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RUDIMENTARY TREATISE

ON

L O G A R I T H M S.

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P R E F A C E.

THE following little work is intended to have a twofold object—both to explain and illustrate the use and application of logarithms for the practical calculator, and to set forth and demonstrate their nature and properties for the Mathematics student. While, therefore, the Theoretical and Practical parts have been kept distinct, so that either might be separately studied or referred to, they have been so written with reference to each other, as to form but one connected treatise which the student, who really wishes to become thoroughly acquainted with the subject, should entirely peruse. For although a knowledge of their mathematical properties is not essential to a knowledge of their use, yet they are so intimately connected, that the acquirement of one greatly facilitates the acquirement of the other.

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A
 RUDIMENTARY TREATISE
 ON
 LOGARITHMS.

CHAPTER I.

Explanation and Definitions of Logarithms.

THE word Logarithm is derived from two Greek words (*λογος*, *ratio*, and *αριθμος*, *number*), and signifies the *ratios of numbers*.

By the *ratio* of two numbers, or the *proportion* which one number bears to the other (the two terms being synonymous), is meant the *magnitude of the quotient* arising from the division of one number by the other. Thus, the ratio of 2 to 6 is expressed by $\frac{2}{6}$, and any other two numbers would be said to have the same ratio when the quotient arising from the division of one by the other was the same; so, $\frac{4}{12}$ being equal to $\frac{2}{6}$, 4 is said to have the same ratio to 12 that 2 has to 6.

This is frequently written—

$$4 : 12 :: 2 : 6$$

and is read, as 4 is to 12 so is 2 to 6; it signifies nothing more than that the ratio of the two first numbers is the same as that of the two last, or that $\frac{4}{12} = \frac{2}{6}$.

A series of numbers is said to be in *continued proportion* when the ratio between each two consecutive numbers is the same, thus—

$$2, 6, 18, 54, 162,$$

are in continued proportion, because the ratios of 2 to 6, 6 to 18, 18 to 54, and 54 to 162, or $\frac{2}{6}$, $\frac{6}{18}$, $\frac{18}{54}$, $\frac{54}{162}$ are all equal. Now, the ratio of 2 to 18 is made up of the ratio of 2 to 6 and 6 to 18; but as these are equal, it is twice the ratio of 2 to 6; so, in like manner, the ratio of 2 to 54 is three times the ratio of 2 to 6; and the ratio of 2 to 162 is four times that of 2 to 6.

In order to examine some of the properties of a series of numbers in continued proportion, let us take the following, which is a more extensive series than the preceding:—

1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048 . . . (A),
 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 . . . (B),

and let us place under each term in this series a number expressing how many times the ratio of 1 to 2 is contained in the ratio of 1 to that term; we see at once that under 1 we must place 0, and under 2 we must place 1; also, since the ratio of 1 to 4 is twice that of 1 to 2, under 4 we must place 2, and since the ratio of 1 to 8 is three times that of 1 to 2, under 8 we must place 3; and, proceeding in a similar manner, we shall obtain the numbers in the second line above. Now, the numbers which we have thus placed under the terms of the proportion are *logarithms* of those terms, and are so called because they express the number of ratios of unity to the first term contained in the ratio of unity to the term under which they are placed.

The numbers composing a series in continued proportion, similar to the above, will, on examination, be found to be derived from each other by the continual multiplication of the previous term by some constant number; thus, in the first series, 6 is derived from 2 by being multiplied by 3, and in like manner 18 is obtained from 6, and 54 from 18; so in the second series, the constant multiplier is 2, each term being derived from the preceding by multiplication by that number. A series of numbers thus obtained by the continual multiplication of its terms by a constant number is called a *geometrical series*; such is the series (A) above; while a series in which the terms are derived by the continual addition of a constant number is termed an *arithmetical series*, an example of which is afforded by the series (B) above.

Now, whatever the number may be by the continual multiplication of which the *geometrical series* is formed, if the series commences with unity, and under it is written the

arithmetical series formed by the continued addition of unity, commencing with the cypher, then will the numbers in the lower line express the number of ratios of unity to the first term, of which the ratio of unity to all the other terms is made up, and therefore they will be the logarithms of the numbers in the line above them. For example:—

1, 3, 9, 27, 81, 243 { are the numbers forming a geometrical series;
of which 0, 1, 2, 3, 4, 5 { are the logarithms forming an arithmetical series.

So, 1, 7, 49, 343, 2401 { are the numbers forming a geometrical series;
of which 0, 1, 2, 3, 4 { are the logarithms forming an arithmetical series.

And again, 1, 10, 100, 1000, 10000 { are the numbers forming a geometrical series;
of which 0, 1, 2, 3, 4 { are the logarithms forming an arithmetical series.

Now, from the very nature of a geometrical series, it follows, that its terms are all powers of the constant number by the multiplication of which they are produced, and therefore, in place of writing the numbers themselves, we might introduce the expression denoting the power, without actually performing the multiplication, and we should thus obtain for the three geometrical series above, writing them vertically instead of in horizontal lines*,

Nos.	Logs.	Nos.	Logs.	Nos.	Logs.
1	= 3 ⁰	1	= 7 ⁰	1	= 10 ⁰
3	= 3 ¹	7	= 7 ¹	10	= 10 ¹
9	= 3 ²	49	= 7 ²	100	= 10 ²
27	= 3 ³	343	= 7 ³	1000	= 10 ³
81	= 3 ⁴	2401	= 7 ⁴	10000	= 10 ⁴
243	= 3 ⁵				

In these we perceive immediately that the numbers denoting the powers, or, as they are termed, the *indices* or *exponent* of the *powers*, are the same as the arithmetical series given above, and that they are therefore the logarithms of the numbers in the first columns. The constant number, of which the powers are successively taken, is termed the *root* or *radix* and may have any value that we please assigned to it. Thus we derive another definition of a logarithm, which may be de

* It must be borne in mind that $a^0 = 1$, and $a^1 = a$, whatever the value of a may be.

scribed as *the index or exponent, to which a certain root or base must be involved, in order to be equal to the number of which it is the logarithm*. It is, therefore, evident that a given number may have any number of logarithms corresponding with it; or that the same logarithm may serve for several different numbers, according to the value assumed for the base or root to be involved, or what is the same thing, the common ratio of the geometrical progression*. Thus, in the examples above, the bases or common ratios are 3, 7, and 10.

We have, therefore, three distinctly different definitions which may be given of logarithms, depending upon the particular way in which they are regarded, and we shall recapitulate these definitions, before proceeding farther, in order to insure their being thoroughly understood.

1. The logarithm of a given number is the number of ratios of some assumed constant number to unity, contained in the ratio of the given number to unity.

2. Logarithms are a series of numbers in *arithmetical progression*, answering to another series of numbers in *geometrical progression*; so taken that 0 in the first corresponds with 1 in the latter.

3. The logarithm of a number is the index or exponent of the power, to which a given constant base or root must be involved, to be equal to that number.

Whichever of these definitions may be adopted, the same general properties may be deduced as belonging to logarithms; we shall, however, in the following pages, consider them under the notion involved in the third definition, as the exponents of the powers of some constant root. And, in order to a more perfect conception of the subject, we shall first consider the properties of the exponents of powers generally.

CHAPTER II.

On the Exponents of Powers.

In algebra, the powers of a quantity, or the number of times that that quantity has been employed as a factor to produce a given quantity, are denoted by that number being written

* See page 13.

somewhat to the right and above the number or letter expressing the original quantity or root of the power. Thus, the square of 6 is written 6^2 ; the cube of x , x^3 ; and the fifth power of 12, 12^5 . In the first example, as 6 enters twice as a factor, it is called the second power, and is denoted by 2 written over the 6; in the second example, as x enters three times as a factor, it is called the third power, and is denoted by a 3 written above the x ; and in the last example, as 12 enters five times as a factor, it is termed the fifth power, and is written 12^5 . The number thus placed over a number, to denote the power to which it is required to be raised, is termed the *index* or *exponent* of that power; as the former of these terms is sometimes employed in a different sense, to avoid ambiguity we shall use only the last. Thus, in the foregoing examples, 2, 3, and 5 are the exponents of the powers, to which the quantities 6, x , and 12 are to be respectively raised or involved.

Frequently letters are employed instead of numbers as exponents of powers; thus, a^n denotes that the quantity represented by a is to be raised to the power represented by n ; and b^n , that the quantity b is to be raised to the power of n , or the n th power. The quantities, as x or b , in the foregoing examples, which have to be involved, or the powers of which are to be taken, are termed the *roots* or *bases*.

When it is desired to multiply any two powers of a quantity, a very little consideration will show that their product will be equal to a power of that same quantity, whose exponent is the sum of the two exponents of the powers to be multiplied. For, let us suppose the powers to be multiplied to be x^3 and x^2 , then $x^3 = x \cdot x \cdot x$, and $x^2 = x \cdot x$, therefore, $x^3 \times x^2 = x \cdot x \cdot x \cdot x \cdot x = x^5$, the exponent of which 5 is equal to $3 + 2$, the sum of the exponents of the two factors. And the converse of this rule holds good, for if it is required to divide a power of a given quantity by any other power of the same quantity, it is only necessary to subtract the exponent of the divisor from the exponent of the dividend to obtain the exponent of their quotient. Thus, let it be required to divide

x^5 by x^3 , we have $x^5 \div x^3 = \frac{x \cdot x \cdot x \cdot x \cdot x}{x \cdot x} = x \cdot x \cdot x = x^3$,

the exponent of which is equal to $5 - 2$.

Let us next examine the value of the power of a power; for instance, the square of x^3 . In this case, we see at once that the square of x^3 is nothing more than x^3 multiplied by itself, and by

our former rule for the multiplication of powers, we have $x^2 \times x^3 = x^5$; if we had required the cube of x^2 , it would have been $x^2 \cdot x^2 \cdot x^2 = x^6$, and for every higher power of x^2 we must add another 2 to the exponent; it is therefore obvious, that as the exponent of the original power has to be taken as many times as the exponent of the power to which it has to be raised, that the new exponent will be equal to the product of the other two; thus, in the above examples, $3 \times 2 = 6$, therefore $(x^2)^3 = x^6$, and $3 \times 3 = 9$, therefore $(x^3)^3 = x^9$. The converse of this rule also holds good, for if it is required to extract any root of a power, we have only to divide the exponent of the power by the exponent of the root, to obtain the exponent desired. Thus the square root of x^4 is x^2 , because $4 \div 2 = 2$; and the square root of x^6 is x^3 , because $6 \div 2 = 3$.

The four processes which we have here described are those which are of the most frequent occurrence, and as it is essential that they should be perfectly comprehended before entering on the use of logarithms, we shall recapitulate them in the form of rules.

1. The multiplication of the powers of any quantity is performed by the addition of their exponents; that is, $x^n \times x^m = x^{(n+m)}$.

2. The division of the power of a quantity by any other power of the same quantity, is performed by subtracting the exponent of the divisor from the exponent of the dividend; that is, $x^n \div x^m = x^{(n-m)}$.

3. The involution of any power of a quantity to some power is performed by multiplying its exponent by the exponent of the power to which it is to be raised; that is, the n th power of x^m is $x^{n \cdot m}$.

4. The extraction of the root of any power is performed by dividing its exponent by the exponent of the root required; that is, the n th root of x^m is $x^{\frac{m}{n}}$.

In the last example we have an exponent differing from any which we have previously met with, namely, a *fractional* exponent; its use, however, in that example sufficiently explains its meaning, which is, that the quantity to which it is attached is to be raised to the power denoted by the numerator of the fraction, and is then to have the root extracted, which is denoted by the denominator of the same; or, the processes may be reversed, and the root first extracted, and then the power raised, since the order in which these operations are performed makes no difference in the final re-

sult. For example, let x above equal 4, m equal 8, and n equal 2; then $x^{\frac{m}{n}} = 4^{\frac{8}{2}}$, and if we take the cube of 4, which equals 64, and extract its square root, we obtain 8; or, if we first extract its square root we obtain 2, the cube of which is also equal to 8. And therefore we perceive that the final result is the same, whichever process is first performed.

In the example to the second rule, namely, $x^{(n-m)} = x^r$; if m is less than n , then the exponent r is a *positive* number, and x^r is termed a *direct* power of x ; if, however, m exceeds n , then will r be a *negative* number, and in this case x^{-r} is termed an *inverse* power of x . In order to arrive at a correct idea of the value of an inverse power, we will take a direct power, and successively divide by its root, or subtract unity from its exponent, until we obtain a negative value; thus, let us start with x^1 , then—

$$x^{3-1} = \frac{x^3}{x} = x^2$$

$$x^{2-1} = \frac{x^2}{x} = x^1 = x$$

$$x^{1-1} = \frac{x^1}{x} = x^0 = 1$$

$$x^{0-1} = \frac{x^0}{x} = \frac{1}{x} = x^{-1}$$

$$x^{-1-1} = \frac{1}{x} \div x = \frac{1}{x^2} = x^{-2}$$

$$x^{-2-1} = \frac{1}{x^2} \div x = \frac{1}{x^3} = x^{-3},$$

or, in more general terms, $x^{-n} = \frac{1}{x^n}$; that is to say, *the inverse power of any number is equal to unity divided by the direct power with an equal exponent.*

This last rule holds equally, when the exponent of the inverse power is a fraction, as it does when an integer; thus, $x^{-\frac{1}{n}}$ is equal to unity divided by the n th root of x , or to $\frac{1}{x^{\frac{1}{n}}}$.

We have then four different forms in which an exponent may be presented.

1. The *positive integral* exponent, as x^n , which denotes the

direct n th power of x , and is equal to the product arising from the multiplication of n factors, each equal to x .

2. The *negative integral* exponent, as x^{-n} , which denotes the *inverse* n th power of x , and is equal to unity divided n times by x .

3. The *positive fractional* exponent, as $x^{\frac{1}{n}}$, which denotes the *direct* n th root of x , and is equal to a quantity which, being multiplied n times by itself, shall be equal to x .

4. The *negative fractional* exponent, as $x^{-\frac{1}{n}}$, which denotes the *inverse* n th root of x , and is equal to unity divided by the *direct* n th root of x .

CHAPTER III.

Of various Systems of Logarithms.

WE next proceed with the consideration of logarithms, under the view suggested in the third definition given of them in the first chapter, as the exponents of the powers of some constant number, taken as a base for the system. It was there stated that any value might be assumed for this base; two only have, however, been employed, namely, 2.7182818 and 10. The first was that adopted by Baron Napier, the inventor of logarithms, and was employed by him in the first system of logarithms, which was calculated by Briggs. The reason why such an intricate number was adopted, and not some simple integer, will be presently explained; it may be sufficient at present to state, that the system having this number for its base, being capable of being expressed more simply, and calculated more easily, than any other, was the reason of its adoption; from which circumstance, they have also been occasionally designated the *natural* system of logarithms; they are, however, more frequently termed *Napierian* or *Hyperbolic* logarithms. The latter term, derived from certain relations, found to exist between the logarithms of this system and the asymptotic spaces of the hyperbola, and which were believed to be peculiar to it, is very properly falling into disuse, since it is now known that the same property belongs to every system, the only difference being in the angle included between the asymptotes, which depends upon and varies with the value of the base; for in the system of which we are now speaking, in which the base equals 2.7182818, the

asymptotes are at right angles to each other; in the other system, having 10 for its base, they make an angle of $25^{\circ}7404$.

It was soon perceived by Briggs, who had calculated the first table of Napierian logarithms, that several important advantages were possessed by a system of logarithms whose base was 10; he consequently proposed it to Baron Napier, by whom it was adopted, and it is now universally employed for the purposes of calculation; although the Napierian logarithms are always employed in the Differential and Integral Calculus, and the other higher branches of analysis.

The logarithms of any particular system are immediately reduced to those of any other system, by merely being multiplied by a constant number, whose value depends on the relative values of the bases of the two systems. Thus, the logarithms belonging to the common, or as it is sometimes termed *Briggean*, system, whose base is 10, are converted into the Napierian, whose base is 2.71828, by being multiplied by 2.3025851, while the Napierian are reduced to the Briggean by being divided by the same number, or, what is the same thing, being multiplied by its reciprocal 0.4342945. We shall not stop here to prove this, or to explain its reason, as it would involve considerations with which the student is supposed at present not to be acquainted; its demonstration will be given in a subsequent chapter*.

We shall now proceed to explain why the base of the system was altered from 2.71828 to 10, and to point out the advantages thereby attained.

In the tables below we have given the numbers whose logarithms are the first six integers in both systems, the left-hand table being taken to the Napierian base, and the right-hand to the base of 10.

Nos.	Base.	Log.	Nos.	Base.	Log.
1.00	=	2.71828 ⁰	1	=	10 ⁰
2.72	=	2.71828 ¹	10	=	10 ¹
7.39	=	2.71828 ²	100	=	10 ²
20.09	=	2.71828 ³	1000	=	10 ³
54.60	=	2.71828 ⁴	10000	=	10 ⁴
148.41	=	2.71828 ⁵	100000	=	10 ⁵
408.48	=	2.71828 ⁶	1000000	=	10 ⁶

By reference to the right-hand table it will be seen that the common logarithm of 1 is 0, that of 10 is 1, and of 100 is

* See page 22.

2; it is requisite, however, for the purposes of general computation that we should know the logarithms of all the intermediate numbers included between these, as from 1 to 10, from 10 to 100, and so on. Now, since the logarithm of 1 is 0, and of 10 is 1, it follows that the logarithms of any intermediate numbers, greater than 1, but less than 10, must be some fraction, whose value lies between 0 and 1; and in like manner that, since the logarithm of 100 is 2, the logarithm of any intermediate number between 10 and 100, must have a value between 1 and 2. Interpolating, therefore, these fractional values of the logarithms of the intermediate numbers, we obtain the following series:—

Nos.	Logs.	Nos.	Logs.
1 = 10	0.00000	11 = 10	1.04139
2 = 10	0.30103	12 = 10	1.07918
3 = 10	0.47712	13 = 10	1.11304
4 = 10	0.60206	14 = 10	1.14613
5 = 10	0.69897	15 = 10	1.17609
6 = 10	0.77815	16 = 10	1.20412
7 = 10	0.84510	17 = 10	1.23045
8 = 10	0.90309	18 = 10	1.25527
9 = 10	0.95424	19 = 10	1.27875
10 = 10	1.00000	20 = 10	1.30103
		&c.	&c.

All numbers which are powers of 10, necessarily have integers for their logarithms, but the logarithms of all the intermediate numbers are compounded of an integer and a decimal fraction. The decimal portion is termed the *mantissa*, and the integer, which precedes it, is called the *index*, or *characteristic*; as, however, the former of these terms is frequently employed in a different sense, we shall here only use the latter.

In the foregoing Table, if we compare the logarithm of 2 with that of 20, we shall find that they only differ in the characteristic, the mantissa or decimal portion being identical in both; the reason of this will be very evident, if we consider that 20 is 2 multiplied by 10, and therefore that the logarithm of 20 is equal to the logarithm of 2, with that of 10 added to it, and, as the logarithm of 10 is an integral number, its addition only affects the value of the characteristic. In fact, the addition of 1 to the characteristic is multiplying the number which it represents by 10; in like manner, adding 2

to the characteristic, is multiplying the number by 100, and so on. Thus the logarithm

$$\begin{aligned} \text{Of } 2 & \text{ is } 0.30103; \\ \text{Of } 2 \times 10 = 20 & \text{ is } 0.30103 + 1 = 1.30103; \\ \text{Of } 2 \times 100 = 200 & \text{ is } 0.30103 + 2 = 2.30103; \\ \text{Of } 2 \times 1000 = 2000 & \text{ is } 0.30103 + 3 = 3.30103. \end{aligned}$$

The mantissa, or the decimal portion of the logarithm, is always the same with the same figures, whether they are decimals or integers; it is only the *characteristic* which changes its value, with a change in the position of the decimal point. The value of the characteristic of the logarithm of a number is always one less than the number of integers in that number; thus, in the above example, when the number is 20 the characteristic is 1, when 200 it is 2, and when 2000 it is 3.

The characteristic, therefore, of the logarithms of all numbers

Equal to, or greater than 1, but less than 10, is 1,			
" " 10,	"	100, ..	2,
" " 100,	"	1000, ..	3,
" " 1000,	"	10000, ..	4,
&c.		&c.	&c.

By way of further illustration, we will take the number 67854, and successively divide it by 10, examining the change thus produced in the value of the corresponding logarithms:

Nos.	Logs.
67854	= 4.831576
6785.4	= 3.831576
678.54	= 2.831576
67.854	= 1.831576
6.7854	= 0.831576
.67854	= 0.831576 - 1
.067854	= 0.831576 - 2
.0067854	= 0.831576 - 3

We here perceive, as we have already stated, that, the figures remaining unaltered, no change takes place in the *mantissa* of the logarithm, but that as the number is successively divided by 10, the value of the *characteristic* is diminished by unity. We see further that, when the number is wholly a decimal fraction, the characteristic of its logarithm is *negative*; when the first figure after the decimal

point is a *significant figure**, the characteristic of its logarithm is -1 , when a nought is interposed after the decimal point, so that the first significant figure is the second decimal figure, the characteristic is -2 , with two noughts it is -3 , and generally, the characteristic of the logarithm of a decimal fraction is a negative number, greater by unity than the number of noughts following the decimal point. Instead of writing, as we have above, $0.831576 - 3$, the characteristic is placed to the left of the mantissa, with the negative sign *above* it, thus $\bar{3}.831576$. The negative sign is placed *above*, instead of *before* the characteristic, to denote that it is only the *characteristic* and not the mantissa that is negative. Thus, the characteristic of the logarithm of

.1	is	$\bar{1}$,
.01	„	$\bar{2}$,
.001	„	$\bar{3}$,
.0001	„	$\bar{4}$.
&c.	&c.	

Since the characteristic of the logarithm of any number does not depend upon the value of the figures composing that number, and is so easily found by attention to the foregoing rules, it is usual to omit them altogether in the tables of logarithms, and only to give the mantissa or decimal portion.

It is only logarithms having 10 for their base which possess this important property, of having the same mantissa for the same figures, and this was the reason of that number being proposed by Briggs for the base of the common system of logarithms.

CHAPTER IV.

Mode of calculating Logarithms, and Demonstration of their Properties.

In the following Chapter the expressions, or formulæ employed for the calculation of logarithms, are mathematically deduced, and demonstrations are given of all the properties of logarithms referred to in any other portion of the work. By those not familiar with mathematical investigation, the present

*All the numerals are significant figures, with the exception of the cypher.

chapter may be omitted, as it is in nowise necessary to the proper understanding of the remainder of the work; the subject would, however, have been hardly complete without it, and it was considered that a rigid demonstration would be far more satisfactory to those by whom it could be followed, than a mere enunciation of the several propositions without any proof; and that, the reason of the several propositions and rules being understood, they would become much more firmly fixed in the memory, and their practical application and adaptation to peculiar cases rendered far more easy.

DEFINITIONS.

1. The *Power* of a number or quantity, is the product arising from the multiplication of that number, any number of times by itself.

2. The *Root*, or *base* of a power, is the number or quantity, by the continual multiplication of which by itself, that power is produced.

3. The *Exponent*, or *index of a power*, is the number of times that the root of that power enters into it, as a factor.

4. The *Exponent*, or *index of a root*, is the number of times that it must be employed as a factor, to produce a given power.

5. A *Logarithm* of a number, to any base, is the index or exponent of the power to which that base must be involved, to be equal to the number.

6. A *System of Logarithms*, is the collection of the logarithms of a series of numbers, taken to the same base.

SCHOLIUM. The logarithm of any number, as x , to any base b , is expressed by $\log_b x$; in like manner, the logarithm of the same number, to any other base, as c , is written $\log_c x$.

7. A series of numbers is in *Arithmetical Progression*, when each number is derived from that which precedes it, by the *addition* of a constant number.

SCHOLIUM. Such a series is called an *Arithmetical Series*, and any one of the numbers composing it, a *term*.

8. The *Common Difference*, is the constant number, by the continual addition of which, an arithmetical series is formed.

9. A series of numbers is in *Geometrical Progression*, when each number is derived from that which precedes it, by the *multiplication* by a constant number.

SCHOLIUM. Such a series is called a *Geometrical Series*.

10. The *Common Ratio*, is the constant number, by the

continual multiplication by which, a geometrical series is formed.

SCHOLIUM. In investigations similar to the following, the term *coefficient* is employed in a somewhat extended signification, to mean any quantity or expression (however complicated) by which the quantity, more immediately under consideration, is multiplied.

Thus, in the expression,

$$\frac{r}{\lambda} \left(\frac{r}{\lambda} - 1 \right) x^2 + \frac{r}{\lambda} \left(\frac{r}{\lambda} - 1 \right) \cdot \left(\frac{r}{\lambda} - 2 \right) x^3,$$

the quantities $\frac{r}{\lambda} \left(\frac{r}{\lambda} - 1 \right)$ and $\frac{r}{\lambda} \left(\frac{r}{\lambda} - 1 \right) \cdot \left(\frac{r}{\lambda} - 2 \right)$

are looked upon as the coefficients of x^2 and x^3 respectively.

11. The *Characteristic* of a Logarithm, is the integral number, to the left of the decimal point.

12. The *Mantissa* of a Logarithm, is the decimal number, to the right of the decimal point.

13. A *Significant Figure* is every figure but a cypher; the *cypher* signifying no actual quantity, but being employed only to determine the place of the other figures.

PROPOSITION A.

THEOREM. *In an equation of the form*

$$A + Bx + Cx^2 + Dx^3 + \dots + \&c. = a + bx + cx^2 + dx^3 + \dots + \&c.$$

the coefficient of any power of x on one side of the equation, is equal to the coefficient of the like power of x on the other side; that is, $A = a$, $B = b$, $C = c$, &c.

Because, in the above expression, the values of the coefficients are perfectly independent of the value of x , therefore, we may assume x to have any value we please, without destroying the equation.

Let, therefore, $x = 0$, the equation then becomes

$$A = a.$$

Now, since A and a are equal, we may remove them from the original equation, which then becomes

$$Bx + Cx^2 + Dx^3 + \dots + \&c. = bx + cx^2 + dx^3 + \dots + \&c.$$

Dividing both sides by x , we obtain

$$\begin{aligned} B + Cx + Dx^2 + \dots + \&c. = \\ b + cx + dx^2 + \dots + \&c. \end{aligned}$$

And again, assuming $x = 0$, we have

$$B = b.$$

And in like manner, it may be shown that $C = c$, $D = d$, &c.

SCHOLIUM. 1. The above Theorem is true, whatever signs the terms of the equation may be affected with, provided only, that the terms involving like powers of x , on the opposite sides, are affected with like signs. Thus, it is true if

$$\begin{aligned} A - Bx + Cx^2 - Dx^3 + \dots - \&c. = \\ a - bx + cx^2 - dx^3 + \dots - \&c. \end{aligned}$$

or if,

$$\begin{aligned} -A + Bx - Cx^2 + Dx^3 - \dots + \&c. = \\ -a + bx - cx^2 + dx^3 - \dots + \&c. \end{aligned}$$

2. This Theorem also holds good when more complicated functions of x take the place of x , x^2 , x^3 , &c., provided only, that the same functions occur in the same order on opposite sides; as for example, if

$$\begin{aligned} A + Bx + Cx^2 + Dxy + E y^2 + Fx^3 + \dots + \&c. = \\ a + bx + cx^2 + dxy + e y^2 + fx^3 + \dots + \&c. \end{aligned}$$

PROPOSITION B.

PROBLEM. To expand b^λ in terms of λ .

For b , substitute $(1 + y)$, then $b^\lambda = (1 + y)^\lambda$; expanding this expression by the Binomial Theorem*, it becomes

$$\begin{aligned} b^\lambda &= 1 + \lambda y + \lambda \frac{(\lambda - 1)}{2} y^2 + \lambda \frac{(\lambda - 1) \cdot (\lambda - 2)}{2 \cdot 3} y^3 + \\ &\lambda \frac{(\lambda - 1) \cdot (\lambda - 2) \cdot (\lambda - 3)}{2 \cdot 3 \cdot 4} y^4 + \dots + \&c. \\ &= 1 + \lambda y + \frac{\lambda^2 - \lambda}{2} y^2 + \frac{\lambda^3 - 3\lambda^2 + 2\lambda}{2 \cdot 3} y^3 + \\ &\frac{\lambda^4 - 6\lambda^3 + 11\lambda^2 - 6\lambda}{2 \cdot 3 \cdot 4} y^4 + \dots + \&c. \end{aligned}$$

* For a demonstration of the Binomial Theorem, see the "Elements of Algebra," p. 148, by Mr. Haddon.

$$= 1 + \lambda y + \left(\frac{\lambda^2}{2} - \frac{\lambda}{2} \right) y^2 + \left(\frac{\lambda^3}{6} - \frac{3\lambda^2}{6} + \frac{3\lambda}{6} \right) y^3 + \\ \left(\frac{\lambda^4}{24} - \frac{6\lambda^3}{24} + \frac{11\lambda^2}{24} - \frac{6\lambda}{24} \right) y^4 + \dots + \&c.$$

Arranging this last expression according to the powers of λ , we have

$$b^\lambda = 1 + \lambda \left\{ y - \frac{1}{2} y^2 + \frac{1}{3} y^3 - \frac{1}{4} y^4 + \dots - \&c. \right\} \\ + \lambda^2 \left\{ \frac{1}{2} y^2 - \frac{1}{2} y^3 + \frac{11}{24} y^4 - \dots + \&c. \right\} \\ + \lambda^3 \left\{ \frac{1}{6} y^3 - \frac{1}{4} y^4 + \dots - \&c. \right\}$$

Or, if we put

$$A = \left\{ y - \frac{1}{2} y^2 + \frac{1}{3} y^3 - \frac{1}{4} y^4 + \dots - \&c. \right\}$$

$$B = \left\{ \frac{1}{2} y^2 - \frac{1}{2} y^3 + \frac{11}{24} y^4 - \dots + \&c. \right\}$$

$$C = \left\{ \frac{1}{6} y^3 - \frac{1}{4} y^4 + \dots - \&c. \right\}$$

we have

$$b^\lambda = 1 + A\lambda + B\lambda^2 + C\lambda^3 + \dots + \&c. \dots [1.]$$

Now, in order to obtain the values of the coefficients B, C, &c., in terms of A, let us put s for $A\lambda + B\lambda^2 + C\lambda^3 + \&c.$, then the above expression becomes

$$b^\lambda = 1 + s.$$

Extracting the root on both sides, we have,

$$b = (1 + s)^{\frac{1}{\lambda}},$$

and raising them to the power of r , it becomes

$$b^r = (1 + s)^{\frac{r}{\lambda}}.$$

Expanding by the Binomial Theorem, we have

$$b^r = 1 + \frac{r}{\lambda} x + \frac{\frac{r}{\lambda} \left(\frac{r}{\lambda} - 1 \right)}{2} x^2 + \frac{\frac{r}{\lambda} \left(\frac{r}{\lambda} - 1 \right) \cdot \left(\frac{r}{\lambda} - 2 \right)}{2 \cdot 3} x^3 +$$

$$\frac{\frac{r}{\lambda} \left(\frac{r}{\lambda} - 1 \right) \cdot \left(\frac{r}{\lambda} - 2 \right) \cdot \left(\frac{r}{\lambda} - 3 \right)}{2 \cdot 3 \cdot 4} x^4 + \dots + \&c.$$

Substituting, in this expression, $A\lambda + B\lambda^2 + C\lambda^3 + \&c.$, for x , it becomes

$$b^r = 1 + \frac{r}{\lambda} (A\lambda + B\lambda^2 + C\lambda^3 + \&c.) +$$

$$\frac{\frac{r}{\lambda} \left(\frac{r}{\lambda} - 1 \right)}{2} (A\lambda + B\lambda^2 + C\lambda^3 + \&c.)^2 +$$

$$\frac{\frac{r}{\lambda} \left(\frac{r}{\lambda} - 1 \right) \cdot \left(\frac{r}{\lambda} - 2 \right)}{2 \cdot 3} (A\lambda + B\lambda^2 + C\lambda^3 + \&c.)^3 + \dots + \&c.$$

$$= 1 + r(A + B\lambda + C\lambda^2 + \&c.) +$$

$$\frac{r(r-\lambda)}{2} (A + B\lambda + C\lambda^2 + \&c.)^2 +$$

$$\frac{r(r-\lambda) \cdot (r-2\lambda)}{2 \cdot 3} (A + B\lambda + C\lambda^2 + \&c.)^3 + \dots + \&c.$$

If now we assume $\lambda = 0$, this expression becomes

$$b^r = 1 + Ar + \frac{A^2 r^2}{2} + \frac{A^3 r^3}{2 \cdot 3} + \dots + \&c.$$

Which expression, being perfectly general, is true whatever value is assigned to r ; we may therefore substitute λ for r , whence we obtain

$$b^\lambda = 1 + A\lambda + \frac{A^2}{2} \lambda^2 + \frac{A^3}{2 \cdot 3} \lambda^3 + \dots + \&c. \dots \dots \dots [2.]$$

The value of A is already known in terms of y , but as $b =$

1 + y, therefore y = b - 1, and if we substitute this value for y, we have

$$A = \left\{ (b - 1) - \frac{1}{2}(b - 1)^2 + \frac{1}{3}(b - 1)^3 - \frac{1}{4}(b - 1)^4 + \dots - \&c. \right\} \dots [3.]$$

PROPOSITION C.

PROBLEM. From the equation

$$b^\lambda = n = 1 + A\lambda + \frac{A^2}{2}\lambda^2 + \frac{A^3}{2.3}\lambda^3 + \dots + \&c.$$

to determine the value of λ , in terms of b and n .

If, in the equation $n = b^\lambda$, both sides are raised to the power of x , it becomes $n^x = b^{\lambda x}$; then expanding n^x in terms of x , we obtain (Prop. B, [2])

$$n^x = 1 + A_1 x + \frac{A_1^2}{2} x^2 + \frac{A_1^3}{2.3} x^3 + \dots + \&c.$$

in which (Prop. B, [3])

$$A_1 = \left\{ (n - 1) - \frac{1}{2}(n - 1)^2 + \frac{1}{3}(n - 1)^3 - \dots + \&c. \right\}$$

Also expanding $b^{\lambda x}$ in terms of λx , we have (Prop. B, [2])

$$b^{\lambda x} = 1 + A\lambda x + \frac{A^2}{2}\lambda^2 x^2 + \frac{A^3}{2.3}\lambda^3 x^3 + \dots + \&c.$$

If now in the equation $b^{\lambda x} = n^x$, we substitute the values of $b^{\lambda x}$ and n^x obtained above, it becomes

$$\begin{aligned} & 1 + A\lambda x + \frac{1}{2} A^2 \lambda^2 x^2 + \frac{1}{6} A^3 \lambda^3 x^3 + \dots + \&c. \\ & = 1 + A_1 x + \frac{1}{2} A_1^2 x^2 + \frac{1}{6} A_1^3 x^3 + \dots + \&c. \end{aligned}$$

From which we have, by Prop. A,

$$\begin{aligned} A\lambda &= A_1 \\ A^2\lambda^2 &= A_1^2 \\ A^3\lambda^3 &= A_1^3, \&c. \end{aligned}$$

From each of which we obtain

$$\lambda = \frac{A_1}{A}.$$

Substituting for A_1 , its value given above, and for A its value determined in Prop. B, [3], we have

$$\lambda = \frac{(n-1) - \frac{1}{2}(n-1)^2 + \frac{1}{3}(n-1)^3 - \&c.}{(b-1) - \frac{1}{2}(b-1)^2 + \frac{1}{3}(b-1)^3 - \&c.} \dots\dots [1.]$$

SCHOLIUM. Since $b^\lambda = n$, it follows, from the definition of a logarithm. page 4, that λ is the logarithm of the number n to the base b . Now as b may have any value that we please assigned to it, and, as every different value of b gives a different value of λ , it follows that there may be any number of logarithms corresponding with the number n , because any number of values may be given to the base b^* .

We may therefore assume such a value for b as shall give

$$A = \left\{ (b-1) - \frac{1}{2}(b-1)^2 + \frac{1}{3}(b-1)^3 - \&c. \right\} = 1, \text{ in}$$

which case the expression [1, above] for the logarithm becomes

$$\lambda = (n-1) - \frac{1}{2}(n-1)^2 + \frac{1}{3}(n-1)^3 - \dots + \&c. \dots [2.]$$

This is the value for A actually taken by Baron Napier, and employed by him in his first Table of Logarithms, from which circumstance, logarithms calculated to this base are termed *Napierian Logarithms*.

PROPOSITION D.

PROBLEM. *In the equation*

$$b^\lambda = 1 + A\lambda + \frac{A^2}{2}\lambda^2 + \frac{A^3}{2.3}\lambda^3 + \frac{A^4}{2.3.4}\lambda^4 + \dots + \&c.$$

to determine the value of b , when A is made equal to unity.

Substituting the assumed value of A , in the above expression, it becomes

* See page 8.

$$b^\lambda = 1 + \lambda + \frac{1}{2}\lambda^2 + \frac{1}{2.3}\lambda^3 + \frac{1}{2.3.4}\lambda^4 + \dots + \&c.$$

Now, as this expression is true, whatever be the value of λ , it is true when $\lambda = 1$, in which case it becomes

$$b = 1 + 1 + \frac{1}{2} + \frac{1}{2.3} + \frac{1}{2.3.4} + \frac{1}{2.3.4.5} + \&c.$$

From which expression, as it is rapidly convergent, we may easily determine the value of b , to any required degree of exactness.

SCHOLIUM. The following is the calculation for the first thirteen terms.

1 + 1	=	2.000,000,000	000
+ by $\frac{1}{2}$	=	500,000,000	000
+ by $\frac{1}{6}$	=	166,666,666	667
" 4	=	041,666,666	667
" 5	=	008,333,333	333
" 6	=	001,388,888	889
" 7	=	000,198,412	698
" 8	=	000,024,801	587
" 9	=	000,002,755	732
" 10	=	000,000,275	573
" 11	=	000,000,025	052
" 12	=	000,000,002	088
		2.718,281,828	286

In which the first nine decimals are correct. This number is usually denoted by e , and is, as stated in the scholium to the preceding proposition, the base of the Napierian system of logarithms.

PROPOSITION E.

PROBLEM. To obtain a rapidly convergent series, for calculating the logarithms of numbers.

In the expression Prop. C. [1], if we put A for its equivalent value in the denominator, we have

$$\lambda = \log_e n = \frac{1}{A} \left\{ (n-1) - \frac{1}{2}(n-1)^2 + \frac{1}{3}(n-1)^3 - \dots + \&c. \right\} \dots\dots\dots [1.]$$

This expression being true for all values of n , we may put $1 + m = n$, it then becomes

$$\log_e(1 + m) = \frac{1}{A} \left(m - \frac{1}{2} m^2 + \frac{1}{3} m^3 - \dots + \&c. \right)$$

Again, if we put $1 - m = n$, we have

$$\log_e(1 - m) = \frac{1}{A} \left(-m - \frac{1}{2} m^2 - \frac{1}{3} m^3 - \dots - \&c. \right)$$

Then, subtracting the second equation from the first, we obtain

$$\log_e(1 + m) - \log_e(1 - m) = \log_e \frac{1 + m}{1 - m} =$$

$$\begin{aligned} & \frac{1}{A} \left(m - \frac{1}{2} m^2 + \frac{1}{3} m^3 - \dots + \&c. \right) \\ & - \frac{1}{A} \left(-m - \frac{1}{2} m^2 - \frac{1}{3} m^3 - \dots - \&c. \right) \\ & = \frac{2}{A} \left(m + \frac{1}{3} m^3 + \frac{1}{5} m^5 + \dots + \&c. \right) \end{aligned}$$

Now, let $1 + m = a$, and $1 - m = a - 1$, then we have

$$\frac{1 + m}{1 - m} = \frac{a}{a - 1}.$$

From which we obtain

$$m = \frac{1}{2a - 1}.$$

Substituting this value of m in the above expression, we have

$$\begin{aligned} \log_e \frac{a}{a - 1} = \frac{2}{A} \left\{ \frac{1}{2a - 1} + \frac{1}{3(2a - 1)^3} + \right. \\ \left. \frac{1}{5(2a - 1)^5} + \dots + \&c. \right\} \dots\dots\dots [2.] \end{aligned}$$

a series which is rapidly converging.

PROPOSITION F.

PROBLEM. *To reduce the logarithms of a system having one base, to those having a different base.*

We have, in Prop. E, [1],

$$\log_a n = \frac{1}{A} \left\{ (n-1) - \frac{1}{2}(n-1)^2 + \frac{1}{3}(n-1)^3 - \dots + \&c. \right\}$$

In which expression the coefficient $\frac{1}{A}$ is constant for every logarithm having b for its base, its value being entirely independent of n (Prop. B, [3]); and we have further shown (Prop. D) that, when the base of the system of logarithms is taken equal to $2.718281828 = e$, the value of A is reduced to unity; in this case, therefore, we have

$$\log_e n = (n-1) - \frac{1}{2}(n-1)^2 + \frac{1}{3}(n-1)^3 - \dots + \&c. [1.]$$

This system, therefore, having e for its base, has been called the *natural* system of logarithms, because it can be expressed in terms of n alone, and has unity for its coefficient.

Now, we have (Prob. B, [3])

$$A = (b-1) - \frac{1}{2}(b-1)^2 + \frac{1}{3}(b-1)^3 - \dots + \&c.,$$

an expression from which, by comparison with [1] above, we immediately perceive that $\log_b b = A$, or that the value of A , the denominator of the constant coefficient $\frac{1}{A}$, for any system of logarithms to the base b , is equal to the Napierian logarithm of b . The constant coefficient $\frac{1}{A}$ is called the *modulus* of the system to which it belongs; and to reduce logarithms having one base to those having a different one, it is only necessary to divide them by the modulus of their own system, by which they become reduced to natural, or Napierian logarithms, and then to multiply them by the modulus of the system having the required base*.

* See page 9.

PROPOSITION G.

PROBLEM. To find the Napierian logarithm of b , when b equals 10.

In the expression (Prop. E. [2])

$$\log_s \frac{a}{a-1} = \frac{2}{A} \left\{ \frac{1}{2a-1} + \frac{1}{3(2a-1)^2} + \frac{1}{5(2a-1)^3} + \dots + \&c. \right\}$$

if we put $a = 2$, and bear in mind that, as we want the Napierian logarithm, the modulus equals unity, we obtain

$$\log_s \frac{2}{1} = \log_s 2 = 2 \left\{ \frac{1}{3} + \frac{1}{3 \cdot 3^3} + \frac{1}{5 \cdot 3^5} + \dots + \&c. \right\}$$

Performing the calculation, we have

$$\begin{array}{r} \frac{1}{3} = \cdot 333,333,333,333 \\ \frac{1}{3} \cdot \frac{1}{3^3} = \cdot 012,345,679,012 \\ \frac{1}{5} \cdot \frac{1}{3^5} = \cdot 000,823,045,268 \\ \frac{1}{7} \cdot \frac{1}{3^7} = \cdot 000,065,321,053 \\ \frac{1}{9} \cdot \frac{1}{3^9} = \cdot 000,005,645,029 \\ \frac{1}{11} \cdot \frac{1}{3^{11}} = \cdot 000,000,513,184 \\ \frac{1}{13} \cdot \frac{1}{3^{13}} = \cdot 000,000,048,248 \\ \frac{1}{15} \cdot \frac{1}{3^{15}} = \cdot 000,000,004,646 \\ \frac{1}{17} \cdot \frac{1}{3^{17}} = \cdot 000,000,000,436 \\ \hline \cdot 346,573,590,209 \\ \quad \quad \quad 2 \\ \hline \log_s 2 = 0\cdot 693,147,180,418. \end{array}$$

Now, $4 = 2^2$, therefore $\log_2 4 = 2 \log_2 2 =$

$$1.886,294,360,836.$$

Again, let us put $a = 5$, we have then

$$\log_2 \frac{5}{4} = 2 \left\{ \frac{1}{9} + \frac{1}{8 \cdot 9^2} + \frac{1}{5 \cdot 9^3} + \frac{1}{7 \cdot 9^4} + \dots + \&c. \right\}$$

and, performing the calculation, we have

$$\begin{aligned} \frac{1}{9} &= .111,111,111,111 \\ \frac{1}{8} \cdot \frac{1}{9^2} &= .000,457,247,371 \\ \frac{1}{5} \cdot \frac{1}{9^3} &= .000,003,387,017 \\ \frac{1}{7} \cdot \frac{1}{9^4} &= .000,000,029,869 \\ \frac{1}{9} \cdot \frac{1}{9^5} &= .000,000,000,286 \\ &\hline &.111,571,775,654 \\ &\quad \quad \quad 2 \\ \log_2 \frac{5}{4} &= .223,143,551,308 \end{aligned}$$

Now, the $\log_2 \frac{5}{4} = \log_2 5 - \log_2 4$; if, therefore, we add to

$\log_2 \frac{5}{4}$ the $\log_2 4$, as found above, we shall have

$$\begin{aligned} &.223,143,551,308 \\ &1.886,294,360,836 \\ &\hline &1.609,437,912,144 \end{aligned}$$

equal the $\log_2 5$; then, since $\log_2 5 + \log_2 2 = \log_2 10$, we have

$$1.609,437,912 + .693,147,180 = 2.302,585,092,$$

which is the true value of $\log_2 10$, to nine places of decimals.

PROPOSITION H.

THEOREM. *The logarithm of any number q to the base p , multiplied by the logarithm of p to the base q , is always equal to unity; that is, $\log_p q \cdot \log_q p = 1$.*

Let $\log_p q = l$, and $\log_q p = k$; then $p^l = q$, and $q^k = p$

If the first of these, $p^l = q$, be raised to the power of k , we have

$$p^{l \cdot k} = q^k.$$

But $q^k = p$, therefore $p^{l \cdot k} = p$, and

$$l \cdot k = \log_p q \cdot \log_q p, \text{ must equal unity.}$$

PROPOSITION I.

PROBLEM. *To determine the value of $\log_b r$, r being the base of the Napierian system of logarithms.*

Comparing the expression for the value of A , given in the Scholium to Proposition C, with the formula [2] in the same, we see that A is the Napierian logarithm of b , or $r^A = b$; therefore $\log_b b = A$.

Now we have, from Theorem H,

$$\log_b b \cdot \log_r r = 1, \text{ or } A \cdot \log_r r = 1,$$

$$\text{Therefore } \log_r r = \frac{1}{A} = \frac{1}{2.302585092} = .434294482.$$

This is therefore the value of the modulus [Prop. F] of the common system of logarithms.

PROPOSITION K.

THEOREM. *If a series of logarithms to the same base are in arithmetical progression, the corresponding numbers will form a series in geometrical progression.*

That is, if in $b^{l_1} = n_1$, $b^{l_2} = n_2$, $b^{l_3} = n_3$, $b^{l_4} = n_4$, the values of the exponents of b are such that l_1, l_2, l_3, l_4 form an arithmetical progression, then will n_1, n_2, n_3, n_4 form a geometrical progression.

For, let d be the common difference of the arithmetical series, then

$$b^{l_2} = b^{l_1 + \delta} = b^{l_1} \cdot b^\delta$$

$$b^{l_3} = b^{l_2 + \delta} = b^{l_2} \cdot b^\delta$$

$$b^{l_4} = b^{l_3 + \delta} = b^{l_3} \cdot b^\delta$$

&c. &c. &c.

Let $b^\delta = n_3$, then, substituting in the above for b^δ , b^{l_1} , b^{l_2} , b^{l_3} , &c., their equals n_3 , n_1 , n_2 , n_3 , &c., we obtain

$$n_2 = n_1 \cdot n_3$$

$$n_3 = n_2 \cdot n_3$$

$$n_4 = n_3 \cdot n_3$$

&c. &c.

Or, we see that each term of the series n_1 , n_2 , n_3 , &c., is equal to the preceding term *multiplied* by the constant quantity n_3 ; they are, therefore (Def. 9), in *geometrical* progression, n_3 being their *common ratio*.

SCHOLIUM. It should be observed that, since $b^\delta = n_3$, δ , the *common difference* of the series of logarithms, is the logarithm of n_3 , the *common ratio* of the series of numbers.

PROPOSITION L.

PROBLEM. *To deduce an expression for the limit of the increment of a logarithm, produced by any given increase in the corresponding natural number.*

If, in the expression Prop. E [1], we put $\frac{1}{b} + 1$ for n , it becomes

$$\log\left(\frac{1}{b} + 1\right) = \frac{1}{A} \left\{ \frac{1}{b} - \frac{1}{2b^2} + \frac{1}{3b^3} - \frac{1}{4b^4} + \dots \&c. \right\} \dots [1].$$

$$\text{Now } \log\left(\frac{1}{b} + 1\right) = \log\left(\frac{1+b}{b}\right) = \log(b+1) - \log b,$$

equal the increment occasioned in the logarithm of b , by increasing its value by unity.

In the expression $\left\{ \frac{1}{b} - \frac{1}{2b^2} + \frac{1}{3b^3} - \&c. \right\}$, the first term, $\frac{1}{b}$, is greater than the sum of all the succeeding terms, and therefore

$$\log \left(\frac{1}{b} + 1 \right) = \log (b + 1) - \log b < \frac{1}{A} \cdot \frac{1}{b} \dots [2].$$

That is, the difference between the logarithms of two numbers differing by unity, is less than the modulus of the system divided by the lesser of those numbers.

SCHOLIUM 1. In the common system of logarithms, the modulus $= \frac{1}{A}$ has been shown [Proposition I] to be equal to .434294482; in this case, therefore, we have

$$\log (b + 1) - \log b < \frac{.434294482}{b} \dots \dots \dots [3].$$

SCHOLIUM 2. In the case of the logarithms of several consecutive numbers, each greater by unity than the preceding, putting m for the modulus of the system, we have

$$\log (b + 1) - \log b < \frac{m}{b}$$

$$\log (b + 2) - \log (b + 1) < \frac{m}{b + 1}$$

$$\log (b + 3) - \log (b + 2) < \frac{m}{b + 2},$$

from which we see that, as the numbers increase, the *rate of increase* of their logarithms decrease; thus, the addition of unity to b increases its logarithm by $\frac{m}{b}$, while the addition of

unity to $b + 1$ increases its logarithm only $\frac{m}{b + 1}$; when, however, b is a large number, b and $b + 1$ are very nearly equal, and therefore the rate of increase of the logarithms may be considered as proportional to that of the correspond-

ing numbers, so long as the increment of the latter is small, as compared with the number itself.

PROPOSITION M.

THEOREM. *The sum of the logarithms of two numbers, is the logarithm of their product.*

Let $\lambda = \log, m$, and $l = \log, n$, then $b^\lambda = m$, and $b^l = n$

Now

$$m \cdot n = b^\lambda \cdot b^l = b^{\lambda+l}$$

And because

$$b^{\lambda+l} = m \cdot n,$$

therefore $\lambda + l$ is the logarithm of $m \cdot n$, to the base b ; or, the sum of the logarithms of m and n is the logarithm of their product.

PROPOSITION N.

THEOREM. *The logarithm of the quotient of two numbers is equal to the logarithm of the dividend, with the logarithm of the divisor subtracted from it.*

Let λ and l denote the same as in the foregoing proposition. Then

$$\frac{m}{n} = \frac{b^\lambda}{b^l} = b^{\lambda-l}.$$

And because

$$b^{\lambda-l} = \frac{m}{n}$$

therefore $\lambda - l$ is the logarithm of $\frac{m}{n}$, to the base b ; or, the logarithm of the quotient of m divided by n , is equal to the logarithm of m , with the logarithm of n subtracted from it.

PROPOSITION O.

THEOREM. *The logarithm of any power of a number, is equal to the logarithm of that number, multiplied by the exponent of the power.*

Let $\lambda = \log_b m$, then

$$m = b^\lambda,$$

$$m^2 = b^\lambda \cdot b^\lambda = b^{2\lambda},$$

$$m^3 = b^\lambda \cdot b^\lambda \cdot b^\lambda = b^{3\lambda},$$

$$m^n = b_1^\lambda \cdot b_2^\lambda \cdot b_3^\lambda \dots b_n^\lambda = b^{n\lambda}.$$

And because

$$b^{n\lambda} = m^n,$$

therefore $n\lambda$ is the logarithm of m^n to the base b ; or, *the logarithm of the n th root of m , is equal to n times the logarithm of m .*

PROPOSITION P.

THEOREM. *The logarithm of any root of a number, is equal to the logarithm of that number, divided by the exponent of the root.*

Let $\lambda = \log_b m$, then $m = b^\lambda$; let the square root of $m = x$, and the logarithm of $x = l$, then

$$m = x \cdot x = b^{2l} = b^\lambda,$$

$$\text{therefore, } 2l = \lambda, \text{ and } l = \frac{\lambda}{2}.$$

In like manner, if the cube root of $m = y$, and the logarithm of $y = p$, then

$$m = y \cdot y \cdot y = b^{3p} = b^\lambda;$$

$$\text{therefore, } 3p = \lambda, \text{ and } p = \frac{\lambda}{3}.$$

And generally, if the n th root of $m = s$, and the logarithm of $s = q$, then

$$m = s_1 \cdot s_2 \cdot s_3 \dots s_n = b^{nq} = b^\lambda;$$

$$\text{therefore, } nq = \lambda, \text{ and } q = \frac{\lambda}{n};$$

or, the logarithm of the n th root of m , is equal to the logarithm of m , divided by n .

PROPOSITION Q.

THEOREM. *In the system of logarithms whose base is 10, the mantissa is the same for the same order of figures, whether those figures are integers or decimals.*

If the figures composing the two numbers are in the same order, and only differ in the place of the decimal point, the two numbers may be made equal by altering the position of the point in one of them, which will, in effect, be *multiplying* or *dividing* by 10, for every place that the decimal is moved to the *right* or to the *left*.

The logarithm of the number which has thus been *multiplied* or *divided* by 10, or some integral power of 10, must have the logarithm of that power of 10 *added* to or *subtracted* from it, in order to be still the correct logarithm of that number; and it will then become equal to the logarithm of the other number.

Now, the logarithm of any power of 10 to the base 10, is obviously the *exponent* of that power, and as the exponent is integral, the logarithm of every integral power of 10 must itself be an integer, with no decimals or mantissa. The *addition* or *subtraction*, therefore, of the logarithm of the power of 10, by which the number has been *multiplied* or *divided*, will not affect its mantissa, which will consequently be the same as before its value was altered. And therefore the mantissæ of the two logarithms were originally the same.

PROPOSITION R.

THEOREM. *The characteristic of the logarithm of a number to the base 10, is always one less than the number of integral figures in that number.*

Let the number consist of only one integer; then its value must be less than 10; now the logarithm of 10 is 1; therefore the logarithm of the number must be less than that of 10, and therefore its characteristic must be 0 (followed by some decimal), and in this case is one less than the number of integers in the number.

Then, let the number be successively multiplied by 10, and at the same time let the logarithm of 10, or 1, be successively added to the characteristic of its logarithm.

Now each multiplication by 10, will add an integer to the number, at the same time that it will add 1 to the characteristic of its logarithm, and therefore as originally the character-

istic was 1 less than the number of integers, so it will always continue, however great the number of integers may be.

PROPOSITION 8.

THEOREM. *In the logarithm (to the base 10) of a number less than unity, the characteristic is negative, but the mantissa is positive; and the value of the characteristic is one greater than the number of cyphers between the decimal point and the first significant figure, the number being decimally expressed.*

Let the number be multiplied by such a power of 10, as will make it have only one integral figure, and let that power be the n th; then the logarithm will have been increased by n , and it will now have 0 for a characteristic (Prop. R), followed by a mantissa; both being positive. Let m equal the value of the mantissa, now this must have been also its original value (Prop. Q); therefore, since the logarithm now equals m , and n has been added to it, its original value must have been $m - n$; that is, it must have had a positive mantissa equal to m , and a negative characteristic equal to n .

Now the number of times (or n) that a decimal fraction must be multiplied by 10, to make only its first significant figure an integer, must be one greater than the number of cyphers which originally stood between that significant figure and the decimal point.

Therefore the negative characteristic of the logarithm of a decimal fraction, is one greater than the number of cyphers between the first significant figure and the decimal point.

CHAPTER V.

Description of Logarithmic Tables.

BEFORE proceeding to give rules for performing the various processes of Logarithmic Arithmetic, it will be advantageous to describe generally, a few of the most useful Tables of Logarithms, so as to render the student familiar with their use, before he is actually required to employ them.

The object of Mathematical Tables is to present in a concise form, and one easily referred to, two or more series of numbers mutually dependent upon each other. So that any number in one series being given, the corresponding number

in either of the other series may be immediately found, on inspection of the tables. The number given is termed the *argument* of the tables, and the number sought the *resultant*. Thus in the table a specimen of which is given at page 83, the numbers in the left-hand margin and at the head of the table are the *argument*, by which we are directed where to find the logarithms of those numbers, which logarithms are the *resultants*. When we thus seek in any column of a table for the argument by which to find some other number, we are said to *enter* that column with the argument. For example, if we are looking in the table at page 83 for the logarithm of 2565, we *enter* the column of numbers (distinguished by N. at the top) with the *argument* 2565, and on the same line in the contiguous column we find the *resultant* 4090874, which is the logarithm required.

Tables of the Logarithms of Numbers exist under a great variety of forms, and are calculated to a greater or less number of decimal places, according to the purposes to which they are intended to be applied. For Astronomical and Trigonometrical calculations, where considerable accuracy is required, tables are used in which the logarithms are carried to seven places of decimals; for ordinary purposes tables of six places will be found ample; and even in many cases five places will be sufficient. We shall describe some of the best and most generally employed tables, to seven, six, and five places.

The best tables of the Logarithms of Numbers to seven places, are those by Babbage, although for general use we should recommend Hutton's, which contain logarithmic sines, tangents, &c., to the same number of places, also the natural sines and tangents, and a great variety of other tables which will be found of frequent use. We have given on the opposite page as a specimen of these tables, a portion of one page of the same.

N. 25500 L. 400 OF NUMBERS. 37

N.	0	1	2	3	4	5	6	7	8	9	D. Pr.
2550	4085402	5572	5742	5913	6083	6253	6424	6594	6764	6934	170
51	7105	7275	7445	7615	7786	7956	8126	8296	8466	8637	170
52	8807	8977	9147	9317	9487	9658	9829	9998	0168	0339	170
53	4070508	0678	0848	1018	1189	1359	1529	1699	1869	2039	170
54	2209	2379	2549	2719	2889	3059	3229	3399	3569	3739	170
55	3909	4079	4249	4419	4589	4759	4929	5099	5269	5439	170
56	5608	5778	5948	6118	6288	6458	6628	6798	6968	7137	170
57	7307	7477	7647	7817	7987	8156	8326	8496	8666	8836	170
58	9005	9175	9345	9515	9684	9854	0024	0194	0363	0533	170
59	4080703	0873	1042	1212	1382	1551	1721	1891	2060	2230	170
2560	3400	2569	2739	2909	3078	3248	3417	3587	3757	3926	169
61	4096	4265	4435	4604	4774	4944	5113	5283	5452	5622	169
62	5791	5961	6130	6300	6469	6639	6808	6978	7147	7317	169
63	7486	7656	7825	7994	8164	8333	8503	8672	8841	9011	169
64	9180	9350	9519	9688	9858	0027	0196	0366	0535	0704	169
65	1000874	1043	1212	1382	1551	1720	1889	2059	2228	2397	169
66	2567	2736	2905	3074	3243	3413	3582	3751	3920	4089	169
67	4259	4428	4597	4766	4935	5105	5274	5443	5612	5781	169
68	5950	6119	6288	6458	6627	6796	6965	7134	7303	7472	169
69	7641	7810	7979	8148	8317	8486	8655	8824	8993	9162	169

The natural numbers which form the *arguments* of the table extend from 10000 to 107999, the *resultants*, or logarithms answering to them, from 4.0000000 to 5.03341973, the former being given to 5 and 6 places, while the latter extend to 7 and 8 places. In the extreme left-hand column headed N, which is the column of arguments, only the first four figures of the natural numbers are given, the last figure must be sought for along the top of the table, in the line of figures immediately under the words "Logarithm of Numbers;" and the resultant, or the logarithm itself, will be found at the intersection of the two lines in which the two portions of the argument were found; that is, on the same *line* with the *first four* figures, and in the same *column* as the *last* figure. We observe, however, upon looking at the table, that while the first column of resultants (having 0 at the top) contains 7 figures, the other nine columns contain only 4. The explanation of this is as follows, the four figures given in these columns are only the four final figures of the logarithm, that is the 4th, 5th, 6th, and 7th, decimals, the first three figures, or the 1st, 2nd, and 3rd, decimals, are the same as those of the logarithms in the first column of resultants, and being the same it is considered unnecessary to repeat them, as they may be as easily supplied from the first column, and considerable saving of space is effected by their omission. It is in order to allow of this saving of space, by the omission of the similar figures, that the peculiar arrangement of the tables, by which a portion of the argument is found in the side column and a portion at the head of the table, has been adopted. It is not, however, always the case, that the initial figures found in the first column are the correct initial figures for all the other logarithms in the same line, because as the logarithms successively increase, after a certain interval, the last of the initial figures or the 3rd decimal becomes altered in value, and this alteration is equally likely to occur in any one of the columns. An example of this occurs at the third line of the table, in which the initial figures 406 apply, as far as the column headed with 7, they here, however, change, and in the next column become 407, and so continue until the ninth line, in which they change to 408 in the column headed with 6. Various methods have been adopted for directing attention to this change in the initial figures; in Hutton's tables it is shown by a line being drawn over the first figure of each of the logarithms to which the altered initial figures are to be applied, and in some other tables, as in Babbage's, it is

shown by the first cypher being put in smaller type, as
 $\left| \begin{array}{l} \cdot 168 \\ \cdot 338 \end{array} \right|$.

It has been shown, in the conclusion of the previous chapter (Scholium 2, Prop. L), that with small increments in the natural numbers, the logarithms corresponding with them increase in arithmetical progression, so that the difference between the successive logarithms remains constant for several logarithms in succession. Whenever the value of the difference changes, it is inserted in a column headed D, on the right of the table on the line in which the change occurs. Thus the number 170 is inserted in the column D, on the fifth line, and indicates that the difference between two successive logarithms has changed from 171 to 170 in the line in which it stands. The differences change much more rapidly at the commencement of the table than near its conclusion. The difference given in this column is that due to an increment of one unit in the 5th figure of the natural number, thus

$$\begin{array}{r} \text{Log of } 25584 = 4\cdot4079684 \\ \text{,, } 25585 = 4\cdot4079854 \\ \hline \qquad \qquad \qquad 1 \qquad \qquad \qquad 170 \\ \hline \qquad \qquad \qquad \hline \qquad \qquad \qquad \hline \end{array}$$

and as for any increment less than this, we may consider the logarithms to vary in arithmetical progression, to ascertain the logarithm of any number between those given above, the increment of the logarithm to be added to 4·4079684 will bear the same proportion to 170, that the increment of the natural number does to 1; for example, let it be required to find the logarithm of 25584·6, here the increment of the number being ·6, we form the proportion 1·0 : ·6 :: 170 : 102, by which we find that 102 is the corresponding increment of the logarithm, which being added to 4·4079684 gives 4·4079786 for the logarithm of 25584·6. Again, if the increment of the natural number had been ·06, the corresponding increment of the logarithm would have been 10·2.

If now we divide the whole difference 170 by 10, we obtain 17, the difference corresponding with an increase of one unit in the sixth figure of the natural number, the double of this or 34 for two units, the treble or 51 for three units, and so on; and each of the numbers so obtained will be the increment of the logarithm corresponding with an increase of that number of units in the sixth figure of the natural number. The increment thus obtained, for each of the nine units, is

inserted in an adjoining column (headed "Pro.," an abbreviation of Proportional Parts).

The numbers contained in these little tables are, as already explained, the increments of the logarithm for an increase in the *sixth* figure of the natural numbers, they express, however, the increments for the units in the *seventh* place of the natural number when divided by 10, or for the *eighth* when divided by 100. Thus, suppose the logarithm of 25608587 were required, we derive at once from the table the logarithm of the first five figures, to which we add the proper increment for each additional figure, derived from the little table in the right-hand column. Thus—

Log of	. 25608000	is	7.4083757
Increment for	500	"	85
"	80	"	13.6
"	7	"	1.19
<hr style="width: 50%; margin: 0 auto;"/>			
Therefore the log of	<u>25608587</u>	"	<u>7.4083857</u>

These little tables of proportional parts are of equal service in finding the natural numbers corresponding with any given logarithm. Thus, if the logarithm given were 4.4074327, on looking in the table we see that the next less logarithm is 4.4074249, which corresponds with the natural number 25552; then subtracting the logarithm taken from the table, from the given logarithm, we obtain the difference, 78; looking in the second column of the table of Proportional Parts, we find against the next less difference, 68, the number 4, which is the sixth figure of the number required; we have still 10 left, to which adding a nought we obtain 109, and the nearest number in the table being 102, against which we find 6, that is the seventh figure required. The number answering to the logarithm 4.4074249 is therefore 25552.46.

In these and all the best tables of logarithms, the characteristic is omitted, the tables containing only the mantissa of the logarithm. The characteristic must be added in accordance with the rule given at page 11.

We next pass on to describe tables of logarithms to six decimal places. As a specimen, we have given a page from the "Mathematical Tables," forming one of the same series as the present work.

No. 240 L. 380.] LOGARITHMS OF NUMBERS. [No. 269 L. 481.

N.	0	1	2	3	4	5	6	7	8	9	N.
240	380211	0392	0573	0754	0934	1115	1296	1476	1656	1837	240
1	2017	2197	2377	2557	2737	2917	3097	3277	3456	3636	1
2	3815	3995	4174	4353	4533	4712	4891	5070	5249	5428	2
3	5606	5785	5964	6142	6321	6499	6677	6856	7034	7212	3
4	7390	7568	7746	7924	8101	8279	8456	8634	8811	8989	4
5	9166	9343	9520	9698	9875	0051	0228	0405	0582	0759	5
6	390935	1112	1288	1464	1641	1817	1993	2169	2345	2521	6
7	2697	2873	3048	3224	3400	3575	3751	3926	4101	4277	7
8	4452	4627	4802	4977	5152	5326	5501	5676	5850	6025	8
9	6199	6374	6548	6722	6896	7071	7245	7419	7592	7766	9
250	7940	8114	8287	8461	8634	8808	8981	9154	9328	9501	250
1	9674	9847	0020	0192	0365	0538	0711	0883	1056	1228	1
2	401401	1573	1745	1917	2089	2261	2433	2605	2777	2949	2
3	3121	3292	3464	3635	3807	3978	4149	4320	4492	4663	3
4	4834	5005	5176	5346	5517	5688	5858	6029	6199	6370	4
5	6540	6710	6881	7051	7221	7391	7561	7731	7901	8070	5
6	8240	8410	8579	8749	8918	9087	9257	9426	9595	9764	6
7	9933	0102	0271	0440	0609	0777	0946	1114	1283	1451	7
8	411620	1788	1956	2124	2293	2461	2629	2796	2964	3132	8
9	3300	3467	3635	3803	3970	4137	4305	4472	4639	4806	9
260	4973	5140	5307	5474	5641	5808	5974	6141	6308	6474	260
1	6641	6807	6973	7139	7306	7472	7638	7804	7970	8135	1
2	8301	8467	8633	8798	8964	9129	9295	9460	9625	9791	2
3	9956	0121	0286	0451	0616	0781	0945	1110	1275	1439	3
4	421604	1768	1933	2097	2261	2426	2590	2754	2918	3082	4
5	3246	3410	3574	3737	3901	4065	4228	4392	4555	4718	5
6	4882	5045	5208	5371	5534	5697	5860	6023	6186	6349	6
7	6571	6674	6836	6999	7161	7324	7486	7648	7811	7973	7
8	8135	8297	8459	8621	8783	8944	9106	9268	9429	9591	8
9	9752	9914	0075	0236	0398	0559	0720	0881	1042	1203	9

PROPORTIONAL PARTS.	N.	1	2	3	4	5	6	7	8	9
	2433	17.8	35.6	53.4	71.2	89.0	106.8	124.6	142.4	160.2
	2446	17.7	35.4	53.1	70.8	88.5	106.2	123.9	141.6	159.3
	2460	17.6	35.2	52.8	70.4	88.0	105.6	123.2	140.8	158.4
	2474	17.5	35.0	52.5	70.0	87.5	105.0	122.5	140.0	157.5
	2488	17.4	34.8	52.2	69.6	87.0	104.4	121.8	139.2	156.6
	2503	17.3	34.6	51.9	69.2	86.5	103.8	121.1	138.4	155.7
	2517	17.2	34.4	51.6	68.8	86.0	103.2	120.4	137.6	154.8
	2532	17.1	34.2	51.3	68.4	85.5	102.6	119.7	136.8	153.9
	2547	17.0	34.0	51.0	68.0	85.0	102.0	119.0	136.0	153.0
	2562	16.9	33.8	50.7	67.6	84.5	101.4	118.3	135.2	152.1
	2577	16.8	33.6	50.4	67.2	84.0	100.8	117.6	134.4	151.2
2592	16.7	33.4	50.1	66.8	83.5	100.2	116.9	133.6	150.3	
2608	16.6	33.2	49.8	66.4	83.0	99.6	116.2	132.8	149.4	
2624	16.5	33.0	49.5	66.0	82.5	99.0	115.5	132.0	148.5	
2640	16.4	32.8	49.2	65.6	82.0	98.4	114.8	131.2	147.6	
2656	16.3	32.6	48.9	65.2	81.5	97.8	114.1	130.4	146.7	
2672	16.2	32.4	48.5	64.8	81.0	97.2	113.4	129.6	145.8	
2689	16.1	32.2	48.3	64.4	80.5	96.6	112.7	128.8	144.9	

This table contains the logarithms of every number less than 10,000 to six places of decimals, and in their general form and arrangement are very similar to those just described. The natural numbers which form the argument of the table are given to four places, the first three being found in the left-hand column, and the fourth at the head of the table; the first three figures are also repeated in the last column, to facilitate the use of the tables. In the first column of resultants the whole six figures of the logarithm are given, but in the succeeding columns only the last four, the two initial figures being supplied from the first column. In these tables, a horizontal line is introduced to separate the logarithms which have different initial figures, the line being made to break, or step up, when the change in the initial figures occurs other than at the commencement of a line. Thus in the middle of the sixth line the initial figures change from 88 to 89, and this is indicated by the line thus $\overline{9875} \quad \overline{0051}$, the former of these being 889875, and the latter 890051.

In these tables also the proportional parts are somewhat differently arranged. In Hutton's and other logarithmic tables, the line in which the difference changes its value is shown, but each line contains ten logarithms, and there is nothing to indicate between which of these logarithms the change occurs; in the tables now being described, the number corresponding with the logarithm at which the change takes place is given in the left-hand column, and on the same line will be found the proportional parts for each unit constituting the fifth figure of the natural number. Thus, let the logarithm of 246057 be required; here we obtain the logarithm of the first four figures at once from the body of the table, for the increment to be added for the other two figures we look in the table of proportional parts, and on the same line with the first four figures of the given number, and in the same column as the fifth figure of the same, we find the proportional part to be added for that figure, and on the same line and in the same column as the sixth figure, we find the proportional part, which, having first been divided by ten, must be added for that figure. Thus—

The log of	. 246000	is	5.390935
Increment for	50	..	88
..	7	..	12.82

Therefore the log of 246057 .. 5.391066

If the first four figures of the number are not exactly found in the first column of proportional parts, we must take the next less number. Thus, had the given number, whose logarithm was required, been 254371, we must have looked for the proportional part for the last two figures in the line having 2532 in the left-hand column, those being the next less numbers to 2543.

To find a number from its logarithm, the application of this table is very simple. We must take the next less logarithm in the upper part of the table, and the four first figures of the corresponding number will be obtained; we must then take the difference between the given logarithm and that found in the table, and, looking in the table of proportional parts, on the same line with the first four figures just found (or the next less to them), for the next less number to this difference, the figure at the head of the column in which it is found will be the *fifth* figure of the required number. Then, if the difference found in the table be taken from the difference sought for, and a nought be added, the number at the head of the column in which this second difference may be found (on the same line as before), will be the *sixth* figure of the required number. Thus, what is the natural number whose logarithm is 3.416369?

The given logarithm . . .	= 3.416369	
Next less logarithm . . .	= 3.416308	= the log of 2608.
	61	= 1st diff.
Next less diff. in table . . .	= 49.8	= .3
	112	= 2nd diff.
Nearest diff. in table . . .	= 116	= .07
	Therefore the number required is 2608.87	

Again, what is the natural number whose logarithm is 5.394564?

The given logarithm . . .	= 5.394564	
Next less logarithm . . .	= 5.394452	= log of 248000
	112	= 1st diff.
Next less diff. in table . . .	= 105	= 60
	70	= 2nd diff. = 4
	Therefore the required number is 248064	

The next table of logarithms which we shall describe are those reprinted, under the superintendence of the Society for the Diffusion of Useful Knowledge, from the tables of Lalande, published in France. A specimen of these tables is given

3960" = 1° 6' 0"		D.	3990" = 1° 6' 30"		D.	4020" = 1° 7' 0"		D.
Num.	Log.		Num.	Log.		Num.	Log.	
3960	·59770	10	3990	·60097	11	4020	·60423	10
3961	·59780	11	3991	·60108	11	4021	·60433	11
3962	·59791	11	3992	·60119	11	4022	·60444	11
3963	·59802	11	3993	·60130	11	4023	·60455	11
3964	·59813	11	3994	·60141	11	4024	·60466	11
3965	·59824	11	3995	·60152	11	4025	·60477	10
3966	·59835	11	3996	·60163	10	4026	·60487	11
3967	·59846	11	3997	·60173	11	4027	·60498	11
3968	·59857	11	3998	·60184	11	4028	·60509	11
3969	·59868	11	3999	·60195	11	4029	·60520	11
3970	·59879	11	4000	·60206	11	4030	·60531	10
3971	·59890	11	4001	·60217	11	4031	·60541	11
3972	·59901	11	4002	·60228	11	4032	·60552	11
3973	·59912	11	4003	·60239	10	4033	·60563	11
3974	·59923	11	4004	·60249	11	4034	·60574	10
3975	·59934	11	4005	·60260	11	4035	·60584	11
3976	·59945	11	4006	·60271	11	4036	·60595	11
3977	·59956	10	4007	·60282	11	4037	·60606	11
3978	·59966	11	4008	·60293	11	4038	·60617	10
3979	·59977	11	4009	·60304	10	4039	·60627	11
3980	·59988	11	4010	·60314	11	4040	·60638	11
3981	·59999	11	4011	·60325	11	4041	·60649	11
3982	·60010	11	4012	·60336	11	4042	·60660	10
3983	·60021	11	4013	·60347	11	4043	·60670	11
3984	·60032	11	4014	·60358	11	4044	·60681	11
3985	·60043	11	4015	·60369	10	4045	·60692	11
3986	·60054	11	4016	·60379	11	4046	·60703	10
3987	·60065	11	4017	·60390	11	4047	·60713	11
3988	·60076	10	4018	·60401	11	4048	·60724	11
3989	·60086	11	4019	·60412	11	4049	·60735	11
3990	·60097	11	4020	·60423	11	4050	·60746	11

They are only carried to five decimal places, and their arrangement is quite different from that of the tables already described. They contain the logarithms of every consecutive number from 1 to 10,000, the arguments and resultants being placed in parallel columns, and the differences between the logarithms being given in a third column on the right hand. In these tables no proportional parts of the differences are given for the several units in the fifth place of the natural number, but they have to be found by proportion in the manner explained at page 35.

Thus, suppose the logarithm of 39694 were required: we immediately find, from the table, the logarithm of 39690 to be 4.59868, but we know this to be too small, and we want the proportional part of the whole difference, 11, to be added for the four units in the fifth place of the natural number. Now, the difference, 11, corresponds with an increase of ten units in the fifth figure of the number, therefore, as $10 : 11 :: 4 : 4.4$, which is the proportional part required. The rule, therefore, for finding the proportional parts is as follows:—Multiply the difference given in the third column by all the figures of the natural number, except the first four, and point off as many decimals in the product as there were figures in the multiplier, the integral portion will be the proportional part to be added to the logarithm. In the example above we have $11 \times .4 = 4.4$, the integer of which being added to 4.59868, gives 4.59872 for the logarithm of 39694.

Again, what is the logarithm of 403567? The logarithm of 403500 is 5.60584, and the difference, 11, being multiplied by 67, is 787, from which pointing off two decimals, leaves the integer 7 to be added; therefore, the logarithm of 403567 is 5.60591.

To find a number answering to a logarithm, from these tables, proceed as follows:—Look for the next less logarithm, and the number answering to it will be the first four figures of the number required. Then take the difference between this logarithm and the one given; to this difference add as many cyphers as additional figures are required, and divide by the difference given in the third column of the table, the quotient will be the figures to be added to the first four already derived from the tables; the position of the decimal point will be determined by the value of the character.

For example, what is the number answering to the logarithm 3·60428?

$$\begin{array}{r}
 \text{Logarithm given} \quad . \quad . \quad = 3\cdot60428 \\
 \text{Next less logarithm} \quad . \quad = 3\cdot60428 = \quad 4020 \\
 \hline
 50 \div 10 = \quad .5 \\
 \hline
 4020\cdot5 \\
 \hline
 \end{array}$$

Therefore 4020·5 is the number whose logarithm is 3·60428.

Again, what is the number answering to the logarithm 4·60719?

$$\begin{array}{r}
 \text{Logarithm given} \quad . \quad . \quad = 4\cdot60719 \\
 \text{Next less logarithm} \quad . \quad = 4\cdot60718 = \quad 40470 \\
 \hline
 600 \div 11 = \quad 5\cdot4 \\
 \hline
 40475\cdot4 \\
 \hline
 \end{array}$$

Therefore 40475·4 is the number whose logarithm is 4·60719.

Having described some of the principal tables, and explained the method of using them, it will be desirable to show how many figures may be relied upon as accurate, in the results obtained by tables of five, six, and seven decimal places.

Let us have the logarithm 3·17284 given to five places of decimals: now the real value of this logarithm, if expressed to a greater number of places, might, for aught that can be known, be anything between 3·172835 and 3·172845, and might therefore differ from the logarithm given by very nearly ·000005; which then is the extreme limit of the difference which tables to five places will show; any difference less than this might occur without any change in the value of the logarithm, as given in the table.

It has been shown in Prop. L [8], page 27, that the difference between the logarithms of two numbers, which differ only by unity, is less than the modulus of the system divided by the lesser number, or, in the case of common logarithms, than ·434294482 divided by the lesser number. Now, the

difference between the true logarithm and that given to five places may, as we have shown above, be nearly equal to $\cdot 000005$, which is therefore less than $\cdot 4342945$ divided by the number, or the number is less than $\frac{\cdot 4342945}{\cdot 000005} = 86858\cdot 9$.

That is to say, that unless the number, whose logarithm is given, is less than 86859, its value cannot be determined with certainty beyond *four* figures; but that if less than 86859, the first *five* figures derived from the table will be true.

In a similar way it may be shown that, when working with tables of logarithms to six decimal places, the first *six* figures of the result may be depended upon if less than 868589, but if greater, only the first *five* figures must be kept. And in the case of logarithms to seven decimal places, if the result is less than 8685890, *seven* places will be accurate, but if greater, only *six*. Generally, in any tables of logarithms, the result obtained may be considered accurate to as many figures as there are decimal places in the logarithms, provided the mantissa of the logarithm is less than $\cdot 9888$, but if greater, then the result will only be accurate to one less number of figures than the decimals in the logarithm.

CHAPTER VI.

Logarithmic Arithmetic

WE next proceed to the application of logarithms to the ordinary processes of arithmetic, and to illustrate and explain their general use for the purposes of calculation. The references following the rules show the proposition in Chapter IV., in which the rule is demonstrated.

TO FIND THE ARITHMETICAL COMPLEMENT OF A LOGARITHM.

By the *arithmetical complement* of a logarithm is meant the remainder left by the subtraction of the logarithm from 10. Thus the arithmetical complement of 8.241735 is $10\cdot 000000 - 8\cdot 241735 = 6\cdot 758265$. Its great use is in division, as will be presently shown; for if, instead of subtracting a logarithm, we add its complement, and subtract 10, we obtain the same result. To find the arithmetical complement employ the following rule.

RULE.—Subtract the first right-hand significant figure from 10, and all the others (including the characteristic when positive) from 9; when the characteristic is negative, it must be added to 9.

EXAMPLES.

The arithmetical complement of	5.631642	is	4.368358
"	"	2.170630	" 7.829370
"	"	7.217094	" 10.782906
"	"	3.173680	" 12.826320
"	"	3.607218	" 6.392782
"	"	0.714000	" 9.286000

MULTIPLICATION.

RULE.—To multiply two or more numbers together, add their logarithms, the sum will be the logarithm of their product (Prop. M).

EXAMPLES.

Multiply 5631 by 42.

Logarithm of	5631	=	0.750586
"	42	=	1.623249
			<hr/>
			5.373835
			5.373831 = log of 236500
			<hr/>
		40 =	2
			<hr/>
		Answer =	236502
			<hr/>

Multiply 52, 734, and 6 together.

Logarithm of	52	=	1.716003
"	734	=	2.865696
"	6	=	0.778151
			<hr/>
			5.359850
			5.359835 = log of 229000
			<hr/>
		150 =	2
			<hr/>
		Answer =	229002
			<hr/>

Multiply 61, 22, and 65 together.

Logarithm of	61	=	1.785530
"	22	=	1.342423
"	65	=	1.812913
			<hr/>
			4.940866 = log of 27230.
			<hr/>

DIVISION.

RULE.—To divide one number by another, subtract the logarithm of the divisor from the logarithm of the dividend, and the remainder will be the logarithm of the quotient (Prop. N).

EXAMPLES.

Divide 1164 by 4.

$$\begin{array}{r} \text{Logarithm of } 1164 = 3.065953 \\ \text{'' } 4 = 0.602060 \\ \hline 2.463893 = \text{log of } 291. \end{array}$$

Divide 116908 by 5314.

$$\begin{array}{r} \text{Logarithm of } 116900 = 5.067815 \\ \text{Prop. part for } 8 = 29.68 \\ \hline \text{Logarithm of } 116908 = 5.067845 \\ \text{'' } 5314 = 3.725422 \\ \hline 1.342423 = \text{log of } 22. \end{array}$$

Instead of subtracting the logarithm of the divisor we may add its arithmetical complement, the result, with 10 subtracted from the characteristic, will as before be the logarithm of the quotient. Thus, in the example above, the arithmetical complement of 3.725422, the logarithm of the divisor, is 6.274578, which added to 5.067845, gives 1.342423, the same answer as before. This method will be found very convenient where it is desired to divide one number by several others; we have, in such a case, only to add to the logarithm of the dividend, the arithmetical complement of the logarithms of the several divisors, and subtract from the characteristic as many tens as there were divisors, the result will be the logarithm of the quotient.

Divide 579416 by 4, 23, and 47.

$$\begin{array}{r} \text{Logarithm of } . . . 579400 = 5.762978 \\ \text{Proportional part for } 10 = 7.5 \\ \text{'' } 6 = 4.5 \\ \hline \text{Logarithm of } . . . 579416 = 5.762990 \\ \text{Arith. comp. of log of } 4 = 9.397940 \\ \text{'' } 23 = 8.638272 \\ \text{'' } 47 = 8.327902 \\ \hline 2.127104 = \text{log of } 134. \end{array}$$

PROPORTION, OR THE RULE OF THREE.

Questions in proportion, or the rule of three, may be resolved with great facility with the aid of logarithms.

RULE.—Add together the logarithms of the two middle terms, and from their sum subtract the logarithm of the first term, the remainder will be the logarithm of the fourth term, or quantity required. Or, instead of subtracting the logarithm of the first term, add its arithmetical complement and subtract 10 from the characteristic.

EXAMPLES.

If 14 men, in 47 days, excavate 5631 cubic yards, what length of time will it take them to excavate 47280 cubic yards?

$$\begin{array}{r} \text{Or, as } 5631 : 47 :: 47280 : ? \\ \text{Logarithm of } . . . 47280 = 4.674677 \\ \text{'' } . . . 47 = 1.672098 \\ \hline \text{Logarithm of } . . . 5631 = 3.750586 \\ \hline 2.596189 = \text{log of } 394.626 \end{array}$$

By the second method:—

$$\begin{array}{r} \text{Logarithm of } . . . 47280 = 4.674677 \\ \text{'' } . . . 47 = 1.672098 \\ \text{Arith. comp. of log of } 5631 = 6.249414 \\ \hline 2.596189 \text{ as before.} \end{array}$$

If an engine of 67 horses' power can raise from a reservoir 57,600 cubic feet of water in a given time, what horses' power will be required to raise 8,575,000 cubic feet in the same time?

$$\begin{array}{r} \text{Or, as } 57,600 : 67 :: 8,575,000 : ? \\ \text{Logarithm of } . . . 8,575,000 = 6.933234 \\ \text{'' } . . . 67 = 1.826075 \\ \hline \text{Logarithm of } . . . 57,600 = 4.760422 \\ \hline 3.998887 = \text{log of } 9974.4 \end{array}$$

Or:—

$$\begin{array}{r} \text{Logarithm of } . . . 8,575,000 = 6.933234 \\ \text{'' } . . . 67 = 1.826075 \\ \text{Arith. comp. of log of } 57,600 = 5.239578 \\ \hline 3.998887 \text{ as before.} \end{array}$$

EXAMPLE.

What is the square of '25, the cube of '058, and the 5th power of '9784?

$$\text{Logarithm of } '25 = \bar{1}.397940$$

$$\begin{array}{r} \bar{1}.397940 \\ \underline{\quad\quad\quad} \\ \bar{2}.795880 = \log \text{ of } '0625. \end{array}$$

$$\text{Logarithm of } '058 = \bar{2}.763428$$

$$\begin{array}{r} \bar{2}.763428 \\ \underline{\quad\quad\quad} \\ \bar{4}.290284 = \log \text{ of } '000195112. \end{array}$$

$$\text{Logarithm of } '9784 = \bar{1}.990516$$

$$\begin{array}{r} \bar{1}.990516 \\ \underline{\quad\quad\quad} \\ \bar{1}.952580 = \log \text{ of } '89656. \end{array}$$

In dividing a logarithm with a *negative* characteristic by any number, if the characteristic is a multiple of that number, or is divisible by it, proceed to divide in the usual manner, remembering, however, that the new characteristic will be *negative*. Should the characteristic not be divisible by the number by which it is required to divide the logarithm, separate the mantissa from the characteristic, and add to each such a number as will make the characteristic divisible, then divide each of the sums by the number, and the quotient will be the characteristic and mantissa respectively of the logarithm required. The equal numbers added to the characteristic and mantissa, must of course be considered *negative* in the first case and positive in the other.

EXAMPLES.

What is the square root of '209

$$\text{Logarithm of } '209 = \bar{1}.320146$$

Adding -1 to the characteristic we have $\bar{2} + 2 = \bar{1}$, the new characteristic, and adding 1 to the mantissa we have $\bar{1}.320146 + 2 = \bar{1}.660073$ for the new mantissa, therefore $\bar{1}.320146 \div 2 = \bar{1}.660073 = \log \text{ of } '45716 =$ the square root of '209.

What is the cube root of '000195112?

$$\text{Logarithm of } '000195112 = \bar{4}.290284.$$

$\bar{4} + 2 = \bar{6} + 3 = \bar{3}$ for the characteristic, and $.290284 + 2 = 2.290284 + 3 = .763428$ for the mantissa. Therefore, $\bar{4}.290284 \div 3 = \bar{3}.763428 = \log \text{ of } '058.$

The four operations just described, namely, Multiplication, Division, Involution, and Evolution, comprise actually the

whole of the processes in the performance of which logarithms are employed, and when the student is conversant with these, he will be able to apply logarithms in a variety of cases in which their use will be attended with the saving of immense labour.

As an exercise in the preceding rules, and more especially in their practical application, we shall give a variety of useful formulæ, logarithmically expressed, and illustrate their use by examples; at the same time, that they may not be merely exercises, but may prove useful for reference, we shall arrange and classify them under their proper heads. In the following formulæ the letter λ will be used to denote "logarithm of;" thus, λa , will mean the logarithm of a , or the quantity for which a stands; and $2 \lambda (x^2 + y)$ means twice the logarithm of the quantity inclosed within the parenthesis, or y added to the square of x . All the lineal dimensions are given in feet, all the superficial dimensions in square feet, all the solid dimensions in cube feet, and all the weights or pressures in avoirdupois pounds, unless where it is otherwise expressly stated.

INTEREST.

Simple Interest.—[1.] Add together the logarithms of the principal, the rate, and the time, and from the sum subtract 2; the remainder will be the logarithm of the interest.

Compound Interest.—[2.] Find the amount of £1 at the given rate of interest for the first term; this is called the *ratio*, and the logarithm of the ratio for such rates of interest as are likely to be used are given in the annexed table. Multiply the logarithm of the ratio by the time, and add to the product the logarithm of the principal; the sum is the logarithm of the amount.

Rate of interest	Logarithm of ratio.	Rate of interest	Logarithm of ratio.
1	'0043214	5½	'0232525
1½	'0053950	5¾	'0242804
1	'0064660	6	'0253059
1½	'0075344	6¼	'0263289
2	'0086002	6½	'0273496
2½	'0096633	6¾	'0283679
2	'0107239	7	'0293838
2½	'0117818	7¼	'0303973
3	'0128372	7½	'0314085
3½	'0138901	7¾	'0324173
3	'0149403	8	'0334238
3½	'0159881	8¼	'0344279
4	'0170333	8½	'0354297
4½	'0180761	8¾	'0364293
4	'0191163	9	'0374265
4½	'0201540	9¼	'0384214
5	'0211893	9½	'0394141
5½	'0222221	9¾	'0404046

MENSURATION.

Triangle.—Let a , b , and c be the three sides, $d = \frac{1}{2}(a + b + c)$, and Δ equal the area; then

$$[3.] \lambda \Delta = \frac{1}{2} \{ \lambda d + \lambda (d - a) + \lambda (d - b) + \lambda (d - c) \}.$$

Square.—[4.] The logarithm of the area equals twice the logarithm of one of the sides.

Rectangle.—[5.] The logarithm of the area equals the logarithm of the length added to the logarithm of the height.

Polygon.—Let l equal the length of one of the sides, n equal the number of sides, and Δ equal the area; then

$$[6.]* \lambda \Delta = \cdot 39794 + 2 \lambda l + \lambda n + \lambda \tan \left(\frac{90n - 180}{n} \right) - 1.$$

Circle.—Let d equal the diameter, c equal the circumference, and a equal the area; then

$$[7.] \lambda d = \cdot 50285 + \lambda c - 1 = \cdot 60206 + \lambda a - \lambda c = \cdot 053455 + \frac{1}{2} \lambda a.$$

$$[8.] \lambda c = \cdot 49715 + \lambda d = \cdot 60206 + \lambda a - \lambda d = \cdot 550605 + \frac{1}{2} \lambda a.$$

$$[9.] \lambda a = \cdot 89509 + 2 \lambda d - 1 = \cdot 90079 + 2 \lambda c - 2 = \cdot 39794 + \lambda d + \lambda c - 1.$$

Circular arcs.—Let r equal the radius, m equal the measure of the arc in degrees, and l its length; then

$$[10.] \lambda l = \cdot 2418776 + \lambda r + \lambda m - 2.$$

Circular sectors.—Let d equal the diameter, and a equal the area, the other letters as in [10]; then

$$[11.] \lambda a = \cdot 69897 + \lambda r + \lambda l - 1 = \cdot 338456 + 2 \lambda d + \lambda m - 3.$$

Parabola.—Let x_1 and x_2 be two abscissæ, y_1 and y_2 the corresponding ordinates, and a equal the area; then

$$[12.] \lambda a = \cdot 823909 + \lambda x_2 + \lambda (2y_2) - 1.$$

$$[13.] \lambda y_2 = \frac{1}{2} (\lambda x_2 + 2 \lambda y_1 - \lambda x_1).$$

Ellipse.—Let t equal the transverse, and c the conjugate diameters, y equal any ordinate, and x_1 , x_2 the corresponding abscissæ; also let a equal the area, and p equal the periphery; then

$$[14.] \lambda a = \cdot 89509 + \lambda c + \lambda t - 1.$$

$$[15.] \lambda p = \cdot 196118 + \lambda (t + c).$$

$$[16.] \lambda y = \lambda c + \frac{1}{2} \lambda x_1 + \frac{1}{2} \lambda x_2 - \lambda t.$$

Formula [16] applies also in the case of the Hyperbola.

Parallelepipedon, prism, or cylinder.—[17.] The logarithm of the cubic contents equals the logarithm of the area of the base added to the logarithm of its perpendicular height.

Pyramid or Cone.—Let a equal the area of the base, h its perpendicular height, and s its solidity; then

$$[18.] \lambda s = \cdot 823909 + \lambda a + 2 \lambda h - 1.$$

Sphere.—Let d equal the diameter, c equal the circumference, s equal the solidity, and σ the surface; then

$$[19.] \lambda \sigma = \lambda d + \lambda c = \cdot 696487 + 2 \lambda d = \cdot 502837 + 2 \lambda c - 1.$$

$$[20.] \lambda s = \cdot 719 + 3 \lambda d - 1 = \cdot 227372 + 3 \lambda c - 1.$$

* The logarithmic tan must here be taken to a radius equal unity, therefore 10 must be subtracted from the characteristic given in the table.

Regular Bodies—Let l equal the length of any linear edge, s equal the solidity, σ equal the surface, and a and b , numbers obtained from the annexed table; then

$$[21.] \lambda \sigma = :$$

No. of sides.	Name.	a	b
4	Tetraëdron . . .	0.2385607	1.0713486
6	Hexaëdron . . .	0.7781513	0.0000000
8	Octaëdron . . .	0.5395906	1.6730624
12	Dodecaëdron . .	1.3148301	0.8844056
20	Icosaëdron . . .	0.9375306	0.3387940

TRIGONOMETRY.

Plane Triangles.—[23.] *Given two sides of a triangle and an angle opposite to one of them, to find the angle opposite to the other one.* **RULE:**—To the logarithmic sine of the given angle add the arithmetical complement of the logarithm of the opposite side, and the logarithm of the other given side; the sum with 10 subtracted from it will be the logarithmic sine of the angle required.

[24.] *Given two angles and a side opposite to one of them, to find the side opposite to the other one.* **RULE:**—To the logarithm of the given side, add the arithmetical complement of the logarithmic sine of its opposite angle, and the logarithmic sine of the other angle; the sum with 10 subtracted will be the logarithm of the side required.

[25.] *When two sides and the included angle are given, to find the third side.* **RULE:**—To the logarithm of the difference of the given sides add the arithmetical complement of the logarithm of their sum, and the logarithmic tangent of half the sum of the angles opposite the given sides, and the sum with 10 subtracted will be the logarithmic tangent of half the difference of those angles. Then to the arithmetical complement of the logarithmic cosine of half the said difference, add the logarithmic cosine of half the sum of the same angles, and the logarithm of the sum of the given sides; the sum with 10 subtracted will be the logarithm of the third side required.

[26.] *When the three sides are given, to find the angles.* **RULE:**—To the arithmetical complement of the logarithm of the longest side, add the logarithm of the sum of the other two sides, and the logarithm of the difference of those sides; the sum with 10 subtracted from it is the logarithm of the difference of the segments of the base or longest side. Then half this difference added to half the base will equal the longer segment, and from it will equal the shorter one.

Right-angled triangles.—Let h equal the hypotenuse, b equal the base, and p equal the perpendicular; then

$$[27.] \lambda h = \frac{1}{2} \lambda (b^2 + p^2).$$

$$[28.] \lambda b = \frac{1}{2} \lambda (h^2 - p^2) = \frac{1}{2} \lambda (h + p) + \frac{1}{2} \lambda (h - p).$$

$$[29.] \lambda p = \frac{1}{2} \lambda (h^2 - b^2) = \frac{1}{2} \lambda (h + b) + \frac{1}{2} \lambda (h - b).$$

MECHANICS.

Vis vivâ.—Let w equal the weight of a body, v its velocity in feet per second, and v its vis vivâ; then

$$[30.] \lambda v = 1.507732 + \lambda w + 2 \lambda v.$$

Action of gravity.—Let s equal the space passed over in t seconds, and v the velocity as above; then

$$[31.] \lambda s = .69797 = \lambda t + \lambda v - 1 = 2.205702 + 2 \lambda t - 1 \\ = .190238 + 2 \lambda v - 2.$$

$$[32.] \lambda v = 1.507732 + \lambda t = .30103 + \lambda s - \lambda t = .904881 + \frac{1}{2} \lambda s.$$

$$[33.] \lambda t = .492268 + \lambda v - 2 = .30203 + \lambda s - \lambda v \\ = .306649 + \frac{1}{2} \lambda s - 1.$$

Pendulums.—Let t equal the time in seconds of one vibration in a very small circular arc, and l the length; then

$$[34.] \lambda t = .251016 + \frac{1}{2} \lambda l.$$

Central forces.—Let w equal the weight of a body moving in a circle whose radius is r , with a velocity of v feet per second, and let f equal the centrifugal force; then

$$[35.] \lambda f = .492268 + 2 \lambda v + \lambda w - \lambda r - 2.$$

Arches.—Let r equal radius of curvature at crown, b equal breadth of arch, w equal vertical weight on every square foot of the key-stone, including its own weight, and p equal the thrust or horizontal pressure on the key-stone; then

$$[36.] \lambda p = \lambda r + \lambda b + \lambda w.$$

Also let d equal horizontal distance of center of gravity of half the arch from its springing, r equal the rise of the arch, and w equal the weight of half the arch; then

$$[37.] \lambda p = \lambda w + \lambda d - \lambda r.$$

Retaining walls.—Let h equal height of wall, p equal pressure against wall, acting horizontally at one-third of the height of the wall above its base, and b a number obtained from the annexed table; then

$$[38.] \lambda p = 2 \lambda h + b.$$

Material supported by wall.	b
Water	1.494850
Fine dry sand	1.194952
Loose shingle, perfectly dry	1.211867
Common earth, perfectly dry and pulverulent . . . . .	.945222
The same, slightly moistened, or in its natural state . . . . .	.747800
Earth, the most dense and compact . . . . .	.793301

Resistance of air.—Let a equal the area of a thin surface moving through water with a velocity equal v feet per second, and x equal the resistance; then

$$[39.] \lambda x = .230449 + 2 \lambda v + \lambda a - 2.$$

Resistance of water.—The notation being the same; then

$$[40.] \lambda x = .98945 + 2 \lambda v + \lambda a - 1.$$

HYDRAULICS.

Discharge through pipes.—Let d equal diameter in inches, q equal quantity of water discharged in cubic feet per minute, l equal the length of the pipe, and h equal the head; then

$$[41.] \lambda d = \frac{1}{2} \{ 2 \lambda q + .6515 + \lambda (l + 4.2 d) - \lambda h - 2 \}.$$

$$[42.] \lambda q = \frac{1}{2} \{ 1.3485 + \lambda h + 5 \lambda d - \lambda (l + 4.2 d) \}.$$

$$[43.] \lambda l = 1.3485 + \lambda h + 5 \lambda d - 2 \lambda q.$$

$$[44.] \lambda h = .6515 + 2 \lambda q + \lambda (l + 4.2 d) - 5 \lambda d - 2.$$

Discharge through canals.—Let a equal sectional area of canal, p equal the wetted perimeter, l equal length, h equal corresponding fall, and v equal the velocity in feet per second; then

$$[45.] \lambda v = 1.961142 + \frac{1}{2} \{ \lambda a + \lambda h - \lambda p - \lambda l \}.$$

Discharge over weirs.—Let d equal the depth of water flowing over the weir, b equal its breadth, and q equal the cubic feet discharged in a second; then

$$[46.] \lambda q = .511883 + \lambda b + \frac{1}{2} \lambda d.$$

STRENGTH OF MATERIALS.

Tensile strength.—Let a equal area in square inches, w equal weight producing fracture, and λ equal number in column 2 of annexed table; then

$$[47.] \lambda w = \lambda a + \lambda.$$

Strength to resist Crushing.—Let a equal the area in square inches, w the weight producing fracture, and B numbers in column 3 of annexed table; then when the height of piece is between one and $4\frac{1}{2}$ times its diameter,

$$[48.] \lambda w = \lambda a + B.$$

Strength of Columns.*—Let w equal the breaking weight in tons, D equal external, and d internal diameter, both in inches, l equal the length, and c equal number in column 4 of annexed table; then when the column is solid, with both ends rounded, and its length not less than 15 times its diameter,

$$[49.] \lambda w = 3.6 \lambda D - 1.7 \lambda l + c.$$

* Professor Hodgkinson's Formula.

When the column is hollow; then

$$[50.] \lambda w = \lambda (D^{2.5} - d^{2.5}) - 1.7 \lambda l - .059243 + a.$$

When the column is solid both ends are flat, and the length is not less than 30 times the diameter; then

$$[51.] \lambda w = 3.6 \lambda D - 1.7 \lambda l + .471843 + a.$$

When the column is hollow; then

$$[52.] \lambda w = \lambda (D^{2.5} - d^{2.5}) - 1.7 \lambda l + .473217 + a.$$

Transverse strength of a rectangular bar.—Let b equal the breadth and d the depth, both in inches, l equal the length, w the breaking weight, and D the number in the fifth column of the annexed table; then

$$[53.] \lambda w = \lambda b + 2 \lambda d - \lambda l + D.$$

Transverse strength of Professor Hodgkinson's girder.—Let a equal area of bottom flange in inches, and d , w , and l have the same meaning as above; then

$$[54.] \lambda w = 3.685921 + \lambda a + \lambda d - \lambda l.$$

Deflexion.—Let d equal the deflexion in inches with the weight w , and λ equal the numbers in the sixth column of the annexed table; then

$$[55.] \lambda d = 3 \lambda l + \lambda w - \lambda b - 3 \lambda d - \lambda.$$

Material.	A	B	C	D	E
Cast iron	4.253338	5.032417	1.173186	3.310693	4.629338
Wrought iron . . .	4.770499	.....	1.414973	3.359836	4.761063
Steel	5.113943	.....	1.574031	.....	4.826910
Tim	3.988559	3.108565	.....	2.528917	3.209515
Oak	4.074816	3.586587	0.209515	2.745855	3.527501
Fir	3.977724	.....	0.068186	2.567026	3.428723

The following collection of examples apply to the foregoing formulæ, reference being made by the numbers in parentheses. Only a portion of the examples are worked out at length, but answers are given in every case.

EXAMPLES.

[1.] What would the interest at $4\frac{1}{2}$ per cent. upon £3653 for 7 years amount to?

$$\begin{aligned} \text{Logarithm of } 3653 &= 3.562650 \\ \text{'' } 4.5 &= 0.653213 \\ \text{'' } 7 &= 0.845098 \end{aligned}$$

$$\begin{array}{r} 5.060961 \\ \underline{} \\ 3.060961 \end{array}$$

$$3.060961 = \text{Log of } 1150.69.$$

∴ Answer is £1150 14s.

[2.] What would £364 put out at 6 per cent. compound interest yearly, amount to at the end of 23 years?

$$\text{Log of ratio from table} = 0.0253059$$

23

$$0.5420357$$

$$\text{Logarithm of } 364 = 2.561101$$

$$3.103137 = \text{Log of } 1268.05.$$

∴ Answer is £1268 1s.

[2.] What would £100 amount to at the end of 50 years, put out to annual compound interest at 5 per cent. ?

Ans. £1146 15s.

[3.] The sides of a triangle are respectively 564, 373, and 746, what is its area?

$$\text{Log of } d = \frac{1}{2}(564 + 373 + 746) = 2.925312$$

$$\text{Log of } (d - a) = (842 - 564) = 2.444045$$

$$\text{Log of } (d - b) = (842 - 373) = 2.671173$$

$$\text{Log of } (d - c) = (842 - 746) = 1.982271$$

$$2)10.022811$$

$$5.011405 = \text{Log of } 1026.6.$$

Therefore the area required is 1026.61.

[4.] What is the area of a square, the length of one side of which is 56.24 feet?

Ans. 3162.94.

[5.] What is the area of a rectangle, the length of whose sides is 15.6 and 16.2?

Ans. 252.62.

[6.] What is the area of a polygon of 12 sides, each of which is 5.06 feet in length?

$$\frac{90\pi - 180}{n} = 75^\circ$$

$$\text{Logarithm of } l = 5.06 = 0.704151$$

2

$$1.408302$$

$$\text{Logarithmic tan of } 75^\circ = 0.571948$$

$$\text{Logarithm of } n = 12 = 1.079181$$

$$.397940$$

$$3.457371$$

1.

$$\text{Logarithm of area} = 2.457371 = 286.663.$$

[4.] What is the area of an octagonal room, each side of which is 5 feet?

Ans. 120.71.

[7, 8, and 9.] What is the circumference and area of a circle whose diameter is 21.72 feet?

$$\text{Logarithm of } d = 21.72 = 1.336860$$

$$\quad \quad \quad \underline{\quad \quad \quad} .497150$$

$$\text{Logarithm of circumference} = 1.834010 = 68.236.$$

$$\quad \quad \quad \underline{\quad \quad \quad} 2$$

$$3.668020$$

$$\underline{\quad \quad \quad} 0.900790$$

$$4.568810$$

$$\underline{\quad \quad \quad} 2.$$

$$\text{Logarithm of area} = 2.568810 = 370.52.$$

$$\underline{\quad \quad \quad}$$

[7, 8, and 9.] What is the diameter and circumference of a circle whose area is 562 square feet?

Ans. Circumference is 84.0376 feet, and diameter is 26.75 feet.

[10.] What is the length of an arc of 73° of a circle, whose radius is 34.72 feet?

Ans. 44.237 feet.

[11.] What is the area of a sector of a circle whose radius is 26 feet, and whose sides include an angle of 42° ?

Ans. 247.58 feet.

[12.] What is the area of a parabola whose abscissa is 5.32, and the corresponding ordinate 4.13?

$$\text{Log of } (2y_1) = 2 \times 4.13 = 0.916980$$

$$\text{Log of } x_2 = 5.32 = 0.725912$$

$$\quad \quad \quad \underline{\quad \quad \quad} .823909$$

$$2.466801$$

$$\underline{\quad \quad \quad} 1.$$

$$1.466801 = 29.295 = \text{area of parabola.}$$

$$\underline{\quad \quad \quad}$$

[13.] In a parabola an ordinate measured 5.17, and its corresponding abscissa 8.95, what will be the length of the ordinate whose abscissa is 10?

$$\text{Log } y_1 = 5.17 = 0.713491$$

$$\quad \quad \quad \underline{\quad \quad \quad} 2$$

$$1.426982$$

$$\text{Log } x_2 = 10.00 = 1.000000$$

$$\underline{\quad \quad \quad} 2.426982$$

$$\text{Log } x_1 = 8.95 = 0.951823$$

$$\underline{\quad \quad \quad} 2)1.475155$$

$$\text{Logarithm of } y_2 = 0.737577 = 5.4648 = \text{the ordinate required.}$$

$$\underline{\quad \quad \quad}$$

[14 and 15.] What is the area and periphery of an ellipse whose conjugate diameter is 27 and its transverse diameter is 49?

Ans. Area is 1039.08; and periphery is 119.38.

[16.] In an ellipse whose two diameters are 51 and 38, what is the length of the ordinate corresponding with an absciss of 20 feet?

Since $x_1 = 20$, $x_2 = 51 - 20 = 31$.

$$\text{Log } x_1 = 20 = 1.301030$$

$$\text{Log } x_2 = 31 = 1.491367$$

$$2) 2.792397$$

$$\hline 1.396198$$

$$\text{Log } c = 38 = 1.579784$$

$$\hline 2.975982$$

$$\text{Log } t = 51 = 1.707570$$

$$\text{Log } y = 1.268412 = 18.553 = \text{the ordinate required.}$$

[17.] What is the cubic contents of a cylinder whose diameter is 2.75 feet, and its height 6 feet?

Ans. 35.637.

[18.] What is the cubic content of a cone whose diameter is 3.5 feet, and its height 5.42 feet?

Ans. 34.764.

[19 and 20.] What is the spherical surface and the solidity of a sphere whose diameter is 5.734 feet?

Ans. Surface is 163.46 feet; solidity is 98.712 feet.

[21 and 22.] What is the surface and solidity of a tetraëdron, one of whose lineal edges is 7.31 feet, of an octaëdron whose lineal edge is 3.17, and of a dodecaëdron whose lineal edge is 5.69?

Ans. Tetraëdron, surface is 146.69 feet; solidity is 46.036 feet.

Octaëdron, surface is 34.81 feet; solidity is 15.005 feet.

Dodecaëdron, surface is 668.43 feet; solidity is 1411.7 feet.

[23 and 24.] In a plane triangle two of its sides are 7.3 and 6.92, and the angle opposite the longer side is $74^\circ 39'$, what are the remaining angles and the length of the other side?

Then by [23]

$$\text{Logarithmic sin of } 74^\circ 39' = 9.984224$$

$$\text{Arithm. comp. of log of } 7.3 = 9.136677$$

$$\text{Logarithm of } \dots 6.92 = 0.840106$$

$$\hline 19.961007$$

$$10^\circ$$

$$\text{Log sine of angle op. other side} = 9.961007 = 66^\circ 4' 56''.$$

Then, since the three angles of a triangle are equal to 180° we have

$180^\circ - (74^\circ 39' + 66^\circ 4' 56'') = 39^\circ 16' 4''$ for the angle opposite the side yet to be found.

Then by [24]

Logarithm of 6.92 =	0.240106
Arith. comp. of log sin of $66^\circ 4' 56'' =$	0.032993
Logarithmic sin of . . . $39^\circ 16' 4'' =$	9.801366
	10.680465
	10'
Logarithm of side required . . . =	0.680465 = 4.791.

Ans. The three sides are 4.791, 6.92, and 7.3, and the three angles opposite to each respectively are $39^\circ 16' 4''$, $66^\circ 4' 56''$, and $74^\circ 39'$.

[25 and 3.] Two sides of a triangular piece of ground measure 81.10 and 105.75, and the angle included between them is $47^\circ 52'$, what is the length of the other side, and the area of the piece of ground?

Log (105.75 - 81.10) =	1.391817
Arith. comp. of log (105.75 + 81.1) . . =	7.728507
Logarithmic tan of $66^\circ 4' =$	10.352778
	19.473102
	10'

Log tan of half the difference of the angles } opposite the given sides }	9.473102 = $16^\circ 33' 14''$.
--	----------------------------------

Arith. comp. of log cos of $16^\circ 33' 14'' =$	0.018324
Logarithmic cosine of . . . $66^\circ 4' 0'' =$	9.608177
Logarithm of . . . (105.75 + 81.1) =	2.271493
	11.898054
	10'

Logarithm of third side =	1.898054 = 79.08. Ans.
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Ans. And the area by [3] is 32355 square feet.

[26.] In a plane triangle whose sides are 27.3, 54.5, and 62, what are the angles opposite those sides respectively?

Arithmetical comp. of log of 62 . . . =	8.207608
Log of (27.3 + 54.5) =	1.912753
Log of (54.5 - 27.3) =	1.424569
	11.554930
	10'

Log of the difference of the seg- } ments of the base }	1.554930 = 35.286.
--	--------------------

Therefore the larger segment is $31 + 17.943 = 48.943$, and the lesser segment is $31 - 17.943 = 13.057$.

Then by [23]

Logarithmic sine of . $90^\circ = 10.000000$
 Arith. comp. of log of $54.5 = 8.263603$
 Logarithm of . . $48.943 = 1.689691$

19.953294
 10.

Log sine of angle opp. larger segment = $9.953294 = 63^\circ 54' 4''$.

Then $90^\circ - 63^\circ 54' 4'' = 26^\circ 5' 56'' =$ angle opposite side which measures 27.3. Again,

Logarithmic sine of . $90^\circ = 10.000000$
 Arith. comp. of log of 27.3 = 8.563837
 Logarithm of . . $13.057 = 1.115843$

19.679680
 10.

Log sine of angle opp. lesser segment = $9.679680 = 28^\circ 34' 23''$.

Then $90^\circ - 28^\circ 34' 23'' = 61^\circ 25' 37'' =$ the angle opposite the side which measures 54.5; and $28^\circ 34' 23'' + 63^\circ 54' 4'' = 92^\circ 28' 27'' =$ the angle opposite the longest side.

[27.] What is the length of the diagonal of a rectangle whose two sides are 34 and 53.2? Ans. 63.14.

[28.] A house is 47 feet in height, at what distance must the base of a ladder 53 feet long be placed from the house in order that the top of the ladder may just meet that of the house? Ans. 24.5 feet.

[30.] What is the vis viva of a railway train weighing 117 tons, and travelling at a rate of 33 miles per hour? Ans. 19,313,300,000.

[31.] A body having been falling freely by the action of gravity for 7.5 seconds, 't is desired to know the space which it has fallen through. Ans. 915.37 feet.

[32 and 33.] A body falls under the influence of gravity from a height of 427 feet, what time will it occupy and what will be its final velocity, neglecting the resistance of the air?

Ans. It will occupy 4.1866 seconds, and acquire a velocity of 165.995 feet per second.

[34.] What length of time will a pendulum 34.7 inches in length be in making one vibration? Ans. 0.9416 seconds.

[35.] A body weighing 53 lbs. is whirled round in a circle whose radius is 15 feet, with a velocity of 12.7 feet per second, what is the strain upon the rope by which it is constrained to move in the circle? Ans. 17.703 lbs.

[36.] What is the horizontal pressure at the crown of an arch whose radius of curvature is 147.52 feet, whose breadth is 35 feet, and the vertical weight on each square foot at the key-stone is 974 lbs.? Ans. 5,018,950 lbs.

[37.] A stone arch bridge having a span of 212 feet, with a rise of 25 feet, the weight of lead the arch is 998 tons, and the distance of its center of gravity from the springing is 43 feet, what is the horizontal thrust of the arch?
 Ans. 19073 tons.

[38.] A retaining wall 37 feet in height supports a loose sandy soil, required the pressure which every foot in length of it has to sustain?
 Ans. 21447 lbs.

[39.] What is the pressure against a sluice 20 feet wide, and having a depth of 7 feet water against it?
 Ans. 30,012,360 lbs.

[39 and 40.] What resistance would a board whose area is 14.7 square feet experience in being moved through the air with a velocity of 17 feet per second, and what would be the resistance in water?
 Ans. In air, 72.221 lbs.; in water, 4146.34 lbs.

[42.] What quantity of water will be discharged by a pipe 18 inches in diameter, 5371 feet long, and under a head of 75 feet?

$$\begin{aligned} \text{Log of } d &= 18 = 1.2552725 \\ &\quad \underline{ 5} \\ &\quad 6.2763625 \\ \text{Log of } h &= 75 = 1.8750613 \\ &\quad \underline{ 1.3485000} \\ &\quad 9.4999238 \\ \text{Log } (l + 4.2d) &= 5446.6 = 3.7361255 \\ &\quad \underline{ 2.57637983} \\ \text{Log of quantity per minute} &= 2.8818991 = 761.9. \end{aligned}$$

Ans. 761.9 cubic feet per minute.

[44.] What head will be required to force 350 cubic feet of water per minute through a pipe 15.5 inches in diameter, and 3640 feet long?
 Ans. 22.739 feet.

[45.] What is the velocity with which water will flow through a conduit, 15 feet wide at the surface, 4 feet deep, with the sides sloped at 1 to 1, and the inclination of the surface of the water in which is 6 inches per mile?
 Ans. 1.383 feet per second.

[46.] What is the quantity of water flowing over a weir 127 feet long, when the surface of the river is 6 inches above the top of the weir?
 Ans. 145.93 cubic feet per second.

[47.] What weights would be requisite to tear asunder rods 2 inches square, of cast iron, wrought iron, oak, and fir?
 Ans. Cast iron, 71,680 lbs.; wrought iron, 235,810 lbs.; oak, 47,520 lbs.; fir, 38,000 lbs.

[48.] What weight will be necessary to crush a block of cast iron 3 inches square?
 Ans. 969,750 lbs.

[52.] What weight will be required to break a hollow column with flat

and, the length of which is 37 feet, its external diameter 22 inches, and its internal diameter 10 inches?

$$\text{Log of } 22 = 1.342422$$

$$\underline{\underline{3.8850516}} = \text{log of } 22^3 = 7674.6.$$

$$\text{Log of } 10 = 1.000000$$

$$\underline{\underline{3.6000000}} = \text{log of } 10^3 = 3981.1$$

$$22^3 - 10^3 = 3693.5$$

$$\text{Log } (22^3 - 10^3) = 3693.5 = 3.567438$$

$$0 = 1.173186$$

$$0.473217$$

$$5.213841$$

$$\text{Log } l = 37 = 1.568202 \times 1.7 = 2.6659434$$

$$\underline{\underline{2.547898}} = \text{log of } 353.1.$$

Therefore the answer is 353.1 tons.

[53.] A bar of cast iron 2 inches wide and 3 inches deep is laid upon supports 6 feet apart, what weight applied in the center would break it?

Ans. 6135 lbs.

[54.] What weight applied in the center will be required to break a girder of Professor Hodgkinson's form of section, in which the area of the bottom flange is 26 square inches, the depth 15 inches, and the distance between the supports 23 feet?

Ans. 82,273 lbs.

[55.] What deflexion will be produced in a bar of cast iron 2 inches wide, 3 inches in depth, and with a 6 feet bearing, by a weight of 2730 lbs. applied in the center?

Ans. 256 inch.

APPENDIX.

Table of the Logarithms of every Prime Number from 2 to 1000.

Prime number.	Logarithm.	Prime number.	Logarithm.	Prime number.	Logarithm.	Prime number.	Logarithm.
2	3010300	191	2810334	439	6424645	709	8506462
3	4771213	193	2855573	443	6464037	719	8567289
5	6989700	197	2944662	449	6522463	727	8615344
7	8450980	199	2988531	457	6599162	733	8651040
11	0413927	211	3242825	461	6637009	739	8686444
13	1139434	223	3483049	463	6655810	743	8709888
17	2304489	227	356c259	467	6693169	751	8756399
19	2787536	229	3598355	479	6803355	757	8790959
23	3617278	233	3673559	487	6875290	761	8813847
29	4623980	239	3783979	491	6910815	769	8859263
31	4913617	241	3820170	499	6981005	773	8881795
37	5682017	251	3996737	503	7015680	787	8959747
41	6127839	257	4099331	509	7067178	797	9014583
43	6334685	263	4199557	521	7168377	809	9079485
47	6720979	269	4297523	523	7185017	811	9090209
53	7242759	271	4329693	541	7331973	821	9143432
59	7708520	277	4424798	547	7379873	823	9153998
61	7853298	281	4487063	557	7458552	827	9175055
67	8260748	283	4517864	563	7505084	829	9185545
71	8512583	293	4668676	569	7551123	839	9237620
73	8633229	307	4871384	571	7566361	853	9309490
79	8976271	311	4927604	577	7611758	857	9329808
83	9190781	313	4955443	587	7686381	859	9339932
89	9493900	317	5010593	593	7730547	863	9360108
97	9867717	331	5198280	599	7774268	877	9429996
101	0043214	337	5276299	601	7788745	881	9449759
103	0128372	347	5403295	607	7831887	883	9459607
107	0293838	349	5428254	613	7874605	887	9479236
109	0374265	353	5477747	617	7902852	907	9576073
113	0530784	359	5550944	619	7916906	911	9595184
127	1038037	367	5646661	631	8000294	919	9633155
131	1172713	373	5717088	641	8068580	929	9680157
137	1367206	379	5786392	643	8082110	937	9717396
139	1430148	383	5831988	647	8109043	941	9735896
149	1731863	389	5899496	653	8149132	947	9763500
151	1789769	397	5987905	659	8188854	953	9790929
157	1958997	401	6031444	661	8202015	967	9854265
163	2121876	409	6117233	673	8280151	971	9872192
167	2227165	419	6222140	677	8305887	977	9898946
173	2380461	421	6242821	683	8344207	983	9925535
179	2528530	431	6344773	691	8394780	991	9960737
181	2576786	433	6364879	701	8457180	997	9986952

Prime numbers are those which are not divisible by any other number, or which cannot be resolved into factors; thus 233 is a prime number, because it cannot be divided by any number without leaving a remainder, while 234 is not a prime number, it being divisible by 2 and other numbers. The logarithms of any number which is not a prime number may be readily found by adding together the logarithms of the several prime factors by the multiplication of which the number is produced. Thus the number 234 is produced by the multiplication of 2, 3, 3 and 13 (all prime numbers,) and the logarithms of those numbers being taken from the table and added together, the sum will be the logarithm of 234. For example—

$$\begin{array}{r}
 \text{Log of } 2 = 0.3010300 \\
 \quad \quad \quad \text{.. } 3 = 0.4771213 \\
 \quad \quad \quad \text{.. } 3 = 0.4771213 \\
 \quad \quad \quad \text{.. } 13 = 1.1130434 \\
 \hline
 \therefore \text{Log of } 234 = 2.3692160
 \end{array}$$

Again, the number 578 is composed of the prime factors 2, 17, and 17; then

$$\begin{array}{r}
 \text{Log of } 2 = 0.3010300 \\
 \quad \quad \quad \text{.. } 17 = 1.2304489 \\
 \quad \quad \quad \text{.. } 17 = 1.2304489 \\
 \hline
 \therefore \text{Log of } 578 = 2.7619278
 \end{array}$$

In this manner we are enabled by the foregoing table to find the logarithm (true to at least 6 figures) of any number which may be given, whether prime or otherwise; for if prime its logarithm will be found at once in the table, but if not prime its logarithm will then be found by taking the sum of the logarithms of its prime factors, as explained above.

Table by the aid of which the number answering to any logarithm can be found to six places.

		I	10	100	1000	10000	100000
1	0000000	0413927	043214	04341	0434	043	04
2	3010300	0791812	086002	08677	0869	087	09
3	4771213	1139434	128372	13009	1303	130	13
4	6020600	1461280	170333	17337	1737	174	17
5	6989700	1760913	211893	21661	2171	217	22
6	7781513	2041200	253059	25980	2605	261	26
7	8450980	2304489	293838	30295	3039	304	30
8	9030900	2552725	334238	34605	3473	347	35
9	9542425	2787536	374265	38912	3907	391	39

In the above table the arguments are natural numbers, and the resultants their logarithms. The first figures of the arguments are found in the top horizontal line, and the final or unit's figure of the same in the extreme left-hand column; the logarithm is found at the place of intersection, that is, on the same line with the final figure, and in the same column as the other figures of the natural number. In the five last columns only the final *significant* figures of the mantissa of the logarithms will be found in the table; as many cyphers must be added to the left of the figures given as are necessary to make up seven figures. Thus at the top of the fifth column we have 100, and on the fourth line we have 4, then the figures found at the place of intersection are 17887, to which adding two cyphers on the left hand to make up the seven figures, we have .0017887, which is the mantissa of the logarithm of 1004.

The manner of using the table is as follows:—Having given a logarithm of which it is desired to know the corresponding number, look among the resultants in the table for the next less number to the mantissa of the given logarithm, and write down the natural number corresponding with the logarithm taken from the table, subtract this logarithm from the mantissa given, and again look among the resultants in the table for the next less number to the remainder, noting the number among the arguments answering to it; then subtract the resultant from the remainder, and look again for the next less resultant to this remainder, and thus proceed until the given logarithm has been exhausted, that is, until no remainder is left, each time noting the natural numbers cor-

responding to the logarithms taken from the table. These numbers being then multiplied together, the product will be the natural number corresponding to the logarithm originally given. These numbers have been so arranged that their multiplication may be very readily performed.

EXAMPLE.—Of what number is 8.3574202 the logarithm?

Given logarithm	=	3574202	
Next less log in table	=	3010300	= log of 2
<hr/>			
1st remainder	=	563902	
Next less logarithm	=	418927	= log of 11
<hr/>			
2nd remainder	=	149975	
Next less logarithm	=	128372	= log of 103
<hr/>			
3rd remainder	=	21608	
Next less logarithm	=	17337	= log of 1004
<hr/>			
4th remainder	=	4266	
Next less logarithm	=	3907	= log of 10009
<hr/>			
5th remainder	=	359	
Next less logarithm	=	347	= log of 100008
<hr/>			
6th remainder	=	12	
Nearest logarithm	=	13	= log of 1000003
<hr/>			

Then $2 \times 11 \times 103 = 2266$, which has to be next multiplied by 1004, or by 1000 and by 4, thus

$$\begin{aligned} 2266000 &= 2266 \times 1000 \\ 9064 &= 2266 \times 4 \end{aligned}$$

2275064

This again has to be multiplied by 10009,

$$\begin{aligned} 22750640000 \\ 20475576 \end{aligned}$$

22771115576

This has again to be multiplied by 100008, but we need not retain more than 8 figures, and the remainder to the right may be cut off, and any figures in the multiplication by 8 which would fall under any of the figures so cut off may be omitted; to know how many figures thus to omit, point off as many figures from the right as there are figures before the number by which you are about to multiply, and perform the multiplication only upon the remaining figures, taking care, however, to carry to the multiplication of the first number whatever would have been carried from that of the last figure cut off. Thus, in the example, there being *six* figures before 8, the number by which we are going to multiply, we point off the *six* right hand figures, and only multiply 227 by 8; we add in, however, 6 carried from the multiplication of the 7 cut off.

$$\begin{array}{r}
 227,71115 \\
 \quad 1822 \\
 \hline
 22,772937 \\
 \quad 68 \\
 \hline
 22778005 \\
 \hline
 \hline
 \end{array}$$

The last multiplication is by 100008, and the answer is true to seven places, the real number being 2277·8. In the example above, as the figures to be multiplied by 100008 are not affected by the addition of 1822, this need not have been performed until afterwards, as below.

$$\begin{array}{r}
 227,71115 \\
 \quad 1822 \\
 \quad 68 \\
 \hline
 22778005 \\
 \hline
 \hline
 \end{array}$$

What is the number corresponding to the logarithm 4.8551071?

$\begin{array}{r} 8551071 \\ 8450980 = \log \text{ of } 7 \\ \hline 100091 \\ 86002 = \log \text{ of } 102 \\ \hline 14089 \\ 13009 = \log \text{ of } 1003 \\ \hline 1080 \\ 869 = \log \text{ of } 10002 \\ \hline 211 \\ 174 = \log \text{ of } 100004 \\ \hline 37 = \log \text{ of } 1000009 \\ \hline \end{array}$	$\begin{array}{r} 7 \times 102 = 714000 \\ 2142 \\ \hline 71,61,4200 \\ 14328 \\ 2865 \\ 648 \\ \hline 71682081 \\ \hline \end{array}$
--	---

The number is 71682.

What is the number whose logarithm is 2.6103833?

$\begin{array}{r} 6103833 \\ 6020800 = \log \text{ of } 4 \\ \hline 83238 \\ 49214 = \log \text{ of } 101 \\ \hline 40019 \\ 38912 = \log \text{ of } 1009 \\ \hline 1107 \\ 869 = \log \text{ of } 10002 \\ \hline 288 \\ 217 = \log \text{ of } 100005 \\ \hline 21 = \log \text{ of } 1000005 \\ \hline \end{array}$	$\begin{array}{r} 101 \\ 4 \\ \hline 404000 \\ 8686 \\ \hline 407,6,8600 \\ 8168 \\ 2088 \\ 204 \\ \hline 40778995 \\ \hline \end{array}$
---	--

The answer is 407.74.

What is the number whose logarithm is 3.7797587?

$\begin{array}{r} 7797587 \\ 7781513 = \log \text{ of } 6 \\ \hline 16074 \\ 18009 = \log \text{ of } 1003 \\ \hline 3065 \\ 3089 = \log \text{ of } 10007 \\ \hline 26 = \log \text{ of } 1000006 \\ \hline \end{array}$	$\begin{array}{r} 1003 \\ 6 \\ \hline 6018.0000 \\ 42126 \\ 361 \\ \hline 60222487 \\ \hline \end{array}$
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The number required is 6022.248.

MATHEMATICAL TABLES

FOR FACILITATING

ASTRONOMICAL, NAUTICAL,
TRIGONOMETRICAL, AND LOGARITHMIC

CALCULATIONS.

By HENRY LAW,

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P R E F A C E.

THE present little work, while complete within itself, is intended also to form a companion or supplemental volume to three others of Mr. Weale's Rudimentary Series; namely, to the Rudiments of Nautical Astronomy, the Rudiments of Navigation, and the volume on Logarithms. In order to the attainment of the first object, such an explanation has been prefixed to the Tables as is sufficient for showing the manner in which they are to be used, and the purposes for which they are to be employed; and such examples of their application have been added as will, it is hoped, remove all difficulty in their employment.

The Tables of the Logarithms of Numbers, and of Logarithmic sines, tangents, &c., have been reprinted from the third edition of Gregory's Mathematics for Practical Men; and the Table of Proportional Parts, first given in that work, has been arranged in a new and more convenient way in the present Tables.

Tables I. to V. will be found of considerable service for general purposes of calculation, in addition to their application with Tables VI. to XVIII. to the important purposes of Navigation and Nautical Astronomy.

The remaining Tables will be found of constant use in all mathematical investigations involving trigonometrical expressions; these are principally compiled from Hutton's Mathematical Tables.

In the preparation of the Tables and in their progress through the press, every care has been taken by careful and repeated reading to insure accuracy, an object which it is confidently hoped has been successfully attained.

H. L.

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MATHEMATICAL TABLES.

EXPLANATION AND USE OF THE TABLES.

Tables I. and II.

Logarithms of Numbers.

As a description of the nature and properties of logarithms will be found in the Rudimentary Work on Logarithms, and is not essentially requisite to their mere application to the purposes of calculation, we shall here only explain the method of using the accompanying tables.

By an inspection of Table II., which contains the logarithms of all numbers from 1 to 100, it will be seen that each logarithm consists of two distinct parts, separated by a decimal point; thus, the logarithm of 13 is 1.113943; the number to the left of the decimal point (or 1 in the above example) is called the *index* or *characteristic**, and its value depends *only* upon the *number of digits* in the quantity whose logarithm it is, without any regard to the *value* of that quantity, and it is always 1 less than that number of digits; thus in the example, the characteristic of the logarithm of 13, which contains two digits, is 1, or one less than that number; and it will be seen from the Table, that 1 is the characteristic of all the logarithms from 10 to 99, but that, for numbers below 10, the index is 0, and for 100 is 2, in each case 1 less than the number of digits in the quantity of whose logarithm it is the characteristic. The characteristic, therefore, of the logarithms of all numbers

equal to or greater than	1	and less than	10	is 0.
"	"	10	"	100 " 1.
"	"	100	"	1000 " 2.
"	"	1000	"	10000 " 3.
"	"	10000	"	100000 " 4.
		&c.		&c. &c.

* In order to avoid confusion from the use of the word *index* to signify two things, we shall throughout this work employ the term *characteristic* when speaking of logarithms, and *index* when speaking of roots or powers.

When the quantity is less than unity, the characteristic of its logarithm becomes negative, and its value is determined by the number of cyphers which occur between the decimal point and the first significant figure (the fraction being decimally expressed), and is always 1 greater than such number of cyphers; or it is equal to the difference in the number of figures in the numerator and decimal denominator; thus, the characteristic of the logarithm of

·1	or	$\frac{1}{10}$	is	$\overline{1}$.
·01	..	$\frac{1}{100}$	..	$\overline{2}$.
·001	..	$\frac{1}{1000}$	..	$\overline{3}$.
·0001	..	$\frac{1}{10000}$	..	$\overline{4}$.
&c.		&c.		&c.

The *decimal* part of the logarithm, or that lying to the right of the decimal point, is called the *mantissa*, and depends entirely on the *relative* value of the figures composing the quantity whose logarithm it is, and not at all upon the actual *numerical* value of that quantity; thus, in the example already given, the decimal part of the logarithm of 13 is ·118943, which is also the decimal part of the logarithm of 1·3, or 130, or 1300, for in each case the 1 and the 3 have the same *relative* value. So that the decimal portion of a logarithm is always the same for the same figures, and is not altered by the addition of any number of cyphers either to the right or to the left hand of those figures, or what is equivalent, by the multiplication or division of the quantity by 10, or any power of 10; it is only the characteristic of the logarithm which alters its value, 1 being *added* to the characteristic for every 10 by which the quantity is *multiplied*, or *subtracted* from it for every 10 by which the quantity is *divided*. Thus,

the logarithm of 745800	being	5·872622
that of 74580	is	4·872622
.. 7458	..	3·872622
.. 745·8	..	2·872622
.. 74·58	..	1·872622
.. 7·458	..	0·872622
.. ·7458	..	$\overline{1}$ ·872622
.. ·07458	..	$\overline{2}$ ·872622
.. ·007458	..	$\overline{3}$ ·872622

(-) is always placed above the characteristic, thus $\overline{2}$, to avoid its being misunderstood for the sign of

It must be borne in mind, that in the logarithm of a fractional quantity, it is only the *characteristic* which has a *negative* value, and that the decimal part of a logarithm is always positive. It is, however, sometimes convenient to have the whole logarithm expressed, negatively, both characteristic and decimal; for which purpose, subtract the last right hand figure in the decimal portion from 10, and all the others from 9, and the result will be what is termed the *arithmetical complement* of the decimal, to which prefix the former characteristic less 1, and the result will be a negative logarithm, equivalent in value to the original logarithm having only a negative characteristic; for example, the logarithm of .07458, as above, is $\bar{2}\cdot872622$, which is equivalent to $-1\cdot127378$. It is also frequently convenient to take the *arithmetical complement* of the whole logarithm, and this is obtained by subtracting the right hand figure of the decimal from 10, and all the others from 9, including the characteristic when *positive*, but if *negative* it must be *added* to 9. Thus, the arithmetical complement

of 3·146128 is	6·853872
„ $\bar{2}\cdot076276$ „	11·923714
„ $\bar{5}\cdot322839$ „	4·677161
„ $\bar{1}\cdot986772$ „	10·013228

USE OF THE TABLES.

To find the logarithm of any given number.

If the number is less than 100, its logarithm will be found in Table II., with its proper characteristic prefixed; but if the number contains more than two figures, its logarithm may be found from Table I. as follows:—If there are only three figures in the number, look for that number in the first column of the table, and on the same line in the next column to the right, under 0, will be found the decimal portion of the required logarithm, to which the proper characteristic must be prefixed, according to the rules which we have just explained. If the quantity contains four figures, look for the first three figures in the first column as before, and the four last figures of the logarithm of the required number will be found on the same line with those three figures, and in that column which has at its head the fourth figure of the given number; the two first figures of the logarithm will be found in the second column (headed 0), and which figures being common to all the logarithms inclosed by each pair of horizontal lines, it is

unnecessary to repeat. Where these first figures change their value in the middle of a line, the same is indicated by a break in the horizontal line, thus, $\overline{139379} \sqrt{0194}$, which shows that the two first figures (13) have changed to 14, and the right hand logarithm is therefore 140194.

Examples.

Required the logarithm of 734.

In Table I., on the same line with 734 and under 0, are found 5696, the four last figures of the logarithm, to which the *common* figures 86 and the proper characteristic 2 being prefixed, we obtain 2·865696, the logarithm required.

Find the logarithm of 3476.

Here, on the same line with 347 and under 6, will be found 1080, which, with the two first figures and the characteristic prefixed, is 3·541080, the logarithm required.

The log. of	5·84	is	0·766413
„	0932	„	2·969416
„	10·24	„	1·010300
„	3708	„	3·569140

When the quantity whose logarithm is required contains more than four figures, proceed as follows:—Find the logarithm for the first four figures as above, then look in the first column of the Table of Proportional Parts, at the lower part of each page, for the first four figures, and on the same line in the column having at its head the fifth figure will be found the quantity which must be added to the logarithm already taken out, to give the logarithm of the quantity first required. If the first four figures are not found in the first column of the table, then take the line containing the next *less* number to it. If the number whose logarithm is required contains more than five figures, proceed as above to obtain the logarithm of the first five figures, then, on the same line of the Table of Proportional Parts that the number added to the logarithm for the fifth figure was found, and in the column having at its head the sixth figure, will be found a quantity which, divided by 10 (or what is the same, having its right hand figure taken away*), and added to the logarithm already found, will give the logarithm of the first six figures; again, on the same line and in the column having at its head the

* If the figure thus cut off exceeds five, one must be added to the last right hand figure left.

seventh figure, will be found a quantity which, divided by 100 (or having two figures cut off from the right hand), and added, will give the logarithm for seven figures*.

Examples.

Required the logarithms of 11488, 621547, 708654, 7642·179.

Log. of the first four figures from Tab. I.	=	4·059942	4
From Table of Proportional Parts on line with 1148 and under 8 }	=	802	

Logarithm of 11488, as required = 4·060244

Log. of 6215	=	5·793441	9
From Table of Proportional Parts, on line with 6160, the next less No. in the table to 6215, and under 4 }	=	28	
On same line under 7	=	4	

Logarithm of 621547 = 5·793474

Log. of 7686	=	5·885700	2
From Table of Proportional Parts on same line with 7686 and under 5 . . . }	=	28	
On same line under 4	=	2	

Logarithm of 708654 = 5·885730

Log. of 7642	=	3·883207	513
From Table of Proportional Parts on same line with 7552 and under 1 . . . }	=	5	
On same line under 7	=	8	
On same line under 9	=	13	

Logarithm of 7642·179 = 3·883217

To find the number answering to any given logarithm.

Look in the upper portion of Table I. for the given logarithm, or the next less in value to it that can be found, then

* See remark at page 7, with regard to the number of places to be depended upon.

on the same line, in the first column, will be found the first three figures, and at the head of the column in which the logarithm was found, the fourth figure of the number sought. If the given logarithm is found exactly in the table, the figures thus obtained will be the required number, care being taken to point off one more figure to the left hand than there are units in the characteristic of the given logarithm, cyphers being attached to the right hand of the number, if requisite. If, however, the given logarithm is not found exactly in the table, subtract from it the next less logarithm found, calling the remainder the first difference; then look in the Table of Proportional Parts on the same line with the four figures already obtained from Table I. (or the next less figures which can be found) for this difference, and at the head of the column in which it is found will be the fifth figure of the number sought. If the first difference is not found exactly in the table, look for the next less number to it, which subtract from the first difference for the second difference; then add a cypher to this second difference, and look for it on the same line of the Table of Proportional Parts, as before, and the figure at the head of the column containing the nearest number to it, either greater or less, will be the sixth figure of the number required.

Examples.

Required the number answering to the logarithm 3·241756.

Given log. = 3·241756

Next less log. in Table I. = 3·241546 = the log. of 1744·

	210 first dif.	
In Table of Prop. Parts on same line with the next less No. to 1744	199 is found in col. 8	·8
	110 second dif.	
On the same line . . .	99 is found in col. 4	·04
	The No. required = 1744·84	

In this example the next less logarithm which can be found in Table I. is 3·241546, the number answering to which, 1744, is the first four figures of the number sought; then subtracting this logarithm from the given logarithm, we obtain for the first difference 210, and looking in the Table of Proportional

Parts on a line with 1740 (the next less number to 1744), for the next less number to 210, we find 199, at the head of the column containing which is 8, the fifth figure required; then, subtracting 199 from 210, we obtain the second difference, 11, and adding a cypher, the nearest number which we find on the same line is 99, at the head of the column containing which is 4, the sixth figure required.

Required the numbers answering to the following logarithms:—3·510000, 2·475771, 5·871624.

The number answering to the logarithm 3·510000 is found at once to be 3236.

	Given log. = 2·475771	
	Next less log. = 2·475671 = the log. of 200·0	
	<hr style="width: 10%; margin: 0 auto;"/>	
	100 = 1st dif.	
From Table of Proportional Parts	87	·06
	<hr style="width: 10%; margin: 0 auto;"/>	
	130 = 2nd dif.	
	130	·009
	<hr style="width: 10%; margin: 0 auto;"/>	
	No. required =	<hr style="width: 10%; margin: 0 auto;"/>

	Given log. = 5·871624	
	Next less log. = 5·871573 = the log. of 744000·	
	<hr style="width: 10%; margin: 0 auto;"/>	
	51 = 1st dif.	
From Table of Proportional Parts	40	80·
	<hr style="width: 10%; margin: 0 auto;"/>	
	50	
	52	9·
	<hr style="width: 10%; margin: 0 auto;"/>	
	The No. required =	<hr style="width: 10%; margin: 0 auto;"/>

It should be observed here, that the number of figures which may be depended upon in any result obtained by logarithms, will be equal to the number of decimal places in the logarithms employed; thus, in using the tables appended to this work, the results obtained will be accurate to six figures, except towards the end of the tables, in which only five figures should be trusted.

III., IV., and V.

Trigonometrical Tables.

Mathematicians have computed the lengths of the sines, tangents, and secants (assuming unity for the radius) corresponding to arcs from 1 minute of a degree, through all the gradations of magnitude, up to a quadrant, or 90° ; and the results of the computations are arranged for use in tables called *Trigonometrical Tables*. As, however, these quantities have to be carried to several places of decimals in order to obtain sufficiently accurate results, their use in calculations is attended with much labour, and therefore it is usual to employ their logarithms instead; but in this case the assumed radius is taken as 10,000,000,000 instead of unity, since with the latter most of the quantities would be *fractional*, and therefore have *negative* characteristics, the use of which would be inconvenient, and is superseded by taking the radius as above.

Table V. is such a table of the logarithms of the sines, cosines, tangents, cotangents, secants, and cosecants, for every minute from 1 minute to 90 degrees, calculated to a radius of 10,000,000,000 as above. It will be observed that the headings of the columns run along the *tops* of the pages as far as the 45th degree, after which they return along the *bottoms* of the pages in contrary order, as below:—

Sin	D.	Cosec	Tan	D.	Cot	Sec	D.	Cos
Cos	D.	Sec	Cot	D.	Tan	Cosec	D.	Sin

The reason of this will be apparent, if we only consider that the cos, cot, or cosec of an arc is the sin, tan, or sec of the *complement* of that arc. The intermediate columns, headed D, contain the differences of the consecutive logarithms in the contiguous columns on either side; it will be seen that the same difference is common to the sin and cosec, the tan and cot, and the sec and cos; since, from Table XXI.,

$$\sin = \frac{1}{\text{cosec}}, \text{ or } 1 = \sin \cdot \text{cosec}; \quad \tan = \frac{1}{\text{cot}}, \text{ or } 1 = \tan \cdot \text{cot};$$

$$\sec = \frac{1}{\cos}, \text{ or } 1 = \sec \cdot \cos; \text{ and consequently, } \log \sin + \log$$

$\text{cosec} = \log \tan + \log \cot = \log \sec + \log \cos = 2 \log \text{rad} = 20$; therefore as the sin, tan, or sec increases, so must the corresponding cosec, cot, or cos diminish, and their differences

must be equal. The differences of the sines and tangents are not inserted on the two first pages, for the reason explained at page 10.

USE OF TABLE V.

To find the logarithmic sine, tangent, &c., of a given arc.

If the arc contains only degrees and minutes, its sin, tan, &c., will be found simply by inspection, by looking along the top or bottom of the tables for the degrees, and then in the first or last vertical column for the minutes, according as the number of degrees is less or greater than 45° ; and on the same line, in the column having for its title (either at the top or bottom, according as the degrees were found) the name of the trigonometrical quantity required, its log will be found.

If the arc contains seconds as well, the logarithm must be found as above for the degrees and minutes; then take the number in the contiguous column headed D on the same line, multiply it by the number of seconds, and divide by 100 (which is done by cutting off the two last figures); the quotient must then be added to or subtracted from the log already taken out, according as the same would be increased or decreased by an increase in the arc.

Examples.

1. Find the log sin of $37^\circ 47'$.

As the arc is less than 45° , by looking along the top of the table for the degrees, and in the first column for the minutes, we find in the column having at its top the word sin the figures 9.787282, which is the log sin of the arc required.

2. Find the log tan of $75^\circ 34'$.

Here, as the arc is greater than 45° , looking at the bottom of the tables for the degrees, and in the last column for the minutes, we find in the column having tan at the bottom, 10.589431, the tan of $75^\circ 34'$.

3. Find the log sin of $31^\circ 45' 5''$.

The log sin of $31^\circ 45'$ is 9.721162

The No. in col. D is $340 \times 5'' \div 100 = +$ 17

\therefore The log sin of $31^\circ 45' 5'' =$ 9.721179

4. Find the log cos of $25^\circ 1' 47''$.

The log cos of $25^\circ 1'$ is 9.957917

The No. in col. D is $98 \times 47'' \div 100 = -$ 47

\therefore The log cos of $25^\circ 1' 47'' =$ 9.957170

To find the arc corresponding to any given log sin, tan, &c.:—Look in Table V. for the given log sin, &c., or the next less log thereto, and on the same line will be found the minutes, and at the top or bottom of the page the degrees, of the arc required; if the log thus found is less than the given log, subtract the former from the latter, add two cyphers to the right of the remainder, and divide it by the number found in the contiguous column headed D; the quotient will be the number of seconds to be added to the degrees and minutes in the arc already obtained.

Examples.

1. Find the arc whose log tan is 10·577537.

Here the arc is found by inspection to be $75^{\circ} 11'$.

2. Find the arc corresponding to the log sin 9·395401.

Given log = 9·395401

Next less log = 9·395166 = log tan $14^{\circ} 23'$

$$\frac{23500}{820} = 29 \text{ seconds;}$$

\therefore 9·395401 is the log tan of $14^{\circ} 23' 29''$.

In the sines and tangents of arcs less than about 5° , the differences between any two successive values are so great (as will be seen by an inspection of column D in the table) that the method above given for finding the intermediate values for seconds will not be sufficiently correct; and the same remark applies to the cosines and tangents of arcs greater than about 85° . It will also be observed, that in the cosines and secants of arcs less than 5° , and in the sines and cosecants of arcs greater than 85° , the differences are too small to enable us to calculate accurately the value of any arc from them.

The first of these difficulties may be removed by the rules given below for determining the values of the sines and tangents of small arcs, and the tangents of large arcs, and conversely the arcs from the sines and tangents. A table has also been given (Table IV.) of the logarithmic sines for every tenth of a minute as far as a degree and a half, and of the cosines for every tenth of a minute from $88^{\circ} 29'$ to the end of the quadrant. The second difficulty, however, could only be got over by extending the tables to more decimal places, but as this would also require all other quantities employed in the same calculations to be taken to an equal number of decimals, much additional trouble would be occasioned; and it is therefore better for determining the value of an arc when near 90° ,

to employ some other function than its sine, as, for instance, its cosine. In order to render this clearer to those who are not familiar with the use of logarithms, we subjoin an example of such a substitution of the cosine for the sine.

For instance, let it be desired from the formula,

$$P_1 : P_2 :: \sin \beta : \sin \delta$$

to determine the value of the angle δ , when $P_1 = 600.1$; $P_2 = 669$; and the angle $\beta = 63^\circ 45'$.

First by multiplying the means and extremes, and dividing both sides by P_1 , we obtain

$$\sin \delta = \frac{P_2 \sin \beta}{P_1} \dots \dots \dots (a)$$

Then from Table XXI.

$$\sin \delta = \sqrt{1 - (\cos \delta)^2}$$

$$\therefore \frac{P_2 \sin \beta}{P_1} = \sqrt{1 - (\cos \delta)^2};$$

squaring both sides

$$\left(\frac{P_2 \sin \beta}{P_1}\right)^2 = 1 - (\cos \delta)^2,$$

transposing, and extracting the square root

$$\cos \delta = \sqrt{1 - \left(\frac{P_2 \sin \beta}{P_1}\right)^2} \dots (b)$$

We have, therefore, two equations, (a) and (b), from either of which we can obtain the value of the angle δ , by substituting the values of the known quantities; but in doing so we shall find that the second equation will give the value of δ much more exactly than the first.

Thus, by substituting the known quantities in equation (a), we have

$$\frac{669 \times \sin 63^\circ 45'}{600.1} = \sin \delta.$$

Whence by logarithms,

$$\text{Log } \sin 63^\circ 45' = 9.952781$$

$$\text{Log } 669 = 2.825426$$

$$12.778157$$

$$\text{Log } 600.1 = 2.778224$$

$$\text{Log } \sin \delta = 9.999933$$

$$\therefore \delta = 88^\circ 59' 25''.$$

Proceeding in a similar manner with equation (b), we have

$$\sqrt{1 - \left(\frac{669 \times \sin 63^\circ 45'}{600.1}\right)^2} = \cos \delta.$$

Whence by logarithms, taking the radius as unity, for the reasons explained at page 15.

Log sin 63° 45'	= 1.952731
Log 669	= 2.825426
	<hr style="width: 100%;"/>
	2.778157
Log 600.1	= 2.778224
	<hr style="width: 100%;"/>
	1.999933
	2
	<hr style="width: 100%;"/>
Log .99969	= <u>1.999866</u>

Then $1 - .99969 = .00031$, the log of which = $\bar{4}.491362$,
and $\bar{4}.491362 \div 2 = \bar{2}.245681 = \cos \delta$;

or, restoring the radius of the tables,

$$\cos \delta = 8.245681 = \sin \text{ of the complement of } \delta;$$

therefore, by the rule given below for finding a small arc from its sin, we have

8.245681
5.814425
22
<hr style="width: 100%;"/>
<u>3.560128</u> = 3631.86 seconds = $1^\circ 0' 31''.86$;

$$\therefore \delta = 88^\circ 59' 28''.14,$$

whence we see that the former value of δ obtained from equation (a) is upwards of three seconds too small.

To find accurately the log sin of an arc less than 5°.

Reduce the arc to seconds, and find the log of that number from Table I., to which add 4.685575 (the log sin of $1''$), and subtract one-third of the decimal portion of the log sec of the arc taken from Table V.; the remainder is the log sin of the arc required.

Examples

Find the log sines of 13' and of 1° 3'.

$$\begin{aligned} \text{Log } (13' \times 60) = 780'' &= 2.892095 \\ &4.685575 \end{aligned}$$

$$7.577670$$

$$\text{Log sec of } 13' = .000003 \div 3 = .000001$$

$$\text{Log sin of } 13' = 7.577669$$

$$\begin{aligned} \text{Log } (63' \times 60) = 3780'' &= 3.577492 \\ &4.685575 \end{aligned}$$

$$8.263067$$

$$\text{Log sec of } 1^\circ 3' = .000073 \div 3 = .000024$$

$$\text{Log sin of } 1^\circ 3' = 8.263043$$

To find accurately the log tan of an arc less than 5°.

To the log of the number of seconds in the arc add 4.685575, and two-thirds of the decimal portion of its log sec; the sum is the log tan of the arc required.

Examples.

Find the log tans of 24' and 1° 15'.

$$\begin{aligned} \text{Log } (24' \times 60) = 1440'' &= 3.158363 \\ &4.685575 \end{aligned}$$

$$\text{Log sec of } 24' = .000011 \times \frac{2}{3} = .000007$$

$$\text{Log tan of } 24' = 7.853945$$

$$\begin{aligned} \text{Log } (75' \times 60) = 4500'' &= 3.653213 \\ &4.685575 \end{aligned}$$

$$\text{Log sec of } 1^\circ 15' = .000103 \times \frac{2}{3} = .000068$$

$$\text{Log tan of } 1^\circ 15' = 8.338856$$

To find accurately the log tan of an arc greater than about 85°.

Add to the log of the number of seconds that the arc is less than 90°, two-thirds of the decimal portion of the log cosec,

and subtract the sum from 15·814425; the remainder will be the log tan required.

Examples.

1. Find the log tan of $89^{\circ} 5' 13''$.

$$\begin{array}{r} 90^{\circ} 0' 0'' \\ 89 \quad 5 \quad 13 \\ \hline \end{array}$$

$$\underline{\underline{0^{\circ} 54' 47'' = 3287 \text{ seconds.}}}$$

$$\begin{array}{r} \text{Constant log} \dots\dots\dots = 15\cdot814425 \\ \text{Log of } 3287 \dots\dots\dots = 3\cdot516800 \\ \text{Log cosec of } 89^{\circ} 5' 13'' = \cdot000057 \times \frac{2}{3} = \cdot000038 \\ \hline \phantom{\text{Constant log}} \phantom{\text{Log of } 3287} \phantom{\text{Log cosec of } 89^{\circ} 5' 13''} = 3\cdot516838 \\ \hline \end{array}$$

$$\underline{\underline{\text{Log tan of } 89^{\circ} 5' 13'' = 11\cdot797587}}$$

2. Find the log tan of $88^{\circ} 51' 10''$.

$$\begin{array}{r} 90^{\circ} 0' 0'' \\ 88 \quad 51 \quad 10 \\ \hline \end{array}$$

$$\underline{\underline{1^{\circ} 8' 50'' = 4130 \text{ seconds.}}}$$

$$\begin{array}{r} \text{Constant log} \dots\dots\dots = 15\cdot814425 \\ \text{Log of } 4130 \dots\dots\dots = 3\cdot615950 \\ \text{Log cosec of } 88^{\circ} 51' 10'' = \cdot000087 \times \frac{2}{3} = \cdot000058 \\ \hline \phantom{\text{Constant log}} \phantom{\text{Log of } 4130} \phantom{\text{Log cosec of } 88^{\circ} 51' 10''} = 3\cdot616008 \\ \hline \end{array}$$

$$\underline{\underline{\text{Log tan of } 88^{\circ} 51' 10'' = 11\cdot608417}}$$

To find accurately an arc of not more than 5° from its log sine.

To the given log sin, add 5·814425, and one-third of the decimal portion of the secant of the nearest arc to that whose log sin is given, the sum, rejecting 10 from the characteristic, will be the logarithm of the number of seconds in the arc.

Example.

Required the arc whose log sin is 8·314719.

$$\text{Given log sin} \dots\dots\dots = 8\cdot314719$$

$$\text{Constant log} \dots\dots\dots = 5\cdot814425$$

$$\text{Log sec of nearest arc} = \cdot000093 \div 3 = \cdot000031$$

$$\underline{\underline{\text{Arc required } 1^{\circ} 10' 58'' = 4258'' = 3\cdot629175}}$$

To find accurately an arc of not more than 5° from its log tan.

To the given log tan add 5·314425, and from the sum subtract two-thirds of the decimal portion of the log sec of the arc whose log tan is nearest to that given, and the remainder, rejecting 10 from the characteristic, will be the log of the number of seconds in the arc.

Example.

Required the arc whose log tan is 8·281461.

Given log tan = 8·281461
 Constant log = 5·314425

19·545886

Log sec of nearest arc = ·000069 × $\frac{2}{3}$ = ·000042

Required arc = 58' 34" = 3514" = 13 545844

To find accurately an arc greater than 85° from its log tan.

Add to the given log tan two-thirds of the decimal portion of the log cosec of the nearest arc to that whose log tan is given, and subtract the sum from 15·314425; the remainder is the log of the number of seconds that the arc is less than 90°.

Example.

Required the arc whose log tan is 11·695900.

Constant log = 15·314425
 Given log tan = 11·695900

Log cosec of nearest arc ·000088 × $\frac{2}{3}$ = ·000059

11·695959

Required arc = 1° 9' 14" = 4154" = 3·618466

In extracting the root or raising the power of any trigonometrical quantity by means of its logarithm, it will always be found most convenient to reduce the assumed radius to unity, by subtracting 10 from the characteristic of the logarithm, which will frequently then become *negative*; it must, however, be borne in mind that the *decimal* part of the logarithm is always *positive*; and therefore, if it is required to multiply a logarithm with a *negative* characteristic by any number (as the index of a power), first multiply the *decimal* part of the logarithm, putting off as many decimal figures in the product

as there were in the logarithm, then multiply the characteristic, and subtract from the product the number (if any) pointed off to the *left* in the first product: the result will be the negative characteristic, and the decimals pointed off in the first product will be the decimal part of the required logarithm. To divide a logarithm with a negative characteristic by any number: if the characteristic is a *multiple* of that number, that is, if it is *divisible* by it without remainder, proceed as in ordinary division; if, not, separate the characteristic from the decimal, and add to the characteristic a number which will make it *divisible*, and prefix to the decimal the same number, then divide both by the given divisor, and the quotients will be the characteristic and decimal of the logarithm required. An example of this alteration of the characteristic is given at page 12.

Although Table V. only purports to give the sines, tangents, &c., of angles less than, or equal to 90° , any of these functions of angles *greater* than 90° may readily be obtained, since any function of an angle greater than 90° is equal to the same function of the *supplement* of that angle; due regard being had to changing the sign, if requisite, according to Table III., which exhibits the value of each trigonometrical line at the commencement of each quadrant, and also the sign with which it is effected in passing through the same. Thus, the *log sin* of $141^\circ 15'$ is 9.796521 , the same as the *sin* of its supplement $38^\circ 45'$; the *log sec* of $95^\circ 43'$ is -11.001701 , or the *sec* of $84^\circ 17'$ with its sign changed; the *log cosec* of the same is 10.002165 , or the *cosec* of $84^\circ 17'$, the sign remaining the same; and the *log tan* of $173^\circ 4'$ is -9.084947 , or the *tan* of $6^\circ 56'$, with its sign altered.

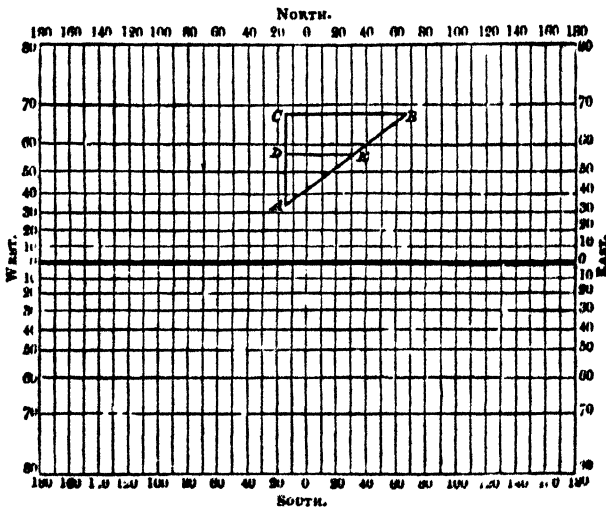
Table VI.

Meridional Parts.

In nautical charts, drawn according to Mercator's projection of the sphere, the meridional lines are drawn parallel to each other, or equidistant in every latitude, as shown in fig. 1, so that the distance between any two meridians being assumed as true at the equator would be too great in every other latitude; for whereas the length of a degree of latitude really decreases as we approach the poles, here it is represented as though its length were everywhere the same. If, therefore, the parallels of latitude were drawn at equal distances in representing any country situated in a high latitude its form

would become so much distorted from its breadth being thus increased without its length, that the country would hardly be recognised, and very erroneous views would be occasioned of its form and relative extent. Thus, in the latitude of 60° , a degree of longitude is only half what it is at the equator, and therefore all dimensions east and west would be twice as great as they should be, if drawn to the same scale as those north and south. To correct this distortion, therefore, and preserve the true form of the countries, the distance between the parallels of latitude is increased precisely in the same proportion as that between the meridians; so that on a Mercator's chart the relative magnitude of a degree of latitude and longitude is everywhere truly preserved; the parallels of latitude being drawn more and more distant as we leave the equator, as shown in fig. 1.

Fig. 1.



Now, the numbers in the table of meridional parts are nothing more than the distances of the several parallels of latitude from the equator, as shown on a Mercator's chart, expressed in minutes* of longitude at the equator. In using

* It is hardly necessary to state that a minute is the 60th part of a degree, and a second the 60th part of a minute.

the table the degrees of latitude must be sought at the top of the table, and the minutes in the side column, the meridional parts will then be found at their intersection; thus the meridional parts of $27^{\circ} 25'$ are 1712, and of $76^{\circ} 8'$ are 7222.

The great use of this table for nautical purposes is to determine the latitude and longitude of a ship at sea, when the course and distance that she has run are known. By the *course* of a ship is meant the direction in which she sails, estimated by the angle which that direction makes with the meridian. When the course makes the same angle with every meridian crossed, it is termed a *rhumb*, and this course is that usually adopted by navigators, in consequence of the facilities which it affords in ascertaining the position of their vessels.

On a Mercator's chart any rhumb is obviously a straight line, because no other than a straight line would on such a chart cross every meridian at the same angle. Thus, if A and B, figure 1, are any two places between which a vessel sails, then the straight line A B is the rhumb upon which the vessel would sail to preserve the same course or make the same angle with every meridian crossed; A C is the difference of latitude, C B the difference of longitude, and A B the *nautical distance* run. If now we set off from A towards C, a distance A D equal to the actual difference of latitude measured in degrees at the equator, and draw a line D E parallel to the equator, then will the line A E, measured on the equator, be the true nautical distance, and, being multiplied by 60 (the number of nautical miles in a degree), will give the distance run by the ship, and the line D E is termed the *departure* or distance run either to the east or west.

By inspecting the diagram, we see that $A E : \text{rad} :: A D : \cos < A$, or the nautical distance is to radius as the actual difference of latitude is to the cosine of the course; and also $A B : \text{rad} :: B C : \tan < A$, or the meridional difference of latitude is to radius as the difference of longitude is to the tangent of the course.

If we put d for the nautical distance, c for the course, l for the difference of the latitude, λ for the meridional difference of latitude, and L for the difference of longitude, we have, from the above proportions,

$$\begin{aligned} \text{rad} \cdot l &= d \cos c, \\ \text{And rad} \cdot L &= \lambda \tan c. \end{aligned}$$

From which formulæ either two of the four quantities d , c , l , and L being known, the others may be easily found.

For example, a vessel leaving latitude $25^{\circ} 34'$ N. and longitude $61^{\circ} 24'$ W. sails 543 nautical miles on a rhumb line, whose course is N. $42^{\circ} 5'$ E., what latitude and longitude is she then in?

$$\begin{array}{r}
 \text{Log cos } c (= 42^{\circ} 5') = 9.870504 \\
 \text{Log } d (= 543) = 2.784800 \\
 \hline
 \phantom{\text{Log}} 12.605304 \\
 \text{Rad} = 10.000000 \\
 \hline
 \phantom{\text{Log}} 2.605304 = \log \text{ of } 403 = l,
 \end{array}$$

then $403 \div 60 = 6^{\circ} 43'$ = the ship's difference of latitude to the north; therefore, $25^{\circ} 34' + 6^{\circ} 43' = 32^{\circ} 17'$ N. is the latitude she is now in. Again,

$$\begin{array}{r}
 \text{Meridional parts for } 32^{\circ} 17' = 2048 \\
 \phantom{\text{Meridional parts for}} \text{for } 25^{\circ} 34' = 1588 \\
 \hline
 \text{Meridional difference of latitude} = \lambda = 560 \\
 \text{Log tan } c (= 42^{\circ} 5') = 9.955707 \\
 \text{Log } \lambda (= 560) = 2.748188 \\
 \hline
 \text{Rad} = 10.000000 \\
 \hline
 \phantom{\text{Log}} 2.703895 = \log \text{ of } 505.7 = L,
 \end{array}$$

then $505.7 \div 60 = 8^{\circ} 25' 42''$ = the ship's difference of longitude to the east; therefore, $61^{\circ} 24' - 8^{\circ} 25' 42'' = 52^{\circ} 58' 28''$ W. is the longitude she is now in.

Example 2.—A vessel sails from latitude $41^{\circ} 20'$ N., and longitude $49^{\circ} 50'$ W., to latitude $64^{\circ} 25'$ N., and longitude $10^{\circ} 13' 6''$ W., what was her course and nautical distance?

$$\begin{array}{r}
 \text{Meridional parts for } 64^{\circ} 25' = 5097 \\
 \phantom{\text{Meridional parts for}} \text{for } 41^{\circ} 20' = 2728 \\
 \hline
 \phantom{\text{Meridional parts for}} 2389 = \lambda = \left\{ \begin{array}{l} \text{meridional} \\ \text{difference} \\ \text{of latitude.} \end{array} \right. \\
 \phantom{\text{Meridional parts for}} \begin{array}{r} 2389 \\ 60 \end{array}
 \end{array}$$

Difference of lat. = $l = 1385$

	49° 50' 0"	
	10 13 6	
	<hr style="width: 100%;"/>	
	39 36 54	
	60	
	<hr style="width: 100%;"/>	
Log L (= 2376.9) =	3.376010	
Rad =	10.000000	
	<hr style="width: 100%;"/>	
	13.376010	
Log λ (= 2389) . =	3.374565	
	<hr style="width: 100%;"/>	
	10.001445 = log tan 45° 5' 44" = c	
	<hr style="width: 100%;"/>	
Log l (= 1385) . =	3.141450	
Rad =	10.000000	
	<hr style="width: 100%;"/>	
	13.141450	
Log cos c (= 45° 5' 44") =	9.848757	
	<hr style="width: 100%;"/>	
	9.292693 = log of 1962 = d.	
	<hr style="width: 100%;"/>	

Table VII.

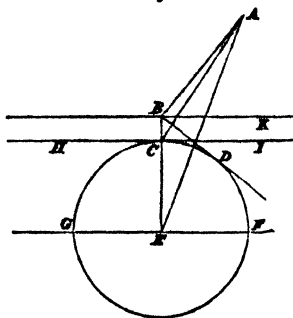
Length of a Degree of Longitude on each Parallel of Latitude.

This table requires no explanation; it exhibits the length of a degree of Longitude in nautical miles (each of which equals 6076.6 feet) at every degree of latitude from the Equator to the Poles.

*Tables VIII. and IX.**Dip of the Horizon.*

The latitude and longitude of a vessel is determined by observations made on the heavenly bodies, which observations consist principally in measuring their altitudes or the angle which they make with the horizon. The altitudes thus taken being compared with certain altitudes given in the "Nautical Almanac," in the manner more fully explained in the "Elements of Navigation," enable the observer to determine both his latitude and longitude. It is however requisite to make certain corrections in the observed altitudes in order to obtain the true altitudes.

Fig. 2.



If, in fig. 2, $G C D F$ is a section of the earth, and B the place of an observer, then $G E F$ is the *rational horizon*, and $H C I$ the *sensible horizon*. Also, if A is the place of a heavenly body, the angle $A E F$ is its *true altitude*, $A C I$ its *apparent altitude*, and $A B D$ its *observed altitude*.

If the observer had been on the surface of the earth as C , then the *observed* altitude would have coincided with the

apparent altitude, but when raised above the same, as is always the case at sea when the observations are made from the vessel's deck, the horizon *dips*, or becomes depressed, as shown by the line $B D$, and the *observed* altitude $A B D$ becomes greater than the apparent altitude $A B K$ or $A C I$ * by the angle $K B D$; the magnitude of this angle (termed the *dip of the horizon*) depends upon the height of the observer above the surface of the earth; its values for all heights between 1 and 140 feet are given in Table VIII. The angle found in the second column must be *subtracted* from the *observed* altitude to obtain the *apparent* altitude.

The dip given in Table VIII. supposes that the view of the sea horizon is perfectly unobstructed. Should, however, any object intervene, as a coast, the margin of the sea where it meets the shore must then be taken as the horizon; and in this case the angle to be *subtracted* from the *observed* altitude will be found in Table IX. under the proper height, and on a line with the distance of the object from the observer, which may always be judged of with sufficient precision by an experienced eye. Thus, if the vessel is about 2 miles from the shore and the observer is 20 feet above the surface of the sea, the angle to be subtracted for the dip will be 6 minutes.

Table X.

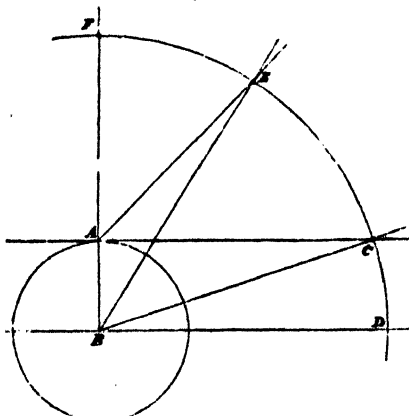
Reduction of the Moon's Horizontal Parallax.

The difference between the *apparent* altitude of a heavenly

* The distance $B C$ of the observer above the earth's surface is so inconsiderable, as compared with $B A$, the distance of the body, that these two angles may be considered as equal without any appreciable error.

body, or the angle which it makes with the *sensible* horizon, and its *true* altitude, or the angle which it forms with the *rational* horizon, is termed its *parallax*. The parallax of a body is greatest when it is in the horizon, and it decreases as its altitude increases, until, when it attains the zenith, its parallax becomes nothing. Thus in fig. 3 the parallax at C is greater than that at E, and is nothing at the zenith F.

Fig. 3.



The amount of the horizontal parallax depends upon the distance of the body A C and upon the earth's radius A B. The nearer the object, that is the less A C is, the greater is the angle A C B or the parallax. The moon being much nearer to the earth than any other of the heavenly bodies, its parallax is much greater, and as its distance from the earth varies so also does its parallax; the amount of its parallax is given in the "Nautical Almanac" for every day throughout the year. The parallax there given is, however, calculated for the earth's greatest or equatorial radius; and since, from the proximity of the moon, the decrease of the earth's radius in higher latitudes diminishes the parallax to such an extent as to require correction, we have given in Table X. the amount to be *subtracted* from the equatorial parallax to give the true parallax in any given latitude. For example, let the earth's equatorial parallax on any given day, as found in the "Nautical Almanac," be 58 minutes, what will it be for the same day in latitude 52° ? Here under 58', and on a line with 52° , we find $7^{\prime} 2$, which

must be subtracted from 58', giving 57' 52''8 for the moon's parallax in that latitude.

Table XI.

Augmentation of the Moon's Semidiameter.

In making an observation, it is the position of the center of the object which is required, but as it would not be easy in practice to judge with sufficient precision of its position, it is usual to measure to the nearest edge (or *limb*, as it is termed) of the object, and to add the angular value of its semidiameter. In the case of the moon, its apparent semidiameter varies considerably according to its distance from the earth, and also from its great proximity its semidiameter is sensibly increased by the parallax; for, as her altitude increases, she approaches nearer to the observer, and the apparent semidiameter becomes greater. The value of her *horizontal* semidiameter for every day is given in the "Nautical Almanac;" and Table XI. shows the augmentation of the same occasioned by an increased altitude. Thus, when the moon's *horizontal* semidiameter is 15' 30'' her *apparent* semidiameter, with an altitude of 51°, will be 15' 42''.

Tables XII. and XIII.

Longitude and Time.

As the sun apparently revolves round the earth once in every twenty-four hours, with an equal rate, it arrives at each meridian at a different time. And it is on this principle that the longitude of a place is determined by the interval of time between the sun's passing the meridian of that place and the meridian of Greenwich. As the whole 360° are equal to an interval of 24 hours, any lesser number of degrees are equal to a proportionate interval of time, and these two tables are for facilitating the conversion of longitude into time, or *vice versa*. As an example of their use, let it be required to find the interval of time corresponding with a difference of longitude of 43° 18' 10''.

				M.	M.	S.
From 2nd column, Table XII.	40°	=	2	40		
" 1st	"	"	3	=	12	
" 1st	"	"	10'	=	40	
" 1st	"	"	8'	=	12	
" 3rd	"	"	10''	=	0.667	

The time is therefore . 2 52

Again, if it were required to know the difference of longitude corresponding with an interval of 4 hours, 31 minutes, and 6 seconds; we have

From 1st column of Table XIII.	4 hours	=	60° 0' 0"
„ 2nd „ „ „	30 mins.	=	7 30 0
„ 2nd „ „ „	1 min.	=	0 15 0
„ 2nd „ „ „	6 secs.	=	0 1 30

Which gives for the diff. of longitude . 67 46 30

Table XIV.

Parallax in altitude of the Sun and Planets.

The *horizontal* parallax of the sun and planets depends upon their distance from the earth, and is given for every day in the "Nautical Almanac." The parallax for any altitude is, as already explained, less than when the object is in the horizon; and Table XIV. is intended to give the amount of parallax for any apparent altitude when the amount of the horizontal parallax is known. In using the Table look for the *horizontal* parallax at the head of the Table, and in the column at the head of which it stands, and on the same line with the *apparent* altitude, will be found the parallax required. For example, if the sun's horizontal parallax is 9", what is her parallax with an apparent altitude of 48°? Here, in the column having 9" at its head, and on the same line with 48°, will be found 6", which is the sun's parallax at the time.

XV. and XVI.

Refraction of the Sun and Stars.

There is another correction rendered necessary in order to reduce the *observed* altitude of a heavenly body to its *apparent* altitude; in consequence of the optical property of the atmosphere termed refraction. While the effect of the parallax is to make the object appear lower than its true place, that of refraction is to make its altitude appear greater. The effect of refraction is greatest when the object is in the horizon, and it gradually diminishes until at the zenith it becomes nothing; it is not, however, always constant for the same altitude, but varies with the temperature and density of the atmosphere.

Table XV. gives the refraction for every ten minutes of apparent altitude, calculated for a mean temperature of 50° Fahr., and a mean pressure of 29.6 in.; and Table XVI. contains the correction requisite to be made for any other temperature and pressure. For example, what is the refraction of any heavenly body whose observed altitude is $31^{\circ} 20'$ when the temperature is 72° , and the barometer 30.35? In this case we first find, from Table XV., the refraction for a mean state of the atmosphere to be $1' 35.5''$, we then find, from Table XVI., that at the temperature of 72° we must subtract $5''$, and with the barometer at 30.35, that we must add $1''$, after which we have $1' 31.5''$ for the required refraction. It must be observed, that when the temperature is *below* the mean, the correction must be *added*, and when *above*, the mean *subtracted*; also, when the barometer is *below* the mean the correction must be *subtracted*, but when *above* the same it must be *added*. The correction for the thermometer is found in the column having the temperature at its head, while that for the barometer is found in that having the pressure at its foot.

Table XVII.

Correction of the Moon's Altitude.

As already explained, the effect of the refraction is to raise the object, while that of parallax is to depress it; the parallax, however, being always the greater, the *apparent* altitude is always less than the *true* altitude. Table XVII. contains the difference of the refraction and parallax for the moon, which is therefore the correction to be *added* to the *apparent* altitude to obtain her *true* altitude. In using the table, the correction will be found in the column having at its head the moon's horizontal parallax, and opposite to the apparent altitude. Should these not be found exactly in the table, we must take the next less values, and to the number thus found we must add or subtract (as the case may be) a proportional part for the requisite number of minutes or seconds wanting, which are given for the altitudes in the left-hand column, and for the parallax in the right-hand column. For example, let the correction be required when the apparent altitude is $29^{\circ} 37'$, and the moon's horizontal parallax is $56' 24''$. In this case the next less numbers to these in the Table are $29^{\circ} 30'$ and $56'$

MATHEMATICAL TABLES.

Under 56', and opposite 29° 30', we find	47'	1"
Add proportional parts for parallax 20"		18
" " " " 4"		8.5
		<hr/>
		17 22.5
Subtract prop. parts for altitude 7'		3
		<hr/>
Correction required		17 10.5
		<hr/>

The moon's true altitude therefore equals 29° 54' 19".5.

Ex. 2. What is the moon's true altitude when its apparent altitude is 9° 53', and its horizontal parallax is 58° 20'?

Under 58' and opposite 9° 50' we find .	51'	44"
Add proportional parts for parallax 20"		20
" " " for altitude 3'		2
		<hr/>
Correction	52	6
		<hr/>

Therefore the moon's true altitude equals 10° 45' 6".

Table XVIII.

Logarithms for finding the Horary Angle or Apparent Time.

The use of this Table is to facilitate the calculation of the Apparent Time at any place, from observations made on the altitude of some known celestial body. The logarithms in the Table are twice the sine of half the arc of longitude corresponding with the number of hours and minutes at which it stands. The manner of performing the calculation by which this logarithm is derived from the observed altitude is fully explained in the "Rudimentary Work on Navigation." The use of the Table is as follows:—having obtained this logarithm, look in the table for it, or for the next less logarithm to it, and take out the time in hours and minutes as found (if the altitude is *decreasing*) at the top and in the left-hand column (but if *increasing*) at the bottom, and in the right-hand column. Then subtract the logarithm taken in the table from the given logarithm, and having added to the right of the difference thus obtained two cyphers, divide it by the nearest number in the contiguous column headed *Diff.*, and the quotient will be the number of seconds to be added

to the hours and minutes already obtained, when the altitude is *decreasing*, and to be *subtracted* when *increasing*. For example, what is the apparent time corresponding to the logarithm 9.649321 when the altitude was decreasing?

$$\begin{array}{r} \text{Given log} \quad 9.649321 \\ \text{Next less log in Table } 9.648913 \quad = \text{log of 5 h. 35 m.} \\ \hline 40800 \div 3516 = 11 \text{ seconds.} \\ \hline \end{array}$$

Therefore, the apparent time required is 5 h. 35 m. 11 s.

Ex. 2. What is the apparent time corresponding with the logarithm 9.215630, when the altitude was increasing?

$$\begin{array}{r} \text{Given log} \quad 9.215630 \\ \text{Next less log in Table } 9.214358 \quad = 20 \text{ h. 49 m.} \\ \hline 127200 \div 7114 = 18 \text{ seconds.} \\ \hline \end{array}$$

Therefore, the apparent time is 20 h. 48 m. 42 s.

Table XIX.

Common and Hyperbolic Logarithms

The object of this Table is to facilitate the conversion of common logarithms into hyperbolic, and *vice versa*. Its use is as follows:—To convert common logarithms into hyperbolic, write the common logarithm, as shown in the first example below, and then take from the second column of the Table the equivalent value of each figure in hyperbolic logarithms, taking care that the latter are each moved as many places to the right as the corresponding numbers in the common logarithm are; the sum of the whole will be the hyperbolic logarithm required.

To convert hyperbolic logarithms into common, proceed in a similar manner, writing the hyperbolic logarithm as in the second example below, and taking its equivalent value in common logarithms from the fourth column of the Table.

Ex. 1. What is the hyperbolic logarithm of 3156?

By reference to Table I. we find the common logarithm of 3156 is 3.499137; then—

Com. Log.	Hyp. Log.	
8	= 6 907755	8
4	= 921084	0
09	= 207282	7
009	= 020728	8
0001	= 000230	8
00008	= 000069	1
000007	= 000016	1
<hr/>		
8.057081		
<hr/>		

Ex. 2. What is the common logarithm of the number whose hyperbolic logarithm is 5.160731?

Hyp. Log.	Com. Log.	
5	= 2.171472	4
1	= 043429	5
06	= 026057	7
0007	= 000304	0
00008	= 000018	0
000001	= 000000	4
<hr/>		
2.241277		
<hr/>		

Table XX.

Curvature of the Earth and Refraction.

This Table is of use in Geodesical operations. Practically, a level line on the earth's surface is a line everywhere equally distant from its center. It is obviously, therefore, not a straight line, but is a portion of a circle, having the same radius as the earth. When a level, theodolite, or other instrument has the axis of its telescope so adjusted as to be truly level, the prolongation of that axis is not a level line, but is a tangent to that line, coinciding with it only at the point where the instrument stands, and being *above* it everywhere else. The height of this line above the true level line, if there were no refraction, would be equal to the versine of an arc whose radius equalled that of the earth, and whose length was equal to the distance from the instrument: these heights for various distances up to 30 miles are given in the second column of the Table. The effect, however, of the refraction of the atmosphere is to curve the visual ray passing through the center or axis of the telescope, so that the optical axis is

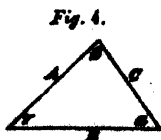
really a curved line which approximates very nearly to a circle, having a radius seven times greater than that of the earth. The heights in the second column require to be reduced by a seventh part, and the numbers thus obtained are given in the third column. To exemplify its use, let us suppose that an instrument, placed in an elevated position, has its telescope directed to a church tower 3 miles distant, and that when its telescope is perfectly level the horizontal wires are found to cut a point in one of the windows, which, on direct measurement, is found to be 95 feet from the ground, it is required to ascertain the real difference of level of the two spots. Now, on reference to the Table, we find the correction for 3 miles is 5.14, which, being *subtracted* from 95 feet, gives 89.86 feet for the actual height of the instrument above the ground on which the tower stands. In taking a series of consecutive observations, as in the ordinary operation of levelling by *back* and *fore* sights, to ascertain the relative level of two distant places, so long as no great difference in the range or length of the sights occurs, no correction for curvature or refraction need be made, for when the sights are actually equal no error arises in the ultimate result.

Tables XXI., XXII., XXIII., and XXIV.

Trigonometrical Expressions.

These Tables require no particular explanation. Table XXI. contains equivalent expressions for $\sin a$, $\cos a$, $\tan a$, $\cot a$, $\sec a$, $\operatorname{cosec} a$, $\operatorname{versin} a$, and will be found of considerable use in reducing formulæ containing trigonometrical expressions. Table XXII contains expressions, the \sin , \cos , \tan , and \cot , of multiple arcs. Table XXIII. contains a variety of formulæ relating to the trigonometrical functions of two angles or arcs. And Table XXIV. contains expressions for the \sin , \cos , \tan , and \cot , in terms of the arc, and for the arc in terms of the \sin and \tan , and also expressions for the powers of the \sin and \cos .

Table XXV.



The formulæ given in this Table are intended to enable all the six parts of a plane rectilinear triangle to be determined when any three of those parts were previously known. When either a side or angle is wanted it will only be necessary to make

A or β the side or angle as the case may be, and to insert in the formulæ the proper values of those letters which are known, which will then express the value wanted. For example, in a triangle, two of whose sides are 23 and 35 feet in length, and the angle included between is 51° , what is the length of the third side? In this case we have given B, C and a , and want to find A, we must, therefore, select a formulæ containing only those letters; we find, accordingly, No. 7 gives.

$$A = \sqrt{(B^2 + C^2 - 2 B \cdot C \cdot \cos a.)}$$

We have $B = 23$, $C = 35$, $\cos 51^\circ = .62932$; inserting these values, we have

$A = \sqrt{(23^2 + 35^2 - 2 \times 23 \times 35 \times .62932)} = 27.217$,
which is the length of the side required.

Table XXVI.

The formulæ given in this Table are to facilitate the solution of quadratic and cubic equations, in order to which it is only necessary to substitute for p and q their known values in the formulæ when the value of x will be determined. By way of example, let it be required to find the value of x in the cubic equation $x^3 + 3x - 536 = 0$. We see by reference to the Table that this corresponds with equation (6) in the Table, p being equal to 3, and q to 536. Then, if we substitute these values in the second expression, it becomes—

$$\tan a = \frac{3}{3 \times 536} \sqrt[3]{\frac{3}{3}} = \frac{2}{536}$$

therefore, $a = 0^\circ 12' 36''$, and $\frac{1}{2}a = 0^\circ 6' 18''$;

Then,

$$\tan \beta = \sqrt[3]{\tan (6' 18'')};$$

therefore, $\beta = 7^\circ 1' 5''$, and $2\beta = 14^\circ 2' 10''$,

and,

$$x = 2 \sqrt[3]{\frac{3}{3}} \cdot \cot (14^\circ 2' 10'') = 8,$$

which is the true value of x .

Table XXVII.

This Table contains the differential coefficients of some of the most frequently-occurring functions of x , and will be found to include all the rules for simple differentiation.

Table XXVIII.

This Table contains a variety of constant numbers of frequent use in general calculations; it also contains their logarithms to seven places of decimals, and the arithmetical complements of the same. The latter will be found of use in cases where it is required to divide by the numbers in the Table.

Table XXIX.

To reduce the Sun's Declination to any given Meridian, and to any time under that Meridian.

In the "Nautical Almanac" the sun's declination is given for each day at noon at Greenwich; it is, however, necessary for the purposes of navigation to ascertain its declination at any other meridian, either at noon or at any other time of the day. In either of these cases, having obtained the declination from page II. of the month, in the "Nautical Almanac," the correction to be either added or subtracted therefrom, according to the directions given below, may be found in the following manner.

I. *If the sun's declination is required for some other meridian at noon*, reckon the difference of longitude between that meridian and Greenwich, then look for this difference in the first left-hand column of the table, and on the line on which the same is found, and in the vertical column having at its head the nearest number to the declination already taken from the "Nautical Almanac," will be found the correction required. It will be seen in the "Nautical Almanac," whether the sun's declination is increasing or decreasing; when decreasing, add the correction in east longitude, and subtract it in west longitude; but when the declination is increasing, subtract the correction in east longitude, and add it in west longitude.

Example.

What was the sun's declination at noon, on the 13th of November, 1850, in longitude 175° w.?

Here we find, from the "Nautical Almanac," that the sun's declination at noon at Greenwich was $17^{\circ} 58' 1''$ south, and that it was increasing. We next look in the first column

of the table for the given difference of longitude, viz., 175° , but the nearest number that we find is 170° , which is 5° too small, and we must therefore add together the corrections found in the proper vertical column on both the lines having 5° and 170° in the first column. Thus, in the present instance, in the column having at its head 18° (the nearest to $17^\circ 58' 1''$) and on the same line with 5° we find $13''$, and on the same line with 170° we find $7' 22''$; these being added together give $7' 35''$ for the required correction, which, as the sun's declination is increasing and the difference of longitude is westerly, has to be added to $17^\circ 58' 1''$, making $18^\circ 5' 36'$ for the sun's declination at noon in longitude 175° west.

II. If the sun's declination is required for Greenwich at any other hour than noon, reckon the interval between that time and noon; then look for this interval in the last right-hand column of the table, and on the same line in which it is found, and in the vertical column having at its head the nearest number to the sun's declination (from the "Nautical Almanac"), will be found the required correction, which, when the sun's declination is increasing, is to be added, if the time is after noon, and subtracted if before noon; but when the declination is decreasing must be subtracted if the time is after noon, and added if before noon.

Examples.

What was the sun's declination at Greenwich on the 4th of July, 1850, at 7 h. 28 m.?

From the "Nautical Almanac" we find the sun's declination at noon to have been $22^\circ 54' 58''$ north, and to have been decreasing. Then looking in the last column of the table for the nearest number to 7 h. 28 m., we find 7 h. 20 m., and on the same line in the column headed with 23° (the nearest number to $22^\circ 54' 58''$) we find $1' 30''$, and in the same vertical column on the same line with 8 m. we find $2''$, therefore the correction is $1' 32''$, which, as the sun's declination was decreasing, and the time after noon, has to be subtracted from $22^\circ 54' 58''$, leaving $22^\circ 53' 26''$ north for the sun's declination at the hour required.

What was the sun's declination at Greenwich on the 24th of August, 1850, at 20 h. 12 m.?

In this instance the time given, viz., 20 h. 12 m. on the 24th is equivalent to 3 h. 48 m. before noon on the 25th, for which day the sun's declination is found in the "Nautical Almanac" to have been $10^\circ 48' 50''$ north, and to have been

decreasing. Looking then in the column of the table having at its head 11° (the nearest to $10^\circ 48' 56''$) and on the same line with 3 h. 20 m. we find $2' 56''$, and on the same line with 28 m. we find $25''$; adding these two together, we obtain $3' 21''$ for the correction, which, as the sun's declination is decreasing, and the time before noon, must be added to $10^\circ 48' 56''$, making $10^\circ 52' 17''$ north for the sun's declination at the time required.

[1]. If the sun's declination is required for some other meridian than Greenwich, at any other hour than noon, we must first make the necessary correction for the difference of longitude in the manner already explained, and then the correction for time according to rule II.

Examples.

What was the sun's declination on the 17th of May, 1850, at 5 h. 40 m., in longitude 128° E.?

Sun's declination (increasing) at Greenwich,	}	$19^\circ 18' 38''$ N
at noon		
Subtract correction for 120°	}	$4' 46''$
Subtract correction for 8°	}	$0 19$
		$19 18 33$
Add correction for 5 h. 20 m.	}	$3' 11''$
Add correction for 0 h. 20 m.	}	$0 12$
		$0 8 23$
Sun's declination at the time and place required		$19 16 56$ N.

What was the sun's declination on the 3rd of June, 1850, at 17 h. 20 m., in longitude 79° W.?

17 h. 20 m. on the 3rd, is equivalent to 6 h. 40 m. on the 4th.

Sun's declination (increasing) at Greenwich,	}	$22^\circ 25' 47''$ N.
at noon		
Add correction for 70°	}	$1' 41''$
Add correction for 9°	}	$0 12$
		$22 27 40$
Subtract correction for 6 h. 40 m.		$0 2 24$
		$22 25 16$ N.

When the sun is near either of the equinoxes its declination may be less than the correction, in which case, when the correction is subtractive, the declination must be subtracted from it, and the remainder will be the sun's declination of a contrary name to that which it was before.

Example.

What was the sun's declination at noon on the 23rd of September, 1850, in longitude 164° π ?

The sun's declination (increasing) at noon,	}	0° 1' 57" a.
at Greenwich	}	
Subtract correction for 160° at noon	} 10' 25"	0 10 41
Subtract correction for 4°	} 0 16	
Sun's declination at the place required . . .		0 8 44 π .

[No. 100 L. 000.]		LOGARITHMS OF NUMBERS.									[No. 109 L. 000.]	
N.	0	1	2	3	4	5	6	7	8	9	N.	
100	000000	0434	0868	1301	1734	2166	2598	3029	3461	3891	100	
1	4321	4751	5181	5609	6038	6466	6894	7321	7748	8174	1	
2	8600	9026	9451	9876	0300	0724	1147	1570	1993	2415	2	
3	012837	3259	3680	4100	4521	4940	5360	5779	6197	6616	3	
4	7033	7451	7868	8284	8700	9116	9532	9947	0361	0775	4	
5	021189	1603	2016	2428	2841	3252	3664	4075	4486	4896	5	
6	5306	5715	6125	6533	6942	7350	7757	8164	8571	8978	6	
7	9384	9789	0195	0600	1004	1408	1812	2216	2619	3021	7	
8	033424	3826	4227	4628	5029	5430	5830	6230	6629	7028	8	
9	7426	7825	8223	8620	9017	9414	9811	0207	0602	0998	9	

ПРОЦЕНТАЛ. РАККА	N.	1	2	3	4	5	6	7	8	9
	1000	43.4	86.8	130.2	173.6	217.0	260.4	303.8	347.2	390.6
1002	43.3	86.6	129.9	173.2	216.5	259.8	303.1	346.4	389.7	
1004	43.2	86.4	129.6	172.8	216.0	259.2	302.4	345.6	388.8	
1006	43.1	86.2	129.3	172.4	215.5	258.6	301.7	344.8	387.9	
1009	43.0	86.0	129.0	172.0	215.0	258.0	301.0	344.0	387.0	
1011	42.9	85.8	128.7	171.6	214.5	257.4	300.3	343.2	386.1	
1014	42.8	85.6	128.4	171.2	214.0	256.8	299.6	342.4	385.2	
1016	42.7	85.4	128.1	170.8	213.5	256.2	298.9	341.6	384.3	
1018	42.6	85.2	127.8	170.4	213.0	255.6	298.2	340.8	383.4	
1020	42.5	85.0	127.5	170.0	212.5	255.0	297.5	340.0	382.5	
1023	42.4	84.8	127.2	169.6	212.0	254.4	296.8	339.2	381.6	
1026	42.3	84.6	126.9	169.2	211.5	253.8	296.1	338.4	380.7	
1028	42.2	84.4	126.6	168.8	211.0	253.2	295.4	337.6	379.8	
1030	42.1	84.2	126.3	168.4	210.5	252.6	294.7	336.8	378.9	
1033	42.0	84.0	126.0	168.0	210.0	252.0	294.0	336.0	378.0	
1035	41.9	83.8	125.7	167.6	209.5	251.4	293.3	335.2	377.1	
1038	41.8	83.6	125.4	167.2	209.0	250.8	292.6	334.4	376.2	
1040	41.7	83.4	125.1	166.8	208.5	250.2	291.9	333.6	375.3	
1043	41.6	83.2	124.8	166.4	208.0	249.6	291.2	332.8	374.4	
1045	41.5	83.0	124.5	166.0	207.5	249.0	290.5	332.0	373.5	
1048	41.4	82.8	124.2	165.6	207.0	248.4	289.8	331.2	372.6	
1050	41.3	82.6	123.9	165.2	206.5	247.8	289.1	330.4	371.7	
1053	41.2	82.4	123.6	164.8	206.0	247.2	288.4	329.6	370.8	
1055	41.1	82.2	123.3	164.4	205.5	246.6	287.7	328.8	369.9	
1058	41.0	82.0	123.0	164.0	205.0	246.0	287.0	328.0	369.0	
1060	40.9	81.8	122.7	163.6	204.5	245.4	286.3	327.2	368.1	
1063	40.8	81.6	122.4	163.2	204.0	244.8	285.6	326.4	367.2	
1066	40.7	81.4	122.1	162.8	203.5	244.2	284.9	325.6	366.3	
1068	40.6	81.2	121.8	162.4	203.0	243.6	284.2	324.8	365.4	
1071	40.5	81.0	121.5	162.0	202.5	243.0	283.5	324.0	364.5	
1074	40.4	80.8	121.2	161.6	202.0	242.4	282.8	323.2	363.6	
1076	40.3	80.6	120.9	161.2	201.5	241.8	282.1	322.4	362.7	
1079	40.2	80.4	120.6	160.8	201.0	241.2	281.4	321.6	361.8	
1082	40.1	80.2	120.3	160.4	200.5	240.6	280.7	320.8	360.9	
1084	40.0	80.0	120.0	160.0	200.0	240.0	280.0	320.0	360.0	
1087	39.9	79.8	119.7	159.6	199.5	239.4	279.3	319.2	359.1	
1090	39.8	79.6	119.4	159.2	199.0	238.8	278.6	318.4	358.2	
1093	39.7	79.4	119.1	158.8	198.5	238.2	277.9	317.6	357.3	
1095	39.6	79.2	118.8	158.4	198.0	237.6	277.2	316.8	356.4	
1098	39.5	79.0	118.5	158.0	197.5	237.0	276.5	316.0	355.5	

No. 110 L. 041.]

LOGARITHMS OF NUMBERS.

[No. 119 L. 078.]

N.	0	1	2	3	4	5	6	7	8	9	N.
110	041393	1787	2182	2576	2969	3362	3755	4148	4540	4932	110
1	5323	5714	6105	6495	6885	7275	7664	8053	8442	8830	1
2	9218	9606	9993	0380	0766	1153	1538	1924	2309	2694	2
3	053078	3463	3846	4230	4613	4996	5378	5760	6142	6524	3
4	6905	7286	7666	8046	8426	8805	9185	9563	9942	0320	4
5	060698	1075	1452	1829	2206	2582	2958	3333	3709	4083	5
6	4458	4832	5206	5580	5953	6326	6699	7071	7443	7815	6
7	8186	8557	8928	9298	9668	0038	0407	0776	1145	1514	7
8	071882	2250	2617	2985	3352	3718	4085	4451	4816	5182	8
9	5547	5912	6276	6640	7004	7368	7731	8094	8457	8819	9

PROPORTIONAL PARTS.

N.	1	2	3	4	5	6	7	8	9
1101	39.4	78.8	118.2	157.6	197.0	236.4	275.8	315.2	354.6
1104	39.3	78.6	117.9	157.2	196.5	235.8	275.1	314.4	353.7
1106	39.2	78.4	117.6	156.8	196.0	235.2	274.4	313.6	352.8
1109	39.1	78.2	117.3	156.4	195.5	234.6	273.7	312.8	351.9
1112	39.0	78.0	117.0	156.0	195.0	234.0	273.0	312.0	351.0
1115	38.9	77.8	116.7	155.6	194.5	233.4	272.3	311.2	350.1
1118	38.8	77.6	116.4	155.2	194.0	232.8	271.6	310.4	349.2
1121	38.7	77.4	116.1	154.8	193.5	232.2	270.9	309.6	348.3
1124	38.6	77.2	115.8	154.4	193.0	231.6	270.2	308.8	347.4
1127	38.5	77.0	115.5	154.0	192.5	231.0	269.5	308.0	346.5
1129	38.4	76.8	115.2	153.6	192.0	230.4	268.8	307.2	345.6
1132	38.3	76.6	114.9	153.2	191.5	229.8	268.1	306.4	344.7
1135	38.2	76.4	114.6	152.8	191.0	229.2	267.4	305.6	343.8
1138	38.1	76.2	114.3	152.4	190.5	228.6	266.7	304.8	342.9
1141	38.0	76.0	114.0	152.0	190.0	228.0	266.0	304.0	342.0
1144	37.9	75.8	113.7	151.6	189.5	227.4	265.3	303.2	341.1
1148	37.8	75.6	113.4	151.2	189.0	226.8	264.6	302.4	340.2
1151	37.7	75.4	113.1	150.8	188.5	226.2	263.9	301.6	339.3
1154	37.6	75.2	112.8	150.4	188.0	225.6	263.2	300.8	338.4
1157	37.5	75.0	112.5	150.0	187.5	225.0	262.5	300.0	337.5
1160	37.4	74.8	112.2	149.6	187.0	224.4	261.8	299.2	336.6
1163	37.3	74.6	111.9	149.2	186.5	223.8	261.1	298.4	335.7
1166	37.2	74.4	111.6	148.8	186.0	223.2	260.4	297.6	334.8
1169	37.1	74.2	111.3	148.4	185.5	222.6	259.7	296.8	333.9
1172	37.0	74.0	111.0	148.0	185.0	222.0	259.0	296.0	333.0
1175	36.9	73.8	110.7	147.6	184.5	221.4	258.3	295.2	332.1
1178	36.8	73.6	110.4	147.2	184.0	220.8	257.6	294.4	331.2
1182	36.7	73.4	110.1	146.8	183.5	220.2	256.9	293.6	330.3
1185	36.6	73.2	109.8	146.4	183.0	219.6	256.2	292.8	329.4
1188	36.5	73.0	109.5	146.0	182.5	219.0	255.5	292.0	328.5
1192	36.4	72.8	109.2	145.6	182.0	218.4	254.8	291.2	327.6
1195	36.3	72.6	108.9	145.2	181.5	217.8	254.1	290.4	326.7
1198	36.2	72.4	108.6	144.8	181.0	217.2	253.4	289.6	325.8
1202	36.1	72.2	108.3	144.4	180.5	216.6	252.7	288.8	324.9
1205	36.0	72.0	108.0	144.0	180.0	216.0	252.0	288.0	324.0
1208	35.9	71.8	107.7	143.6	179.5	215.4	251.3	287.2	323.1
1212	35.8	71.6	107.4	143.2	179.0	214.8	250.6	286.4	322.2
1215	35.7	71.4	107.1	142.8	178.5	214.2	249.9	285.6	321.3
1218	35.6	71.2	106.8	142.4	178.0	213.6	249.2	284.8	320.4

No. 120 L. 079.] LOGARITHMS OF NUMBERS. [No. 134 L. 130.

N.	0	1	2	3	4	5	6	7	8	9	N.
120	079181	9543	9904	0266	0626	0987	1347	1707	2067	2426	120
1	082785	3144	3503	3861	4219	4576	4934	5291	5647	6004	1
2	6360	6716	7071	7426	7781	8136	8490	8845	9198	9552	2
3	9905	0258	0611	0963	1315	1667	2018	2370	2721	3071	3
4	093422	3772	4122	4471	4820	5169	5518	5866	6215	6562	4
5	6910	7257	7604	7951	8298	8644	8990	9335	9681	0026	5
6	100371	0715	1059	1403	1747	2091	2434	2777	3119	3462	6
7	3804	4146	4487	4828	5169	5510	5851	6191	6531	6871	7
8	7210	7549	7888	8227	8565	8903	9241	9579	9916	0253	8
9	110590	0926	1263	1599	1934	2270	2605	2940	3275	3609	9
130	3943	4277	4611	4944	5278	5611	5943	6276	6608	6940	130
1	7271	7603	7934	8265	8595	8926	9256	9586	9915	0245	1
2	120574	0903	1231	1560	1888	2216	2544	2871	3198	3525	2
3	3852	4178	4504	4830	5156	5481	5806	6131	6456	6781	3
4	7105	7429	7753	8076	8399	8722	9045	9368	9690	0012	4

PROPORTIONAL PARTS.	N.	1	2	3	4	5	6	7	8	9
	1222	35'5	71'0	106'5	142'0	177'5	213'0	248'5	284'0	319'5
1225	35'4	70'8	106'2	141'6	177'0	212'4	247'8	283'2	318'6	
1228	35'3	70'6	105'9	141'2	176'5	211'8	247'1	282'4	317'7	
1231	35'2	70'4	105'6	140'8	176'0	211'2	246'4	281'6	316'8	
1235	35'1	70'2	105'3	140'4	175'5	210'6	245'7	280'8	315'9	
1239	35'0	70'0	105'0	140'0	175'0	210'0	245'0	280'0	315'0	
1243	34'9	69'8	104'7	139'6	174'5	209'4	244'3	279'2	314'1	
1247	34'8	69'6	104'4	139'2	174'0	208'8	243'6	278'4	313'2	
1250	34'7	69'4	104'1	138'8	173'5	208'2	242'9	277'6	312'3	
1253	34'6	69'2	103'8	138'4	173'0	207'6	242'2	276'8	311'4	
1257	34'5	69'0	103'5	138'0	172'5	207'0	241'5	276'0	310'5	
1261	34'4	68'8	103'2	137'6	172'0	206'4	240'8	275'2	309'6	
1264	34'3	68'6	102'9	137'2	171'5	205'8	240'1	274'4	308'7	
1268	34'2	68'4	102'6	136'8	171'0	205'2	239'4	273'6	307'8	
1272	34'1	68'2	102'3	136'4	170'5	204'6	238'7	272'8	306'9	
1276	34'0	68'0	102'0	136'0	170'0	204'0	238'0	272'0	306'0	
1279	33'9	67'8	101'7	135'6	169'5	203'4	237'3	271'2	305'1	
1283	33'8	67'6	101'4	135'2	169'0	202'8	236'6	270'4	304'2	
1287	33'7	67'4	101'1	134'8	168'5	202'2	235'9	269'6	303'3	
1291	33'6	67'2	100'8	134'4	168'0	201'6	235'2	268'8	302'4	
1295	33'5	67'0	100'5	134'0	167'5	201'0	234'5	268'0	301'5	
1298	33'4	66'8	100'2	133'6	167'0	200'4	233'8	267'2	300'6	
1302	33'3	66'6	99'9	133'2	166'5	199'8	233'1	266'4	299'7	
1306	33'2	66'4	99'6	132'8	166'0	199'2	232'4	265'6	298'8	
1310	33'1	66'2	99'3	132'4	165'5	198'6	231'7	264'8	297'9	
1314	33'0	66'0	99'0	132'0	165'0	198'0	231'0	264'0	297'0	
1318	32'9	65'8	98'7	131'6	164'5	197'4	230'3	263'2	296'1	
1322	32'8	65'6	98'4	131'2	164'0	196'8	229'6	262'4	295'2	
1326	32'7	65'4	98'1	130'8	163'5	196'2	228'9	261'6	294'3	
1330	32'6	65'2	97'8	130'4	163'0	195'6	228'2	260'8	293'4	
1334	32'5	65'0	97'5	130'0	162'5	195'0	227'5	260'0	292'5	
1338	32'4	64'8	97'2	129'6	162'0	194'4	226'8	259'2	291'6	
1343	32'3	64'6	96'9	129'2	161'5	193'8	226'1	258'4	290'7	
1347	32'2	64'4	96'6	128'8	161'0	193'2	225'4	257'6	289'8	

[No. 135 L. 130.]		LOGARITHMS OF NUMBERS.									[No. 149 L. 175.]	
N.	q	1	2	3	4	5	6	7	8	9	N.	
33	190334	0655	0977	1298	1619	1939	2260	2580	2900	3219	135	
6	3539	3858	4177	4496	4814	5133	5451	5769	6086	6403	6	
7	6721	7037	7354	7671	7987	8303	8618	8934	9249	9564	7	
8	9879	0194	0508	0822	1136	1450	1763	2076	2389	2702	8	
9	143015	3327	3639	3951	4263	4574	4885	5196	5507	5818	9	
40	6128	6438	6748	7058	7367	7676	7985	8294	8603	8911	140	
1	9219	9527	9835	0142	0449	0756	1063	1370	1676	1982	1	
2	152288	2594	2900	3205	3510	3815	4120	4424	4728	5032	2	
3	5336	5640	5943	6246	6549	6852	7154	7457	7759	8061	3	
4	8362	8664	8965	9266	9567	9868	0168	0469	0769	1068	4	
5	161368	1667	1967	2266	2564	2863	3161	3460	3758	4055	5	
6	4353	4650	4947	5244	5541	5838	6134	6430	6726	7022	6	
7	7317	7613	7908	8203	8497	8792	9086	9380	9674	9968	7	
8	170262	0555	0848	1141	1434	1726	2019	2311	2603	2895	8	
9	3186	3478	3769	4060	4351	4641	4932	5222	5512	5802	9	

P. ПРОМЕЖУГАЛ. РАДКИ.	N.	1	2	3	4	5	6	7	8	9
	1351	32.1	64.2	96.3	128.4	160.5	192.6	224.7	256.8	288.9
1355	32.0	64.0	96.0	128.0	160.0	192.0	224.0	256.0	288.0	
1359	31.9	63.8	95.7	127.6	159.5	191.4	223.3	255.2	287.1	
1364	31.8	63.6	95.4	127.2	159.0	190.8	222.6	254.4	286.2	
1368	31.7	63.4	95.1	126.8	158.5	190.2	221.9	253.6	285.3	
1372	31.6	63.2	94.8	126.4	158.0	189.6	221.2	252.8	284.4	
1376	31.5	63.0	94.5	126.0	157.5	189.0	220.5	252.0	283.5	
1381	31.4	62.8	94.2	125.6	157.0	188.4	219.8	251.2	282.6	
1385	31.3	62.6	93.9	125.2	156.5	187.8	219.1	250.4	281.7	
1390	31.2	62.4	93.6	124.8	156.0	187.2	218.4	249.6	280.8	
1394	31.1	62.2	93.3	124.4	155.5	186.6	217.7	248.8	279.9	
1398	31.0	62.0	93.0	124.0	155.0	186.0	217.0	248.0	279.0	
1403	30.9	61.8	92.7	123.6	154.5	185.4	216.3	247.2	278.1	
1408	30.8	61.6	92.4	123.2	154.0	184.8	215.6	246.4	277.2	
1412	30.7	61.4	92.1	122.8	153.5	184.2	214.9	245.6	276.3	
1417	30.6	61.2	91.8	122.4	153.0	183.6	214.2	244.8	275.4	
1422	30.5	61.0	91.5	122.0	152.5	183.0	213.5	244.0	274.5	
1426	30.4	60.8	91.2	121.6	152.0	182.4	212.8	243.2	273.6	
1431	30.3	60.6	90.9	121.2	151.5	181.8	212.1	242.4	272.7	
1436	30.2	60.4	90.6	120.8	151.0	181.2	211.4	241.6	271.8	
1441	30.1	60.2	90.3	120.4	150.5	180.6	210.7	240.8	270.9	
1446	30.0	60.0	90.0	120.0	150.0	180.0	210.0	240.0	270.0	
1450	29.9	59.8	89.7	119.6	149.5	179.4	209.3	239.2	269.1	
1455	29.8	59.6	89.4	119.2	149.0	178.8	208.6	238.4	268.2	
1460	29.7	59.4	89.1	118.8	148.5	178.2	207.9	237.6	267.3	
1465	29.6	59.2	88.8	118.4	148.0	177.6	207.2	236.8	266.4	
1470	29.5	59.0	88.5	118.0	147.5	177.0	206.5	236.0	265.5	
1475	29.4	58.8	88.2	117.6	147.0	176.4	205.8	235.2	264.6	
1480	29.3	58.6	87.9	117.2	146.5	175.8	205.1	234.4	263.7	
1485	29.2	58.4	87.6	116.8	146.0	175.2	204.4	233.6	262.8	
1490	29.1	58.2	87.3	116.4	145.5	174.6	203.7	232.8	261.9	
1495	29.0	58.0	87.0	116.0	145.0	174.0	203.0	232.0	261.0	
1500	28.9	57.8	86.7	115.6	144.5	173.4	202.3	231.2	260.1	
1505	28.8	57.6	86.4	115.2	144.0	172.8	201.6	230.4	259.2	
1511	28.7	57.4	86.1	114.8	143.5	172.2	200.9	229.6	258.3	
1516	28.6	57.2	85.8	114.4	143.0	171.6	200.2	228.8	257.4	

[No. 150 L. 176.]

LOGARITHMS OF NUMBERS.

[No. 169 L. 290.]

N.	0	1	2	3	4	5	6	7	8	9	N.
150	176091	6381	6670	6959	7248	7536	7825	8113	8401	8689	150
1	8977	9264	9552	9839	0126	0413	0699	0986	1272	1558	1
2	181844	2129	2415	2700	2985	3270	3555	3839	4123	4407	2
3	4691	4975	5259	5542	5825	6108	6391	6674	6956	7239	3
4	7521	7803	8084	8366	8647	8928	9209	9490	9771	0051	4
5	190332	0612	0892	1171	1451	1730	2010	2289	2567	2846	5
6	3125	3403	3681	3959	4237	4514	4792	5069	5346	5623	6
7	5900	6176	6453	6729	7005	7281	7556	7832	8107	8382	7
8	8657	8932	9206	9481	9755	0029	0303	0577	0850	1124	8
9	201397	1670	1943	2216	2488	2761	3033	3305	3577	3848	9
160	4120	4391	4663	4934	5204	5475	5746	6016	6286	6556	160
1	6826	7096	7365	7634	7904	8173	8441	8710	8979	9247	1
2	9515	9783	0051	0319	0586	0853	1121	1388	1654	1921	2
3	212188	2454	2720	2986	3252	3518	3783	4049	4314	4579	3
4	4844	5109	5373	5638	5902	6166	6430	6694	6957	7221	4
5	7484	7747	8010	8273	8536	8798	9060	9323	9585	9846	5
6	220108	0370	0631	0892	1153	1414	1675	1936	2196	2456	6
7	2716	2976	3236	3496	3755	4015	4274	4533	4792	5051	7
8	5309	5568	5826	6084	6342	6600	6858	7115	7372	7630	8
9	7887	8144	8400	8657	8913	9170	9426	9682	9938	0193	9

PROPORTIONAL PARTS.

N.	1	2	3	4	5	6	7	8	9
1521	28'5	57'0	85'5	114'0	142'5	171'0	199'5	228'0	256'5
1522	28'4	56'8	85'2	113'6	142'0	170'4	198'8	227'2	255'6
1532	28'3	56'6	84'9	113'2	141'5	169'8	198'1	226'4	254'7
1537	28'2	56'4	84'6	112'8	141'0	169'2	197'4	225'6	253'8
1543	28'1	56'2	84'3	112'4	140'5	168'6	196'7	224'8	252'9
1548	28'0	56'0	84'0	112'0	140'0	168'0	196'0	224'0	252'0
1554	27'9	55'8	83'7	111'6	139'5	167'4	195'3	223'2	251'1
1559	27'8	55'6	83'4	111'2	139'0	166'8	194'6	222'4	250'2
1565	27'7	55'4	83'1	110'8	138'5	166'2	193'9	221'6	249'3
1570	27'6	55'2	82'8	110'4	138'0	165'6	193'2	220'8	248'4
1576	27'5	55'0	82'5	110'0	137'5	165'0	192'5	220'0	247'5
1582	27'4	54'8	82'2	109'6	137'0	164'4	191'8	219'2	246'6
1587	27'3	54'6	81'9	109'2	136'5	163'8	191'1	218'4	245'7
1593	27'2	54'4	81'6	108'8	136'0	163'2	190'4	217'6	244'8
1599	27'1	54'2	81'3	108'4	135'5	162'6	189'7	216'8	243'9
1605	27'0	54'0	81'0	108'0	135'0	162'0	189'0	216'0	243'0
1611	26'9	53'8	80'7	107'6	134'5	161'4	188'3	215'2	242'1
1617	26'8	53'6	80'4	107'2	134'0	160'8	187'6	214'4	241'2
1623	26'7	53'4	80'1	106'8	133'5	160'2	186'9	213'6	240'3
1629	26'6	53'2	79'8	106'4	133'0	159'6	186'2	212'8	239'4
1635	26'5	53'0	79'5	106'0	132'5	159'0	185'5	212'0	238'5
1641	26'4	52'8	79'2	105'6	132'0	158'4	184'8	211'2	237'6
1648	26'3	52'6	78'9	105'2	131'5	157'8	184'1	210'4	236'7
1654	26'2	52'4	78'6	104'8	131'0	157'2	183'4	209'6	235'8
1660	26'1	52'2	78'3	104'4	130'5	156'6	182'7	208'8	234'9
1667	26'0	52'0	78'0	104'0	130'0	156'0	182'0	208'0	234'0
1673	25'9	51'8	77'7	103'6	129'5	155'4	181'3	207'2	233'1
1680	25'8	51'6	77'4	103'2	129'0	154'8	180'6	206'4	232'2
1686	25'7	51'4	77'1	102'8	128'5	154'2	179'9	205'6	231'3
1693	25'6	51'2	76'8	102'4	128'0	153'6	179'2	204'8	230'4
1699	25'5	51'0	76'5	102'0	127'5	153'0	178'5	204'0	229'5

No. 170 L. 230.]		LOGARITHMS OF NUMBERS.										[No. 189 L. 278.]	
N.	0	1	2	3	4	5	6	7	8	9	N.		
170	230449	0704	0960	1215	1470	1724	1979	2234	2488	2742	170		
1	2996	3250	3504	3757	4011	4264	4517	4770	5023	5276	1		
2	5328	5781	6033	6285	6537	6789	7041	7292	7544	7795	2		
3	8046	8297	8548	8799	9049	9299	9550		0050	0300	3		
4	240549	0799	1048	1297	1546	1795	2044	2293	2541	2790	4		
5	3038	3286	3534	3782	4030	4277	4525	4772	5019	5266	5		
6	5513	5759	6006	6252	6499	6745	6991	7237	7482	7728	6		
7	7973	8219	8464	8709	8954	9198	9443	9687	9932	0176	7		
8	250420	0664	0908	1151	1395	1638	1881	2125	2368	2610	8		
9	2853	3096	3338	3580	3822	4064	4306	4548	4790	5031	9		
180	5273	5514	5755	5996	6237	6477	6718	6958	7198	7439	180		
1	7679	7918	8158	8398	8637	8877	9116	9355	9594	9833	1		
2	260071	0310	0548	0787	1025	1263	1501	1739	1976	2214	2		
3	2451	2688	2925	3162	3399	3636	3873	4109	4346	4582	3		
4	4818	5054	5290	5525	5761	5996	6232	6467	6702	6937	4		
5	7172	7406	7641	7875	8110	8344	8578	8812	9046	9279	5		
6	9513	9746	9980	0213	0446	0679	0912	1144	1377	1609	6		
7	271842	2074	2306	2538	2770	3001	3233	3464	3696	3927	7		
8	4158	4389	4620	4850	5081	5311	5542	5772	6002	6232	8		
9	6462	6692	6921	7151	7380	7609	7838	8067	8296	8525	9		

N.	ГЛОБОКАЛ РАДКА.								
	1	2	3	4	5	6	7	8	9
1706	25.4	50.8	76.2	101.6	127.0	152.4	177.8	203.2	228.6
1713	25.3	50.6	75.9	101.2	126.5	151.8	177.1	202.4	227.7
1719	25.2	50.4	75.6	100.8	126.0	151.2	176.4	201.6	226.8
1726	25.1	50.2	75.3	100.4	125.5	150.6	175.7	200.8	225.9
1733	25.0	50.0	75.0	100.0	125.0	150.0	175.0	200.0	225.0
1740	24.9	49.8	74.7	99.6	124.5	149.4	174.3	199.2	224.1
1747	24.8	49.6	74.4	99.2	124.0	148.8	173.6	198.4	223.2
1754	24.7	49.4	74.1	98.8	123.5	148.2	172.9	197.6	222.3
1761	24.6	49.2	73.8	98.4	123.0	147.6	172.2	196.8	221.4
1769	24.5	49.0	73.5	98.0	122.5	147.0	171.5	196.0	220.5
1776	24.4	48.8	73.2	97.6	122.0	146.4	170.8	195.2	219.6
1783	24.3	48.6	72.9	97.2	121.5	145.8	170.1	194.4	218.7
1790	24.2	48.4	72.6	96.8	121.0	145.2	169.4	193.6	217.8
1798	24.1	48.2	72.3	96.4	120.5	144.6	168.7	192.8	216.9
1805	24.0	48.0	72.0	96.0	120.0	144.0	168.0	192.0	216.0
1813	23.9	47.8	71.7	95.6	119.5	143.4	167.3	191.2	215.1
1820	23.8	47.6	71.4	95.2	119.0	142.8	166.6	190.4	214.2
1828	23.7	47.4	71.1	94.8	118.5	142.2	165.9	189.6	213.3
1836	23.6	47.2	70.8	94.4	118.0	141.6	165.2	188.8	212.4
1844	23.5	47.0	70.5	94.0	117.5	141.0	164.5	188.0	211.5
1852	23.4	46.8	70.2	93.6	117.0	140.4	163.8	187.2	210.6
1859	23.3	46.6	69.9	93.2	116.5	139.8	163.1	186.4	209.7
1867	23.2	46.4	69.6	92.8	116.0	139.2	162.4	185.6	208.8
1876	23.1	46.2	69.3	92.4	115.5	138.6	161.7	184.8	207.9
1884	23.0	46.0	69.0	92.0	115.0	138.0	161.0	184.0	207.0
1892	22.9	45.8	68.7	91.6	114.5	137.4	160.3	183.2	206.1
1900	22.8	45.6	68.4	91.2	114.0	136.8	159.6	182.4	205.2
1908	22.7	45.4	68.1	90.8	113.5	136.2	158.9	181.6	204.3
1917	22.6	45.2	67.8	90.4	113.0	135.6	158.2	180.8	203.4

No. 190 L. 278.]		LOGARITHMS OF NUMBERS.									[No. 214 L. 332.]	
N.	0	1	2	3	4	5	6	7	8	9	N.	
190	278754	8982	9211	9439	9667	9895	0123	0351	0578	0806	190	
1	281033	1261	1488	1715	1942	2169	2396	2622	2849	3075	1	
2	3301	3537	3753	3979	4205	4431	4656	4882	5107	5332	2	
3	5557	5782	6007	6232	6456	6681	6905	7130	7354	7578	3	
4	7802	8026	8249	8473	8696	8920	9143	9366	9589	9812	4	
5	290035	0257	0480	0702	0925	1147	1369	1591	1813	2034	5	
6	2256	2478	2699	2920	3141	3363	3584	3804	4025	4246	6	
7	4466	4687	4907	5127	5347	5567	5787	6007	6226	6446	7	
8	6665	6884	7104	7323	7542	7761	7979	8198	8416	8635	8	
9	8853	9071	9289	9507	9725	9943	0161	0378	0595	0813	9	
200	301030	1247	1464	1681	1898	2114	2331	2547	2764	2980	200	
1	3196	3412	3628	3844	4059	4275	4491	4706	4921	5136	1	
2	5351	5566	5781	5996	6211	6425	6639	6854	7068	7282	2	
3	7496	7710	7924	8137	8351	8564	8778	8991	9204	9417	3	
4	9630	9843	0056	0268	0481	0693	0906	1118	1330	1542	4	
5	311754	1966	2177	2389	2600	2812	3023	3234	3445	3656	5	
6	3867	4078	4289	4499	4710	4920	5130	5340	5551	5760	6	
7	5970	6180	6390	6599	6809	7018	7227	7436	7646	7854	7	
8	8063	8272	8481	8689	8898	9106	9314	9522	9730	9938	8	
9	320146	0354	0562	0769	0977	1184	1391	1598	1805	2012	9	
210	2219	2426	2633	2839	3046	3252	3458	3665	3871	4077	210	
1	4282	4488	4694	4899	5105	5310	5516	5721	5926	6131	1	
2	6336	6541	6745	6950	7155	7359	7563	7767	7972	8176	2	
3	8380	8583	8787	8991	9194	9398	9601	9805	0008	0211	3	
4	330414	0617	0819	1022	1225	1427	1630	1832	2034	2236	4	
PROPORTIONAL PARTS.												
	N.	1	2	3	4	5	6	7	8	9		
	1925	22.5	45.0	67.5	90.0	112.5	135.0	157.5	180.0	202.5		
	1934	22.4	44.8	67.2	89.6	112.0	134.4	156.8	179.2	201.6		
	1943	22.3	44.6	66.9	89.2	111.5	133.8	156.1	178.4	200.7		
	1952	22.2	44.4	66.6	88.8	111.0	133.2	155.4	177.6	199.8		
	1961	22.1	44.2	66.3	88.4	110.5	132.6	154.7	176.8	198.9		
	1969	22.0	44.0	66.0	88.0	110.0	132.0	154.0	176.0	198.0		
	1978	21.9	43.8	65.7	87.6	109.5	131.4	153.3	175.2	197.1		
	1987	21.8	43.6	65.4	87.2	109.0	130.8	152.6	174.4	196.2		
	1996	21.7	43.4	65.1	86.8	108.5	130.2	151.9	173.6	195.3		
	2005	21.6	43.2	64.8	86.4	108.0	129.6	151.2	172.8	194.4		
	2015	21.5	43.0	64.5	86.0	107.5	129.0	150.5	172.0	193.5		
	2024	21.4	42.8	64.2	85.6	107.0	128.4	149.8	171.2	192.6		
	2034	21.3	42.6	63.9	85.2	106.5	127.8	149.1	170.4	191.7		
	2043	21.2	42.4	63.6	84.8	106.0	127.2	148.4	169.6	190.8		
	2053	21.1	42.2	63.3	84.4	105.5	126.6	147.7	168.8	189.9		
	2063	21.0	42.0	63.0	84.0	105.0	126.0	147.0	168.0	189.0		
	2073	20.9	41.8	62.7	83.6	104.5	125.4	146.3	167.2	188.1		
	2082	20.8	41.6	62.4	83.2	104.0	124.8	145.6	166.4	187.2		
	2092	20.7	41.4	62.1	82.8	103.5	124.2	144.9	165.6	186.3		
	2103	20.6	41.2	61.8	82.4	103.0	123.6	144.2	164.8	185.4		
	2113	20.5	41.0	61.5	82.0	102.5	123.0	143.5	164.0	184.5		
	2123	20.4	40.8	61.2	81.6	102.0	122.4	142.8	163.2	183.6		
	2134	20.3	40.6	60.9	81.2	101.5	121.8	142.1	162.4	182.7		
	2144	20.2	40.4	60.6	80.8	101.0	121.2	141.4	161.6	181.8		

N.	0	1	2	3	4	5	6	7	8	9	N.
215	332438	2640	2842	3044	3246	3447	3649	3850	4051	4253	215
6	4454	4655	4856	5057	5257	5458	5658	5859	6059	6260	6
7	6460	6660	6860	7060	7260	7459	7659	7858	8058	8257	7
8	8456	8656	8855	9054	9253	9451	9650	9849	0047	0246	8
9	340444	0642	0841	1039	1237	1435	1632	1830	2028	2225	9
220	2423	2620	2817	3014	3212	3409	3606	3802	3999	4196	220
1	4392	4589	4785	4981	5178	5374	5570	5766	5962	6157	1
2	6353	6549	6744	6939	7135	7330	7525	7720	7915	8110	2
3	8305	8500	8694	8889	9083	9278	9472	9666	9860	0054	3
4	350248	0442	0636	0829	1023	1216	1410	1603	1796	1989	4
5	2183	2375	2568	2761	2954	3147	3339	3532	3724	3916	5
6	4108	4301	4493	4685	4876	5068	5260	5452	5643	5834	6
7	6026	6217	6408	6599	6790	6981	7172	7363	7554	7744	7
8	7935	8125	8316	8506	8696	8886	9076	9266	9456	9646	8
9	9835	0025	0215	0404	0593	0783	0972	1161	1350	1539	9
230	361728	1917	2105	2294	2482	2671	2859	3048	3236	3424	230
1	3612	3800	3988	4176	4363	4551	4739	4926	5113	5301	1
2	5428	5615	5802	6049	6236	6423	6610	6796	6983	7169	2
3	7356	7542	7729	7915	8101	8287	8473	8659	8845	9030	3
4	9216	9401	9587	9772	9958	0143	0328	0513	0698	0883	4
5	371068	1253	1437	1622	1806	1991	2175	2360	2544	2728	5
6	2912	3096	3280	3464	3647	3831	4015	4198	4382	4565	6
7	4748	4932	5115	5298	5481	5664	5846	6029	6212	6394	7
8	6577	6759	6942	7124	7306	7488	7670	7852	8034	8216	8
9	8398	8580	8761	8943	9124	9306	9487	9668	9849	0030	9

PROPORTIONAL PARTS.	N.	1	2	3	4	5	6	7	8	9
	2155	20'1	40'2	60'3	80'4	100'5	120'6	140'7	160'8	180'9
2166	20'0	40'0	60'0	80'0	100'0	120'0	140'0	160'0	180'0	
2176	19'9	39'8	59'7	79'6	99'5	119'4	139'3	159'2	179'1	
2187	19'8	39'6	59'4	79'2	99'0	118'8	138'6	158'4	178'2	
2198	19'7	39'4	59'1	78'8	98'5	118'2	137'9	157'6	177'3	
2210	19'6	39'2	58'8	78'4	98'0	117'6	137'2	156'8	176'4	
2221	19'5	39'0	58'5	78'0	97'5	117'0	136'5	156'0	175'5	
2232	19'4	38'8	58'2	77'6	97'0	116'4	135'8	155'2	174'6	
2244	19'3	38'6	57'9	77'2	96'5	115'8	135'1	154'4	173'7	
2256	19'2	38'4	57'6	76'8	96'0	115'2	134'4	153'6	172'8	
2267	19'1	38'2	57'3	76'4	95'5	114'6	133'7	152'8	171'9	
2279	19'0	38'0	57'0	76'0	95'0	114'0	133'0	152'0	171'0	
2291	18'9	37'8	56'7	75'6	94'5	113'4	132'3	151'2	170'1	
2303	18'8	37'6	56'4	75'2	94'0	112'8	131'6	150'4	169'2	
2316	18'7	37'4	56'1	74'8	93'5	112'2	130'9	149'6	168'3	
2328	18'6	37'2	55'8	74'4	93'0	111'6	130'2	148'8	167'4	
2341	18'5	37'0	55'5	74'0	92'5	111'0	129'5	148'0	166'5	
2353	18'4	36'8	55'2	73'6	92'0	110'4	128'8	147'2	165'6	
2366	18'3	36'6	54'9	73'2	91'5	109'8	128'1	146'4	164'7	
2379	18'2	36'4	54'6	72'8	91'0	109'2	127'4	145'6	163'8	
2392	18'1	36'2	54'3	72'4	90'5	108'6	126'7	144'8	162'9	
2406	18'0	36'0	54'0	72'0	90'0	108'0	126'0	144'0	162'0	
2419	17'9	35'8	53'7	71'6	89'5	107'4	125'3	143'2	161'1	

[No. 240 L. 380.]		LOGARITHMS OF NUMBERS.									[No. 269 L. 431.]	
N.	0	1	2	3	4	5	6	7	8	9	N.	
240	380211	0392	0573	0754	0934	1115	1296	1476	1656	1837	240	
1	2017	2197	2377	2557	2737	2917	3097	3277	3456	3636	1	
2	3815	3995	4174	4353	4533	4712	4891	5070	5249	5428	2	
3	5606	5785	5964	6142	6321	6499	6677	6856	7034	7212	3	
4	7390	7568	7746	7924	8101	8279	8456	8634	8811	8989	4	
5	9166	9343	9520	9698	9875	0051	0228	0405	0582	0759	5	
6	390935	1112	1288	1464	1641	1817	1993	2169	2345	2521	6	
7	2697	2873	3048	3224	3400	3575	3751	3926	4101	4277	7	
8	4452	4627	4802	4977	5152	5326	5501	5676	5850	6025	8	
9	6199	6374	6548	6722	6896	7071	7245	7419	7592	7766	9	
250	7940	8114	8287	8461	8634	8808	8981	9154	9328	9501	250	
1	9674	9847	0020	0192	0365	0538	0711	0883	1056	1228	1	
2	401401	1573	1745	1917	2089	2261	2433	2605	2777	2949	2	
3	3121	3292	3464	3635	3807	3978	4149	4320	4492	4663	3	
4	4834	5005	5176	5346	5517	5688	5858	6029	6199	6370	4	
5	6540	6710	6881	7051	7221	7391	7561	7731	7901	8070	5	
6	8240	8410	8579	8749	8918	9087	9257	9426	9595	9764	6	
7	9933	0102	0271	0440	0609	0777	0946	1114	1283	1451	7	
8	411620	1788	1956	2124	2293	2461	2629	2796	2964	3132	8	
9	3300	3467	3635	3803	3970	4137	4305	4472	4639	4806	9	
260	4973	5140	5307	5474	5641	5808	5974	6141	6308	6474	260	
1	6641	6807	6973	7139	7306	7472	7638	7804	7970	8135	1	
2	8301	8467	8633	8798	8964	9129	9295	9460	9625	9791	2	
3	9956	0121	0286	0451	0616	0781	0945	1110	1275	1439	3	
4	421604	1768	1933	2097	2261	2426	2590	2754	2918	3082	4	
5	3246	3410	3574	3737	3901	4065	4228	4392	4555	4718	5	
6	4882	5045	5208	5371	5534	5697	5860	6023	6186	6349	6	
7	6511	6674	6836	6999	7161	7324	7486	7648	7811	7973	7	
8	8135	8297	8459	8621	8783	8944	9106	9268	9429	9591	8	
9	9752	9914	0075	0236	0398	0559	0720	0881	1042	1203	9	

PROPORTIONAL PARTS.	N.	1	2	3	4	5	6	7	8	9
	2433	17.8	35.6	53.4	71.2	89.0	106.8	124.6	142.4	160.2
	2446	17.7	35.4	53.1	70.8	88.5	106.2	123.9	141.6	159.3
	2460	17.6	35.2	52.8	70.4	88.0	105.6	123.2	140.8	158.4
	2474	17.5	35.0	52.5	70.0	87.5	105.0	122.5	140.0	157.5
	2488	17.4	34.8	52.2	69.6	87.0	104.4	121.8	139.2	156.6
	2503	17.3	34.6	51.9	69.2	86.5	103.8	121.1	138.4	155.7
	2517	17.2	34.4	51.6	68.8	86.0	103.2	120.4	137.6	154.8
	2532	17.1	34.2	51.3	68.4	85.5	102.6	119.7	136.8	153.9
	2547	17.0	34.0	51.0	68.0	85.0	102.0	119.0	136.0	153.0
	2562	16.9	33.8	50.7	67.6	84.5	101.4	118.3	135.2	152.1
	2577	16.8	33.6	50.4	67.2	84.0	100.8	117.6	134.4	151.2
2592	16.7	33.4	50.1	66.8	83.5	100.2	116.9	133.6	150.3	
2608	16.6	33.2	49.8	66.4	83.0	99.6	116.2	132.8	149.4	
2624	16.5	33.0	49.5	66.0	82.5	99.0	115.5	132.0	148.5	
2640	16.4	32.8	49.2	65.6	82.0	98.4	114.8	131.2	147.6	
2656	16.3	32.6	48.9	65.2	81.5	97.8	114.1	130.4	146.7	
2672	16.2	32.4	48.5	64.8	81.0	97.2	113.4	129.6	145.8	
2689	16.1	32.2	48.3	64.4	80.5	96.6	112.7	128.8	144.9	

No. 270 L. 431.] LOGARITHMS OF NUMBERS. [No. 299 L. 476.]

N.	0	1	2	3	4	5	6	7	8	9	N.
270	431364	1525	1685	1846	2007	2167	2328	2488	2649	2809	270
1	2969	3130	3290	3450	3610	3770	3930	4090	4249	4409	1
2	4569	4729	4888	5048	5207	5367	5526	5685	5844	6004	2
3	6163	6322	6481	6640	6799	6957	7116	7275	7433	7592	3
4	7751	7909	8067	8226	8384	8542	8701	8859	9017	9175	4
5	9333	9491	9648	9806	9964	0122	0279	0437	0594	0752	5
6	440909	1066	1224	1381	1538	1695	1852	2009	2166	2323	6
7	2480	2637	2793	2950	3106	3263	3419	3576	3732	3889	7
8	4045	4201	4357	4513	4669	4825	4981	5137	5293	5449	8
9	5604	5760	5915	6071	6226	6382	6537	6692	6848	7003	9
280	7158	7313	7468	7623	7778	7933	8088	8242	8397	8552	280
1	8706	8861	9015	9170	9324	9478	9633	9787	9941	0095	1
2	450249	0403	0557	0711	0865	1018	1172	1326	1479	1633	2
3	1786	1940	2093	2247	2400	2553	2706	2859	3012	3165	3
4	3318	3471	3624	3777	3930	4082	4235	4387	4540	4692	4
5	4845	4997	5150	5302	5454	5606	5758	5910	6062	6214	5
6	6366	6518	6670	6821	6973	7125	7276	7428	7579	7731	6
7	7882	8033	8184	8336	8487	8638	8789	8940	9091	9242	7
8	9392	9543	9694	9845	9995	0146	0296	0447	0597	0748	8
9	460898	1048	1198	1348	1499	1649	1799	1948	2098	2248	9
290	2398	2548	2697	2847	2997	3146	3296	3445	3594	3744	290
1	3893	4042	4191	4340	4490	4639	4788	4936	5085	5234	1
2	5383	5532	5680	5829	5977	6126	6274	6423	6571	6719	2
3	6868	7016	7164	7312	7460	7608	7756	7904	8052	8200	3
4	8347	8495	8643	8790	8938	9085	9233	9380	9527	9675	4
5	9822	9969	0116	0263	0410	0557	0704	0851	0998	1145	5
6	471292	1438	1585	1732	1878	2025	2171	2318	2464	2610	6
7	2756	2903	3049	3195	3341	3487	3633	3779	3925	4071	7
8	4216	4362	4508	4653	4799	4944	5090	5235	5381	5526	8
9	5671	5816	5962	6107	6252	6397	6542	6687	6832	6976	9

PROPORTIONAL PARTS.	N.	1	2	3	4	5	6	7	8	9
	2705	16'0	32'0	48'0	64'0	80'0	96'0	112'0	128'0	144'0
	2722	15'9	31'8	47'7	63'6	79'5	95'4	111'3	127'2	143'1
	2740	15'8	31'6	47'4	63'2	79'0	94'8	110'6	126'4	142'2
	2757	15'7	31'4	47'1	62'8	78'5	94'2	109'9	125'6	141'3
	2775	15'6	31'2	46'8	62'4	78'0	93'6	109'2	124'8	140'4
	2792	15'5	31'0	46'5	62'0	77'5	93'0	108'5	124'0	139'5
	2810	15'4	30'8	46'2	61'6	77'0	92'4	107'8	123'2	138'6
	2827	15'3	30'6	45'9	61'2	76'5	91'8	107'1	122'4	137'7
	2844	15'2	30'4	45'6	60'8	76'0	91'2	106'4	121'6	136'8
	2866	15'1	30'2	45'3	60'4	75'5	90'6	105'7	120'8	135'9
	2885	15'0	30'0	45'0	60'0	75'0	90'0	105'0	120'0	135'0
2904	14'9	29'8	44'7	59'6	74'5	89'4	104'3	119'2	134'1	
2924	14'8	29'6	44'4	59'2	74'0	88'8	103'6	118'4	133'2	
2944	14'7	29'4	44'1	58'8	73'5	88'2	102'9	117'6	132'3	
2964	14'6	29'2	43'8	58'4	73'0	87'6	102'2	116'8	131'4	
2984	14'5	29'0	43'5	58'0	72'5	87'0	101'5	116'0	130'5	
3005	14'4	28'8	43'2	57'6	72'0	86'4	100'8	115'2	129'6	
3026	14'3	28'6	42'9	57'2	71'5	85'8	100'1	114'4	128'7	
3047	14'2	28'4	42'6	56'8	71'0	85'2	99'4	113'6	127'8	
3069	14'1	28'2	42'3	56'4	70'5	84'6	98'7	112'8	126'9	
3091	14'0	28'0	42'0	56'0	70'0	84'0	98'0	112'0	126'0	

No. 300 L. 477.] LOGARITHMS OF NUMBERS. [No. 339 L. 531.

N.	0	1	2	3	4	5	6	7	8	9	N.
300	47721	7266	7411	7555	7700	7844	7989	8133	8278	8422	300
1	8566	8711	8855	8999	9143	9287	9431	9575	9719	9863	1
2	480007	0151	0294	0438	0582	0725	0869	1012	1156	1299	2
3	1443	1586	1729	1872	2016	2159	2302	2445	2588	2731	3
4	2874	3016	3159	3302	3445	3587	3730	3872	4015	4157	4
5	4300	4442	4585	4727	4869	5011	5153	5295	5437	5579	5
6	5721	5863	6005	6147	6289	6430	6572	6714	6855	6997	6
7	7138	7280	7421	7563	7704	7845	7986	8127	8269	8410	7
8	8551	8692	8833	8974	9114	9255	9396	9537	9677	9818	8
9	9958	0099	0239	0380	0520	0661	0801	0941	1081	1222	9
310	491362	1502	1642	1782	1922	2062	2201	2341	2481	2621	310
1	2760	2900	3040	3179	3319	3458	3597	3737	3876	4015	1
2	4155	4294	4433	4572	4711	4850	4989	5128	5267	5406	2
3	5544	5683	5822	5960	6099	6238	6376	6515	6653	6791	3
4	6930	7068	7206	7344	7483	7621	7759	7897	8035	8173	4
5	8311	8448	8586	8724	8862	8999	9137	9275	9412	9550	5
6	9687	9824	9962	0099	0236	0374	0511	0648	0785	0922	6
7	501059	1106	1333	1470	1607	1744	1880	2017	2154	2291	7
8	2427	2564	2700	2837	2973	3109	3246	3382	3518	3655	8
9	3791	3927	4063	4199	4335	4471	4607	4743	4878	5014	9
320	5150	5286	5421	5557	5693	5828	5964	6099	6234	6370	320
1	6505	6640	6776	6911	7046	7181	7316	7451	7586	7721	1
2	7856	7991	8126	8260	8395	8530	8664	8799	8934	9068	2
3	9203	9337	9471	9606	9740	9874	0009	0143	0277	0411	3
4	510545	0679	0813	0947	1081	1215	1349	1482	1616	1750	4
5	1883	2017	2151	2284	2418	2551	2684	2818	2951	3084	5
6	3218	3351	3484	3617	3750	3883	4016	4149	4282	4415	6
7	4548	4681	4813	4946	5079	5211	5344	5476	5609	5741	7
8	5874	6006	6139	6271	6403	6535	6668	6800	6932	7064	8
9	7196	7328	7460	7592	7724	7855	7987	8119	8251	8382	9
330	8514	8646	8777	8909	9040	9171	9303	9434	9566	9697	330
1	9828	9959	0090	0221	0353	0485	0615	0745	0876	1007	1
2	521138	1269	1400	1530	1661	1792	1922	2053	2183	2314	2
3	2444	2575	2705	2835	2966	3096	3226	3356	3486	3616	3
4	3746	3876	4006	4136	4266	4396	4526	4656	4785	4915	4
5	5045	5174	5304	5434	5563	5693	5822	5951	6081	6210	5
6	6339	6469	6598	6727	6856	6985	7114	7243	7372	7501	6
7	7630	7759	7888	8016	8145	8274	8402	8531	8660	8788	7
8	8917	9045	9174	9302	9430	9559	9687	9815	9943	0072	8
9	530200	0328	0456	0584	0712	0840	0968	1096	1223	1351	9

PROPORTIONAL PARTS.	N.	1	2	3	4	5	6	7	8	9
	3113	13'9	27'8	41'7	55'6	69'5	83'4	97'3	111'2	125'1
	3135	13'8	27'6	41'4	55'2	69'0	82'8	96'6	110'4	124'2
	3158	13'7	27'4	41'1	54'8	68'5	82'2	95'9	109'6	123'3
	3181	13'6	27'2	40'8	54'4	68'0	81'6	95'2	108'8	122'4
	3205	13'5	27'0	40'5	54'0	67'5	81'0	94'5	108'0	121'5
	3228	13'4	26'8	40'2	53'6	67'0	80'4	93'8	107'2	120'6
	3253	13'3	26'6	39'9	53'2	66'5	79'8	93'1	106'4	119'7
	3277	13'2	26'4	39'6	52'8	66'0	79'2	92'4	105'6	118'8
	3302	13'1	26'2	39'3	52'4	65'5	78'6	91'7	104'8	117'9
	3327	13'0	26'0	39'0	52'0	65'0	78'0	91'0	104'0	117'0
	3353	12'9	25'8	38'7	51'6	64'5	77'4	90'3	103'2	116'1

No. 340 L. 531.]		LOGARITHMS OF NUMBERS.										[No. 379 L. 579.	
N.	0	1	2	3	4	5	6	7	8	9	N.		
340	531479	1607	1734	1862	1990	2117	2245	2372	2500	2627	340		
1	2754	2882	3009	3136	3264	3391	3518	3645	3772	3899	1		
2	4026	4153	4280	4407	4534	4661	4787	4914	5041	5167	2		
3	5294	5421	5547	5674	5800	5927	6053	6179	6306	6432	3		
4	6558	6685	6811	6937	7063	7189	7315	7441	7567	7693	4		
5	7819	7945	8071	8197	8322	8448	8574	8699	8825	8951	5		
6	9076	9202	9327	9452	9578	9703	9829	9954	0079	0204	6		
7	540329	0455	0580	0705	0830	0955	1080	1205	1330	1454	7		
8	1579	1704	1829	1953	2078	2203	2327	2452	2576	2701	8		
9	2825	2950	3074	3199	3323	3447	3571	3696	3820	3944	9		
350	4068	4192	4316	4440	4564	4688	4812	4936	5060	5183	350		
1	5307	5431	5555	5678	5802	5925	6049	6172	6296	6419	1		
2	6543	6666	6789	6913	7036	7159	7282	7405	7529	7652	2		
3	7775	7898	8021	8144	8267	8389	8512	8635	8758	8881	3		
4	9003	9126	9249	9371	9494	9616	9739	9861	9984	0106	4		
5	550228	0351	0473	0595	0717	0840	0962	1084	1206	1328	5		
6	1450	1572	1694	1816	1938	2060	2181	2303	2425	2547	6		
7	2668	2790	2911	3033	3155	3276	3398	3519	3640	3762	7		
8	3883	4004	4126	4247	4368	4489	4610	4731	4852	4973	8		
9	5094	5215	5336	5457	5578	5699	5820	5940	6061	6182	9		
360	6303	6423	6544	6664	6785	6905	7026	7146	7267	7387	360		
1	7507	7627	7748	7868	7988	8108	8228	8349	8469	8589	1		
2	8709	8829	8948	9068	9188	9308	9428	9548	9667	9787	2		
3	9907	0026	0146	0265	0385	0504	0624	0743	0863	0982	3		
4	561101	1221	1340	1459	1578	1698	1817	1936	2055	2174	4		
5	2293	2412	2531	2650	2769	2887	3006	3125	3244	3362	5		
6	3481	3600	3718	3837	3955	4074	4192	4311	4429	4548	6		
7	4666	4784	4903	5021	5139	5257	5376	5494	5612	5730	7		
8	5848	5966	6084	6202	6320	6437	6555	6673	6791	6909	8		
9	7026	7144	7262	7379	7497	7614	7732	7849	7967	8084	9		
370	8202	8319	8436	8554	8671	8788	8905	9023	9140	9257	370		
1	9374	9491	9608	9725	9842	9959	0076	0193	0309	0426	1		
2	570543	0660	0776	0893	1010	1126	1243	1359	1476	1592	2		
3	1709	1825	1942	2058	2174	2291	2407	2523	2639	2755	3		
4	2872	2988	3104	3220	3336	3452	3568	3684	3800	3915	4		
5	4031	4147	4263	4379	4494	4610	4726	4841	4957	5072	5		
6	5188	5303	5419	5534	5650	5765	5880	5996	6111	6226	6		
7	6341	6457	6572	6687	6802	6917	7032	7147	7262	7377	7		
8	7492	7607	7722	7836	7951	8066	8181	8295	8410	8525	8		
9	8639	8754	8868	8983	9097	9212	9326	9441	9555	9669	9		

PROPORTIONAL PARTS.	N.	1	2	3	4	5	6	7	8	9
	3379	12.8	25.6	38.4	51.2	64.0	76.8	89.6	102.4	115.2
	3406	12.7	25.4	38.1	50.8	63.5	76.2	88.9	101.6	114.3
	3433	12.6	25.2	37.8	50.4	63.0	75.6	88.2	100.8	113.4
	3460	12.5	25.0	37.5	50.0	62.5	75.0	87.5	100.0	112.5
	3488	12.4	24.8	37.2	49.6	62.0	74.4	86.8	99.2	111.6
	3516	12.3	24.6	36.9	49.2	61.5	73.8	86.1	98.4	110.7
	3545	12.2	24.4	36.6	48.8	61.0	73.2	85.4	97.6	109.8
	3574	12.1	24.2	36.3	48.4	60.5	72.6	84.7	96.8	108.9
	3604	12.0	24.0	36.0	48.0	60.0	72.0	84.0	96.0	108.0
	3634	11.9	23.8	35.7	47.6	59.5	71.4	83.3	95.2	107.1

No. 380 L. 579.] LOGARITHMS OF NUMBERS. [No. 414 L. 617.

N.	0	1	2	3	4	5	6	7	8	9	N.
380	579784	9898	0012	0126	0241	0355	0469	0583	0697	0811	380
1	580925	1039	1153	1267	1381	1495	1608	1722	1836	1950	1
2	2063	2177	2291	2404	2518	2631	2745	2858	2972	3085	2
3	3199	3312	3426	3539	3652	3765	3879	3992	4105	4218	3
4	4331	4444	4557	4670	4783	4896	5009	5122	5235	5348	4
5	5481	5574	5686	5799	5912	6024	6137	6250	6362	6475	5
6	6587	6700	6812	6925	7037	7149	7262	7374	7486	7599	6
7	7711	7823	7935	8047	8160	8272	8384	8496	8608	8720	7
8	8832	8944	9056	9167	9279	9391	9503	9615	9726	9838	8
9	9950	0061	0173	0284	0396	0507	0619	0730	0842	0953	9
390	591065	1176	1287	1399	1510	1621	1732	1843	1955	2066	390
1	2177	2288	2399	2510	2621	2732	2843	2954	3064	3175	1
2	3286	3397	3508	3618	3729	3840	3950	4061	4171	4282	2
3	4393	4503	4614	4724	4834	4945	5055	5165	5276	5386	3
4	5496	5606	5717	5827	5937	6047	6157	6267	6377	6487	4
5	6597	6707	6817	6927	7037	7146	7256	7366	7476	7586	5
6	7695	7805	7914	8024	8134	8243	8353	8462	8572	8681	6
7	8791	8900	9009	9119	9228	9337	9446	9556	9665	9774	7
8	9883	9992	0101	0210	0319	0428	0537	0646	0755	0864	8
9	600973	1082	1191	1299	1408	1517	1625	1734	1843	1951	9
400	2060	2169	2277	2386	2494	2603	2711	2819	2928	3036	400
1	3144	3253	3361	3469	3577	3686	3794	3902	4010	4118	1
2	4226	4334	4442	4550	4658	4766	4874	4982	5089	5197	2
3	5305	5413	5521	5628	5736	5844	5951	6059	6166	6274	3
4	6381	6489	6596	6704	6811	6919	7026	7133	7241	7348	4
5	7455	7562	7669	7777	7884	7991	8098	8205	8312	8419	5
6	8526	8633	8740	8847	8954	9061	9167	9274	9381	9488	6
7	9594	9701	9808	9914	0021	0128	0234	0341	0447	0554	7
8	610660	0767	0873	0979	1086	1192	1298	1405	1511	1617	8
9	1723	1829	1936	2042	2148	2254	2360	2466	2572	2678	9
410	2784	2890	2996	3102	3207	3313	3419	3525	3630	3736	410
1	3842	3947	4053	4159	4264	4370	4475	4581	4686	4792	1
2	4897	5003	5108	5213	5319	5424	5529	5634	5740	5845	2
3	5950	6055	6160	6265	6370	6476	6581	6686	6790	6895	3
4	7000	7105	7210	7315	7420	7525	7629	7734	7839	7943	4

PROPORTIONAL PARTS.	N.	1	2	3	4	5	6	7	8	9
	3665	11.8	23.6	35.4	47.2	59.0	70.8	82.6	94.4	106.2
	3696	11.7	23.4	35.1	46.8	58.5	70.2	81.9	93.6	105.3
	3727	11.6	23.2	34.8	46.4	58.0	69.6	81.2	92.8	104.4
	3760	11.5	23.0	34.5	46.0	57.5	69.0	80.5	92.0	103.5
	3792	11.4	22.8	34.2	45.6	57.0	68.4	79.8	91.2	102.6
	3826	11.3	22.6	33.9	45.2	56.5	67.8	79.1	90.4	101.7
	3860	11.2	22.4	33.6	44.8	56.0	67.2	78.4	89.6	100.8
	3895	11.1	22.2	33.3	44.4	55.5	66.6	77.7	88.8	99.9
	3930	11.0	22.0	33.0	44.0	55.0	66.0	77.0	88.0	99.0
3966	10.9	21.8	32.7	43.6	54.5	65.4	76.3	87.2	98.1	
4002	10.8	21.6	32.4	43.2	54.0	64.8	75.6	86.4	97.2	
4039	10.7	21.4	32.1	42.8	53.5	64.2	74.9	85.6	96.3	
4077	10.6	21.2	31.8	42.4	53.0	63.6	74.2	84.8	95.4	
4115	10.5	21.0	31.5	42.0	52.5	63.0	73.5	84.0	94.5	

No. 415 L. 618.]

LOGARITHMS OF NUMBERS.

[No. 459 L. 662.]

N.	0	1	2	3	4	5	6	7	8	9	N.
15	618048	8153	8257	8362	8466	8571	8676	8780	8884	8989	415
6	9093	9198	9302	9406	9511	9615	9719	9824	9928	0032	6
7	620136	0240	0344	0448	0552	0656	0760	0864	0968	1072	7
8	1176	1280	1384	1488	1592	1695	1799	1903	2007	2110	8
9	2214	2318	2421	2525	2628	2732	2835	2939	3042	3146	9
420	3249	3353	3456	3559	3663	3766	3869	3973	4076	4179	420
1	4282	4385	4488	4591	4695	4798	4901	5004	5107	5210	1
2	5312	5415	5518	5621	5724	5827	5929	6032	6135	6238	2
3	6340	6443	6546	6648	6751	6853	6956	7058	7161	7263	3
4	7366	7468	7571	7673	7775	7878	7980	8082	8185	8287	4
5	8389	8491	8593	8695	8797	8900	9002	9104	9206	9308	5
6	9410	9512	9613	9715	9817	9919	0021	0123	0224	0326	6
7	630428	0530	0631	0733	0835	0936	1038	1139	1241	1342	7
8	1444	1545	1647	1748	1849	1951	2052	2153	2255	2356	8
9	2457	2559	2660	2761	2862	2963	3064	3165	3266	3367	9
430	3468	3569	3670	3771	3872	3973	4074	4175	4276	4376	430
1	4477	4578	4679	4779	4880	4981	5081	5182	5283	5383	1
2	5484	5584	5685	5785	5886	5986	6087	6187	6287	6388	2
3	6488	6588	6688	6789	6889	6989	7089	7189	7290	7390	3
4	7490	7590	7690	7790	7890	7990	8090	8190	8290	8389	4
5	8489	8589	8689	8789	8888	8988	9088	9188	9287	9387	5
6	9486	9586	9686	9785	9885	9984	0084	0183	0283	0382	6
7	640481	0581	0680	0779	0879	0978	1077	1177	1276	1375	7
8	1474	1573	1672	1771	1871	1970	2069	2168	2267	2366	8
9	2465	2563	2662	2761	2860	2959	3058	3156	3255	3354	9
440	3453	3551	3650	3749	3847	3946	4044	4143	4242	4340	440
1	4439	4537	4636	4734	4832	4931	5029	5127	5226	5324	1
2	5422	5521	5619	5717	5815	5913	6011	6110	6208	6306	2
3	6404	6502	6600	6698	6796	6894	6992	7089	7187	7285	3
4	7383	7481	7579	7676	7774	7872	7969	8067	8165	8262	4
5	8360	8458	8555	8653	8750	8848	8945	9043	9140	9237	5
6	9335	9432	9530	9627	9724	9821	9919	0016	0113	0210	6
7	650308	0405	0502	0599	0696	0793	0890	0987	1084	1181	7
8	1278	1375	1472	1569	1666	1762	1859	1956	2053	2150	8
9	2246	2343	2440	2536	2633	2730	2826	2923	3019	3116	9
450	3213	3309	3405	3502	3598	3695	3791	3888	3984	4080	450
1	4177	4273	4369	4465	4562	4658	4754	4850	4946	5042	1
2	5138	5235	5331	5427	5523	5619	5715	5810	5906	6002	2
3	6098	6194	6290	6386	6482	6577	6673	6769	6864	6960	3
4	7056	7152	7247	7343	7438	7534	7629	7725	7820	7916	4
5	8011	8107	8202	8298	8393	8488	8584	8679	8774	8870	5
6	8965	9060	9155	9250	9346	9441	9536	9631	9726	9821	6
7	9916	0011	0106	0201	0296	0391	0486	0581	0676	0771	7
8	660865	0960	1055	1150	1245	1339	1434	1529	1623	1718	8
9	1813	1907	2002	2096	2191	2286	2380	2475	2569	2663	9

LOGARITHMS
 OF NUMBERS

N.	1	2	3	4	5	6	7	8	9
4155	10.4	20.8	31.2	41.6	52.0	62.4	72.8	83.2	93.6
4196	10.3	20.6	30.9	41.3	51.5	61.8	72.1	82.4	92.7
4237	10.2	20.4	30.6	40.8	51.0	61.2	71.4	81.6	91.8
4278	10.1	20.3	30.3	40.4	50.5	60.6	70.7	80.8	90.9
4318	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0
4358	9.9	19.8	29.7	39.6	49.5	59.4	69.3	79.2	89.1

No. 460 L. 662.]		LOGARITHMS OF NUMBERS.									[No. 499 L. 698.	
N.	0	1	2	3	4	5	6	7	8	9	N.	
460	662758	2852	2947	3041	3135	3230	3324	3418	3512	3607	460	
1	3701	3795	3889	3983	4078	4172	4266	4360	4454	4548	1	
2	4642	4736	4830	4924	5018	5112	5206	5299	5393	5487	2	
3	5581	5675	5769	5862	5956	6050	6143	6237	6331	6424	3	
4	6518	6612	6705	6799	6892	6986	7079	7173	7266	7360	4	
5	7453	7546	7640	7733	7826	7920	8013	8106	8199	8293	5	
6	8386	8479	8572	8665	8759	8852	8945	9038	9131	9224	6	
7	9317	9410	9503	9596	9689	9782	9875	9967	0060	0153	7	
8	670246	0339	0431	0524	0617	0710	0802	0895	0988	1080	8	
9	1173	1265	1358	1451	1543	1635	1728	1821	1913	2005	9	
470	2098	2190	2283	2375	2467	2560	2652	2744	2836	2929	470	
1	3021	3113	3205	3297	3390	3482	3574	3666	3758	3850	1	
2	3942	4034	4126	4218	4310	4402	4494	4586	4677	4769	2	
3	4861	4953	5045	5137	5228	5320	5412	5503	5595	5687	3	
4	5778	5870	5962	6053	6145	6236	6328	6419	6511	6602	4	
5	6694	6785	6876	6968	7059	7151	7242	7333	7424	7516	5	
6	7607	7698	7789	7881	7972	8063	8154	8245	8336	8427	6	
7	8518	8609	8700	8791	8882	8973	9064	9155	9246	9337	7	
8	9428	9519	9610	9700	9791	9882	9973	0063	0154	0245	8	
9	680336	0426	0517	0607	0698	0789	0879	0970	1060	1151	9	
480	1241	1332	1422	1513	1603	1693	1784	1874	1964	2055	480	
1	2145	2235	2326	2416	2506	2596	2686	2777	2867	2957	1	
2	3047	3137	3227	3317	3407	3497	3587	3677	3767	3857	2	
3	3947	4037	4127	4217	4307	4396	4486	4576	4666	4756	3	
4	4845	4935	5025	5114	5204	5294	5383	5473	5563	5652	4	
5	5742	5831	5921	6010	6100	6189	6279	6368	6458	6547	5	
6	6636	6726	6815	6904	6994	7083	7172	7261	7351	7440	6	
7	7529	7618	7707	7796	7886	7975	8064	8153	8242	8331	7	
8	8420	8509	8598	8687	8776	8865	8953	9042	9131	9220	8	
9	9309	9398	9486	9575	9664	9753	9841	9930	0019	0107	9	
490	690196	0285	0373	0462	0550	0639	0728	0816	0905	0993	490	
1	1081	1170	1258	1347	1435	1524	1612	1700	1789	1877	1	
2	1965	2053	2142	2230	2318	2406	2494	2583	2671	2759	2	
3	2847	2935	3023	3111	3199	3287	3375	3463	3551	3639	3	
4	3727	3815	3903	3991	4078	4166	4254	4342	4430	4517	4	
5	4605	4693	4781	4868	4956	5044	5131	5219	5307	5394	5	
6	5482	5569	5657	5744	5832	5919	6007	6094	6182	6269	6	
7	6356	6444	6531	6618	6706	6793	6880	6968	7055	7142	7	
8	7229	7317	7404	7491	7578	7665	7752	7839	7926	8014	8	
9	8100	8188	8275	8362	8449	8535	8622	8709	8796	8883	9	
PROPORTIONAL PARTS.		N.	1	2	3	4	5	6	7	8	9	
		4410	9·8	19·6	29·4	39·2	49·0	58·8	68·6	78·4	88·2	
		4454	9·7	19·4	29·1	38·8	48·5	58·2	67·9	77·6	87·3	
		4500	9·6	19·2	28·8	38·4	48·0	57·6	67·2	76·8	86·4	
		4547	9·5	19·0	28·5	38·0	47·5	57·0	66·5	76·0	85·5	
		4595	9·4	18·8	28·2	37·6	47·0	56·4	65·8	75·2	84·6	
		4644	9·3	18·6	27·9	37·2	46·5	55·8	65·1	74·4	83·7	
		4695	9·2	18·4	27·6	36·8	46·0	55·2	64·4	73·6	82·8	
		4746	9·1	18·2	27·3	36·4	45·5	54·6	63·7	72·8	81·9	
		4798	9·0	18·0	27·0	36·0	45·0	54·0	63·0	72·0	81·0	
4852	8·9	17·8	26·7	35·6	44·5	53·4	62·3	71·2	80·1			
4907	8·8	17·6	26·4	35·2	44·0	52·8	61·6	70·4	79·2			

No. 500 L. 698.]		LOGARITHMS OF NUMBERS.									[No. 544 L. 736.	
N.	0	1	2	3	4	5	6	7	8	9	N.	
500	698970	9057	9144	9231	9317	9404	9491	9578	9664	9751	500	
1	9838	9924	0011	0098	0184	0271	0358	0444	0531	0617	1	
2	700704	0790	0877	0963	1050	1136	1222	1309	1395	1482	2	
3	1568	1654	1741	1827	1913	1999	2086	2172	2258	2344	3	
4	2431	2517	2603	2689	2775	2861	2947	3033	3119	3205	4	
5	3291	3377	3463	3549	3635	3721	3807	3893	3979	4065	5	
6	4151	4236	4322	4408	4494	4579	4665	4751	4837	4922	6	
7	5008	5094	5179	5265	5350	5436	5522	5607	5693	5778	7	
8	5864	5949	6035	6120	6206	6291	6376	6462	6547	6632	8	
9	6718	6803	6888	6974	7059	7144	7229	7315	7400	7485	9	
510	7570	7655	7740	7826	7911	7996	8081	8166	8251	8336	510	
1	8421	8506	8591	8676	8761	8846	8931	9015	9100	9185	1	
2	9270	9355	9440	9524	9609	9694	9779	9863	9948	0033	2	
3	710117	0202	0287	0371	0456	0540	0625	0710	0794	0879	3	
4	0963	1048	1132	1217	1301	1385	1470	1554	1639	1723	4	
5	1807	1892	1976	2060	2144	2229	2313	2397	2481	2565	5	
6	2650	2734	2818	2902	2986	3070	3154	3238	3322	3406	6	
7	3491	3575	3659	3742	3826	3910	3994	4078	4162	4246	7	
8	4330	4414	4497	4581	4665	4749	4833	4916	5000	5084	8	
9	5167	5251	5335	5418	5502	5586	5669	5753	5836	5920	9	
520	6003	6087	6170	6254	6337	6421	6504	6588	6671	6754	520	
1	6838	6921	7004	7088	7171	7254	7338	7421	7504	7587	1	
2	7671	7754	7837	7920	8003	8086	8169	8253	8336	8419	2	
3	8502	8585	8668	8751	8834	8917	9000	9083	9165	9248	3	
4	9331	9414	9497	9580	9663	9745	9828	9911	9994	0077	4	
5	720159	0242	0325	0407	0490	0573	0655	0738	0821	0903	5	
6	0986	1068	1151	1233	1316	1398	1481	1563	1646	1728	6	
7	1811	1893	1975	2058	2140	2222	2305	2387	2469	2552	7	
8	2634	2716	2798	2881	2963	3045	3127	3209	3291	3374	8	
9	3456	3538	3620	3702	3784	3866	3948	4030	4112	4194	9	
530	4276	4358	4440	4522	4604	4685	4767	4849	4931	5013	530	
1	5095	5176	5258	5340	5422	5503	5585	5667	5748	5830	1	
2	5912	5993	6075	6156	6238	6320	6401	6483	6564	6646	2	
3	6727	6809	6890	6972	7053	7134	7216	7297	7379	7460	3	
4	7541	7623	7704	7785	7866	7948	8029	8110	8191	8273	4	
5	8354	8435	8516	8597	8678	8759	8841	8922	9003	9084	5	
6	9165	9246	9327	9408	9489	9570	9651	9732	9813	9893	6	
7	9974	0055	0136	0217	0298	0378	0459	0540	0621	0702	7	
8	730782	0863	0944	1024	1105	1186	1266	1347	1428	1508	8	
9	1589	1669	1750	1830	1911	1991	2072	2152	2233	2313	9	
540	2394	2474	2555	2635	2715	2796	2876	2956	3037	3117	540	
1	3197	3278	3358	3438	3518	3598	3679	3759	3839	3919	1	
2	3999	4079	4160	4240	4320	4400	4480	4560	4640	4720	2	
3	4800	4880	4960	5040	5120	5199	5279	5359	5439	5519	3	
4	5599	5679	5759	5838	5918	5998	6078	6157	6237	6317	4	
PROP. PARTS.	N.	1	2	3	4	5	6	7	8	9		
	4963	8.7	17.4	26.1	34.8	43.5	52.2	60.9	69.6	78.3		
	5000	8.6	17.2	25.8	34.4	43.0	51.6	60.2	68.8	77.4		
	5079	8.5	17.0	25.5	34.0	42.5	51.0	59.5	68.0	76.5		
5139	8.4	16.8	25.2	33.6	42.0	50.4	58.8	67.2	75.6			

No. 545 L. 736.]		LOGARITHMS OF NUMBERS.										[No. 584 L. 767.	
N.	0	1	2	3	4	5	6	7	8	9	N.		
545	736397	6476	6556	6635	6715	6795	6874	6954	7034	7113	545		
6	7193	7272	7552	7431	7511	7590	7670	7749	7829	7908	6		
7	7987	8067	8146	8225	8305	8384	8463	8543	8622	8701	7		
8	8781	8860	8959	9018	9097	9177	9256	9335	9414	9493	8		
9	9572	9651	9731	9810	9889	9968	0047	0126	0205	0284	9		
550	740363	0442	0521	0600	0678	0757	0836	0915	0994	1073	550		
1	1152	1230	1309	1388	1467	1546	1624	1703	1782	1860	1		
2	1939	2018	2096	2175	2254	2332	2411	2489	2568	2647	2		
3	2725	2804	2882	2961	3039	3118	3196	3275	3353	3431	3		
4	3510	3588	3667	3745	3823	3902	3980	4058	4136	4215	4		
5	4293	4371	4449	4528	4606	4684	4762	4840	4919	4997	5		
6	5075	5153	5231	5309	5387	5465	5543	5621	5699	5777	6		
7	5855	5933	6011	6089	6167	6245	6323	6401	6479	6556	7		
8	6634	6712	6790	6868	6945	7023	7101	7179	7256	7334	8		
9	7412	7489	7567	7645	7722	7800	7878	7955	8033	8110	9		
560	8188	8266	8343	8421	8498	8576	8653	8731	8808	8885	560		
1	8963	9040	9118	9195	9272	9350	9427	9504	9582	9659	1		
2	9736	9814	9891	9968	0045	0123	0200	0277	0354	0431	2		
3	750508	0586	0663	0740	0817	0894	0971	1048	1125	1202	3		
4	1279	1356	1433	1510	1587	1664	1741	1818	1895	1972	4		
5	2048	2125	2202	2279	2356	2433	2509	2586	2663	2740	5		
6	2816	2893	2970	3047	3123	3200	3277	3353	3430	3506	6		
7	3583	3660	3736	3813	3889	3966	4042	4119	4195	4272	7		
8	4348	4425	4501	4578	4654	4730	4807	4883	4960	5036	8		
9	5112	5189	5265	5341	5417	5494	5570	5646	5722	5799	9		
570	5875	5951	6027	6103	6180	6256	6332	6408	6484	6560	570		
1	6636	6712	6788	6864	6940	7016	7092	7168	7244	7320	1		
2	7396	7472	7548	7624	7700	7775	7851	7927	8003	8079	2		
3	8155	8230	8306	8382	8458	8533	8609	8685	8761	8836	3		
4	8912	8988	9063	9139	9214	9290	9366	9441	9517	9592	4		
5	9668	9743	9819	9894	9970	0045	0121	0196	0272	0347	5		
6	760422	0498	0573	0649	0724	0799	0875	0950	1025	1101	6		
7	1176	1251	1326	1402	1477	1552	1627	1702	1778	1853	7		
8	1928	2003	2078	2153	2228	2303	2378	2453	2529	2604	8		
9	2679	2754	2829	2904	2978	3053	3128	3203	3278	3353	9		
580	3428	3503	3578	3653	3727	3802	3877	3952	4027	4101	580		
1	4176	4251	4326	4400	4475	4550	4624	4699	4774	4848	1		
2	4923	4998	5072	5147	5221	5296	5370	5445	5520	5594	2		
3	5669	5743	5818	5892	5966	6041	6115	6190	6264	6338	3		
4	6413	6487	6562	6636	6710	6785	6859	6933	7007	7082	4		
PROPORTIONAL PARTS.	N.	1	2	3	4	5	6	7	8	9			
	5201	8.3	16.6	24.9	33.2	41.5	49.8	58.1	66.4	74.7			
	5264	8.2	16.4	24.6	32.8	41.0	49.2	57.4	65.6	73.8			
	5328	8.1	16.2	24.3	32.4	40.5	48.6	56.7	64.8	72.9			
	5394	8.0	16.0	24.0	32.0	40.0	48.0	56.0	64.0	72.0			
	5462	7.9	15.8	23.7	31.6	39.5	47.4	55.3	63.2	71.1			
	5532	7.8	15.6	23.4	31.2	39.0	46.8	54.6	62.4	70.2			
	5603	7.7	15.4	23.1	30.8	38.5	46.2	53.9	61.6	69.3			
	5677	7.6	15.2	22.8	30.4	38.0	45.6	53.2	60.8	68.4			
	5752	7.5	15.0	22.5	30.0	37.5	45.0	52.5	60.0	67.5			
5829	7.4	14.8	22.2	29.6	37.0	44.4	51.8	59.2	66.6				

[No. 585 L. 767.]

LOGARITHMS OF NUMBERS.

[No. 629 L. 799.]

N.	0	1	2	3	4	5	6	7	8	9	N.
585	767156	7230	7304	7379	7453	7527	7601	7675	7749	7823	585
6	7898	7972	8046	8120	8194	8268	8342	8416	8490	8564	6
7	8638	8712	8786	8860	8934	9008	9082	9156	9230	9303	7
8	9377	9451	9525	9599	9673	9746	9820	9894	9968	0042	8
9	770115	0189	0263	0336	0410	0484	0557	0631	0705	0778	9
590	0852	0926	0999	1073	1146	1220	1293	1367	1440	1514	590
1	1587	1661	1734	1808	1881	1955	2028	2102	2175	2248	1
2	2322	2395	2468	2542	2615	2688	2762	2835	2908	2981	2
3	3055	3128	3201	3274	3348	3421	3494	3567	3640	3713	3
4	3786	3860	3933	4006	4079	4152	4225	4298	4371	4444	4
5	4517	4590	4663	4736	4809	4882	4955	5028	5101	5173	5
6	5246	5319	5392	5465	5538	5611	5684	5757	5829	5902	6
7	5974	6047	6120	6193	6265	6338	6411	6483	6556	6629	7
8	6701	6774	6846	6919	6992	7064	7137	7209	7282	7354	8
9	7427	7499	7572	7644	7717	7789	7862	7934	8006	8079	9
600	8151	8224	8296	8368	8441	8513	8585	8658	8730	8802	600
1	8874	8947	9019	9091	9163	9235	9308	9380	9452	9524	1
2	9596	9669	9741	9813	9885	9957	0029	0101	0173	0245	2
3	780317	0389	0461	0533	0605	0677	0749	0821	0893	0965	3
4	1037	1109	1181	1253	1324	1396	1468	1540	1612	1684	4
5	1755	1827	1899	1971	2042	2114	2186	2258	2329	2401	5
6	2473	2544	2616	2688	2759	2831	2902	2974	3046	3117	6
7	3189	3260	3332	3403	3475	3546	3618	3689	3761	3832	7
8	3904	3975	4046	4118	4189	4261	4332	4403	4475	4546	8
9	4617	4689	4760	4831	4902	4974	5045	5116	5187	5259	9
610	5330	5401	5472	5543	5615	5686	5757	5828	5899	5970	610
1	6041	6112	6183	6254	6325	6396	6467	6538	6609	6680	1
2	6751	6822	6893	6964	7035	7106	7177	7248	7319	7390	2
3	7460	7531	7602	7673	7744	7815	7885	7956	8027	8098	3
4	8168	8239	8310	8381	8451	8522	8593	8663	8734	8804	4
5	8875	8946	9016	9087	9157	9228	9299	9369	9440	9510	5
6	9581	9651	9722	9792	9863	9933	0004	0074	0144	0215	6
7	790285	0356	0426	0496	0567	0637	0707	0778	0848	0918	7
8	0988	1059	1129	1199	1269	1339	1410	1480	1550	1620	8
9	1691	1761	1831	1901	1971	2041	2111	2181	2252	2322	9
620	2392	2462	2532	2602	2672	2742	2812	2882	2952	3022	620
1	3092	3162	3231	3301	3371	3441	3511	3581	3651	3721	1
2	3790	3860	3930	4000	4070	4139	4209	4279	4349	4418	2
3	4488	4558	4627	4697	4767	4836	4906	4976	5045	5115	3
4	5185	5254	5324	5393	5463	5532	5602	5672	5741	5811	4
5	5880	5949	6019	6088	6158	6227	6297	6366	6436	6505	5
6	6574	6644	6713	6782	6852	6921	6990	7060	7129	7198	6
7	7268	7337	7406	7475	7545	7614	7683	7752	7821	7890	7
8	7960	8029	8098	8167	8236	8305	8374	8443	8513	8582	8
9	8651	8720	8789	8858	8927	8996	9065	9134	9203	9272	9
PROP. PARTS.	N.	1	2	3	4	5	6	7	8	9	
	5908	7.3	14.6	21.9	29.2	36.5	43.8	51.1	58.4	65.7	
	5990	7.2	14.4	21.6	28.8	36.0	43.2	50.4	57.6	64.8	
	6074	7.1	14.2	21.3	28.4	35.5	42.6	49.7	56.8	63.9	
	6160	7.0	14.0	21.0	28.0	35.0	42.0	49.0	56.0	63.0	
6248	6.9	13.8	20.7	27.6	34.5	41.4	48.3	55.2	62.1		

No. 630 L. 799.]		LOGARITHMS OF NUMBERS.										[No. 674 L. 829	
N.	0	1	2	3	4	5	6	7	8	9	N.		
630	799341	9409	9478	9547	9616	9685	9754	9823	9892	9961	630		
1	800029	0098	0167	0236	0305	0373	0442	0511	0580	0648	1		
2	0717	0786	0854	0923	0992	1061	1129	1198	1266	1335	2		
3	1404	1472	1541	1609	1678	1747	1815	1884	1952	2021	3		
4	2089	2158	2226	2295	2363	2432	2500	2568	2637	2705	4		
5	2774	2842	2910	2979	3047	3116	3184	3252	3321	3389	5		
6	3457	3525	3594	3662	3730	3798	3867	3935	4003	4071	6		
7	4139	4208	4276	4344	4412	4480	4548	4616	4685	4753	7		
8	4821	4889	4957	5025	5093	5161	5229	5297	5365	5433	8		
9	5501	5569	5637	5705	5773	5841	5908	5976	6044	6112	9		
640	806180	6248	6316	6384	6451	6519	6587	6655	6723	6790	640		
1	6858	6926	6994	7061	7129	7197	7264	7332	7400	7467	1		
2	7555	7623	7690	7758	7826	7893	7961	8028	8096	8163	2		
3	8211	8279	8346	8414	8481	8549	8616	8684	8751	8818	3		
4	8886	8953	9021	9088	9156	9223	9290	9358	9425	9492	4		
5	9560	9627	9694	9762	9829	9896	9964	0031	0098	0165	5		
6	810233	0300	0367	0434	0501	0569	0636	0703	0770	0837	6		
7	0904	0971	1039	1106	1173	1240	1307	1374	1441	1508	7		
8	1575	1642	1709	1776	1843	1910	1977	2044	2111	2178	8		
9	2245	2312	2379	2445	2512	2579	2646	2713	2780	2847	9		
650	2913	2980	3047	3114	3181	3247	3314	3381	3448	3514	650		
1	3581	3648	3714	3781	3848	3914	3981	4048	4114	4181	1		
2	4248	4314	4381	4447	4514	4581	4647	4714	4780	4847	2		
3	4913	4980	5046	5113	5179	5246	5312	5378	5445	5511	3		
4	5578	5644	5711	5777	5843	5910	5976	6042	6109	6175	4		
5	6241	6308	6374	6440	6506	6573	6639	6705	6771	6838	5		
6	6904	6970	7036	7102	7169	7235	7301	7367	7433	7499	6		
7	7565	7631	7698	7764	7830	7896	7962	8028	8094	8160	7		
8	8226	8292	8358	8424	8490	8556	8622	8688	8754	8820	8		
9	8885	8951	9017	9083	9149	9215	9281	9346	9412	9478	9		
660	9544	9610	9676	9741	9807	9873	9939	0004	0070	0136	660		
1	820201	0267	0333	0399	0464	0530	0595	0661	0727	0792	1		
2	0858	0924	0989	1055	1120	1186	1251	1317	1382	1448	2		
3	1514	1579	1645	1710	1775	1841	1906	1972	2037	2103	3		
4	2168	2233	2299	2364	2430	2495	2560	2626	2691	2756	4		
5	2822	2887	2952	3018	3083	3148	3213	3279	3344	3409	5		
6	3474	3539	3604	3670	3735	3800	3865	3930	3996	4061	6		
7	4126	4191	4256	4321	4386	4451	4516	4581	4646	4711	7		
8	4776	4841	4906	4971	5036	5101	5166	5231	5296	5361	8		
9	5426	5491	5556	5621	5686	5751	5815	5880	5945	6010	9		
670	6075	6140	6204	6269	6334	6399	6464	6528	6593	6658	670		
1	6723	6787	6852	6917	6981	7046	7111	7175	7240	7305	1		
2	7369	7433	7499	7563	7628	7692	7757	7821	7886	7951	2		
3	8015	8080	8144	8209	8273	8338	8402	8467	8531	8595	3		
4	8660	8724	8788	8853	8918	8982	9046	9111	9175	9239	4		

PROP. PARTS.	N.	1	2	3	4	5	6	7	8	9
	6340	6.8	13.6	20.4	27.2	34.0	40.8	47.6	54.4	61.2
6433	6.7	13.4	20.1	26.8	33.5	40.2	46.9	53.6	60.3	
6530	6.6	13.2	19.8	26.4	33.0	39.6	46.2	52.8	59.4	
6630	6.5	13.0	19.5	26.0	32.5	39.0	45.5	52.0	58.5	
6733	6.4	12.8	19.2	25.6	32.0	38.4	44.8	51.2	57.6	

N.	0	1	2	3	4	5	6	7	8	9	N.
675	829304	9368	9432	9497	9561	9625	9690	9754	9818	9882	675
6	9247	0011	0075	0139	0204	0268	0332	0396	0460	0525	6
7	830589	0653	0717	0781	0845	0909	0973	1037	1102	1166	7
8	1230	1294	1358	1422	1486	1550	1614	1678	1742	1806	8
9	1870	1934	1998	2062	2126	2189	2253	2317	2381	2445	9
680	2509	2573	2637	2700	2764	2828	2892	2956	3020	3083	680
1	3147	3211	3275	3338	3402	3466	3530	3593	3657	3721	1
2	3784	3848	3912	3975	4039	4103	4166	4230	4294	4357	2
3	4421	4484	4548	4611	4675	4739	4802	4866	4929	4993	3
4	5056	5120	5183	5247	5310	5373	5437	5500	5564	5627	4
5	5691	5754	5817	5881	5944	6007	6071	6134	6197	6261	5
6	6324	6387	6451	6514	6577	6641	6704	6767	6830	6894	6
7	6957	7020	7083	7146	7210	7273	7336	7399	7462	7525	7
8	7588	7652	7715	7778	7841	7904	7967	8030	8093	8156	8
9	8219	8282	8345	8408	8471	8534	8597	8660	8723	8786	9
690	8849	8912	8975	9038	9101	9164	9227	9289	9352	9415	690
1	9478	9541	9604	9667	9729	9792	9855	9918	9981	0043	1
2	840106	0169	0232	0294	0357	0420	0482	0545	0608	0671	2
3	0733	0796	0859	0921	0984	1046	1109	1172	1234	1297	3
4	1359	1422	1485	1547	1610	1672	1735	1797	1860	1922	4
5	1985	2047	2110	2172	2235	2297	2360	2422	2484	2547	5
6	2609	2672	2734	2796	2859	2921	2983	3046	3108	3170	6
7	3233	3295	3357	3420	3482	3544	3606	3669	3731	3793	7
8	3855	3918	3980	4042	4104	4166	4229	4291	4353	4415	8
9	4477	4539	4601	4664	4726	4788	4850	4912	4974	5036	9
700	5098	5160	5222	5284	5346	5408	5470	5532	5594	5656	700
1	5718	5780	5842	5904	5966	6028	6090	6151	6213	6275	1
2	6337	6399	6461	6523	6585	6646	6708	6770	6832	6894	2
3	6955	7017	7079	7141	7202	7264	7326	7388	7449	7511	3
4	7573	7634	7696	7758	7819	7881	7943	8004	8066	8128	4
5	8189	8251	8312	8374	8435	8497	8559	8620	8682	8743	5
6	8805	8866	8928	8989	9051	9112	9174	9235	9297	9358	6
7	9419	9481	9542	9604	9665	9726	9788	9849	9911	9972	7
8	850033	0095	0156	0217	0279	0340	0401	0462	0524	0585	8
9	0646	0707	0769	0830	0891	0952	1014	1075	1136	1197	9
710	1258	1320	1381	1442	1503	1564	1625	1686	1747	1809	710
1	1870	1931	1992	2053	2114	2175	2236	2297	2358	2419	1
2	2480	2541	2602	2663	2724	2785	2846	2907	2968	3029	2
3	3090	3150	3211	3272	3333	3394	3455	3516	3577	3637	3
4	3698	3759	3820	3881	3941	4002	4063	4124	4185	4245	4
5	4306	4367	4428	4488	4549	4610	4671	4731	4792	4852	5
6	4913	4974	5034	5095	5156	5216	5277	5337	5398	5459	6
7	5519	5580	5640	5701	5761	5822	5882	5943	6003	6064	7
8	6124	6185	6245	6306	6366	6427	6487	6548	6608	6668	8
9	6789	6850	6910	6970	7031	7091	7152	7212	7272	7332	9

PROP. PARTS.	N.	1	2	3	4	5	6	7	8	9
	6839	6.3	12.6	18.9	25.2	31.5	37.8	44.1	50.4	56.7
	6948	6.2	12.4	18.6	24.8	31.0	37.2	43.4	49.6	55.8
	7061	6.1	12.2	18.3	24.4	30.5	36.6	42.7	48.8	54.9
	7178	6.0	12.0	18.0	24.0	30.0	36.0	42.0	48.0	54.0

No. 720 L. 857.]		LOGARITHMS OF NUMBERS.									[No. 764 L. 883.]	
N.	0	1	2	3	4	5	6	7	8	9	N.	
720	857332	7393	7453	7513	7574	7634	7694	7755	7815	7875	720	
1	7935	7995	8056	8116	8176	8236	8297	8357	8417	8477	1	
2	8537	8597	8657	8718	8778	8838	8898	8958	9018	9078	2	
3	9138	9198	9258	9318	9379	9439	9490	9550	9610	9670	3	
4	9739	9799	9859	9918	9978	0038	0098	0158	0218	0278	4	
5	860338	0398	0458	0518	0578	0637	0697	0757	0817	0877	5	
6	0937	1996	1056	1116	1176	1231	1295	1355	1415	1475	6	
7	1534	1594	1654	1714	1773	1833	1893	1952	2012	2072	7	
8	2131	2191	2251	2310	2370	2430	2489	2543	2608	2668	8	
9	2728	2787	2847	2906	2966	3025	3085	3144	3204	3263	9	
730	3323	3382	3442	3501	3561	3620	3680	3739	3799	3858	730	
1	3917	3977	4036	4096	4155	4214	4274	4333	4392	4452	1	
2	4511	4570	4630	4689	4748	4808	4867	4926	4985	5045	2	
3	5104	5163	5222	5282	5341	5400	5459	5519	5578	5637	3	
4	5696	5755	5814	5874	5933	5992	6051	6110	6169	6228	4	
5	6287	6346	6405	6465	6524	6583	6642	6701	6760	6819	5	
6	6878	6937	6996	7055	7114	7173	7232	7291	7350	7409	6	
7	7467	7526	7585	7644	7703	7762	7821	7880	7939	7998	7	
8	8056	8115	8174	8233	8292	8350	8409	8468	8527	8586	8	
9	8644	8703	8762	8821	8879	8938	8997	9056	9114	9173	9	
740	9232	9290	9349	9408	9466	9525	9584	9642	9701	9760	740	
1	9818	9877	9935	9994	0053	0111	0170	0228	0287	0345	1	
2	870404	0462	0521	0579	0638	0696	0755	0813	0872	0930	2	
3	0989	1047	1106	1164	1223	1281	1339	1398	1456	1515	3	
4	1573	1631	1690	1748	1806	1865	1923	1981	2040	2098	4	
5	2156	2215	2273	2331	2389	2448	2506	2564	2622	2681	5	
6	2739	2797	2855	2913	2972	3030	3088	3146	3204	3262	6	
7	3321	3379	3437	3495	3553	3611	3669	3727	3785	3844	7	
8	3902	3960	4018	4076	4134	4192	4250	4308	4366	4424	8	
9	4482	4540	4598	4656	4714	4772	4830	4888	4945	5003	9	
750	5061	5119	5177	5235	5293	5351	5409	5466	5524	5582	750	
1	5640	5698	5756	5813	5871	5929	5987	6045	6102	6160	1	
2	6218	6276	6333	6391	6449	6507	6564	6622	6680	6737	2	
3	6795	6853	6910	6968	7026	7083	7141	7199	7256	7314	3	
4	7371	7429	7487	7544	7602	7659	7717	7774	7832	7889	4	
5	7947	8004	8062	8119	8177	8234	8292	8349	8407	8464	5	
6	8522	8579	8637	8694	8752	8809	8866	8924	8981	9039	6	
7	9096	9153	9211	9268	9325	9383	9440	9497	9555	9612	7	
8	9669	9726	9784	9841	9898	9956	0013	0070	0127	0185	8	
9	880242	0299	0356	0413	0471	0528	0585	0642	0699	0756	9	
760	0814	0871	0928	0985	1042	1099	1156	1213	1271	1328	760	
1	1385	1442	1499	1556	1613	1670	1727	1784	1841	1898	1	
2	1955	2012	2069	2126	2183	2240	2297	2354	2411	2468	2	
3	2525	2581	2638	2695	2752	2809	2866	2923	2980	3037	3	
4	3093	3150	3207	3264	3321	3377	3434	3491	3548	3605	4	
PROP. PARTS.	N.	1	2	3	4	5	6	7	8	9		
	7299	5'9	11'8	17'7	23'6	29'5	35'4	41'3	47'2	53'1		
	7423	5'8	11'6	17'4	23'2	29'0	34'8	40'6	46'4	52'2		
	7552	5'7	11'4	17'1	22'8	28'5	34'2	39'9	45'6	51'3		

No. 765 L. 883.] LOGARITHMS OF NUMBERS. [No. 809 L. 908.

N.	0	1	2	3	4	5	6	7	8	9	N.
765	883661	3718	3775	3832	3888	3945	4002	4059	4115	4172	765
6	4229	4285	4342	4399	4455	4512	4569	4625	4682	4739	6
7	4795	4852	4909	4965	5022	5078	5135	5192	5248	5305	7
8	5361	5418	5474	5531	5587	5644	5700	5757	5813	5870	8
9	5926	5983	6039	6096	6152	6209	6265	6321	6378	6434	9
770	6491	6547	6604	6660	6716	6773	6829	6885	6942	6998	770
1	7054	7111	7167	7223	7280	7336	7392	7449	7505	7561	1
2	7617	7674	7730	7786	7842	7898	7955	8011	8067	8123	2
3	8179	8236	8292	8348	8404	8460	8516	8573	8629	8685	3
4	8741	8797	8853	8909	8965	9021	9077	9134	9190	9246	4
5	9302	9358	9414	9470	9526	9582	9638	9694	9750	9806	5
6	9862	9918	9974	0030	0086	0141	0197	0253	0309	0365	6
7	890421	0477	0533	0589	0645	0700	0756	0812	0868	0924	7
8	0980	1035	1091	1147	1203	1259	1314	1370	1426	1482	8
9	1537	1593	1647	1705	1760	1816	1872	1928	1983	2039	9
780	2095	2150	2206	2262	2317	2373	2429	2484	2540	2595	780
1	2651	2707	2762	2818	2873	2929	2985	3040	3096	3151	1
2	3207	3262	3318	3373	3429	3484	3540	3595	3651	3706	2
3	3762	3817	3873	3928	3984	4039	4094	4150	4205	4261	3
4	4316	4371	4427	4482	4538	4593	4648	4704	4759	4814	4
5	4870	4925	4980	5036	5091	5146	5201	5257	5312	5367	5
6	5423	5478	5533	5588	5644	5699	5754	5809	5864	5920	6
7	5975	6030	6085	6140	6195	6251	6306	6361	6416	6471	7
8	6526	6581	6636	6692	6747	6802	6857	6912	6967	7022	8
9	7077	7132	7187	7242	7297	7352	7407	7462	7517	7572	9
790	7627	7682	7737	7792	7847	7902	7957	8012	8067	8122	790
1	8176	8231	8286	8341	8396	8451	8506	8561	8615	8670	1
2	8725	8780	8835	8890	8944	8999	9054	9109	9164	9218	2
3	9273	9328	9383	9437	9492	9547	9602	9656	9711	9766	3
4	9821	0875	0930	0985	0039	0094	0149	0203	0258	0312	4
5	00367	0422	0476	0531	0586	0640	0695	0749	0804	0859	5
6	0913	0968	1022	1077	1131	1186	1240	1295	1349	1404	6
7	1458	1513	1567	1622	1676	1731	1785	1840	1894	1948	7
8	2003	2057	2112	2166	2221	2275	2329	2384	2438	2492	8
9	2547	2601	2655	2710	2764	2818	2873	2927	2981	3036	9
800	3090	3144	3199	3253	3307	3361	3416	3470	3524	3578	800
1	3633	3687	3741	3795	3849	3904	3958	4012	4066	4120	1
2	4174	4229	4283	4337	4391	4445	4499	4553	4607	4661	2
3	4716	4770	4824	4878	4932	4986	5040	5094	5148	5202	3
4	5256	5310	5364	5418	5472	5526	5580	5634	5688	5742	4
5	5796	5850	5904	5958	6012	6066	6119	6173	6227	6281	5
6	6335	6389	6443	6497	6551	6604	6658	6712	6766	6820	6
7	6874	6927	6981	7035	7089	7143	7196	7250	7304	7358	7
8	7411	7465	7519	7573	7626	7680	7734	7787	7841	7895	8
9	7949	8002	8056	8109	8163	8217	8270	8324	8378	8431	9

Prop. Parts.	N.								
	1	2	3	4	5	6	7	8	9
	7686	5.6	11.2	16.8	22.4	28.0	33.6	39.2	44.8	50.4
7825	5.5	11.0	16.5	22.0	27.5	33.0	38.5	44.0	49.5
7968	5.4	10.8	16.2	21.6	27.0	32.4	37.8	43.2	48.6

No. 810 L. 908.]		LOGARITHMS OF NUMBERS.									[No. 854 L. 931	
N.	0	1	2	3	4	5	6	7	8	9	N.	
810	908485	8539	8592	8646	8699	8753	8807	8860	8914	8967	810	
1	9021	9074	9128	9181	9235	9289	9342	9396	9449	9503	1	
2	9556	9609	9663	9716	9770	9823	9877	9930	6984	0037	2	
3	910091	0144	0197	0251	0304	0358	0411	0464	0518	0571	3	
4	0624	0678	0731	0784	0838	0891	0944	0998	1051	1104	4	
5	1158	1211	1264	1317	1371	1424	1477	1530	1584	1637	5	
6	1690	1743	1797	1850	1903	1956	2009	2063	2116	2169	6	
7	2222	2275	2328	2381	2435	2488	2541	2594	2647	2700	7	
8	2753	2806	2859	2913	2966	3019	3072	3125	3178	3231	8	
9	3284	3337	3390	3443	3496	3549	3602	3655	3708	3761	9	
820	3814	3867	3920	3973	4026	4079	4132	4184	4237	4290	820	
1	4343	4396	4449	4502	4555	4608	4660	4713	4766	4819	1	
2	4872	4925	4977	5030	5083	5136	5189	5241	5294	5347	2	
3	5400	5453	5505	5558	5611	5664	5716	5769	5822	5875	3	
4	5927	5980	6033	6085	6138	6191	6243	6296	6349	6401	4	
5	6454	6507	6559	6612	6664	6717	6770	6822	6875	6927	5	
6	6980	7033	7085	7138	7190	7243	7295	7348	7400	7453	6	
7	7506	7558	7611	7663	7716	7768	7820	7873	7925	7978	7	
8	8030	8083	8135	8188	8240	8293	8345	8397	8450	8502	8	
9	8555	8607	8659	8712	8764	8816	8869	8921	8973	9026	9	
830	9078	9130	9183	9235	9287	9340	9392	9444	9496	9549	830	
1	9601	9653	9706	9758	9810	9862	9914	9967	0019	0071	1	
2	920123	0176	0228	0280	0332	0384	0436	0489	0541	0593	2	
3	0645	0697	0749	0801	0853	0906	0958	1010	1062	1114	3	
4	1166	1218	1270	1322	1374	1426	1478	1530	1582	1634	4	
5	1686	1738	1790	1842	1894	1946	1998	2050	2102	2154	5	
6	2206	2258	2310	2362	2414	2466	2518	2570	2622	2674	6	
7	2725	2777	2829	2881	2933	2985	3037	3089	3140	3192	7	
8	3244	3296	3348	3399	3451	3503	3555	3607	3658	3710	8	
9	3762	3814	3865	3917	3969	4021	4072	4124	4176	4228	9	
840	4279	4331	4383	4434	4486	4538	4589	4641	4693	4744	840	
1	4796	4848	4899	4951	5003	5054	5106	5157	5209	5261	1	
2	5312	5364	5415	5467	5518	5570	5621	5673	5725	5776	2	
3	5828	5879	5931	5982	6034	6085	6137	6188	6239	6291	3	
4	6342	6394	6445	6497	6548	6600	6651	6702	6754	6805	4	
5	6857	6908	6959	7011	7062	7114	7165	7216	7268	7319	5	
6	7370	7422	7473	7524	7576	7627	7678	7729	7781	7832	6	
7	7883	7935	7986	8037	8088	8140	8191	8242	8293	8345	7	
8	8396	8447	8498	8549	8601	8652	8703	8754	8805	8857	8	
9	8908	8959	9010	9061	9112	9163	9215	9266	9317	9368	9	
850	9419	9470	9521	9572	9623	9674	9725	9776	9827	9879	850	
1	9930	9981	0032	0083	0134	0185	0236	0287	0338	0389	1	
2	930440	0491	0542	0593	0644	0694	0745	0796	0847	0898	2	
3	0949	1000	1051	1102	1153	1203	1254	1305	1356	1407	3	
4	1458	1509	1560	1610	1661	1712	1763	1814	1864	1915	4	

PROP. PARTS.	N.								
	1	2	3	4	5	6	7	8	9
	8117	5.3	10.6	15.9	21.2	26.5	31.8	37.1	42.4	47.7
8271	5.2	10.4	15.6	20.8	26.0	31.2	36.4	41.6	46.8
8432	5.1	10.2	15.3	20.4	25.5	30.6	35.7	40.8	45.9

No. 855 L. 931.]		LOGARITHMS OF NUMBERS.										[No. 899 L. 954.	
N.	0	1	2	3	4	5	6	7	8	9	N.		
855	931966	2017	2068	2118	2169	2220	2271	2322	2372	2423	855		
6	2474	2524	2575	2626	2677	2727	2778	2829	2879	2930	6		
7	2981	3031	3082	3133	3183	3234	3285	3335	3386	3437	7		
8	3487	3538	3589	3639	3690	3740	3791	3841	3892	3943	8		
9	3993	4044	4094	4145	4195	4246	4296	4347	4397	4448	9		
860	4498	4549	4599	4650	4700	4751	4801	4852	4902	4953	860		
1	5003	5054	5104	5154	5205	5255	5306	5356	5406	5457	1		
2	5507	5558	5608	5658	5709	5759	5809	5860	5910	5960	2		
3	6011	6061	6111	6162	6212	6262	6313	6363	6413	6463	3		
4	6514	6564	6614	6665	6715	6765	6815	6865	6916	6966	4		
5	7016	7066	7116	7167	7217	7267	7317	7367	7418	7468	5		
6	7518	7568	7618	7668	7718	7769	7819	7869	7919	7969	6		
7	8019	8069	8119	8169	8219	8269	8319	8370	8420	8470	7		
8	8520	8570	8620	8670	8720	8770	8820	8870	8920	8970	8		
9	9020	9070	9120	9170	9220	9270	9319	9369	9419	9469	9		
870	9519	9569	9619	9669	9719	9769	9819	9869	9918	9968	870		
1	940018	0068	0118	0168	0218	0267	0317	0367	0417	0467	1		
2	0516	0566	0616	0666	0716	0765	0815	0865	0915	0964	2		
3	1014	1064	1114	1163	1213	1263	1313	1362	1412	1462	3		
4	1511	1561	1611	1660	1710	1760	1809	1859	1909	1958	4		
5	2008	2058	2107	2157	2207	2256	2306	2355	2405	2455	5		
6	2504	2554	2603	2653	2702	2752	2801	2851	2901	2950	6		
7	3000	3049	3099	3148	3198	3247	3297	3346	3396	3445	7		
8	3495	3544	3593	3643	3692	3742	3791	3841	3890	3939	8		
9	3989	4038	4088	4137	4186	4236	4285	4335	4384	4433	9		
880	4483	4532	4581	4631	4680	4729	4779	4828	4877	4927	880		
1	4976	5025	5074	5124	5173	5222	5272	5321	5370	5419	1		
2	5469	5518	5567	5616	5665	5715	5764	5813	5862	5912	2		
3	5961	6010	6059	6108	6157	6207	6256	6305	6354	6403	3		
4	6452	6501	6551	6600	6649	6698	6747	6796	6845	6894	4		
5	6943	6992	7041	7090	7139	7189	7238	7287	7336	7385	5		
6	7434	7483	7532	7581	7630	7679	7728	7777	7826	7875	6		
7	7924	7973	8022	8070	8119	8168	8217	8266	8315	8364	7		
8	8413	8462	8511	8560	8608	8657	8706	8755	8804	8853	8		
9	8902	8951	8999	9048	9097	9146	9195	9244	9292	9341	9		
890	9390	9439	9488	9536	9585	9634	9683	9731	9780	9829	890		
1	9878	9926	9975	0024	0073	0121	0170	0219	0267	0316	1		
2	950365	0414	0462	0511	0560	0608	0657	0706	0754	0803	2		
3	0851	0900	0949	0997	1046	1095	1143	1192	1240	1289	3		
4	1338	1386	1435	1483	1532	1580	1629	1677	1726	1775	4		
5	1823	1872	1920	1969	2017	2066	2114	2163	2211	2259	5		
6	2308	2356	2405	2453	2502	2550	2599	2647	2696	2744	6		
7	2792	2841	2889	2938	2986	3034	3083	3131	3180	3228	7		
8	3276	3325	3373	3421	3470	3518	3566	3615	3663	3711	8		
9	3760	3808	3856	3905	3953	4001	4049	4098	4146	4194	9		
PROP. PARTS.	N.	1	2	3	4	5	6	7	8	9			
	8599	5°	10°0	15°0	20°0	25°0	30°0	35°0	40°0	45°0			
	8773	4°9	9°8	14°7	19°6	24°5	29°4	34°3	39°2	44°1			
	8954	4°8	9°6	14°4	19°2	24°0	28°8	33°6	38°4	43°2			

No. 900 L. 954.]		LOGARITHMS OF NUMBERS.									[No. 944 L. 975.	
N.	0	1	2	3	4	5	6	7	8	9	N.	
900	954243	4291	4339	4387	4435	4484	4532	4580	4628	4677	900	
1	4725	4773	4821	4869	4918	4966	5014	5062	5110	5158	1	
2	5207	5255	5303	5352	5399	5447	5495	5543	5592	5640	2	
3	5688	5736	5784	5832	5880	5928	5976	6024	6072	6120	3	
4	6168	6216	6265	6313	6361	6409	6457	6505	6553	6601	4	
5	6649	6697	6745	6793	6840	6888	6936	6984	7032	7080	5	
6	7128	7176	7224	7272	7320	7368	7416	7464	7512	7559	6	
7	7607	7655	7703	7751	7799	7847	7894	7942	7990	8038	7	
8	8086	8134	8181	8229	8277	8325	8373	8421	8468	8516	8	
9	8564	8612	8659	8707	8755	8803	8850	8898	8946	8994	9	
910	9041	9089	9137	9185	9232	9280	9328	9375	9423	9471	910	
1	9518	9566	9614	9661	9709	9757	9804	9852	9900	9947	1	
2	9995	0042	0090	0138	0185	0233	0281	0328	0376	0423	2	
3	960471	0518	0566	0613	0661	0709	0756	0804	0851	0899	3	
4	0946	0994	1041	1089	1136	1184	1231	1279	1326	1374	4	
5	1421	1469	1516	1563	1611	1658	1706	1753	1801	1848	5	
6	1895	1943	1990	2038	2085	2132	2180	2227	2275	2322	6	
7	2369	2417	2464	2511	2559	2606	2653	2701	2748	2795	7	
8	2843	2890	2937	2985	3032	3079	3126	3174	3221	3268	8	
9	3316	3363	3410	3457	3504	3552	3599	3646	3693	3741	9	
920	3788	3835	3882	3929	3977	4024	4071	4118	4165	4212	920	
1	4260	4307	4354	4401	4448	4495	4542	4590	4637	4684	1	
2	4731	4778	4825	4872	4919	4966	5013	5060	5108	5155	2	
3	5202	5249	5296	5343	5390	5437	5484	5531	5578	5625	3	
4	5672	5719	5766	5813	5860	5907	5954	6001	6048	6095	4	
5	6142	6189	6236	6283	6329	6376	6423	6470	6517	6564	5	
6	6611	6658	6705	6752	6799	6845	6892	6939	6986	7033	6	
7	7080	7127	7173	7220	7267	7314	7361	7408	7454	7501	7	
8	7548	7595	7642	7688	7735	7782	7829	7875	7922	7969	8	
9	8016	8062	8109	8156	8203	8249	8296	8343	8389	8436	9	
930	8483	8530	8576	8623	8670	8716	8763	8810	8856	8903	930	
1	8950	8996	9043	9090	9136	9183	9229	9276	9323	9369	1	
2	9416	9463	9509	9556	9602	9649	9695	9742	9789	9835	2	
3	9882	9928	9975	0021	0068	0114	0161	0207	0254	0300	3	
4	970347	0393	0440	0486	0533	0579	0626	0672	0719	0765	4	
5	0812	0858	0904	0951	0997	1044	1090	1137	1183	1229	5	
6	1276	1322	1369	1415	1461	1508	1554	1601	1647	1693	6	
7	1740	1786	1832	1879	1925	1971	2018	2064	2110	2157	7	
8	2203	2249	2295	2342	2388	2434	2481	2527	2573	2619	8	
9	2666	2712	2758	2804	2851	2897	2943	2989	3035	3082	9	
940	3128	3174	3220	3266	3313	3359	3405	3451	3497	3543	940	
1	3590	3636	3682	3728	3774	3820	3866	3913	3959	4005	1	
2	4051	4097	4143	4189	4235	4281	4327	4374	4420	4466	2	
3	4512	4558	4604	4650	4696	4742	4788	4834	4880	4926	3	
4	4972	5018	5064	5110	5156	5202	5248	5294	5340	5386	4	

PROP. PARTS.	N.	1	2	3	4	5	6	7	8	9
	9143	4.7	9.4	14.1	18.8	23.5	28.2	32.9	37.6	42.3
	9339	4.6	9.2	13.8	18.4	23.0	27.6	32.2	36.8	41.4
9544	4.5	9.0	13.5	18.0	22.5	27.0	31.5	36.0	40.5	

No. 990 L. 995.] LOGARITHMS OF NUMBERS. [No. 999 L. 999.

N.	0	1	2	3	4	5	6	7	8	9	N.
990	995635	5679	5723	5767	5811	5854	5898	5942	5986	6030	990
1	6074	6117	6161	6205	6249	6293	6337	6380	6424	6468	1
2	6512	6555	6599	6643	6687	6731	6774	6818	6862	6906	2
3	6949	6993	7037	7080	7124	7168	7212	7255	7299	7343	3
4	7386	7430	7474	7517	7561	7605	7648	7692	7736	7779	4
5	7823	7867	7910	7954	7998	8041	8085	8129	8172	8216	5
6	8259	8303	8347	8390	8434	8477	8521	8564	8608	8652	6
7	8695	8739	8782	8826	8869	8913	8956	9000	9043	9087	7
8	9130	9174	9218	9261	9305	9348	9392	9435	9479	9522	8
9	9565	9609	9652	9696	9739	9783	9826	9870	9913	9957	9

TABLE II.—LOGARITHMS OF NUMBERS FROM 1 TO 100.

N.	Log.	N.	Log.	N.	Log.	N.	Log.	N.	Log.
1	0.000000	21	1.322219	41	1.612784	61	1.785330	81	1.908485
2	0.301030	22	1.342423	42	1.623249	62	1.792392	82	1.913814
3	0.477121	23	1.361728	43	1.633468	63	1.799341	83	1.919078
4	0.602060	24	1.380211	44	1.643453	64	1.806180	84	1.924279
5	0.698970	25	1.397940	45	1.653213	65	1.812913	85	1.929419
6	0.778151	26	1.414973	46	1.662758	66	1.819544	86	1.934498
7	0.845098	27	1.431364	47	1.672098	67	1.826075	87	1.939519
8	0.903090	28	1.447158	48	1.681241	68	1.832509	88	1.944483
9	0.954243	29	1.462398	49	1.690196	69	1.838849	89	1.949390
10	1.000000	30	1.477121	50	1.698970	70	1.845098	90	1.954243
11	1.041393	31	1.491362	51	1.707570	71	1.851258	91	1.959041
12	1.079181	32	1.505150	52	1.716003	72	1.857332	92	1.963788
13	1.113943	33	1.518514	53	1.724276	73	1.863323	93	1.968483
14	1.146128	34	1.531479	54	1.732394	74	1.869232	94	1.973128
15	1.176091	35	1.544068	55	1.740363	75	1.875061	95	1.977724
16	1.204120	36	1.556302	56	1.748188	76	1.880814	96	1.982271
17	1.230449	37	1.568202	57	1.755875	77	1.886491	97	1.986772
18	1.255273	38	1.579784	58	1.763428	78	1.892095	98	1.991226
19	1.278754	39	1.591065	59	1.770852	79	1.897627	99	1.995635
20	1.301030	40	1.602060	60	1.778151	80	1.903090	100	2.000000

TABLE III.

	Value at 0°.	Sign in 1st Quad.	Value at 90°.	Sign in 2nd Quad.	Value at 180°.	Sign in 3rd Quad.	Value at 270°.	Sign in 4th Quad.	Value at 360°.
Sin	O	+	R	+	O	-	R	-	O
Tan	O	+	∞	-	O	+	∞	-	O
Sec	R	+	∞	-	R	+	∞	+	R
Verain	O	+	R	+	2 R	+	R	+	O
Cos	R	+	O	-	R	+	O	+	R
Cot....	∞	+	O	-	∞	+	O	-	∞
Cosec..	∞	+	R	+	∞	-	R	-	∞

R signifies equal to rad; ∞ signifies infinite; O signifies evanescent.

TABLE IV.—LOGARITHMIC SINES.

	'0	'1	'2	'3	'4	'5	
0							
0	6'463726	6'505119	6'542907	6'577669	6'60854	6'639817	89 59
1	764756	785945	806149	825454	843937	861666	58
2	940847	955088	968876	982240	995205	7'007794	57
3	7'065786	7'076510	7'086975	7'097194	7'107179	116938	56
4	162696	171296	179729	188002	196120	204089	55
5	241877	249056	256118	263066	269906	276639	54
6	308824	314984	321058	327049	332958	338787	53
7	366816	372211	377540	382804	388005	393145	52
8							89 51
9	7'417968	7'422767	7'427513	7'432208	7'436853	7'441449	50
10	463725	468047	472326	476563	480759	484915	49
11	505118	509048	512943	516804	520630	524423	48
12	542906	546511	550085	553630	557147	560635	47
13	577668	580996	584299	587577	590830	594059	46
14	609853	612941	616013	619051	622087	625093	45
15	639816	642702	645568	648416	651245	654056	44
16	667845	670550	673239	675912	678568	681208	43
17	694173	696720	699253	701770	704273	706762	89 42
18	7'718997	7'721403	7'723795	7'726175	7'728542	7'730896	41
19	742477	744757	747025	749281	751525	753758	40
20	766754	766920	769075	771220	773354	775477	39
21	785943	788006	790059	792103	794137	796162	38
22	806146	808115	810076	812028	813971	815905	37
23	825451	827335	829211	831079	832939	834791	36
24	843934	845740	847538	849329	851112	852888	35
25	861662	863396	865123	866843	868556	870262	34
26	878695	880362	882023	883678	885326	886968	89 33
27	7'895085	7'896691	7'898291	7'899884	7'901472	7'903054	32
28	910879	912428	913970	915508	917039	918566	31
29	926119	927614	929104	930589	932068	933543	30
30	940842	942287	943727	945163	946594	948020	29
31	955082	956481	957875	959264	960650	962031	28
32	968870	970225	971576	972922	974265	975603	27
33	982233	983547	984857	986164	987466	988764	26
34	995198	996473	997745	999013	8'000277	8'001538	25
35	8'007787	8'009026	8'010261	8'011493	012722	013947	89 24
36	8'020021	8'021225	8'022427	8'023625	8'024819	8'026011	23
37	031919	033092	034261	035426	036589	037749	22
38	043501	044642	045781	046916	048048	049178	21
39	054781	055893	057003	058109	059213	060314	20
40	065776	066861	067942	069021	070098	071171	19
41	076500	077558	078613	079666	080716	081764	18
42	086965	087997	089028	090056	091081	092104	17
43	097183	098192	099198	100203	101204	102204	16
44	107167	108153	109136	110118	111097	112074	15
45	116926	117890	118852	119812	120769	121725	89 14
	1'0	'9	'8	'7	'6	'5	

TABLE IV.—LOGARITHMIC SINES.

	'6	'7	'8	'9	'10	
0	6.241877	6.308824	6.366816	6.417969	6.463726	89 59
1	667846	694175	718999	742480	764756	58
2	878699	895090	910884	926124	940847	57
3	7.020028	7.031928	7.043510	7.054791	7.065786	56
4	126484	135824	144967	153922	162696	55
5	211914	219601	227154	234578	241877	54
6	283270	289801	296235	302575	308824	53
7	344539	350217	355820	361353	366816	52
8	398224	403245	408208	413116	417968	89 51
9	7.445998	7.450497	7.454952	7.459361	7.463725	50
10	489031	493109	497149	501152	505118	49
11	528183	531911	535607	539272	542906	48
12	564096	567529	570935	574315	577668	47
13	597264	600445	603604	606740	609853	46
14	628078	631042	633986	636911	639816	45
15	656849	659624	662382	665122	667844	44
16	683832	686441	689034	691611	694173	43
17	709237	711697	714144	716577	718997	89 42
18	7.733237	7.735566	7.737882	7.740186	7.742477	41
19	755980	758190	760389	762577	764754	40
20	777591	779694	781787	783870	785943	39
21	798177	800183	802180	804167	806146	38
22	817831	819749	821658	823558	825451	37
23	836635	838471	840300	842120	843934	36
24	854657	856419	858174	859922	861662	35
25	871962	873655	875342	877022	878695	34
26	888603	890233	891856	893474	895085	89 33
27	7.904630	7.906201	7.907766	7.909326	7.910879	32
28	920087	921603	923113	924619	926119	31
29	935012	936477	937937	939392	940842	30
30	949442	950859	952271	953679	955082	29
31	963407	964779	966147	967511	968870	28
32	976937	978267	979593	980915	982233	27
33	990058	991349	992636	993919	995198	26
34	8.002795	8.004048	8.005298	8.006544	8.007787	25
35	015168	016386	017601	018813	020021	89 24
36	8.027199	8.028384	8.029566	8.030744	8.031919	23
37	038905	040059	041209	042356	043501	22
38	050304	051428	052549	053666	054781	21
39	061412	062507	063599	064689	065776	20
40	072422	073310	074376	075439	076500	19
41	082809	083851	084892	085929	086965	18
42	093125	094143	095159	096172	097183	17
43	103201	104196	105188	106179	107167	16
44	113049	114021	114992	115960	116926	15
45	122678	123629	124579	125526	126471	89 14
	'4	'3	'2	'1	'0	

TABLE IV.—LOGARITHMIC SINES.

	'0	'1	'2	'3	'4	'5	
0							
0 45	8:116926	8:117870	8:118852	8:119812	8:120769	8:121725	89 14
46	126471	127414	128355	129294	130231	131166	13
47	135810	136733	137654	138574	139491	140406	12
48	144953	145857	146759	147659	148557	149453	11
49	153907	154793	155676	156558	157438	158316	10
50	162681	163548	164414	165279	166141	167002	9
51	171280	172131	172980	173827	174673	175517	8
52	179713	180547	181380	182211	183041	183868	7
53	187985	188803	189620	190436	191250	192062	89 6
0 54	8:196102	8:196905	8:197707	8:198508	8:199307	8:200104	5
55	204070	204859	205646	206432	207217	208000	4
56	211895	212670	213443	214215	214986	215755	3
57	219581	220342	221102	221861	222618	223374	2
58	227134	227882	228628	229374	230118	230861	1
59	234557	235292	236026	236759	237491	238221	89 0
1 0	241855	242578	243300	244021	244741	245459	59
1	249033	249744	250455	251164	251871	252578	58
2	256094	256794	257492	258190	258887	259582	89 57
1 3	8:263042	8:263731	8:264419	8:265105	8:265791	8:266475	56
4	269881	270559	271236	271912	272587	273260	55
5	276614	277281	277948	278613	279278	279941	54
6	283243	283901	284557	285213	285867	286521	53
7	289773	290421	291068	291713	292358	293002	52
8	296207	296844	297482	298118	298754	299388	51
9	302546	303174	303803	304430	305056	305681	50
10	308794	309414	310033	310651	311268	311885	49
11	314954	315565	316175	316784	317393	318001	89 48
1 12	8:321027	8:321629	8:322231	8:322832	8:323433	8:324032	47
13	327016	327611	328204	328797	329389	329980	46
14	332924	333511	334096	334681	335265	335848	45
15	338753	339331	339909	340486	341063	341638	44
16	344504	345075	345645	346215	346784	347352	43
17	350181	350744	351307	351869	352430	352991	42
18	355783	356340	356895	357450	358004	358558	41
19	361315	361864	362413	362961	363508	364054	40
20	366777	367319	367861	368402	368943	369482	88 39
1 21	8:372171	8:372707	8:373242	8:373776	8:374310	8:374843	38
22	377499	378028	378557	379084	379612	380138	37
23	382762	383285	383807	384329	384850	385370	36
24	387962	388479	388995	389510	390025	390539	35
25	393101	393611	394121	394631	395139	395647	34
26	398179	398684	399188	399691	400194	400696	33
27	403199	403698	404196	404694	405191	405687	32
28	408161	408654	409147	409639	410130	410621	31
29	413068	413555	414042	414529	415015	415500	30
30	417919	418401	418883	419364	419844	420324	88 29
	10	9	8	7	6	5	

Log. Cosines.

TABLE IV.—LOGARITHMIC SINES.

	.6	.7	.8	.9	1.0	
3 1						
3 45	8.122678	8.123629	8.124579	8.125526	8.126471	89 14
46	132099	133030	133959	134885	135810	13
47	141319	142231	143140	144048	144953	12
48	150348	151241	152131	153020	153907	11
49	159193	160067	160940	161811	162681	10
50	167861	168718	169574	170428	171280	9
51	176359	177200	178039	178877	179713	8
52	184695	185520	186343	187165	187985	7
53	192873	193683	194491	195297	196102	89 6
3 54	8.200900	8.201695	8.202488	8.203280	8.204070	5
55	208782	209562	210341	211119	211895	4
56	216523	217289	218055	218819	219581	3
57	224128	224881	225634	226384	227133	2
58	231603	232343	233082	233820	234557	1
59	238951	239679	240405	241131	241855	89 0
1 0	246176	246892	247607	248321	249033	59
1 1	253284	253988	254691	255393	256094	58
2	260276	260970	261662	262352	263042	88 57
1 3	8.267158	8.267841	8.268522	8.269202	8.269881	56
4	273933	274605	275275	275945	276614	55
5	280604	281265	281925	282585	283243	54
6	287173	287825	288475	289125	289773	53
7	293645	294287	294928	295568	296207	52
8	300021	300654	301286	301916	302546	51
9	306306	306929	307552	308173	308794	50
10	312500	313115	313729	314342	314954	49
11	318608	319214	319819	320423	321027	88 48
1 12	8.324630	8.325228	8.325825	8.326421	8.327016	47
13	330571	331160	331749	332337	332924	46
14	336431	337012	337593	338174	338753	45
15	342213	342787	343360	343933	344504	44
16	347919	348485	349051	349616	350180	43
17	353551	354110	354669	355226	355783	42
18	359111	359663	360214	360765	361315	41
19	364600	365145	365690	366234	366777	40
20	370021	370560	371095	371635	372171	88 39
1 21	8.375375	8.375907	8.376438	8.376969	8.377499	38
22	380664	381190	381714	382239	382762	37
23	385889	386409	386927	387445	387962	36
24	391053	391566	392078	392590	393101	35
25	396155	396662	397168	397674	398179	34
26	401198	401699	402200	402700	403199	33
27	406183	406679	407173	407668	408161	32
28	411112	411601	412091	412579	413068	31
29	415985	416469	416953	417436	417919	30
30	420804	421283	421762	422239	422717	88 29
	4	3	2	1	0	

Log. Cosines.

0 Deg.		TABLE V.—LOG. SINES, ETC.					90 Deg.		
°	'	Sine	Coec.	Tang.	Cotang.	Sec.	D.	Cosine	'
0	0	0.000000	Infinite.	0.000000	Infinite.	0000	10'00	10.000000	60
1	6	463726	13536274	6463726	13536274	0000	0	0000	59
2	7	64756	235244	764756	235244	0000	0	0000	58
3	9	40847	059153	940847	059153	0000	0	0000	57
4	7	065786	12934214	7065786	12934214	0000	0	0000	56
5	16	2696	837304	162696	837304	0000	0	0000	55
6	24	1877	758123	241878	758122	0001	1	9999999	54
7	30	8824	691176	308825	691175	0001	1	9999	53
8	36	816	633184	366817	633183	0001	1	9999	89 52
9	41	7968	12582032	7417970	12582030	0001	1	9999999	51
10	46	3725	536275	463727	536273	0002	1	9998	50
11	50	5118	494882	505120	494880	0002	1	9998	49
12	54	2906	457094	542909	457091	0003	1	9997	48
13	57	7668	422332	577672	422328	0003	1	9997	47
14	60	9853	390147	609857	390143	0004	1	9996	46
15	63	9816	360184	639820	360180	0004	1	9996	45
16	66	7845	332155	667849	332151	0005	1	9995	44
17	69	4173	305827	694179	305821	0005	1	9995	89 43
18	71	8997	12281003	7719003	12280997	0006	1	9999994	42
19	74	2477	257523	742484	257516	0007	1	9993	41
20	76	4754	235246	764761	235239	0007	1	9993	40
21	78	5943	214057	785951	214049	0008	1	9992	39
22	80	6146	193854	806155	193845	0009	1	9991	38
23	82	5451	174549	825460	174540	0010	1	9990	37
24	84	3934	156066	843944	156056	0011	2	9989	36
25	86	1662	138338	861674	138326	0011	2	9989	35
26	87	8695	121305	878708	121292	0012	2	9988	89 34
27	7895085	12104915	7895099	12104901	0013	2	9999987	33	
28	910879	089121	910894	089106	0014	2	9986	32	
29	926119	073881	926134	073866	0015	2	9985	31	
30	940842	059158	940858	059142	0017	2	9983	30	
31	955082	044918	955100	044900	0018	2	9982	29	
32	968870	031130	968889	031111	0019	2	9981	28	
33	982233	017767	982253	017747	0020	2	9980	27	
34	995198	004802	995219	004781	0021	2	9979	26	
35	8007787	11992123	8007809	11992191	0023	2	9977	89 25	
36	8020021	11979979	8020045	11979955	0024	2	9999976	24	
37	031919	968081	031945	968055	0025	2	9975	23	
38	043501	956499	043527	956473	0027	2	9973	22	
39	054781	945219	054809	945191	0028	2	9972	21	
40	065776	934224	065806	934194	0029	2	9971	20	
41	076500	923500	076531	923469	0031	2	9969	19	
42	086965	913055	086997	913003	0032	2	9968	18	
43	097183	902817	097217	902783	0034	2	9966	17	
44	107167	892833	107202	892798	0036	3	9964	16	
45	116926	883074	116963	883037	0037	3	9963	89 15	
		Cosine	Secant	Cotang.	Tang.	Co. D.		Sine	'
90 Deg.								89 1/2 Deg.	

0 $\frac{1}{2}$ Deg.		TABLE V.—LOG. SINES, ETC.					1 $\frac{1}{2}$ Deg.	
°	Sine	Cosec.	Tang.	Cotang.	Sec.	D.	Cosine	
					10 ^{co}			
0	45	8.116926	11.883074	8.116963	11.883037	0037	9.999963	15
	46	126471	873529	126510	873490	0039	9961	14
	47	135810	864190	135851	864149	0041	9959	13
	48	144953	855047	144996	855004	0042	9958	12
	49	153907	846093	153952	846048	0044	9956	11
	50	162681	837319	162727	837273	0046	9954	10
	51	171280	828720	171328	828672	0048	9952	9
	52	179713	820287	179763	820237	0050	9950	8
	53	187985	812015	188036	811964	0052	9948	89 7
0	54	8.196102	11.803898	8.196156	11.803844	0054	9.999946	6
	55	204070	795930	204126	795874	0056	0044	5
	56	211895	788105	211953	788047	0058	9942	4
	57	219581	780419	219641	780359	0060	9940	3
	58	227134	772866	227195	772805	0062	9938	2
	59	234557	765443	234621	765379	0064	9936	1
1	c	241855	758145	241921	758079	0066	9934	80 0
	1	249033	750967	249102	750898	0068	9932	59
	2	256094	743906	256165	743835	0071	9929	88 58
1	3	8.263042	11.736958	8.263115	11.736885	0073	9.999927	57
	4	269881	730119	269956	730044	0075	9925	56
	5	276614	723386	276691	723309	0078	9922	55
	6	283243	716757	283323	716677	0080	9920	54
	7	289773	710227	289856	710144	0082	9918	53
	8	296207	703793	196292	703708	0085	9915	52
	9	302546	697454	302634	697366	0087	9913	51
	10	308794	691206	308884	691116	0090	9910	50
	11	314954	685046	315046	684954	0093	9907	88 49
1	12	8.321027	11.678973	8.321122	11.678878	0095	9.999905	48
	13	327016	672984	327114	672886	0098	9902	47
	14	332924	667076	333025	666975	0101	9899	46
	15	338753	661247	338856	661144	0103	9897	45
	16	344504	655496	344610	655390	0106	9894	44
	17	350181	649819	350289	649711	0109	9891	43
	18	355783	644217	355895	644105	0112	9888	42
	19	361315	638685	361430	638570	0115	9885	41
	20	366777	633223	366895	633105	0118	9882	88 40
1	21	8.372171	11.627829	8.372292	11.627708	0121	9.999879	39
	22	377499	622501	377622	622378	0124	9876	38
	23	382762	617238	382889	617111	0127	9873	37
	24	387962	612038	388092	611908	0130	9870	36
	25	393101	606899	393234	606766	0133	9867	35
	26	398179	601821	398315	601683	0136	9864	34
	27	403199	596801	403338	596662	0139	9861	33
	28	408161	591839	408304	591696	0142	9858	32
	29	413068	586932	413213	586787	0146	9854	31
	30	417919	582081	418068	581932	0149	9851	88 30
		Cosine	Secant	Cotang.	Tang.	Cos. D.	Sine	

1½ Deg.		TABLE V.—LOG. SINES, ETC.								2½ Deg.	
°	'	Sine	D.	Coec.	Tang.	D.	Cot.	Sec.	D.	Cos.	
		8'		11'	8'		11'	10'00		9'99	
1	30	417919		582c81	418c68	8cc2	581932	0149	6	9851	30
	31	422717	7996	577283	422869		577131	0152	6	9848	29
	32	427462	7909	572538	427618	7914	572382	0156	6	9844	28
	33	432156	7823	567844	432315	7828	567685	0159	6	9841	27
	34	436800	7740	563200	436962	7745	563c38	0162	6	9838	26
	35	441394	7657	5586c6	44156c	7663	55844c	0166	6	9834	25
	36	445941	7577	554059	44611c	7583	55389c	0169	6	9831	24
	37	450440	7499	549560	450613	7505	549387	0173	6	9827	23
	38	454893	7422	545107	455070	7428	544930	0177	6	9823	88 22
			7346			7352					
1	39	459301		540699	459481		540519	0180	6	9820	21
	40	463665	7273	536335	463849	7279	536151	0184	6	9816	20
	41	467985	7200	532015	468172	7206	531828	0188	6	9812	19
	42	472263	7129	527737	472454	7135	527546	0191	6	9809	18
	43	476498	7060	523502	476693	7066	523307	0195	6	9805	17
	44	480693	6991	519307	480892	6998	519108	0199	6	9801	16
	45	484848	6924	515152	485050	6931	514950	0203	7	9797	15
	46	488963	6859	511037	489170	6865	510830	0207	7	9793	14
	47	493040	6794	506960	493250	6801	506750	0210	7	9790	88 13
			6731			6738					
1	48	497078		502922	497293		502707	0214	7	9786	12
	49	501080	6669	498920	501298	6676	498702	0218	7	9782	11
	50	505045	6608	494955	505267	6615	494733	0222	7	9778	10
	51	508974	6548	491026	509200	6555	490800	0226	7	9774	9
	52	512867	6489	487133	513098	6496	486902	0231	7	9769	8
	53	516726	6432	483274	516961	6439	483039	0235	7	9765	7
	54	520551	6375	479449	520793	6382	479210	0239	7	9761	6
	55	524343	6319	475657	524586	6326	475414	0243	7	9757	5
	56	528102	6264	471898	528349	6272	471651	0247	7	9753	88 4
			6211			6218					
1	57	531828		468172	532080		467920	0252	7	9748	3
	58	535523	6158	464477	535779	6165	464221	0256	7	9744	2
	59	539180	6106	460814	539447	6113	460553	0260	7	9740	1
2	0	542819	6055	457181	543184	6062	456916	0265	7	9735	88 0
	1	546422	6004	453578	546091	6012	453309	0269	7	9731	59
	2	549995	5955	450005	550268	5962	449732	0274	7	9726	58
	3	553539	5906	446461	553817	5914	446183	0278	7	9722	57
	4	557054	5858	442946	557330	5866	442664	0283	8	9717	56
	5	560540	5811	439460	560828	5819	439172	0287	8	9713	87 55
			5765			5773					
2	6	563999		436001	564291		435709	0292	8	9708	54
	7	567431	5719	432569	567727	5727	432273	0296	8	9704	53
	8	570836	5674	429164	571137	5682	428863	0301	8	9699	52
	9	574214	5630	425786	574520	5638	425480	0306	8	9694	51
	10	577566	5587	422434	577877	5595	422123	0311	8	9689	50
	11	580892	5544	419108	581208	5552	418792	0315	8	9685	49
	12	584193	5502	415807	584514	5510	415486	0320	8	9680	48
	13	587469	5460	412531	587795	5468	412205	0325	8	9675	47
	14	590721	5419	409279	591051	4427	408949	0330	8	9670	46
	15	593948	5379	406052	594283	5387	405717	0335	8	9665	87 45
		Coec.	D.	Sec.	Cot.	D.	Tang.	Coec.	D.	Sine	°
88½ Deg.										87½ Deg.	

2 1/2 Deg.		TABLE V.—LOG. SINES, ETC.								3 Deg.		
°	'	Sine	D.	Coscc.	Tang.	D.	Cot.	Sec.	D.	Cos.	'	
		8'		11'	8'		11'	10'00		9'99		
15		593948		4c6c52	594283		405717	0335		9665		45
16		597152	5339	402848	597492	5347	402508	0340	8	9660		44
17		600332	5300	399668	600677	5308	399323	0345	8	9655		43
18		603489	5261	396511	603839	5270	396161	0350	8	9650		42
19		606623	5223	393377	606978	5232	393022	0355	8	9645		41
20		609734	5186	390266	610094	5194	389906	0360	9	9640		40
21		612823	5149	387177	613189	5158	386811	0365	9	9635		39
22		615891	5112	384109	616262	5121	383738	0371	9	9629		38
23		618937	5076	381063	619313	5085	380687	0376	9	9624	87	37
24		621962	5041	378038	622343	5050	377657	0381	9	9619		36
25		624965	5006	375035	625352	5015	374648	0386	9	9614		35
26		627948	4972	372052	628340	4981	371660	0392	9	9608		34
27		630911	4938	369089	631308	4947	368692	0397	9	9603		33
28		633854	4904	366146	634256	4913	365744	0403	9	9597		32
29		636776	4871	363224	637184	4880	362816	0408	9	9592		31
30		639680	4839	360320	640093	4848	359907	0414	9	9586		30
31		642563	4806	357437	642982	4816	357018	0419	9	9581		29
32		645428	4775	354572	645853	4784	354147	0425	9	9575	87	28
33		648274	4743	351726	648704	4753	351296	0430	9	9570		27
34		651102	4712	348898	651537	4722	348463	0436	9	9564		26
35		653911	4682	346089	654352	4691	345648	0442	9	9558		25
36		656702	4652	343298	657149	4661	342851	0447	10	9553		24
37		659475	4622	340525	659928	4631	340072	0453	10	9547		23
38		662230	4592	337770	662689	4602	337311	0459	10	9541		22
39		664968	4563	335032	665433	4573	334567	0465	10	9535		21
40		667689	4535	332311	668160	4544	331840	0471	10	9529		20
41		670393	4506	329607	670870	4517	329130	0476	10	9524	87	19
42		673080	4479	326920	673563	4488	326437	0482	10	9518		18
43		675751	4451	324249	676239	4461	323761	0488	10	9512		17
44		678405	4424	321593	678900	4434	321100	0494	10	9506		16
45		681043	4397	318957	681544	4407	318456	0500	10	9500		15
46		683665	4370	316335	684172	4380	315828	0507	10	9493		14
47		686272	4344	313728	686784	4354	313216	0513	10	9487		13
48		688863	4318	311137	689381	4328	310619	0519	10	9481		12
49		691438	4292	308562	691963	4303	308037	0525	10	9475		11
50		693998	4267	306002	694529	4277	305471	0531	10	9469	87	10
51		696543	4242	303457	697081	4252	302919	0537	11	9463		9
52		699073	4217	300927	699617	4228	300383	0544	11	9456		8
53		701589	4192	298411	702139	4203	297861	0550	11	9450		7
54		704090	4168	295910	704646	4179	295354	0557	11	9443		6
55		706577	4144	293423	707140	4155	292860	0563	11	9437		5
56		709049	4121	290951	709618	4132	290382	0569	11	9431		4
57		711507	4097	288493	712083	4108	287917	0576	11	9424		3
58		713952	4074	286048	714534	4085	285466	0582	11	9418		2
59		716383	4051	283617	716972	4062	283028	0589	11	9411		1
60		718800	4029	281200	719396	4040	280604	0596	11	9404	87	0
		Con.	D.	Sec.	Cot.	D.	Tang.	Con.	D.	Sine	'	

87 1/2 Deg.

87 Deg.

8 Deg.		TABLE V.—LOG. SINES, ETC.								8½ Deg.	
°	'	Sine	D.	Co-sec.	Tang.	D.	Col.	Sec.	D.	Co-s.	
		8"		11"	8"		11"	10'00		9'99	
8	0	718100	4006	281200	719396	4017	280604	0596	11	9404	87 0
	1	721204	3984	278796	721806	3995	278194	0602	11	9398	59
	2	723595	3962	276405	724204	3974	275796	0609	11	9391	58
	3	725972	3941	274028	726588	3952	273412	0616	11	9384	57
	4	728337	3919	271663	728959	3930	271041	0622	11	9378	56
	5	730688	3898	269312	731317	3909	268683	0629	11	9371	55
	6	733027	3877	266973	733663	3889	266337	0636	12	9364	54
	7	735354	3857	264646	735996	3868	264004	0643	12	9357	53
	8	737667	3836	262333	738317	3848	261683	0650	12	9350	86 52
3	9	739969	3816	260031	740626	3827	259374	0657	12	9343	51
	10	742259	3796	257741	742922	3807	257078	0664	12	9336	50
	11	744536	3776	255464	745207	3787	254793	0671	12	9329	49
	12	746802	3756	253198	747479	3768	252521	0678	12	9322	48
	13	749055	3737	250945	749740	3749	250260	0685	12	9315	47
	14	751297	3717	248703	751989	3729	248011	0692	12	9308	46
	15	753528	3698	246472	754227	3710	245773	0699	12	9301	45
	16	755747	3678	244253	756453	3692	243547	0706	12	9294	44
	17	757955	3661	242045	758668	3673	241332	0714	12	9286	86 43
3	18	760151	3642	239849	760872	3655	239128	0721	12	9279	42
	19	762337	3624	237663	763065	3636	236935	0728	12	9272	41
	20	764511	3606	235489	765246	3618	234754	0735	12	9265	40
	21	766675	3588	233325	767417	3600	232583	0743	12	9257	39
	22	768828	3570	231172	769578	3583	230422	0750	12	9250	38
	23	770970	3553	229030	771727	3565	228273	0758	13	9242	37
	24	773101	3535	226899	773866	3548	226134	0765	13	9235	36
	25	775223	3518	224777	775995	3531	224005	0773	13	9227	35
	26	777333	3501	222667	778114	3514	221886	0780	13	9220	86 34
3	27	779434	3484	220566	780222	3497	219778	0788	13	9212	33
	28	781524	3467	218476	782320	3480	217680	0795	13	9205	32
	29	783605	3451	216395	784408	3464	215592	0803	13	9197	31
	30	785675	3434	214325	786486	3447	213514	0811	13	9189	30
	31	787736	3418	212264	788554	3431	211446	0819	13	9181	29
	32	789787	3402	210213	790613	3415	209387	0826	13	9174	28
	33	791828	3386	208172	792662	3399	207338	0834	13	9166	27
	34	793859	3370	206141	794701	3383	205299	0842	13	9158	26
	35	795881	3354	204119	796731	3368	203269	0850	13	9150	86 25
3	36	797894	3339	202106	798752	3352	201248	0858	13	9142	24
	37	799897	3323	200103	800763	3337	199237	0866	13	9134	23
	38	801892	3308	198108	802765	3322	197235	0874	13	9126	22
	39	803876	3293	196124	804758	3307	195242	0882	13	9118	21
	40	805852	3278	194148	806742	3292	193258	0890	13	9110	20
	41	807819	3263	192181	808717	3277	191283	0898	13	9102	19
	42	809777	3249	190223	810683	3262	189317	0906	13	9094	18
	43	811726	3234	188274	812641	3248	187359	0914	14	9086	17
	44	813667	3219	186333	814589	3233	185411	0923	14	9077	16
	45	815599	3204	184401	816529	3219	183471	0931	14	9069	15
		Co-s.	D.	Sec.	Col.	D.	Tang.	Co-s.	D.	Sine	°

3½ Deg.		TABLE V.—LOG. SINES, ETC.								4½ Deg.	
°	'	Sine	D.	Co-sec.	Tang.	D.	Co-t.	Sec.	D.	Co-s.	
		8'	11'		8'	11'		10'00	9'99		
3	45	815599		184401	816529		183471	0931		9069	15
	46	817522	3205	182478	818461	3219	181539	0939	14	9061	14
	47	819436	3191	180564	820384	3205	179616	0947	14	9053	13
	48	821343	3177	178657	822298	3191	177702	0956	14	9044	12
	49	823240	3163	176760	824205	3177	175795	0964	14	9036	11
	50	825130	3149	174870	826103	3163	173897	0973	14	9027	10
	51	827011	3135	172989	827992	3150	172008	0981	14	9019	9
	52	828884	3122	171116	829874	3136	170126	0990	14	9010	8
	53	830749	3108	169251	831748	3123	168252	0998	14	9002	86 7
			3095			3108			14		
3	54	832607	3082	167393	833613		166387	1007		8993	6
	55	834456	3069	165544	835471	3096	164529	1016	14	8984	5
	56	836297	3056	163703	837321	3083	162679	1024	14	8976	4
	57	838130	3043	161870	839163	3070	160837	1033	14	8967	3
	58	839956	3030	160044	840998	3057	159002	1042	15	8958	2
	59	841774	3017	158226	842825	3045	157175	1050	15	8950	1
4	0	843585	3005	156415	844644	3032	155356	1059	15	8941	86 0
	1	845387	2992	154613	846455	3019	153545	1068	15	8932	59
	2	847183	2980	152817	848260	3007	151740	1077	15	8923	58
			2967			2995			15		
4	3	848971	2967	151029	850057		149943	1086		8914	57
	4	850751	2955	149249	851846	2982	148154	1095	15	8905	56
	5	852525	2943	147475	853628	2970	146372	1104	15	8896	55
	6	854291	2931	145709	855403	2958	144597	1113	15	8887	54
	7	856049	2919	143951	857171	2946	142829	1122	15	8878	53
	8	857801	2908	142199	858932	2935	141068	1131	15	8869	52
	9	859546	2896	140454	860686	2923	139314	1140	15	8860	51
	10	861283	2884	138717	862433	2911	137567	1149	15	8851	50
	11	863014	2873	136986	864173	2900	135827	1159	15	8841	85 49
			2861			2888			15		
4	12	864738	2861	135262	865906		134094	1168		8832	48
	13	866455	2850	133545	867632	2877	132368	1177	16	8823	47
	14	868165	2839	131835	869351	2866	130649	1187	16	8813	46
	15	869868	2828	130132	871064	2854	128936	1196	16	8804	45
	16	871565	2817	128435	872770	2843	127230	1205	16	8795	44
	17	873255	2806	126745	874469	2832	125531	1215	16	8785	43
	18	874938	2795	125062	876162	2821	123838	1224	16	8776	42
	19	876615	2783	123385	877849	2811	122151	1234	16	8766	41
	20	878285	2773	121715	879529	2800	120471	1243	16	8757	85 40
			2763			2789			16		
4	21	879949	2763	120051	881202		118798	1253		8747	39
	22	881607	2752	118393	882869	2779	117131	1262	16	8738	38
	23	883258	2742	116742	884530	2768	115470	1272	16	8728	37
	24	884903	2731	115097	886185	2758	113815	1282	16	8718	36
	25	886542	2721	113458	887833	2747	112167	1292	16	8708	35
	26	888174	2711	111826	889476	2737	110524	1301	16	8699	34
	27	889801	2700	110199	891112	2727	108888	1311	16	8689	33
	28	891421	2690	108579	892742	2717	107258	1321	16	8679	32
	29	893035	2680	106965	894366	2707	105634	1331	16	8669	31
	30	894643	2680	105357	895984	2697	104016	1341	17	8659	85 30
Co-s.	D.	Sec.	Co-t.	D.	Tang.	Co-s.	D.	Sine			

4½ Deg.		TABLE V.—LOG. SINES, ETC.								5½ Deg.	
°	'	Sine	D.	Cos.	Tang.	D.	Cot.	Sec.	D.	Co.	
		8'		11'	8'		11'	10'00		9'99	
4	30	894643	2670	105357	895984	2687	104016	1341	17	8659	30
	31	896246	2660	103754	897596	2677	102404	1351	17	8649	29
	32	897842	2651	102158	899203	2667	100797	1361	17	8639	28
	33	899432	2641	100568	900803	2658	999197	1371	17	8629	27
	34	901017	2631	998983	902398	2648	997602	1381	17	8619	26
	35	902596	2622	997404	903987	2638	996013	1391	17	8609	25
	36	904169	2612	995831	905570	2629	994430	1401	17	8599	24
	37	905736	2603	994264	907147	2620	992853	1411	17	8589	23
	38	907297	2593	992703	908719	2610	991281	1422	17	8578	85 22
4	39	908853	2584	991147	910285	2601	989715	1432	17	8568	21
	40	910404	2575	989596	911846	2592	988154	1442	17	8558	20
	41	911949	2566	988051	913401	2583	986599	1452	17	8548	19
	42	913488	2556	986512	914951	2574	985049	1463	17	8537	18
	43	915022	2547	984978	916495	2565	983505	1473	17	8527	17
	44	916550	2538	983450	918034	2556	981966	1484	18	8516	16
	45	918073	2529	981927	919568	2547	980432	1494	18	8506	15
	46	919591	2520	980409	921096	2538	978904	1505	18	8495	14
	47	921103	2512	978897	922619	2530	977381	1515	18	8485	85 13
4	48	922610	2503	977390	924136	2521	975864	1526	18	8474	12
	49	924112	2494	975888	925649	2512	974351	1536	18	8464	11
	50	925609	2486	974391	927156	2503	972844	1547	18	8453	10
	51	927100	2477	972900	928658	2495	971342	1558	18	8442	9
	52	928587	2469	971413	930155	2486	969845	1569	18	8431	8
	53	930068	2460	969932	931647	2478	968353	1579	18	8421	7
	54	931544	2452	968456	933134	2470	966866	1590	18	8410	6
	55	933015	2443	966985	934616	2461	965384	1601	18	8399	5
	56	934481	2435	965519	936093	2453	963907	1612	18	8388	85 4
4	57	935942	2427	964058	937565	2445	962435	1623	18	8377	3
	58	937398	2419	962602	939032	2437	960968	1634	18	8366	2
	59	938850	2411	961150	940494	2430	959506	1645	18	8355	1
5	0	940296	2403	959704	941952	2421	958048	1656	19	8344	8 0
	1	941738	2394	958262	943404	2413	956596	1667	19	8333	59
	2	943174	2387	956826	944852	2405	955148	1678	19	8322	58
	3	944606	2379	955394	946295	2397	953705	1689	19	8311	57
	4	946034	2371	953966	947734	2390	952266	1700	19	8300	56
	5	947456	2363	952544	949168	2382	950832	1711	19	8289	84 55
5	6	948874	2355	951126	950597	2374	949403	1723	19	8277	54
	7	950287	2348	949713	952021	2366	947979	1734	19	8266	53
	8	951696	2340	948304	953441	2358	946559	1745	19	8255	52
	9	953100	2332	946900	954856	2351	945144	1757	19	8243	51
	10	954499	2325	945501	956267	2344	943733	1768	19	8232	50
	11	955894	2317	944106	957674	2337	942326	1780	19	8220	49
	12	957284	2310	942716	959075	2329	940925	1791	19	8209	48
	13	958670	2302	941330	960473	2321	939527	1803	19	8197	47
	14	960052	2295	939948	961866	2314	938134	1814	19	8186	46
	15	961429		938571	963255		936745	1826	19	8174	84 45
		Co.	D.	Sec.	Cot.	D.	Tang.	Co.	D.	Sine	°

85½ Deg.

84½ Deg.

6 1/2 Deg.		TABLE V.—LOG. SINUS, ETC.								6 Deg.	
°	Sine	D.	Cosac.		D.	Cot.		D.	Con.		
	8'		11'	8'		11'	10 00				
15	961429	2282	038571	963255	2307	036745	1826	19	8174	45	
16	962801	2280	037199	964639	2300	035361	1837	19	8163	44	
17	964170	2273	035830	966019	2293	033981	1849	19	8151	43	
18	965534	2266	034466	967394	2286	032606	1861	20	8139	42	
19	966893	2259	033107	968766	2279	031234	1872	20	8128	41	
20	968249	2252	031751	970133	2271	029867	1884	20	8116	40	
21	969600	2245	030400	971496	2265	028504	1896	20	8104	39	
22	970947	2238	029053	972855	2257	027145	1908	20	8092	38	
23	972289	2231	027711	974209	2251	025791	1920	20	8080	37	
5 24	973628	2224	026372	975560	2244	024440	1932	20	8068	36	
25	974962	2217	025038	976906	2237	023094	1944	20	8056	35	
26	976293	2210	023707	978248	2230	021752	1956	20	8044	34	
27	977619	2203	022381	979586	2223	020414	1968	20	8032	33	
28	978941	2197	021059	980921	2217	019079	1980	20	8020	32	
29	980259	2190	019741	982251	2210	017749	1992	20	8008	31	
30	981573	2183	018427	983577	2204	016423	2004	20	7996	30	
31	982883	2177	017117	984899	2197	015101	2016	20	7984	29	
32	984189	2170	015811	986217	2191	013783	2028	20	7972	28	
5 33	985491	2163	014509	987532	2184	012468	2041	20	7959	27	
34	986789	2157	013211	988842	2178	011158	2053	20	7947	26	
35	988083	2150	011917	990149	2171	009851	2065	21	7935	25	
36	989374	2144	010626	991451	2165	008549	2078	21	7922	24	
37	990660	2138	009340	992750	2158	007250	2090	21	7910	23	
38	991943	2131	008057	994045	2152	005955	2103	21	7897	22	
39	993222	2125	006778	995337	2146	004663	2115	21	7885	21	
40	994497	2119	005503	996624	2140	003376	2128	21	7872	20	
41	995768	2112	004232	997908	2134	002092	2140	21	7860	19	
5 42	997036	2106	002964	999188	2127	000812	2153	21	7847	18	
43	998299	2100	001701	000465	2121	099535	2165	21	7835	17	
44	999560	2094	000440	001738	2115	098262	2178	21	7822	16	
45	000816	2088	099184	003007	2109	096993	2191	21	7809	15	
46	002069	2082	097931	004272	2103	095728	2203	21	7797	14	
47	003318	2076	096682	005534	2097	094466	2216	21	7784	13	
48	004563	2070	095437	006792	2091	093208	2229	21	7771	12	
49	005805	2064	094195	008047	2085	091953	2242	21	7758	11	
50	007044	2058	092956	009298	2080	090702	2255	21	7745	10	
5 51	008278	2052	091722	010546	2074	089454	2268	21	7732	9	
52	009510	2046	090490	011790	2068	088210	2281	21	7719	8	
53	010737	2040	089263	013031	2062	086969	2294	21	7706	7	
54	011962	2034	088038	014268	2056	085732	2307	22	7693	6	
55	013182	2029	086818	015502	2051	084498	2320	22	7680	5	
56	014400	2023	085600	016732	2045	083268	2333	22	7667	4	
57	015613	2017	084387	017959	2040	082041	2346	22	7654	3	
58	016824	2012	083176	019183	2033	080817	2359	22	7641	2	
59	018031	2006	081969	020403	2028	079597	2372	22	7628	1	
60	019235		080765	021620		078380	2386	22	7614	0	
	Con.	D.	Sec.	Cot.	D.	Tang.	Con.	D.	Sine		

6 Deg. TABLE V.—LOG. SINES, ETC. 6 1/2 Deg.

°	Sine	D.	Co-sec.	Tang.	D.	Cot.	Sec.	D.	Con.	
	9'		10'	9'		10'	10'00		9'99	
6 0	019235	2000	980765	021620	2023	978380	2386	22	7614	60
1	020435	1995	979565	022834	2017	977166	2399	22	7601	59
2	021632	1989	978368	024044	2011	975956	2412	22	7588	58
3	022825	1984	977175	025251	2006	974749	2426	22	7574	57
4	024016	1978	975984	026455	2000	973545	2439	22	7561	56
5	025203	1973	974797	027655	1995	972345	2453	22	7547	55
6	026386	1967	973614	028852	1990	971148	2466	23	7534	54
7	027567	1962	972433	030046	1985	969954	2480	23	7520	53
8	028744	1957	971256	031237	1979	968763	2493	23	7507	83 52
6 9	029918	1951	970082	032425	1974	967575	2507	23	7493	51
10	031089	1946	968911	033609	1969	966391	2520	23	7480	50
11	032257	1941	967743	034791	1964	965209	2534	23	7466	49
12	033421	1936	966579	035969	1958	964031	2548	23	7452	48
13	034582	1930	965418	037144	1953	962856	2561	23	7439	47
14	035741	1925	964259	038316	1948	961684	2575	23	7425	46
15	036896	1920	963104	039485	1943	960515	2589	23	7411	45
16	038048	1915	961952	040651	1938	959349	2603	23	7397	44
17	039197	1910	960803	041813	1933	958187	2617	23	7383	83 43
6 18	040342	1905	959658	042973	1928	957027	2631	23	7369	42
19	041485	1899	958515	044130	1923	955870	2645	23	7355	41
20	042625	1895	957375	045284	1918	954716	2659	23	7341	40
21	043762	1889	956238	046434	1913	953566	2673	24	7327	39
22	044895	1884	955105	047582	1908	952418	2687	24	7313	38
23	046026	1879	953974	048727	1903	951273	2701	24	7299	37
24	047154	1875	952846	049869	1898	950131	2715	24	7285	36
25	048279	1870	951721	051008	1893	948992	2729	24	7271	35
26	049400	1865	950600	052144	1889	947856	2743	24	7257	83 34
6 27	050519	1860	949481	053277	1884	946723	2758	24	7242	33
28	051635	1855	948365	054407	1879	945593	2772	24	7228	32
29	052749	1850	947251	055535	1874	944465	2786	24	7214	31
30	053859	1845	946141	056659	1870	943341	2801	24	7199	30
31	054966	1841	945034	057781	1865	942219	2815	24	7185	29
32	056071	1836	943929	058900	1860	941100	2830	24	7170	28
33	057172	1831	942828	060016	1855	939984	2844	24	7156	27
34	058271	1827	941729	061130	1851	938870	2859	24	7141	26
35	059367	1822	940633	062240	1846	937760	2873	24	7127	83 25
6 36	060460	1817	939540	063348	1842	936652	2888	24	7112	24
37	061551	1813	938449	064453	1837	935547	2902	24	7098	23
38	062639	1808	937361	065556	1833	934444	2917	24	7083	22
39	063724	1804	936276	066655	1828	933345	2932	25	7068	21
40	064806	1799	935194	067752	1824	932248	2947	25	7053	20
41	065885	1794	934115	068846	1819	931154	2961	25	7039	19
42	066962	1790	933038	069938	1815	930062	2976	25	7024	18
43	068036	1786	931964	071027	1810	928973	2991	25	7009	17
44	069107	1781	930893	072113	1806	927887	3006	25	6994	16
45	070176		929824	073197		926803	3021	25	6979	83 15
	Coa.	D.	Sec.	Cot.	D.	Tang.	Coa.	D.	Sine	°

84 Deg.

84 1/2 Deg.

6½ Deg.		TABLE V.—LOG. SINES, ETC.								7½ Deg.	
°	Sine	D.	Co-sec.	Tang.	D.	CoL	Sec.	D.	Co.		
	9'		10'	9'		10'	10'00		9'99		
45	070176	1777	929824	073197	1802	926803	3021	25	6979	15	
46	071242	1772	928758	074278	1797	925722	3036	25	6964	14	
47	072306	1768	927694	075356	1793	924644	3051	25	6949	13	
48	073366	1763	926634	076432	1789	923568	3066	25	6934	12	
49	074424	1759	925576	077505	1784	922495	3081	25	6919	11	
50	075480	1755	924520	078576	1780	921424	3096	25	6904	10	
51	076533	1750	923467	079644	1776	920356	3111	25	6889	9	
52	077583	1746	922417	080710	1772	919290	3126	25	6874	8	
53	078631	1742	921369	081773	1767	918227	3142	25	6858	8½ 7	
6	079676	1738	920324	082833	1763	917167	3157	25	6843	6	
55	080719	1733	919281	083891	1759	916109	3172	25	6828	5	
56	081759	1729	918241	084947	1755	915053	3188	25	6812	4	
57	082797	1725	917203	086000	1751	914000	3203	26	6797	3	
58	083832	1721	916168	087050	1747	912950	3218	26	6782	2	
59	084864	1717	915136	088098	1743	911902	3234	26	6766	1	
7	085894	1713	914106	089144	1738	910856	3249	26	6751	83 0	
1	086922	1709	913078	090187	1735	909813	3265	26	6735	59	
2	087947	1704	912053	091228	1731	908772	3280	26	6720	82 2	
7	088970	1700	911030	092266	1727	907734	3296	26	6704	57	
4	089990	1696	910010	093302	1722	906698	3312	26	6688	56	
5	091008	1692	908992	094336	1719	905664	3327	26	6673	55	
6	092024	1688	907976	095367	1715	904633	3343	26	6657	54	
7	093037	1684	906963	096395	1711	903605	3359	26	6641	53	
8	094047	1680	905953	097422	1707	902578	3375	26	6625	52	
9	095056	1676	904944	098446	1703	901554	3390	26	6610	51	
10	096062	1673	903938	099468	1699	900532	3406	26	6594	50	
11	097065	1668	902935	100487	1695	899513	3422	27	6578	82 49	
7	098066	1665	901934	101504	1691	898496	3438	27	6562	48	
12	099065	1661	900935	102519	1687	897481	3454	27	6546	47	
13	100062	1657	899938	103532	1684	896468	3470	27	6530	46	
14	101056	1653	898944	104542	1680	895458	3486	27	6514	45	
15	102048	1649	897952	105550	1676	894450	3502	27	6498	44	
16	103037	1645	896963	106556	1672	893444	3518	27	6482	43	
17	104025	1642	895975	107559	1669	892441	3535	27	6465	42	
18	105010	1638	894990	108560	1665	891440	3551	27	6449	41	
19	106001	1634	894008	109559	1661	890441	3567	27	6433	82 40	
20	106973	1630	893027	110556	1658	889444	3583	27	6417	39	
21	107951	1627	892049	111551	1654	888449	3600	27	6400	38	
22	108927	1623	891073	112543	1650	887457	3616	27	6384	37	
23	109901	1619	890099	113533	1647	886467	3632	27	6368	36	
24	110873	1616	889127	114521	1643	885479	3649	27	6351	35	
25	111842	1612	888158	115507	1639	884493	3665	27	6335	34	
26	112809	1608	887191	116491	1635	883509	3682	27	6318	33	
27	113774	1605	886226	117472	1632	882528	3698	28	6302	32	
28	114737	1601	885263	118452	1629	881548	3715	28	6285	31	
29	115698		884302	119429		880571	3731	28	6269	82 30	
30											
	Co.	D.	Sec.	CoL	D.	Tang.	Co.	D.	Sine		

83½ Deg.

82½ Deg.

7½ Deg.		TABLE V.—LOG. SINES, ETC.								8½ Deg.	
°	'	Sine	D.	Co-sec.	Tang.	D.	Col.	Sec.	D.	Co-sec.	
		9'		10'	9'		10'	10'00		9'99	
7	30	115698	1597	884302	119429	1625	880571	3731	28	6269	30
	31	116656	1594	883344	120404	1622	879596	3748	28	6252	29
	32	117613	1590	882387	121377	1618	878623	3765	28	6235	28
	33	118567	1587	881433	122348	1615	877652	3781	28	6219	27
	34	119519	1583	880481	123317	1611	876683	3798	28	6202	26
	35	120469	1580	879531	124284	1608	875716	3815	28	6185	25
	36	121417	1576	878583	125249	1604	874751	3832	28	6168	24
	37	122362	1573	877638	126211	1601	873789	3849	28	6151	23
	38	123306	1569	876694	127172	1597	872828	3866	28	6134	82 22
7	39	124248	1566	875752	128130	1594	871870	3883	28	6117	21
	40	125187	1562	874813	129087	1591	870913	3900	28	6100	20
	41	126125	1559	873875	130041	1587	869959	3917	28	6083	19
	42	127060	1556	872940	130994	1584	869006	3934	29	6066	18
	43	127993	1552	872007	131944	1581	868056	3951	29	6049	17
	44	128925	1549	871075	132893	1577	867107	3968	29	6032	16
	45	129854	1545	870146	133839	1574	866161	3985	29	6015	15
	46	130781	1542	869219	134784	1571	865216	4002	29	5998	14
	47	131706	1539	868294	135726	1567	864274	4020	29	5980	82 13
7	48	132630	1535	867370	136667	1564	863333	4037	29	5963	12
	49	133551	1532	866449	137605	1561	862395	4054	29	5946	11
	50	134470	1529	865530	138542	1558	861458	4072	29	5928	10
	51	135387	1525	864613	139476	1555	860524	4089	29	5911	9
	52	136303	1522	863697	140409	1551	859591	4106	29	5894	8
	53	137216	1519	862784	141340	1548	858660	4124	29	5876	7
	54	138128	1516	861872	142269	1545	857731	4141	29	5859	6
	55	139037	1512	860963	143196	1542	856804	4159	29	5841	5
	56	139944	1509	860056	144121	1539	855879	4177	29	5823	82 4
7	57	140850	1506	859150	145044	1535	854956	4194	29	5806	3
	58	141754	1503	858246	145966	1532	854034	4212	29	5788	2
	59	142655	1500	857345	146885	1529	853115	4229	29	5771	82 1
8	0	143555	1496	856445	147803	1526	852197	4247	30	5753	0
	1	144453	1493	855547	148718	1523	851282	4265	30	5735	59
	2	145349	1490	854651	149632	1520	850368	4283	30	5717	58
	3	146243	1487	853757	150544	1517	849456	4301	30	5699	57
	4	147136	1484	852864	151454	1514	848546	4319	30	5681	56
	5	148026	1481	851974	152363	1511	847637	4336	30	5664	81 55
8	6	148915	1478	851085	153269	1508	846731	4354	30	5646	54
	7	149802	1475	850198	154174	1505	845826	4372	30	5628	53
	8	150686	1472	849314	155077	1502	844923	4390	30	5610	52
	9	151569	1469	848431	155978	1499	844022	4409	30	5591	51
	10	152451	1466	847549	156877	1496	843123	4427	30	5573	50
	11	153330	1463	846670	157775	1493	842225	4445	30	5555	49
	12	154208	1460	845792	158671	1490	841329	4463	30	5537	48
	13	155083	1457	844917	159565	1487	840435	4481	30	5519	47
	14	155957	1454	844043	160457	1484	839543	4499	31	5501	46
	15	156830		843170	161347		838653	4518		5482	82 45
		Co-sec.	D.	Sec.	Col.	D.	Tang.	Co-sec.	D.	Sine	

8½ Deg.		TABLE V.—LOG SINES, ETC.										9 Deg.	
°	'	Sine	D.	Co-sec.	Tang.	D.	Cot.	Sec.	D.	Coa.			
		9'		10'	9'		10'	10'00		9'99			
15		156830		843170	161347		838653	4518		5482		45	
16		157700	1448	842300	162236	1481	837764	4536	31	5464		44	
17		158569	1448	841431	163123	1479	836877	4554	31	5446		43	
18		159435	1445	840565	164008	1476	835992	4573	31	5427		42	
19		160301	1442	839699	164892	1473	835108	4591	31	5409		41	
20		161164	1439	838836	165774	1470	834226	4610	31	5390		40	
21		162025	1436	837975	166654	1467	833346	4628	31	5372		39	
22		162885	1433	837115	167532	1464	832468	4647	31	5353		38	
23		163743	1430	836257	168409	1461	831591	4666	31	5334	81	37	
			1427			1458			31				
8 24		164600	1424	835400	189284	1455	830716	4684	31	5316		36	
25		165454	1422	834546	170157	1453	829843	4703	31	5297		35	
26		166307	1419	833693	171029	1450	828971	4722	31	5278		34	
27		167159	1416	832841	171899	1447	828101	4740	31	5260		33	
28		168008	1413	831992	172767	1444	827233	4759	31	5241		32	
29		168856	1410	831144	173634	1442	826366	4778	32	5222		31	
30		169702	1407	830298	174499	1439	825501	4797	32	5203		30	
31		170547	1405	829453	175362	1436	824638	4816	32	5184		29	
32		171389	1402	828611	176224	1433	823776	4835	32	5165	81	28	
									32				
8 33		172230	1399	827770	177084	1431	822916	4854	32	5146		27	
34		173070	1396	826930	177942	1428	822058	4873	32	5127		26	
35		173908	1394	826092	178799	1425	821201	4892	32	5108		25	
36		174744	1391	825256	179655	1423	820345	4911	32	5089		24	
37		175578	1388	824422	180508	1420	819492	4930	32	5070		23	
38		176411	1386	823589	181360	1417	818642	4949	32	5051		22	
39		177242	1383	822758	182211	1415	817789	4968	32	5032		21	
40		178072	1380	821928	183059	1412	816941	4987	32	5013		20	
41		178900	1377	821100	183907	1409	816093	5007	32	4993	81	19	
									32				
8 42		179726	1374	820274	184752	1407	815248	5026	32	4974		18	
43		180551	1372	819449	185597	1404	814403	5045	32	4955		17	
44		181374	1369	818626	186439	1402	813561	5065	32	4935		16	
45		182196	1366	817804	187280	1399	812720	5084	33	4916		15	
46		183016	1364	816984	188120	1396	811880	5104	33	4896		14	
47		183834	1361	816166	188958	1393	811042	5123	33	4877		13	
48		184651	1359	815349	189794	1391	810206	5143	33	4857		12	
49		185466	1356	814534	190629	1389	809371	5162	33	4838		11	
50		186280	1353	813720	191462	1386	808538	5182	33	4818	81	10	
									33				
8 51		187092	1351	812908	192294	1384	807706	5202	33	4798		9	
52		187903	1348	812097	193124	1381	806876	5221	33	4779		8	
53		188712	1346	811288	193953	1379	806047	5241	33	4759		7	
54		189519	1343	810481	194780	1376	805220	5261	33	4739		6	
55		190325	1341	809675	195606	1374	804394	5281	33	4719		5	
56		191130	1338	808870	196430	1371	803570	5300	33	4700		4	
57		191933	1336	808067	197253	1369	802747	5320	33	4680		3	
58		192734	1333	807266	198074	1366	801926	5340	33	4660		2	
59		193534	1330	806466	198894	1364	801106	5360	33	4640		1	
60		194332		805668	199713		800287	5380	33	4620	81	0	
		Coa.	D.	Sec.	Cot.	D.	Tang.	Coa.	D.	Sine	°		

9 Deg.		TABLE V.—LOG. SINES, ETC.										9½ Deg.	
°	'	Sine	D.	Co-sec.	Tang.	D.	Cot.	Sec.	D.	Co.			
		9'		10'	9'		10'	10'00		9'99			
0	0	194332		805668	199713		800287	5380		4620		60	
1	1	195129	1328	804871	200529	1361	799471	5400	33	4600		59	
2	2	195925	1326	804075	201345	1359	798655	5420	33	4580		58	
3	3	196719	1323	803281	202159	1356	797841	5440	33	4560		57	
4	4	197511	1321	802489	202971	1354	797029	5460	34	4540		56	
5	5	198302	1318	801698	203782	1352	796218	5481	34	4519		55	
6	6	199091	1316	800909	204592	1349	795408	5501	34	4499		54	
7	7	199879	1313	800121	205400	1347	794600	5521	34	4479		53	
8	8	200666	1311	799334	206207	1345	793793	5541	34	4459	80	52	
9	9	201451	1308	798549	207013	1342	792987	5562	34	4438		51	
10	10	202234	1306	797766	207817	1340	792183	5582	34	4418		50	
11	11	203017	1304	796983	208619	1338	791381	5603	34	4397		49	
12	12	203797	1301	796203	209420	1335	790580	5623	34	4377		48	
13	13	204577	1299	795423	210220	1333	789780	5643	34	4357		47	
14	14	205354	1296	794646	211018	1331	788982	5664	34	4336		46	
15	15	206131	1294	793869	211815	1328	788185	5684	34	4316		45	
16	16	206906	1292	793094	212611	1326	787389	5705	34	4295		44	
17	17	207679	1289	792321	213405	1324	786595	5726	34	4274	80	43	
18	18	208452	1287	791548	214198	1321	785802	5746	35	4254		42	
19	19	209222	1285	790778	214989	1319	785011	5767	35	4233		41	
20	20	209992	1282	790008	215780	1317	784220	5788	35	4212		40	
21	21	210760	1280	789240	216568	1315	783432	5809	35	4191		39	
22	22	211526	1278	788474	217356	1312	782644	5829	35	4171		38	
23	23	212291	1275	787709	218142	1310	781858	5850	35	4150		37	
24	24	213055	1273	786945	218926	1308	781074	5871	35	4129		36	
25	25	213818	1271	786182	219710	1305	780290	5892	35	4108		35	
26	26	214579	1268	785421	220492	1303	779508	5913	35	4087	80	34	
27	27	215338	1266	784662	221272	1301	778728	5934	35	4066		33	
28	28	216097	1264	783903	222052	1299	777948	5955	35	4045		32	
29	29	216854	1261	783146	222830	1297	777170	5976	35	4024		31	
30	30	217609	1259	782391	223606	1294	776394	5997	35	4003		30	
31	31	218363	1257	781637	224382	1292	775618	6019	35	3981		29	
32	32	219116	1255	780884	225156	1290	774844	6040	35	3960		28	
33	33	219868	1253	780132	225929	1288	774071	6061	35	3939		27	
34	34	220618	1250	779382	226700	1286	773300	6082	35	3918		26	
35	35	221367	1248	778633	227471	1284	772529	6104	35	3896	80	25	
36	36	222115	1246	777885	228239	1281	771761	6125	36	3875		24	
37	37	222861	1244	777139	229007	1279	770993	6146	36	3854		23	
38	38	223606	1242	776394	229773	1277	770227	6168	36	3832		22	
39	39	224349	1239	775651	230539	1275	769461	6189	36	3811		21	
40	40	225092	1237	774908	231302	1273	768698	6211	36	3789		20	
41	41	225833	1235	774167	232065	1271	767935	6232	36	3768		19	
42	42	226573	1233	773427	232826	1269	767174	6254	36	3746		18	
43	43	227311	1231	772689	233586	1267	766414	6275	36	3725		17	
44	44	228048	1228	771952	234345	1265	765655	6297	36	3703		16	
45	45	228784	1226	771216	235103	1262	764897	6319	36	3681	80	15	
		Coa.	D.	Sec.	Cot.	D.	Tang.	Coa.	D.	Sine			

97 Deg.		TABLE V.—LOG. SINES, ETC.								10 Deg.	
°	'	Sine	D.	Cosec.	Tang.	D.	Col.	Sec.	11	Col.	
		9'		10'	9'		10'	10'00		9'99	
45		228784	1224	771216	235103	1260	764897	6319	36	3681	15
46		229518	1222	770482	235859	1258	764141	6340	36	3660	14
47		230252	1220	769748	236614	1256	763386	6362	36	3638	13
48		230984	1218	769016	237368	1254	762632	6384	36	3616	12
49		231714	1216	768286	238120	1252	761880	6406	36	3594	11
50		232444	1214	767556	238872	1250	761128	6428	37	3572	10
51		233172	1212	766828	239622	1248	760378	6450	37	3550	9
52		233899	1209	766101	240371	1246	759629	6472	37	3528	8
53		234625	1207	765375	241118	1244	758882	6494	37	3506	80 7
9 54		235349	1205	764651	241865	1242	758135	6516	37	3484	6
55		236073	1203	763927	242610	1240	757390	6538	37	3462	5
56		236795	1201	763205	243354	1238	756646	6560	37	3440	4
57		237515	1199	762485	244097	1236	755903	6582	37	3418	3
58		238235	1197	761765	244839	1234	755161	6604	37	3396	2
59		238953	1195	761047	245579	1232	754421	6626	37	3374	1
10 0		239670	1193	760330	246319	1230	753681	6649	37	3351	80 0
1		240386	1191	759614	247057	1228	752943	6671	37	3329	59
2		241101	1189	758899	247794	1226	752206	6693	37	3307	79 58
10 3		241814	1187	758186	248530	1224	751470	6715	37	3285	57
4		242528	1185	757474	249264	1222	750736	6738	37	3262	56
5		243237	1183	756763	249998	1220	750002	6760	37	3240	55
6		243947	1181	756053	250730	1218	749270	6783	38	3217	54
7		244656	1179	755344	251461	1217	748539	6805	38	3195	53
8		245363	1177	754637	252191	1215	747809	6828	38	3172	52
9		246069	1175	753931	252920	1213	747080	6851	38	3149	51
10		246775	1173	753225	253648	1211	746352	6873	38	3127	50
11		247478	1171	752522	254374	1209	745626	6896	38	3104	79 49
10 12		248181	1169	751819	255100	1207	744900	6919	38	3081	48
13		248883	1167	751117	255824	1205	744176	6941	38	3059	47
14		249583	1165	750417	256547	1203	743453	6964	38	3036	46
15		250282	1163	749718	257269	1201	742731	6987	38	3013	45
16		250980	1161	749020	257990	1200	742010	7010	38	2990	44
17		251677	1159	748323	258710	1198	741290	7033	38	2967	43
18		252373	1158	747627	259429	1196	740571	7056	38	2944	42
19		253067	1156	746933	260146	1194	739854	7079	38	2921	41
20		253761	1154	746239	260863	1192	739137	7102	38	2898	79 40
10 21		254453	1152	745547	261578	1190	738422	7125	38	2875	39
22		255144	1150	744856	262292	1189	737708	7148	38	2852	38
23		255834	1148	744166	263005	1187	736995	7171	39	2829	37
24		256523	1146	743477	263717	1185	736283	7194	39	2806	36
25		257211	1144	742789	264428	1183	735572	7217	39	2783	35
26		257898	1142	742102	265138	1181	734862	7241	39	2759	34
27		258583	1141	741417	265847	1179	734153	7264	39	2736	33
28		259268	1139	740732	266555	1178	733445	7287	39	2713	32
29		259951	1137	740049	267261	1176	732739	7310	39	2690	31
30		260633		739367	267967		732033	7334		2666	70 30
		Con.	D.	Sec.	Col.	D.	Tang.	Com.	D.	Sine	

80 Deg.

70 Deg.

10 1/4 Deg. TABLE V.—Loc. Sines, etc. 11 1/4 Deg.

10 1/4 Deg.		TABLE V.—Loc. Sines, etc.							11 1/4 Deg.		
°	'	Sine	D.	Cosec.	Tang.	D.	Cot.	Sec.	D.	Coa.	
		9'		10'	9'		10'	10'00		9'99	
10	30	260633		739367	267967		732033	7334		2666	30
	31	261314	1135	738686	268671	1174	731329	7357	39	2643	29
	32	261994	1133	738006	269375	1172	730625	7381	39	2619	28
	33	262673	1131	737327	270077	1170	729923	7404	39	2596	27
	34	263351	1130	736649	270779	1169	729221	7428	39	2572	26
	35	264027	1128	735973	271479	1167	728521	7451	39	2549	25
	36	264703	1126	735297	272178	1165	727822	7475	39	2525	24
	37	265377	1124	734623	272876	1164	727124	7499	39	2501	23
	38	266051	1122	733949	273573	1162	726427	7522	39	2478	22
			1120			1160			40		
10	39	266723		733277	274269		725731	7546	40	2454	21
	40	267395	1119	732605	274964	1158	725036	7570	40	2430	20
	41	268065	1117	731935	275658	1157	724342	7594	40	2406	19
	42	268734	1115	731266	276351	1155	723649	7618	40	2382	18
	43	269402	1113	730598	277043	1153	722957	7641	40	2359	17
	44	270069	1111	729931	277734	1151	722266	7665	40	2335	16
	45	270735	1110	729265	278424	1150	721576	7689	40	2311	15
	46	271400	1108	728600	279113	1148	720887	7713	40	2287	14
	47	272064	1106	727936	279801	1147	720199	7737	40	2263	13
			1105			1145			40		
10	48	272726		727274	280488		719512	7761		2239	12
	49	273388	1103	726612	281174	1143	718826	7786	40	2214	11
	50	274049	1101	725951	281858	1141	718142	7810	40	2190	10
	51	274708	1099	725292	282542	1140	717458	7834	40	2166	9
	52	275367	1098	724633	283225	1138	716775	7858	40	2142	8
	53	276024	1096	723976	283907	1136	716093	7883	40	2117	7
	54	276681	1094	723319	284588	1135	715412	7907	41	2093	6
	55	277337	1092	722663	285268	1133	714732	7931	41	2069	5
	56	277991	1091	722009	285947	1131	714053	7956	41	2044	4
			1089			1130			41		
10	57	278644		721356	286624		713376	7980		2020	3
	58	279297	1087	720703	287301	1128	712699	8004	41	1996	2
	59	279948	1086	720052	287977	1126	712023	8029	41	1971	1
11	0	280599	1084	719401	288652	1125	711348	8053	41	1947	0
	1	281248	1082	718752	289326	1123	710674	8078	41	1922	59
	2	281897	1081	718103	289999	1122	710001	8103	41	1897	58
	3	282544	1079	717456	290671	1120	709329	8127	41	1873	57
	4	283190	1077	716810	291342	1118	708658	8152	41	1848	56
	5	283836	1076	716164	292013	1117	707987	8177	41	1823	55
			1074			1115			41		
11	6	284480		715520	292685		707318	8201		1799	54
	7	285124	1072	714876	293350	1114	706650	8226	41	1774	53
	8	285766	1071	714234	294017	1112	705983	8251	42	1749	52
	9	286408	1069	713592	294684	1111	705316	8276	42	1724	51
	10	287048	1067	712952	295349	1109	704651	8301	42	1699	50
	11	287687	1066	712313	296013	1107	703987	8326	42	1674	49
	12	288326	1064	711674	296677	1106	703323	8351	42	1649	48
	13	288964	1063	711036	297339	1104	702661	8376	42	1624	47
	14	289600	1061	710400	298001	1103	701999	8401	42	1599	46
	15	290236	1059	709764	298662	1101	701338	8426	42	1574	45

11½ Deg.		TABLE V.—LOG. SINES, ETC.								12 Deg.	
°	'	Sine	D.	Co-sec.	Tang.	D.	Cot.	Sec.	D.	Coa.	
		9'		10'	9'		10'	10'00		9'99	
11	15	290236	1058	709764	298662	1100	701338	8426	42	1574	45
	16	290870	1056	709130	299322	1098	700678	8451	42	1549	44
	17	291504	1054	708496	299980	1096	700020	8476	42	1524	43
	18	292137	1053	707863	300638	1095	699362	8502	42	1498	42
	19	292768	1051	707232	301295	1093	698705	8527	42	1473	41
	20	293399	1050	706601	301951	1092	698049	8552	42	1448	40
	21	294029	1048	705971	302607	1090	697393	8578	42	1422	39
	22	294658	1046	705342	303261	1089	696739	8603	42	1397	38
	23	295286	1045	704714	303914	1087	696086	8628	43	1372	78 37
11	24	295913	1043	704087	304567	1086	695433	8654	43	1346	36
	25	296539	1042	703461	305218	1084	694782	8679	43	1321	35
	26	297164	1040	702836	305869	1083	694131	8705	43	1295	34
	27	297788	1039	702212	306519	1081	693481	8730	43	1270	33
	28	298412	1037	701588	307168	1080	692832	8756	43	1244	32
	29	299035	1036	700966	307815	1078	692185	8782	43	1218	31
	30	299658	1034	700345	308463	1077	691537	8807	43	1193	30
	31	300276	1032	699724	309109	1075	690891	8833	43	1167	29
	32	300895	1031	699105	309754	1074	690246	8859	43	1141	78 28
11	33	301514	1029	698486	310398	1073	689602	8885	43	1115	27
	34	302132	1028	697868	311042	1071	688958	8910	43	1090	26
	35	302748	1026	697252	311685	1070	688315	8936	43	1064	25
	36	303364	1025	696636	312327	1068	687673	8962	43	1038	24
	37	303979	1023	696021	312967	1067	687033	8988	43	1012	23
	38	304593	1022	695407	313608	1065	686392	9014	43	0986	22
	39	305207	1020	694793	314247	1064	685753	9040	43	0960	21
	40	305819	1019	694181	314885	1062	685115	9066	43	0934	20
	41	306430	1017	693570	315523	1061	684477	9092	44	0908	78 19
11	42	307041	1016	692959	316159	1060	683841	9118	44	0882	18
	43	307650	1014	692350	316795	1058	683205	9145	44	0855	17
	44	308259	1013	691741	317430	1057	682570	9171	44	0829	16
	45	308867	1011	691133	318064	1055	681936	9197	44	0803	15
	46	309474	1010	690526	318697	1054	681303	9223	44	0777	14
	47	310080	1008	689920	319329	1053	680671	9250	44	0750	13
	48	310685	1007	689315	319961	1051	680039	9276	44	0724	12
	49	311289	1005	688711	320592	1050	679408	9303	44	0697	11
	50	311893	1004	688107	321222	1048	678778	9329	44	0671	78 10
11	51	312495	1003	687505	321851	1047	678149	9356	44	0644	9
	52	313097	1001	686903	322479	1045	677521	9382	44	0618	8
	53	313698	1000	686302	323106	1044	676894	9409	44	0591	7
	54	314297	998	685703	323733	1043	676267	9435	44	0565	6
	55	314897	997	685103	324358	1041	675642	9462	44	0538	5
	56	315495	996	684505	324983	1040	675017	9489	44	0511	4
	57	316092	994	683908	325607	1039	674393	9515	45	0485	3
	58	316689	993	683311	326231	1037	673769	9542	45	0458	2
	59	317284	991	682716	326853	1036	673147	9569	45	0431	1
	60	317879		682121	327475		672525	9596	45	0404	78 0
		Coa.	D.	Sec.	Cot.	D.	Tang.	Coa.	D.	Sine	'

78½ Deg.

78 Deg.

12 Deg.		TABLE V.—LOG. SINES, ETC.								12½ Deg.	
°	'	Sine	D.	Cosec.	Tang.	D.	Cot.	Sec.	D.	Coa.	
		9'3		10'6	9'		10'	10'0		9'9	
12	0	17879	990	82121	327474	1035	672526	09596	45	90404	60
	1	18473	988	81527	328095	1033	671905	09622	45	90378	59
	2	19066	987	80934	328715	1032	671285	09649	45	90351	58
	3	19658	986	80344	329334	1030	670666	09676	45	90324	57
	4	20249	984	79751	329953	1029	670047	09703	45	90297	56
	5	20840	983	79160	330570	1028	669430	09730	45	90270	55
	6	21430	982	78570	331187	1026	668813	09757	45	90243	54
	7	22019	980	77981	331803	1025	668197	09785	45	90215	53
	8	22607	979	77393	332418	1024	667582	09812	45	90188	77 52
12	9	23194	977	76806	333033	1023	666967	09839	45	90161	51
	10	23780	976	76220	333646	1021	666354	09866	45	90134	50
	11	24366	975	75634	334259	1020	665741	09893	46	90107	49
	12	24950	973	75050	334871	1019	665129	09921	46	90079	48
	13	25534	972	74466	335482	1017	664518	09948	46	90052	47
	14	26117	970	73883	336093	1016	663907	09975	46	90025	46
	15	26700	969	73300	336702	1015	663298	10003	46	89997	45
	16	27281	968	72719	337311	1013	662689	10030	46	89970	44
	17	27862	966	72138	337919	1012	662081	10058	46	89942	77 43
12	18	28442	965	71558	338527	1011	661473	10085	46	89915	42
	19	29021	964	70979	339133	1010	660867	10113	46	89887	41
	20	29599	962	70401	339739	1008	660261	10140	46	89860	40
	21	30176	961	69824	340344	1007	659656	10168	46	89832	39
	22	30753	960	69247	340948	1006	659052	10196	46	89804	38
	23	31329	958	68671	341552	1004	658448	10223	46	89777	37
	24	31903	957	68097	342155	1003	657845	10251	47	89749	36
	25	32478	956	67522	342757	1002	657243	10279	47	89721	35
	26	33051	954	66949	343358	1000	656642	10307	47	89693	77 34
12	27	33624	953	66376	343958	999	656042	10335	47	89665	33
	28	34195	952	65805	344558	998	655442	10363	47	89637	32
	29	34766	950	65234	345157	997	654843	10391	47	89609	31
	30	35337	949	64663	345755	996	654245	10418	47	89582	30
	31	35906	948	64094	346353	994	653647	10447	47	89553	29
	32	36475	946	63525	346949	993	653051	10475	47	89525	28
	33	37043	945	62957	347545	992	652455	10503	47	89497	27
	34	37610	944	62390	348141	991	651859	10531	47	89469	26
	35	38176	943	61824	348735	990	651265	10559	47	89441	77 25
12	36	38742	941	61258	349329	988	650671	10587	47	89413	24
	37	39306	940	60694	349922	987	650078	10616	47	89384	23
	38	39871	939	60129	350514	986	649486	10644	47	89356	22
	39	40434	937	59566	351106	985	648894	10672	47	89328	21
	40	40996	936	59004	351697	983	648303	10700	47	89300	20
	41	41558	935	58442	352287	982	647713	10729	47	89271	19
	42	42119	934	57881	352876	981	647124	10757	47	89243	18
	43	42679	932	57321	353465	980	646535	10786	47	89214	17
	44	43239	931	56761	354053	979	645947	10814	47	89186	16
	45	43797	931	56203	354640	979	645360	10842	47	89157	77 15
		Coa.	D.	Sec.	Cot.	D.	Tang.	Coa.	D.	Sine	°

12 $\frac{1}{2}$ Deg.		TABLE V.—LOG. SINE, ETC.										13 $\frac{1}{2}$ Deg.	
°	'	Sine	D.	Co-sec.	Tang.	D.	Col.	Sec.	D.	Co.			
		9'		10'	9'		10'	10'01		9'98			
12	45	343797	930	656203	354640	977	645360	0843	47	9157		15	
	46	344355	929	655645	355227	976	644773	0872	48	9128		14	
	47	344912	927	655028	355813	975	644187	0900	48	9100		13	
	48	345469	926	654531	356398	975	643602	0929	48	9071		12	
	49	346024	925	653976	356982	974	643018	0958	48	9042		11	
	50	346579	925	653421	357566	973	642434	0986	48	9014		10	
	51	347134	924	652866	358149	971	641851	1015	48	8985		9	
	52	347687	922	652313	358731	970	641269	1044	48	8956		8	
	53	348240	921	651760	359313	969	640687	1073	48	8927	77	7	
			920			968			48				
12	54	348792	919	651208	359893	967	640107	1102	48	8898		6	
	55	349343	917	650657	360474	966	639526	1131	48	8869		5	
	56	349893	916	650107	361053	965	638947	1160	48	8840		4	
	57	350443	915	649557	361632	965	638368	1189	48	8811		3	
	58	350992	914	649008	362210	963	637790	1218	49	8782		2	
	59	351540	914	648460	362787	962	637213	1247	49	8753		1	
13	0	352088	913	647912	363364	961	636636	1276	49	8724	77	0	
	1	352635	911	647365	363940	960	636060	1305	49	8695		59	
	2	353181	910	646819	364515	959	635485	1334	49	8666	76	58	
			909			958			49				
13	3	353726	908	646274	365090	957	634910	1364	49	8636		57	
	4	354271	907	645729	365664	955	634336	1393	49	8607		56	
	5	354815	907	645185	366237	955	633763	1422	49	8578		55	
	6	355358	905	644642	366810	954	633190	1452	49	8548		54	
	7	355901	904	644099	367382	953	632618	1481	49	8519		53	
	8	356443	903	643557	367953	952	632047	1511	49	8489		52	
	9	356984	902	643016	368524	951	631476	1540	49	8460		51	
	10	357524	901	642476	369094	950	630906	1570	49	8430		50	
	11	358064	899	641936	369663	949	630337	1599	49	8401	76	49	
			898			948			49				
13	12	358603	897	641397	370232	946	629768	1629	49	8371		48	
	13	359141	896	640859	370799	945	629201	1658	49	8342		47	
	14	359678	895	640322	371367	944	628633	1688	49	8312		46	
	15	360215	895	639785	371933	944	628067	1718	50	8282		45	
	16	360752	893	639248	372499	943	627501	1748	50	8252		44	
	17	361287	892	638713	373064	942	626936	1777	50	8223		43	
	18	361822	891	638178	373629	941	626371	1807	50	8193		42	
	19	362356	890	637644	374193	940	625807	1837	50	8163		41	
	20	362889	889	637111	374756	939	625244	1867	50	8133	76	40	
			888			938			50				
13	21	363422	887	636578	375319	937	624681	1897	50	8103		39	
	22	363954	885	636046	375881	935	624119	1927	50	8073		38	
	23	364485	884	635515	376442	934	623558	1957	50	8043		37	
	24	365016	883	634984	377003	934	622997	1987	50	8013		36	
	25	365546	882	634454	377563	933	622437	2017	50	7983		35	
	26	366075	881	633925	378122	932	621878	2047	50	7953		34	
	27	366604	880	633396	378681	931	621319	2078	50	7922		33	
	28	367131	879	632869	379239	929	620761	2108	50	7892		32	
	29	367659	879	632341	379797	929	620203	2138	50	7862		31	
	30	368185	877	631815	380354	928	619646	2168	50	7832	76	30	
		Con.	D.	Sec.	Col.	D.	Tang.	Con.	D.	Sine			

77 $\frac{1}{2}$ Deg.

76 $\frac{1}{2}$ Deg.

18½ Deg.		TABLE V.—LOG. SINES, ETC.								14½ Deg.	
°	'	Sine	D.	Cosoc.	Tang.	D.	Cot.	Sec.	D.	Cor.	
		9'	10'		9'	10'		10'01	9'98		
18	30	368185	876	631815	380354	927	619646	2168	51	7832	30
	31	368711	875	631289	380910	926	619090	2199	51	7801	29
	32	369236	874	630764	381466	925	618534	2229	51	7771	28
	33	369761	873	630239	382020	924	617980	2260	51	7740	27
	34	370285	872	629715	382575	923	617425	2290	51	7710	26
	35	370808	871	629192	383129	922	616871	2321	51	7679	25
	36	371330	870	628670	383682	921	616318	2351	51	7649	24
	37	371852	869	628148	384234	920	615766	2382	51	7618	23
	38	372373	867	627627	384786	919	615214	2412	51	7588	76 22
13	39	372894	866	627106	385337	918	614663	2443	51	7557	21
	40	373414	865	626586	385888	917	614112	2474	51	7526	20
	41	373933	864	626067	386438	915	613562	2504	51	7496	19
	42	374452	863	625548	386987	914	613013	2535	51	7465	18
	43	374970	862	625030	387536	913	612464	2566	51	7434	17
	44	375487	861	624513	388084	912	611916	2597	52	7403	16
	45	376003	860	623997	388631	911	611369	2628	52	7372	15
	46	376519	859	623481	389178	910	610822	2659	52	7341	14
	47	377035	858	622965	389724	909	610276	2690	52	7310	76 13
13	48	377549	857	622451	390270	908	609730	2721	52	7279	12
	49	378063	856	621937	390815	907	609185	2752	52	7248	11
	50	378577	854	621423	391360	906	608640	2783	52	7217	10
	51	379089	853	620911	391903	905	608097	2814	52	7186	9
	52	379601	852	620399	392447	904	607553	2845	52	7155	8
	53	380113	851	619887	392989	903	607011	2876	52	7124	7
	54	380624	850	619376	393531	902	606469	2908	52	7092	6
	55	381134	849	618866	394073	901	605927	2939	52	7061	5
	56	381643	848	618357	394614	900	605386	2970	52	7030	76 4
13	57	382152	847	617848	395154	899	604846	3002	52	6998	3
	58	382661	846	617339	395694	898	604306	3033	52	6967	2
	59	383168	845	616832	396233	897	603767	3064	52	6936	1
14	0	383675	844	616325	396771	896	603229	3096	52	6904	76 0
	1	384182	843	615818	397309	896	602691	3127	52	6873	59
	2	384687	842	615313	397846	895	602154	3159	52	6841	58
	3	385192	841	614808	398383	894	601617	3191	52	6809	57
	4	385697	840	614303	398919	893	601081	3222	52	6778	56
	5	386201	839	613799	399455	892	600545	3254	52	6746	75 55
14	6	386704	838	613296	399990	891	600010	3286	52	6714	54
	7	387207	837	612793	400524	890	599476	3317	52	6683	53
	8	387709	836	612291	401058	889	598942	3349	52	6651	52
	9	388210	835	611790	401591	888	598409	3381	52	6619	51
	10	388711	834	611289	402124	887	597876	3413	52	6587	50
	11	389211	833	610789	402656	886	597344	3445	52	6555	49
	12	389711	832	610289	403187	885	596813	3477	52	6523	48
	13	390210	831	609790	403718	884	596282	3509	52	6491	47
	14	390708	830	609292	404249	883	595751	3541	52	6459	46
	15	391206	830	608794	404778		595222	3573	52	6427	75 45
		Cor.	D.	Sec.	Cot.	D.	Tang.	Cor.	D.	Sine	°

76½ Deg.

75½ Deg.

14 1/2 Deg.		TABLE V.—LOG. SINUS, ETC.								15 Deg.	
°	Sine	D.	Secoc.	Tang.	D.	Cot.	Sec.	D.	Coa.		
	9'		10'	9'		10'	10'01		9'98		
14	15	391206	828	608794	404778	882	595222	3573	6427		45
	16	391703	827	608297	405308	881	594692	3605	6395		44
	17	392199	826	607801	405836	880	594164	3637	6363		43
	18	392695	825	607305	406364	879	593636	3669	6331		42
	19	393191	824	606809	406892	878	593108	3701	6299		41
	20	393685	823	606315	407419	877	592581	3734	6266		40
	21	394179	822	605821	407945	876	592055	3766	6234		39
	22	394673	821	605327	408471	875	591529	3798	6202		38
	23	395166	820	604834	408997	874	591003	3831	6169	75	37
14	24	395658	819	604342	409521	874	590479	3863	6137		36
	25	396150	818	603850	410045	873	589955	3896	6104		35
	26	396641	817	603359	410569	872	589431	3928	6072		34
	27	397132	817	602868	411092	871	588908	3961	6039		33
	28	397621	816	602379	411615	870	588385	3993	6007		32
	29	398111	815	601889	412137	869	587863	4026	5974		31
	30	398600	814	601400	412658	868	587342	4058	5942		30
	31	399088	813	600912	413179	867	586821	4091	5909		29
	32	399575	812	600425	413699	866	586301	4124	5876	75	28
14	33	400062	811	599938	414219	865	585781	4157	5843		27
	34	400549	810	599451	414738	864	585262	4189	5811		26
	35	401035	809	598965	415257	864	584743	4222	5778		25
	36	401520	808	598480	415775	863	584225	4255	5745		24
	37	402005	807	597995	416293	862	583707	4288	5712		23
	38	402489	806	597511	416810	861	583190	4321	5679		22
	39	402972	805	597028	417326	860	582674	4354	5646		21
	40	403455	804	596545	417842	859	582158	4387	5613		20
	41	403938	803	596062	418358	858	581642	4420	5580	75	19
14	42	404420	802	595580	418873	857	581127	4453	5547		18
	43	404901	801	595099	419387	856	580613	4486	5514		17
	44	405382	800	594618	419901	855	580099	4520	5480		16
	45	405862	799	594138	420415	855	579585	4553	5447		15
	46	406341	798	593659	420927	854	579073	4586	5414		14
	47	406820	797	593180	421440	853	578560	4620	5380		13
	48	407299	796	592701	421952	852	578048	4653	5347		12
	49	407777	795	592223	422463	851	577537	4686	5314		11
	50	408254	794	591746	422974	850	577026	4720	5280	75	10
14	51	408731	794	591269	423484	849	576516	4753	5247		9
	52	409207	793	590793	423993	848	576007	4787	5213		8
	53	409682	792	590318	424503	848	575497	4820	5180		7
	54	410157	791	589843	425011	847	574989	4854	5146		6
	55	410631	790	589368	425519	846	574481	4887	5113		5
	56	411106	789	588894	426027	845	573973	4921	5079		4
	57	411579	788	588421	426534	844	573466	4955	5045		3
	58	412052	787	587948	427041	843	572959	4989	5011		2
	59	412524	786	587476	427547	843	572453	5022	4978		1
	60	412996		587004	428052		571948	5056	4944	75	0
	Coa.	D.	Sec.	Cot.	D.	Tang.	Coa.	D.	Sine		°

75 1/2 Deg.

75 Deg.

15 Deg.

TABLE V.—LOG. SINES, ETC.

15½ Deg.

°	'	Sine	D.	Coscc.	Tang.	D.	Cot.	Sec.	D.	Cos.	
		9'		10'	9'		10'	10'01		9'98	
15	0	412996	785	587004	428052	842	571948	5056	57	4944	60
	1	413467	784	586533	428557	841	571443	5090	57	4910	59
	2	413938	783	586062	429062	840	570938	5124	57	4876	58
	3	414408	783	585592	429566	839	570434	5158	57	4842	57
	4	414878	782	585122	430070	838	569930	5192	57	4808	56
	5	415347	781	584653	430573	838	569427	5226	57	4774	55
	6	415815	780	584185	431075	837	568925	5260	57	4740	54
	7	416283	779	583717	431577	836	568423	5294	57	4706	53
	8	416751	778	583249	432079	835	567921	5328	57	4672	74 52
15	9	417217	777	582783	432580	834	567420	5363	57	4637	51
	10	417684	776	582316	433080	833	566920	5397	57	4603	50
	11	418150	775	581850	433580	832	566420	5431	57	4569	49
	12	418615	774	581385	434080	832	565920	5465	57	4535	48
	13	419079	773	580921	434579	831	565421	5500	57	4500	47
	14	419544	773	580456	435078	830	564922	5534	57	4466	46
	15	420007	772	579993	435576	829	564424	5568	58	4432	45
	16	420470	771	579530	436073	828	563927	5603	58	4397	44
	17	420933	770	579067	436570	828	563430	5637	58	4363	74 43
15	18	421395	769	578605	437067	827	562933	5672	58	4328	42
	19	421857	768	578143	437563	826	562437	5706	58	4294	41
	20	422318	767	577682	438059	825	561941	5741	58	4259	40
	21	422778	767	577222	438554	824	561446	5776	58	4224	39
	22	423238	766	576762	439048	823	560952	5810	58	4190	38
	23	423697	765	576303	439543	823	560457	5845	58	4155	37
	24	424156	764	575844	440036	822	559964	5880	58	4120	36
	25	424615	763	575385	440529	821	559471	5915	58	4085	35
	26	425073	762	574927	441022	820	558978	5950	58	4050	74 34
15	27	425530	761	574470	441514	819	558486	5985	58	4015	33
	28	425987	760	574013	442006	819	557994	6019	58	3981	32
	29	426443	760	573557	442497	818	557503	6054	58	3946	31
	30	426899	759	573101	442988	817	557012	6089	58	3911	30
	31	427354	758	572646	443479	816	556521	6125	58	3875	29
	32	427809	757	572191	443968	816	556032	6160	58	3840	28
	33	428263	756	571737	444458	815	555542	6195	59	3805	27
	34	428717	755	571283	444947	814	555053	6230	59	3770	26
	35	429170	754	570830	445435	813	554565	6265	59	3735	74 25
15	36	429623	753	570377	445923	812	554077	6300	59	3700	24
	37	430075	752	569925	446411	812	553589	6336	59	3664	23
	38	430527	752	569473	446898	811	553102	6371	59	3629	22
	39	430978	751	569022	447384	810	552616	6406	59	3594	21
	40	431429	750	568571	447870	809	552130	6442	59	3558	20
	41	431879	749	568121	448356	809	551644	6477	59	3523	19
	42	432329	749	567671	448841	808	551159	6513	59	3487	18
	43	432778	748	567222	449326	807	550674	6548	59	3452	17
	44	433226	747	566774	449810	806	550190	6584	59	3416	16
	45	433675	747	566325	450294		549706	6619	59	3381	74 15
		Con.	D.	Sec.	Cot.	D.	Tang.	Con.	D.	Sine	°

76 Deg.

74½ Deg.

15½ Deg.		TABLE V.—LOC. SINES, ETC.								16½ Deg.	
°	'	Sine	D.	Co-sec.	Tang.	D.	Cot.	Sec.	D.	Coa.	
		9'		10'	9'		10'	10'01		9'98	
15	45	433675		566325	450294	806	549706	6619		3381	15
	46	434122	746	565878	450777	806	549223	6655	59	3345	14
	47	434569	745	565431	451260	805	548740	6691	59	3309	13
	48	435016	744	564984	451743	803	548257	6727	59	3273	12
	49	435462	744	564538	452225	802	547775	6762	60	3238	11
	50	435908	743	564092	452706	802	547294	6798	60	3202	10
	51	436353	742	563647	453187	801	546813	6834	60	3166	9
	52	436798	741	563202	453668	800	546332	6870	60	3130	8
	53	437242	740	562758	454148	799	545852	6906	60	3094	74 7
15	54	437686		562314	454628		545372	6942		3058	6
	55	438129	739	561871	455107	799	544893	6978	60	3022	5
	56	438572	738	561428	455586	798	544414	7014	60	2986	4
	57	439014	737	560986	456064	797	543936	7050	60	2950	3
	58	439456	736	560544	456542	796	543458	7086	60	2914	2
	59	439897	736	560103	457019	796	542981	7122	60	2878	1
16	0	440338	735	559662	457496	795	542504	7158	60	2842	74 1
	1	440778	734	559222	457973	794	542027	7195	60	2805	59
	2	441218	733	558782	458449	793	541551	7231	60	2769	73 58
16	3	441658	732	558342	458925	793	541075	7267	61	2733	57
	4	442096	731	557904	459400	792	540600	7304	61	2696	56
	5	442535	731	557465	459875	791	540125	7340	61	2660	55
	6	442973	730	557027	460349	790	539651	7376	61	2624	54
	7	443411	729	556590	460823	790	539177	7413	61	2587	53
	8	443847	728	556153	461297	789	538703	7449	61	2551	52
	9	444284	727	555716	461770	788	538230	7486	61	2514	51
	10	444720	727	555280	462242	787	537758	7523	61	2477	50
	11	445155	726	554845	462714	787	537286	7559	61	2441	73 49
16	12	445590	725	554410	463186	786	536814	7596	61	2404	48
	13	446025	724	553975	463658	785	536342	7633	61	2367	47
	14	446459	723	553541	464129	785	535871	7669	61	2331	46
	15	446893	723	553107	464599	784	535401	7706	61	2294	45
	16	447326	722	552674	465069	783	534931	7743	61	2257	44
	17	447759	721	552241	465539	783	534461	7780	61	2220	43
	18	448191	720	551809	466008	782	533992	7817	62	2183	42
	19	448623	720	551377	466476	781	533524	7854	62	2146	41
	20	449054	719	550946	466945	780	533055	7891	62	2109	73 40
16	21	449485	718	550515	467413	780	532587	7928	62	2072	39
	22	449915	717	550085	467880	779	532120	7965	62	2035	38
	23	450345	716	549655	468347	778	531653	8002	62	1998	37
	24	450775	715	549225	468814	777	531186	8039	62	1961	36
	25	451204	715	548796	469280	777	530720	8076	62	1924	35
	26	451632	714	548368	469746	776	530254	8114	62	1886	34
	27	452060	713	547940	470211	775	529789	8151	62	1849	33
	28	452488	713	547512	470676	775	529324	8188	62	1812	32
	29	452915	712	547085	471141	774	528859	8226	62	1774	31
	30	453342	711	546658	471605	773	528395	8263	62	1737	72 30
		Con.	D.	Sec.	Cot.	D.	Tang.	Con.	D.	Sine	
74½ Deg.										75½ Deg.	

16 1/2 Deg. TABLE V.—LOG. SINES, ETC. 17 1/2 Deg.

°	'	Sine		Cos.		Tang.		Sec.		D.	Cos.	
		9'	D.	10'	D.	9'	D.	10'	10'01			
16	30	453342		546658		471605		528395	8263	62	1737	30
	31	453768	710	546232	710	472068	773	527932	8301	63	1699	29
	32	454194	710	545806	710	472532	772	527468	8338	63	1662	28
	33	454619	709	545381	709	472995	771	527005	8375	63	1625	27
	34	455044	708	544956	708	473457	771	526543	8413	63	1587	26
	35	455469	707	544531	707	473919	770	526081	8451	63	1549	25
	36	455893	707	544107	707	474381	769	525619	8488	63	1512	24
	37	456316	706	543684	706	474842	769	525158	8526	63	1474	23
	38	456739	705	543261	705	475303	768	524697	8564	63	1436	73 22
			704		704		767			63		
16	37	457162		542838		475763		524237	8601	63	1399	21
	40	457584	704	542416	704	476223	767	523777	8639	63	1361	20
	41	458006	703	541994	703	476683	766	523317	8677	63	1323	19
	42	458427	702	541573	702	477142	765	522858	8715	63	1285	18
	43	458848	701	541152	701	477601	764	522399	8753	63	1247	17
	44	459268	701	540732	701	478059	763	521941	8791	63	1209	16
	45	459688	700	540312	700	478517	763	521483	8829	63	1171	15
	46	460108	699	539892	699	478975	763	521025	8867	63	1133	14
	47	460527	698	539473	698	479432	762	520568	8905	64	1095	73 13
			698		698		761			64		
16	48	460946		539054		479889		520111	8943	64	1057	12
	49	461364	697	538636	697	480345	761	519655	8981	64	1019	11
	50	461782	696	538218	696	480801	760	519199	9019	64	981	10
	51	462199	695	537801	695	481257	759	518743	9058	64	942	9
	52	462616	695	537384	695	481712	759	518288	9096	64	904	8
	53	463032	694	536968	694	482167	758	517833	9134	64	866	7
	54	463448	693	536552	693	482621	757	517379	9173	64	827	6
	55	463864	693	536136	693	483075	757	516925	9211	64	789	5
	56	464279	692	535721	692	483529	756	516471	9250	64	750	73 4
			691		691		755			64		
16	57	464694		535306		483982		516018	9288	64	712	3
	58	465108	690	534892	690	484435	755	515565	9327	64	673	2
	59	465522	689	534478	689	484887	754	515113	9365	64	635	1
17	0	465935		534065		485339		514661	9404	64	596	73 0
	1	466348	688	533652	688	485791	753	514209	9442	64	558	59
	2	466761	688	533239	688	486242	752	513758	9481	64	519	58
	3	467173	687	532827	687	486693	751	513307	9520	64	480	57
	4	467585	686	532415	686	487143	751	512857	9558	65	442	56
	5	467996	685	532004	685	487593	750	512407	9597	65	403	72 55
			685		685		749			65		
17	6	468407		531593		488043		511957	9636	65	364	54
	7	468817	684	531183	684	488492	749	511508	9675	65	325	53
	8	469227	683	530773	683	488941	748	511059	9714	65	286	52
	9	469637	682	530363	682	489390	747	510610	9753	65	247	51
	10	470046	681	529954	681	489838	746	510162	9792	65	208	50
	11	470455	680	529545	680	490286	746	509714	9831	65	169	49
	12	470863	680	529137	680	490733	746	509267	9870	65	130	48
	13	471271	679	528729	679	491180	745	508820	9909	65	91	47
	14	471679	678	528321	678	491627	744	508373	9948	65	52	46
	15	472086		527914		492073		507927	9988	65	12	72 45

17½ Deg.		TABLE V.—LOG SINE, ETC.								18 Deg.	
°	Sine	D.	Cosec.	Tang.	D.	Cot.	Sec.	D.	Coa.		
	94		105	9		10	100		99		
17	15	72086	678	27914	492073	743	507927	19988	65	80012	45
	16	72492	677	27508	492519	743	507481	20027	65	79973	44
	17	72898	676	27102	492965	742	507035	20066	66	79934	43
	18	73304	676	26696	493410	741	506590	20105	66	79895	42
	19	73710	675	26290	493854	740	506146	20145	66	79855	41
	20	74115	674	25885	494299	740	505701	20184	66	79816	40
	21	74519	674	25481	494743	740	505257	20224	66	79776	39
	22	74923	673	25077	495186	740	504814	20263	66	79737	38
	23	75327	672	24673	495630	739	504370	20303	66	79697	72 37
						738			66		
17	24	75730	672	24270	496073	737	503927	20342	66	79658	36
	25	76133	671	23867	496515	737	503485	20382	66	79618	35
	26	76536	670	23464	496957	736	503043	20421	66	79579	34
	27	76938	669	23062	497399	736	502601	20461	66	79539	33
	28	77340	669	22660	497841	735	502159	20501	66	79499	32
	29	77741	668	22259	498282	735	501718	20541	66	79459	31
	30	78142	667	21858	498722	734	501278	20580	66	79420	30
	31	78542	667	21458	499163	734	500837	20620	66	79380	29
	32	78942	666	21058	499603	733	500397	20660	66	79340	72 28
						733			66		
17	33	79342	665	20658	500042	732	499958	20700	67	79300	27
	34	79741	665	20259	500481	731	499519	20740	67	79260	26
	35	80140	664	19860	500920	731	499080	20780	67	79220	25
	36	80539	663	19461	501359	730	498641	20820	67	79180	24
	37	80937	663	19063	501797	730	498203	20860	67	79140	23
	38	81334	662	18666	502235	729	497765	20900	67	79100	22
	39	81731	661	18269	502672	728	497328	20941	67	79059	21
	40	82128	661	17872	503109	728	496891	20981	67	79019	20
	41	82525	660	17475	503546	727	496454	21021	67	78979	72 19
									67		
17	42	82921	659	17079	503982	727	496018	21061	67	78939	18
	43	83316	659	16684	504418	726	495582	21102	67	78898	17
	44	83712	658	16288	504854	725	495146	21142	67	78858	16
	45	84107	657	15893	505289	725	494711	21183	67	78817	15
	46	84501	657	15499	505724	724	494276	21223	67	78777	14
	47	84895	656	15105	506159	724	493841	21264	67	78736	13
	48	85289	655	14711	506593	723	493407	21304	68	78696	12
	49	85682	655	14318	507027	722	492973	21345	68	78655	11
	50	86075	654	13925	507460	722	492540	21385	68	78615	72 10
									68		
17	51	86467	653	13533	507893	721	492107	21426	68	78574	9
	52	86860	653	13140	508326	721	491674	21467	68	78533	8
	53	87251	652	12749	508759	720	491241	21507	68	78493	7
	54	87643	651	12357	509191	719	490809	21548	68	78452	6
	55	88034	651	11966	509622	719	490378	21589	68	78411	5
	56	88424	650	11576	510054	718	489946	21630	68	78370	4
	57	88814	650	11186	510485	718	489515	21671	68	78329	3
	58	89204	649	10796	510916	717	489084	21712	68	78288	2
	59	89593	648	10407	511346	716	488654	21753	68	78247	1
	60	89982		10018	511776		488224	21794		78206	72 c
	Coa.	D.	Sec.	Cot.	D.	Tang.	Coa.	D.	Sine	°	

18 Deg.		TABLE V.—LOG. SINES, ETC.								18½ Deg.	
°	'	Sine	D.	Co-sec.	Tang.	D.	Cot.	Sec.	D.	Cos.	
		9'	10'		9'	10'		10'02	9'97		
0		489982		510018	511776		488224	1794		8206	60
1		490371	648	509629	512206	716	487794	1835	68	8165	59
2		490759	648	509241	512635	716	487365	1876	68	8124	58
3		491147	647	508853	513064	715	486936	1917	68	8083	57
4		491535	646	508465	513493	714	486507	1958	69	8042	56
5		491922	646	508078	513921	714	486079	1999	69	8001	55
6		492308	645	507692	514349	713	485651	2041	69	7959	54
7		492695	644	507305	514777	713	485223	2082	69	7918	53
8		493081	644	506919	515204	712	484796	2123	69	7877	71 52
18	9	493466	642	506534	515631	711	484369	2165	69	7835	51
	10	493851	642	506149	516057	710	483943	2206	69	7794	50
	11	494236	641	505764	516484	710	483516	2248	69	7752	49
	12	494621	641	505379	516910	709	483090	2289	69	7711	48
	13	495005	640	504995	517335	709	482665	2331	69	7669	47
	14	495388	640	504612	517761	708	482239	2372	69	7628	46
	15	495772	639	504228	518185	708	481815	2414	69	7586	45
	16	496154	638	503846	518610	707	481390	2456	69	7544	44
	17	496537	637	503463	519034	706	480966	2497	70	7503	71 43
18	18	496919	637	503081	519458	706	480542	2539	70	7461	42
	19	497301	636	502699	519882	705	480118	2581	70	7419	41
	20	497682	636	502318	520305	705	479695	2623	70	7377	40
	21	498064	635	501936	520728	704	479272	2665	70	7335	39
	22	498444	634	501556	521151	703	478849	2707	70	7293	38
	23	498825	634	501175	521573	703	478427	2749	70	7251	37
	24	499204	633	500796	521995	703	478005	2791	70	7209	36
	25	499584	632	500416	522417	702	477583	2833	70	7167	35
	26	499963	632	500037	522838	702	477162	2875	70	7125	71 34
18	27	500342	631	499658	523259	701	476741	2917	70	7083	33
	28	500721	631	499279	523680	701	476320	2959	70	7041	32
	29	501099	630	498901	524100	700	475900	3001	70	6999	31
	30	501476	629	498524	524520	699	475480	3043	70	6957	30
	31	501854	629	498146	524939	699	475061	3086	70	6914	29
	32	502231	628	497769	525359	698	474641	3128	70	6872	28
	33	502607	628	497393	525778	698	474222	3170	71	6830	27
	34	502984	627	497016	526197	697	473803	3213	71	6787	26
	35	503360	626	496640	526615	697	473385	3255	71	6745	71 25
18	36	503735	626	496265	527033	696	472967	3298	71	6702	24
	37	504110	625	495890	527451	696	472549	3340	71	6660	23
	38	504485	625	495515	527868	695	472132	3383	71	6617	22
	39	504860	624	495140	528285	695	471715	3426	71	6574	21
	40	505234	623	494766	528702	694	471298	3468	71	6532	20
	41	505608	623	494392	529119	693	470881	3511	71	6489	19
	42	505981	622	494019	529535	693	470465	3554	71	6446	18
	43	506354	622	493646	529950	693	470050	3596	71	6404	17
	44	506727	621	493273	530366	692	469634	3639	71	6361	16
	45	507099	621	492901	530781	692	469219	3682	71	6318	71 15
		Co-sec.	D.	Sec.	Cot.	D.	Tang.	Co-sec.	D.	Sine	'

18½ Deg.		TABLE V.—LOG. SINES, ETC.										10½ Deg.	
°	'	Sine	D.	Cosec.	Tang.	D.	Cot.	Sec.	D.	Cos.			
		9'		10'	9'		10'	10'ca		9'97			
18	45	507099	620	492901	530781	691	469219	3682	71	6318		15	
	46	507471	620	492529	531196	691	468804	3725	71	6275		14	
	47	507843	619	492157	531611	690	468389	3768	71	6232		13	
	48	508214	619	491786	532025	690	467975	3811	72	6189		12	
	49	508585	618	491415	532439	689	467561	3854	72	6146		11	
	50	508956	618	491044	532853	689	467147	3897	72	6103		10	
	51	509326	617	490674	533266	688	466733	3940	72	6060		9	
	52	509696	616	490304	533679	688	466321	3983	72	6017		8	
	53	510065	616	489935	534092	687	465908	4026	72	5974	71	7	
18	54	510434	615	489566	534504	687	465496	4070	72	5930		6	
	55	510803	615	489197	534916	686	465084	4113	72	5887		5	
	56	511172	614	488828	535328	686	464672	4156	72	5844		4	
	57	511540	613	488460	535739	685	464261	4200	72	5800		3	
	58	511907	613	488093	536150	685	463850	4243	72	5757		2	
	59	512275	612	487725	536561	684	463439	4286	72	5714		1	
10	0	512642	612	487358	536972	684	463028	4330	72	5670	71	0	
	1	513009	611	486991	537382	683	462618	4373	73	5627		59	
	2	513375	611	486625	537792	683	462208	4417	73	5583	70	58	
19	3	513741	610	486259	538202	682	461798	4461	73	5539		57	
	4	514107	609	485893	538611	682	461389	4504	73	5496		56	
	5	514472	609	485528	539020	681	460980	4548	73	5452		55	
	6	514837	608	485163	539429	681	460571	4592	73	5408		54	
	7	515202	608	484798	539837	680	460163	4635	73	5365		53	
	8	515566	607	484434	540245	680	459755	4679	73	5321		52	
	9	515930	607	484070	540653	679	459347	4723	73	5277		51	
	10	516294	606	483706	541061	679	458939	4767	73	5233		50	
	11	516657	605	483343	541468	678	458532	4811	73	5189	70	49	
19	12	517020	605	482980	541875	678	458125	4855	73	5145		48	
	13	517382	604	482618	542281	677	457719	4899	73	5101		47	
	14	517745	604	482255	542688	677	457312	4943	73	5057		46	
	15	518107	603	481893	543094	676	456906	4987	73	5013		45	
	16	518468	603	481532	543499	676	456501	5031	74	4969		44	
	17	518829	602	481171	543905	675	456095	5075	74	4925		43	
	18	519190	601	480810	544310	675	455690	5120	74	4880		42	
	19	519551	601	480449	544715	674	455285	5164	74	4836		41	
	20	519911	600	480089	545119	674	454881	5208	74	4792	70	40	
19	21	520271	600	479729	545524	673	454476	5252	74	4748		39	
	22	520631	599	479369	545928	673	454072	5297	74	4703		38	
	23	520990	599	479010	546331	672	453669	5341	74	4659		37	
	24	521349	598	478651	546735	672	453265	5386	74	4614		36	
	25	521707	598	478293	547138	671	452862	5430	74	4570		35	
	26	522066	597	477934	547540	671	452460	5475	74	4525		34	
	27	522424	596	477576	547943	670	452057	5519	74	4481		33	
	28	522781	596	477219	548345	670	451655	5564	74	4436		32	
	29	523138	595	476862	548747	669	451253	5609	74	4391		31	
	30	523495	595	476505	549149	669	450851	5653	74	4347	70	30	
		Coa.	D.	Sec.	Cot.	D.	Tang.	Coa.	D.	Sine			
71½ Deg.												70½ Deg.	

10 $\frac{1}{2}$ Deg.		TABLE V.—LOG. SINES, ETC.								20 $\frac{1}{2}$ Deg.	
°	'	Sine	D.	Cosec.	Tang.	D.	Cot.	Sec.	D.	Com.	
		9'		10'	9'		10'	10'02		9'97	
19	30	523495	595	476505	549149	669	450851	5653	75	4347	30
	31	523852	594	476148	549550	668	450450	5698	75	4302	29
	32	524208	594	475792	549951	668	450049	5743	75	4257	28
	33	524564	594	475436	550352	667	449648	5788	75	4212	27
	34	524920	593	475080	550752	667	449248	5833	75	4167	26
	35	525275	593	474725	551152	666	448848	5878	75	4122	25
	36	525630	592	474370	551552	666	448448	5923	75	4077	24
	37	525984	591	474016	551952	665	448048	5968	75	4032	23
	38	526339	590	473661	552351	665	447649	6013	75	3987	70 22
19	39	526693	590	473307	552750	665	447250	6058	75	3942	21
	40	527046	589	472954	553149	664	446851	6103	75	3897	20
	41	527400	589	472600	553548	664	446452	6148	75	3852	19
	42	527753	588	472247	553946	663	446054	6193	75	3807	18
	43	528105	588	471895	554344	663	445656	6239	75	3761	17
	44	528458	587	471542	554741	662	445259	6284	75	3716	16
	45	528810	587	471190	555139	662	444861	6329	76	3671	15
	46	529161	586	470839	555536	661	444464	6375	76	3625	14
	47	529513	586	470487	555933	661	444067	6420	76	3580	70 13
19	48	529864	585	470136	556329	660	443671	6465	76	3535	12
	49	530215	585	469785	556725	660	443275	6511	76	3489	11
	50	530565	584	469435	557121	659	442879	6556	76	3444	10
	51	530915	584	469085	557517	659	442483	6602	76	3398	9
	52	531265	583	468735	557913	659	442087	6648	76	3352	8
	53	531614	582	468386	558308	658	441692	6693	76	3307	7
	54	531963	582	468037	558702	658	441298	6739	76	3261	6
	55	532312	581	467688	559097	657	440903	6785	76	3215	5
	56	532661	581	467339	559491	657	440509	6831	76	3169	70 4
19	57	533009	580	466991	559885	656	440115	6876	76	3124	3
	58	533357	580	466643	560279	656	439721	6922	76	3078	2
	59	533704	579	466296	560673	655	439327	6968	77	3032	1
20	0	534052	578	465948	561066	655	438934	7014	77	2986	70 0
	1	534399	577	465601	561459	654	438541	7060	77	2940	59
	2	534745	577	465255	561851	654	438149	7106	77	2894	58
	3	535092	577	464908	562244	653	437756	7152	77	2848	57
	4	535438	576	464562	562636	653	437364	7198	77	2802	56
	5	535783	576	464217	563028	653	436972	7245	77	2755	69 55
20	6	536129	575	463871	563419	652	436581	7291	77	2709	54
	7	536474	574	463526	563811	652	436189	7337	77	2663	53
	8	536818	574	463182	564202	651	435798	7383	77	2617	52
	9	537163	573	462837	564592	651	435408	7430	77	2570	51
	10	537507	573	462493	564983	650	435017	7476	77	2524	50
	11	537851	572	462149	565373	650	434627	7522	77	2478	49
	12	538194	572	461806	565763	649	434237	7569	78	2431	48
	13	538538	571	461462	566153	649	433847	7615	78	2385	47
	14	538880	571	461120	566542	649	433458	7662	78	2338	46
	15	539223	571	460777	566932	649	433068	7709	78	2291	45
		Com.	D.	Sec.	Cot.	D.	Tang.	Com.	D.	Sine	°

20½ Deg.		TABLE V.—LOG. SINES, ETC.								21 Deg.	
°	Sine	D.	Cosec.	Tang.	D.	Col.	Sec.	D.	Com.		
	9'		10'	9'		10'	10'02		9'97		
20	15	539223	570	460777	566932	648	433068	7709	78	2291	45
	16	539565	570	460435	567320	648	432680	7755	78	2245	44
	17	539907	569	460093	567709	647	432291	7802	78	2198	43
	18	540249	569	459751	568098	647	431902	7849	78	2151	42
	19	540590	568	459410	568486	646	431514	7895	78	2105	41
	20	540931	568	459069	568873	646	431127	7942	78	2058	40
	21	541272	567	458728	569261	645	430739	7989	78	2011	39
	22	541613	567	458387	569648	645	430352	8036	78	1964	38
	23	541953	566	458047	570035	645	429965	8083	78	1917	69 37
20	24	542293	566	457707	570422	644	429578	8130	78	1870	36
	25	542632	565	457368	570809	644	429191	8177	78	1823	35
	26	542971	565	457029	571195	643	428805	8224	78	1776	34
	27	543310	564	456690	571581	643	428419	8271	79	1729	33
	28	543649	564	456351	571967	642	428033	8318	79	1682	32
	29	543987	563	456013	572352	642	427648	8365	79	1635	31
	30	544325	563	455675	572738	642	427262	8412	79	1588	30
	31	544663	562	455337	573123	641	426877	8460	79	1540	29
	32	545000	562	455000	573507	641	426493	8507	79	1493	69 28
20	33	545338	561	454662	573892	640	426108	8554	79	1446	27
	34	545674	561	454326	574276	640	425724	8602	79	1398	26
	35	546011	560	453989	574660	639	425340	8649	79	1351	25
	36	546347	560	453653	575044	639	424956	8697	79	1303	24
	37	546683	559	453317	575427	639	424573	8744	79	1256	23
	38	547019	559	452981	575810	638	424190	8792	79	1208	22
	39	547354	558	452646	576193	638	423807	8839	79	1161	21
	40	547689	558	452311	576576	637	423424	8887	79	1113	20
	41	548024	557	451976	576958	637	423042	8934	80	1066	69 19
20	42	548359	557	451641	577341	636	422659	8982	80	1018	18
	43	548693	556	451307	577723	636	422277	9030	80	970	17
	44	549027	556	450973	578104	636	421896	9078	80	922	16
	45	549360	555	450640	578486	635	421514	9126	80	874	15
	46	549693	555	450307	578867	635	421133	9173	80	827	14
	47	550026	554	449974	579248	634	420752	9221	80	779	13
	48	550359	554	449641	579629	634	420371	9269	80	731	12
	49	550692	553	449308	580009	634	419991	9317	80	683	11
	50	551024	553	448976	580389	633	419611	9365	80	635	69 10
20	51	551356	552	448644	580769	633	419231	9414	80	586	9
	52	551687	552	448313	581149	632	418851	9462	80	538	8
	53	552018	552	447982	581528	632	418472	9510	80	490	7
	54	552349	551	447651	581907	632	418093	9558	80	442	6
	55	552680	551	447320	582286	631	417714	9606	80	394	5
	56	553010	550	446990	582665	631	417335	9655	81	345	4
	57	553341	550	446659	583043	630	416957	9703	81	297	3
	58	553670	549	446330	583422	630	416578	9751	81	249	2
	59	554000	549	446000	583800	629	416200	9800	81	200	1
	60	554329	549	445671	584177		415823	9848	81	152	0
		Com.	D.	Sec.	Col.	D.	Tang.	Com.	D.	Sine	

21 Deg.		TABLE V.—LOG. SINES, ETC.										21½ Deg.	
°	'	Sine	D.	Co-sec.	Tang.	D.	Cot.	Sec.	D.	Coa.			
		9'5		10'4	9'		10'	10'0		9'9			
21	0	54329	548	45671	584177	629	415823	29848	81	70152		60	
	1	54658	548	45342	584555	629	415445	29897	81	70103		59	
	2	54987	547	45013	584932	628	415068	29945	81	70055		58	
	3	55315	547	44685	585309	628	414691	29994	81	70006		57	
	4	55643	546	44357	585686	627	414314	30043	81	69957		56	
	5	55971	546	44029	586062	627	413938	30091	81	69909		55	
	6	56299	545	43701	586439	627	413561	30140	81	69860		54	
	7	56626	545	43374	586815	626	413185	30189	81	69811		53	
	8	56953	544	43047	587190	626	412810	30238	81	69762	68	52	
21	9	57280	544	42720	587566	625	412434	30286	81	69714		51	
	10	57606	543	42394	587941	625	412059	30335	81	69665		50	
	11	57932	543	42068	588316	625	411684	30384	82	69616		49	
	12	58258	543	41742	588691	624	411309	30433	82	69567		48	
	13	58583	542	41417	589066	624	410934	30482	82	69518		47	
	14	58909	542	41091	589440	623	410560	30531	82	69469		46	
	15	59234	541	40766	589814	623	410186	30580	82	69420		45	
	16	59558	541	40442	590188	623	409812	30630	82	69370		44	
	17	59883	540	40117	590562	622	409438	30679	82	69321	68	43	
21	18	60207	540	39793	590935	622	409065	30728	82	69272		42	
	19	60531	539	39469	591308	622	408692	30777	82	69223		41	
	20	60855	539	39145	591681	621	408319	30827	82	69173		40	
	21	61178	538	38821	592054	621	407946	30876	82	69124		39	
	22	61501	538	38499	592426	620	407574	30925	82	69075		38	
	23	61824	537	38176	592798	620	407202	30975	82	69025		37	
	24	62146	537	37854	593171	619	406829	31024	82	68976		36	
	25	62468	536	37532	593542	619	406458	31074	83	68926		35	
	26	62790	536	37210	593914	618	406086	31123	83	68877	68	34	
21	27	63112	536	36888	594285	618	405715	31173	83	68827		33	
	28	63433	535	36567	594656	618	405344	31223	83	68777		32	
	29	63755	535	36245	595027	617	404973	31272	83	68728		31	
	30	64075	534	35925	595398	617	404602	31322	83	68678		30	
	31	64396	534	35604	595768	617	404232	31372	83	68628		29	
	32	64716	534	35284	596138	616	403862	31422	83	68578		28	
	33	65036	533	34964	596508	616	403492	31472	83	68528		27	
	34	65356	532	34644	596878	616	403122	31521	83	68479		26	
	35	65676	532	34324	597247	615	402753	31571	83	68429	68	25	
21	36	65995	531	34005	597616	615	402384	31621	83	68379		24	
	37	66314	531	33686	597985	615	402015	31671	83	68329		23	
	38	66632	531	33368	598354	614	401646	31722	83	68278		22	
	39	66951	531	33049	598722	614	401278	31772	84	68228		21	
	40	67269	530	32731	599091	613	400909	31822	84	68178		20	
	41	67587	529	32413	599459	613	400541	31872	84	68128		19	
	42	67904	529	32096	599827	613	400173	31922	84	68078		18	
	43	68222	528	31778	600194	612	399806	31973	84	68027		17	
	44	68539	528	31461	600562	612	399438	32023	84	67977		16	
	45	68856	528	31144	600929	612	399071	32073	84	67927	68	15	
		Coa.	D.	Sec.	Cot.	D.	Tang.	Coa.	D.	Sine			

21½ Deg.		TABLE V.—LOG. SINES, ETC.								22½ Deg.	
°	Sine	D.	Co-sec.	Tang.	D.	Cot.	Sec.	D.	Co.		
	9'		10'	9'		10'	1000		9'96		
21	45	568856	528	431144	600929	611	399071	2073	84	7927	15
	46	569172	527	430828	601296	611	398704	2124	84	7876	14
	47	569488	527	430512	601662	611	398338	2174	84	7826	13
	48	569804	526	430196	602029	610	397971	2225	84	7775	12
	49	570120	526	429880	602395	610	397605	2275	84	7725	11
	50	570435	525	429565	602761	610	397239	2326	84	7674	10
	51	570751	525	429249	603127	609	396873	2376	84	7624	9
	52	571066	524	428934	603493	609	396507	2427	84	7573	8
	53	571380	524	428620	603858	609	396142	2478	85	7522	68 7
21	54	571695	523	428305	604223	608	395777	2529	85	7471	6
	55	572009	523	427991	604588	608	395412	2579	85	7421	5
	56	572323	523	427677	604953	607	395047	2630	85	7370	4
	57	572636	522	427364	605317	607	394683	2681	85	7319	3
	58	572950	522	427050	605682	607	394318	2732	85	7268	2
	59	573263	521	426737	606046	606	393954	2783	85	7217	1
22	0	573575	521	426423	606410	606	393590	2833	85	7166	68 c
	1	573888	520	426112	606773	606	393227	2885	85	7115	59
	2	574200	520	425800	607137	605	392863	2936	85	7064	67 58
22	3	574512	519	425488	607500	605	392500	2987	85	7013	57
	4	574824	519	425176	607863	604	392137	3039	85	6961	56
	5	575136	519	424864	608225	604	391775	3090	85	6910	55
	6	575447	518	424553	608588	604	391412	3141	85	6859	54
	7	575758	518	424242	608950	603	391050	3192	85	6808	53
	8	576069	517	423931	609312	603	390688	3244	86	6756	52
	9	576379	517	423621	609674	603	390326	3295	86	6705	51
	10	576689	516	423311	610036	602	389964	3347	86	6653	50
	11	576999	516	423001	610397	602	389603	3398	86	6602	67 49
22	12	577309	516	422691	610759	602	389241	3450	86	6550	48
	13	577618	515	422382	611120	601	388880	3501	86	6499	47
	14	577927	515	422073	611480	601	388520	3553	86	6447	46
	15	578236	514	421764	611841	601	388159	3605	86	6395	45
	16	578545	514	421455	612201	600	387799	3656	86	6344	44
	17	578853	514	421147	612561	600	387439	3708	86	6292	43
	18	579162	513	420838	612921	600	387079	3760	86	6240	42
	19	579470	513	420530	613281	599	386719	3812	86	6188	41
	20	579777	512	420223	613641	599	386359	3864	86	6136	67 40
22	21	580085	512	419915	614000	598	386000	3915	87	6085	39
	22	580392	511	419608	614359	598	385641	3967	87	6033	38
	23	580699	511	419301	614718	598	385282	4019	87	5981	37
	24	581005	511	418995	615077	597	384923	4072	87	5928	36
	25	581312	510	418688	615435	597	384565	4124	87	5876	35
	26	581618	510	418382	615793	597	384207	4176	87	5824	34
	27	581924	509	418076	616151	597	383849	4228	87	5772	33
	28	582229	509	417771	616509	596	383491	4280	87	5720	32
	29	582535	509	417465	616867	596	383133	4332	87	5668	31
	30	582840	509	417160	617224	596	382776	4385	87	5615	67 30
		Co.	D.	Sec.	Cot.	D.	Tang.	Co.	D.	Sine	

68½ Deg.

67½ Deg.

22½ Deg.		TABLE V.—LOG. SINUS, ETC.										23½ Deg.	
°	Sine	D.	Consec.	Tang.	D.	Cot.	Sec.	D.	Co.				
	2'		10'	9'		10'	10'03		9'96				
22	30	582840	508	417160	617224	595	382776	4385	87	5615	30		
	31	583145	508	416855	617582	595	382418	4437	87	5563	29		
	32	583449	507	416551	617939	595	382061	4489	87	5511	28		
	33	583754	507	416246	618295	594	381705	4542	87	5458	27		
	34	584058	506	415942	618652	594	381348	4594	87	5406	26		
	35	584361	506	415639	619008	594	380992	4647	88	5353	25		
	36	584665	506	415335	619364	593	380636	4699	88	5301	24		
	37	584968	505	415032	619721	593	380279	4752	88	5248	23		
	38	585272	505	414728	620076	593	379924	4805	88	5195	67 22		
22	39	585574	504	414426	620432	592	379568	4857	88	5143	21		
	40	585877	504	414123	620787	592	379213	4910	88	5090	20		
	41	586179	503	413821	621142	592	378858	4963	88	5037	19		
	42	586482	503	413518	621497	591	378503	5016	88	4984	18		
	43	586783	503	413217	621852	591	378148	5069	88	4931	17		
	44	587085	502	412915	622207	590	377793	5121	88	4879	16		
	45	587386	502	412614	622561	590	377439	5174	88	4826	15		
	46	587688	501	412312	622915	590	377085	5227	88	4773	14		
	47	587989	501	412011	623269	589	376731	5281	88	4719	67 13		
22	48	588289	501	411711	623623	589	376377	5334	89	4666	12		
	49	588590	500	411410	623976	589	376024	5387	89	4613	11		
	50	588890	500	411110	624330	588	375670	5440	89	4560	10		
	51	589190	499	410810	624683	588	375317	5493	89	4507	9		
	52	589489	499	410511	625036	588	374964	5546	89	4454	8		
	53	589789	499	410211	625388	587	374612	5600	89	4400	7		
	54	590088	498	409912	625741	587	374259	5653	89	4347	6		
	55	590387	498	409613	626093	587	373907	5706	89	4294	5		
	56	590686	497	409314	626445	586	373555	5760	89	4240	67 4		
22	57	590984	497	409016	626797	586	373203	5813	89	4187	3		
	58	591282	497	408718	627149	586	372851	5867	89	4133	2		
	59	591580	496	408420	627501	585	372499	5920	89	4080	1		
23	0	591878	496	408122	627852	585	372148	5974	89	4026	67 0		
	1	592176	495	407824	628203	585	371797	6028	89	3972	59		
	2	592473	495	407527	628554	585	371446	6081	89	3919	58		
	3	592770	495	407230	628905	584	371095	6135	90	3865	57		
	4	593067	494	406933	629255	584	370745	6189	90	3811	56		
	5	593363	494	406637	629606	583	370394	6243	90	3757	66 55		
23	6	593659	493	406341	629956	583	370044	6296	90	3704	54		
	7	593955	493	406045	630306	583	369694	6350	90	3650	53		
	8	594251	493	405749	630656	583	369344	6404	90	3596	52		
	9	594547	492	405453	631005	582	368995	6458	90	3542	51		
	10	594842	492	405158	631355	582	368645	6512	90	3488	50		
	11	595137	491	404863	631704	582	368296	6566	90	3434	49		
	12	595432	491	404568	632053	581	367947	6621	90	3379	48		
	13	595727	491	404273	632401	581	367599	6675	90	3325	47		
	14	596021	490	403979	632750	581	367250	6729	90	3271	46		
	15	596315	490	403685	633098	581	366902	6783	90	3217	66 45		
	Con.	D.	Sec.	Cot.	D.	Tang.	Co.	D.	Sine				

67½ Deg.

66½ Deg.

23 1/2 Deg.

TABLE V.—LOG. SINUS, ETC.

24 Deg.

°	Sine	D.	Cosec.	Tang.	D.	Cot.	Sec.	D.	Cos.	°
	9'		10'	9'		10'	1003		996	
23	596315	490	403685	633098	580	366902	6783		3217	45
16	596609	489	403391	633447	580	366553	6837	90	3163	44
17	596903	489	403097	633795	580	366205	6892	91	3108	43
18	597196	489	402804	634143	579	365857	6946	91	3054	42
19	597490	488	402510	634490	579	365510	7001	91	2999	41
20	597783	488	402217	634838	579	365162	7055	91	2945	40
21	598075	487	401925	635185	579	364815	7110	91	2890	39
22	598368	487	401632	635532	578	364468	7164	91	2836	38
23	598660	487	401340	635879	578	364121	7219	91	2781	66 37
23	598952	486	401048	636226	577	363774	7273	91	2727	36
25	599244	486	400756	636572	577	363428	7328	91	2672	35
26	599536	485	400464	636919	577	363081	7382	91	2617	34
27	599827	485	400173	637265	577	362735	7438	91	2562	33
28	600118	485	399882	637611	577	362389	7492	91	2508	32
29	600409	484	399591	637956	576	362044	7547	91	2453	31
30	600700	484	399300	638302	576	361698	7602	92	2398	30
31	600990	484	399010	638647	575	361353	7657	92	2343	29
32	601280	483	398720	638992	575	361008	7712	92	2288	66 28
23	601570	483	398430	639337	575	360663	7767	92	2233	27
34	601860	482	398140	639682	574	360318	7822	92	2178	26
35	602150	482	397850	640027	574	359973	7877	92	2123	25
36	602439	482	397561	640371	574	359629	7933	92	2067	24
37	602728	481	397272	640716	574	359284	7988	92	2012	23
38	603017	481	396983	641060	573	358940	8043	92	1957	22
39	603305	481	396695	641404	573	358596	8098	92	1902	21
40	603594	480	396406	641747	572	358253	8154	92	1846	20
41	603882	480	396118	642091	572	357909	8209	92	1791	66 19
23	604170	479	395830	642434	572	357566	8265	92	1735	18
43	604457	479	395543	642777	572	357223	8320	92	1680	17
44	604745	479	395255	643120	571	356880	8376	92	1624	16
45	605032	478	394968	643463	571	356537	8431	93	1569	15
46	605319	478	394681	643806	571	356194	8487	93	1513	14
47	605606	478	394394	644148	570	355852	8542	93	1458	13
48	605892	477	394108	644490	570	355510	8598	93	1402	12
49	606179	477	393821	644832	570	355168	8654	93	1346	11
50	606465	476	393535	645174	569	354826	8710	93	1290	66 10
23	606751	476	393249	645516	569	354484	8765	93	1235	9
52	607036	476	392964	645857	569	354143	8821	93	1179	8
53	607322	475	392678	646199	569	353801	8877	93	1123	7
54	607607	475	392393	646540	568	353460	8933	93	1067	6
55	607892	474	392108	646881	568	353119	8989	93	1011	5
56	608177	474	391823	647222	568	352778	9045	93	955	4
57	608461	474	391539	647562	567	352438	9101	93	899	3
58	608745	473	391255	647903	567	352097	9157	93	843	2
59	609029	473	390971	648243	567	351757	9214	94	786	1
60	609313	473	390687	648583	567	351417	9270	94	730	00 0

66 1/2 Deg.

66 Deg.

24 Deg.		TABLE V.—Loc. Sines, etc.								24½ Deg.	
°	'	Sine	D.	Cosec.	Tang.	D.	Cot.	Sec.	D.	Con.	
		96		103	9		10	100		99	
24	0	09313	473	90687	648583	566	351417	39270		60730	60
	1	09597	472	90403	648923	566	351077	39326	94	60674	59
	2	09880	472	90120	649263	566	350737	39382	94	60618	58
	3	10164	472	89836	649602	566	350398	39439	94	60561	57
	4	10447	471	89553	649942	565	350058	39495	94	60505	56
	5	10729	471	89271	650281	565	349719	39552	94	60448	55
	6	11012	471	88988	650620	565	349380	39608	94	60392	54
	7	11294	470	88706	650959	565	349041	39665	94	60335	53
	8	11576	470	88424	651297	564	348703	39721	94	60279	52
	9	11858	469	88142	651636	564	348364	39778	94	60222	51
	10	12140	469	87860	651974	563	348026	39835	94	60165	50
	11	12421	469	87579	652312	563	347688	39891	94	60109	49
	12	12702	468	87298	652650	563	347350	39948	95	60052	48
	13	12983	468	87017	652988	563	347012	40005	95	59995	47
	14	13264	468	86736	653326	563	346674	40062	95	59938	46
	15	13545	467	86455	653663	562	346337	40118	95	59882	45
	16	13825	467	86175	654000	562	346000	40175	95	59825	44
	17	14105	466	85895	654337	561	345663	40232	95	59768	43
	18	14385	466	85615	654674	561	345326	40289	95	59711	42
	19	14665	466	85335	655011	561	344989	40346	95	59654	41
	20	14944	465	85056	655348	561	344652	40404	95	59596	40
	21	15223	465	84777	655684	560	344316	40461	95	59539	39
	22	15502	465	84498	656020	560	343980	40518	95	59482	38
	23	15781	464	84219	656356	560	343644	40575	95	59425	37
	24	16060	464	83940	656692	560	343308	40632	95	59368	36
	25	16338	464	83661	657028	559	342972	40689	95	59310	35
	26	16616	463	83384	657364	559	342636	40747	96	59253	34
	27	16894	463	83106	657699	559	342301	40805	96	59195	33
	28	17172	462	82828	658034	558	341966	40862	96	59138	32
	29	17450	462	82550	658369	558	341631	40919	96	59081	31
	30	17727	462	82273	658704	558	341296	40977	96	59023	30
	31	18004	461	81996	659039	558	340961	41035	96	58965	29
	32	18281	461	81719	659373	557	340627	41092	96	58908	28
	33	18558	461	81442	659708	557	340292	41150	96	58850	27
	34	18834	460	81166	660042	557	339958	41208	96	58792	26
	35	19110	460	80890	660376	557	339624	41266	96	58734	25
	36	19386	460	80614	660710	556	339290	41323	96	58677	24
	37	19662	459	80338	661043	556	338957	41381	96	58619	23
	38	19938	459	80062	661377	556	338623	41439	96	58561	22
	39	20213	459	79787	661710	555	338290	41497	97	58503	21
	40	20488	458	79512	662043	555	337957	41555	97	58445	20
	41	20763	458	79237	662376	555	337624	41613	97	58387	19
	42	21038	457	78962	662709	555	337291	41671	97	58329	18
	43	21313	457	78687	663042	554	336958	41729	97	58271	17
	44	21587	457	78413	663375	554	336625	41787	97	58213	16
	45	21861	457	78139	663707	554	336293	41846	97	58154	15
		Con.	D.	Sec.	Cot.	D.	Tang.	Con.	D.	Sine	

24½ Deg.		TABLE V.—LOG. SINE, ETC.								25½ Deg.	
°	Sine	D.	Cosec.	Tang.	D.	Col.	Sec.	D.	Com.		
	9'		10'	9'		10'	10'04		9'95		
24	45	621861	456	378139	663707	554	336293	1846	97	8154	15
	46	622135	456	377865	664039	553	335961	1904	97	8096	14
	47	622409	456	377591	664371	553	335629	1962	97	8038	13
	48	622682	455	377318	664703	553	335297	2021	97	7979	12
	49	622956	455	377044	665035	553	334965	2079	97	7921	11
	50	623229	455	376771	665366	553	334634	2137	97	7863	10
	51	623502	455	376498	665697	552	334303	2196	97	7804	9
	52	623774	454	376226	666029	552	333971	2254	97	7746	8
	53	624047	454	375953	666360	552	333640	2313	98	7687	65 7
24	54	624319	453	375681	666691	551	333309	2372	98	7628	6
	55	624591	453	375409	667021	551	332979	2430	98	7570	5
	56	624863	453	375137	667352	551	332648	2489	98	7511	4
	57	625135	453	374865	667682	551	332318	2548	98	7452	3
	58	625406	452	374594	668013	550	331987	2607	98	7393	2
	59	625677	452	374323	668343	550	331657	2665	98	7335	1
25	0	625948	451	374052	668672	550	331328	2724	98	7276	65 c
	1	626219	451	373781	669002	550	330998	2783	98	7217	59
	2	626490	451	373510	669332	549	330668	2842	98	7158	64 58
25	3	626760	450	373240	669661	549	330339	2901	98	7099	57
	4	627030	450	372970	669991	548	330009	2960	98	7040	56
	5	627300	450	372700	670320	548	329680	3019	98	6981	55
	6	627570	450	372430	670649	548	329351	3079	99	6921	54
	7	627840	449	372160	670977	548	329023	3138	99	6862	53
	8	628110	449	371891	671306	548	328694	3197	99	6803	52
	9	628378	448	371622	671634	547	328366	3256	99	6744	51
	10	628647	448	371353	671963	547	328037	3316	99	6684	50
	11	628916	447	371084	672291	547	327709	3375	99	6625	64 49
25	12	629185	447	370815	672619	546	327381	3434	99	6566	48
	13	629453	447	370547	672947	546	327053	3494	99	6506	47
	14	629721	446	370279	673274	546	326726	3553	99	6447	46
	15	629989	446	370011	673602	546	326398	3613	99	6387	45
	16	630257	446	369743	673929	545	326071	3673	99	6327	44
	17	630524	446	369476	674257	545	325743	3732	99	6268	43
	18	630792	445	369208	674584	545	325416	3792	99	6208	42
	19	631059	445	368941	674910	545	325090	3852	100	6148	41
	20	631326	445	368674	675237	544	324763	3911	100	6089	64 40
25	21	631593	444	368407	675564	544	324436	3971	100	6029	39
	22	631859	444	368141	675890	544	324110	4031	100	5969	38
	23	632125	444	367875	676216	543	323784	4091	100	5909	37
	24	632392	444	367608	676543	543	323457	4151	100	5849	36
	25	632658	443	367342	676869	543	323131	4211	100	5789	35
	26	632923	443	367077	677194	543	322806	4271	100	5729	34
	27	633189	443	366811	677520	542	322480	4331	100	5669	33
	28	633454	442	366546	677846	542	322154	4391	100	5609	32
	29	633719	442	366281	678171	542	321829	4452	100	5548	31
	30	633984	442	366016	678496	542	321504	4512	100	5488	64 30
		Com.	D.	Sec.	Col.	D.	Tang.	Com.	D.	Sine	

65½ Deg.

64½ Deg.

26 1/2 Deg.		TABLE V.—LOG SINES, ETC.						27 Deg.		
•	Sine	D.	Co-sec.	Tang.	D.	Cot.	Sec.	D.	Coa.	
	9'6		10'3	9'		10'	10'0		9'9	
26 15	45706	427	54294	692975	531	307025	47269	104	52731	43
16	45962	426	54038	693293	530	306707	47331	104	52669	44
17	46218	426	53782	693612	530	306388	47394	104	52606	43
18	46474	426	53526	693930	530	306070	47456	104	52544	42
19	46729	425	53271	694248	530	305752	47519	104	52481	41
20	46984	425	53016	694566	529	305434	47581	104	52419	40
21	47240	425	52760	694883	529	305117	47644	104	52356	39
22	47494	424	52506	695201	529	304799	47706	104	52294	38
23	47749	424	52251	695518	529	304482	47769	104	52231	63 37
26 24	48004	424	51996	695836	529	304164	47832	105	52168	36
25	48258	424	51742	696153	528	303847	47894	105	52106	35
26	48512	423	51488	696470	528	303530	47957	105	52043	34
27	48766	423	51234	696787	528	303213	48020	105	51980	33
28	49020	423	50980	697103	528	302897	48083	105	51917	32
29	49274	422	50726	697420	527	302580	48146	105	51854	31
30	49527	422	50473	697736	527	302264	48209	105	51791	30
31	49781	422	50219	698053	527	301947	48272	105	51728	29
32	50034	422	49966	698369	527	301631	48335	105	51665	63 28
26 33	50287	421	49713	698685	526	301315	48398	105	51602	27
34	50539	421	49461	699001	526	300999	48461	105	51539	26
35	50792	421	49208	699316	526	300684	48524	105	51476	25
36	51044	420	48956	699632	526	300368	48588	105	51412	24
37	51297	420	48703	699947	526	300053	48651	105	51349	23
38	51549	420	48451	700263	525	299737	48714	106	51286	22
39	51800	420	48200	700578	525	299422	48778	106	51222	21
40	52052	419	47948	700893	525	299107	48841	106	51159	20
41	52304	419	47696	701208	524	298792	48904	106	51096	63 19
26 42	52555	418	47445	701523	524	298477	48968	106	51032	18
43	52806	418	47194	701837	524	298163	49032	106	50968	17
44	53057	418	46943	702152	524	297848	49095	106	50905	16
45	53308	418	46692	702466	524	297534	49159	106	50841	15
46	53558	418	46442	702780	523	297220	49222	106	50778	14
47	53808	417	46192	703095	523	296905	49286	106	50714	13
48	54059	417	45941	703409	523	296591	49350	106	50650	12
49	54309	416	45691	703723	523	296277	49414	106	50586	11
50	54558	416	45442	704036	522	295964	49478	107	50522	63 10
26 51	54808	416	45192	704350	522	295650	49542	107	50458	9
52	55058	416	44942	704663	522	295337	49606	107	50394	8
53	55307	415	44693	704977	522	295023	49670	107	50330	7
54	55556	415	44444	705290	522	294710	49734	107	50266	6
55	55805	415	44195	705603	521	294397	49798	107	50202	5
56	56054	415	43946	705916	521	294084	49862	107	50138	4
57	56302	414	43697	706228	521	293772	49926	107	50074	3
58	56551	414	43449	706541	521	293459	49990	107	50010	2
59	56799	414	43201	706854	521	293146	50055	107	49945	1
60	57047	413	42953	707166	521	292834	50119	107	49881	63 C
	Coa.	D.	Sec.	Cot.	D.	Tang.	Coa.	D.	Sine	

27 Deg.

TABLE V.—Loc. SIKKA, etc.

27½ Deg.

°	'	Sine	D.	Consec.	Tang.	D.	Cot.	Sec.	D.	Con.	°
		9'		10'	9'		10'	10'05		9'94	
27	0	657047		342953	707166		292834	0119		9881	60
	1	657295	413	342705	707478	520	292522	0184	107	9816	59
	2	657542	413	342458	707790	520	292210	0248	107	9752	58
	3	657790	412	342210	708102	520	291898	0312	108	9688	57
	4	658037	412	341963	708414	520	291586	0377	108	9623	56
	5	658284	412	341716	708726	519	291274	0442	108	9558	55
	6	658531	411	341469	709037	519	290963	0506	108	9494	54
	7	658778	411	341222	709349	519	290651	0571	108	9429	53
	8	659025	411	340975	709660	519	290340	0636	108	9364	62 52
27	9	659271	410	340729	709971	518	290029	0700	108	9300	51
	10	659517	410	340483	710282	518	289718	0765	108	9235	50
	11	659763	410	340237	710593	518	289407	0830	108	9170	49
	12	660009	409	339991	710904	518	289096	0895	108	9105	48
	13	660255	409	339745	711215	518	288785	0960	108	9040	47
	14	660501	409	339499	711525	518	288475	1025	108	8975	46
	15	660746	409	339254	711836	517	288164	1090	108	8910	45
	16	660991	408	339009	712146	517	287854	1155	108	8845	44
	17	661236	408	338764	712456	517	287544	1220	109	8780	62 43
27	18	661481	408	338519	712766	516	287234	1285	109	8715	42
	19	661726	407	338274	713076	516	286924	1350	109	8650	41
	20	661970	407	338030	713386	516	286614	1416	109	8584	40
	21	662214	407	337786	713696	516	286304	1481	109	8519	39
	22	662459	407	337541	714005	516	285995	1546	109	8454	38
	23	662703	406	337297	714314	515	285686	1612	109	8388	37
	24	662946	406	337054	714624	515	285376	1677	109	8323	36
	25	663190	406	336810	714933	515	285067	1743	109	8257	35
	26	663433	405	336567	715242	515	284758	1808	109	8192	62 34
27	27	663677	405	336323	715551	514	284449	1874	109	8126	33
	28	663920	405	336080	715860	514	284140	1940	109	8060	32
	29	664163	405	335837	716168	514	283832	2005	110	7995	31
	30	664406	404	335594	716477	514	283523	2071	110	7929	30
	31	664648	404	335352	716785	514	283215	2137	110	7863	29
	32	664891	404	335109	717093	513	282907	2203	110	7797	28
	33	665133	404	334867	717401	513	282599	2269	110	7731	27
	34	665375	403	334625	717709	513	282291	2335	110	7665	26
	35	665617	403	334383	718017	513	281983	2400	110	7600	62 25
27	36	665859	402	334141	718325	513	281675	2467	110	7533	24
	37	666100	402	333900	718633	512	281367	2533	110	7467	23
	38	666342	402	333658	718940	512	281060	2599	110	7401	22
	39	666583	401	333417	719248	512	280752	2665	110	7335	21
	40	666824	401	333176	719555	512	280445	2731	110	7269	20
	41	667065	401	332935	719862	512	280138	2797	110	7203	19
	42	667305	401	332695	720169	511	279831	2864	111	7136	18
	43	667546	401	332454	720476	511	279524	2930	111	7070	17
	44	667786	400	332214	720783	511	279217	2996	111	7004	16
	45	668027	400	331973	721089	511	278911	3063	111	6937	62 15
		Con.	D.	Sec.	Cot.	D.	Tang.	Con.	D.	Sine	°

63 Deg.

62½ Deg.

27½ Deg.		TABLE V.—LOG. SINES, ETC.								28½ Deg.		
°	'	Sine	D.	Cosc.	Tang.	D.	Col.	Sec.	D.	Con.	°	'
		2'	10'		9'	10'		10'05	9'94			
27	45	668207	400	331973	721089	511	278911	3063	111	6937		15
	46	668267	400	331733	721396	511	278604	3139	111	6871		14
	47	668506	399	331494	721702	510	278298	3196	111	6804		13
	48	668746	399	331254	722009	510	277991	3262	111	6738		12
	49	668986	399	331014	722315	510	277685	3329	111	6671		11
	50	669225	399	330775	722621	510	277379	3396	111	6604		10
	51	669464	398	330536	722927	510	277073	3462	111	6538		9
	52	669703	398	330297	723232	509	276768	3529	111	6471		8
	53	669942	398	330058	723538	509	276462	3596	111	6404	62	7
27	54	670181	397	329819	723844	509	276156	3663	111	6337		6
	55	670419	397	329581	724149	509	275851	3730	112	6270		5
	56	670658	397	329342	724454	509	275546	3797	112	6203		4
	57	670896	397	329104	724759	508	275241	3864	112	6136		3
	58	671134	396	328866	725065	508	274935	3931	112	6069		2
	59	671372	396	328628	725369	508	274631	3998	112	6002		1
28	0	671609	396	328391	725674	508	274326	4065	112	5935	62	0
	1	671847	395	328153	725979	508	274021	4132	112	5868		59
	2	672084	395	327916	726284	507	273716	4200	112	5800	61	58
28	3	672321	395	327679	726588	507	273412	4267	112	5733		57
	4	672558	395	327442	726892	507	273108	4334	112	5666		56
	5	672795	394	327205	727197	507	272803	4402	112	5598		55
	6	673032	394	326968	727501	507	272499	4469	112	5531		54
	7	673268	394	326732	727805	506	272195	4536	113	5464		53
	8	673505	394	326495	728109	506	271891	4604	113	5396		52
	9	673741	393	326259	728412	506	271588	4672	113	5328		51
	10	673977	393	326023	728716	506	271284	4739	113	5261		50
	11	674213	393	325787	729020	506	270980	4807	113	5193	61	49
28	12	674448	392	325552	729323	505	270677	4875	113	5125		48
	13	674684	392	325316	729626	505	270374	4942	113	5058		47
	14	674919	392	325081	729929	505	270071	5010	113	4990		46
	15	675155	392	324845	730233	505	269767	5078	113	4922		45
	16	675390	391	324610	730535	505	269465	5146	113	4854		44
	17	675624	391	324376	730838	504	269162	5214	113	4786		43
	18	675859	391	324141	731141	504	268859	5282	113	4718		42
	19	676094	391	323906	731444	504	268556	5350	113	4650		41
	20	676328	390	323672	731746	504	268254	5418	114	4582	61	40
28	21	676562	390	323438	732048	504	267952	5486	114	4514		39
	22	676796	390	323204	732351	503	267649	5554	114	4446		38
	23	677030	390	322970	732653	503	267347	5623	114	4377		37
	24	677264	389	322736	732955	503	267045	5691	114	4309		36
	25	677498	389	322502	733257	503	266743	5759	114	4241		35
	26	677731	388	322269	733558	503	266442	5828	114	4172		34
	27	677964	388	322036	733860	502	266140	5896	114	4104		33
	28	678197	388	321803	734162	502	265838	5964	114	4036		32
	29	678430	388	321570	734463	502	265537	6033	114	3967		31
	30	678663	388	321337	734764	502	265236	6101	114	3899	62	30
		Con.	D.	Sec.	Col.	D.	Tang.	Con.	D.	Sine		

62½ Deg.

61½ Deg.

28½ Deg.		TABLE V.—LOG. SINES, ETC.								29½ Deg.	
°	Sine	D.	Cosoc.	Tang.	D.	Cot.	Sec.	D.	Coa.		
	9'		10'	9'		10'	10'05		9'94		
28	30	678663	388	321337	734764	502	265236	6101	114	3899	30
	31	678895	387	321105	735066	502	264934	6170	114	3830	29
	32	679128	387	320872	735367	502	264633	6239	114	3761	28
	33	679360	387	320640	735668	502	264332	6307	114	3693	27
	34	679592	387	320408	735969	501	264031	6376	115	3624	26
	35	679824	387	320176	736269	501	263731	6445	115	3555	25
	36	680056	386	319944	736570	501	263430	6514	115	3486	24
	37	680288	386	319712	736871	501	263129	6583	115	3417	23
	38	680519	385	319481	737171	500	262829	6652	115	3348	61 22
28	39	680750	385	319250	737471	500	262529	6721	115	3279	21
	40	680982	385	319018	737771	500	262229	6790	115	3210	20
	41	681213	385	318787	738071	500	261929	6859	115	3141	19
	42	681443	384	318557	738371	500	261629	6928	115	3072	18
	43	681674	384	318326	738671	499	261329	6997	115	3003	17
	44	681905	384	318095	738971	499	261029	7066	115	2934	16
	45	682135	384	317865	739271	499	260729	7135	115	2864	15
	46	682365	383	317635	739570	499	260430	7205	116	2795	14
	47	682595	383	317405	739870	499	260130	7274	116	2726	61 13
28	48	682825	383	317175	740169	499	259831	7344	116	2656	12
	49	683055	383	316945	740468	498	259532	7413	116	2587	11
	50	683284	382	316716	740767	498	259233	7483	116	2517	10
	51	683514	382	316486	741066	498	258934	7552	116	2448	9
	52	683743	382	316257	741365	498	258635	7622	116	2378	8
	53	683972	382	316028	741664	498	258336	7692	116	2308	7
	54	684201	381	315799	741962	497	258037	7761	116	2239	6
	55	684430	381	315570	742261	497	257739	7831	116	2169	5
	56	684658	381	315342	742559	497	257441	7901	116	2099	61 4
28	57	684887	380	315113	742858	497	257142	7971	116	2029	3
	58	685115	380	314884	743156	497	256844	8041	116	1959	2
	59	685343	380	314657	743454	497	256546	8111	117	1889	1
29	0	685571	380	314429	743752	496	256248	8181	117	1819	61 0
	1	685799	379	314201	744050	496	255950	8251	117	1749	59
	2	686027	379	313973	744348	496	255652	8321	117	1679	58
	3	686254	379	313746	744645	496	255355	8391	117	1609	57
	4	686482	379	313518	744943	496	255057	8461	117	1539	56
	5	686709	378	313291	745240	495	254760	8531	117	1469	60 55
29	6	686936	378	313064	745538	495	254462	8602	117	1398	54
	7	687163	378	312837	745835	495	254165	8672	117	1328	53
	8	687389	378	312611	746132	495	253868	8742	117	1258	52
	9	687616	377	312384	746429	495	253571	8813	117	1187	51
	10	687843	377	312157	746726	495	253274	8883	117	1117	50
	11	688069	377	311931	747023	494	252977	8954	118	1046	49
	12	688295	377	311705	747319	494	252681	9025	118	975	48
	13	688521	376	311479	747616	494	252384	9095	118	905	47
	14	688747	376	311253	747913	494	252087	9166	118	834	46
	15	688972	376	311028	748209	494	251791	9237	118	763	60 45
		Coa.	D.	Sec.	Cot.	D.	Tang.	Coa.	D.	Sine	°

61½ Deg.

60½ Deg.

20½ Deg.		TABLE V.—LOG. SINES, ETC.										30 Deg.	
	Sine	D.	Co-sec.	Tang.	D.	Co-t.	Sec.	D.	Co-s.				
	9.6		10.3	9		10	10.0		9.9				
20	15	88972	376	11028	748209	494	251791	59237	118	40763	45		
	16	89198	376	10802	748505	493	251495	59307	118	40693	44		
	17	89423	375	10577	748801	493	251199	59378	118	40622	43		
	18	89648	375	10352	749097	493	250903	59449	118	40551	42		
	19	89873	375	10127	749393	493	250607	59520	118	40480	41		
	20	90098	375	9902	749689	493	250311	59591	118	40409	40		
	21	90323	374	9677	749985	493	250015	59662	118	40338	39		
	22	90548	374	9452	750281	493	249719	59733	118	40267	38		
	23	90772	374	9228	750576	492	249424	59804	118	40196	60 37		
	24	90996	374	9004	750872	492	249128	59875	119	40125	36		
	25	91220	373	8780	751167	492	248833	59946	119	40054	35		
	26	91444	373	8556	751462	492	248538	60018	119	39982	34		
	27	91668	373	8332	751757	492	248243	60089	119	39911	33		
	28	91892	373	8108	752052	491	247948	60160	119	39840	32		
	29	92115	372	7885	752347	491	247653	60231	119	39768	31		
	30	92339	372	7661	752642	491	247358	60303	119	39697	30		
	31	92562	372	7438	752937	491	247063	60375	119	39625	29		
	32	92785	371	7215	753231	491	246769	60446	119	39554	60 28		
29	33	93008	371	6992	753526	491	246474	60518	119	39482	27		
	34	93231	371	6769	753820	490	246180	60590	119	39410	60 26		
	35	93453	371	6547	754115	490	245885	60661	119	39339	25		
	36	93676	370	6324	754409	490	245591	60733	120	39267	24		
	37	93898	370	6102	754703	490	245297	60805	120	39195	23		
	38	94120	370	5880	754997	490	245003	60877	120	39123	22		
	39	94342	370	5658	755291	490	244709	60948	120	39052	21		
	40	94564	369	5436	755585	489	244415	61020	120	38980	20		
	41	94786	369	5214	755878	489	244122	61092	120	38908	60 19		
29	42	95007	369	4993	756172	489	243828	61164	120	38836	18		
	43	95229	369	4771	756465	489	243535	61237	120	38763	17		
	44	95450	368	4550	756759	489	243241	61309	120	38691	16		
	45	95671	368	4329	757052	489	242948	61381	120	38619	15		
	46	95892	368	4108	757345	488	242655	61453	120	38547	14		
	47	96113	368	3887	757638	488	242362	61525	120	38475	13		
	48	96334	368	3666	757931	488	242069	61598	121	38402	12		
	49	96554	367	3446	758224	488	241776	61670	121	38330	11		
	50	96775	367	3225	758517	488	241483	61742	121	38258	60 10		
29	51	96995	367	3005	758810	488	241190	61815	121	38185	9		
	52	97215	366	2785	759102	487	240898	61887	121	38113	8		
	53	97435	366	2565	759395	487	240605	61960	121	38040	7		
	54	97654	366	2346	759687	487	240313	62033	121	37967	6		
	55	97874	366	2126	759979	487	240021	62105	121	37895	5		
	56	98094	365	1906	760272	487	239728	62178	121	37822	4		
	57	98313	365	1687	760564	487	239436	62251	121	37749	3		
	58	98532	365	1468	760856	486	239144	62324	121	37676	2		
	59	98751	365	1249	761148	486	238852	62396	121	37604	1		
	60	98970	365	1030	761439	486	238561	62469	121	37531	60 0		
	Co-s.	D.	Sec.	Co-t.	D.	Tang.	Co-s.	D.	Sine				

60½ Deg.

60 Deg.

30 Deg.		TABLE V.—LOG. SINUS, ETC.								30½ Deg.	
°	'	Sine	D.	Co-sec.	Tang.	D.	Cot.	Sec.	D.	Co-sec.	
		9'		10'	9'		10'	10'06		9'93	
30	0	698970	364	301030	761439	486	238561	2469	121	7531	60
	1	699189	364	300811	761731	486	238269	2542	122	7458	59
	2	699407	364	300593	762023	486	237977	2615	122	7385	58
	3	699626	364	300374	762314	486	237686	2688	122	7312	57
	4	699844	363	300156	762606	485	237394	2762	122	7238	56
	5	700062	363	299938	762897	485	237103	2835	122	7165	55
	6	700280	363	299720	763188	485	236812	2908	122	7092	54
	7	700498	363	299502	763479	485	236521	2981	122	7019	53
	8	700716	363	299284	763770	485	236230	3054	122	6946	59 52
30	9	700933	362	299067	764061	485	235939	3128	122	6872	51
	10	701151	362	298849	764352	484	235648	3201	122	6799	50
	11	701368	362	298632	764643	484	235357	3275	122	6725	49
	12	701585	362	298415	764933	484	235067	3348	122	6652	48
	13	701802	361	298198	765224	484	234776	3422	123	6578	47
	14	702019	361	297981	765514	484	234486	3495	123	6505	46
	15	702236	361	297764	765805	484	234195	3569	123	6431	45
	16	702452	361	297548	766095	484	233905	3643	123	6357	44
	17	702669	360	297331	766385	483	233615	3716	123	6284	59 43
30	18	702885	360	297115	766675	483	233325	3790	123	6210	42
	19	703101	360	296899	766965	483	233035	3864	123	6136	41
	20	703317	360	296683	767255	483	232745	3938	123	6062	40
	21	703533	359	296467	767545	483	232455	4012	123	5988	39
	22	703749	359	296251	767834	483	232166	4086	123	5914	38
	23	703964	359	296036	768124	482	231876	4160	123	5840	37
	24	704179	359	295821	768413	482	231587	4234	124	5766	36
	25	704395	359	295605	768703	482	231297	4308	124	5692	35
	26	704610	358	295390	768992	482	231008	4382	124	5618	59 34
30	27	704825	358	295175	769281	482	230719	4457	124	5543	33
	28	705040	358	294960	769570	482	230430	4531	124	5469	32
	29	705254	358	294746	769860	481	230140	4605	124	5395	31
	30	705469	357	294531	770148	481	229852	4680	124	5320	30
	31	705683	357	294317	770437	481	229563	4754	124	5246	29
	32	705898	357	294102	770726	481	229274	4829	124	5171	28
	33	706112	357	293888	771015	481	228985	4903	124	5097	27
	34	706326	356	293674	771303	481	228697	4978	124	5022	26
	35	706539	356	293461	771592	481	228408	5052	124	4948	59 25
30	36	706753	356	293247	771880	480	228120	5127	124	4873	24
	37	706967	356	293033	772168	480	227832	5202	125	4798	23
	38	707180	355	292820	772457	480	227543	5277	125	4723	22
	39	707393	355	292607	772745	480	227255	5351	125	4649	21
	40	707606	355	292394	773033	480	226967	5426	125	4574	20
	41	707819	355	292181	773321	480	226679	5501	125	4499	19
	42	708032	355	291968	773608	480	226392	5576	125	4424	18
	43	708245	354	291755	773896	479	226104	5651	125	4349	17
	44	708458	354	291542	774184	479	225816	5726	125	4274	16
	45	708670	354	291330	774471	479	225529	5801	125	4199	59 15
		Co-sec.	D.	Sec.	Cot.	D.	Tang.	Co-sec.	D.	Sine	°

30° Deg.		TABLE V.—LOG. SINUS, ETC.								31° Deg.	
°	Sine	D.	Co-sec.	Tang.	D.	Cot.	Sec.	D.	Coa.		
	9'		10'	9'		10'	10'06		9'93		
30	45	708670	354	291330	774471	479	225529	5801	125	4199	15
	46	708882	353	291118	774759	479	225241	5877	125	4123	14
	47	709094	353	290906	775046	479	224954	5952	125	4048	13
	48	709306	353	290694	775333	479	224667	6027	125	3973	12
	49	709518	353	290482	775621	479	224379	6102	125	3898	11
	50	709730	353	290270	775908	478	224092	6178	126	3822	10
	51	709941	353	290059	776195	478	223805	6253	126	3747	9
	52	710153	352	289847	776482	478	223518	6329	126	3671	8
	53	710364	352	289636	776769	478	223231	6404	126	3596	59 7
	54	710575	352	289425	777055	478	222945	6480	126	3520	6
	55	710786	351	289214	777342	478	222658	6555	126	3445	5
	56	710997	351	289003	777628	477	222372	6631	126	3369	4
	57	711208	351	288792	777915	477	222085	6707	126	3293	3
	58	711419	351	288581	778201	477	221799	6783	126	3217	2
	59	711629	350	288371	778487	477	221513	6859	126	3141	1
31	0	711839	350	288161	778774	477	221226	6934	126	3066	30 0
	1	712050	350	287950	779060	477	220940	7010	127	2990	59
	2	712260	350	287740	779346	476	220654	7086	127	2914	58 58
	3	712469	349	287531	779632	476	220368	7162	127	2838	57
	4	712679	349	287321	779918	476	220082	7238	127	2762	56
	5	712889	349	287111	780203	476	219797	7315	127	2685	55
	6	713098	349	286902	780489	476	219511	7391	127	2609	54
	7	713308	349	286692	780775	476	219225	7467	127	2533	53
	8	713517	348	286483	781060	476	218940	7543	127	2457	52
	9	713726	348	286274	781346	475	218654	7620	127	2380	51
	10	713935	348	286065	781631	475	218369	7696	127	2304	50
	11	714144	348	285856	781916	475	218084	7772	127	2228	58 49
	12	714352	347	285648	782201	475	217799	7849	127	2151	48
	13	714561	347	285439	782486	475	217514	7925	128	2075	47
	14	714769	347	285231	782771	475	217229	8002	128	1998	46
	15	714978	347	285022	783056	475	216944	8079	128	1921	45
	16	715186	347	284814	783341	475	216659	8155	128	1845	44
	17	715394	347	284606	783626	475	216374	8232	128	1768	43
	18	715602	346	284398	783910	474	216090	8309	128	1691	42
	19	715809	346	284191	784195	474	215805	8386	128	1614	41
	20	716017	346	283983	784479	474	215521	8463	128	1537	58 40
	21	716224	345	283776	784764	474	215236	8540	128	1460	39
	22	716432	345	283568	785048	474	214952	8617	128	1383	38
	23	716639	345	283361	785332	473	214668	8694	128	1306	37
	24	716846	345	283154	785616	473	214384	8771	129	1229	36
	25	717053	345	282947	785900	473	214100	8848	129	1152	35
	26	717259	344	282741	786184	473	213816	8925	129	1075	34
	27	717466	344	282534	786468	473	213532	9002	129	998	33
	28	717673	344	282327	786752	473	213248	9079	129	921	32
	29	717879	344	282121	787036	473	212964	9157	129	844	31
	30	718085	344	281915	787319	473	212681	9234	129	766	30 30
		Coa.	D.	Sec.	Cot.	D.	Tang.	Coa.	D.	Sine	

31½ Deg.		TABLE V.—LOG. SINES, ETC.								32½ Deg.	
°	'	Sine	D.	Cosec.	Tang.	D.	Cot.	Sec.	D.	Coa.	
		9'7		10'2	9'		10'	10'0		9'9	
31	30	18085	343	81915	787319	472	212681	69234	129	30766	30
	31	18291	343	81709	787603	472	212397	69312	129	30688	29
	32	18497	343	81503	787886	472	212114	69389	129	30611	28
	33	18703	343	81297	788170	472	211830	69467	129	30533	27
	34	18909	343	81091	788453	472	211547	69544	129	30456	26
	35	19114	343	80886	788736	472	211264	69622	129	30378	25
	36	19320	342	80680	789019	472	210981	69700	130	30300	24
	37	19525	342	80475	789302	472	210698	69777	130	30223	23
	38	19730	342	80270	789585	471	210415	69855	130	30145	58 22
	39	19935	341	80065	789868	471	210132	69933	130	30067	21
	40	20140	341	79860	790151	471	209849	70011	130	29989	20
	41	20345	341	79655	790433	471	209567	70089	130	29911	19
	42	20549	341	79451	790716	471	209284	70167	130	29833	18
	43	20754	340	79246	790999	471	209001	70245	130	29755	17
	44	20958	340	79042	791281	471	208719	70323	130	29677	16
	45	21162	340	78838	791563	471	208437	70401	130	29599	15
	46	21366	340	78634	791846	470	208154	70479	130	29521	14
	47	21570	340	78430	792128	470	207872	70558	130	29442	58 13
	48	21774	339	78226	792410	470	207590	70636	131	29364	12
	49	21978	339	78022	792692	470	207308	70714	131	29286	11
	50	22181	339	77819	792974	470	207026	70793	131	29207	10
	51	22385	339	77615	793256	470	206744	70871	131	29129	9
	52	22588	339	77412	793538	469	206462	70950	131	29050	8
	53	22791	339	77209	793819	469	206181	71028	131	28972	7
	54	22994	338	77006	794101	469	205899	71107	131	28893	6
	55	23197	338	76803	794383	469	205617	71185	131	28815	5
	56	23400	338	76600	794664	469	205336	71264	131	28736	58 4
	57	23603	337	76397	794945	469	205055	71343	131	28657	3
	58	23805	337	76195	795227	469	204773	71422	131	28578	2
	59	24007	337	75993	795508	468	204492	71501	131	28499	1
32	0	24210	337	75790	795789	468	204211	71580	132	28420	32 0
	1	24412	337	75588	796070	468	203930	71658	132	28342	59
	2	24614	336	75386	796351	468	203649	71737	132	28263	58
	3	24816	336	75184	796632	468	203368	71817	132	28183	57
	4	25017	336	74983	796913	468	203087	71896	132	28104	56
	5	25219	336	74781	797194	468	202806	71975	132	28025	57 55
	6	25420	335	74580	797475	468	202525	72054	132	27946	54
	7	25622	335	74378	797755	468	202245	72133	132	27867	53
	8	25823	335	74177	798036	467	201964	72213	132	27787	52
	9	26024	335	73976	798316	467	201684	72292	132	27708	51
	10	26225	335	73775	798596	467	201404	72371	132	27629	50
	11	26426	334	73574	798877	467	201123	72451	132	27549	49
	12	26626	334	73374	799157	467	200843	72530	132	27470	48
	13	26827	334	73173	799437	467	200563	72610	132	27390	47
	14	27027	334	72973	799717	467	200283	72690	132	27310	46
	15	27228	334	72772	799997	467	200003	72769	132	27231	57 45
		Coa.	D.	Sec.	Cot.	D.	Tang.	Coa.	D.	Sine	°

32 1/2 Deg.		TABLE V.—LOG. SINUS, ETC.								33 Deg.	
°	Sine.	D.	Coec.	Tang.	D.	Cot.	Sec.	D.	Coa.		
	9'		10'	9'		10'	10'07		9'92		
32	15	727228	334	272772	799997	466	200003	2769	133	7231	45
	16	727428	333	272572	800277	466	199723	2849	133	7151	44
	17	727628	333	272372	800557	466	199443	2929	133	7071	43
	18	727828	333	272172	800836	466	199164	3009	133	6991	42
	19	728027	333	271973	801116	466	198884	3089	133	6911	41
	20	728227	333	271773	801396	466	198604	3169	133	6831	40
	21	728427	333	271573	801675	466	198325	3249	133	6751	39
	22	728626	332	271374	801955	466	198045	3329	133	6671	38
	23	728825	332	271175	802234	465	197766	3409	133	6591	37
32	24	729024	332	270976	802513	465	197487	3489	134	6511	36
	25	729223	331	270777	802792	465	197208	3569	134	6431	35
	26	729422	331	270578	803072	465	196928	3649	134	6351	34
	27	729621	331	270379	803351	465	196649	3730	134	6270	33
	28	729820	331	270180	803630	465	196370	3810	134	6190	32
	29	730018	330	269982	803908	465	196092	3890	134	6110	31
	30	730216	330	269784	804187	465	195813	3971	134	6029	30
	31	730415	330	269585	804466	464	195534	4051	134	5949	29
	32	730613	330	269387	804745	464	195255	4132	134	5868	28
32	33	730811	330	269189	805023	464	194977	4212	134	5788	27
	34	731009	329	268991	805302	464	194698	4293	134	5707	26
	35	731206	329	268794	805580	464	194420	4374	134	5626	25
	36	731404	329	268596	805859	464	194141	4455	134	5545	24
	37	731602	329	268398	806137	464	193863	4535	135	5465	23
	38	731799	329	268201	806415	463	193585	4616	135	5384	22
	39	731996	328	268004	806693	463	193307	4697	135	5303	21
	40	732193	328	267807	806971	463	193029	4778	135	5222	20
	41	732390	328	267610	807249	463	192751	4859	135	5141	19
32	42	732587	328	267413	807527	463	192473	4940	135	5060	18
	43	732784	328	267216	807805	463	192195	5021	135	4979	17
	44	732980	327	267020	808083	463	191917	5103	135	4897	16
	45	733177	327	266823	808361	463	191639	5184	135	4816	15
	46	733373	327	266627	808638	462	191362	5265	136	4735	14
	47	733569	327	266431	808916	462	191084	5346	136	4654	13
	48	733765	327	266235	809193	462	190807	5428	136	4572	12
	49	733961	326	266039	809471	462	190529	5509	136	4491	11
	50	734157	326	265843	809748	462	190252	5591	136	4409	10
32	51	734353	326	265647	810025	462	189975	5672	136	4328	9
	52	734549	326	265451	810302	462	189698	5754	136	4246	8
	53	734744	325	265256	810580	462	189420	5836	136	4164	7
	54	734939	325	265061	810857	462	189143	5917	136	4083	6
	55	735135	325	264865	811134	461	188866	5999	136	4001	5
	56	735330	325	264670	811410	461	188590	6081	136	3919	4
	57	735525	325	264475	811687	461	188313	6163	136	3837	3
	58	735719	324	264281	811964	461	188036	6245	137	3755	2
	59	735914	324	264086	812241	461	187759	6327	137	3673	1
	60	736109	324	263891	812517	461	187483	6409	137	3591	0
		Coa.	D.	Sec.	Cot.	D.	Tang.	Coa.	D.	Sine	

88 Deg.

TABLE V.—LOG. SINES, ETC.

88½ Deg.

°	'	Sine	D.	Cosec.	Tang.	D.	Cot.	Sec.	D.	Coa.	
		9'7		10'2	9'		10'	10'0		9'9	
32	0	36109		63891	812517	461	187483	76409		23591	60
	1	36303	324	63697	812794	461	187206	76491	137	23509	59
	2	36498	324	63502	813070	461	186930	76573	137	23427	58
	3	36692	324	63308	813347	460	186653	76655	137	23345	57
	4	36886	323	63114	813623	460	186377	76737	137	23263	56
	5	37080	323	62920	813899	460	186101	76819	137	23181	55
	6	37274	323	62726	814175	460	185825	76902	137	23098	54
	7	37467	323	62533	814452	460	185548	76984	137	23016	53
	8	37661	322	62339	814728	460	185272	77067	137	22933	56 52
	9	37855	322	62145	815004	460	184996	77149	137	22851	51
	10	38048	322	61952	815279	460	184721	77232	138	22768	50
	11	38241	322	61759	815555	459	184445	77314	138	22686	49
	12	38434	322	61566	815831	459	184169	77397	138	22603	48
	13	38627	322	61373	816107	459	183893	77480	138	22520	47
	14	38820	321	61180	816382	459	183618	77562	138	22438	46
	15	39013	321	60987	816658	459	183342	77645	138	22355	45
	16	39206	321	60794	816933	459	183067	77728	138	22272	44
	17	39398	321	60602	817209	459	182791	77811	138	22189	56 43
	18	39590	320	60410	817484	459	182516	77894	138	22106	42
	19	39783	320	60217	817759	459	182241	77977	138	22023	41
	20	39975	320	60025	818035	458	181965	78060	138	21940	40
	21	40167	320	59833	818310	458	181690	78143	139	21857	39
	22	40359	320	59641	818585	458	181415	78226	139	21774	38
	23	40550	320	59450	818860	458	181140	78309	139	21691	37
	24	40742	319	59258	819135	458	180865	78393	139	21607	36
	25	40934	319	59066	819410	458	180590	78476	139	21524	35
	26	41125	319	58875	819684	458	180316	78559	139	21441	56 34
	27	41316	319	58684	819959	458	180041	78643	139	21357	33
	28	41508	318	58492	820234	458	179766	78726	139	21274	32
	29	41699	318	58301	820508	457	179492	78810	139	21190	31
	30	41889	318	58111	820783	457	179217	78893	139	21107	30
	31	42080	318	57920	821057	457	178943	78977	139	21023	29
	32	42271	318	57729	821332	457	178668	79061	139	20939	28
	33	42462	317	57538	821606	457	178394	79144	140	20856	27
	34	42652	317	57348	821880	457	178120	79228	140	20772	26
	35	42842	317	57158	822154	457	177846	79312	140	20688	56 25
	36	43033	317	56967	822429	457	177571	79396	140	20604	24
	37	43223	317	56777	822703	457	177297	79480	140	20520	23
	38	43413	316	56587	822977	456	177023	79564	140	20436	22
	39	43602	316	56398	823250	456	176750	79648	140	20352	21
	40	43792	316	56208	823524	456	176476	79732	140	20268	20
	41	43982	316	56018	823798	456	176202	79816	140	20184	19
	42	44171	316	55829	824072	456	175928	79901	140	20099	18
	43	44361	315	55639	824345	456	175653	79985	140	20015	17
	44	44550	315	55450	824619	456	175378	80069	141	19931	16
	45	44739	315	55261	824893	456	175107	80154	141	19846	56 15
		Coa.	D.	Sec.	Cot.	D.	Tang.	Coa.	D.	Sine	°

87 Deg.

88½ Deg.

33½ Deg.		TABLE V.—LOG. SINES, ETC.								34½ Deg.	
°	Sine	D.	Co-sec.	Tang.	D.	Cot.	Sec.	D.	Coa.		
	9'		10'	9'		10'	10'c8		9'91		
33	45	744739	315	255261	824893	456	175107	0154	141	9846	15
	46	744928	315	255072	825166	456	174834	0238	141	9762	14
	47	745117	315	254883	825439	455	174561	0323	141	9677	13
	48	745306	314	254694	825713	455	174287	0407	141	9593	12
	49	745494	314	254506	825986	455	174014	0492	141	9508	11
	50	745683	314	254317	826259	455	173741	0576	141	9424	10
	51	745871	314	254129	826532	455	173468	0661	141	9339	9
	52	746059	314	253941	826805	455	173195	0746	141	9254	8
	53	746248	313	253752	827078	455	172922	0831	141	9169	56 7
33	54	746436	313	253564	827351	455	172649	0915	141	9085	6
	55	746624	313	253376	827624	455	172376	1000	141	9000	5
	56	746812	313	253188	827897	455	172103	1085	141	8915	4
	57	746999	313	253001	828170	454	171830	1170	142	8830	3
	58	747187	313	252813	828442	454	171558	1255	142	8745	2
	59	747374	312	252626	828715	454	171285	1341	142	8659	1
34	0	747562	312	252438	828987	454	171013	1426	142	8574	58 0
	1	747749	312	252251	829260	454	170740	1511	142	8489	59
	2	747936	312	252064	829532	454	170468	1596	142	8404	55 58
34	3	748123	311	251877	829805	454	170196	1682	142	8318	57
	4	748310	311	251690	830077	454	169923	1767	142	8233	56
	5	748497	311	251503	830349	453	169651	1853	142	8147	55
	6	748683	311	251317	830621	453	169379	1938	142	8062	54
	7	748870	311	251130	830893	453	169107	2024	142	7976	53
	8	749056	310	250944	831165	453	168835	2109	143	7891	52
	9	749243	310	250757	831437	453	168563	2195	143	7805	51
	10	749429	310	250571	831709	453	168291	2281	143	7719	50
	11	749615	310	250385	831981	453	168019	2366	143	7634	55 49
34	12	749801	310	250199	832253	453	167747	2452	143	7548	48
	13	749987	309	250013	832525	453	167475	2538	143	7462	47
	14	750172	309	249828	832796	453	167204	2624	143	7376	46
	15	750358	309	249642	833068	453	166932	2710	143	7290	45
	16	750543	309	249457	833339	452	166661	2796	143	7204	44
	17	750729	309	249271	833611	452	166389	2882	143	7118	43
	18	750914	308	249086	833882	452	166118	2968	144	7032	42
	19	751099	308	248901	834154	452	165846	3054	144	6946	41
	20	751284	308	248716	834425	452	165575	3141	144	6859	55 40
34	21	751469	308	248531	834696	452	165304	3227	144	6773	39
	22	751654	308	248346	834967	452	165033	3313	144	6687	38
	23	751839	308	248161	835238	452	164762	3400	144	6600	37
	24	752023	308	247977	835509	452	164491	3486	144	6514	36
	25	752208	307	247792	835780	451	164220	3573	144	6427	35
	26	752392	307	247608	836051	451	163949	3659	144	6341	34
	27	752576	307	247424	836322	451	163678	3746	144	6254	33
	28	752760	307	247240	836593	451	163407	3833	144	6167	32
	29	752944	306	247056	836864	451	163136	3919	145	6081	31
	30	753128	306	246872	837134	451	162866	4006	145	5994	58 30
		Coa.	D.	Sec.	Cot.	D.	Tang.	Coa.	D.	Sine	

34 1/2 Deg.

TABLE V.—LOG. SINES, ETC.

35 1/2 Deg.

°	Sine	D.	Cosec.	Tang.	D.	Cot.	Sec.	D.	Co.	°	
	9'		10'	9'		10'	10'08		9'91		
34	30	753128	306	246872	837134	451	162866	4006	145	5994	30
	31	753312	306	246688	837405	451	162595	4093	145	5907	29
	32	753495	306	246505	837675	451	162325	4180	145	5820	28
	33	753679	306	246321	837946	451	162054	4267	145	5733	27
	34	753862	305	246138	838216	451	161784	4354	145	5646	26
	35	754046	305	245954	838487	450	161513	4441	145	5559	25
	36	754229	305	245771	838757	450	161243	4528	145	5472	24
	37	754412	305	245588	839027	450	160973	4615	145	5385	23
	38	754595	305	245405	839297	450	160703	4703	145	5297	55 22
34	39	754778	304	245222	839568	450	160432	4790	145	5210	21
	40	754960	304	245040	839838	450	160162	4877	146	5123	20
	41	755143	304	244857	840108	450	159892	4965	146	5035	19
	42	755326	304	244674	840378	450	159622	5052	146	4948	18
	43	755508	304	244492	840647	450	159353	5140	146	4860	17
	44	755690	304	244310	840917	449	159083	5227	146	4773	16
	45	755872	303	244128	841187	449	158813	5315	146	4685	15
	46	756054	303	243946	841457	449	158543	5402	146	4598	14
	47	756236	303	243764	841726	449	158274	5490	146	4510	55 13
34	48	756418	303	243582	841996	449	158004	5578	146	4422	12
	49	756600	303	243400	842266	449	157734	5666	146	4334	11
	50	756782	302	243218	842535	449	157465	5754	147	4246	10
	51	756963	302	243037	842805	449	157195	5842	147	4158	9
	52	757144	302	242856	843074	449	156926	5930	147	4070	8
	53	757326	302	242674	843343	449	156657	6018	147	3982	7
	54	757507	302	242493	843612	449	156388	6106	147	3894	6
	55	757688	301	242312	843882	448	156118	6194	147	3806	5
	56	757869	301	242131	844151	448	155849	6282	147	3718	55 4
34	57	758050	301	241950	844420	448	155580	6370	147	3630	3
	58	758230	301	241770	844689	448	155311	6459	147	3541	2
	59	758411	301	241589	844958	448	155042	6547	147	3453	1
35	0	758591	301	241409	845227	448	154773	6635	147	3365	55 0
	1	758772	300	241228	845496	448	154504	6724	147	3276	59
	2	758952	300	241048	845764	448	154236	6813	147	3187	58
	3	759132	300	240868	846033	448	153967	6901	148	3099	57
	4	759312	300	240688	846302	448	153698	6990	148	3010	56
	5	759492	300	240508	846570	447	153430	7078	148	2922	54 55
35	6	759672	299	240328	846839	447	153161	7167	148	2833	54
	7	759852	299	240148	847107	447	152893	7256	148	2744	53
	8	760031	299	239969	847376	447	152624	7345	148	2655	52
	9	760211	299	239789	847644	447	152356	7434	148	2566	51
	10	760390	299	239610	847913	447	152087	7523	148	2477	50
	11	760569	298	239431	848181	447	151819	7612	148	2388	49
	12	760748	298	239252	848449	447	151551	7701	149	2299	48
	13	760927	298	239073	848717	447	151283	7790	149	2210	47
	14	761106	298	238894	848986	447	151014	7879	149	2121	46
	15	761285	298	238715	849254	447	150746	7969	149	2031	54 45
		Co.	D.	Sec.	Cot.	D.	Tang.	Co.	D.	Sine	

55 1/2 Deg.

54 1/2 Deg.

35½ Deg. TABLE V.—Loc. Sines, etc. 36 Deg.

		Sine	D.	Cosec.	Tang.	D.	Cot.	Sec.	D.	Coa.	
		97		102	97		101	100		99	
35	15	61285		38715	849254	447	150746	87969		12031	45
	16	61464	298	38536	849522	447	150478	88058	149	11942	44
	17	61642	298	38358	849790	446	150210	88147	149	11853	43
	18	61821	297	38179	850058	446	149942	88237	149	11763	42
	19	61999	297	38001	850325	446	149675	88326	149	11674	41
	20	62177	297	37823	850593	446	149407	88416	149	11584	40
	21	62356	297	37644	850861	446	149139	88505	149	11495	39
	22	62534	297	37466	851129	446	148871	88595	149	11405	38
	23	62712	296	37288	851396	446	148604	88685	149	11315	37
35	24	62889	296	37111	851664	446	148336	88774	150	11226	36
	25	63067	296	36933	851931	446	148069	88864	150	11136	35
	26	63245	296	36755	852199	446	147801	88954	150	11046	34
	27	63422	296	36578	852466	446	147534	89044	150	10956	33
	28	63600	295	36400	852733	445	147267	89134	150	10866	32
	29	63777	295	36223	853001	445	146999	89224	150	10776	31
	30	63954	295	36046	853268	445	146732	89314	150	10686	30
	31	64131	295	35869	853535	445	146465	89404	150	10596	29
	32	64308	295	35692	853802	445	146198	89494	150	10506	28
35	33	64485	294	35515	854069	445	145931	89585	150	10415	27
	34	64662	294	35338	854336	445	145664	89675	151	10325	26
	35	64838	294	35162	854603	445	145397	89765	151	10235	25
	36	65015	294	34985	854870	445	145130	89856	151	10144	24
	37	65191	294	34809	855137	445	144863	89946	151	10054	23
	38	65367	294	34633	855404	445	144596	90037	151	9963	22
	39	65544	293	34456	855671	444	144329	90127	151	9873	21
	40	65720	293	34280	855938	444	144062	90218	151	9782	20
	41	65896	293	34104	856204	444	143796	90309	151	9691	19
35	42	66072	293	33928	856471	444	143529	90399	151	9601	18
	43	66247	293	33753	856737	444	143263	90490	151	9510	17
	44	66423	293	33577	857004	444	142996	90581	151	9419	16
	45	66598	293	33402	857270	444	142730	90672	152	9328	15
	46	66774	292	33226	857537	444	142463	90763	152	9237	14
	47	66949	292	33051	857803	444	142197	90854	152	9146	13
	48	67124	292	32876	858069	444	141931	90945	152	9055	12
	49	67300	292	32700	858336	444	141664	91036	152	8964	11
	50	67475	291	32525	858602	443	141398	91127	152	8873	10
35	51	67649	291	32351	858868	443	141132	91219	152	8781	9
	52	67824	291	32176	859134	443	140866	91310	152	8690	8
	53	67999	291	32001	859400	443	140600	91401	152	8599	7
	54	68173	291	31827	859666	443	140334	91493	152	8507	6
	55	68348	290	31652	859932	443	140068	91584	153	8416	5
	56	68522	290	31478	860198	443	139802	91676	153	8324	4
	57	68697	290	31303	860464	443	139536	91767	153	8233	3
	58	68871	290	31129	860730	443	139270	91859	153	8141	2
	59	69045	290	30955	860995	443	139005	91951	153	8049	1
	60	69219	290	30781	861261	443	138739	92042	153	7958	0
		Con.	D.	Sec.	Cot.	D.	Tang.	Con.	D.	Sine	'

54½ Deg.

54 Deg.

36½ Deg.		TABLE V.—LOG. SINES, ETC.						37½ Deg.		
•	Sine	D.	Cosec.	Tang.	D.	Cot.	Sec.	D.	Coa.	
	9'7		10'2	9'8		10'1	10'		9'	
36	45 76937	282	23063	73167	439	26833	096230	157	903770	13
	46 77106	282	22894	73430	439	26570	c96324	157	903676	14
	47 77275	281	22725	73694	439	26306	c96419	157	903581	13
	48 77444	281	22556	73957	439	26043	096513	157	903487	12
	49 77613	281	22387	74220	439	25780	096608	157	903392	11
	50 77781	281	22219	74484	439	25516	096702	158	903298	10
	51 77950	281	22050	74747	439	25253	096797	158	903203	9
	52 78119	281	21881	75010	439	24990	096892	158	903108	8
	53 78287	280	21713	75273	438	24727	096986	158	903014	53 7
36	54 78455	280	21545	75536	438	24464	c97081	158	902919	6
	55 78624	280	21376	75800	438	24200	097176	158	902824	5
	56 78792	280	21208	76063	438	23937	c97271	158	902729	4
	57 78960	280	21040	76326	438	23674	097366	158	902634	3
	58 79128	280	20872	76589	438	23411	c97461	158	902539	2
	59 79295	279	20705	76851	438	23149	097556	159	902444	1
37	0 79463	279	20537	77114	438	22886	c97651	159	902349	53 0
	1 79631	279	20369	77377	438	22623	c97747	159	902253	59
	2 79798	279	20202	77640	438	22360	097842	159	902158	52 58
37	3 79966	279	20034	77903	438	22097	097937	159	902063	57
	4 80133	279	19867	78165	438	21835	098033	159	901967	56
	5 80300	278	19700	78428	438	21572	098128	159	901872	55
	6 80467	278	19533	78691	438	21309	c98224	159	901776	54
	7 80634	278	19366	78953	438	21047	098319	159	901681	53
	8 80801	278	19199	79216	437	20784	098415	159	901585	52
	9 80968	278	19032	79478	437	20522	098510	159	901490	51
	10 81134	278	18866	79741	437	20259	098606	160	901394	50
	11 81301	277	18699	80003	437	19997	098702	160	901298	52 49
37	12 81468	277	18532	80265	437	19735	c98798	160	901202	48
	13 81634	277	18366	80528	437	19472	098894	160	901106	47
	14 81800	277	18200	80790	437	19210	098990	160	901010	46
	15 81966	277	18034	81052	437	18948	099086	160	900914	45
	16 82132	277	17868	81314	437	18686	099182	160	900818	44
	17 82298	277	17702	81576	437	18424	c99278	160	900722	43
	18 82464	276	17536	81839	437	18161	099374	160	900626	42
	19 82630	276	17370	82101	437	17899	099471	160	900529	41
	20 82796	276	17204	82363	436	17637	099567	161	900433	52 40
37	21 82961	276	17039	82625	436	17375	c99663	161	900337	39
	22 83127	276	16873	82887	436	17113	099756	161	900240	38
	23 83292	275	16708	83148	436	16852	099850	161	900144	37
	24 83458	275	16542	83410	436	16590	099953	161	900047	36
	25 83623	275	16377	83672	436	16328	100049	161	899951	35
	26 83788	275	16212	83934	436	16066	100146	161	899854	34
	27 83953	275	16047	84196	436	15804	100243	161	899757	33
	28 84118	275	15882	84457	436	15543	100340	161	899660	32
	29 84282	275	15718	84719	436	15281	100436	161	899564	31
	30 84447	274	15553	84980	436	15020	100533	161	899467	52 30
	Coa.	D.	Sec.	Cot.	D.	Tang.	Coa.	D.	Sine	•

37½ Deg.		TABLE V.—LOG. SINES, ETC.								38½ Deg.	
°	'	Sine	D.	Consec.	Tang.	D.	Cot.	Sec.	D.	Cos.	
		9'		10'	9'		10'	10'10		9'89	
37	30	784447	274	215553	884980	436	115020	0533	162	9467	30
	31	784612	274	215388	885242	436	114758	0630	162	9370	29
	32	784776	274	215224	885503	436	114497	0727	162	9273	28
	33	784941	274	215059	885765	436	114235	0824	162	9176	27
	34	785105	274	214895	886026	436	113974	0922	162	9078	26
	35	785269	274	214731	886288	436	113712	1019	162	8981	25
	36	785433	273	214567	886549	436	113451	1116	162	8884	24
	37	785597	273	214403	886810	435	113190	1213	162	8787	23
	38	785761	273	214239	887072	435	112928	1311	162	8689	52 22
37	39	785925	273	214075	887333	435	112667	1408	162	8592	21
	40	786089	273	213911	887594	435	112406	1506	163	8494	20
	41	786252	272	213748	887855	435	112145	1603	163	8397	19
	42	786416	272	213584	888116	435	111884	1701	163	8299	18
	43	786579	272	213421	888377	435	111623	1798	163	8202	17
	44	786742	272	213258	888639	435	111361	1896	163	8104	16
	45	786906	272	213094	888900	435	111100	1994	163	8006	15
	46	787069	272	212931	889160	435	110840	2092	163	7908	14
	47	787232	271	212768	889421	435	110579	2190	163	7810	52 13
37	48	787395	271	212605	889682	435	110318	2288	163	7712	12
	49	787557	271	212443	889943	435	110057	2386	163	7614	11
	50	787720	271	212280	890204	434	109796	2484	163	7516	10
	51	787883	271	212117	890465	434	109535	2582	164	7418	9
	52	788045	271	211955	890725	434	109275	2680	164	7320	8
	53	788208	271	211792	890986	434	109014	2778	164	7222	7
	54	788370	270	211630	891247	434	108753	2877	164	7123	6
	55	788532	270	211468	891507	434	108493	2975	164	7025	5
	56	788694	270	211306	891768	434	108232	3074	164	6926	52 4
37	57	788856	270	211144	892028	434	107972	3172	164	6828	3
	58	789018	270	210982	892289	434	107711	3271	164	6729	2
	59	789180	270	210820	892549	434	107451	3369	164	6631	1
38	0	789342	269	210658	892810	434	107190	3468	164	6532	52 0
	1	789504	269	210496	893070	434	106930	3567	165	6433	59
	2	789665	269	210335	893331	434	106669	3665	165	6335	58
	3	789827	269	210173	893591	434	106409	3764	165	6236	57
	4	789988	269	210012	893851	434	106149	3863	165	6137	56
	5	790149	269	209851	894111	434	105889	3962	165	6038	51 55
38	6	790310	268	209690	894371	434	105629	4061	165	5939	54
	7	790471	268	209529	894632	433	105368	4160	165	5840	53
	8	790632	268	209368	894892	433	105108	4259	165	5741	52
	9	790793	268	209207	895152	433	104848	4359	165	5641	51
	10	790954	268	209046	895412	433	104588	4458	165	5542	50
	11	791115	268	208885	895672	433	104328	4557	166	5443	49
	12	791275	267	208725	895932	433	104068	4657	166	5343	48
	13	791436	267	208564	896192	433	103808	4756	166	5244	47
	14	791596	267	208404	896452	433	103548	4855	166	5145	46
	15	791757	267	208243	896712	433	103288	4955	166	5045	52 45
		Cos.	D.	Sec.	Cot.	D.	Tang.	Cos.	D.	Sine	

52½ Deg.

51½ Deg.

38½ Deg.

TABLE V.—LOG. SINES, ETC.

89 Deg.

°	Sine	D.	Cosec.	Tang.	D.	Cot.	Sec.	D.	Cos.	°
	9'		10'	9'		10'	10-10		9-89	
38 15	791757	267	208243	896712	433	103288	4955	166	5045	45
16	791917	267	208083	896971	433	103029	5055	166	4945	44
17	792077	267	207923	897231	433	102769	5154	166	4846	43
18	792237	266	207763	897491	433	102509	5254	166	4746	42
19	792397	266	207603	897751	433	102249	5354	166	4646	41
20	792557	266	207443	898010	433	101990	5454	166	4546	40
21	792716	266	207284	898270	433	101730	5554	167	4446	39
22	792876	266	207124	898530	433	101470	5654	167	4346	38
23	793035	266	206965	898789	433	101211	5754	167	4246	51 37
38 24	793195	265	206805	899049	432	100951	5854	167	4146	36
25	793354	265	206646	899308	432	100692	5954	167	4046	35
26	793514	265	206486	899568	432	100432	6054	167	3946	34
27	793673	265	206327	899827	432	100173	6154	167	3846	33
28	793832	265	206168	900086	432	99914	6255	167	3745	32
29	793991	265	206009	900346	432	99654	6355	167	3645	31
30	794150	264	205850	900605	432	99395	6456	167	3544	30
31	794308	264	205692	900864	432	99136	6556	168	3444	29
32	794467	264	205533	901124	432	98876	6657	168	3343	51 28
38 33	794626	264	205374	901383	432	98617	6757	168	3243	27
34	794784	264	205216	901642	432	98358	6858	168	3142	26
35	794942	264	205058	901901	432	98099	6959	168	3041	25
36	795101	264	204899	902160	432	97840	7060	168	2940	24
37	795259	263	204741	902419	432	97581	7161	168	2839	23
38	795417	263	204583	902679	432	97322	7261	168	2739	22
39	795575	263	204425	902938	432	97062	7362	168	2638	21
40	795733	263	204267	903197	431	96803	7464	168	2536	20
41	795891	263	204109	903455	431	96545	7565	169	2435	51 19
38 42	796049	263	203951	903714	431	96286	7666	169	2334	18
43	796206	263	203794	903973	431	96027	7767	169	2233	17
44	796364	262	203636	904232	431	95768	7868	169	2132	16
45	796521	262	203479	904491	431	95509	7970	169	2030	15
46	796679	262	203321	904750	431	95250	8071	169	1929	14
47	796836	262	203164	905008	431	94992	8173	169	1827	13
48	796993	262	203007	905267	431	94733	8274	169	1726	12
49	797150	261	202850	905526	431	94474	8376	169	1624	11
50	797307	261	202693	905784	431	94216	8477	170	1523	51 10
38 51	797464	261	202536	906043	431	93957	8579	170	1421	9
52	797621	261	202379	906302	431	93698	8681	170	1319	8
53	797777	261	202223	906560	431	93440	8783	170	1217	7
54	797934	261	202066	906819	431	93181	8885	170	1115	6
55	798091	261	201909	907077	431	92923	8987	170	1013	5
56	798247	261	201753	907336	431	92664	9089	170	0911	4
57	798403	260	201597	907594	431	92406	9191	170	0809	3
58	798560	260	201440	907852	431	92148	9293	170	0707	2
59	798716	260	201284	908111	431	91889	9395	170	0605	1
60	798872	260	201128	908369	430	91631	9497	170	0503	51 0
	Con.	D.	Sec.	Cot.	D.	Tang.	Con.	D.	Sine	

51½ Deg.

51 Deg.

39 Deg.		TABLE V.—LOG. SINES, ETC.								39½ Deg.	
°	'	Sine	D.	Co-sec.	Tang.	D.	Cot.	Sec.	D.	Co-s.	
		9'		10'	9'		10'	10'		9'	
39	0	798872		201128	08369		91631	09497		90503	60
	1	799028	260	200972	08628	430	91372	09700	170	90400	59
	2	799184	260	200816	08886	430	91114	09902	171	90298	58
	3	799339	260	200661	09144	430	90856	09805	171	90195	57
	4	799495	259	200505	09402	430	90598	09907	171	90093	56
	5	799651	259	200349	09660	430	90340	10010	171	89990	55
	6	799806	259	200194	09918	430	90082	10112	171	89888	54
	7	799962	259	200038	10177	430	89823	10215	171	89785	53
	8	800117	259	199883	10435	430	89565	10318	171	89682	52
	9	800272	258	199728	10693	430	89307	10421	171	89579	51
39	10	800427	258	199573	10951	430	89049	10523	171	89477	50
	11	800582	258	199418	11209	430	88791	10626	171	89374	49
	12	800737	258	199263	11467	430	88533	10729	172	89271	48
	13	800892	258	199108	11724	430	88276	10832	172	89168	47
	14	801047	258	198953	11982	430	88018	10936	172	89064	46
	15	801201	258	198799	12240	430	87760	11039	172	88961	45
	16	801356	257	198644	12498	430	87502	11142	172	88858	44
	17	801511	257	198489	12756	430	87244	11245	172	88755	50 43
	18	801665	257	198335	13014	429	86986	11349	172	88651	42
	19	801819	257	198181	13271	429	86729	11452	172	88548	41
	20	801973	257	198027	13529	429	86471	11556	172	88444	40
	21	802128	257	197872	13787	429	86213	11659	173	88341	39
	22	802282	256	197718	14044	429	85956	11763	173	88237	38
	23	802436	256	197564	14302	429	85698	11866	173	88134	37
	24	802589	256	197411	14560	429	85440	11970	173	88030	36
	25	802743	256	197257	14817	429	85183	12074	173	87926	35
	26	802897	256	197103	15075	429	84925	12178	173	87822	50 34
	27	803050	256	196950	15332	429	84668	12282	173	87718	33
	28	803204	256	196796	15590	429	84410	12386	173	87614	32
	29	803357	255	196643	15847	429	84153	12490	173	87510	31
	30	803511	255	196489	16104	429	83896	12594	173	87406	30
	31	803664	255	196336	16362	429	83638	12698	174	87302	29
	32	803817	255	196183	16619	429	83381	12802	174	87198	28
	33	803970	255	196030	16877	429	83123	12907	174	87093	27
	34	804123	255	195877	17134	429	82866	13011	174	86989	26
	35	804276	254	195724	17391	429	82609	13115	174	86885	50 25
	36	804428	254	195572	17648	429	82352	13220	174	86780	24
	37	804581	254	195419	17905	429	82095	13324	174	86676	23
	38	804734	254	195266	18163	428	81837	13429	174	86571	22
	39	804886	254	195114	18420	428	81580	13534	174	86466	21
	40	805039	254	194961	18677	428	81323	13638	174	86362	20
	41	805191	254	194809	18934	428	81066	13743	175	86257	19
	42	805343	254	194657	19191	428	80809	13848	175	86152	18
	43	805495	253	194505	19448	428	80552	13953	175	86047	17
	44	805647	253	194353	19705	428	80295	14058	175	85942	16
	45	805799	253	194201	19962	428	80038	14163	175	85837	50 15
		Co-s.	D.	Sec.	Cot.	D.	Tang.	Co-s.	D.	Sine	°

39½ Deg		TABLE V.—Loc. SINES, ETC.								40½ Deg.	
°	Sine	D.	Cocec.	Tang.	D.	Cot.	Sec.	D.	Coa.		
	9'		10'	9'		10'	10' 11		9' 8 8		
39	45	805799	253	194201	919962	428	080038	4163	175	5837	15
	46	805951	253	194049	920219	428	079781	4268	175	5732	14
	47	806103	253	193897	920476	428	079524	4373	175	5627	13
	48	806254	253	193746	920733	428	079267	4478	175	5522	12
	49	806406	252	193594	920990	428	079010	4584	175	5416	11
	50	806557	252	193443	921247	428	078753	4689	176	5311	10
	51	806709	252	193291	921503	428	078497	4795	176	5205	9
	52	806860	252	193140	921760	428	078240	4900	176	5100	8
	53	807011	252	192989	922017	428	077983	5006	176	4994	50 7
39	54	807163	252	192837	922274	428	077726	5111	176	4889	6
	55	807314	252	192686	922530	428	077470	5217	176	4783	5
	56	807465	251	192535	922787	428	077213	5323	176	4677	4
	57	807615	251	192385	923044	428	076956	5428	176	4572	3
	58	807766	251	192234	923300	428	076700	5534	176	4466	2
	59	807917	251	192083	923557	427	076443	5640	176	4360	1
40	0	808067	251	191933	923813	427	076187	5746	177	4254	50 0
	1	808218	251	191782	924070	427	075930	5852	177	4148	59
	2	808368	251	191631	924327	427	075673	5958	177	4042	49 58
40	3	808519	250	191481	924583	427	075417	6064	177	3936	57
	4	808669	250	191331	924840	427	075160	6171	177	3829	56
	5	808819	250	191181	925096	427	074904	6277	177	3723	55
	6	808969	250	191031	925352	427	074648	6383	177	3617	54
	7	809119	250	190881	925609	427	074391	6490	177	3510	53
	8	809269	250	190731	925865	427	074135	6596	177	3404	52
	9	809419	249	190581	926122	427	073878	6703	177	3297	51
	10	809569	249	190431	926378	427	073622	6809	178	3191	50
	11	809718	249	190282	926634	427	073366	6916	178	3084	49 49
40	12	809868	249	190132	926890	427	073110	7023	178	2977	48
	13	810017	249	189983	927147	427	072853	7129	178	2871	47
	14	810167	249	189833	927403	427	072597	7236	178	2764	46
	15	810316	248	189684	927659	427	072341	7343	178	2657	45
	16	810465	248	189535	927915	427	072085	7450	178	2550	44
	17	810614	248	189386	928171	427	071829	7557	178	2443	43
	18	810763	248	189237	928427	427	071573	7664	179	2336	42
	19	810912	248	189088	928683	427	071317	7771	179	2229	41
	20	811061	248	188939	928940	427	071060	7879	179	2121	40 40
40	21	811210	248	188790	929196	427	070804	7986	179	2014	39
	22	811358	247	188642	929452	427	070548	8093	179	1907	38
	23	811507	247	188493	929708	427	070292	8201	179	1799	37
	24	811655	247	188345	929964	426	070036	8308	179	1692	36
	25	811804	247	188196	930220	426	069780	8416	179	1584	35
	26	811952	247	188048	930475	426	069525	8523	179	1477	34
	27	812100	247	187900	930731	426	069269	8631	179	1369	33
	28	812248	247	187752	930987	426	069013	8739	180	1261	32
	29	812396	246	187604	931243	426	068757	8847	180	1153	31
	30	812544	246	187456	931499	426	068501	8954	180	1046	40 30
		Con.	D.	Sec.	Cot.	D.	Tang.	Con.	D.	Sine	
50½ Deg.										49½ Deg.	

42 Dog.

TABLE V.—LOS SIERRA, MEX.

42 Dog.

°	Size	D.	Coec.		D.	Oot.		D.	Coa.	
			10'1	9'9		10'0	10'1			
42 0	25511	234	74489	54437	423	45563	28927	190	71073	60
1	25651	233	74349	54691	423	45309	29040	190	70960	59
2	25791	233	74209	54945	423	45055	29154	190	70846	58
3	25931	233	74069	55200	423	44800	29268	190	70732	57
4	26071	233	73929	55454	423	44546	29382	190	70618	56
5	26211	233	73789	55707	423	44293	29496	190	70504	55
6	26351	233	73649	55961	423	44039	29610	190	70390	54
7	26491	233	73509	56215	423	43785	29724	190	70276	53
8	26631	233	73369	56469	423	43531	29839	190	70161	47 52
42 9	26770	232	73230	56723	423	43277	29953	191	70047	51
10	26910	232	73090	56977	423	43023	30067	191	69933	50
11	27049	232	72951	57231	423	42769	30182	191	69818	49
12	27189	232	72811	57485	423	42515	30296	191	69704	48
13	27328	232	72672	57739	423	42261	30411	191	69589	47
14	27467	232	72533	57993	423	42007	30526	191	69474	46
15	27606	232	72394	58246	423	41754	30640	191	69360	45
16	27745	232	72255	58500	423	41500	30755	191	69245	44
17	27884	231	72116	58754	423	41246	30870	191	69130	47 43
42 18	28023	231	71977	59008	423	40992	30985	192	69015	42
19	28162	231	71838	59262	423	40738	31100	192	68900	41
20	28301	231	71699	59516	423	40484	31215	192	68785	40
21	28440	231	71561	59769	423	40231	31330	192	68670	39
22	28578	231	71422	60023	423	39977	31445	192	68555	38
23	28716	231	71284	60277	423	39723	31560	192	68440	37
24	28855	230	71145	60531	423	39469	31676	192	68324	36
25	28993	230	71007	60784	423	39216	31791	192	68209	35
26	29131	230	70869	61038	423	38962	31907	192	68093	47 34
42 27	29269	230	70731	61291	423	38709	32022	193	67978	33
28	29407	230	70593	61545	423	38455	32138	193	67862	32
29	29545	230	70455	61799	423	38201	32253	193	67747	31
30	29683	230	70317	62052	423	37948	32369	193	67631	30
31	29821	229	70179	62306	423	37694	32485	193	67515	29
32	29959	229	70041	62560	423	37440	32601	193	67399	28
33	30097	229	69903	62813	423	37187	32717	193	67283	27
34	30234	229	69766	63067	423	36933	32833	193	67167	26
35	30372	229	69628	63320	423	36680	32949	193	67051	47 25
42 36	30509	229	69491	63574	423	36426	33065	194	66935	24
37	30646	229	69354	63827	423	36173	33181	194	66819	23
38	30784	229	69216	64081	423	35919	33297	194	66703	22
39	30921	228	69079	64335	423	35665	33414	194	66586	21
40	31058	228	68942	64588	422	35412	33530	194	66470	20
41	31195	228	68805	64842	422	35158	33647	194	66353	19
42	31332	228	68668	65095	422	34905	33763	194	66237	18
43	31469	228	68531	65349	422	34651	33880	194	66120	17
44	31606	228	68394	65602	422	34398	33996	194	66004	16
45	31742		68258	65855	422	34145	34113	195	65887	15

42 Dog.

42 Dog.

49° Deg.

TABLE V.—Loc. SINUS, &c.

49° Deg.

°	Sine	D.	Coec. Tang.		D.	Cot. Sec.		D.	Cot.	D.	Cot.
			10:1	9:9		10:0	10:1				
42	31742	228	68258	63855	422	34145	34113	195	65887	18	18
46	31879	228	68121	66109	422	33891	34230	195	65770	14	14
47	32015	227	67985	66362	422	33638	34347	195	65653	13	13
48	32152	227	67848	66616	422	33384	34464	195	65536	12	12
49	32288	227	67712	66869	422	33131	34581	195	65419	11	11
50	32425	227	67575	67123	422	32877	34698	195	65302	10	10
51	32561	227	67439	67376	422	32624	34815	195	65185	9	9
52	32697	227	67303	67629	422	32371	34932	195	65068	8	8
53	32833	227	67167	67883	422	32117	35050	195	64950	47	7
42	32969	226	67031	68136	422	31864	35167	196	64833	6	6
55	33105	226	66895	68389	422	31611	35284	196	64716	5	5
56	33241	226	66759	68643	422	31357	35402	196	64598	4	4
57	33377	226	66623	68896	422	31104	35519	196	64481	3	3
58	33512	226	66488	69149	422	30851	35637	196	64363	2	2
59	33648	226	66352	69403	422	30597	35755	196	64245	1	1
43	33783	226	66217	69656	422	30344	35873	196	64127	47	0
1	33919	225	66081	69909	422	30091	35990	196	64010	59	59
2	34054	225	65946	70162	422	29838	36108	197	63892	46	58
43	34189	225	65811	70416	422	29584	36226	197	63774	57	57
4	34325	225	65675	70669	422	29331	36344	197	63656	56	56
5	34460	225	65540	70922	422	29078	36462	197	63538	55	55
6	34595	225	65405	71175	422	28825	36581	197	63419	54	54
7	34730	225	65270	71429	422	28571	36699	197	63301	53	53
8	34865	225	65135	71682	422	28318	36817	197	63183	52	52
9	34999	224	65000	71935	422	28065	36936	197	63064	51	51
10	35134	224	64866	72188	422	27812	37054	198	62946	50	50
11	35269	224	64731	72441	422	27559	37173	198	62827	46	49
43	35403	224	64597	72694	422	27306	37291	198	62709	48	48
13	35538	224	64462	72948	422	27052	37410	198	62590	47	47
14	35672	224	64328	73201	422	26799	37529	198	62471	46	46
15	35807	224	64193	73454	422	26546	37647	198	62353	45	45
16	35941	224	64059	73707	422	26293	37766	198	62234	44	44
17	36075	223	63925	73960	422	26040	37885	198	62115	43	43
18	36209	223	63791	74213	422	25787	38004	198	61996	42	42
19	36343	223	63657	74466	422	25534	38123	198	61877	41	41
20	36477	223	63523	74719	422	25281	38242	199	61758	46	40
43	36611	223	63389	74973	422	25027	38361	199	61638	39	39
21	36745	223	63255	75226	422	24774	38481	199	61519	38	38
22	36878	223	63122	75479	422	24521	38600	199	61400	37	37
23	37012	222	62988	75732	422	24268	38720	199	61280	36	36
24	37146	222	62854	75985	422	24015	38839	199	61161	35	35
25	37279	222	62721	76238	422	23762	38959	199	61041	34	34
26	37412	222	62588	76491	422	23509	39078	199	60922	33	33
27	37546	222	62454	76744	422	23256	39198	199	60802	32	32
28	37679	222	62321	76997	422	23003	39318	199	60682	31	31
29	37812	222	62188	77250	422	22750	39438	200	60562	40	30

47° Deg.

48° Deg.

48½ Deg. TABLE V.—LOG. SINES, ETC. 44½ Deg.

•	Sine		Cos.		Tang.		D.		Cot.		Sec.		D.		Cot.	
	9°8'	D.	10°1'	9°9'	10°0'	10°1'							9°8'			
30	37812	222	62188	77250	422	22750	39438	200	60562	30						
31	37945	222	62055	77503	422	22497	39558	200	60442	29						
32	38078	221	61922	77756	422	22244	39678	200	60322	28						
33	38211	221	61789	78009	422	21991	39798	200	60202	27						
34	38344	221	61656	78262	422	21738	39918	200	60082	26						
35	38477	221	61523	78515	422	21485	40038	200	59962	25						
36	38610	221	61390	78768	422	21232	40158	200	59842	24						
37	38742	221	61258	79021	422	20979	40279	201	59721	23						
38	38875	221	61125	79274	422	20726	40399	201	59601	46 22						
39	39007	221	60993	79527	422	20473	40520	201	59480	21						
40	39140	220	60860	79780	422	20220	40640	201	59360	20						
41	39272	220	60728	80033	422	19967	40761	201	59239	19						
42	39404	220	60596	80286	422	19714	40881	201	59119	18						
43	39536	220	60464	80538	422	19462	41002	201	58998	17						
44	39668	220	60332	80791	422	19209	41123	201	58877	16						
45	39800	220	60200	81044	421	18956	41244	202	58756	15						
46	39932	220	60068	81297	421	18703	41365	202	58635	14						
47	40064	219	59936	81550	421	18450	41486	202	58514	46 13						
48	40196	219	59804	81803	421	18197	41607	202	58393	12						
49	40328	219	59672	82056	421	17944	41728	202	58272	11						
50	40459	219	59541	82309	421	17691	41849	202	58151	10						
51	40591	219	59409	82562	421	17438	41971	202	58029	9						
52	40722	219	59278	82814	421	17186	42092	202	57908	8						
53	40854	219	59146	83067	421	16933	42214	202	57786	7						
54	40985	219	59015	83320	421	16680	42335	203	57665	6						
55	41116	218	58884	83573	421	16427	42457	203	57543	5						
56	41247	218	58753	83826	421	16174	42578	203	57422	46 4						
57	41378	218	58622	84079	421	15921	42700	203	57300	3						
58	41509	218	58491	84331	421	15669	42822	203	57178	2						
59	41640	218	58360	84584	421	15416	42944	203	57056	1						
44 0	41771	218	58229	84837	421	15163	43066	203	56934	48 0						
1	41902	218	58098	85090	421	14910	43188	203	56812	59						
2	42033	218	57967	85343	421	14657	43310	204	56690	58						
3	42163	217	57837	85596	421	14404	43432	204	56568	57						
4	42294	217	57706	85848	421	14152	43554	204	56446	56						
5	42424	217	57576	86101	421	13899	43677	204	56323	45 55						
44 6	42555	217	57445	86354	421	13646	43799	204	56201	54						
7	42685	217	57315	86607	421	13393	43922	204	56078	53						
8	42815	217	57185	86860	421	13140	44044	204	55956	52						
9	42946	217	57054	87112	421	12888	44167	204	55833	51						
10	43076	217	56924	87365	421	12635	44289	205	55711	50						
11	43206	216	56794	87618	421	12382	44412	205	55588	49						
12	43336	216	56664	87871	421	12129	44535	205	55465	48						
13	43466	216	56534	88123	421	11877	44658	205	55342	47						
14	43595	216	56405	88376	421	11624	44781	205	55219	46						
15	43725	216	56275	88629	421	11371	44904	205	55096	45 45						

44½ Deg.		TABLE V.—LOG. SINUS, ETC.						45 Deg.		
•	Sine	D.	Coacc.	Tang.	D.	Col.	Sec.	D.	Con.	•
	9°84		10'1	10'0		10'1	9'8			
15	3725	216	56275	9'988629	421	11371	44904	205	55096	45
16	3855	216	56145	9'988882	421	11118	45027	205	54973	44
17	3984	216	56016	9'989134	421	10866	45150	205	54850	43
18	4114	215	55886	9'989387	421	10613	45273	206	54727	42
19	4243	215	55757	9'989640	421	10360	45397	206	54603	41
20	4372	215	55628	9'989893	421	10107	45520	206	54480	40
21	4502	215	55498	9'990145	421	09855	45644	206	54356	39
22	4631	215	55369	9'990398	421	09602	45767	206	54233	38
23	4760	215	55240	9'990651	421	09349	45891	206	54109	45 37
44 24	4889	215	55111	9'990903	421	09097	46014	206	53986	36
25	5018	215	54982	9'991156	421	08844	46138	206	53862	35
26	5147	215	54853	9'991409	421	08591	46262	206	53738	34
27	5276	214	54724	9'991662	421	08338	46386	207	53614	33
28	5405	214	54595	9'991914	421	08086	46510	207	53490	32
29	5533	214	54467	9'992167	421	07833	46634	207	53366	31
30	5662	214	54338	9'992420	421	07580	46758	207	53242	30
31	5790	214	54210	9'992672	421	07328	46882	207	53118	29
32	5919	214	54081	9'992925	421	07075	47006	207	52994	45 28
44 33	6047	214	53953	9'993178	421	06822	47131	207	52869	27
34	6175	214	53825	9'993430	421	06570	47255	207	52745	26
35	6304	214	53696	9'993683	421	06317	47380	207	52620	25
36	6432	213	53568	9'993936	421	06064	47504	208	52496	24
37	6560	213	53440	9'994189	421	05811	47629	208	52371	23
38	6688	213	53312	9'994441	421	05559	47753	208	52247	22
39	6816	213	53184	9'994694	421	05306	47878	208	52122	21
40	6944	213	53056	9'994947	421	05053	48003	208	51997	20
41	7071	213	52929	9'995199	421	04801	48128	208	51872	45 19
44 42	7199	213	52801	9'995452	421	04548	48253	208	51747	18
43	7327	213	52673	9'995705	421	04295	48378	208	51622	17
44	7454	212	52546	9'995957	421	04043	48503	209	51497	16
45	7582	212	52418	9'996210	421	03790	48628	209	51372	15
46	7709	212	52291	9'996463	421	03537	48754	209	51247	14
47	7836	212	52164	9'996715	421	03285	48879	209	51121	13
48	7964	212	52036	9'996968	421	03032	49004	209	50996	12
49	8091	212	51909	9'997221	421	02779	49130	209	50870	11
50	8218	212	51782	9'997473	421	02527	49255	209	50745	45 10
44 51	8345	212	51655	9'997726	421	02274	49381	209	50619	9
52	8472	211	51528	9'997979	421	02021	49507	210	50493	8
53	8599	211	51401	9'998231	421	01769	49632	210	50368	7
54	8726	211	51274	9'998484	421	01516	49758	210	50242	6
55	8852	211	51148	9'998737	421	01263	49884	210	50116	5
56	8979	211	51021	9'998989	421	01011	50010	210	49990	4
57	9106	211	50894	9'999242	421	00758	50136	210	49864	3
58	9232	211	50768	9'999495	421	00505	50262	210	49738	2
59	9359	211	50641	9'999747	421	00253	50389	210	49611	1
60	9485	211	50515	10.000000	421	00000	50515	210	49485	45 0
	Con.	D.	Sec.	Col.	D.	Tang.	Con.	D.	Sine	•

TABLE VI.—MERIDIONAL PART.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
30	90	150	210	270	330	390	451	512	573	634	695	756	818	879	940	1001	1062	1123	1184	1245	1306	1367	1428
31	91	151	211	271	331	391	452	513	574	635	696	757	819	880	941	1002	1063	1124	1185	1246	1307	1368	1429
32	92	152	212	272	332	392	453	514	575	636	697	758	820	881	942	1003	1064	1125	1186	1247	1308	1369	1430
33	93	153	213	273	333	393	454	515	576	637	698	759	821	882	943	1004	1065	1126	1187	1248	1309	1370	1431
34	94	154	214	274	334	394	455	516	577	638	699	760	822	883	944	1005	1066	1127	1188	1249	1310	1371	1432
35	95	155	215	275	335	395	456	517	578	639	700	761	823	884	945	1006	1067	1128	1189	1250	1311	1372	1433
36	96	156	216	276	336	396	457	518	579	640	701	762	824	885	946	1007	1068	1129	1190	1251	1312	1373	1434
37	97	157	217	277	337	397	458	519	580	641	702	763	825	886	947	1008	1069	1130	1191	1252	1313	1374	1435
38	98	158	218	278	338	398	459	520	581	642	703	764	826	887	948	1009	1070	1131	1192	1253	1314	1375	1436
39	99	159	219	279	339	399	460	521	582	643	704	765	827	888	949	1010	1071	1132	1193	1254	1315	1376	1437
40	100	160	220	280	340	400	461	522	583	644	705	766	828	889	950	1011	1072	1133	1194	1255	1316	1377	1438
41	101	161	221	281	341	401	462	523	584	645	706	767	829	890	951	1012	1073	1134	1195	1256	1317	1378	1439
42	102	162	222	282	342	402	463	524	585	646	707	768	830	891	952	1013	1074	1135	1196	1257	1318	1379	1440
43	103	163	223	283	343	403	464	525	586	647	708	769	831	892	953	1014	1075	1136	1197	1258	1319	1380	1441
44	104	164	224	284	344	404	465	526	587	648	709	770	832	893	954	1015	1076	1137	1198	1259	1320	1381	1442
45	105	165	225	285	345	405	466	527	588	649	710	771	833	894	955	1016	1077	1138	1199	1260	1321	1382	1443
46	106	166	226	286	346	406	467	528	589	650	711	772	834	895	956	1017	1078	1139	1200	1261	1322	1383	1444
47	107	167	227	287	347	407	468	529	590	651	712	773	835	896	957	1018	1079	1140	1201	1262	1323	1384	1445
48	108	168	228	288	348	408	469	530	591	652	713	774	836	897	958	1019	1080	1141	1202	1263	1324	1385	1446
49	109	169	229	289	349	409	470	531	592	653	714	775	837	898	959	1020	1081	1142	1203	1264	1325	1386	1447
50	110	170	230	290	350	410	471	532	593	654	715	776	838	899	960	1021	1082	1143	1204	1265	1326	1387	1448
51	111	171	231	291	351	411	472	533	594	655	716	777	839	900	961	1022	1083	1144	1205	1266	1327	1388	1449
52	112	172	232	292	352	412	473	534	595	656	717	778	840	901	962	1023	1084	1145	1206	1267	1328	1389	1450
53	113	173	233	293	353	413	474	535	596	657	718	779	841	902	963	1024	1085	1146	1207	1268	1329	1390	1451
54	114	174	234	294	354	414	475	536	597	658	719	780	842	903	964	1025	1086	1147	1208	1269	1330	1391	1452
55	115	175	235	295	355	415	476	537	598	659	720	781	843	904	965	1026	1087	1148	1209	1270	1331	1392	1453
56	116	176	236	296	356	416	477	538	599	660	721	782	844	905	966	1027	1088	1149	1210	1271	1332	1393	1454
57	117	177	237	297	357	417	478	539	600	661	722	783	845	906	967	1028	1089	1150	1211	1272	1333	1394	1455
58	118	178	238	298	358	418	479	540	601	662	723	784	846	907	968	1029	1090	1151	1212	1273	1334	1395	1456
59	119	179	239	299	359	419	480	541	602	663	724	785	847	908	969	1030	1091	1152	1213	1274	1335	1396	1457
60	120	180	240	300	360	420	481	542	603	664	725	786	848	909	970	1031	1092	1153	1214	1275	1336	1397	1458

TABLE VI.—MERIDIONAL PARTS.

'	67°	68°	69°	70°	71°	72°	73°	74°	75°	76°	77°	78°	79°	80°	81°	82°	83°	84°	85°
0	5474	5831	5795	5966	6146	6335	6534	6746	6970	7210	7467	7745	8046	8375	8739	9145	9606	10137	10765
1	5477	5933	5797	5969	6149	6338	6538	6749	6974	7214	7472	7749	8051	8381	8745	9153	9614	10146	10776
2	5479	5936	5800	5972	6152	6341	6541	6753	6978	7218	7476	7754	8056	8387	8751	9160	9622	10156	10788
3	5482	5939	5803	5975	6155	6345	6545	6757	6982	7222	7481	7759	8061	8393	8757	9167	9631	10166	10799
4	5484	5942	5806	5978	6158	6348	6548	6760	6986	7226	7485	7763	8065	8398	8763	9174	9639	10175	10811
5	5487	5944	5809	5981	6161	6351	6552	6764	6990	7231	7490	7769	8072	8404	8771	9182	9647	10185	10822
6	5489	5947	5811	5984	6164	6354	6555	6768	6994	7235	7494	7774	8077	8410	8778	9189	9655	10195	10834
7	5492	5950	5814	5987	6167	6358	6558	6771	6997	7239	7498	7778	8083	8416	8784	9196	9664	10205	10846
8	5495	5953	5817	5990	6170	6361	6562	6775	7001	7243	7503	7783	8088	8422	8791	9203	9672	10214	10858
9	5497	5955	5820	5992	6173	6364	6565	6779	7005	7247	7507	7787	8093	8427	8797	9211	9680	10224	10869
10	5500	5958	5823	5995	6177	6367	6569	6782	7009	7252	7512	7793	8099	8433	8804	9218	9689	10234	10881
11	5502	5960	5825	5998	6180	6371	6572	6786	7013	7256	7516	7798	8104	8439	8810	9225	9697	10244	10893
12	5505	5963	5828	6001	6183	6374	6576	6790	7017	7260	7521	7803	8109	8445	8817	9233	9706	10254	10905
13	5507	5966	5831	6004	6186	6377	6579	6793	7021	7264	7525	7808	8115	8451	8823	9240	9714	10264	10917
14	5510	5968	5834	6007	6189	6380	6583	6797	7025	7268	7530	7813	8120	8457	8830	9248	9723	10273	10929
15	5513	5971	5837	6010	6192	6384	6586	6801	7029	7272	7535	7817	8125	8463	8836	9255	9731	10283	10941
16	5515	5974	5839	6013	6195	6387	6590	6804	7033	7276	7540	7822	8131	8469	8843	9262	9740	10293	10953
17	5518	5976	5842	6016	6198	6390	6593	6808	7037	7281	7544	7827	8136	8474	8849	9270	9748	10303	10965
18	5520	5979	5845	6019	6201	6394	6597	6812	7041	7285	7548	7832	8141	8480	8856	9277	9757	10314	10978
19	5523	5982	5848	6022	6205	6397	6600	6815	7045	7289	7553	7837	8147	8486	8863	9285	9765	10324	10990
20	5526	5985	5851	6025	6208	6400	6603	6819	7048	7294	7557	7843	8153	8493	8869	9292	9774	10334	11002
21	5528	5987	5854	6028	6211	6403	6607	6823	7052	7298	7562	7847	8158	8498	8876	9299	9783	10344	11014
22	5531	5990	5856	6031	6214	6407	6610	6826	7056	7302	7566	7852	8163	8504	8883	9307	9791	10354	11027
23	5533	5993	5859	6034	6217	6410	6614	6830	7060	7306	7571	7857	8169	8510	8890	9315	9800	10364	11039
24	5536	5995	5862	6037	6220	6413	6617	6834	7064	7311	7576	7863	8174	8516	8896	9322	9809	10374	11052
25	5539	5998	5865	6040	6223	6417	6621	6838	7068	7315	7580	7867	8179	8522	8903	9330	9817	10385	11064
26	5541	5701	5868	6043	6226	6420	6624	6841	7072	7319	7585	7872	8185	8528	8909	9337	9826	10395	11077
27	5544	5704	5871	6046	6230	6423	6628	6845	7076	7323	7589	7877	8190	8534	8916	9345	9835	10405	11090
28	5546	5706	5874	6049	6233	6427	6631	6849	7080	7328	7594	7882	8196	8538	8923	9353	9844	10416	11102
29	5549	5709	5877	6052	6236	6430	6635	6853	7084	7331	7599	7887	8201	8546	8930	9360	9852	10426	11115

TABLE VI.—MERIDIONAL PARTS.

'	67°	68°	69°	70°	71°	72°	73°	74°	75°	76°	77°	78°	79°	80°	81°	82°	83°	84°	85°	'
30	5554	5712	5879	6055	6239	6433	6639	6856	7088	7336	7603	7894	8207	8552	8936	9368	9861	10437	11127	30
31	5557	5715	5882	6058	6242	6437	6642	6860	7092	7340	7607	7899	8212	8558	8942	9375	9870	10447	11140	31
32	5557	5715	5885	6061	6245	6440	6645	6864	7096	7344	7611	7904	8217	8564	8948	9382	9879	10457	11153	32
33	5559	5717	5888	6064	6249	6444	6649	6868	7100	7348	7615	7909	8222	8570	8954	9389	9888	10468	11166	33
34	5562	5720	5891	6067	6252	6447	6653	6871	7104	7353	7620	7915	8228	8577	8961	9399	9897	10479	11179	34
35	5565	5722	5894	6070	6255	6450	6656	6875	7108	7358	7625	7920	8234	8583	8967	9407	9906	10489	11192	35
36	5567	5724	5896	6073	6258	6453	6660	6879	7112	7362	7629	7924	8238	8587	8971	9414	9915	10500	11205	36
37	5570	5726	5899	6076	6261	6457	6663	6882	7115	7366	7633	7928	8242	8591	8975	9422	9924	10515	11218	37
38	5573	5728	5902	6079	6264	6460	6666	6886	7120	7371	7638	7933	8248	8597	8981	9430	9933	10531	11231	38
39	5575	5730	5905	6082	6267	6463	6669	6889	7124	7375	7641	7937	8251	8600	8984	9438	9942	10539	11244	39
40	5578	5732	5908	6085	6271	6467	6674	6894	7128	7379	7645	7940	8255	8604	8988	9445	9951	10544	11257	40
41	5580	5734	5911	6088	6274	6470	6677	6897	7132	7382	7648	7943	8258	8608	8992	9453	9960	10553	11270	41
42	5583	5736	5914	6091	6277	6473	6681	6901	7136	7388	7654	7949	8262	8612	8996	9461	9969	10564	11284	42
43	5586	5738	5917	6094	6280	6477	6685	6905	7140	7392	7660	7953	8266	8616	8999	9469	9978	10575	11297	43
44	5588	5740	5919	6097	6283	6480	6688	6909	7145	7397	7665	7958	8270	8620	8999	9477	9987	10586	11310	44
45	5591	5753	5922	6100	6287	6483	6692	6913	7149	7401	7671	7962	8274	8624	9000	9485	9996	10597	11324	45
46	5594	5756	5925	6103	6290	6487	6695	6917	7153	7406	7674	7965	8277	8628	9004	9493	10005	10608	11337	46
47	5596	5758	5928	6106	6293	6490	6699	6920	7157	7410	7678	7968	8280	8631	9007	9501	10015	10619	11351	47
48	5599	5761	5931	6109	6296	6494	6702	6924	7161	7414	7681	7970	8283	8635	9011	9506	10024	10630	11365	48
49	5602	5764	5934	6112	6299	6497	6706	6928	7165	7419	7684	7973	8286	8639	9015	9511	10033	10641	11378	49
50	5604	5767	5937	6115	6303	6500	6710	6932	7169	7423	7687	7984	8290	8643	9019	9517	10043	10652	11392	50
51	5607	5770	5940	6118	6306	6504	6713	6936	7173	7427	7690	7989	8295	8647	9023	9521	10052	10663	11406	51
52	5610	5772	5943	6121	6309	6507	6717	6940	7177	7431	7694	7991	8299	8651	9027	9525	10061	10674	11420	52
53	5612	5775	5946	6124	6312	6511	6720	6943	7181	7435	7701	8000	8305	8655	9031	9530	10071	10685	11434	53
54	5615	5778	5948	6127	6315	6514	6724	6947	7185	7441	7706	8005	8310	8659	9035	9535	10080	10696	11448	54
55	5617	5781	5951	6130	6319	6517	6728	6951	7189	7445	7711	8010	8315	8663	9039	9540	10089	10708	11462	55
56	5620	5784	5954	6133	6322	6521	6731	6955	7194	7451	7717	8015	8320	8667	9043	9545	10099	10719	11476	56
57	5623	5786	5957	6136	6325	6524	6735	6959	7198	7454	7720	8020	8325	8671	9047	9550	10108	10730	11490	57
58	5625	5789	5960	6139	6328	6528	6739	6963	7202	7458	7725	8025	8330	8675	9051	9555	10118	10742	11504	58
59	5628	5792	5963	6143	6331	6531	6742	6966	7206	7461	7728	8030	8335	8679	9055	9560	10127	10753	11518	59

TABLE VII.—LENGTH OF A DEGREE OF LONGITUDE ON EACH
PARALLEL OF LATITUDE.

Latitude.	Nautical miles.	Latitude.	Nautical miles.	Latitude.	Nautical miles.
0		0		0	
1	59'99	31	51'43	61	29'09
2	59'96	32	50'88	62	28'17
3	59'92	33	50'32	63	27'74
4	59'85	34	49'74	64	26'30
5	59'77	35	49'15	65	25'36
6	59'67	36	48'54	66	24'40
7	59'55	37	47'92	67	23'44
8	59'42	38	47'28	68	22'48
9	59'26	39	46'63	69	21'50
10	59'09	40	45'96	70	20'52
11	58'89	41	45'28	71	19'53
12	58'69	42	44'59	72	18'54
13	58'46	43	43'88	73	17'54
14	58'22	44	43'16	74	16'54
15	57'95	45	42'43	75	15'53
16	57'67	46	41'68	76	14'52
17	57'38	47	40'92	77	13'50
18	57'06	48	40'15	78	12'48
19	56'73	49	39'36	79	11'45
20	56'38	50	38'57	80	10'42
21	56'01	51	37'76	81	9'38
22	55'63	52	36'94	82	8'35
23	55'23	53	36'11	83	7'31
24	54'81	54	35'27	84	6'27
25	54'38	55	34'41	85	5'23
26	53'93	56	33'45	86	4'18
27	53'46	57	32'62	87	3'14
28	52'97	58	31'79	88	2'09
29	52'48	59	30'90	89	1'05
30	51'96	60	30'00	90	0'00

TABLE VIII.
DIP OF HORIZON, CORRECTED
FOR REFRACTION.

Height of eye.	Dip of Horizon.	Height of eye.	Dip of Horizon.
feet.	' "	feet.	' "
1	0 59	41	6 18
2	1 24	42	6 23
3	1 42	43	6 27
4	1 58	44	6 32
5	2 12	45	6 37
6	2 25	47	6 45
7	2 36	48	6 50
8	2 47	50	6 58
9	2 57	53	7 10
10	3 7	56	7 22
11	3 16	59	7 34
12	3 25	62	7 45
13	3 33	65	7 56
14	3 41	68	8 7
15	3 49	71	8 18
16	3 56	74	8 28
17	4 4	77	8 38
18	4 11	80	8 48
19	4 17	83	8 58
20	4 24	86	9 8
21	4 31	89	9 17
22	4 37	90	9 22
23	4 43	92	9 26
24	4 49	95	9 36
25	4 55	98	9 45
26	5 1	100	9 52
27	5 7	101	9 54
28	5 13	104	10 2
29	5 18	107	10 11
30	5 24	110	10 19
31	5 29	113	10 28
32	5 34	116	10 36
33	5 39	119	10 44
34	5 44	122	10 52
35	5 49	125	11 0
36	5 54	128	11 8
37	5 59	131	11 16
38	6 4	134	11 24
39	6 9	137	11 31
40	6 14	140	11 39

TABLE IX.
DIP OF THE HORIZON AT VARIOUS
DISTANCES FROM IT.

Distance in miles.	HEIGHT OF EYE.					
	feet.	feet.	feet.	feet.	feet.	feet.
	5	10	15	20	25	30
0½	11	22	34	45	56	68
0¾	6	11	17	22	28	34
0¾	4	8	12	15	19	23
1	4	6	9	12	15	17
1¼	3	5	7	9	12	14
1½	3	4	6	8	10	12
2	2	3	5	6	8	10
2½	2	3	5	6	7	8
3	2	3	4	5	6	7
3½	2	3	4	5	6	6
4	2	3	4	4	5	6
5	2	3	4	4	5	5
6	2	3	4	4	5	5

TABLE X.—REDUCTION OF
MOON'S EQUATORIAL PARALLAX.

Lat.	HORIZONTAL PARALLAX.				
	54	56	58	60	62
4	0'1	0'1	0'1	0'1	0'1
8	0'2	0'2	0'2	0'2	0'2
12	0'4	0'5	0'5	0'5	0'5
16	0'8	0'8	0'9	0'9	0'9
20	1'3	1'3	1'4	1'4	1'5
24	1'8	1'9	1'9	2'0	2'0
28	2'4	2'5	2'6	2'6	2'7
32	3'0	3'1	3'3	3'4	3'5
36	3'7	3'9	4'0	4'1	4'3
40	4'5	4'6	4'8	5'0	5'1
44	5'2	5'4	5'6	5'8	6'0
48	6'0	6'2	6'3	6'6	6'8
52	6'7	7'0	7'2	7'4	7'6
56	7'4	7'7	8'0	8'2	8'5
60	8'1	8'4	8'7	9'0	9'3
64	8'7	9'1	9'4	9'7	10'0
68	9'3	9'6	10'0	10'3	10'6
72	9'8	10'1	10'4	10'8	11'2
76	10'2	10'6	10'9	11'3	11'7
80	10'5	10'9	11'2	11'6	12'0

TABLE XI.
AUGMENTATION OF THE MOON'S
SEMIDIAMETER.

Altitude.	HORIZONTAL SEMIDIAMETER.					
	14° 30'	15° 0'	15° 30'	16° 0'	16° 30'	17° 0'
0	"	"	"	"	"	"
2	0	0	0	0	0	0
4	1	1	1	1	1	1
6	1	1	1	1	1	1
8	2	2	2	2	2	2
10	2	3	3	3	3	3
12	3	3	3	4	4	4
14	3	4	4	4	4	5
16	4	4	4	5	5	5
18	4	5	5	5	6	6
21	5	5	6	6	6	7
24	6	6	6	7	7	8
27	6	7	7	8	8	9
30	7	7	8	8	9	9
33	7	8	9	9	10	10
36	8	9	9	10	10	11
39	9	9	10	11	11	12
42	9	10	10	11	12	13
45	10	10	11	12	13	13
48	10	11	12	12	13	14
51	11	11	12	13	14	15
54	11	12	13	13	14	15
57	11	12	13	14	15	16
60	12	13	14	14	15	16
63	12	13	14	15	16	17
66	12	13	14	15	16	17
69	13	14	15	16	17	18
72	13	14	15	16	17	18
75	13	14	15	16	17	18
78	13	14	15	16	17	18
81	14	14	15	16	18	19
84	14	15	16	17	18	19
87	14	15	16	17	18	19
90	14	15	16	17	18	19

TABLE XII.
FOR CONVERTING LONGITUDE
INTO TIME.

Long.	Time.	Long.	Time.	Long.	Time.
1	0 4	30	2 0	1	067
2	0 8	40	2 40	2	133
3	0 12	50	3 20	3	200
4	0 16	60	4 0	4	267
5	0 20	70	4 40	5	333
6	0 24	80	5 20	6	400
7	0 28	90	6 0	7	467
8	0 32	100	6 40	8	533
9	0 36	200	13 20	9	600
10	0 40	300	20 0	10	667
20	1 20				

TABLE XIII.
FOR CONVERTING TIME INTO
LONGITUDE.

Time.	Long.	Time.	Long.	Time.	Long.
1	15	1	0 15	0 1	1 5
2	30	2	0 30	0 2	3 0
3	45	3	0 45	0 3	4 5
4	60	4	1 0	0 4	6 0
5	75	5	1 15	0 5	7 5
6	90	6	1 30	0 6	9 0
7	105	7	1 45	0 7	10 5
8	120	8	2 0	0 8	12 0
9	135	9	2 15	0 9	13 5
10	150	10	2 30		
11	165	20	5 0		
12	180	30	7 30		
16	240	40	10 0		
20	300	50	12 30		

TABLE XV.—REFRACTION OF THE SUN AND STARS.

App. Alt.		Refraction.		App. Alt.		Refraction.		App. Alt.		Refraction.		App. Alt.		Refraction.	
0	1	1	2	0	1	1	2	0	1	1	2	0	1	1	2
46	0	56.2		55	0	40.8		64	0	28.4		73	0	17.8	
	10	55.8			10	40.5			10	28.2			10	17.6	
	20	55.5			20	40.3			20	28.0			20	17.4	
	30	55.2			30	40.0			30	27.8			30	17.2	
	40	54.9			40	39.8			40	27.6			40	17.0	
	50	54.6			50	39.5			50	27.4			50	16.8	
47	0	54.3		56	0	39.3		65	0	27.2		74	0	16.7	
	10	54.0			10	39.0			10	26.9			10	16.5	
	20	53.6			20	38.8			20	26.7			20	16.3	
	30	53.3			30	38.5			30	26.5			30	16.1	
	40	53.0			40	38.3			40	26.3			40	16.0	
	50	52.7			50	38.0			50	26.1			50	15.8	
48	0	52.4		57	0	37.8		66	0	25.9		75	0	15.6	
	10	52.1			10	37.6			10	25.7			10	15.4	
	20	51.8			20	37.3			20	25.5			20	15.2	
	30	51.5			30	37.1			30	25.3			30	15.0	
	40	51.2			40	36.9			40	25.1			40	14.8	
	50	50.9			50	36.6			50	24.9			50	14.7	
49	0	50.6		58	0	36.4		67	0	24.7		76	0	14.5	
	10	50.4			10	36.2			10	24.5			10	14.3	
	20	50.1			20	36.0			20	24.3			20	14.2	
	30	49.8			30	35.7			30	24.1			30	14.0	
	40	49.5			40	35.5			40	23.9			40	13.8	
	50	49.2			50	35.2			50	23.7			50	13.7	
50	0	48.9		59	0	35.0		68	0	23.5		77	0	13.5	
	10	48.6			10	34.8			10	23.4			10	13.4	
	20	48.3			20	34.6			20	23.2			20	13.2	
	30	48.1			30	34.3			30	23.0			30	13.0	
	40	47.8			40	34.1			40	22.8			40	12.8	
	50	47.5			50	33.8			50	22.6			50	12.6	
51	0	47.2		60	0	33.6		69	0	22.4		78	0	12.4	
	10	46.9			10	33.4			10	22.2			10	12.2	
	20	46.6			20	33.1			20	22.0			20	12.0	
	30	46.3			30	32.9			30	21.8			30	11.9	
	40	46.1			40	32.7			40	21.6			40	11.7	
	50	45.8			50	32.5			50	21.4			50	11.5	
52	0	45.6		61	0	32.3		70	0	21.2		79	0	11.3	
	10	45.2			10	32.0			10	21.0			10	11.2	
	20	45.0			20	31.8			20	20.8			20	11.0	
	30	44.6			30	31.6			30	20.6			30	10.8	
	40	44.4			40	31.4			40	20.4			40	10.7	
	50	44.1			50	31.2			50	20.2			50	10.5	
53	0	43.9		62	0	31.0		71	0	20.0		80	0	10.3	
	10	43.6			10	30.8			10	19.8			10	10.1	
	20	43.3			20	30.6			20	19.6			20	10.0	
	30	43.1			30	30.4			30	19.4			30	9.8	
	40	42.8			40	30.2			40	19.2			40	9.6	
	50	42.6			50	30.0			50	19.0			50	9.4	
54	0	42.3		63	0	29.7		72	0	18.9		81	0	9.2	
	10	42.0			10	29.4			10	18.8			10	9.0	
	20	41.8			20	29.2			20	18.6			20	8.9	
	30	41.5			30	29.0			30	18.4			30	8.7	
	40	41.3			40	28.8			40	18.2			40	8.6	
	50	41.0			50	28.6			50	18.0			50	8.4	

TABLE XVII.—CORRECTION OF THE MOON'S ALTITUDE.

P. P. for Alt.	Moon's App. Alt.	MOON'S HORIZONTAL PARALLAX.										P. P. for Par.
		54'	55'	56'	57'	58'	59'	60'	61'			
	0	35 36	36 36	37 36	38 36	39 36	40 36	41 36	42 36	43 36		
	10	36 22	37 22	38 22	39 22	40 22	41 22	42 22	43 22	44 22		
+	20	37 4	38 4	39 4	40 4	41 4	42 4	43 4	44 4	45 4	1 10	
1	30	37 44	38 44	39 44	40 44	41 44	42 44	43 44	44 44	45 44	2 20	
2	40	38 20	39 20	40 20	41 20	42 20	43 20	44 20	45 20	46 20	3 30	
3	50	38 55	39 55	40 55	41 55	42 55	43 55	44 55	45 55	46 55	4 40	
4	5	39 28	40 27	41 27	42 27	43 27	44 27	45 27	46 27	47 27	5 50	
5	10	39 58	40 58	41 58	42 58	43 58	44 58	45 58	46 58	47 58	6 60	
6	20	40 26	41 26	42 26	43 25	44 25	45 25	46 25	47 25	48 25	7 70	
7	30	40 53	41 53	42 53	43 52	44 52	45 52	46 52	47 52	48 52	8 80	
8	40	41 17	42 17	43 17	44 17	45 17	46 17	47 17	48 17	49 17	9 90	
9	50	41 42	42 42	43 41	44 41	45 41	46 41	47 41	48 41	49 41		
	4	42 4	43 4	44 4	45 4	46 4	47 4	48 3	49 3	50 3		
	10	42 25	43 24	44 24	45 24	46 24	47 24	48 23	49 23	50 23		
1	20	42 45	43 44	44 44	45 44	46 44	47 44	48 43	49 43	50 43	1 10	
2	30	43 3	44 3	45 3	46 2	47 2	48 2	49 2	50 2	51 2	2 20	
3	40	43 21	44 21	45 21	46 21	47 21	48 20	49 20	50 20	51 20	3 30	
4	50	43 38	44 37	45 37	46 37	47 36	48 36	49 36	50 36	51 36	4 40	
5	5	43 53	44 53	45 53	46 53	47 53	48 53	49 52	50 52	51 52	5 50	
6	10	44 9	45 9	46 8	47 8	48 8	49 8	50 8	51 7	52 7	6 60	
7	20	44 23	45 23	46 23	47 22	48 22	49 21	50 21	51 21	52 21	7 70	
8	30	44 36	45 36	46 35	47 35	48 35	49 35	50 34	51 34	52 34	8 80	
9	40	44 49	45 49	46 49	47 48	48 48	49 48	50 48	51 47	52 47	9 90	
	50	45 1	46 1	47 1	48 0	49 0	49 59	50 59	51 59	52 59		
	6	45 12	46 12	47 11	48 11	49 11	50 11	51 10	52 10	53 10		
	10	45 23	46 23	47 23	48 22	49 22	50 22	51 21	52 21	53 21		
1	20	45 33	46 33	47 33	48 32	49 32	50 31	51 31	52 31	53 31	1 10	
2	30	45 43	46 43	47 42	48 42	49 42	50 41	51 41	52 41	53 41	2 20	
3	40	45 53	46 53	47 52	48 52	49 52	50 51	51 50	52 50	53 50	3 30	
4	50	46 2	47 2	48 1	49 1	50 0	51 0	51 59	52 59	53 59	4 40	
5	5	46 11	47 10	48 10	49 10	50 9	51 9	52 8	53 8	54 8	5 50	
6	10	46 20	47 19	48 19	49 18	50 18	51 17	52 17	53 16	54 16	6 60	
7	20	46 28	47 27	48 26	49 26	50 26	51 25	52 25	53 24	54 24	7 70	
8	30	46 34	47 34	48 33	49 33	50 32	51 32	52 31	53 31	54 31	8 80	
9	40	46 41	47 41	48 40	49 39	50 39	51 38	52 38	53 37	54 37	9 90	
	50	46 48	47 47	48 47	49 46	50 46	51 45	52 44	53 44	54 44		
	8	46 54	47 54	48 53	49 53	50 52	51 52	52 51	53 51	54 51		
	10	47 0	47 59	48 59	49 58	50 58	51 57	52 56	53 56	54 56		
1	20	47 6	48 5	49 5	50 4	51 3	52 3	53 2	54 2	55 2	1 10	
2	30	47 12	48 11	49 10	50 9	51 9	52 8	53 7	54 7	55 7	2 20	
3	40	47 17	48 16	49 16	50 15	51 14	52 14	53 13	54 12	55 12	3 30	
4	50	47 22	48 21	49 20	50 19	51 19	52 18	53 17	54 17	55 17	4 40	
5	5	47 26	48 25	49 25	50 24	51 23	52 22	53 22	54 21	55 21	5 50	
6	10	47 32	48 31	49 30	50 29	51 29	52 28	53 27	54 26	55 26	6 60	
7	20	47 35	48 34	49 34	50 33	51 32	52 31	53 31	54 30	55 30	7 70	
8	30	47 40	48 39	49 38	50 37	51 36	52 35	53 35	54 34	55 34	8 80	
9	40	47 44	48 43	49 42	50 41	51 41	52 40	53 39	54 38	55 38	9 90	
	50	47 48	48 46	49 46	50 45	51 44	52 43	53 42	54 41	55 41		

TABLE XVII.—CORRECTION OF THE MOON'S ALTITUDE.

P. P. for Alt.	Moon's App. Alt.		MOON'S HORIZONTAL PARALLAX.										P. P. for Par.
	0'	1'	54'	55'	56'	57'	58'	59'	60'	61'			
1	0	0	47 51	48 50	49 49	50 48	51 47	52 46	53 45	54 44			
1	+	10	47 54	48 53	49 52	50 51	51 50	52 49	53 49	54 47			
2	0	20	47 57	48 57	49 55	50 55	51 54	52 52	53 52	54 51	1	1'0	
3	0	30	48 1	49 0	49 59	50 58	51 57	52 56	53 55	54 54	2	2'0	
4	1	40	48 4	49 3	50 2	51 1	52 0	52 59	53 58	54 57	3	3'0	
5	1	50	48 6	49 5	50 4	51 3	52 2	53 1	54 0	54 59	4	4'0	
6	1	11	48 9	49 7	50 6	51 5	52 4	53 3	54 2	55 1	5	5'0	
7	1	20	48 11	49 10	50 8	51 7	52 6	53 5	54 4	55 3	6	6'0	
8	1	30	48 13	49 12	50 11	51 9	52 8	53 7	54 6	55 5	7	7'0	
9	1	40	48 15	49 14	50 13	51 12	52 10	53 9	54 8	55 7	8	8'0	
		50	48 17	49 16	50 14	51 13	52 12	53 11	54 10	55 8	9	8'8	
		50	48 19	49 18	50 17	51 15	52 14	53 13	54 11	55 10			
1	"	12	48 21	49 20	50 19	51 17	52 16	53 15	54 13	55 12			
1	0	10	48 23	49 22	50 20	51 19	52 18	53 16	54 15	55 14	1	"	
2	0	20	48 24	49 23	50 22	51 20	52 19	53 17	54 16	55 15	1	1'0	
3	0	30	48 26	49 25	50 23	51 22	52 21	53 19	54 17	55 16	2	2'0	
4	0	40	48 27	49 26	50 24	51 23	52 22	53 20	54 18	55 17	3	3'0	
5	0	50	48 28	49 27	50 25	51 24	52 23	53 21	54 19	55 18	4	4'0	
6	1	13	48 29	49 27	50 26	51 24	52 23	53 21	54 20	55 19	5	5'0	
7	1	20	48 31	49 29	50 28	51 26	52 25	53 23	54 21	55 19	6	6'0	
8	1	30	48 31	49 30	50 28	51 27	52 25	53 24	54 22	55 20	7	7'0	
9	1	40	48 33	49 31	50 29	51 27	52 26	53 24	54 22	55 20	8	8'0	
		50	48 33	49 31	50 30	51 28	52 26	53 24	54 23	55 21			
1	"	14	48 34	49 32	50 30	51 29	52 27	53 25	54 23	55 21			
1	0	10	48 34	49 33	50 31	51 29	52 27	53 26	54 24	55 22	1	"	
2	0	20	48 34	49 32	50 31	51 29	52 27	53 25	54 24	55 22	1	1'0	
3	0	30	48 35	49 33	50 31	51 29	52 27	53 25	54 24	55 22	2	2'0	
4	0	40	48 35	49 34	50 32	51 29	52 28	53 26	54 23	55 22	3	3'0	
5	0	50	48 35	49 33	50 31	51 29	52 27	53 25	54 23	55 21	4	4'0	
6	0	15	48 36	49 34	50 31	51 30	52 27	53 25	54 23	55 21	5	5'0	
7	0	20	48 35	49 33	50 31	51 29	52 27	53 25	54 23	55 21	6	6'0	
8	0	30	48 35	49 33	50 31	51 29	52 28	53 26	54 24	55 22	7	7'0	
9	0	40	48 34	49 33	50 30	51 28	52 26	53 24	54 21	55 19	8	8'0	
		50	48 34	49 32	50 30	51 27	52 25	53 23	54 20	55 18			
1	—	16	48 34	49 31	50 29	51 28	52 24	53 22	54 20	55 17			
1	0	10	48 33	49 31	50 28	51 26	52 24	53 21	54 19	55 16	1	"	
2	0	20	48 32	49 30	50 27	51 25	52 23	53 20	54 18	55 15	1	1'0	
3	0	30	48 32	49 29	50 26	51 24	52 22	53 19	54 17	55 14	2	2'0	
4	0	40	48 31	49 28	50 26	51 24	52 21	53 18	54 16	55 13	3	3'0	
5	0	50	48 30	49 27	50 25	51 23	52 20	53 17	54 15	55 12	4	4'0	
6	1	17	48 29	49 27	50 24	51 22	52 19	53 16	54 14	55 11	5	5'0	
7	1	20	48 28	49 26	50 24	51 21	52 18	53 15	54 13	55 10	6	6'0	
8	1	30	48 28	49 25	50 23	51 20	52 17	53 14	54 12	55 9	7	7'0	
9	1	40	48 27	49 24	50 22	51 19	52 16	53 13	54 10	55 8	8	8'0	
		50	48 26	49 24	50 21	51 18	52 15	53 12	54 9	55 6	9	8'6	
		50	48 26	49 23	50 20	51 17	52 14	53 11	54 8	55 5			

TABLE XVII.—CORRECTION OF THE MOON'S ALTITUDE.

P. P. for AM.	Moon's App. AM.	MOON'S HORIZONTAL PARALLAX.										P. P. for PM.
		54'	55'	56'	57'	58'	59'	60'	61'			
		"	"	"	"	"	"	"	"	"	"	
	0	48 24	49 21	50 18	51 15	52 12	53 9	54 6	55 3			
1	10	48 23	49 20	50 17	51 14	52 11	53 8	54 5	55 2			
2	20	48 22	49 19	50 16	51 13	52 10	53 7	54 3	55 0	1 0.9		
3	30	48 20	49 17	50 14	51 10	52 7	53 4	54 1	54 58	2 1.9		
4	40	48 19	49 16	50 12	51 9	52 6	53 3	53 59	54 56	3 2.8		
5	50	48 18	49 15	50 11	51 8	52 4	53 1	53 58	54 55	4 3.8		
6	19	48 16	49 13	50 9	51 5	52 2	52 59	53 56	54 53	5 4.7		
7	10	48 15	49 11	50 8	51 4	52 1	52 58	53 54	54 51	6 5.7		
8	20	48 12	49 9	50 5	51 2	51 59	52 55	53 52	54 49	7 6.7		
9	30	48 11	49 8	50 4	51 1	51 57	52 54	53 51	54 47	8 7.6		
	40	48 9	49 5	50 2	50 58	51 53	52 52	53 48	54 44	9 8.5		
	50	48 8	49 4	50 1	50 57	51 54	52 50	53 46	54 43			
	10	48 5	49 1	49 58	50 55	51 51	52 47	53 44	54 40			
	20	48 3	49 0	49 56	50 53	51 48	52 45	53 42	54 38			
1	30	48 2	48 58	49 55	50 51	51 47	52 43	53 40	54 36	1 0.9		
2	40	48 0	48 56	49 52	50 48	51 45	52 41	53 37	54 33	2 1.9		
3	50	47 58	48 54	49 50	50 46	51 42	52 38	53 34	54 30	3 2.8		
4	1	47 56	48 52	49 48	50 44	51 41	52 36	53 32	54 28	4 3.7		
5	11	47 54	48 50	49 46	50 42	51 38	52 34	53 30	54 26	5 4.7		
6	21	47 53	48 48	49 44	50 40	51 35	52 32	53 27	54 23	6 5.6		
7	31	47 50	48 46	49 42	50 37	51 34	52 30	53 25	54 21	7 6.6		
8	41	47 47	48 43	49 39	50 35	51 31	52 27	53 22	54 19	8 7.5		
9	51	47 45	48 41	49 36	50 32	51 28	52 24	53 20	54 15	9 8.4		
	50	47 44	48 39	49 35	50 31	51 26	52 22	53 18	54 13			
	10	47 41	48 37	49 32	50 28	51 24	52 19	53 15	54 11			
	20	47 39	48 34	49 30	50 25	51 21	52 16	53 12	54 7			
1	30	47 36	48 31	49 27	50 22	51 18	52 13	53 9	54 4	1 0.9		
2	40	47 33	48 29	49 24	50 20	51 15	52 11	53 6	54 2	2 1.8		
3	50	47 31	48 26	49 21	50 16	51 12	52 6	53 2	53 57	3 2.8		
4	1	47 28	48 23	49 19	50 14	51 9	52 5	53 0	53 55	4 3.8		
5	11	47 26	48 21	49 16	50 11	51 6	52 2	52 57	53 52	5 4.7		
6	21	47 24	48 19	49 14	50 9	51 4	51 59	52 54	53 50	6 5.6		
7	31	47 21	48 16	49 11	50 6	51 2	51 56	52 51	53 47	7 6.5		
8	41	47 18	48 13	49 9	50 3	50 58	51 54	52 48	53 43	8 7.4		
9	51	47 16	48 10	49 5	50 1	50 55	51 50	52 45	53 40	9 8.3		
	50	47 13	48 8	49 2	49 57	50 52	51 47	52 42	53 37			
	10	47 10	48 5	49 0	49 54	50 49	51 44	52 39	53 34			
	20	47 7	48 2	48 56	49 51	50 46	51 41	52 35	53 30			
1	30	47 4	47 59	48 54	49 48	50 43	51 38	52 32	53 27	1 0.9		
2	40	47 1	47 56	48 51	49 46	50 41	51 35	52 29	53 23	2 1.8		
3	50	46 58	47 53	48 47	49 42	50 37	51 32	52 25	53 20	3 2.7		
4	1	46 56	47 50	48 44	49 39	50 33	51 27	52 22	53 17	4 3.6		
5	11	46 53	47 47	48 41	49 36	50 30	51 24	52 19	53 13	5 4.5		
6	21	46 50	47 44	48 38	49 32	50 26	51 21	52 15	53 10	6 5.4		
7	31	46 48	47 41	48 34	49 28	50 22	51 17	52 11	53 5	7 6.4		
8	41	46 45	47 38	48 30	49 25	50 19	51 13	52 7	53 2	8 7.3		
9	51	46 42	47 35	48 27	49 22	50 16	51 10	52 4	53 58	9 8.3		
	50	46 39	47 32	48 24	49 18	50 12	51 6	52 0	53 54			

TABLE XVII.—CORRECTION OF THE MOON'S ALTITUDE.

P.P. for Alt.	Moon's App. Alt.	MOON'S HORIZONTAL PARALLAX.										P.P. for Par.
		54'	55'	56'	57'	58'	59'	60'	61'			
' "	26 0	46 33	47 27	48 21	49 15	50 9	51 3	51 57	52 51	' "		
—	10	46 30	47 24	48 18	49 12	50 6	50 59	51 53	52 47	' "		
1 0	20	46 27	47 20	48 14	49 8	50 2	50 56	51 49	52 43	1 0.9		
2 1	30	46 24	47 17	48 11	49 5	49 59	50 52	51 46	52 39	2 1.8		
3 1	40	46 20	47 13	48 6	49 1	49 54	50 47	51 41	52 35	3 2.7		
4 1	50	46 16	47 10	48 3	48 57	49 50	50 44	51 37	52 31	4 3.5		
5 2	27 0	46 13	47 7	48 0	48 53	49 47	50 40	51 34	52 27	5 4.4		
6 2	10	46 9	47 3	47 56	48 50	49 43	50 36	51 30	52 23	6 5.3		
7 2	20	46 6	47 0	47 53	48 46	49 39	50 33	51 26	52 19	7 6.3		
8 3	30	46 2	46 56	47 48	48 42	49 35	50 28	51 21	52 15	8 7.1		
9 3	40	45 59	46 52	47 45	48 38	49 31	50 24	51 17	52 11	9 8.0		
	50	45 55	46 48	47 41	48 34	49 27	50 20	51 14	52 6			
' "	28 0	45 52	46 45	47 38	48 31	49 24	50 16	51 10	52 3	' "		
1 0	10	45 49	46 42	47 35	48 28	49 21	50 14	51 7	51 59	' "		
2 1	20	45 45	46 38	47 30	48 23	49 16	50 9	51 2	51 54	1 0.9		
3 1	30	45 41	46 34	47 27	48 19	49 12	50 5	50 58	51 51	2 1.8		
4 2	40	45 37	46 31	47 23	48 16	49 8	50 1	50 54	51 46	3 2.6		
5 2	50	45 33	46 26	47 19	48 11	49 4	49 56	50 49	51 41	4 3.5		
6 2	29 0	45 29	46 21	47 14	48 6	48 59	49 51	50 44	51 36	5 4.4		
7 2	10	45 25	46 18	47 10	48 2	48 55	49 47	50 39	51 32	6 5.3		
8 3	20	45 22	46 14	47 6	47 58	48 51	49 43	50 36	51 28	7 6.2		
9 3	30	45 17	46 9	47 1	47 54	48 46	49 38	50 30	51 23	8 7.0		
	40	45 13	46 5	46 58	47 50	48 42	49 34	50 26	51 18	9 7.9		
	50	45 9	46 2	46 54	47 46	48 38	49 31	50 22	51 14			
' "	30 0	45 5	45 57	46 49	47 41	48 33	49 25	50 17	51 9	' "		
1 0	10	45 1	45 53	46 45	47 37	48 28	49 21	50 12	51 4	' "		
2 1	20	44 58	45 49	46 41	47 33	48 25	49 16	50 8	51 0	1 0.9		
3 1	30	44 53	45 44	46 36	47 28	48 19	49 11	50 3	50 55	2 1.7		
4 2	40	44 49	45 41	46 32	47 24	48 15	49 7	49 59	50 50	3 2.6		
5 2	50	44 44	45 36	46 27	47 18	48 10	49 2	49 53	50 45	4 3.4		
6 3	31 0	44 40	45 31	46 23	47 15	48 6	48 57	49 49	50 40	5 4.3		
7 3	10	44 36	45 27	46 18	47 9	48 1	48 52	49 43	50 35	6 5.2		
8 3	20	44 31	45 23	46 14	47 5	47 56	48 48	49 39	50 30	7 6.1		
9 4	30	44 27	45 19	46 10	47 1	47 52	48 44	49 35	50 26	8 6.8		
	40	44 24	45 15	46 6	46 57	47 48	48 39	49 30	50 21	9 7.7		
	50	44 19	45 10	46 1	46 52	47 43	48 34	49 25	50 16			
' "	32 0	44 14	45 5	45 56	46 47	47 38	48 29	49 20	50 11	' "		
1 0	10	44 10	45 1	45 51	46 42	47 33	48 23	49 14	50 5	' "		
2 1	20	44 6	44 56	45 47	46 38	47 29	48 19	49 10	50 0	1 0.8		
3 1	30	44 0	44 51	45 42	46 33	47 23	48 14	49 4	49 55	2 1.7		
4 2	40	43 57	44 47	45 37	46 28	47 19	48 9	49 0	49 50	3 2.5		
5 2	50	43 51	44 42	45 32	46 22	47 13	48 3	48 54	49 45	4 3.3		
6 3	33 0	43 47	44 38	45 28	46 18	47 8	47 59	48 49	49 40	5 4.2		
7 3	10	43 43	44 33	45 24	46 14	47 4	47 54	48 44	49 35	6 5.0		
8 3	20	43 39	44 29	45 19	46 9	47 0	47 49	48 40	49 30	7 5.9		
9 4	30	43 34	44 24	45 14	46 4	46 54	47 44	48 34	49 24	8 6.7		
	40	43 29	44 20	45 10	45 59	46 49	47 39	48 29	49 19	9 7.5		
	50	43 25	44 14	45 4	45 54	46 44	47 34	48 23	49 13			

TABLE XVII. LONGITUDE OF THE MOON'S STATIONS.

P. P. for Alt.	Moon's App. Alt.	Moon's Horizontal PARALLAX.									P. P. for Pat.
		54'	55'	56'	57'	58'	59'	60'	61'		
	0	"	"	"	"	"	"	"	"	"	
	42	0	39 3	39 47	40 32	41 17	42 1	42 46	43 30	44 15	
		10	38 56	39 41	40 26	41 10	41 54	42 39	43 23	44 8	"
1		20	38 51	39 35	40 20	41 4	41 49	42 33	43 17	44 1	1 07
2		30	38 45	39 29	40 13	40 57	41 42	42 26	43 10	43 54	2 15
3		40	38 40	39 23	40 8	40 52	41 36	42 20	43 4	43 48	3 22
4		50	38 33	39 17	40 1	40 45	41 29	42 13	42 57	43 41	4 29
5	43	0	38 27	39 11	39 56	40 39	41 23	42 7	42 51	43 35	5 36
6		10	38 21	39 5	39 48	40 32	41 16	42 0	42 44	43 27	6 44
7		20	38 15	38 59	39 42	40 26	41 9	41 53	42 36	43 20	7 51
8		30	38 8	38 52	39 35	40 19	41 2	41 46	42 29	43 13	8 58
9		40	38 3	38 46	39 30	40 13	40 57	41 40	42 23	43 7	9 66
		50	37 56	38 39	39 23	40 6	40 49	41 33	42 16	42 59	
	44	0	37 50	38 34	39 17	40 0	40 43	41 26	42 10	42 53	
		10	37 44	38 27	39 10	39 53	40 36	41 19	42 3	42 46	"
1		20	37 38	38 20	39 4	39 46	40 29	41 12	41 55	42 38	1 07
2		30	37 31	38 14	38 56	39 40	40 22	41 5	41 48	42 31	2 14
3		40	37 26	38 8	38 51	39 33	40 16	40 59	41 41	42 24	3 21
4		50	37 18	38 1	38 44	39 26	40 9	40 51	41 34	42 17	4 28
5	45	0	37 13	37 55	38 3	39 21	40 3	40 45	41 28	42 10	5 35
6		10	37 7	37 49	38 3	39 14	39 56	40 39	41 21	42 3	6 42
7		20	37 0	37 42	38 24	39 6	39 48	40 31	41 13	41 55	7 49
8		30	36 53	37 35	38 17	38 59	39 41	40 23	41 5	41 48	8 56
9		40	36 47	37 29	38 11	38 53	39 35	40 17	40 59	41 41	9 63
		50	36 40	37 22	38 4	38 46	39 28	40 10	40 51	41 33	
	46	0	36 35	37 17	37 56	38 40	39 21	40 3	40 45	41 26	
		10	36 28	37 9	37 51	38 33	39 14	39 56	40 37	41 19	"
1		20	36 21	37 3	37 44	38 26	39 7	39 48	40 30	41 11	1 07
2		30	36 14	36 56	37 37	38 18	38 59	39 41	40 22	41 3	2 14
3		40	36 9	36 49	37 31	38 12	38 53	39 34	40 15	40 57	3 20
4		50	36 1	36 43	37 24	38 5	38 46	39 27	40 8	40 49	4 27
5	47	0	35 56	36 37	37 17	37 58	38 40	39 20	40 1	40 42	5 34
6		10	35 49	36 29	37 10	37 51	38 32	39 13	39 53	40 24	6 41
7		20	35 42	36 23	37 3	37 44	38 25	39 5	39 46	40 26	7 48
8		30	35 35	36 16	36 56	37 37	38 17	38 58	39 38	40 19	8 55
9		40	35 29	36 9	36 50	37 30	38 11	38 51	39 32	40 12	9 62
		50	35 22	36 2	36 42	37 22	38 3	38 44	39 24	40 4	
	48	0	35 16	35 56	36 36	37 16	37 57	38 37	39 17	39 57	
		10	35 9	35 49	36 29	37 9	37 49	38 29	39 9	39 49	"
1		20	35 2	35 42	36 21	37 1	37 42	38 21	39 1	39 41	1 06
2		30	34 55	35 34	36 15	36 54	37 34	38 13	38 54	39 33	2 13
3		40	34 49	35 28	36 8	36 47	37 28	38 7	38 47	39 24	3 19
4		50	34 42	35 21	36 1	36 40	37 20	37 59	38 39	39 28	4 26
5	49	0	34 35	35 14	35 53	36 33	37 12	37 52	38 31	39 10	5 32
6		10	34 28	35 7	35 46	36 25	37 4	37 44	38 23	39 2	6 39
7		20	34 21	35 0	35 39	36 18	36 58	37 37	38 16	38 55	7 46
8		30	34 14	34 53	35 32	36 11	36 50	37 29	38 8	38 47	8 52
9		40	34 7	34 46	35 26	36 4	36 43	37 22	38 1	38 40	9 59
		50	34 1	34 40	35 18	35 57	36 36	37 15	37 53	38 32	

TABLE XVII.—CORRECTION OF THE MOON'S ALTITUDE.

P. P. for Alt.	Moon's App. Alt.	Moon's Horizontal Parallax.									P. P. for Par.
		54'	55'	56'	57'	58'	59'	60'	61'		
1	0	28 1	28 33	29 5	29 37	30 8	30 40	31 12	31 44		
	10	27 53	28 25	28 56	29 28	29 59	30 31	31 3	31 34		
	20	27 45	28 16	28 48	29 19	29 51	30 22	30 54	31 25		
	30	27 37	28 8	28 40	29 11	29 42	30 14	30 45	31 16		
	40	27 29	28 0	28 31	29 2	29 34	30 5	30 36	31 7		
	50	27 22	27 53	28 24	28 55	29 26	29 57	30 28	30 59		
	59	27 14	27 45	28 15	28 47	29 17	29 48	30 19	30 50		
	10	27 6	27 36	28 7	28 38	29 9	29 39	30 10	30 41		
	20	26 58	27 29	28 0	28 30	29 1	29 31	30 2	30 33		
	30	26 51	27 21	27 51	28 22	28 52	29 22	29 53	30 24		
2	40	26 43	27 13	27 43	28 13	28 43	29 14	29 44	30 15		
	50	26 34	27 4	27 34	28 4	28 35	29 5	29 35	30 5		
	60	26 26	26 56	27 26	27 56	28 26	28 56	29 26	29 56		
	10	26 18	26 48	27 18	27 48	28 17	28 47	29 17	29 47		
	20	26 11	26 40	27 10	27 40	28 10	28 39	29 9	29 38		
	30	26 2	26 32	27 2	27 31	28 1	28 30	29 0	29 29		
	40	25 54	26 23	26 53	27 22	27 52	28 21	28 50	29 20		
	50	25 47	26 16	26 45	27 15	27 44	28 13	28 42	29 12		
	61	25 39	26 8	26 37	27 6	27 35	28 4	28 33	29 2		
	10	25 30	25 59	26 29	26 57	27 26	27 55	28 24	28 53		
3	20	25 22	25 51	26 20	26 48	27 17	27 46	28 15	28 44		
	30	25 14	25 42	26 11	26 40	27 9	27 37	28 6	28 35		
	40	25 6	25 34	26 2	26 31	27 0	27 28	27 57	28 25		
	50	24 58	25 27	25 55	26 24	26 52	27 20	27 48	28 16		
	62	24 50	25 18	25 46	26 15	26 43	27 11	27 39	28 7		
	10	24 42	25 10	25 38	26 6	26 34	27 2	27 30	27 58		
	20	24 34	25 2	25 30	25 58	26 26	26 54	27 22	27 49		
	30	24 26	24 54	25 22	25 49	26 17	26 44	27 12	27 40		
	40	24 17	24 45	25 13	25 40	26 8	26 35	27 3	27 31		
	50	24 10	24 37	25 4	25 32	25 59	26 26	26 53	27 21		
4	63	24 1	24 28	24 55	25 23	25 50	26 17	26 44	27 11		
	10	23 53	24 20	24 47	25 14	25 41	26 8	26 35	27 2		
	20	23 45	24 12	24 39	25 6	25 33	26 0	26 27	26 54		
	30	23 36	24 3	24 30	24 57	25 24	25 51	26 17	26 44		
	40	23 28	23 55	24 21	24 48	25 15	25 41	26 8	26 35		
	50	23 21	23 47	24 14	24 40	25 7	25 33	26 0	26 26		
	64	23 12	23 39	24 5	24 31	24 58	25 24	25 50	26 16		
	10	23 4	23 30	23 56	24 22	24 48	25 16	25 41	26 7		
	20	22 55	23 21	23 48	24 13	24 39	25 5	25 31	25 57		
	30	22 47	23 13	23 39	24 4	24 30	24 56	25 22	25 48		
40	22 39	23 4	23 30	23 55	24 21	24 47	25 12	25 38			
5	50	22 31	22 56	23 22	23 47	24 13	24 38	25 4	25 29		
	65	22 22	22 47	23 13	23 38	24 4	24 29	24 53	25 20		
	10	22 14	22 39	23 4	23 29	23 55	24 20	24 45	25 10		
	20	22 5	22 30	22 55	23 20	23 46	24 10	24 35	25 1		
	30	21 56	22 22	22 48	23 11	23 36	24 1	24 26	24 51		
	40	21 48	22 13	22 37	23 1	23 27	23 52	24 16	24 41		
	50	21 41	22 5	22 30	22 54	23 18	23 43	24 3	24 32		
	1	20	21 32	22 4	22 29	23 5	23 30	24 11	24 36		
	2	20	21 24	22 5	22 21	23 16	23 41	24 19	24 44		
	3	20	21 16	22 16	22 13	23 23	23 48	24 27	24 52		

TABLE XVII.—CORRECTION OF THE MOON'S ALTITUDE.

P. P. 1-2 Alt.	Moon's App. Alt.	MOON'S HORIZONTAL PARALLAX.								P. P. Per Pan.	
		54'	55'	56'	57'	58'	59'	60'	61'		
1	66	0	21 32	21 56	22 21	22 45	23 9	23 34	23 58	24 23	"
		10	21 23	21 47	22 12	22 36	23 0	23 24	23 48	24 13	
		20	21 16	21 40	22 4	22 28	22 52	23 16	23 40	24 4	
		30	21 7	21 31	21 55	22 19	22 43	23 7	23 31	23 54	
		40	20 58	21 22	21 46	22 10	22 33	22 57	23 21	23 45	
		50	20 49	21 13	21 37	22 0	22 24	22 48	23 11	23 35	
		60	20 41	21 4	21 28	21 51	22 15	22 38	23 1	23 25	
		70	20 32	20 55	21 19	21 42	22 6	22 29	22 52	23 15	
		80	20 25	20 48	21 11	21 34	21 57	22 20	22 43	23 7	
		90	20 16	20 39	21 2	21 25	21 48	22 11	22 34	22 56	
2	67	0	20 7	20 30	20 53	21 16	21 38	22 1	22 24	22 47	
		10	19 58	20 21	20 44	21 7	21 29	21 52	22 14	22 37	
		20	19 50	20 12	20 35	20 57	21 20	21 42	22 5	22 27	
		30	19 41	20 3	20 26	20 48	21 11	21 32	21 55	22 17	
		40	19 33	19 56	20 18	20 39	21 2	21 24	21 46	22 8	
		50	19 24	19 47	20 8	20 30	20 53	21 14	21 36	21 59	
		60	19 15	19 38	19 59	20 21	20 43	21 3	21 25	21 49	
		70	19 8	19 30	19 51	20 13	20 34	20 56	21 18	21 40	
		80	18 59	19 21	19 42	20 4	20 25	20 46	21 8	21 30	
		90	18 51	19 12	19 33	19 54	20 16	20 36	20 58	21 19	
3	69	0	18 42	19 3	19 24	19 45	20 6	20 27	20 49	21 10	
		10	18 33	18 54	19 15	19 36	19 57	20 18	20 39	21 0	
		20	18 24	18 45	19 6	19 27	19 46	20 8	20 29	20 50	
		30	18 16	18 37	18 58	19 18	19 39	19 59	20 20	20 41	
		40	18 7	18 28	18 48	19 9	19 29	19 50	20 10	20 31	
		50	17 58	18 19	18 39	18 59	19 20	19 40	20 1	20 21	
		60	17 49	18 10	18 30	18 50	19 10	19 31	19 50	20 11	
		70	17 41	18 1	18 20	18 41	19 1	19 20	19 41	20 1	
		80	17 33	17 53	18 12	18 32	18 52	19 12	19 32	19 51	
		90	17 24	17 44	18 3	18 23	18 42	19 2	19 22	19 42	
4	71	0	17 15	17 35	17 54	18 14	18 33	18 53	19 12	19 32	
		10	17 6	17 25	17 45	18 4	18 23	18 43	19 2	19 21	
		20	16 57	17 16	17 35	17 54	18 14	18 33	18 52	19 11	
		30	16 48	17 7	17 26	17 45	18 4	18 23	18 42	19 2	
		40	16 40	16 59	17 18	17 37	17 55	18 15	18 33	18 52	
		50	16 31	16 50	17 9	17 27	17 46	18 5	18 24	18 42	
		60	16 22	16 41	16 59	17 18	17 36	17 55	18 13	18 32	
		70	16 13	16 31	16 50	17 9	17 27	17 45	18 3	18 22	
		80	16 4	16 22	16 41	16 59	17 17	17 35	17 54	18 12	
		90	15 55	16 13	16 31	16 49	17 7	17 25	17 43	18 12	
5	73	0	15 47	16 5	16 23	16 41	16 59	17 17	17 35	17 52	
		10	15 38	15 56	16 14	16 31	16 49	17 7	17 25	17 42	
		20	15 30	15 47	16 4	16 22	16 40	16 57	17 14	17 32	
		30	15 21	15 38	15 55	16 13	16 30	16 47	17 5	17 22	
		40	15 11	15 28	15 46	16 3	16 20	16 37	16 55	17 12	
		50	15 2	15 19	15 36	15 53	16 10	16 28	16 44	17 2	
		60	14 54	15 11	15 28	15 45	16 2	16 18	16 35	16 52	
		70	14 45	15 2	15 18	15 35	15 52	16 9	16 26	16 42	
		80	14 36	14 53	15 10	15 27	15 44	16 0	16 17	16 33	
		90	14 27	14 44	15 0	15 17	15 34	15 51	16 8	16 24	

TABLE XVII.—CORRECTION OF THE MOON'S ALTITUDE.

P. P. for Alt.	Moon's App. Alt.	MOON'S HORIZONTAL PARALLAX.										P. P. Par.
		54	55	56	57	58	59	60	61			
	74	0	14 36	14 53	15 9	15 26	15 42	15 59	16 15	16 32		
		10	14 27	14 44	15 0	15 16	15 32	15 49	16 5	16 21		
1	1	20	14 18	14 34	14 50	15 6	15 23	15 39	15 55	16 11	1 0.3	
2	2	30	14 9	14 25	14 41	14 57	15 13	15 29	15 45	16 1	2 0.5	
3	3	40	14 1	14 16	14 33	14 48	15 4	15 20	15 36	15 52	3 0.8	
4	4	50	13 52	14 7	14 23	14 39	14 54	15 10	15 26	15 42	4 1.1	
5	5	75	0	13 43	13 58	14 13	14 29	14 45	15 0	15 16	5 1.3	
6	6	10	13 33	13 49	14 4	14 19	14 35	14 50	15 6	15 21	6 1.6	
7	7	20	13 24	13 40	13 55	14 10	14 25	14 40	14 55	15 10	7 1.8	
8	8	30	13 15	13 30	13 45	14 0	14 15	14 30	14 45	15 0	8 2.1	
9	9	40	13 7	13 22	13 37	13 52	14 7	14 22	14 36	14 51	9 2.4	
		50	12 58	13 13	13 28	13 42	13 57	14 11	14 26	14 41		
	76	0	12 49	13 4	13 18	13 32	13 47	14 1	14 16	14 31		
		10	12 40	12 54	13 8	13 23	13 37	13 52	14 6	14 20		
1	1	20	12 31	12 44	12 59	13 13	13 27	13 41	13 56	14 10	1 0.2	
2	2	30	12 22	12 35	12 49	13 4	13 17	13 31	13 46	13 59	2 0.5	
3	3	40	12 13	12 27	12 41	12 55	13 9	13 23	13 36	13 50	3 0.7	
4	4	50	12 4	12 18	12 32	12 45	12 59	13 12	13 26	13 39	4 0.9	
5	5	77	0	11 55	12 8	12 22	12 35	12 49	13 8	13 29	5 1.1	
6	6	10	11 45	11 59	12 12	12 26	12 40	12 53	13 7	13 20	6 1.4	
7	7	20	11 37	11 51	12 3	12 16	12 30	12 43	12 57	13 10	7 1.6	
8	8	30	11 28	11 41	11 54	12 7	12 21	12 34	12 47	13 0	8 1.8	
9	9	40	11 19	11 32	11 45	11 58	12 11	12 24	12 37	12 49	9 2.1	
		50	11 11	11 23	11 36	11 49	12 1	12 14	12 26	12 39		
	78	0	11 2	11 14	11 26	11 39	11 51	12 4	12 16	12 29		
		10	10 52	11 5	11 17	11 29	11 42	11 54	12 6	12 19		
1	1	20	10 43	10 55	11 8	11 20	11 32	11 44	11 56	12 8	1 0.2	
2	2	30	10 34	10 46	10 58	11 10	11 22	11 34	11 46	11 58	2 0.4	
3	3	40	10 26	10 38	10 49	11 1	11 12	11 24	11 36	11 48	3 0.6	
4	4	50	10 17	10 28	10 39	10 51	11 3	11 14	11 26	11 38	4 0.8	
5	5	79	0	10 7	10 18	10 30	10 41	10 53	11 4	11 16	5 1.0	
6	6	10	9 58	10 9	10 21	10 32	10 43	10 54	11 6	11 17	6 1.2	
7	7	20	9 48	10 0	10 11	10 22	10 33	10 44	10 56	11 7	7 1.4	
8	8	30	9 39	9 50	10 2	10 13	10 24	10 35	10 46	10 57	8 1.6	
9	9	40	9 31	9 42	9 52	10 3	10 14	10 25	10 35	10 46	9 1.8	
		50	9 22	9 33	9 43	9 53	10 4	10 15	10 25	10 36		
	80	0	9 13	9 23	9 33	9 44	9 54	10 5	10 15	10 25		
		10	9 3	9 14	9 24	9 34	9 44	9 55	10 5	10 15		
1	1	20	8 54	9 4	9 15	9 25	9 35	9 45	9 55	10 5	1 0.2	
2	2	30	8 45	8 55	9 5	9 15	9 25	9 35	9 45	9 55	2 0.3	
3	3	40	8 36	8 46	8 56	9 5	9 15	9 25	9 34	9 44	3 0.5	
4	4	50	8 27	8 37	8 46	8 56	9 5	9 15	9 24	9 34	4 0.6	
5	5	81	0	8 18	8 27	8 37	8 46	8 55	9 5	9 14	5 0.8	
6	6	10	8 9	8 18	8 27	8 36	8 45	8 55	9 4	9 13	6 1.0	
7	7	20	8 0	8 9	8 18	8 27	8 36	8 45	8 54	9 3	7 1.1	
8	8	30	7 50	7 59	8 8	8 17	8 26	8 35	8 44	8 52	8 1.2	
9	9	40	7 41	7 50	7 59	8 7	8 16	8 25	8 33	8 42	9 1.3	
		50	7 32	7 41	7 49	7 58	8 6	8 15	8 23	8 32		

TABLE VIII.

LONGITUDES FOR FINDING THE HORIZONTAL AREA OF A TRIANGLE.

Mins.	2 Hours.	Diff.	3 Hours.	Diff.	4 Hours.	Diff.	5 Hours.	Diff.	6 Hours.	Diff.	7 Hours.	Diff.	Mins.
0	8465998	11737	9165679	7608	9139790	5457	9168824	4107	9169870	3152	9170933	2418	40
1	813094	11635	170240	401214	401214	3438	571358	4088	700861	3138	800384	2407	39
2	840015	11533	194773	7555	404471	5401	573811	4070	702743	3124	801228	2396	58
3	846976	11431	179278	7509	407713	5375	576253	4052	704618	3110	802066	2385	57
4	853798	11340	183736	7418	410938	5348	578684	4033	706484	3097	802907	2375	56
5	860608	11245	9188207	7373	914147	5322	9138104	4015	9170832	3083	9126122	2364	55
6	867349	11152	192631	7329	417340	5296	583513	3997	710192	3070	807340	2353	54
7	874040	11061	197028	7285	420517	5270	585911	3980	712074	3057	808025	2342	53
8	880676	10970	201949	7241	423679	5243	588299	3962	713868	3043	810357	2332	52
9	887258	10880	205725	7198	426825	5217	590676	3944	715694	3030	811796	2321	51
10	893785	10792	9220064	7156	9122955	5192	9199028	3927	9171512	3017	9121349	2311	50
11	900261	10706	214358	7114	433070	5167	595338	3910	719322	3005	814535	2300	49
12	906684	10620	218227	7073	436170	5142	597744	3892	721124	2992	815915	2289	48
13	913055	10536	222870	7032	439255	5117	600078	3875	722919	2978	817289	2279	47
14	919377	10453	227029	6991	442325	5092	602403	3857	724705	2965	818656	2268	46
15	925648	10371	9231224	6950	9142379	5067	9160477	3840	9176624	2952	9180017	2258	45
16	931871	10290	235494	6910	446419	5043	607021	3823	728255	2939	821378	2248	44
17	938045	10210	239800	6870	451445	5018	609315	3806	730018	2926	822721	2237	43
18	944171	10132	244222	6831	456455	4993	611598	3790	731774	2913	824065	2227	42
19	950251	10055	248781	6792	461451	4969	613872	3772	733522	2900	825399	2217	41
20	956284		253497		466433		616155		735262		826729		40
21 Hours.		Diff.	20 Hours.	Diff.	19 Hours.	Diff.	18 Hours.	Diff.	17 Hours.	Diff.	16 Hours.	Diff.	Mins.

TABLE XVIII.

ALGORITHMS FOR FINDING THE HORARY ANGLE OR APPARENT TIME.

Min.	2 Hours.	3 Hours.	4 Hours.	5 Hours.	6 Hours.	7 Hours.	D.M.E.	Min.
40	9°05'103	9°32'8811	9°51'7183	9°59'9367	9°768'908	9°580'528	2007	20
41	07'3293	312'4423	519'813	661'410	770'094	853'263	1998	19
42	07'3446	316'033	522'570	663'445	771'674	854'461	1988	18
43	08'3305	319'645	523'245	665'530	773'247	855'644	1979	17
44	08'3651	323'219	527'908	667'567	774'812	856'811	1969	16
45	9°09'3702	9°34'6773	9°53'0559	9°66'9594	9°77'6371	9°85'8022	1959	15
46	09'6720	350'309	533'197	671'613	777'922	859'198	1949	14
47	10'3706	353'827	535'823	673'623	779'467	860'367	1940	13
48	10'4658	357'326	538'437	675'621	781'005	861'532	1931	12
49	11'3379	360'807	541'040	677'617	782'536	862'690	1921	11
50	9°11'8468	9°36'2570	9°54'3630	9°67'9601	9°78'4061	9°86'5843	1912	10
51	12'3325	367'715	546'208	681'576	785'578	864'990	1903	9
52	12'8351	371'142	548'775	683'543	787'089	866'152	1893	8
53	13'0946	374'552	551'330	685'501	788'593	867'267	1884	7
54	13'7711	377'945	553'874	687'450	790'090	868'397	1874	6
55	9°14'2446	9°38'3300	9°55'6406	9°68'9391	9°79'1580	9°86'9522	1865	5
56	14'7151	384'678	558'926	691'324	792'064	870'641	1856	4
57	15'1826	388'018	562'435	693'248	794'541	871'754	1846	3
58	15'6473	391'348	565'933	695'163	796'012	872'862	1837	2
59	16'1090	394'650	568'419	697'071	797'476	873'964	1828	1
60	16'5679	397'940	568'894	698'970	798'933	875'061		0
	21 Hours.	20 Hours.	19 Hours.	18 Hours.	17 Hours.	16 Hours.	D.M.E. <td></td>	

TABLE XIX.
COMMON AND HYPERBOLIC LOGARITHMS.

Common Logarithms.	Hyp. Logarithms.	Hyperbolic Logarithms.	Com. Logarithms.
1°	2'3025851	1°	°4342945
2°	4'6051702	2°	°8685890
3°	6'9077553	3°	1°3028834
4°	9'2103404	4°	1°7371779
5°	11'5129255	5°	2°1714724
6°	13'8155106	6°	2°6057669
7°	16'1180957	7°	3°0400614
8°	18'4206807	8°	3°4743559
9°	20'7232658	9°	3°9086503

TABLE XX.
CURVATURE OF THE EARTH AND REFRACTION.

Distance in Chains.	Curvature.	Curvature and Refraction.	Distance in Miles.	Curvature.	Curvature and Refraction.
1	Feet. °00010	Feet. °00009	1	Feet. °67	Feet. °57
2	°00042	°00036	2	2°67	2°29
3	°00094	°00080	3	6°00	5°14
4	°00167	°00143	4	10°67	9°15
5	°00261	°00223	5	16°67	14°29
6	°00375	°00322	6	24°00	20°57
7	°00511	°00438	7	32°68	28°01
8	°00667	°00572	8	42°69	36°60
9	°00844	°00724	9	54°02	46°30
10	°01042	°00893	10	66°70	57°17
11	°01261	°01081	11	80°71	69°18
12	°01501	°01286	12	96°05	72°33
13	°01761	°01510	13	112°72	96°62
14	°02043	°01751	14	130°73	112°05
15	°02345	°02010	15	150°08	128°64
16	°02668	°02287	16	170°75	146°36
17	°03012	°02582	17	192°77	165°23
18	°03377	°02894	18	216°10	185°23
19	°03762	°03225	19	240°80	206°40
20	°04169	°03573	20	266°80	228°68
30	°16685	°14302	25	416°88	357°22
60	°37519	°32173	30	600°30	514°39

TABLE XXI.—TRIGONOMETRICAL EQUIVALENTS.

(Arc c = half the arc a .)

$$\begin{aligned}
 (1.) \quad \sin a &= \cos a \cdot \tan a = \frac{\cos a}{\cot a} = \sqrt{1 - (\cos a)^2} = \frac{1}{\operatorname{cosec} a} \\
 &= \frac{1}{\sqrt{1 + (\cot a)^2}} = \frac{\tan a}{\sqrt{1 + (\tan a)^2}} = 2 \sin c \cdot \cos c \\
 &= \sqrt{\frac{1 - \cos 2c}{2}} = \frac{2 \tan c}{1 + (\tan c)^2} = \frac{2}{\cot c + \tan c} \\
 &= \frac{1}{\cot a + \tan a} = 2 \{ \sin (45^\circ + c) \}^2 - 1 = 1 - 2 \{ \sin (45^\circ - c) \}^2 \\
 &= \frac{1 - \{ \tan (45^\circ - c) \}^2}{1 + \{ \tan (45^\circ - c) \}^2} = \sin (60^\circ + a) - \sin (60^\circ - a).
 \end{aligned}$$

$$\begin{aligned}
 (2.) \quad \cos a &= \sin a \cdot \cot a = \frac{\sin a}{\tan a} = \sqrt{1 - (\sin a)^2} = \frac{1}{\sec a} \\
 &= \frac{1}{\sqrt{1 + (\tan a)^2}} = \frac{\cot a}{\sqrt{1 + (\cot a)^2}} = (\cos c)^2 - (\sin c)^2 \\
 &= 1 - 2 (\sin c)^2 = 2 (\cos c)^2 - 1 = \sqrt{\frac{1 + \cos 2c}{2}} \\
 &= \frac{1 - (\tan c)^2}{1 + (\tan c)^2} = \frac{\cot c - \tan c}{\cot c + \tan c} = \frac{1}{1 + \tan a \cdot \tan c}
 \end{aligned}$$

$$\begin{aligned}
 (3.) \quad \tan a &= \frac{\sin a}{\cos a} = \frac{1}{\cot a} = \sqrt{\frac{1}{(\cos a)^2} - 1} = \sqrt{(\sec a)^2 - 1} \\
 &= \frac{\sec a}{\operatorname{cosec} a} = \frac{\sin a}{\sqrt{1 - (\sin a)^2}} = \frac{\sin a \cdot \cos a}{\cot a} = \frac{\sqrt{1 - (\cos a)^2}}{\cos a} \\
 &= \frac{2 \tan c}{1 - (\tan c)^2} = \frac{2 \cot c}{(\cot c)^2 - 1} = \frac{2}{\cot c - \tan c} = \frac{1 - \cos 2c}{\sin 2c} \\
 &= \cot a - 2 \cot 2c = \frac{\sin 2c}{1 + \cos 2c} = \sqrt{\frac{1 - \cos 2c}{1 + \cos 2c}}
 \end{aligned}$$

$$(4.) \quad \cot a = \sqrt{(\operatorname{cosec} a)^2 - 1} = \frac{\cos a}{\sin a} = \frac{1}{\tan a} = \text{the reciprocals of the above expressions for the tangent.}$$

$$(5.) \quad \sec a = \sqrt{1 + (\tan a)^2} = \frac{\tan a}{\sin a} = \frac{1}{\cos a} = \text{the reciprocals of the above expressions for the cosine.}$$

$$(6.) \quad \operatorname{cosec} a = \sqrt{1 + (\cot a)^2} = \frac{\sec a}{\tan a} = \sec a \cdot \cot a = \frac{1}{\sin a} = \text{the reciprocals of the above expressions for the sine.}$$

$$(7.) \quad \operatorname{Havers} a = \frac{(\sin a)^2}{1 + \cos a}$$

$$(8.) \quad \operatorname{Covers} a = \frac{(\cos a)^2}{1 + \sin a}$$

TABLE XXII.—EXPRESSIONS FOR MULTIPLE ANGLES.

- (2.) $\sin 2a = 2 \sin a \cdot \cos a$.
 (3.) $\sin 3a = 3 \sin a - 4 (\sin a)^3$.
 (4.) $\sin 4a = \cos a \{4 \sin a - 8 (\sin a)^3\}$.
 (5.) $\sin 5a = 5 \sin a - 20 (\sin a)^3 + 16 (\sin a)^5$.
 (6.) $\sin na = 2^{n-1} \cdot \sin \beta \cdot \sin \left(\beta + \frac{\sigma}{n} \right) \cdot \sin \left(\beta + \frac{2\sigma}{n} \right) + \dots$
 (7.) $= \cos a \left\{ (2 \sin a)^{n-1} - \frac{n-2}{1} (2 \sin a)^{n-3} \right.$

- (9.) $\cos 2a = 2 (\cos a)^2 - 1$.
 (10.) $\cos 3a = 4 (\cos a)^3 - 3 \cos a$.
 (11.) $\cos 4a = 8 (\cos a)^4 - 8 (\cos a)^2 + 1$.
 (12.) $\cos 5a = 16 (\cos a)^5 - 20 (\cos a)^3 + 5 \cos a$.
 (13.) $\cos na = \dots$

...
 $+ \&c. \}$

- (14.) $\tan \frac{a}{2} = \frac{\tan a}{1 + \sqrt{1 + (\tan a)^2}}$.
 (15.) $\tan 2a = \frac{2 \tan a}{1 - (\tan a)^2}$.
 (16.) $\tan 3a = \frac{3 \tan a - (\tan a)^3}{1 - 3 (\tan a)^2}$.
 (17.) $\tan 4a = \frac{4 \tan a - 4 (\tan a)^3}{1 - 6 (\tan a)^2 + (\tan a)^4}$.
 (18.) $\tan 5a = \frac{5 \tan a - 10 (\tan a)^3 + (\tan a)^5}{1 - 10 (\tan a)^2 + 5 (\tan a)^4}$.
 (19.) $\cot \frac{a}{2} = \frac{1}{\sqrt{1 + (\cot a)^2} - \cot a}$.
 (20.) $\cot 2a = \frac{(\cot a)^2 - 1}{2 \cot a}$.
 (21.) $\cot 3a = \frac{(\cot a)^3 - 3 \cot a}{3 (\cot a)^2 - 1}$.
 (22.) $\cot 4a = \frac{(\cot a)^4 - 6 (\cot a)^2 + 1}{4 (\cot a)^3 - 4 \cot a}$.
 (23.) $\cot 5a = \frac{(\cot a)^5 - 10 (\cot a)^3 + 5 \cot a}{5 (\cot a)^4 - 10 (\cot a)^2 + 1}$.

TABLE XXIII.—FORMULÆ RELATING TO TWO ANGLES OR ARCS.

- (1.) $\sin (\alpha + \beta) = \sin \alpha \cdot \cos \beta + \cos \alpha \cdot \sin \beta$.
- (2.) $\sin (\alpha - \beta) = \sin \alpha \cdot \cos \beta - \cos \alpha \cdot \sin \beta$.
- (3.) $\cos (\alpha + \beta) = \cos \alpha \cdot \cos \beta - \sin \alpha \cdot \sin \beta$.
- (4.) $\cos (\alpha - \beta) = \cos \alpha \cdot \cos \beta + \sin \alpha \cdot \sin \beta$.
- (5.) $\tan (\alpha + \beta) = \frac{\tan \alpha + \tan \beta}{1 - \tan \alpha \cdot \tan \beta}$.
- (6.) $\tan (\alpha - \beta) = \frac{\tan \alpha - \tan \beta}{1 + \tan \alpha \cdot \tan \beta}$.
- (7.) $\cot (\alpha + \beta) = \frac{\cot \alpha \cdot \cot \beta - 1}{\cot \beta + \cot \alpha}$.
- (8.) $\cot (\alpha - \beta) = \frac{\cot \alpha \cdot \cot \beta + 1}{\cot \beta - \cot \alpha}$.
- (9.) $\sin (\alpha + \beta) \cdot \sin (\alpha - \beta) = (\sin \alpha)^2 - (\sin \beta)^2 = (\cos \beta)^2 - (\cos \alpha)^2$.
- (10.) $\cos (\alpha + \beta) \cdot \cos (\alpha - \beta) = (\cos \alpha)^2 - (\sin \beta)^2 = (\cos \beta)^2 - (\sin \alpha)^2$.
- (11.) $\frac{\sin (\alpha + \beta)}{\sin (\alpha - \beta)} = \frac{\tan \alpha + \tan \beta}{\tan \alpha - \tan \beta} = \frac{\cot \beta + \cot \alpha}{\cot \beta - \cot \alpha}$.
- (12.) $\frac{\cos (\alpha + \beta)}{\sin (\alpha - \beta)} = \frac{\cot \beta - \tan \alpha}{\cot \beta + \tan \alpha} = \frac{\cot \alpha - \tan \beta}{\cot \alpha + \tan \beta}$.
- (13.) $\sin \alpha + \sin \beta = 2 \sin \frac{1}{2} (\alpha + \beta) \cdot \cos \frac{1}{2} (\alpha - \beta)$.
- (14.) $\sin \alpha - \sin \beta = 2 \sin \frac{1}{2} (\alpha - \beta) \cdot \cos \frac{1}{2} (\alpha + \beta)$.
- (15.) $\cos \alpha + \cos \beta = 2 \cos \frac{1}{2} (\alpha + \beta) \cdot \cos \frac{1}{2} (\alpha - \beta)$.
- (16.) $\cos \alpha - \cos \beta = 2 \sin \frac{1}{2} (\alpha - \beta) \cdot \sin \frac{1}{2} (\alpha + \beta)$.
- (17.) $\tan \alpha + \tan \beta = \frac{\sin (\alpha + \beta)}{\cos \alpha \cdot \cos \beta}$.
- (18.) $\tan \alpha - \tan \beta = \frac{\sin (\alpha - \beta)}{\cos \alpha \cdot \cos \beta}$.
- (19.) $\cot \alpha + \cot \beta = \frac{\sin (\alpha + \beta)}{\sin \alpha \cdot \sin \beta}$.
- (20.) $\cot \alpha - \cot \beta = \frac{\sin (\alpha - \beta)}{\sin \alpha \cdot \sin \beta}$.
- (21.) $2 \sin \alpha \cdot \cos \beta = \sin (\alpha + \beta) + \sin (\alpha - \beta)$.
- (22.) $2 \cos \alpha \cdot \sin \beta = \sin (\alpha + \beta) - \sin (\alpha - \beta)$.
- (23.) $2 \cos \alpha \cdot \cos \beta = \cos (\alpha + \beta) + \cos (\alpha - \beta)$.
- (24.) $2 \sin \alpha \cdot \sin \beta = \cos (\alpha - \beta) - \cos (\alpha + \beta)$.
- (25.) $\tan (\alpha + \beta + \gamma) = \frac{\tan (\alpha + \beta) + \tan \gamma}{1 - \tan (\alpha + \beta) \cdot \tan \gamma}$
 $= \frac{\tan \alpha + \tan \beta + \tan \gamma - \tan \alpha \cdot \tan \beta \cdot \tan \gamma}{1 - \tan \alpha \cdot \tan \beta - \tan \alpha \cdot \tan \gamma - \tan \beta \cdot \tan \gamma}$
- If $\alpha + \beta + \gamma = \pi$.
- (26.) $\tan \alpha + \tan \beta + \tan \gamma = \tan \alpha \cdot \tan \beta \cdot \tan \gamma$.

TABLE XXIV.—TRIGONOMETRICAL EXPRESSIONS.

Expressions for the sin, cos, tan, and cot, in terms of the arc a .

$$(1.) \sin a = a - \frac{a^3}{1 \cdot 2 \cdot 3} + \frac{a^5}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5} - \frac{a^7}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6 \cdot 7} + \&c.$$

$$= a \left(1 - \frac{a^2}{6} \right) \cdot \left(1 - \frac{a^2}{42} \right) \cdot \left(1 - \frac{a^2}{360} \right) \&c.$$

$$(2.) \cos a = 1 - \frac{a^2}{1 \cdot 2} + \frac{a^4}{1 \cdot 2 \cdot 3 \cdot 4} - \frac{a^6}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6} + \&c.$$

$$= \left(1 - \frac{a^2}{2} \right) \cdot \left(1 - \frac{a^2}{6} \right) \cdot \left(1 - \frac{a^2}{120} \right) \cdot \&c.$$

$$(3.) \tan a = \frac{3a}{a^2 - 4a^3} + \frac{8a}{9a^3 - 4a^4} + \frac{2a}{25a^5 - 4a^6} + \&c.$$

$$(4.) \cot a = \frac{1}{a} - \frac{2a}{a^2 - a^3} - \frac{2a}{4a^2 - a^3} - \&c.$$

Expressions for the arc in terms of the sin and tan.

$$(5.) \text{Arc } a = \sin a + \frac{(\sin a)^3}{1 \cdot 2 \cdot 3} + \frac{1 \cdot 3 \cdot (\sin a)^5}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5} + \&c.$$

$$(6.) \text{Arc } a = \tan a - \frac{(\tan a)^3}{3} + \frac{(\tan a)^5}{5} - \&c.$$

Expressions for the powers of the sin and cos.

$$(7.) 2(\sin a)^2 = 1 - \cos 2a,$$

$$(8.) 4(\sin a)^4 = 3 \sin a - \sin 3a,$$

$$(9.) 8(\sin a)^6 = 3 - 4 \cos 2a + \cos 4a,$$

$$(10.) 16(\sin a)^8 = \sin 5a - 5 \sin 3a + 10 \sin a,$$

$$(11.) 2^n (\sin a)^n = \pm 2 \sin na \mp 2n \cdot \sin(n-2)a \pm \frac{2n(n-1)}{1 \cdot 2} \sin(n-4)a$$

$$\mp \frac{2n(n-1) \cdot (n-2)}{1 \cdot 2 \cdot 3} \sin(n-6)a \pm \&c.$$

$$(12.) \text{Or, } 2^n (\sin a)^n = \pm 2 \cos na \mp 2n \cdot \cos(n-2)a \pm \frac{2n(n-1)}{1 \cdot 2} \cos(n-4)a$$

$$\mp \frac{2n(n-1) \cdot (n-2)}{1 \cdot 2 \cdot 3} \cos(n-6)a \pm \&c.$$

When n is of the form $4m+1$, use series (11) with the upper signs." " " " $4m-1$, " (11) " lower sign." " " " $4m$, " (12) " upper sign." " " " $4m+2$, " (12) " lower sign.

$$(13.) 2(\cos a)^2 = \cos 2a + 1,$$

$$(14.) 4(\cos a)^4 = \cos 3a + 3 \cos a,$$

$$(15.) 8(\cos a)^6 = \cos 4a + 7 \cos 2a + 3,$$

$$(16.) 16(\cos a)^8 = \cos 5a + 5 \cos 3a + 10 \cos a.$$

$$(17.) 2^n (\cos a)^n = 2 \cos na + 2n \cdot \cos(n-2)a \mp \frac{2n(n-1)}{1 \cdot 2} \cos(n-4)a$$

$$\mp \frac{2n(n-1) \cdot (n-2)}{1 \cdot 2 \cdot 3} \cos(n-6)a \pm \&c.$$

The formulae ending in $\frac{2n(n-1) \cdot (n-2)}{1 \cdot 2 \cdot 3} \cdot \&c. \cos(n-n)a$, or in $\frac{2n(n-1) \cdot (n-2)}{1 \cdot 2 \cdot 3} \cdot \&c. \cos a$, according as n is an even or an odd number,

and in the former case half the expression is to be taken for the last term.

TABLE XXV.—FORMULÆ FOR SOLVING ALL THE CASES OF A RECTILINEAL TRIANGLE, OF WHICH THREE PARTS ARE KNOWN.

Value of any side, as A.

$$(1.) A = \frac{B \sin a}{\sin \beta}$$

$$(2.) = \frac{C \sin a}{\sin \gamma}$$

$$(3.) = \frac{B}{\cos \gamma + \sin \gamma \cot a}$$

$$(4.) = \frac{C}{\cos \beta + \sin \beta \cot a}$$

$$(5.) = B \cos \gamma + B \sin \gamma \cot \beta$$

$$(6.) = C \cos \beta + C \sin \beta \cot \gamma$$

$$(7.) = \sqrt{B^2 + C^2 - 2 B \cdot C \cos a}$$

$$(8.) = B \cos \gamma \pm \sqrt{C^2 - B^2 \cdot (\sin \gamma)^2}$$

$$(9.) = C \cos \beta \pm \sqrt{B^2 - C^2 \cdot (\sin \beta)^2}$$



Value of the sin of any angle, as β .

$$(10.) \sin \beta = \frac{B \sin a}{A}$$

$$(11.) = \frac{B \sin \gamma}{C}$$

$$(12.) = \sin(\gamma + a)$$

$$(13.) = \sin \gamma \cos a + \cos \gamma \sin a$$

$$(14.) = \frac{B \sin a}{\sqrt{B^2 + C^2 - 2 B \cdot C \cos a}}$$

$$(15.) = \frac{B \sin \gamma}{\sqrt{B^2 + A^2 - 2 B \cdot A \cos \gamma}}$$

$$(16.) = \sqrt{1 - \left(\frac{A^2 + C^2 - B^2}{2 A \cdot C} \right)^2}$$

$$(17.) = \frac{\sin a \left\{ C \cos a \pm \sqrt{A^2 - C^2 \cdot (\sin a)^2} \right\}}{A}$$

$$(18.) = \frac{\sin \gamma \left\{ A \cos \gamma \pm \sqrt{C^2 - A^2 \cdot (\sin \gamma)^2} \right\}}{C}$$

TABLE XXVI.—TRIGONOMETRICAL FORMULÆ FOR THE SOLUTION OF QUADRATES AND CUBES.

EQUATIONS OF THE SECOND DEGREE.	
(1.) $x^2 + px = q$.	(4.) $x^2 - px = -q$.
Let $\tan \alpha = \frac{2}{p} \sqrt{q}$.	$\sin \alpha = \frac{2}{p} \sqrt{\frac{q}{3}}$.
Root $x = \sqrt{q} \cdot \tan \frac{1}{2} \alpha$,	$x = \sqrt{q} \cdot \tan \frac{1}{2} \alpha$,
and Root $x = -\sqrt{q} \cdot \cot \frac{1}{2} \alpha$.	$x = \sqrt{q} \cdot \cot \frac{1}{2} \alpha$.
EQUATIONS OF THE THIRD DEGREE.	
(5.) $x^3 + px + q = 0$.	(8.) $x^3 - px - q = 0$.
Let $\tan \alpha = \frac{p}{3q} \sqrt{\frac{p}{3}}$.	$\sin \alpha = \frac{p}{3q} \sqrt{\frac{p}{3}}$,
Let $\tan \beta = \sqrt{\tan \frac{1}{2} \alpha}$.	$\tan \alpha = \sqrt{\tan \frac{1}{2} \alpha}$,
Only real root $x = -2\sqrt{\frac{p}{3}} \cdot \cot \frac{1}{2} \beta$.	$x = \sqrt{\frac{p}{3}}$.
	$x = \frac{p}{\sin \frac{1}{2} \beta}$.
	(11.) $x^3 - px - q = 0$.
	$\sin \frac{1}{2} \alpha = \frac{q}{p}$.
	$x = -2\sqrt{\frac{p}{3}} \cdot \sin \alpha$.
	$x = -2\sqrt{\frac{p}{3}} \cdot \sin(50^\circ - \alpha)$.
	$x = 2\sqrt{\frac{p}{3}} \cdot \sin(60^\circ + \alpha)$.

If $p^2 \Delta 4q$ is imaginary.

When $4p^3 \Delta 27q^2$.

When $4p^3 >$ or $= 27q^2$, the following will be the solution of the two last cases.

TABLE XXVII.—DIFFERENTIAL COEFFICIENTS.

Value of u .	Value of $\frac{d u}{d x}$.
(1.) x .	1.
(2.) πx	π .
(3.) x^n .	πx^{n-1} .
(4.) $\log_b x$.	$\frac{m}{x}$ in which m is the modulus of the system of logarithms.
(5.) $\log_e x$.	$\frac{1}{x}$ [$e = 2.7182818$.]
(6.) a^x .	$a^x \log_e a$.
(7.) $\sin x$.	$\cos x$.
(8.) $\cos x$.	$-\sin x$.
(9.) $\tan x$.	$\frac{1}{(\cos x)^2}$.
(10.) $\cot x$.	$-\frac{1}{(\sin x)^2}$.
(11.) $(\sin x)^2$.	$2 \sin x \cdot \cos x$.
(12.) $(\cos x)^2$.	$-2 \sin x \cdot \cos x$.
(13.) $(\tan x)^2$.	$\frac{2 \tan x}{(\cos x)^2}$.
(14.) $(\cot x)^2$.	$\frac{2 \cot x}{(\sin x)^2}$.
(15.) $\sin^{-1} x$.	$\frac{1}{\sqrt{1-x^2}}$.
(16.) $\cos^{-1} x$.	$-\frac{1}{\sqrt{1-x^2}}$.
(17.) $\tan^{-1} x$.	$\frac{1}{1+x^2}$.
(18.) $\phi x \pm \psi x$.	$\frac{d(\phi x)}{d x} \pm \frac{d(\psi x)}{d x}$.
(19.) $\frac{\phi x}{\psi x}$.	$\frac{\psi x \cdot \frac{d(\phi x)}{d x} - \phi x \cdot \frac{d(\psi x)}{d x}}{(\psi x)^2}$.
(20.) $f x \cdot \phi x \cdot \psi x$.	$\phi x \cdot \psi x \cdot \frac{d(f x)}{d x} + f x \cdot \psi x \cdot \frac{d(\phi x)}{d x} + f x \cdot \phi x \cdot \frac{d(\psi x)}{d x}$.
(21.) ϕv , in which $v = \psi x$.	$\frac{d(\psi x)}{d x} \cdot \frac{d(\phi v)}{d v}$.

TABLE XXVIII.
USEFUL NUMBERS, WITH THEIR LOGARITHMS.

	Number.	Logarithm.	Complement of Logarithm.
Circumference of a circle } whose dia. = 1 } = π =	3.1415927	0.4971499	9.5028501
Area of the same = $\frac{\pi}{4}$ =	0.7853982	1.8950899	10.1049101
Diameter of a circle } whose area = 1 } = $\sqrt{\frac{4}{\pi}}$ =	1.1283792	0.0524551	9.9475449
Surface of a sphere whose } dia. = 1 = π =	3.1415927	0.4971499	9.5028501
Solidity of the same = $\frac{\pi}{6}$ =	0.5235988	1.7189986	10.2810014
Diameter of a sphere } whose solidity = 1 } = $\sqrt[3]{\frac{6}{\pi}}$ =	1.2407010	0.0936672	9.9063328
Length of arc 1" = sin 1" (rad being unity) } = 0.00004848		6.6855749	15.3144251
Length of arc 2" = sin 2" (rad being unity) } = 0.00009696		6.9366049	15.0133951
Length of arc 3" = sin 3" (rad being unity) } = 0.000014544		5.1626961	14.8373039
Length of arc 1' = sin 1' (rad being unity) } = 0.000291888		4.4637261	13.5362739
Length of arc 1" (rad being unity) =	0.017453293	2.2418774	11.7581226
Length of sin 1" (rad being unity) =	0.017452406	2.2418553	11.7581447
Radius reduced to seconds =	2.062648	5.3144251	4.6855749
" " to minutes =	123.74677	3.5362739	6.4637261
" " to degrees =	57.295780	1.7581226	8.2418774
36. degrees expressed in seconds =	1296000	6.1126050	3.8873940
12 hours expressed in seconds =	43200	4.6354837	5.3645163
24 hours expressed in seconds =	86400	4.9365137	5.0634863
No. whose hyperbolic logs rithm is 1 =	2.718281829	0.4342944	9.5657056
Modulus of common logarithms =	2.302585093	1.6377843	10.3622157
No. of French metres in a toise =	1.949040	0.2898127	9.7101873
No. of English yards in a French toise } =	2.1315308	0.3286916	9.6713084
No. of English feet in a French toise } =	6.3945925	0.8058128	9.1941872
No. of English yards in a French metre } =	1.0936331	0.0388716	9.9611284
No. of English feet in a French metre } =	3.2808992	0.5159929	9.4840071
No. of English inches in a French metre } =	39.37079	1.5951742	8.4048258
No. of English feet in a French foot =	1.0657654	0.0276616	9.9723384
No. of English acres in a French are =	0.02471143	3.3928978	11.6071022
No. of imp. lbs. Troy in a French gramme } =	0.00268098	3.4282936	12.5717064

TABLE XXVIII.
USEFUL NUMBERS, WITH THEIR LOGARITHMS.

	Number.	Logarithm.	Complement of Logarithm.
No. of imp. lbs. Avord. in a French gramme	= 0'00220606	3 3436173	12 6563827
No. of English cwt. in a French kilogramme	= 0'0196969	2 2943979	11 7056021
No. of imp. gallons in a French litre	= 0 22009687	1 3426137	10 6573863
No. of Sexagesimal degrees in a Centesimal degree	= 0 9	1 9542425	10 0457575
No. of Sexagesimal minutes in a Centesimal minute	= 0 54	1 7323938	10 2676062
No. of Sexagesimal seconds in a Centesimal second	= 0 324	1 5105450	10 4894540
Weight of a cubic foot of pure water in lbs. Avord. the Bar. being 30, and the Ther. 62	= 62 3210606	1 7946348	8 2053652
Length in inches of a pendulum which vibrates seconds in the latitude of Greenwich	= 39 1393	1 5976130	8 4073860
Velocity (in feet per second) acquired in a second by a body falling in vacuo in the lat. of Greenwich	= $\sqrt{}$ = 32 19084	1 5077222	8 4922778
No. of cubic inches in an imperial gallon	= 277 274	2 4429 92	7 5570908
No. of feet in a statute mile	= 5280	3 7226339	6 2773661
No. of feet in a geographical or nautical mile	= 6075 6	3 7835892	6 2164108
Diurnal acceleration of stars (= 3 ^m 55 ^s 9093) expressed in mean solar seconds	= 235 9093	2 3727441	8 6272559
Sidereal day (= 23 ^h 56 ^m 4 ^s 09) expressed in mean solar days	= 0 99726967	1 9988127	10 0011873
Mean solar day (= 24 ^h 3 ^m 56 ^s 5554) expressed in sidereal days	= 1 00273791	0 0011874	9 9988126
Sidereal revolution of Earth expressed in mean solar days	= 365 25636	2 5625978	7 4374022
Tropical revolution of Earth expressed in mean solar days	= 365 24224	2 5625910	7 4374080
Earth's equatorial radius expressed in feet	= 20921665	7 3205963	2 6794037
Earth's polar radius expressed in feet	= 20852394	7 3191559	2 6808441
Compression of the Earth	= $\frac{1}{302}$	3 5199931	12 4800069
Length of a degree of latitude in feet at the Equator	= 362 732	5 5595859	4 4404141
Length of a degree of latitude in feet in latitude 45°	= 364 543 5	5 561 494	4 4382506

