Points will the negligent Sailor miss in sundry Places? and what false Bearings and Distances of Places will he make? this added to the false Projection

Projection of the common Sea Chart, renders it an inextricable Labyrinth of Error, out of which it will be hard for a Man to free himself. Moreover, the following Cautions ought to be minded in making the Bittacle or Case where the Compass is placed; great Care should be taken to make it exactly Square, or at right Angles, and so fixed that two of its Sides be exactly parallel to the true Direction of the Ship, which is generally shewn by the Crevise between the two middle Planks upon the Deck. 'Tis also a bad Custom to have two Compasses in the same Bittacle; for their Attraction may make them vary half a Point from each other, which is plain if they were removed farther off, they would exactly point out the same Degree, tho' touch'd by different Magnets, provided both were good. Also to use a Slow Chard in bad Weather is absurd; for if the Chard will not Traverse, it may as well be laid aside; and consider that the apparent Motions of the Chard shews the real Motion of the Ship, and not of it self; which Motion being shewn, they have the Advantage of knowing how and when to check her, and consequently of bringing her steady much sooner. The Mariner should often examine how the Compass plays or traverses; whether if moved from its Point it will return again or stand on either Side; then examine whether the Center-Pin and Cap be free from Rust, Roughness, Bluntness, or Dirtyness; for the least Resistance or Friction about the Center, will very much hinder its Vibration, because the attractive Power of the Magnet is small in Proportion to that of Gravity.

For the easier cleaning the Cap and Needle, 'tis no small Improvement to fasten the Glass in a Brass Ring fitted to the Head of the Box like a Surveyor's, so that at any Time it may be taken off, or lifted up with Ease, without jolting the Chard off and on, whereby the Pin is blunted and spoil'd; and besides, if the Mariner has several Chards very light fitted to the same Box, he may easily change and use which he likes best, without the Charge and Lumber of Compass-Boxes carried only for the Sake of their Chards.

Also I prefer an heavy Brass Compass to a light Wooden one: for the less the Chard is disturb'd, the truer will it keep to its true Meridian.

As to the common Azimuth Compass, 'tis hardly practicable to observe within half a Point, notwithstanding the pretended Accuracy of some People in observing the Minutes of a Degree; for if any Observation were to be made by the common Azimuth Compass, on *Terra Firma*, (where we may have Time and Opportunity sufficient for rectifying it, which is not easily had at Sea) the said Instrument must be first of all rectified by the Help of the Chard, and this Rectification will be more or less accurate according to the Goodness or Length of the Needle: It plainly appears then, that whatever Exactness we pretend to by Help of the Index, is only Imaginary; since the Goodness of the Observation entirely depends upon the Position of the Needle; for rectifying of which, the Index is of no Manner of Help to us, and consequently 'tis very absurd to pretend to make Use of it even on *Terra Firma*, but vastly more on Ship-board, where the continual Yawing of the Ship, and Motion of the Chard, render such Observations vastly uncertain, differing, and less exact than the Course pointed by the common Chard; because, when one looks downwards upon the Glass, the smallest Alteration in the Position of the Eye, will make an apparent Alteration in the Position of the Chard; whereas looking directly before at a Perpendicular Line drawn in the Box, we are not so lyable to err; and as the Ship and Chard are both in continual Motion, the Motion of the Chard is render'd ambiguous, and hence no Manner of Certainty, whether the Needle at the Time of Observation be in its own Meridian, or considerably to the E. or W. nor how much we cannot judge. Again one Person continually

tinually moves the Index as the Ship yaws, and another looks through the Sight, ſaying, *very well*; as Notice he ſees the Object, which Notice has been given, even while the Index had moved 15 or 20 Degrees out of its former Poſition: And conſequently the Obſervation muſt be vaſtly uncertain, ſince there is no manner of Guide, when and where to take it; nor do I like any Celeſtial Obſervation taken by two or three Hands at once, and perhaps among the Catalogue of vulgar Errors, there is not an Inſtance, wherein People impoſe more upon themſelves, than by their common Notion concerning the Accuracy of Obſervations made by this Inſtrument.

The Deſcription of a New Azimuth-Compaſs.

THIS Inſtrument conſiſts of a Chard and two Boxes, and is hung in two Braſs Rings after the ſame Manner with the common Sea-Compaſs, the innermoſt Box wherein the Chard is placed is made to turn eaſily in the innermoſt Ring without diſturbing the outward Box; to the Outſide of the ſaid innermoſt Box are fixed two upright Sights like Surveyor's, diametrically oppoſite for rectifying the Inſtrument, by keeping the ſaid Sights to the Object; at the Bottom of the ſaid Box is fixed a large Piece of Lead to keep it parallel to the Horizon; within this Box are drawn two upright black Lines, exactly under the Middle of the two upright Sights, and at 90° Diſtance from theſe are drawn two other black Lines after the ſame Manner.

In obſerving look through the ſlit-Sight, turning till the Hair or Thread cut the Sun or Star, then hold and keep ſtill the ſame Sight ſteady, which will ſtay the Inſtrument from being affected with the yawing of the Ship; then obſerve what Degree of the Chard is cut by the Perpendicular black Line under the object-Sight, for the magnetical Amplitude or Azimuth.

Note, 'Tis beſt to take the Sun's Amplitude when its lower Limb is about $\frac{1}{4}$° above the Horizon, becauſe the Refraction makes the Sun appear ſo high when his Center is really in the Horizon; but indeed for Practice, if the Place of Obſervation be not too far from the Equator, the Bearing of the Sun may be very well taken for an Amplitude at any Height not exceeding 2 Degrees.

This Inſtrument is very uſeful for finding the Lee-Way; and alſo for ſetting the Bearings of Head-Lands, for having directed the Index to the Wake of the Ship, the Chard will point out the true Courſe, the Difference of which, and the Courſe ſhewn by the Compaſs in the Bittacle is the Lee-Way required.

Or when the Ship is within Sight of Land, the Lee-Way may be found without ſetting her Wake, thus, As the Ship ſails along obſerve carefully what Point on the Shore keeps ſtill on the ſame Point of the Compaſs without any Alteration. I ſay that is the Ship's true Courſe, and the Difference betwixt it and the Point of the Compaſs the Ship capes at, is the Ship's Drift or Lee-Way.

Of Davis's Quadrant, *commonly called the* English Quadrant.

THE common Method of slitting the Horizon-Vane slopewise, is both absurd, and leads the Observer into Error; for when the Sight-Vane and Horizon-Vane are directly in a right Line passing through the Center near the Middle of the Quadrant, the Opening in the Horizon-Vane appears so contracted, that the Horizon is not distinctly discern'd, and the said Opening will appear wider, or narrower, according as the Sight-Vane is nearer to, or farther from the Beginning of the Graduation; Whereas, the upper Edge thereof on the Foreside of the Horizon-Vane, should be made the fiducial Edge, (because the Sky is quicker discern'd than the Water) and so that it may be exactly perpendicular to the Center of the Instrument. Or let said Vane have a wide Opening, and in the Middle a String, Wire, *&c.* to cut the Horizon, above it, the Sky, and under it, the Water. When the Sun's Altitude exceed 12 or 15° use the Sea Quadrant, if less, use the Fore- or Cross-Staff.

Note, When Observation is made by the upper Edge of the shade-Vane, add 16' to the Zenith-Distance; for the true Zenith-Distance, if by the lower Edge of the shade-Vane, subtract 16 from the Zenith-Distance for the true; because in the first Case the Shadow is terminated by a Ray proceeding from the upper Part of the Sun's Disk, and not from its Center: In the last Case 'tis the lowest Part of the Sun that determines the Shadow.

To help this, there is another Vane call'd the Glass-Vane, having a double convex Glass fitted in it, which contracts the Sun's Rays, and casts them in a small bright Spot upon a little Circle made upon the Horizon-Vane; this Spot being made by all the solar Rays contracted together corresponds to the Center of the Sun, and is so clear and conspicuous that even in hazy Weather the Sun's Altitude may be taken, and in clear Weather the Spot is more conspicuous than the Shadow, which at best is hardly defin'd.

The Cross-Staff.

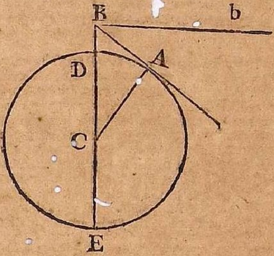
WHereby the Altitude of Sun, Moon and Stars is taken, and the Latitude found; and by which the dead Reckoning is corrected, both as to Course and Distance, may lead the Mariner astray, if he neglect the proper Abatement for the Eccentricity of the Eye by 20, 30, or 60 Minutes, if the Height be much, the Staff small, and the Eccentricity of the Eye great. To this may be added other proper Allowances for the Height of the Eye above the Level, for the Parallax and Refraction of the Sun: Tables of which follow:

Height of the Eye. Feet.	Allowances. Minutes.
3	2
6	3
12	4
20	5
30	6
40	7
50	8

Because the Eye of the Observer is always above the Surface of the Sea, the apparent Horizon must be lower than the true Horizon (passing thro' the Eye) and consequently the Altitude must be made more than it really is, and the Zenith-Distance so much less, and this Error will be greater or less according to the Height of of th Eye above the Water, which being kno n, the Dip may be found ne foregoing Table. Thus, if the Height o the Eye above the Surface be 20 Feet, the Dip of the Horizo be 5 Minutes, and so uch added to the Zenith-Distance.

The Calculation of the above TABLE s.

Let DE = Dia. of the Earth, CD = C A its Semidiameter, and B D = Height of the Eye above the Surface of the Water, then will A be the Point where the Sky and Water seem to meet. Let B b be parallel to DA (which because of the Smallness of the Arch may in this Case be taken for a right Line) then is the Angle A B b the Dip of the Horizon, to find which by Calculation, in the right-angled Triangle C A B right-angled at A, are given C A = Semidiameter of the Earth, and CB = (CD + DB) equal to



the Semidiameter of the Earth together, with the Height of the Eye above its Surface; where to find the Angle B say as CB to CA so is Radi to Sine of B the Complement, whereof is AB b, the Dip required; afte he same Manner BA the Semidiameter of the apparent Horizon may be fo *Euclid* 3. 36. B E + BD = BAq or BCq — CAq = BAq.

Zenith Distance. Degrees.	Add Refraction Minutes.	Deduct Parallax. Minutes.
90	33	3
89	23 $\frac{1}{3}$	3
88	17 $\frac{1}{8}$	3
87	13 $\frac{1}{3}$	3
86	10 $\frac{2}{3}$	3
85	9	2.59
84	7 $\frac{3}{4}$	2.58
83	6 $\frac{3}{4}$	2.58
82	6	2.57
81	5 $\frac{1}{3}$	2.57
80	5	2.57
79	4 $\frac{1}{3}$	2.56
77	3 $\frac{3}{4}$	2.55
75	3 $\frac{1}{4}$	2.54
70	2 $\frac{1}{3}$	2.48
60	1 $\frac{1}{2}$	2.36
50	1	2.18
30	$\frac{1}{2}$	1.30
20	$\frac{1}{3}$	1.

D 2 The

The Refraction of all [illegible]venly Bodies (occasion'd by the Density o[illegible] Atmosphere or thick[illegible]urs of the Air) makes them appe[illegible] they really are, especi[illegible]ly when they are near the Horizon, [illegible] wh[illegible] you have found t[illegible]enith Distance, add thereto the Refra[illegible] subtract it from the Altitude which according to *Flamsteed's* Observation, is in our Latitude as in the foregoing Table. Supposing the Obse[illegible]s Eye to be 20 Foot above the Surface of the Sea, and the Zenith Distance observed by the Quadrant or Cross-Staff, to be 75° the true Zenith Distance (allowing for Refraction and Dip of the Horizon) will be 75° 8′

The common Fore or Cross-Staff, is very incommodious, and also liable to Error, For, 1. Because the Vanes are made to slide towards or from the Eye, the Radius is continually alter'd from about 30 Inches, to about 8 or 9 Inches, which is a very great Defect and Inconvenience. 2. The Manner we are obliged to hold the Instrument being Sideways from the Eye, and then look as it were slanting over the Crosses, is very aukward and unnatural; for certainly in all Observations, the Instrument which carries the Sight ought to be so contriv'd as to be held directly betwixt the Eye and the Object. Lastly 'tis difficult to place the Staff so that the Eye may exactly answer to the Center; also the Number of Crosses and so many Sets of Divisions on the Staff, and to make the Crosses keep always perpendicular to the Place of the Staff, are no small Inconveniencies.

To help all which Defects, &c. some contrive a new Sort with a flat Staff, and one transum Cross, having at the End of the Staff a Sight Vane on the transum Cross slide two Object Vanes like the Sight of a Circumferentor, one for the Stars, and the other for the Horizon, having Degrees graduated on both Sides from the End of the Staff, which Degrees in Time of Observatio[illegible] be added to form the Altitude.

These Instruments ca[illegible] do but little Servic[illegible] tho' never so well contriv'd and used, if the Declination of the Sun and Stars be not also known; wherefore new and [illegible]rect Tables agreeing with Celestial Observations should not only be made [illegible] of, such as make the greatest Declination of the Sun, but 23°. 29′ not [illegible]3°. 31′. 30″. or more, as formerly; but the proportional Parts agreeing t[illegible] the daily Difference of Declination, and Difference of Longitude the Ship [illegible] in at Sea, should be also properly applied as the Declination either increase or decreases, else by such Neglect, an Error of 24′ in the Latitude may happen. Moreover, the Declination of Stars in some Tables have been out in whole Degrees, and the Mariners beloved Pole Star has been made 40′ farther from the Pole than it ought, wherefore *Flamsteed's* new Table of the Stars Rectified to the present Year, ought to be prefer'd above all other extant.

The Nocturnal is design'd for finding the Hour of the Night, and Altitude of the Pole Star; but it happens to be so imperfect as not to answer either of these Particulars. 1. For holding the Instrument in the Plane of the Equinoctial, there is no other Guide than to look through the Hole in the Middle of a thin Plane; in this Case 'tis easy to err even half a Score Degrees, both in Direction towards the North, and in the Elevation above the Horrizon. Some are of Opinion a better Guess may be made without the Instrument than with it; moreover, the Pole-Star's Distance from the Pole is 20′ more than it ought, and is variable both in the same and Different Latitudes.

A T[illegible]E *of the Variation of th*[illegible]
[illegible]*nation for* 100 *Years to* [illegible]

		4	8	12	16	20	40	60		
D.	M.	' "	' "	' "	' "	' "	' "	' "	' "	[illegible]
Jan.	10	S 23	S 45	1S 08	1S 31	1S54	3S48	5S42	7S37	[illegible]
	20	0 29	0 57	1 26	1 55	2 24	4 48	7 12	9 36	12 [illegible]
	30	0 34	1 09	1 43	2 18	2 49	5 38	8 27	11 15	14 04
Feb.	9	0 38	1 15	1 53	2 31	3 08	6 17	9 25	12 34	15 43
	19	0 41	1 21	2 02	2 42	3 23	6 46	10 09	13 32	16 55
	29	0 42	1 25	2 07	2 49	3 32	7 04	10 36	14 08	17 40
March	10	A 43	1A26	2A 09	2A 52	3A35	7A11	10A46	14A21	17A57
	20	0 43	1 25	2 08	2 50	3 33	7 06	10 39	14 13	17 46
	30	0 41	1 22	2 03	2 45	3 26	6 5[illegible]	10 18	13 43	17 09
April	9	0 39	1 17	1 56	2 34	3 13	6 26	9 39	12 52	16 05
	19	0 35	1 09	1 44	2 19	2 54	5 48	8 42	11 37	14 31
	29	0 30	1 00	1 30	2 00	2 29	4 59	7 28	9 58	12 28
May	9	0 24	0 48	1 12	1 36	1 59	3 59	5 58	7 58	9 58
	19	0 17	0 34	0 51	1 08	1 25	2 50	4 15	5 39	7 04
	29	0 09	0 19	0 28	0 37	0 46	1 33	2 19	3 [illegible]	3 52
June	8	0 01	0 02	0 03	0 05	0 05	0 11	0 16	0 [illegible]	0 28
	18	S 07	S 14	S 21	S 28	0S35	1S10	1S[illegible]	[illegible]	2S55
	28	0 15	0 30	0 45	1 00	1 14	2 28	[illegible] 42	[illegible] 57	6 11
July	8	0 22	0 44	1 06	1 28	1 50	[illegible]	5 [illegible]	7 21	9 12
	18	0 28	0 57	1 25	1 54	2 22	[illegible] 45	[illegible] 07	9 29	11 52
	28	0 34	1 07	1 41	2 15	2 49	5 [illegible]	8 27	11 16	14 05
Aug.	7	0 38	1 16	1 54	2 32	3 10	[illegible] 20	9 30	12 39	15 49
	17	0 41	1 22	2 03	2 44	3 25	[illegible] 50	10 15	13 39	17 04
	27	0 43	1 26	2 09	2 52	3 3[illegible]	7 10	10 45	1[illegible]	[illegible] 55
Sept.	6	0 44	1 27	2 11	2 55	3 38	7 17	10 55	14 33	18 12
	16	A 43	1A27	2A 10	2A 53	3A37	7A14	10A51	14A27	18A 4
	26	0 42	1 24	2 06	2 48	3 30	7 00	10 30	13 59	17 29
Octo.	6	0 39	1 19	1 58	2 38	3 17	6 34	9 51	13 09	16 27
	16	0 36	1 12	1 48	2 24	2 59	5 59	8 58	11 58	14 58
	26	0 31	1 02	1 33	2 05	2 36	5 13	7 49	10 25	13 02
Nov.	5	0 26	0 51	1 17	1 42	2 08	4 16	6 24	8 32	10 40
	15	0 19	0 38	0 57	1 16	1 35	3 10	4 45	6 19	7 54
	25	0 12	0 23	0 35	0 46	0 58	1 56	2 54	3 52	4 50
Dec.	5	0 04	0 08	0 12	0 15	0 18	0 37	0 55	1 14	1 33
	15	S 04	S 09	S 13	S 17	0S22	0S44	1S 6	1S27	1S49
	25	0 12	0 24	0 36	0 48	1 00	2 01	3 01	4 01	5 02
	31	0 16	0 33	0 49	1 06	1 22	2 45	4 07	5 30	6 53

S[...]NOPSIS of all the possibl[...] [...]eti[...] [...]ppen in working an Obser[...] [...] at Se[...]

	[...]ati-on.	Sun's Shadow.	RULE.	What Latitude.
	S° d.	N° d.	Add the Declination and Zenith Distance, the Sum is the Latitude.	N°
S°	N° d.	S° d.		S°
N°	N° d.	S° d.	The Difference of them is the Latitude, when the Zenith Distance is greater.	S°
S°	S° d.	N° d.		N°
N°	N° d.	S° d.	But when the Zenith-Distance is less than the Declination, the Difference is the Latitude.	N°
S°	S° d.	N° d.		S°
	N° d.	S° d.		S°
None at a[...]	[...]ith	No Shadow	The Zenith-Distance is the Latitude.	O
	S° d.	N° d.		N°
N°	On the	[...] Sha-	The Declination is the	N°
S°	Zenith	[...]ow.	Latitude.	S°

Note, [N]°, S°, N° d., S° d. stands for North, South, Northward, Southward. | O in the Latitude is nothing, consequently under the Equator.

Betwixt the 10th of *March* and the 12th of *September*, the Declination of the Sun is North, and betwixt the 12th of *September* and 10th of *March* the Declination is South.

But if the Sun or Star do not Rise or Set in 24 Hours, observe this general Rule.

If the Object observ'd be { under / above } the Pole { Sum / Difference } of the Meridian-Altitude and Complement of Declination, is the Latitude of the same Name with the Declination.

Or without the Declination, observe the Meridian-Altitude when above the Pole, and when below: Half their Sum is the Latitude.

To

[illegible] the Longitude by Pend[illegible]n-Watches.

1. Take a[illegible] leaſt two Watches, that if one ſhould [illegible]op by any Miſhap or Negle[illegible] [illegible]ther may keep going.

2. Keep them cloſe, free from Moiſture or Duſt.

3. Let them be well adjuſted by an Equation-Table, before they be taken to Sea, and kept going while at Sea.

4. Set them to the exact Moment of Time obſerved by the Sun in the Place left, regarding the Equation-Number.

5. Then arriving at the Place whoſe Longitude is ſought, obſerve exactly the Time by the Sun in that Place, and alſo by the Watch, allowing for the Equation; if they both agree exactly, there is no Difference of Longitude. But if the Time of the Day there, be greater than that ſhewn by the Watches, then t[illegible] Difference of Longitude is Eaſterly: but if leſs, Weſterly.

6. Convert the Difference of Time into Degrees, which will be the Difference of Longitude in Degrees with greater Exactneſs than thoſe Ways that depend upon Tables, ſo various among themſelves, ſuch as Calculations of Lunar-Eclipſes, *&c.* which are as laborious as uncertain, and their true Beginning or Ending are ſcarce to be diſtinguiſhed for ſome Minutes, by Reaſon of the Penumbra: tho' four Minutes in Time will alter the Longitude a whole Degree.

7. To convert Time into Degrees, or Degrees into Time.

	Time.				Me[illegible]ſure.	
	Hour.	Min.	Sec.		[illegible]	Min.
Remember	1	0	0	is equal to	[illegible]	0
	0	4	0		1	0
	0	1	0		0	15
	0	0	4		0	1

	Hours.	Min.	Sec.		Deg[illegible]	[illegible]in.
Thus	3	42	32	=	55	38
For	3	0	0	=	45	0
		40	0	=	10	0
		2	0	=	0	30
		0	32	=	0	8

8. Wherefore, conſidering the vaſt Improvement in Watch-work by the Learned Dr. *Hook*, the Ingenious *Hugens*, *&c.* whoſe very firſt Work, be[illegible] try'd by Major *Holm's*, prov'd both Satisfactory and Uſeful in a gr[illegible]at Streight, and met with Commendation, and the Approbation of the *States of Holland*; inſomuch that he obtain'd a Patent for them; this ſeems for its Readineſs, and becauſe done by one alone, no deſpiſable Way, tho' not infallible.

To

To learn the Names of the moſt noted Stars *by*

Rectify the Globe to the Latitude, Day, and Hour of the Day, then if every Star on the Globe had a Hole, and the Eye was placed in the very Center of the Globe, and looking thro' each Hole, a direct Ray from the Eye thro' the Center of the Star if extended to the Firmament, would cut the ſame Star in the Heavens, which that Star on the Globe repreſented: if the Globe was duly rectified and ſet exactly level, and the Meridian due North, then would the Stars that be,

Riſing		Riſing	
On the Meridian		On the Meridian	
On the Zenith	on the Globe be	On the Zenith	in the Heavens.
Setting		Setting	
On any Azimuth		On the ſame Azimuth	
On any Almicantar		On the ſame Almicantar	

Wherefore, take the Azimuth or Amplitude by a Compaſs, or Altitude by a Quadrant of any Star whoſe Name is deſired, and find what Star hath the ſame Altitude or Azimuth by it is either its Name, or what Part of the Conſtellation it poſſeſſes, as alſo its Magnitude, *&c.* It may be objected, that the Planets ♃, ♂, and ♀ eſpecially, may cauſe the young Beginner to miſtake, wherefore this ſhall be the next *Problem.*

To diſtinguiſh the Planets *from the fixed* Stars.

1. Planets don't twinkle commonly. 2. They are bigger than ordinary, ♃ and ♀ eſpecially. 3. They are of differing Colors, ♄ of a leaden Color, and of the 3d Magnitude, ♃ bigger than the firſt, of a Silver-Color, ♂ of the ſecond Magnitude, of a Copper-Color, ♀ bigger than ♃, of a Glittering Color like new-coin'd Silver, ☿ of the third Size, Pale, White, like Quick-ſilver, never above thirty Degrees from the Sun, ſeldom ſeen but when he riſes before the Sun, or ſets juſt after the Sun. 4. They ſhift their Places in a Week or two obſervably from ſome known fixed Star. 5. Conſult an *Ephemeris* to ſee in what Sign the Planets are, and if they are not in the Sign obſerved, know it is a fixed Star.

To ſteer in the Night by the fixed Stars.

1. Rectify the Globe to the Latitude and Hour of the Day. 2. Then turn the Globe till the Difference of Longitude has paſſed thro' the Meridian, that is betwixt the Place left and the Place ſail'd to. 3. If any Star in the Latitude and Longitude aim'd at, come to or near the Meridian, that Star is then in or near the Zenith of the Port deſired. Then direct the Ship towards the ſame Star in the Heavens without Fear, ſtill obſerving what Star is in or near the Zenith of the Place ſail'd to.

FINIS.