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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.

H. L.

OLD WINDSOR, 9th July, 1850.

# CONTENTS.

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|                                                                                                       | PAGE |
|-------------------------------------------------------------------------------------------------------|------|
| CHAPTER I. Explanation and Definitions of Logarithms . . . .                                          | 1    |
| „ II. On the Exponents of Powers . . . . .                                                            | 4    |
| „ III. Of various Systems of Logarithms . . . . .                                                     | 8    |
| „ IV. Mode of calculating Logarithms, and Demonstration of<br>their Properties . . . . .              | 12   |
| „ V. Description of Logarithmic Tables . . . . .                                                      | 31   |
| „ VI. Logarithmic Arithmetic . . . . .                                                                | 43   |
| APPENDIX. Table of the Logarithms of every Prime Number from<br>2 to 1000 . . . . .                   | 62   |
| Table by the aid of which the Number answering to<br>any Logarithm can be found to six places . . . . | 64   |

A  
 RUDIMENTARY TREATISE  
 ON  
 LOGARITHMS.

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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\*,

| No. | Log.             | No.  | Log.             | No.   | Log.              |
|-----|------------------|------|------------------|-------|-------------------|
| 1   | = 3 <sup>0</sup> | 1    | = 7 <sup>0</sup> | 1     | = 10 <sup>0</sup> |
| 3   | = 3 <sup>1</sup> | 7    | = 7 <sup>1</sup> | 10    | = 10 <sup>1</sup> |
| 9   | = 3 <sup>2</sup> | 49   | = 7 <sup>2</sup> | 100   | = 10 <sup>2</sup> |
| 27  | = 3 <sup>3</sup> | 343  | = 7 <sup>3</sup> | 1000  | = 10 <sup>3</sup> |
| 81  | = 3 <sup>4</sup> | 2401 | = 7 <sup>4</sup> | 10000 | = 10 <sup>4</sup> |
| 243 | = 3 <sup>5</sup> |      |                  |       |                   |

In these we perceive immediately that the numbers denoting the powers, or, as they are termed, the *indices* or *exponents* 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,  $x^a$  denotes that the quantity represented by  $x$  is to be raised to the power represented by  $a$ ; 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

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

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  $x^3 \times x^3 = x^6$ ; 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 3, and  $n$  equal 2; then  $x^{\frac{m}{n}} = 4^{\frac{3}{2}}$ , 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—

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

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

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

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

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

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

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  $x^r$ , 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. | Loga.                | Nos.    | Base. | Loga.           |
|--------|-------|----------------------|---------|-------|-----------------|
| 1.00   | =     | 2.71828 <sup>0</sup> | 1       | =     | 10 <sup>0</sup> |
| 2.72   | =     | 2.71828 <sup>1</sup> | 10      | =     | 10 <sup>1</sup> |
| 7.39   | =     | 2.71828 <sup>2</sup> | 100     | =     | 10 <sup>2</sup> |
| 20.09  | =     | 2.71828 <sup>3</sup> | 1000    | =     | 10 <sup>3</sup> |
| 54.60  | =     | 2.71828 <sup>4</sup> | 10000   | =     | 10 <sup>4</sup> |
| 148.41 | =     | 2.71828 <sup>5</sup> | 100000  | =     | 10 <sup>5</sup> |
| 408.48 | =     | 2.71828 <sup>6</sup> | 1000000 | =     | 10 <sup>6</sup> |

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

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

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:

| No.              | 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

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

$$\frac{\frac{r}{\lambda} \left( \frac{r}{\lambda} - 1 \right)}{2} x^2 + \frac{\frac{r}{\lambda} \left( \frac{r}{\lambda} - 1 \right) \cdot \left( \frac{r}{\lambda} - 2 \right)}{2.8} x^3,$$

the quantities  $\frac{\frac{r}{\lambda} \left( \frac{r}{\lambda} - 1 \right)}{2}$  and  $\frac{\frac{r}{\lambda} \left( \frac{r}{\lambda} - 1 \right) \cdot \left( \frac{r}{\lambda} - 2 \right)}{2.8}$

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

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

#### PROPOSITION B.

PROBLEM. To expand  $b^\lambda$  in terms of  $\lambda$ .

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

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

\* 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  $\lambda$ , 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

$$b^r = 1 + \frac{r}{\lambda} x + \frac{\frac{r}{\lambda} \left( \frac{r}{\lambda} - 1 \right)}{2} x^2 + \frac{\frac{r}{\lambda} \left( \frac{r}{\lambda} - 1 \right) \cdot \left( \frac{r}{\lambda} - 2 \right)}{2.3} x^3 +$$

$$\frac{\frac{r}{\lambda} \left( \frac{r}{\lambda} - 1 \right) \cdot \left( \frac{r}{\lambda} - 2 \right) \cdot \left( \frac{r}{\lambda} - 3 \right)}{2.3.4} x^4 + \dots + \&c.$$

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

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

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

$$\frac{\frac{r}{\lambda} \left( \frac{r}{\lambda} - 1 \right) \cdot \left( \frac{r}{\lambda} - 2 \right)}{2.3} (A\lambda + B\lambda^2 + C\lambda^3 + \&c.)^3 + \dots + \&c.$$

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

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

$$\frac{r(r-\lambda) \cdot (r-2\lambda)}{2.3} (A + B\lambda + C\lambda^2 + \&c.)^3 + \dots + \&c.$$

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

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

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

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

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  $\lambda$ , 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  $\lambda x$ , 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,

$$A\lambda = A_1$$

$$A^2\lambda^2 = A_1^2$$

$$A^3\lambda^3 = A_1^3, \&c.$$

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  $\lambda$  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  $\lambda$ , 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 *Napierean 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  $\lambda$ , 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 |
| + $\frac{1}{2}$ = | .500,000,000 000  |
| + by 3 =          | .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 =            | .000,000,002 083  |
|                   | 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

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

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 (Prop. 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])

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

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

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

Performing the calculation, we have

$$\begin{array}{rcl} \frac{1}{3} & = & \cdot 333,333,333,333 \\ \frac{1}{3} \cdot \frac{1}{3^2} & = & \cdot 012,345,679,012 \\ \frac{1}{5} \cdot \frac{1}{3^3} & = & \cdot 000,823,045,268 \\ \frac{1}{7} \cdot \frac{1}{3^4} & = & \cdot 000,065,321,053 \\ \frac{1}{9} \cdot \frac{1}{3^5} & = & \cdot 000,005,645,029 \\ \frac{1}{11} \cdot \frac{1}{3^6} & = & \cdot 000,000,513,184 \\ \frac{1}{13} \cdot \frac{1}{3^7} & = & \cdot 000,000,048,248 \\ \frac{1}{15} \cdot \frac{1}{3^8} & = & \cdot 000,000,004,646 \\ \frac{1}{17} \cdot \frac{1}{3^9} & = & \cdot 000,000,000,436 \\ & & \hline & & \cdot 346,573,590,209 \\ & & & 2 \\ \log_a 2 & = & \hline 0 \cdot 693,147,180,418. \end{array}$$

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

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

and, performing the calculation, we have

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

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

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

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

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

## PROPOSITION I.

**PROBLEM.** *To determine the value of  $\log_e e$ ,  $e$  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  $e^A = b$ ; therefore  $\log_e b = A$ .

Now we have, from Theorem H,

$$\log_e b \cdot \log_b e = 1, \text{ or } A \cdot \log_b e = 1,$$

$$\text{Therefore } \log_b e = \frac{1}{A} = \frac{1}{2.302585092} = .434294482.$$

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

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

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

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

$$\&c. \quad \&c. \quad \&c.$$

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

$$n_2 = n_1 \cdot n_3$$

$$n_3 = n_2 \cdot n_3$$

$$n_4 = n_3 \cdot n_3$$

$$\&c. \quad \&c.$$

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  $b^{\delta} = n_3$ ,  $\delta$ , 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  $\lambda$  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 33, 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 33 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. 406 OF NUMBERS. 37 |         |      |      |      |      |      |      |      |      |      |
|--------------------------------|---------|------|------|------|------|------|------|------|------|------|
| N.                             | 0       | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    |
| 2550                           | 4085402 | 5572 | 5742 | 5913 | 6083 | 6253 | 6424 | 6594 | 6764 | 6934 |
| 51                             | 7105    | 7275 | 7445 | 7615 | 7786 | 7956 | 8126 | 8296 | 8466 | 8637 |
| 52                             | 8807    | 8977 | 9147 | 9317 | 9487 | 9658 | 9829 | 9998 | 0168 | 0338 |
| 53                             | 4070508 | 0678 | 0848 | 1018 | 1189 | 1359 | 1529 | 1699 | 1869 | 2039 |
| 54                             | 2209    | 2379 | 2549 | 2719 | 2889 | 3059 | 3229 | 3399 | 3569 | 3739 |
| 55                             | 3909    | 4079 | 4249 | 4419 | 4589 | 4759 | 4929 | 5099 | 5269 | 5439 |
| 56                             | 5608    | 5778 | 5948 | 6118 | 6288 | 6458 | 6628 | 6798 | 6968 | 7137 |
| 57                             | 7307    | 7477 | 7647 | 7817 | 7987 | 8156 | 8326 | 8496 | 8666 | 8836 |
| 58                             | 9005    | 9175 | 9345 | 9515 | 9684 | 9854 | 0024 | 0194 | 0363 | 0533 |
| 59                             | 4080703 | 0873 | 1042 | 1212 | 1382 | 1551 | 1721 | 1891 | 2060 | 2230 |
| 2560                           | 2400    | 2569 | 2739 | 2909 | 3078 | 3248 | 3417 | 3587 | 3757 | 3926 |
| 61                             | 4096    | 4265 | 4435 | 4604 | 4774 | 4944 | 5113 | 5283 | 5452 | 5622 |
| 62                             | 5791    | 5961 | 6130 | 6300 | 6469 | 6639 | 6808 | 6978 | 7147 | 7317 |
| 63                             | 7486    | 7656 | 7825 | 7994 | 8164 | 8333 | 8503 | 8672 | 8841 | 9011 |
| 64                             | 9180    | 9350 | 9519 | 9688 | 9858 | 0027 | 0196 | 0366 | 0535 | 0704 |
| 65                             | 4090874 | 1043 | 1212 | 1382 | 1551 | 1720 | 1889 | 2059 | 2228 | 2397 |
| 66                             | 2567    | 2736 | 2905 | 3074 | 3243 | 3413 | 3582 | 3751 | 3920 | 4089 |
| 67                             | 4259    | 4428 | 4597 | 4766 | 4935 | 5105 | 5274 | 5443 | 5612 | 5781 |
| 68                             | 5950    | 6119 | 6288 | 6458 | 6627 | 6796 | 6965 | 7134 | 7303 | 7472 |
| 69                             | 7641    | 7810 | 7979 | 8148 | 8317 | 8486 | 8655 | 8824 | 8993 | 9162 |

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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  
 $\mid \cdot 168 \mid \cdot 338 \mid$ .

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

$$\text{Log of } 25584 = 4\cdot4079684$$

$$,, \quad 25585 = 4\cdot4079854$$

$$\begin{array}{r} 1 \qquad \qquad 170 \\ \hline \end{array}$$

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  $4\cdot4079684$  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  $25584\cdot6$ , here the increment of the number being  $\cdot6$ , we form the proportion  $1\cdot0 : \cdot6 :: 170 : 102$ , by which we find that 102 is the corresponding increment of the logarithm, which being added to  $4\cdot4079684$  gives  $4\cdot4079786$  for the logarithm of  $25584\cdot6$ . Again, if the increment of the natural number had been  $\cdot06$ , the corresponding increment of the logarithm would have been  $10\cdot2$ .

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             |
| 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 39, and this is indicated by the line thus 9875 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 246037 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 | 60     | "  | 88       |
| "             | 7      | "  | 12.82    |

Therefore the log of 246037 .. 5.391035

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 2608.37

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" |       |    | 3990" = 1° 6' 30" |       |    | 4020" = 1° 7' 0" |       |    |
|------------------|-------|----|-------------------|-------|----|------------------|-------|----|
| Num.             | Log.  | D. | Num.              | Log.  | D. | Num.             | Log.  | D. |
| 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  $11 \times 4 = 44$ , 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?

$$\begin{array}{rcl}
 \text{Logarithm given} & . & = 3.60428 \\
 \text{Next less logarithm} & . & = 3.60423 = 4020 \\
 & & \hline
 & & 50 \div 10 = .5 \\
 & & \hline
 & & 4020.5 \\
 & & \hline
 \end{array}$$

Therefore 4020.5 is the number whose logarithm is 3.60428.

Again, what is the number answering to the logarithm 4.60719?

$$\begin{array}{rcl}
 \text{Logarithm given} & . & = 4.60719 \\
 \text{Next less logarithm} & . & = 4.60713 = 40470 \\
 & & \hline
 & & 600 \div 11 = 5.4 \\
 & & \hline
 & & 40475.4 \\
 & & \hline
 \end{array}$$

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  $8\cdot 241735$  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 | 5.631842 | is | 4.368158  |
| "                              | 2.170630 | "  | 7.829370  |
| "                              | 7.217034 | "  | 10.782966 |
| "                              | 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 = 3.750586

" 42 = 1.623249

5.373835

5.373831 = log of 236500

40 = 2

Answer = 236502

Multiply 52, 734, and 6 together.

Logarithm of 52 = 1.716003

" 734 = 2.865696

" 6 = 0.778151

5.359850

5.359835 = log of 229000

150 = 3

Answer = 229008

Multiply 61, 22, and 65 together.

Logarithm of 61 = 1.785330

" 22 = 1.342423

" 65 = 1.812913

4.940666 = log of 87230.

## 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.

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

Divide 116908 by 5314.

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

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.

$$\begin{array}{rcl} \text{Logarithm of } . . . 579400 & = & 5.762978 \\ \text{Proportional part for } 10 & = & 7.5 \\ \text{"} & 6 & = 4.5 \\ \hline \text{Logarithm of } . . . 579416 & = & 5.762990 \\ \text{Arith. comp. of log of } 4 & = & 9.397940 \\ \text{"} & 23 & = 8.638172 \\ \text{"} & 47 & = 8.327902 \\ \hline & & 2.127104 = \text{log of } 134. \end{array}$$

## 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?

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

By the second method:—

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

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?

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

Or:—

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

## INVOLUTION AND EVOLUTION.

Involution is the process of raising a number to any power of itself, and evolution is the extraction of any root of a number; both these processes are very readily performed by means of logarithms.

**RULE I.**—*To raise a number to any power desired, multiply the logarithm of the number by the exponent of that power, and the product will be the logarithm of the power required.*

**RULE II.**—*To extract any root of a number, divide the logarithm of that number by the exponent of the root, and the quotient will be the logarithm of the root required.*

## EXAMPLES.

What is the square of 745, the cube of 67, and the 7th power of 8?

Logarithm of 745 = 2.872156

$$\begin{array}{r} 2 \\ \hline 5.744312 = \log \text{ of } 555025. \end{array}$$

Logarithm of 67 = 1.826075

$$\begin{array}{r} 3 \\ \hline 5.478225 = \log \text{ of } 300763. \end{array}$$

Logarithm of 8 = 0.903090

$$\begin{array}{r} 7 \\ \hline 6.321630 = \log \text{ of } 2097152 \end{array}$$

What is the square root of 4225, the cube root of 6859, and the 6th root of 117649?

Log of 4225 = 3.625827  $\div$  2 = 1.812913 = log of 65.

Log of 6859 = 3.836261  $\div$  3 = 1.278754 = log of 19.

Log of 117649 = 5.070588  $\div$  6 = 0.845098 = log of 7.

When the number to be involved to any power, or whose root is to be extracted, is a *fraction*, its characteristic will be *negative*; in this case, in multiplying the logarithm by any number, it must be borne in mind that the mantissa is positive, and therefore that any figures carried from the multiplication of the same, must be *deducted* from the characteristic, instead of being added to it.

## EXAMPLE.

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

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

2

$$\bar{2}.795880 = \log \text{ of } .0625.$$

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

3

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

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

5

$$\bar{1}.952580 = \log \text{ of } .89656.$$

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  $1.320146 + 2 = .660073$  for the new mantissa, therefore  $\bar{1}.320146 + 2 = \bar{1}.660073 = \log \text{ of } .45716 =$  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  $.290284 + 2 = .290284 + 3 = .763428$  for the mantissa. Therefore,  $\bar{4}.290284 + 3 = \bar{3}.763428 = \log \text{ of } .058.$

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  $\lambda$  will be used to denote "logarithm of;" thus,  $\lambda a$ , 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            | 56               | '0232525            |
| 1 1/2            | '0053950            | 58               | '0242804            |
| 1 1/4            | '0064660            | 6                | '0253059            |
| 1 1/2            | '0075344            | 6 1/2            | '0263289            |
| 2                | '0086002            | 6 1/4            | '0273496            |
| 2 1/2            | '0096633            | 6 1/2            | '0283679            |
| 2 1/4            | '0107239            | 7                | '0293838            |
| 2 1/2            | '0117818            | 7 1/2            | '0303973            |
| 3                | '0128372            | 7 1/4            | '0314085            |
| 3 1/2            | '0138901            | 7 1/2            | '0324173            |
| 3 1/4            | '0149403            | 8                | '0334238            |
| 3 1/2            | '0159881            | 8 1/2            | '0344279            |
| 4                | '0170333            | 8 1/4            | '0354297            |
| 4 1/2            | '0180761            | 8 1/2            | '0364293            |
| 4 1/4            | '0191163            | 9                | '0374265            |
| 4 1/2            | '0201540            | 9 1/2            | '0384214            |
| 5                | '0211893            | 9 1/4            | '0394141            |
| 5 1/2            | '0222221            | 9 1/2            | '0404046            |

## MEASUREMENT.

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

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

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

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

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

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

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

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

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

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

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

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

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

*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

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

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

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

Formulae [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

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

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

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

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

\* 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,  $\sigma$  equal the surface, and  $a$  and  $b$ , numbers obtained from the annexed table; then

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

| 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 . . . . .                                         | 1.194958 |
| Loose shingle, perfectly dry . . . . .                          | 1.111867 |
| 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

$$[46.] \lambda q = .511883 + \lambda b + \frac{3}{2} \lambda d.$$

## STRENGTH OF MATERIALS.

*Tensile strength.*—Let  $a$  equal area in square inches,  $w$  equal weight producing fracture, and  $\lambda$  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  $\lambda$  numbers in column 3 of annexed table; then when the height of piece is between once and  $4\frac{1}{2}$  times its diameter,

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

*Strength of Columns\*.*—Let  $w$  equal the breaking weight in tons,  $b$  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,

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

\* Professor Hodgkinson's Formula.

When the column is hollow; then

$$[50.] \lambda w = \lambda (D^{1.8} - d^{1.8}) - 1.7 \lambda l - .059243 + c.$$

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

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

When the column is hollow; then

$$[52.] \lambda w = \lambda (D^{1.8} - d^{1.8}) - 1.7 \lambda l + .473217 + c.$$

*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  $\delta$  equal the deflexion in inches with the weight  $w$ , and  $n$  equal the numbers in the sixth column of the annexed table; then

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

| 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 |
| Elm . . . . .    | 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  $\frac{1}{4}$  per cent. upon £3653 for 7 years amount to?

$$\text{Logarithm of } 3653 = 3.562650$$

$$,, \quad 45 = 0.653213$$

$$,, \quad 7 = 0.845098$$

$$5.060961$$

2

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

$\therefore$  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?

$$\text{Log of ratio from table} = 0.0253039$$

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

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

∴ 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?

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

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

$$1.408302$$

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

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

$$.397940$$

$$3.457371$$

$$1.$$

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

[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?

$$\text{Logarithm of } d = 21.72 = 1.336860 \\ \quad \quad \quad .497150$$

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

$$\begin{array}{r} 2 \\ \hline 3.668020 \\ 0.900790 \\ \hline 4.568810 \\ 2. \end{array}$$

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

[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  $73^\circ$  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  $42^\circ$ ?

Ans. 247.58 feet.

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

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

$$\text{Log of } x_1 = 5.32 = 0.725912 \\ \quad \quad \quad .823909$$

$$\begin{array}{r} 2.466801 \\ 1. \end{array}$$

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

[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?

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

$$\begin{array}{r} 1.426982 \end{array}$$

$$\text{Log } x_1 = 10.00 = 1.000000$$

$$\begin{array}{r} 2.426982 \end{array}$$

$$\text{Log } x_2 = 8.95 = 0.951823$$

$$\begin{array}{r} 2.1475155 \end{array}$$

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

[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 31, what is the length of the ordinate corresponding with an abscissa of 20 feet?

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

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

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

$$2) 2.792397$$

$$1.396198$$

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

$$2.975982$$

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

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

[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]

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

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

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

$$19.961007$$

$$10^\circ$$

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

Then, since the three angles of a triangle are equal to  $180^\circ$  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]

$$\begin{array}{rcl} \text{Logarithm of} & . & 6.92 = 0.840106 \\ \text{Arith. comp. of log sin of } 66^\circ 4' 56'' & = & 0.038993 \\ \text{Logarithmic sin of } . & 39^\circ 16' 4'' & = 9.801366 \\ & & \hline & & 10.680465 \\ & & 10^\circ \end{array}$$

$$\text{Logarithm of side required} . . = 0.680465 = 4.791.$$

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?

$$\begin{array}{rcl} \text{Log } (105.75 - 81.10) & . & . = 1.391817 \\ \text{Arith. comp. of log } (105.75 + 81.1) & . & = 7.728507 \\ \text{Logarithmic tan of } . & . & 66^\circ 4' = 10.352778 \\ & & \hline & & 19.473102 \\ & & 10^\circ \end{array}$$

$$\left. \begin{array}{l} \text{Log tan of half the difference of the angles} \\ \text{opposite the given sides} \end{array} \right\} 9.473102 = 16^\circ 33' 14''.$$

$$\begin{array}{rcl} \text{Arith. comp. of log cos of } 16^\circ 33' 14'' & = & 0.018324 \\ \text{Logarithmic cosine of } . & 66^\circ 4' 0'' & = 9.608177 \\ \text{Logarithm of } . & . & (105.75 + 81.1) = 2.271493 \\ & & \hline & & 11.898054 \\ & & 10^\circ \end{array}$$

$$\text{Logarithm of third side} . . . . = 1.898054 = 79.08. \text{ Ans.}$$

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?

$$\begin{array}{rcl} \text{Arithmetical comp. of log of } 62 & . & = 8.207608 \\ \text{Log of } . & . & (27.3 + 54.5) = 1.912753 \\ \text{Log of } . & . & (54.5 - 27.3) = 1.424589 \\ & & \hline & & 11.554930 \\ & & 10^\circ \end{array}$$

$$\left. \begin{array}{l} \text{Log of the difference of the seg-} \\ \text{ments of the base} \end{array} \right\} = 1.554930 = 35.886.$$

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 sin 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 vivâ 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 half 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?

Ana. 1907 $\frac{2}{3}$  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?

Ana. 21447 lbs.

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

Ana. 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?

Ana. 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?

$$\text{Log of } d = 18 = 1.2552725$$

$$6.2763625$$

$$\text{Log of } h = 75 = 1.8750613$$

$$1.3485000$$

$$9.4999238$$

$$\text{Log } (l + 4.2d) = 5446.6 = 3.7361255$$

$$2)5.7637983$$

$$\text{Log of quantity per minute} = 2.8818991 = 761.9.$$

Ana. 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?

Ana. 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?

Ana. 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?

Ana. 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?

Ana. 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?

Ana. 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 12 inches, and its internal diameter 10 inches?

$$\text{Log of } a = 12 = 1.079181$$

$$\underline{3.8850516 = \text{log of } a^2 = 7674.6.}$$

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

$$\underline{3.6000000 = \text{log of } d^2 = 3981.1}$$

$$\underline{a^2 - d^2 = 3693.5}$$

$$\text{Log } (a^2 - d^2) = 3693.5 = 3.567438$$

$$0 = 1.173186$$

$$0.473217$$

$$5.213841$$

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

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

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<br>number. | Logarithm. | Prime<br>number. | Logarithm. | Prime<br>number. | Logarithm. | Prime<br>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              | 3560259    | 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—

$$\begin{array}{rcl} \text{Log of} & 2 & = 0.3010300 \\ & .. & 3 = 0.4771213 \\ & .. & 3 = 0.4771213 \\ & .. & 13 = 1.1130434 \end{array}$$

$$\therefore \text{Log of } 234 = \underline{2.3692160}$$

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

$$\begin{array}{rcl} \text{Log of} & 2 & = 0.3010300 \\ & .. & 17 = 1.2304489 \\ & .. & 17 = 1.2304489 \end{array}$$

$$\therefore \text{Log of } 578 = \underline{2.7619278}$$

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 17897, to which adding two cyphers on the left hand to make up the seven figures, we have .0017897, 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 . . . . = 8.3574202

Next less log in table . . = 8.3010300 = log of 2

1st remainder . . . . . = 556902

Next less logarithm . . . = 4.18927 = log of 11

2nd remainder . . . . . = 149975

Next less logarithm . . . = 1.28372 = log of 103

3rd remainder . . . . . = 21608

Next less logarithm . . . = 1.7337 = log of 1004

4th remainder . . . . . = 4266

Next less logarithm . . . = 3.907 = log of 10000

5th remainder . . . . . = 359

Next less logarithm . . . = 3.47 = log of 100008

6th remainder . . . . . = 12

Nearest logarithm . . . . = 18 = log of 1000008

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

$$2266000 = 2266 \times 1000$$

$$9064 = 2266 \times 4$$

$$\underline{2275064}$$

This again has to be multiplied by 10009,

$$22750640000$$

$$20475576$$

$$\underline{22771115576}$$

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 *five* figures before 8, the number by which we are going to multiply, we point off the *five* right hand figures, and only multiply 227 by 8; we add in, however, 6 carried from the multiplication of the 7 cut off.

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

The last multiplication is by 1000008, 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 1000008 are not affected by the addition of 1822, this need not have been performed until afterwards, as below.

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

What is the number corresponding to the logarithm 4.8551071?

|                     |                         |
|---------------------|-------------------------|
| 8551071             | $7 \times 102 = 714000$ |
| 8450980 = log of 7  | 2142                    |
| <hr/>               | <hr/>                   |
| 100091              | 71,61,4200              |
| 86002 = log of 102  | 14828                   |
| <hr/>               | 2865                    |
| 14089               | 648                     |
| 13009 = log of 1003 | <hr/>                   |
| <hr/>               | 71682081                |
| 1080                | <hr/>                   |
| 869 = log of 10002  |                         |
| <hr/>               |                         |
| 211                 |                         |
| 174 = log of 100004 |                         |
| <hr/>               |                         |
| 37 = log of 1000009 |                         |
| <hr/>               |                         |

The number is 71682.

What is the number whose logarithm is 2.6108883?

|                     |             |
|---------------------|-------------|
| 6108833             | 101         |
| 6020800 = log of 4  | 4           |
| <hr/>               | <hr/>       |
| 88238               | 404000      |
| 49214 = log of 101  | 8686        |
| <hr/>               | <hr/>       |
| 40019               | 40,7,6,8600 |
| 88912 = log of 1009 | 8168        |
| <hr/>               | 2088        |
| 1107                | 204         |
| 869 = log of 10002  | <hr/>       |
| <hr/>               | 40778995    |
| 288                 | <hr/>       |
| 217 = log of 100005 |             |
| <hr/>               |             |
| 21 = log of 1000005 |             |
| <hr/>               |             |

The answer is 407.74.

What is the number whose logarithm is 3.7797587?

|                     |            |
|---------------------|------------|
| 7797587             | 1003       |
| 7781513 = log of 6  | 6          |
| <hr/>               | <hr/>      |
| 18074               | 60.18.0000 |
| 18009 = log of 1003 | 42126      |
| <hr/>               | 861        |
| 3065                | <hr/>      |
| 3039 = log of 10007 | 60222487   |
| <hr/>               | <hr/>      |
| 26 = log of 1000006 |            |
| <hr/>               |            |

The number required is 6022.248.

# MATHEMATICAL TABLES

FOR FACILITATING

ASTRONOMICAL, NAUTICAL,  
TRIGONOMETRICAL, AND LOGARITHMIC

CALCULATIONS.

By HENRY LAW,

CIVIL ENGINEER.

LONDON:

JOHN WEALE, 59, HIGH HOLBORN

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1853.



## 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.

OLD WINDSOR, 18th June, 1850.

# CONTENTS.

|                                                                                                            | PAGE |
|------------------------------------------------------------------------------------------------------------|------|
| Explanation and use of the Tables . . . . .                                                                | 1    |
| <b>TABLE</b> I. Logarithms of Numbers from 1 to 10000 . . . . .                                            | 85   |
| II. Logarithms of Numbers from 1 to 100 . . . . .                                                          | 61   |
| III. Signs of Trigonometrical Quantities . . . . .                                                         | 61   |
| IV. Logarithmic Sines of Small Arcs . . . . .                                                              | 62   |
| V. Logarithmic Sines, Tangents, &c. . . . .                                                                | 66   |
| VI. Meridional Parts . . . . .                                                                             | 126  |
| VII. Length of a degree of Longitude in each Parallel of Latitude . . . . .                                | 134  |
| VIII. Dip of Horizon, corrected for Refraction . . . . .                                                   | 135  |
| IX. Dip of Horizon, at various distances from it . . . . .                                                 | 135  |
| X. Reduction of the Moon's Equatorial Parallax . . . . .                                                   | 135  |
| XI. Augmentation of the Moon's Semi-diameter . . . . .                                                     | 136  |
| XII. For converting Longitude into Time . . . . .                                                          | 136  |
| XIII. For converting Time into Longitude . . . . .                                                         | 136  |
| XIV. Parallax in Altitude of the Sun and Planets . . . . .                                                 | 137  |
| XV. Refraction of the Sun and Stars . . . . .                                                              | 138  |
| XVI. Correction for Table of Refraction . . . . .                                                          | 140  |
| XVII. Correction of the Moon's Altitude . . . . .                                                          | 141  |
| XVIII. Logarithms for finding the Hourly Angle or Apparent Time . . . . .                                  | 152  |
| XIX. Common and Hyperbolic Logarithms . . . . .                                                            | 155  |
| XX. Curvature of the Earth and Refraction . . . . .                                                        | 156  |
| XXI. Trigonometrical Equivalents . . . . .                                                                 | 156  |
| XXII. Expressions for Multiple Arcs . . . . .                                                              | 157  |
| XXIII. Formulae relating to two Arcs or Angles . . . . .                                                   | 158  |
| XXIV. Trigonometrical Expressions . . . . .                                                                | 159  |
| XXV. Formulae for solving all the cases of a rectilineal Angle, of which three parts are known . . . . .   | 160  |
| XXVI. Trigonometrical Formulae for the Solution of Quadratics and Cubics . . . . .                         | 161  |
| XXVII. Differential Coefficients . . . . .                                                                 | 162  |
| XXVIII. Useful Numbers with their Logarithms . . . . .                                                     | 163  |
| XXIX. To reduce the Sun's Declination to any Given Meridian, and to any time under that Meridian . . . . . | 165  |

# 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 ·113943, 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  $\bar{2}.872622$ , which is equivalent to  $-1.127378$ . 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  
 „  $\bar{2}.076276$  „ 11.923714  
 „  $\bar{5}.322839$  „ 4.677161  
 „  $\bar{1}.986772$  „ 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,  $\overline{139379} \mid 0194$ , 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

„ 0·932 „ 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    | = | 302      |   |   |
| with 1148 and under 8 . . . . .             | = |          |   |   |

Logarithm of 11488, as required = 4·060244

|                                                                          |   |          |   |   |
|--------------------------------------------------------------------------|---|----------|---|---|
| Log. of 6215 . . . . .                                                   | = | 5·793441 | } | 9 |
| From Table of Proportional Parts, on line                                | = | 28       |   |   |
| with 6160, the next less No. in the table to 6215, and under 4 . . . . . | = |          |   |   |
| 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 | } | 7<br>00<br>513 |
| From Table of Proportional Parts on same line with 7552 and under 1 . . . . . | = | 5        |   |                |
| On same line under 7 . . . . .                                                | = | 3        |   |                |
| On same line under 9 . . . . .                                                | = |          |   |                |

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<br>on same line with the<br>next less No. to 1744 | 199 is found in col. 3 | ·8             |
|                                                                           | 110 second dif.        |                |
| On the same line . . .                                                    | 99 is found in col. 4  | ·04            |
|                                                                           | The No. required =     | <u>1744·84</u> |

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:—3·510009, 2·475771, 5·871624.

The number answering to the logarithm 3·510009 is found at once to be 3236.

|                                               |               |      |
|-----------------------------------------------|---------------|------|
| Given log. = 2·475771                         |               |      |
| Next less log. = 2·475671 = the log. of 200·0 |               |      |
| <hr/>                                         |               |      |
| 100 = 1st dif.                                |               |      |
| From Table of Proportional Parts              | 87 . . . . .  | ·06  |
| <hr/>                                         |               |      |
| 130 = 2nd dif.                                |               |      |
|                                               | 130 . . . . . | ·009 |
| <hr/>                                         |               |      |
| No. required = 200·069                        |               |      |

|                                                 |              |     |
|-------------------------------------------------|--------------|-----|
| Given log. = 5·871624                           |              |     |
| Next less log. = 5·871573 = the log. of 744000· |              |     |
| <hr/>                                           |              |     |
| 51 = 1st dif.                                   |              |     |
| From Table of Proportional Parts                | 40 . . . . . | 80· |
| <hr/>                                           |              |     |
| 50                                              |              |     |
|                                                 | 52 . . . . . | 9·  |
| <hr/>                                           |              |     |
| The No. required = 744089·                      |              |     |

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  $90^\circ$ ; 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.,

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

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

$\csc = \log \tan + \log \cot = \log \sec + \log \cos = 2 \log \text{rad} = 20$ ; 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  $45^\circ$ ; 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  $45^\circ$ , 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 9.787232, 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  $45^\circ$ , 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 . . . . . 9.721163

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 . . . . . 9.957217

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  $5^{\circ}$ , 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  $85^{\circ}$ . It will also be observed, that in the cosines and secants of arcs less than  $5^{\circ}$ , and in the sines and cosecants of arcs greater than  $85^{\circ}$ , 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  $90^{\circ}$ ,

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  $\delta$ , 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  $\delta$ , by substituting the values of the known quantities; but in doing so we shall find that the second equation will give the value of  $\delta$  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.

$$\begin{array}{rcl} \text{Log sin } 63^\circ 45' & = & 1.952731 \\ \text{Log 669} & = & 2.825426 \end{array}$$

$$\begin{array}{rcl} & & 2.778157 \\ \text{Log 600.1} & = & 2.778224 \end{array}$$

$$\begin{array}{rcl} & & 1.999933 \\ & & 2 \end{array}$$

$$\text{Log } .99969 = \underline{\underline{1.999866}}$$

Then  $1 - .99969 = .00031$ , the log of which  $= 4.491862$ ,  
and  $4.491862 \div 2 = 2.245681 = \cos \delta$ ;

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

$$\begin{array}{r} 8.245681 \\ 5.814425 \\ \hline 22 \end{array}$$

$$\underline{\underline{3.560128}} = 3631.86 \text{ seconds} = 1^\circ 0' 31''.86;$$

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

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

*To find accurately the log sin of an arc less than  $5^\circ$ .*

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'.

$$\begin{array}{r} \text{Log } (13' \times 60) = 780'' = 2.892095 \\ \underline{4.685575} \end{array}$$

$$7.577670$$

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

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

$$\begin{array}{r} \text{Log } (63' \times 60) = 3780'' = 3.577492 \\ \underline{4.685575} \end{array}$$

$$8.263067$$

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

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

*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'.

$$\begin{array}{r} \text{Log } (24' \times 60) = 1440'' = 3.158363 \\ \underline{4.685575} \end{array}$$

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

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

$$\begin{array}{r} \text{Log } (75' \times 60) = 4500'' = 3.653213 \\ \underline{4.685575} \end{array}$$

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

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

*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  $89^{\circ} 5' 13''$ .

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

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

$$\text{Constant log} \dots\dots\dots = 15\cdot814425$$

$$\text{Log of } 3287 \dots\dots\dots = 3\cdot516800$$

$$\text{Log cosec of } 89^{\circ} 5' 13'' = \cdot000057 \times \frac{2}{3} = \cdot000038$$

$$\underline{\hspace{1cm}} \quad 3\cdot516838$$

$$\text{Log tan of } 89^{\circ} 5' 13'' = \underline{\hspace{1cm}} 11\cdot797587$$

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

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

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

$$\text{Constant log} \dots\dots\dots = 15\cdot814425$$

$$\text{Log of } 4130 \dots\dots\dots = 3\cdot615950$$

$$\text{Log cosec of } 88^{\circ} 51' 10'' = \cdot000087 \times \frac{2}{3} = \cdot000058$$

$$\underline{\hspace{1cm}} \quad 3\cdot616008$$

$$\text{Log tan of } 88^{\circ} 51' 10'' = \underline{\hspace{1cm}} 11\cdot608417$$

*To find accurately an arc of not more than  $5^{\circ}$  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.

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

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

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

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

*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.

$$\begin{array}{rcl} \text{Given log tan} & . & . & . & . & . & . & = & 8\cdot281461 \\ \text{Constant log} & . & . & . & . & . & . & = & 5\cdot314425 \end{array}$$

---


$$13\cdot545886$$

$$\text{Log sec of nearest arc} = \cdot000003 \times \frac{2}{3} = \cdot000042$$

---


$$\text{Required arc} = 58' 34'' = 3514'' = \underline{\underline{13\ 545844}}$$

*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.

$$\begin{array}{rcl} \text{Constant log} & . & . & . & . & . & . & = & 15\cdot314425 \\ \text{Given log tan} & . & . & . & . & . & . & = & 11\cdot695900 \end{array}$$

$$\text{Log cosec of nearest arc} \cdot000088 \times \frac{2}{3} = \cdot000059$$

---


$$11\cdot695959$$

---


$$\text{Required arc} = 1^\circ 9' 14'' = 4154'' = \underline{\underline{8\ 618466}}$$

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  $90^\circ$ , any of these functions of angles *greater* than  $90^\circ$  may readily be obtained, since any function of an angle greater than  $90^\circ$  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.

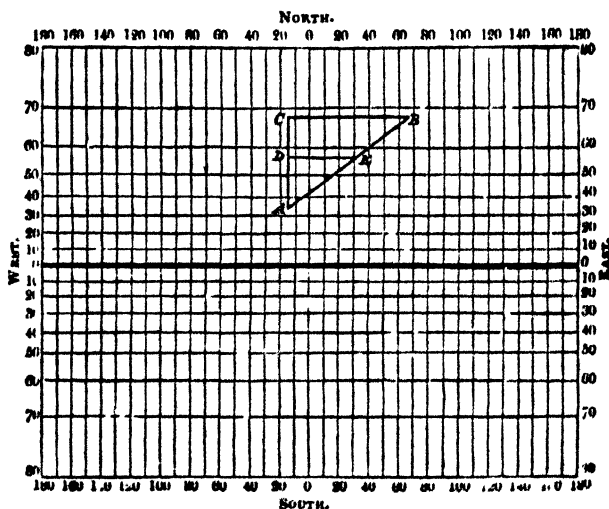
### Table VI.

#### 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  $60^{\circ}$ , 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  $76^{\circ} 3'$  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,  $\lambda$  for the meridional difference of latitude, and  $L$  for the difference of longitude, we have, from the above proportions,

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

From which formulae 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?

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

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,

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

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?

$$\begin{array}{rcl}
 \text{Meridional parts for } 64^{\circ} 25' & = & 5097 \\
 \text{,, , for } 41^{\circ} 20' & = & 2728 \\
 & & \hline
 23 \quad 5 & 2369 = \lambda = & \left\{ \begin{array}{l} \text{meridional} \\ \text{difference} \\ \text{of latitude.} \end{array} \right. \\
 60 & & \hline
 \end{array}$$

$$\text{Difference of lat.} = l = 1385$$

|                            |                                    |
|----------------------------|------------------------------------|
|                            | 49° 50' 0"                         |
|                            | 10 13 6                            |
|                            | <hr/>                              |
|                            | 39 36 54                           |
|                            | 60                                 |
|                            | <hr/>                              |
| Log L (= 2376.9) =         | 3.376010                           |
| Rad . . . . . =            | 10.000000                          |
|                            | <hr/>                              |
|                            | 13.376010                          |
| Log λ (= 2389) . =         | 3.374565                           |
|                            | <hr/>                              |
|                            | 10.001445 = log tan 45° 5' 44" = c |
|                            | <hr/>                              |
| Log l (= 1385) . =         | 3.141450                           |
| Rad . . . . . =            | 10.000000                          |
|                            | <hr/>                              |
|                            | 13.141450                          |
| Log cos c (= 45° 5' 44") = | 9.848757                           |
|                            | <hr/>                              |
|                            | 9.202603 = log of 1962 = d.        |
|                            | <hr/>                              |

Table VII.

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

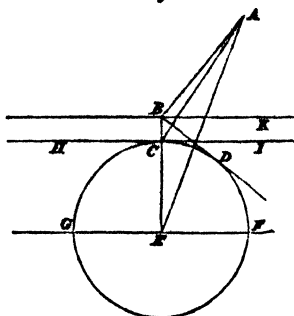
This table requires no explanation; it exhibits the length of a degree of Longitude in nautical miles (each of which equals 6076.6 feet) at every degree of latitude from the Equator to the Poles.

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.

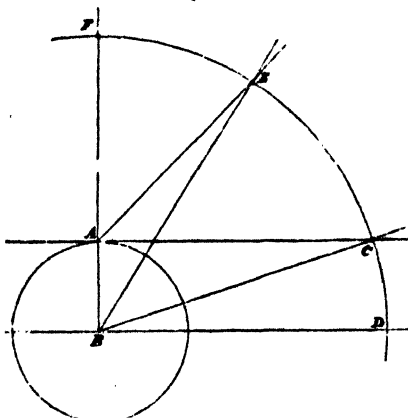
*Reduction of the Moon's Horizontal Parallax.*

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", 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''.

| From 2nd column, Table XII. |     |   |      | h. | m. | s.    |
|-----------------------------|-----|---|------|----|----|-------|
|                             |     |   | 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  $50^{\circ}$  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  $72^{\circ}$ , 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  $72^{\circ}$  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  $56'$

|                                          |     |         |
|------------------------------------------|-----|---------|
| Under 58', 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'     | 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 9.649821 when the altitude was decreasing?

$$\begin{array}{rcl} \text{Given log} & . & . & . & . & 9.649821 \\ \text{Next less log in Table} & 9.648913 & = & \text{log of 5 h. 35 m.} \\ \hline & & & & 40800 \div 3516 = & 11 \text{ seconds.} \\ & & & & \hline \end{array}$$

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?

$$\begin{array}{rcl} \text{Given log} & . & . & . & . & 9.215630 \\ \text{Next less log in Table} & 9.214858 & = & 20 \text{ h. 49 m.} \\ \hline & & & & 127200 \div 7114 = & 18 \text{ seconds.} \\ & & & & \hline \end{array}$$

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 5.499137; then—

| Com. Log.        | Hyp. Log.  |   |
|------------------|------------|---|
| 8 . . . . .      | = 6 907755 | 3 |
| 4 . . . . .      | = 921084   | 0 |
| 09 . . . . .     | = 207282   | 7 |
| 009 . . . . .    | = 020723   | 8 |
| 0001 . . . . .   | = 000230   | 3 |
| 00003 . . . . .  | = 000069   | 1 |
| 000007 . . . . . | = 000016   | 1 |

---

8.057061

---

*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 |
| 00003 . . . . .  | = 000013   | 0 |
| 000001 . . . . . | = 000000   | 4 |

---

2.241277

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### 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

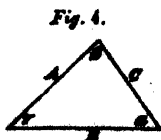
really a curved line which approximates very nearly to a circle, having a radius seven times greater than that of the earth. The heights in the second column require to be reduced by a seventh part, and the numbers thus obtained are given in the third column. To exemplify its use, let us suppose that 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  $\sin a$ ,  $\cos a$ ,  $\tan a$ ,  $\cot a$ ,  $\sec a$ ,  $\csc a$ ,  $\text{versin } a$ , 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  $\beta$  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  $51^\circ$ , what is the length of the third side? In this case we have given B, C and  $\alpha$ , and want to find A, we must, therefore, select a formulæ containing only those letters; we find, accordingly, No. 7 gives.

$$A = \sqrt{(B^2 + C^2 - 2 B \cdot C \cdot \cos \alpha.)}$$

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—

$$\tan \alpha = \frac{3}{3 \times 536} \sqrt[3]{\frac{3}{3}} = \frac{2}{536}$$

$$\text{therefore, } \alpha = 0^\circ 12' 36'', \text{ and } \frac{1}{2} \alpha = 0^\circ 6' 18'';$$

Then,

$$\tan \beta = \sqrt[3]{\tan (6' 18'')};$$

$$\text{therefore, } \beta = 7^\circ 1' 5'', \text{ and } 2 \beta = 14^\circ 2' 10'',$$

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  $175^{\circ}$  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.,  $175^{\circ}$ , but the nearest number that we find is  $170^{\circ}$ , which is  $5^{\circ}$  too small, and we must therefore add together the corrections found in the proper vertical column on both the lines having  $5^{\circ}$  and  $170^{\circ}$  in the first column. Thus, in the present instance, in the column having at its head  $18^{\circ}$  (the nearest to  $17^{\circ} 58' 1''$ ) and on the same line with  $5^{\circ}$  we find  $13''$ , and on the same line with  $170^{\circ}$  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  $175^{\circ}$  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  $23^{\circ}$  (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  $11^{\circ}$  (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.

III. 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  $128^{\circ}$  E.?

|                                                  |               |
|--------------------------------------------------|---------------|
| Sun's declination (increasing) at Greenwich,     | 19° 18' 38" N |
| at noon                                          |               |
| Subtract correction for 120°                     | 4' 46"        |
| Subtract correction for 8°                       | 0 19          |
|                                                  | 0 5 5         |
|                                                  | <hr/>         |
|                                                  | 19 18 33      |
| Add correction for 5 h. 20 m.                    | 3' 11"        |
| Add correction for 0 h. 20 m.                    | 0 12          |
|                                                  | 0 8 23        |
|                                                  | <hr/>         |
| 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  $79^{\circ}$  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° 25' 47" N. |
| at noon                                          |                |
| Add correction for 70°. . . . .                  | 1' 41"         |
| Add correction for 9°. . . . .                   | 0 12           |
|                                                  | <hr/>          |
|                                                  | 22 27 40       |
| Subtract correction for 6 h. 40 m. . . . .       | 0 2 24         |
|                                                  | <hr/>          |
| Sun's declination at the time and place required | 22 25 16 N.    |



| [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                 |  |

| PROPORTIONAL PARTS. | 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   | 093423 | 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 |
| 1342 | 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. 173] |        |      |      |       |       |       |       |       |       |      |     |
|----------------------------------------------------------|--------|------|------|-------|-------|-------|-------|-------|-------|------|-----|
| N.                                                       | 0      | 1    | 2    | 3     | 4     | 5     | 6     | 7     | 8     | 9    | N.  |
| 33                                                       | 130334 | 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   |
| 140                                                      | 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   |
| PROPORTIONAL PARTS.                                      |        |      |      |       |       |       |       |       |       |      |     |
| 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 | 127'3 | 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. 159 L. 230.] |  |  |  |  |  |
|-------------------|--------|------|------|------|------|------------------------|------|------|------|------|-----|-------------------|--|--|--|--|--|
| 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                 | 7424   | 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 |
| 1527 | 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                                                         | 5528   | 5781 | 6033 | 6285  | 6537  | 6789  | 7041  | 7292  | 7544  | 7795 | 2   |
| 3                                                         | 8046   | 8297 | 8548 | 8799  | 9049  | 9299  | 9550  | 9800  | 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   |
| ГЛОБАЛЬНАЯ ТАБЛИЦА                                        |        |      |      |       |       |       |       |       |       |      |     |
| N.                                                        | 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   | 3527 | 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                                                      | 477121 | 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 | 1196 | 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 | 124'3 |     |
|                                                          | 3158   | 13'7 | 27'4 | 41'1 | 54'8 | 68'5 | 82'3 | 95'9 | 109'6 | 123'5 |     |
|                                                          | 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  | 112.0 |     |
|                                                          | 3516   | 12.3 | 24.6 | 36.9 | 49.2 | 61.5 | 73.8 | 86.1 | 98.4  | 111.7 |     |
|                                                          | 3545   | 12.2 | 24.4 | 36.6 | 48.8 | 61.0 | 73.2 | 85.4 | 97.6  | 111.4 |     |
|                                                          | 3574   | 12.1 | 24.2 | 36.3 | 48.4 | 60.5 | 72.6 | 84.7 | 96.8  | 111.1 |     |
|                                                          | 3604   | 12.0 | 24.0 | 36.0 | 48.0 | 60.0 | 72.0 | 84.0 | 96.0  | 110.8 |     |
|                                                          | 3634   | 11.9 | 23.8 | 35.7 | 47.6 | 59.5 | 71.4 | 83.3 | 95.2  | 110.5 |     |

No. 380 L. 579.] LOGARITHMS OF NUMBERS. [No. 414 L. 619.]

| 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                   | 5461   | 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 | 103.0 |     |
|                     | 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.  |
|-----|--------|------|------|------|------|------|------|------|------|------|-----|
| 115 | 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 | 8203 | 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   |

| 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 | 61.3 | 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 |
| 4319 | 10.0 | 20.0 | 30.0 | 40.0 | 50.0 | 60.0 | 70.0 | 80.0 | 90.0 |
| 4360 | 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.                     | 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   |  |  |  |  |  |  |  |  |  |
| 1                | 4642   | 4736 | 4830 | 4924 | 5018 | 5112 | 5206 | 5299 | 5393 | 5487 | 2                      | 2   | 5581   | 5675 | 5769 | 5862 | 5956 | 6050 | 6143 | 6237 | 6331 | 6424             | 2   |  |  |  |  |  |  |  |  |  |
| 2                | 6518   | 6612 | 6705 | 6799 | 6892 | 6986 | 7079 | 7173 | 7266 | 7360 | 3                      | 3   | 7453   | 7546 | 7640 | 7733 | 7826 | 7920 | 8013 | 8106 | 8199 | 8293             | 3   |  |  |  |  |  |  |  |  |  |
| 3                | 8386   | 8479 | 8572 | 8665 | 8759 | 8852 | 8945 | 9038 | 9131 | 9224 | 4                      | 4   | 9317   | 9410 | 9503 | 9596 | 9689 | 9782 | 9875 | 9967 | 0060 | 0153             | 4   |  |  |  |  |  |  |  |  |  |
| 4                | 670246 | 0339 | 0431 | 0524 | 0617 | 0710 | 0802 | 0895 | 0988 | 1080 | 5                      | 5   | 1173   | 1265 | 1358 | 1451 | 1543 | 1635 | 1728 | 1821 | 1913 | 2005             | 5   |  |  |  |  |  |  |  |  |  |
| 5                | 2098   | 2190 | 2283 | 2375 | 2467 | 2560 | 2652 | 2744 | 2836 | 2929 | 6                      | 6   | 3021   | 3113 | 3205 | 3297 | 3390 | 3482 | 3574 | 3666 | 3758 | 3850             | 6   |  |  |  |  |  |  |  |  |  |
| 6                | 3942   | 4034 | 4126 | 4218 | 4310 | 4402 | 4494 | 4586 | 4677 | 4769 | 7                      | 7   | 4861   | 4953 | 5045 | 5137 | 5228 | 5320 | 5412 | 5503 | 5595 | 5687             | 7   |  |  |  |  |  |  |  |  |  |
| 7                | 4861   | 4953 | 5045 | 5137 | 5228 | 5320 | 5412 | 5503 | 5595 | 5687 | 8                      | 8   | 5778   | 5870 | 5962 | 6053 | 6145 | 6236 | 6328 | 6419 | 6511 | 6602             | 8   |  |  |  |  |  |  |  |  |  |
| 8                | 5778   | 5870 | 5962 | 6053 | 6145 | 6236 | 6328 | 6419 | 6511 | 6602 | 9                      | 9   | 6694   | 6785 | 6876 | 6968 | 7059 | 7151 | 7242 | 7333 | 7424 | 7516             | 9   |  |  |  |  |  |  |  |  |  |
| 9                | 6694   | 6785 | 6876 | 6968 | 7059 | 7151 | 7242 | 7333 | 7424 | 7516 | 470                    | 470 | 7607   | 7698 | 7789 | 7881 | 7972 | 8063 | 8154 | 8245 | 8336 | 8427             | 470 |  |  |  |  |  |  |  |  |  |
| 470              | 8428   | 8519 | 8610 | 8700 | 8791 | 8882 | 8973 | 9064 | 9155 | 9246 | 1                      | 1   | 9317   | 9410 | 9503 | 9596 | 9689 | 9782 | 9875 | 9967 | 0060 | 0153             | 1   |  |  |  |  |  |  |  |  |  |
| 1                | 9317   | 9410 | 9503 | 9596 | 9689 | 9782 | 9875 | 9967 | 0060 | 0153 | 2                      | 2   | 680336 | 0426 | 0517 | 0607 | 0698 | 0789 | 0879 | 0970 | 1060 | 1151             | 2   |  |  |  |  |  |  |  |  |  |
| 2                | 680336 | 0426 | 0517 | 0607 | 0698 | 0789 | 0879 | 0970 | 1060 | 1151 | 3                      | 3   | 1241   | 1332 | 1422 | 1513 | 1603 | 1693 | 1784 | 1874 | 1964 | 2055             | 3   |  |  |  |  |  |  |  |  |  |
| 3                | 1241   | 1332 | 1422 | 1513 | 1603 | 1693 | 1784 | 1874 | 1964 | 2055 | 4                      | 4   | 2145   | 2235 | 2326 | 2416 | 2506 | 2596 | 2686 | 2777 | 2867 | 2957             | 4   |  |  |  |  |  |  |  |  |  |
| 4                | 2145   | 2235 | 2326 | 2416 | 2506 | 2596 | 2686 | 2777 | 2867 | 2957 | 5                      | 5   | 3047   | 3137 | 3227 | 3317 | 3407 | 3497 | 3587 | 3677 | 3767 | 3857             | 5   |  |  |  |  |  |  |  |  |  |
| 5                | 3047   | 3137 | 3227 | 3317 | 3407 | 3497 | 3587 | 3677 | 3767 | 3857 | 6                      | 6   | 3947   | 4037 | 4127 | 4217 | 4307 | 4396 | 4486 | 4576 | 4666 | 4756             | 6   |  |  |  |  |  |  |  |  |  |
| 6                | 3947   | 4037 | 4127 | 4217 | 4307 | 4396 | 4486 | 4576 | 4666 | 4756 | 7                      | 7   | 4845   | 4935 | 5025 | 5114 | 5204 | 5294 | 5383 | 5473 | 5563 | 5652             | 7   |  |  |  |  |  |  |  |  |  |
| 7                | 4845   | 4935 | 5025 | 5114 | 5204 | 5294 | 5383 | 5473 | 5563 | 5652 | 8                      | 8   | 5742   | 5831 | 5921 | 6010 | 6100 | 6189 | 6279 | 6368 | 6458 | 6547             | 8   |  |  |  |  |  |  |  |  |  |
| 8                | 5742   | 5831 | 5921 | 6010 | 6100 | 6189 | 6279 | 6368 | 6458 | 6547 | 9                      | 9   | 6636   | 6726 | 6815 | 6904 | 6994 | 7083 | 7172 | 7261 | 7351 | 7440             | 9   |  |  |  |  |  |  |  |  |  |
| 9                | 6636   | 6726 | 6815 | 6904 | 6994 | 7083 | 7172 | 7261 | 7351 | 7440 | 480                    | 480 | 7529   | 7618 | 7707 | 7796 | 7886 | 7975 | 8064 | 8153 | 8242 | 8331             | 480 |  |  |  |  |  |  |  |  |  |
| 480              | 8420   | 8509 | 8598 | 8687 | 8776 | 8865 | 8953 | 9042 | 9131 | 9220 | 1                      | 1   | 8420   | 8509 | 8598 | 8687 | 8776 | 8865 | 8953 | 9042 | 9131 | 9220             | 1   |  |  |  |  |  |  |  |  |  |
| 1                | 8420   | 8509 | 8598 | 8687 | 8776 | 8865 | 8953 | 9042 | 9131 | 9220 | 2                      | 2   | 9309   | 9398 | 9486 | 9575 | 9664 | 9753 | 9841 | 9930 | 0019 | 0107             | 2   |  |  |  |  |  |  |  |  |  |
| 2                | 9309   | 9398 | 9486 | 9575 | 9664 | 9753 | 9841 | 9930 | 0019 | 0107 | 3                      | 3   | 690196 | 0285 | 0373 | 0462 | 0550 | 0639 | 0728 | 0816 | 0905 | 0993             | 490 |  |  |  |  |  |  |  |  |  |
| 3                | 690196 | 0285 | 0373 | 0462 | 0550 | 0639 | 0728 | 0816 | 0905 | 0993 | 4                      | 4   | 1081   | 1170 | 1258 | 1347 | 1435 | 1524 | 1612 | 1700 | 1789 | 1877             | 4   |  |  |  |  |  |  |  |  |  |
| 4                | 1081   | 1170 | 1258 | 1347 | 1435 | 1524 | 1612 | 1700 | 1789 | 1877 | 5                      | 5   | 1965   | 2053 | 2142 | 2230 | 2318 | 2406 | 2494 | 2583 | 2671 | 2759             | 5   |  |  |  |  |  |  |  |  |  |
| 5                | 1965   | 2053 | 2142 | 2230 | 2318 | 2406 | 2494 | 2583 | 2671 | 2759 | 6                      | 6   | 2847   | 2935 | 3023 | 3111 | 3199 | 3287 | 3375 | 3463 | 3551 | 3639             | 6   |  |  |  |  |  |  |  |  |  |
| 6                | 2847   | 2935 | 3023 | 3111 | 3199 | 3287 | 3375 | 3463 | 3551 | 3639 | 7                      | 7   | 3727   | 3815 | 3903 | 3991 | 4078 | 4166 | 4254 | 4342 | 4430 | 4517             | 7   |  |  |  |  |  |  |  |  |  |
| 7                | 3727   | 3815 | 3903 | 3991 | 4078 | 4166 | 4254 | 4342 | 4430 | 4517 | 8                      | 8   | 4605   | 4693 | 4781 | 4868 | 4956 | 5044 | 5131 | 5219 | 5307 | 5394             | 8   |  |  |  |  |  |  |  |  |  |
| 8                | 4605   | 4693 | 4781 | 4868 | 4956 | 5044 | 5131 | 5219 | 5307 | 5394 | 9                      | 9   | 5482   | 5569 | 5657 | 5744 | 5832 | 5919 | 6007 | 6094 | 6182 | 6269             | 9   |  |  |  |  |  |  |  |  |  |
| 9                | 5482   | 5569 | 5657 | 5744 | 5832 | 5919 | 6007 | 6094 | 6182 | 6269 | 490                    | 490 | 6356   | 6444 | 6531 | 6618 | 6706 | 6793 | 6880 | 6968 | 7055 | 7142             | 490 |  |  |  |  |  |  |  |  |  |
| 490              | 7229   | 7317 | 7404 | 7491 | 7578 | 7665 | 7752 | 7839 | 7926 | 8014 | 1                      | 1   | 7229   | 7317 | 7404 | 7491 | 7578 | 7665 | 7752 | 7839 | 7926 | 8014             | 1   |  |  |  |  |  |  |  |  |  |
| 1                | 7229   | 7317 | 7404 | 7491 | 7578 | 7665 | 7752 | 7839 | 7926 | 8014 | 2                      | 2   | 8100   | 8188 | 8275 | 8362 | 8449 | 8535 | 8622 | 8709 | 8796 | 8883             | 2   |  |  |  |  |  |  |  |  |  |
| 2                | 8100   | 8188 | 8275 | 8362 | 8449 | 8535 | 8622 | 8709 | 8796 | 8883 | 3                      | 3   |        |      |      |      |      |      |      |      |      |                  |     |  |  |  |  |  |  |  |  |  |
| 3                |        |      |      |      |      |      |      |      |      |      | 4                      | 4   | N.     | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9                |     |  |  |  |  |  |  |  |  |  |
| 4                |        |      |      |      |      |      |      |      |      |      | 5                      | 5   | 4410   | 9.8  | 19.6 | 29.4 | 39.2 | 49.0 | 58.8 | 68.6 | 78.4 | 88.2             |     |  |  |  |  |  |  |  |  |  |
| 5                |        |      |      |      |      |      |      |      |      |      | 6                      | 6   | 4454   | 9.7  | 19.4 | 29.1 | 38.8 | 48.5 | 58.2 | 67.9 | 77.6 | 87.3             |     |  |  |  |  |  |  |  |  |  |
| 6                |        |      |      |      |      |      |      |      |      |      | 7                      | 7   | 4500   | 9.6  | 19.2 | 28.8 | 38.4 | 48.0 | 57.6 | 67.2 | 76.8 | 86.4             |     |  |  |  |  |  |  |  |  |  |
| 7                |        |      |      |      |      |      |      |      |      |      | 8                      | 8   | 4547   | 9.5  | 19.0 | 28.5 | 38.0 | 47.5 | 57.0 | 66.5 | 76.0 | 85.5             |     |  |  |  |  |  |  |  |  |  |
| 8                |        |      |      |      |      |      |      |      |      |      | 9                      | 9   | 4595   | 9.4  | 18.8 | 28.2 | 37.6 | 47.0 | 56.4 | 65.8 | 75.2 | 84.6             |     |  |  |  |  |  |  |  |  |  |
| 9                |        |      |      |      |      |      |      |      |      |      |                        |     | 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.                     | 0      | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | N.               |  |  |  |  |  |  |  |  |  |  |
| 500              | 698970 | 9057 | 9144 | 9231 | 9317 | 9404 | 9491 | 9578 | 9664 | 9751 | 500                    | 7570   | 7655 | 7740 | 7826 | 7911 | 7996 | 8081 | 8166 | 8251 | 8336 | 510              |  |  |  |  |  |  |  |  |  |  |
| 1                | 9838   | 9924 | 0011 | 0098 | 0184 | 0271 | 0358 | 0444 | 0531 | 0617 | 1                      | 8421   | 8506 | 8591 | 8676 | 8761 | 8846 | 8931 | 9015 | 9100 | 9185 | 1                |  |  |  |  |  |  |  |  |  |  |
| 2                | 700704 | 0790 | 0877 | 0963 | 1050 | 1136 | 1222 | 1309 | 1395 | 1482 | 2                      | 9270   | 9355 | 9440 | 9524 | 9609 | 9694 | 9779 | 9863 | 9948 | 0033 | 2                |  |  |  |  |  |  |  |  |  |  |
| 3                | 1568   | 1654 | 1741 | 1827 | 1913 | 1999 | 2086 | 2172 | 2258 | 2344 | 3                      | 710117 | 0202 | 0287 | 0371 | 0456 | 0540 | 0625 | 0710 | 0794 | 0879 | 3                |  |  |  |  |  |  |  |  |  |  |
| 4                | 2431   | 2517 | 2603 | 2689 | 2775 | 2861 | 2947 | 3033 | 3119 | 3205 | 4                      | 0963   | 1048 | 1132 | 1217 | 1301 | 1385 | 1470 | 1554 | 1639 | 1723 | 4                |  |  |  |  |  |  |  |  |  |  |
| 5                | 3291   | 3377 | 3463 | 3549 | 3635 | 3721 | 3807 | 3893 | 3979 | 4065 | 5                      | 1807   | 1892 | 1976 | 2060 | 2144 | 2229 | 2313 | 2397 | 2481 | 2565 | 5                |  |  |  |  |  |  |  |  |  |  |
| 6                | 4151   | 4236 | 4322 | 4408 | 4494 | 4579 | 4665 | 4751 | 4837 | 4922 | 6                      | 2650   | 2734 | 2818 | 2902 | 2986 | 3070 | 3154 | 3238 | 3323 | 3407 | 6                |  |  |  |  |  |  |  |  |  |  |
| 7                | 5008   | 5094 | 5179 | 5265 | 5350 | 5436 | 5522 | 5607 | 5693 | 5778 | 7                      | 3491   | 3575 | 3659 | 3742 | 3826 | 3910 | 3994 | 4078 | 4162 | 4246 | 7                |  |  |  |  |  |  |  |  |  |  |
| 8                | 5864   | 5949 | 6035 | 6120 | 6206 | 6291 | 6376 | 6462 | 6547 | 6632 | 8                      | 4330   | 4414 | 4497 | 4581 | 4665 | 4749 | 4833 | 4916 | 5000 | 5084 | 8                |  |  |  |  |  |  |  |  |  |  |
| 9                | 6718   | 6803 | 6888 | 6974 | 7059 | 7144 | 7229 | 7315 | 7400 | 7485 | 9                      | 5167   | 5251 | 5335 | 5418 | 5502 | 5586 | 5669 | 5753 | 5836 | 5920 | 9                |  |  |  |  |  |  |  |  |  |  |
| 510              | 7570   | 7655 | 7740 | 7826 | 7911 | 7996 | 8081 | 8166 | 8251 | 8336 | 510                    | 6003   | 6087 | 6170 | 6254 | 6337 | 6421 | 6504 | 6588 | 6671 | 6754 | 520              |  |  |  |  |  |  |  |  |  |  |
| 1                | 8421   | 8506 | 8591 | 8676 | 8761 | 8846 | 8931 | 9015 | 9100 | 9185 | 1                      | 6838   | 6921 | 7004 | 7088 | 7171 | 7254 | 7338 | 7421 | 7504 | 7587 | 1                |  |  |  |  |  |  |  |  |  |  |
| 2                | 9270   | 9355 | 9440 | 9524 | 9609 | 9694 | 9779 | 9863 | 9948 | 0033 | 2                      | 7671   | 7754 | 7837 | 7920 | 8003 | 8086 | 8169 | 8253 | 8336 | 8419 | 2                |  |  |  |  |  |  |  |  |  |  |
| 3                | 710117 | 0202 | 0287 | 0371 | 0456 | 0540 | 0625 | 0710 | 0794 | 0879 | 3                      | 8502   | 8585 | 8668 | 8751 | 8834 | 8917 | 9000 | 9083 | 9165 | 9248 | 3                |  |  |  |  |  |  |  |  |  |  |
| 4                | 0963   | 1048 | 1132 | 1217 | 1301 | 1385 | 1470 | 1554 | 1639 | 1723 | 4                      | 9331   | 9414 | 9497 | 9580 | 9663 | 9745 | 9828 | 9911 | 9994 | 0077 | 4                |  |  |  |  |  |  |  |  |  |  |
| 5                | 1807   | 1892 | 1976 | 2060 | 2144 | 2229 | 2313 | 2397 | 2481 | 2565 | 5                      | 720159 | 0242 | 0325 | 0407 | 0490 | 0573 | 0655 | 0738 | 0821 | 0903 | 5                |  |  |  |  |  |  |  |  |  |  |
| 6                | 2650   | 2734 | 2818 | 2902 | 2986 | 3070 | 3154 | 3238 | 3323 | 3407 | 6                      | 0986   | 1068 | 1151 | 1233 | 1316 | 1398 | 1481 | 1563 | 1646 | 1728 | 6                |  |  |  |  |  |  |  |  |  |  |
| 7                | 3491   | 3575 | 3659 | 3742 | 3826 | 3910 | 3994 | 4078 | 4162 | 4246 | 7                      | 1811   | 1893 | 1975 | 2058 | 2140 | 2222 | 2305 | 2387 | 2469 | 2552 | 7                |  |  |  |  |  |  |  |  |  |  |
| 8                | 4330   | 4414 | 4497 | 4581 | 4665 | 4749 | 4833 | 4916 | 5000 | 5084 | 8                      | 2634   | 2716 | 2798 | 2881 | 2963 | 3045 | 3127 | 3209 | 3291 | 3374 | 8                |  |  |  |  |  |  |  |  |  |  |
| 9                | 5167   | 5251 | 5335 | 5418 | 5502 | 5586 | 5669 | 5753 | 5836 | 5920 | 9                      | 3456   | 3538 | 3620 | 3702 | 3784 | 3866 | 3948 | 4030 | 4112 | 4194 | 9                |  |  |  |  |  |  |  |  |  |  |
| 520              | 6003   | 6087 | 6170 | 6254 | 6337 | 6421 | 6504 | 6588 | 6671 | 6754 | 520                    | 4276   | 4358 | 4440 | 4522 | 4604 | 4685 | 4767 | 4849 | 4931 | 5013 | 530              |  |  |  |  |  |  |  |  |  |  |
| 1                | 6838   | 6921 | 7004 | 7088 | 7171 | 7254 | 7338 | 7421 | 7504 | 7587 | 1                      | 5095   | 5176 | 5258 | 5340 | 5422 | 5503 | 5585 | 5667 | 5748 | 5830 | 1                |  |  |  |  |  |  |  |  |  |  |
| 2                | 7671   | 7754 | 7837 | 7920 | 8003 | 8086 | 8169 | 8253 | 8336 | 8419 | 2                      | 5912   | 5993 | 6075 | 6156 | 6238 | 6320 | 6401 | 6483 | 6564 | 6646 | 2                |  |  |  |  |  |  |  |  |  |  |
| 3                | 8502   | 8585 | 8668 | 8751 | 8834 | 8917 | 9000 | 9083 | 9165 | 9248 | 3                      | 6727   | 6809 | 6890 | 6972 | 7053 | 7134 | 7216 | 7297 | 7379 | 7460 | 3                |  |  |  |  |  |  |  |  |  |  |
| 4                | 9331   | 9414 | 9497 | 9580 | 9663 | 9745 | 9828 | 9911 | 9994 | 0077 | 4                      | 7541   | 7623 | 7704 | 7785 | 7866 | 7948 | 8029 | 8110 | 8191 | 8273 | 4                |  |  |  |  |  |  |  |  |  |  |
| 5                | 720159 | 0242 | 0325 | 0407 | 0490 | 0573 | 0655 | 0738 | 0821 | 0903 | 5                      | 8354   | 8435 | 8516 | 8597 | 8678 | 8759 | 8841 | 8922 | 9003 | 9084 | 5                |  |  |  |  |  |  |  |  |  |  |
| 6                | 0986   | 1068 | 1151 | 1233 | 1316 | 1398 | 1481 | 1563 | 1646 | 1728 | 6                      | 9165   | 9246 | 9327 | 9408 | 9489 | 9570 | 9651 | 9732 | 9813 | 9893 | 6                |  |  |  |  |  |  |  |  |  |  |
| 7                | 1811   | 1893 | 1975 | 2058 | 2140 | 2222 | 2305 | 2387 | 2469 | 2552 | 7                      | 9974   | 0055 | 0136 | 0217 | 0298 | 0378 | 0459 | 0540 | 0621 | 0702 | 7                |  |  |  |  |  |  |  |  |  |  |
| 8                | 2634   | 2716 | 2798 | 2881 | 2963 | 3045 | 3127 | 3209 | 3291 | 3374 | 8                      | 730782 | 0863 | 0944 | 1024 | 1105 | 1186 | 1266 | 1347 | 1428 | 1508 | 8                |  |  |  |  |  |  |  |  |  |  |
| 9                | 3456   | 3538 | 3620 | 3702 | 3784 | 3866 | 3948 | 4030 | 4112 | 4194 | 9                      | 1589   | 1669 | 1750 | 1830 | 1911 | 1991 | 2072 | 2152 | 2233 | 2313 | 9                |  |  |  |  |  |  |  |  |  |  |
| 530              | 4276   | 4358 | 4440 | 4522 | 4604 | 4685 | 4767 | 4849 | 4931 | 5013 | 530                    | 2394   | 2474 | 2555 | 2635 | 2715 | 2796 | 2876 | 2956 | 3037 | 3117 | 540              |  |  |  |  |  |  |  |  |  |  |
| 1                | 5095   | 5176 | 5258 | 5340 | 5422 | 5503 | 5585 | 5667 | 5748 | 5830 | 1                      | 3197   | 3278 | 3358 | 3438 | 3518 | 3598 | 3679 | 3759 | 3839 | 3919 | 1                |  |  |  |  |  |  |  |  |  |  |
| 2                | 5912   | 5993 | 6075 | 6156 | 6238 | 6320 | 6401 | 6483 | 6564 | 6646 | 2                      | 3999   | 4079 | 4160 | 4240 | 4320 | 4400 | 4480 | 4560 | 4640 | 4720 | 2                |  |  |  |  |  |  |  |  |  |  |
| 3                | 6727   | 6809 | 6890 | 6972 | 7053 | 7134 | 7216 | 7297 | 7379 | 7460 | 3                      | 4800   | 4880 | 4960 | 5040 | 5120 | 5199 | 5279 | 5359 | 5439 | 5519 | 3                |  |  |  |  |  |  |  |  |  |  |
| 4                | 7541   | 7623 | 7704 | 7785 | 7866 | 7948 | 8029 | 8110 | 8191 | 8273 | 4                      | 5599   | 5679 | 5759 | 5838 | 5918 | 5998 | 6078 | 6157 | 6237 | 6317 | 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 |                        |        |      |      |      |      |      |      |      |      |      |                  |  |  |  |  |  |  |  |  |  |  |
| 5020             |        | 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 | 7352 | 7431 | 7511 | 7590 | 7670 | 7749 | 7829 | 7908 | 6   |
| 7                                                        | 7987   | 8067 | 8146 | 8225 | 8305 | 8384 | 8463 | 8543 | 8622 | 8701 | 7   |
| 8                                                        | 8781   | 8860 | 8939 | 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 | 9581 | 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 | 24.4 | 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 | 5610 | 5683 | 5756 | 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 | 1340 | 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. 839. |        |      |      |      |      |      |      |      |      |      |     |
|----------------------------------------------------------|--------|------|------|------|------|------|------|------|------|------|-----|
| 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                                                        | 7535   | 7603 | 7670 | 7738 | 7806 | 7873 | 7941 | 8008 | 8076 | 8143 | 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 | 0301 | 0369 | 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 | 3605 | 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   | 7434 | 7499 | 7563 | 7628 | 7692 | 7757 | 7821 | 7886 | 7951 | 2   |
| 3                                                        | 8015   | 8080 | 8144 | 8209 | 8273 | 8338 | 8402 | 8467 | 8531 | 8595 | 3   |
| 4                                                        | 8660   | 8724 | 8789 | 8853 | 8918 | 8982 | 9046 | 9111 | 9175 | 9239 | 4   |
| P. MOR. PART.                                            | 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 |     |



| No. 720 L. 857.] |        |      |      |      |      |      |      |      |      |      | LOGARITHMS OF NUMBERS. |   |        |      |      |      |      |      |      |      |      | [No. 764 L. 883.] |   |   |  |  |  |  |  |  |  |  |
|------------------|--------|------|------|------|------|------|------|------|------|------|------------------------|---|--------|------|------|------|------|------|------|------|------|-------------------|---|---|--|--|--|--|--|--|--|--|
| N.               | 0      | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 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 |   |  |  |  |  |  |  |  |  |
| 1                | 8537   | 8597 | 8657 | 8718 | 8778 | 8838 | 8898 | 8958 | 9018 | 9078 | 1                      | 2 | 9138   | 9198 | 9258 | 9318 | 9379 | 9439 | 9490 | 9550 | 9610 | 9670              | 2 |   |  |  |  |  |  |  |  |  |
| 2                | 9739   | 9799 | 9859 | 9918 | 9978 | 0038 | 0098 | 0158 | 0218 | 0278 | 2                      | 3 | 860338 | 0398 | 0458 | 0518 | 0578 | 0637 | 0697 | 0757 | 0817 | 0877              | 3 |   |  |  |  |  |  |  |  |  |
| 3                | 860338 | 0398 | 0458 | 0518 | 0578 | 0637 | 0697 | 0757 | 0817 | 0877 | 3                      | 4 | 0937   | 1996 | 1056 | 1116 | 1176 | 1231 | 1295 | 1355 | 1415 | 1475              | 4 |   |  |  |  |  |  |  |  |  |
| 4                | 0937   | 1996 | 1056 | 1116 | 1176 | 1231 | 1295 | 1355 | 1415 | 1475 | 4                      | 5 | 1534   | 1594 | 1654 | 1714 | 1773 | 1833 | 1893 | 1952 | 2012 | 2072              | 5 |   |  |  |  |  |  |  |  |  |
| 5                | 1534   | 1594 | 1654 | 1714 | 1773 | 1833 | 1893 | 1952 | 2012 | 2072 | 5                      | 6 | 2131   | 2191 | 2251 | 2310 | 2370 | 2430 | 2489 | 2543 | 2602 | 2662              | 6 |   |  |  |  |  |  |  |  |  |
| 6                | 2131   | 2191 | 2251 | 2310 | 2370 | 2430 | 2489 | 2543 | 2602 | 2662 | 6                      | 7 | 2728   | 2787 | 2847 | 2906 | 2966 | 3025 | 3085 | 3144 | 3204 | 3263              | 7 |   |  |  |  |  |  |  |  |  |
| 7                | 2728   | 2787 | 2847 | 2906 | 2966 | 3025 | 3085 | 3144 | 3204 | 3263 | 7                      | 8 | 3323   | 3382 | 3442 | 3501 | 3561 | 3620 | 3680 | 3739 | 3799 | 3858              | 8 |   |  |  |  |  |  |  |  |  |
| 8                | 3323   | 3382 | 3442 | 3501 | 3561 | 3620 | 3680 | 3739 | 3799 | 3858 | 8                      | 9 | 3917   | 3977 | 4036 | 4096 | 4155 | 4214 | 4274 | 4333 | 4392 | 4452              | 9 |   |  |  |  |  |  |  |  |  |
| 9                | 3917   | 3977 | 4036 | 4096 | 4155 | 4214 | 4274 | 4333 | 4392 | 4452 | 9                      | 1 | 4511   | 4570 | 4630 | 4689 | 4748 | 4808 | 4867 | 4926 | 4985 | 5045              | 1 |   |  |  |  |  |  |  |  |  |
| 730              | 4511   | 4570 | 4630 | 4689 | 4748 | 4808 | 4867 | 4926 | 4985 | 5045 | 1                      | 2 | 5104   | 5163 | 5222 | 5282 | 5341 | 5400 | 5459 | 5519 | 5578 | 5637              | 2 |   |  |  |  |  |  |  |  |  |
| 1                | 5104   | 5163 | 5222 | 5282 | 5341 | 5400 | 5459 | 5519 | 5578 | 5637 | 2                      | 3 | 5696   | 5755 | 5814 | 5874 | 5933 | 5992 | 6051 | 6110 | 6169 | 6228              | 3 |   |  |  |  |  |  |  |  |  |
| 2                | 5696   | 5755 | 5814 | 5874 | 5933 | 5992 | 6051 | 6110 | 6169 | 6228 | 3                      | 4 | 6287   | 6346 | 6405 | 6465 | 6524 | 6583 | 6642 | 6701 | 6760 | 6819              | 4 |   |  |  |  |  |  |  |  |  |
| 3                | 6287   | 6346 | 6405 | 6465 | 6524 | 6583 | 6642 | 6701 | 6760 | 6819 | 4                      | 5 | 6878   | 6937 | 6996 | 7055 | 7114 | 7173 | 7232 | 7291 | 7350 | 7409              | 5 |   |  |  |  |  |  |  |  |  |
| 4                | 6878   | 6937 | 6996 | 7055 | 7114 | 7173 | 7232 | 7291 | 7350 | 7409 | 5                      | 6 | 7467   | 7526 | 7585 | 7644 | 7703 | 7762 | 7821 | 7880 | 7939 | 7998              | 6 |   |  |  |  |  |  |  |  |  |
| 5                | 7467   | 7526 | 7585 | 7644 | 7703 | 7762 | 7821 | 7880 | 7939 | 7998 | 6                      | 7 | 8056   | 8115 | 8174 | 8233 | 8292 | 8350 | 8409 | 8468 | 8527 | 8586              | 7 |   |  |  |  |  |  |  |  |  |
| 6                | 8056   | 8115 | 8174 | 8233 | 8292 | 8350 | 8409 | 8468 | 8527 | 8586 | 7                      | 8 | 8644   | 8703 | 8762 | 8821 | 8879 | 8938 | 8997 | 9056 | 9114 | 9173              | 8 |   |  |  |  |  |  |  |  |  |
| 7                | 8644   | 8703 | 8762 | 8821 | 8879 | 8938 | 8997 | 9056 | 9114 | 9173 | 8                      | 9 | 9232   | 9290 | 9349 | 9408 | 9466 | 9525 | 9584 | 9642 | 9701 | 9760              | 9 |   |  |  |  |  |  |  |  |  |
| 8                | 9232   | 9290 | 9349 | 9408 | 9466 | 9525 | 9584 | 9642 | 9701 | 9760 | 9                      | 1 | 9818   | 9877 | 9935 | 9994 | 0053 | 0111 | 0170 | 0228 | 0287 | 0345              | 1 |   |  |  |  |  |  |  |  |  |
| 9                | 9818   | 9877 | 9935 | 9994 | 0053 | 0111 | 0170 | 0228 | 0287 | 0345 | 1                      | 2 | 870404 | 0462 | 0521 | 0579 | 0638 | 0696 | 0755 | 0813 | 0872 | 0930              | 2 |   |  |  |  |  |  |  |  |  |
| 740              | 870404 | 0462 | 0521 | 0579 | 0638 | 0696 | 0755 | 0813 | 0872 | 0930 | 2                      | 3 | 0989   | 1047 | 1106 | 1164 | 1223 | 1281 | 1339 | 1398 | 1456 | 1515              | 3 |   |  |  |  |  |  |  |  |  |
| 1                | 0989   | 1047 | 1106 | 1164 | 1223 | 1281 | 1339 | 1398 | 1456 | 1515 | 3                      | 4 | 1573   | 1631 | 1690 | 1748 | 1806 | 1865 | 1923 | 1981 | 2040 | 2098              | 4 |   |  |  |  |  |  |  |  |  |
| 2                | 1573   | 1631 | 1690 | 1748 | 1806 | 1865 | 1923 | 1981 | 2040 | 2098 | 4                      | 5 | 2156   | 2215 | 2273 | 2331 | 2389 | 2448 | 2506 | 2564 | 2622 | 2681              | 5 |   |  |  |  |  |  |  |  |  |
| 3                | 2156   | 2215 | 2273 | 2331 | 2389 | 2448 | 2506 | 2564 | 2622 | 2681 | 5                      | 6 | 2739   | 2797 | 2855 | 2913 | 2972 | 3030 | 3088 | 3146 | 3204 | 3262              | 6 |   |  |  |  |  |  |  |  |  |
| 4                | 2739   | 2797 | 2855 | 2913 | 2972 | 3030 | 3088 | 3146 | 3204 | 3262 | 6                      | 7 | 3321   | 3379 | 3437 | 3495 | 3553 | 3611 | 3669 | 3727 | 3785 | 3844              | 7 |   |  |  |  |  |  |  |  |  |
| 5                | 3321   | 3379 | 3437 | 3495 | 3553 | 3611 | 3669 | 3727 | 3785 | 3844 | 7                      | 8 | 3902   | 3960 | 4018 | 4076 | 4134 | 4192 | 4250 | 4308 | 4366 | 4424              | 8 |   |  |  |  |  |  |  |  |  |
| 6                | 3902   | 3960 | 4018 | 4076 | 4134 | 4192 | 4250 | 4308 | 4366 | 4424 | 8                      | 9 | 4482   | 4540 | 4598 | 4656 | 4714 | 4772 | 4830 | 4888 | 4945 | 5003              | 9 |   |  |  |  |  |  |  |  |  |
| 7                | 4482   | 4540 | 4598 | 4656 | 4714 | 4772 | 4830 | 4888 | 4945 | 5003 | 9                      | 1 | 5061   | 5119 | 5177 | 5235 | 5293 | 5351 | 5409 | 5466 | 5524 | 5582              | 1 |   |  |  |  |  |  |  |  |  |
| 8                | 5061   | 5119 | 5177 | 5235 | 5293 | 5351 | 5409 | 5466 | 5524 | 5582 | 1                      | 2 | 5640   | 5698 | 5756 | 5813 | 5871 | 5929 | 5987 | 6045 | 6102 | 6160              | 2 |   |  |  |  |  |  |  |  |  |
| 9                | 5640   | 5698 | 5756 | 5813 | 5871 | 5929 | 5987 | 6045 | 6102 | 6160 | 2                      | 3 | 6218   | 6276 | 6333 | 6391 | 6449 | 6507 | 6564 | 6622 | 6680 | 6737              | 3 |   |  |  |  |  |  |  |  |  |
| 750              | 6218   | 6276 | 6333 | 6391 | 6449 | 6507 | 6564 | 6622 | 6680 | 6737 | 3                      | 4 | 6795   | 6853 | 6910 | 6968 | 7026 | 7083 | 7141 | 7199 | 7256 | 7314              | 4 |   |  |  |  |  |  |  |  |  |
| 1                | 6795   | 6853 | 6910 | 6968 | 7026 | 7083 | 7141 | 7199 | 7256 | 7314 | 4                      | 5 | 7371   | 7429 | 7487 | 7544 | 7602 | 7659 | 7717 | 7774 | 7832 | 7889              | 5 |   |  |  |  |  |  |  |  |  |
| 2                | 7371   | 7429 | 7487 | 7544 | 7602 | 7659 | 7717 | 7774 | 7832 | 7889 | 5                      | 6 | 7947   | 8004 | 8062 | 8119 | 8177 | 8234 | 8292 | 8349 | 8407 | 8464              | 6 |   |  |  |  |  |  |  |  |  |
| 3                | 7947   | 8004 | 8062 | 8119 | 8177 | 8234 | 8292 | 8349 | 8407 | 8464 | 6                      | 7 | 8522   | 8579 | 8637 | 8694 | 8752 | 8809 | 8866 | 8924 | 8981 | 9039              | 7 |   |  |  |  |  |  |  |  |  |
| 4                | 8522   | 8579 | 8637 | 8694 | 8752 | 8809 | 8866 | 8924 | 8981 | 9039 | 7                      | 8 | 9096   | 9153 | 9211 | 9268 | 9325 | 9383 | 9440 | 9497 | 9555 | 9612              | 8 |   |  |  |  |  |  |  |  |  |
| 5                | 9096   | 9153 | 9211 | 9268 | 9325 | 9383 | 9440 | 9497 | 9555 | 9612 | 8                      | 9 | 9669   | 9726 | 9784 | 9841 | 9898 | 9956 | 0013 | 0070 | 0127 | 0185              | 9 |   |  |  |  |  |  |  |  |  |
| 6                | 9669   | 9726 | 9784 | 9841 | 9898 | 9956 | 0013 | 0070 | 0127 | 0185 | 9                      | 1 | 880242 | 0299 | 0356 | 0413 | 0471 | 0528 | 0585 | 0642 | 0699 | 0756              | 1 |   |  |  |  |  |  |  |  |  |
| 7                | 880242 | 0299 | 0356 | 0413 | 0471 | 0528 | 0585 | 0642 | 0699 | 0756 | 1                      | 2 | 0814   | 0871 | 0928 | 0985 | 1042 | 1099 | 1156 | 1213 | 1271 | 1328              | 2 |   |  |  |  |  |  |  |  |  |
| 8                | 0814   | 0871 | 0928 | 0985 | 1042 | 1099 | 1156 | 1213 | 1271 | 1328 | 2                      | 3 | 1385   | 1442 | 1499 | 1556 | 1613 | 1670 | 1727 | 1784 | 1841 | 1898              | 3 |   |  |  |  |  |  |  |  |  |
| 9                | 1385   | 1442 | 1499 | 1556 | 1613 | 1670 | 1727 | 1784 | 1841 | 1898 | 3                      | 4 | 1955   | 2012 | 2069 | 2126 | 2183 | 2240 | 2297 | 2354 | 2411 | 2468              | 4 |   |  |  |  |  |  |  |  |  |
| 760              | 1955   | 2012 | 2069 | 2126 | 2183 | 2240 | 2297 | 2354 | 2411 | 2468 | 4                      | 5 | 2525   | 2581 | 2638 | 2695 | 2752 | 2809 | 2866 | 2923 | 2980 | 3037              | 5 |   |  |  |  |  |  |  |  |  |
| 1                | 2525   | 2581 | 2638 | 2695 | 2752 | 2809 | 2866 | 2923 | 2980 | 3037 | 5                      | 6 | 3093   | 3150 | 3207 | 3264 | 3321 | 3377 | 3434 | 3491 | 3548 | 3605              | 6 |   |  |  |  |  |  |  |  |  |
| 2                | 3093   | 3150 | 3207 | 3264 | 3321 | 3377 | 3434 | 3491 | 3548 | 3605 | 6                      | 7 |        | N.   | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8                 | 9 | 7 |  |  |  |  |  |  |  |  |
| 3                |        | N.   | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9                      | 8 | 7299   | 5'9  | 11'8 | 17'7 | 23'6 | 29'5 | 35'4 | 41'3 | 47'2 | 53'1              | 8 |   |  |  |  |  |  |  |  |  |
| 4                |        | 7299 | 5'9  | 11'8 | 17'7 | 23'6 | 29'5 | 35'4 | 41'3 | 47'2 | 53'1                   | 8 | 7423   | 5'8  | 11'6 | 17'4 | 23'2 | 29'0 | 34'8 | 40'6 | 46'4 | 52'2              | 9 |   |  |  |  |  |  |  |  |  |
|                  |        | 7423 | 5'8  | 11'6 | 17'4 | 23'2 | 29'0 | 34'8 | 40'6 | 46'4 | 52'2                   | 9 | 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 | 1649 | 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 | 9438 | 9492 | 9547 | 9602 | 9656 | 9711 | 9766 | 3   |
| 4            | 9821   | 9875 | 9930 | 9985 | 0039 | 0094 | 0149 | 0203 | 0258 | 0312 | 4   |
| 5            | 900367 | 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.                     | 0      | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8     | 9     | N.              | 0      | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8     | 9     | N.  |
| 810              | 908485 | 8539   | 8592 | 8646 | 8699 | 8753 | 8807 | 8860 | 8914  | 8967  | 810                    | 908485 | 8539 | 8592 | 8646 | 8699 | 8753 | 8807 | 8860 | 8914  | 8967  | 810             | 908485 | 8539 | 8592 | 8646 | 8699 | 8753 | 8807 | 8860 | 8914  | 8967  | 810 |
| 1                | 9021   | 9074   | 9128 | 9181 | 9235 | 9289 | 9342 | 9396 | 9449  | 9503  | 1                      | 9021   | 9074 | 9128 | 9181 | 9235 | 9289 | 9342 | 9396 | 9449  | 9503  | 1               | 9021   | 9074 | 9128 | 9181 | 9235 | 9289 | 9342 | 9396 | 9449  | 9503  | 1   |
| 2                | 9556   | 9609   | 9663 | 9716 | 9770 | 9823 | 9877 | 9930 | 9984  | 10000 | 2                      | 9556   | 9609 | 9663 | 9716 | 9770 | 9823 | 9877 | 9930 | 9984  | 10000 | 2               | 9556   | 9609 | 9663 | 9716 | 9770 | 9823 | 9877 | 9930 | 9984  | 10000 | 2   |
| 3                | 910091 | 0144   | 0197 | 0251 | 0304 | 0358 | 0411 | 0464 | 0518  | 0571  | 3                      | 910091 | 0144 | 0197 | 0251 | 0304 | 0358 | 0411 | 0464 | 0518  | 0571  | 3               | 910091 | 0144 | 0197 | 0251 | 0304 | 0358 | 0411 | 0464 | 0518  | 0571  | 3   |
| 4                | 0624   | 0678   | 0731 | 0784 | 0838 | 0891 | 0944 | 0998 | 1051  | 1104  | 4                      | 0624   | 0678 | 0731 | 0784 | 0838 | 0891 | 0944 | 0998 | 1051  | 1104  | 4               | 0624   | 0678 | 0731 | 0784 | 0838 | 0891 | 0944 | 0998 | 1051  | 1104  | 4   |
| 5                | 1158   | 1211   | 1264 | 1317 | 1371 | 1424 | 1477 | 1530 | 1584  | 1637  | 5                      | 1158   | 1211 | 1264 | 1317 | 1371 | 1424 | 1477 | 1530 | 1584  | 1637  | 5               | 1158   | 1211 | 1264 | 1317 | 1371 | 1424 | 1477 | 1530 | 1584  | 1637  | 5   |
| 6                | 1690   | 1743   | 1797 | 1850 | 1903 | 1956 | 2009 | 2063 | 2116  | 2169  | 6                      | 1690   | 1743 | 1797 | 1850 | 1903 | 1956 | 2009 | 2063 | 2116  | 2169  | 6               | 1690   | 1743 | 1797 | 1850 | 1903 | 1956 | 2009 | 2063 | 2116  | 2169  | 6   |
| 7                | 2222   | 2275   | 2328 | 2381 | 2435 | 2488 | 2541 | 2594 | 2647  | 2700  | 7                      | 2222   | 2275 | 2328 | 2381 | 2435 | 2488 | 2541 | 2594 | 2647  | 2700  | 7               | 2222   | 2275 | 2328 | 2381 | 2435 | 2488 | 2541 | 2594 | 2647  | 2700  | 7   |
| 8                | 2753   | 2806   | 2859 | 2913 | 2966 | 3019 | 3072 | 3125 | 3178  | 3231  | 8                      | 2753   | 2806 | 2859 | 2913 | 2966 | 3019 | 3072 | 3125 | 3178  | 3231  | 8               | 2753   | 2806 | 2859 | 2913 | 2966 | 3019 | 3072 | 3125 | 3178  | 3231  | 8   |
| 9                | 3284   | 3337   | 3390 | 3443 | 3496 | 3549 | 3602 | 3655 | 3708  | 3761  | 9                      | 3284   | 3337 | 3390 | 3443 | 3496 | 3549 | 3602 | 3655 | 3708  | 3761  | 9               | 3284   | 3337 | 3390 | 3443 | 3496 | 3549 | 3602 | 3655 | 3708  | 3761  | 9   |
| 820              | 3814   | 3867   | 3920 | 3973 | 4026 | 4079 | 4132 | 4184 | 4237  | 4290  | 820                    | 3814   | 3867 | 3920 | 3973 | 4026 | 4079 | 4132 | 4184 | 4237  | 4290  | 820             | 3814   | 3867 | 3920 | 3973 | 4026 | 4079 | 4132 | 4184 | 4237  | 4290  | 820 |
| 1                | 4343   | 4396   | 4449 | 4502 | 4555 | 4608 | 4660 | 4713 | 4766  | 4819  | 1                      | 4343   | 4396 | 4449 | 4502 | 4555 | 4608 | 4660 | 4713 | 4766  | 4819  | 1               | 4343   | 4396 | 4449 | 4502 | 4555 | 4608 | 4660 | 4713 | 4766  | 4819  | 1   |
| 2                | 4872   | 4925   | 4977 | 5030 | 5083 | 5136 | 5189 | 5241 | 5294  | 5347  | 2                      | 4872   | 4925 | 4977 | 5030 | 5083 | 5136 | 5189 | 5241 | 5294  | 5347  | 2               | 4872   | 4925 | 4977 | 5030 | 5083 | 5136 | 5189 | 5241 | 5294  | 5347  | 2   |
| 3                | 5400   | 5453   | 5505 | 5558 | 5611 | 5664 | 5716 | 5769 | 5822  | 5875  | 3                      | 5400   | 5453 | 5505 | 5558 | 5611 | 5664 | 5716 | 5769 | 5822  | 5875  | 3               | 5400   | 5453 | 5505 | 5558 | 5611 | 5664 | 5716 | 5769 | 5822  | 5875  | 3   |
| 4                | 5927   | 5980   | 6033 | 6085 | 6138 | 6191 | 6243 | 6296 | 6349  | 6401  | 4                      | 5927   | 5980 | 6033 | 6085 | 6138 | 6191 | 6243 | 6296 | 6349  | 6401  | 4               | 5927   | 5980 | 6033 | 6085 | 6138 | 6191 | 6243 | 6296 | 6349  | 6401  | 4   |
| 5                | 6454   | 6507   | 6559 | 6612 | 6664 | 6717 | 6770 | 6822 | 6875  | 6927  | 5                      | 6454   | 6507 | 6559 | 6612 | 6664 | 6717 | 6770 | 6822 | 6875  | 6927  | 5               | 6454   | 6507 | 6559 | 6612 | 6664 | 6717 | 6770 | 6822 | 6875  | 6927  | 5   |
| 6                | 6980   | 7033   | 7085 | 7138 | 7190 | 7243 | 7295 | 7348 | 7400  | 7453  | 6                      | 6980   | 7033 | 7085 | 7138 | 7190 | 7243 | 7295 | 7348 | 7400  | 7453  | 6               | 6980   | 7033 | 7085 | 7138 | 7190 | 7243 | 7295 | 7348 | 7400  | 7453  | 6   |
| 7                | 7506   | 7558   | 7611 | 7663 | 7716 | 7768 | 7820 | 7873 | 7925  | 7978  | 7                      | 7506   | 7558 | 7611 | 7663 | 7716 | 7768 | 7820 | 7873 | 7925  | 7978  | 7               | 7506   | 7558 | 7611 | 7663 | 7716 | 7768 | 7820 | 7873 | 7925  | 7978  | 7   |
| 8                | 8030   | 8083   | 8135 | 8188 | 8240 | 8293 | 8345 | 8397 | 8450  | 8502  | 8                      | 8030   | 8083 | 8135 | 8188 | 8240 | 8293 | 8345 | 8397 | 8450  | 8502  | 8               | 8030   | 8083 | 8135 | 8188 | 8240 | 8293 | 8345 | 8397 | 8450  | 8502  | 8   |
| 9                | 8555   | 8607   | 8659 | 8712 | 8764 | 8816 | 8869 | 8921 | 8973  | 9026  | 9                      | 8555   | 8607 | 8659 | 8712 | 8764 | 8816 | 8869 | 8921 | 8973  | 9026  | 9               | 8555   | 8607 | 8659 | 8712 | 8764 | 8816 | 8869 | 8921 | 8973  | 9026  | 9   |
| 830              | 9078   | 9130   | 9183 | 9235 | 9287 | 9340 | 9392 | 9444 | 9496  | 9549  | 830                    | 9078   | 9130 | 9183 | 9235 | 9287 | 9340 | 9392 | 9444 | 9496  | 9549  | 830             | 9078   | 9130 | 9183 | 9235 | 9287 | 9340 | 9392 | 9444 | 9496  | 9549  | 830 |
| 1                | 9601   | 9653   | 9706 | 9758 | 9810 | 9862 | 9914 | 9967 | 10000 | 10000 | 1                      | 9601   | 9653 | 9706 | 9758 | 9810 | 9862 | 9914 | 9967 | 10000 | 10000 | 1               | 9601   | 9653 | 9706 | 9758 | 9810 | 9862 | 9914 | 9967 | 10000 | 10000 | 1   |
| 2                | 920123 | 0176   | 0228 | 0280 | 0332 | 0384 | 0436 | 0489 | 0541  | 0593  | 2                      | 920123 | 0176 | 0228 | 0280 | 0332 | 0384 | 0436 | 0489 | 0541  | 0593  | 2               | 920123 | 0176 | 0228 | 0280 | 0332 | 0384 | 0436 | 0489 | 0541  | 0593  | 2   |
| 3                | 0645   | 0697   | 0749 | 0801 | 0853 | 0906 | 0958 | 1010 | 1062  | 1114  | 3                      | 0645   | 0697 | 0749 | 0801 | 0853 | 0906 | 0958 | 1010 | 1062  | 1114  | 3               | 0645   | 0697 | 0749 | 0801 | 0853 | 0906 | 0958 | 1010 | 1062  | 1114  | 3   |
| 4                | 1166   | 1218   | 1270 | 1322 | 1374 | 1426 | 1478 | 1530 | 1582  | 1634  | 4                      | 1166   | 1218 | 1270 | 1322 | 1374 | 1426 | 1478 | 1530 | 1582  | 1634  | 4               | 1166   | 1218 | 1270 | 1322 | 1374 | 1426 | 1478 | 1530 | 1582  | 1634  | 4   |
| 5                | 1686   | 1738   | 1790 | 1842 | 1894 | 1946 | 1998 | 2050 | 2102  | 2154  | 5                      | 1686   | 1738 | 1790 | 1842 | 1894 | 1946 | 1998 | 2050 | 2102  | 2154  | 5               | 1686   | 1738 | 1790 | 1842 | 1894 | 1946 | 1998 | 2050 | 2102  | 2154  | 5   |
| 6                | 2206   | 2258   | 2310 | 2362 | 2414 | 2466 | 2518 | 2570 | 2622  | 2674  | 6                      | 2206   | 2258 | 2310 | 2362 | 2414 | 2466 | 2518 | 2570 | 2622  | 2674  | 6               | 2206   | 2258 | 2310 | 2362 | 2414 | 2466 | 2518 | 2570 | 2622  | 2674  | 6   |
| 7                | 2725   | 2777   | 2829 | 2881 | 2933 | 2985 | 3037 | 3089 | 3140  | 3192  | 7                      | 2725   | 2777 | 2829 | 2881 | 2933 | 2985 | 3037 | 3089 | 3140  | 3192  | 7               | 2725   | 2777 | 2829 | 2881 | 2933 | 2985 | 3037 | 3089 | 3140  | 3192  | 7   |
| 8                | 3244   | 3296   | 3348 | 3399 | 3451 | 3503 | 3555 | 3607 | 3658  | 3710  | 8                      | 3244   | 3296 | 3348 | 3399 | 3451 | 3503 | 3555 | 3607 | 3658  | 3710  | 8               | 3244   | 3296 | 3348 | 3399 | 3451 | 3503 | 3555 | 3607 | 3658  | 3710  | 8   |
| 9                | 3762   | 3814   | 3865 | 3917 | 3969 | 4021 | 4072 | 4124 | 4176  | 4228  | 9                      | 3762   | 3814 | 3865 | 3917 | 3969 | 4021 | 4072 | 4124 | 4176  | 4228  | 9               | 3762   | 3814 | 3865 | 3917 | 3969 | 4021 | 4072 | 4124 | 4176  | 4228  | 9   |
| 840              | 4279   | 4331   | 4383 | 4434 | 4486 | 4538 | 4589 | 4641 | 4693  | 4744  | 840                    | 4279   | 4331 | 4383 | 4434 | 4486 | 4538 | 4589 | 4641 | 4693  | 4744  | 840             | 4279   | 4331 | 4383 | 4434 | 4486 | 4538 | 4589 | 4641 | 4693  | 4744  | 840 |
| 1                | 4796   | 4848   | 4899 | 4951 | 5003 | 5054 | 5106 | 5157 | 5209  | 5261  | 1                      | 4796   | 4848 | 4899 | 4951 | 5003 | 5054 | 5106 | 5157 | 5209  | 5261  | 1               | 4796   | 4848 | 4899 | 4951 | 5003 | 5054 | 5106 | 5157 | 5209  | 5261  | 1   |
| 2                | 5312   | 5364   | 5415 | 5467 | 5518 | 5570 | 5621 | 5673 | 5725  | 5776  | 2                      | 5312   | 5364 | 5415 | 5467 | 5518 | 5570 | 5621 | 5673 | 5725  | 5776  | 2               | 5312   | 5364 | 5415 | 5467 | 5518 | 5570 | 5621 | 5673 | 5725  | 5776  | 2   |
| 3                | 5828   | 5879   | 5931 | 5982 | 6034 | 6085 | 6137 | 6188 | 6239  | 6291  | 3                      | 5828   | 5879 | 5931 | 5982 | 6034 | 6085 | 6137 | 6188 | 6239  | 6291  | 3               | 5828   | 5879 | 5931 | 5982 | 6034 | 6085 | 6137 | 6188 | 6239  | 6291  | 3   |
| 4                | 6342   | 6394   | 6445 | 6497 | 6548 | 6600 | 6651 | 6702 | 6754  | 6805  | 4                      | 6342   | 6394 | 6445 | 6497 | 6548 | 6600 | 6651 | 6702 | 6754  | 6805  | 4               | 6342   | 6394 | 6445 | 6497 | 6548 | 6600 | 6651 | 6702 | 6754  | 6805  | 4   |
| 5                | 6857   | 6908   | 6959 | 7011 | 7062 | 7114 | 7165 | 7216 | 7268  | 7319  | 5                      | 6857   | 6908 | 6959 | 7011 | 7062 | 7114 | 7165 | 7216 | 7268  | 7319  | 5               | 6857   | 6908 | 6959 | 7011 | 7062 | 7114 | 7165 | 7216 | 7268  | 7319  | 5   |
| 6                | 7370   | 7422   | 7473 | 7524 | 7576 | 7627 | 7678 | 7729 | 7781  | 7832  | 6                      | 7370   | 7422 | 7473 | 7524 | 7576 | 7627 | 7678 | 7729 | 7781  | 7832  | 6               | 7370   | 7422 | 7473 | 7524 | 7576 | 7627 | 7678 | 7729 | 7781  | 7832  | 6   |
| 7                | 7883   | 7935</ |      |      |      |      |      |      |       |       |                        |        |      |      |      |      |      |      |      |       |       |                 |        |      |      |      |      |      |      |      |       |       |     |

| 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 | 4334 | 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   | 50   | 100  | 150  | 200  | 250  | 300  | 350  | 400  | 450  |     |
|                                                          | 8773   | 49   | 98   | 147  | 196  | 245  | 294  | 343  | 392  | 441  |     |
|                                                          | 8954   | 48   | 96   | 144  | 193  | 240  | 288  | 336  | 384  | 432  |     |

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. PART. | 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 |



| LOGARITHMS OF NUMBERS. |        |      |      |      |                  |      |      |      |      |      |
|------------------------|--------|------|------|------|------------------|------|------|------|------|------|
| No. 990 L. 995.]       |        |      |      |      | [No. 999 L. 999] |      |      |      |      |      |
| N.                     | 0      | 1    | 2    | 3    | 4                | 5    | 6    | 7    | 8    | 9    |
| 990                    | 995635 | 5679 | 5723 | 5767 | 5811             | 5854 | 5898 | 5942 | 5986 | 6030 |
| 1                      | 6074   | 6117 | 6161 | 6205 | 6249             | 6293 | 6337 | 6380 | 6424 | 6468 |
| 2                      | 6512   | 6555 | 6599 | 6643 | 6687             | 6731 | 6774 | 6818 | 6862 | 6906 |
| 3                      | 6949   | 6993 | 7037 | 7080 | 7124             | 7168 | 7212 | 7255 | 7299 | 7343 |
| 4                      | 7386   | 7430 | 7474 | 7517 | 7561             | 7605 | 7648 | 7692 | 7736 | 7779 |
| 5                      | 7823   | 7867 | 7910 | 7954 | 7998             | 8041 | 8085 | 8129 | 8172 | 8216 |
| 6                      | 8259   | 8303 | 8347 | 8390 | 8434             | 8477 | 8521 | 8564 | 8608 | 8652 |
| 7                      | 8695   | 8739 | 8782 | 8826 | 8869             | 8913 | 8956 | 9000 | 9043 | 9087 |
| 8                      | 9130   | 9174 | 9218 | 9261 | 9305             | 9348 | 9392 | 9435 | 9479 | 9522 |
| 9                      | 9565   | 9609 | 9652 | 9696 | 9739             | 9783 | 9826 | 9870 | 9913 | 9957 |

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  |          | 5'463726 | 5'764756 | 5'940847 | 6'065786 | 6'162696 | 89 59 |
| 1    | 6'463726 | 6'505119 | 6'542907 | 6'577669 | 6'60854  | 6'639817 | 58    |
| 2    | 764756   | 785945   | 806149   | 825454   | 843937   | 861666   | 57    |
| 3    | 940847   | 955088   | 968876   | 982240   | 995205   | 7'007794 | 56    |
| 4    | 7'065786 | 7'076510 | 7'086975 | 7'097194 | 7'107179 | 116938   | 55    |
| 5    | 162696   | 171296   | 179729   | 188002   | 196120   | 204089   | 54    |
| 6    | 241877   | 249056   | 256118   | 263066   | 269906   | 276639   | 53    |
| 7    | 308824   | 314984   | 321058   | 327049   | 332958   | 338787   | 52    |
| 8    | 366816   | 372211   | 377540   | 382804   | 388005   | 393145   | 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   | 612944   | 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   | 764754   | 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       |       |

Log. Cosines.

TABLE IV.—LOGARITHMIC SINES.

|      | °6       | °7       | °8       | °9       | 1°0      |       |
|------|----------|----------|----------|----------|----------|-------|
| ° 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   | 072423   | 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       |       |

Log. Cosines.

TABLE IV.—LOGARITHMIC SINES.

|    | '0      | '1      | '2      | '3      | '4      | '5      |       |
|----|---------|---------|---------|---------|---------|---------|-------|
| 0  |         |         |         |         |         |         |       |
| 45 | 8116926 | 8117870 | 8118835 | 8119812 | 8120769 | 8121725 | 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 | 8196102 | 8196905 | 8197707 | 8198508 | 8199307 | 8200104 | 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  | 8263042 | 8263731 | 8264419 | 8265105 | 8265791 | 8266475 | 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  | 296845  | 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 | 8321027 | 8321629 | 8322231 | 8322832 | 8323433 | 8324032 | 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  | 356893  | 357450  | 358004  | 358558  | 41    |
| 19 | 361315  | 361864  | 362413  | 362961  | 363508  | 364054  | 40    |
| 20 | 366777  | 367319  | 367861  | 368402  | 368943  | 369482  | 88 39 |
| 1  |         |         |         |         |         |         |       |
| 21 | 8372171 | 8372707 | 8373242 | 8373776 | 8374310 | 8374843 | 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 |
|    |         |         |         |         |         |         | 0     |
|    | '0      | '9      | '8      | '7      | '6      | '5      |       |

Log. Cosines.

TABLE IV.—LOGARITHMIC SINES.

|      | ·6       | ·7       | ·8       | ·9       | 1·0      |       |
|------|----------|----------|----------|----------|----------|-------|
| 2 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  |
| 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    | 253284   | 253988   | 254691   | 255393   | 256094   | 58    |
| 2    | 260276   | 260970   | 261662   | 262352   | 263042   | 88 57 |
| 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 |
| 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 |
| 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     | Co-sec.   | Tang.    | Cotang.   | Sec.  | D. | Cosine    |       |
|----|---|----------|-----------|----------|-----------|-------|----|-----------|-------|
| 0  | 0 | 0.000000 | Infinite. | 0.000000 | Infinite. | 10.00 |    | 10.000000 | 60    |
| 1  | 6 | 463726   | 13536274  | 6.463726 | 13536274  | 0000  | 0  | 0000      | 59    |
| 2  | 7 | 64756    | 235244    | 7.64756  | 235244    | 0000  | 0  | 0000      | 58    |
| 3  | 9 | 40847    | 059153    | 9.40847  | 059153    | 0000  | 0  | 0000      | 57    |
| 4  | 7 | 065786   | 12934214  | 7.065786 | 12934214  | 0000  | 0  | 0000      | 56    |
| 5  | 1 | 62696    | 837304    | 1.62696  | 837304    | 0000  | 0  | 0000      | 55    |
| 6  | 2 | 41877    | 758123    | 2.41877  | 758122    | 0001  | 1  | 9999999   | 54    |
| 7  | 3 | 08824    | 691176    | 3.08825  | 691175    | 0001  | 1  | 9999      | 53    |
| 8  | 3 | 66816    | 633184    | 3.66817  | 633183    | 0001  | 1  | 9999      | 89 52 |
| 9  | 7 | 417968   | 12582032  | 7.417970 | 12582030  | 0001  | 1  | 9999999   | 51    |
| 10 | 4 | 63725    | 536275    | 4.63727  | 536273    | 0002  | 1  | 9998      | 50    |
| 11 | 5 | 05118    | 494882    | 5.05120  | 494880    | 0002  | 1  | 9998      | 49    |
| 12 | 5 | 42906    | 457094    | 5.42909  | 457091    | 0003  | 1  | 9997      | 48    |
| 13 | 5 | 77668    | 422332    | 5.77672  | 422328    | 0003  | 1  | 9997      | 47    |
| 14 | 6 | 09853    | 390147    | 6.09857  | 390143    | 0004  | 1  | 9996      | 46    |
| 15 | 6 | 19816    | 360184    | 6.19820  | 360180    | 0004  | 1  | 9996      | 45    |
| 16 | 6 | 67845    | 332155    | 6.67849  | 332151    | 0005  | 1  | 9995      | 44    |
| 17 | 6 | 94173    | 305827    | 6.94179  | 305821    | 0005  | 1  | 9995      | 89 43 |
| 18 | 7 | 718997   | 12281003  | 7.719003 | 12280997  | 0006  | 1  | 9999994   | 42    |
| 19 | 7 | 42477    | 257523    | 7.42484  | 257516    | 0007  | 1  | 9993      | 41    |
| 20 | 7 | 64754    | 235246    | 7.64761  | 235239    | 0007  | 1  | 9993      | 40    |
| 21 | 7 | 85943    | 214057    | 7.85951  | 214049    | 0008  | 1  | 9992      | 39    |
| 22 | 8 | 06146    | 193854    | 8.06155  | 193845    | 0009  | 1  | 9991      | 38    |
| 23 | 8 | 25451    | 174549    | 8.25460  | 174540    | 0010  | 1  | 9990      | 37    |
| 24 | 8 | 43934    | 156066    | 8.43944  | 156056    | 0011  | 2  | 9989      | 36    |
| 25 | 8 | 61662    | 138338    | 8.61674  | 138326    | 0011  | 2  | 9989      | 35    |
| 26 | 8 | 78695    | 121305    | 8.78708  | 121292    | 0012  | 2  | 9988      | 89 34 |
| 27 | 7 | 895085   | 12104915  | 7.895099 | 12104901  | 0013  | 2  | 9999987   | 33    |
| 28 | 9 | 10879    | 089121    | 9.10894  | 089106    | 0014  | 2  | 9986      | 32    |
| 29 | 9 | 26119    | 073881    | 9.26134  | 073866    | 0015  | 2  | 9985      | 31    |
| 30 | 9 | 40842    | 059158    | 9.40858  | 059142    | 0017  | 2  | 9983      | 30    |
| 31 | 9 | 55082    | 044918    | 9.55100  | 044900    | 0018  | 2  | 9982      | 29    |
| 32 | 9 | 68870    | 031130    | 9.68889  | 031111    | 0019  | 2  | 9981      | 28    |
| 33 | 9 | 82233    | 017767    | 9.82253  | 017747    | 0020  | 2  | 9980      | 27    |
| 34 | 9 | 95198    | 004802    | 9.95219  | 004781    | 0021  | 2  | 9979      | 26    |
| 35 | 8 | 007787   | 11992123  | 8.007809 | 11992191  | 0023  | 2  | 9977      | 89 25 |
| 36 | 8 | 020021   | 11979979  | 8.020045 | 11979955  | 0024  | 2  | 9999976   | 24    |
| 37 | 0 | 31919    | 968081    | 0.31945  | 968055    | 0025  | 2  | 9975      | 23    |
| 38 | 0 | 43501    | 956499    | 0.43527  | 956473    | 0027  | 2  | 9973      | 22    |
| 39 | 0 | 54781    | 945219    | 0.54809  | 945191    | 0028  | 2  | 9972      | 21    |
| 40 | 0 | 65776    | 934224    | 0.65806  | 934194    | 0029  | 2  | 9971      | 20    |
| 41 | 0 | 76500    | 923500    | 0.76531  | 923469    | 0031  | 2  | 9969      | 19    |
| 42 | 0 | 86965    | 913035    | 0.86997  | 913003    | 0032  | 2  | 9968      | 18    |
| 43 | 0 | 97183    | 902817    | 0.97217  | 902783    | 0034  | 2  | 9966      | 17    |
| 44 | 0 | 107167   | 892833    | 1.07202  | 892798    | 0036  | 3  | 9964      | 16    |
| 45 | 1 | 16926    | 883074    | 1.16963  | 883037    | 0037  | 3  | 9963      | 89 15 |
|    |   | Cosine   | Secant    | Cotang.  | Tang.     | Coa.  | D. | Sine      |       |

90 Deg.

89 Deg.

TABLE V.—LOG. SINES, ETC.

04 Deg.

1½ Deg.

| 84 Deg. |          |           |          |           |      |    |          |    |    |
|---------|----------|-----------|----------|-----------|------|----|----------|----|----|
| °       | Sine     | Cosec.    | Tang.    | Cotang.   | Sec. | D. | Cosine   |    |    |
|         |          |           |          |           | 1000 |    |          |    |    |
| 0       | 8.116926 | 11.883074 | 8.116963 | 11.883037 | 0037 | 3  | 9.999963 | 15 |    |
| 1       | 126471   | 873529    | 126510   | 873490    | 0039 | 3  | 9961     | 14 |    |
| 2       | 135810   | 864190    | 135851   | 864149    | 0041 | 3  | 9959     | 13 |    |
| 3       | 144953   | 855047    | 144996   | 855004    | 0042 | 3  | 9958     | 12 |    |
| 4       | 153907   | 846093    | 153952   | 846048    | 0044 | 3  | 9956     | 11 |    |
| 5       | 162681   | 837319    | 162727   | 837273    | 0046 | 3  | 9954     | 10 |    |
| 6       | 171280   | 828720    | 171328   | 828672    | 0048 | 3  | 9952     | 9  |    |
| 7       | 179713   | 820287    | 179763   | 820237    | 0050 | 3  | 9950     | 8  |    |
| 8       | 187985   | 812015    | 188036   | 811964    | 0052 | 3  | 9948     | 89 | 7  |
| 9       | 8.196102 | 11.803898 | 8.196156 | 11.803844 | 0054 | 3  | 9.999946 | 6  |    |
| 10      | 204070   | 795930    | 204126   | 795874    | 0056 | 3  | 0044     | 5  |    |
| 11      | 211895   | 788105    | 211953   | 788047    | 0058 | 3  | 9942     | 4  |    |
| 12      | 219581   | 780419    | 219641   | 780359    | 0060 | 4  | 9940     | 3  |    |
| 13      | 227134   | 772866    | 227195   | 772805    | 0062 | 4  | 9938     | 2  |    |
| 14      | 234557   | 765443    | 234621   | 765379    | 0064 | 4  | 9936     | 1  |    |
| 15      | 241855   | 758145    | 241921   | 758079    | 0066 | 4  | 9934     | 89 | 0  |
| 16      | 249033   | 750967    | 249102   | 750898    | 0068 | 4  | 9932     | 59 |    |
| 17      | 256094   | 743906    | 256165   | 743835    | 0071 | 4  | 9929     | 88 | 58 |
| 18      | 8.263042 | 11.736958 | 8.263115 | 11.736885 | 0073 | 4  | 9.999927 | 57 |    |
| 19      | 269881   | 730119    | 269956   | 730044    | 0075 | 4  | 9925     | 56 |    |
| 20      | 276614   | 723386    | 276691   | 723309    | 0078 | 4  | 9922     | 55 |    |
| 21      | 283243   | 716757    | 283323   | 716677    | 0080 | 4  | 9920     | 54 |    |
| 22      | 289773   | 710227    | 289856   | 710144    | 0082 | 4  | 9918     | 53 |    |
| 23      | 296207   | 703793    | 296292   | 703708    | 0085 | 4  | 9915     | 52 |    |
| 24      | 302546   | 697454    | 302634   | 697366    | 0087 | 4  | 9913     | 51 |    |
| 25      | 308794   | 691206    | 308884   | 691116    | 0090 | 4  | 9910     | 50 |    |
| 26      | 314954   | 685046    | 315046   | 684954    | 0093 | 4  | 9907     | 88 | 49 |
| 27      | 8.321027 | 11.678973 | 8.321122 | 11.678878 | 0095 | 4  | 9.999905 | 48 |    |
| 28      | 327016   | 672984    | 327114   | 672886    | 0098 | 4  | 9902     | 47 |    |
| 29      | 332924   | 667076    | 333025   | 666975    | 0101 | 5  | 9899     | 46 |    |
| 30      | 338753   | 661247    | 338856   | 661144    | 0103 | 5  | 9897     | 45 |    |
| 31      | 344504   | 655496    | 344610   | 655390    | 0106 | 5  | 9894     | 44 |    |
| 32      | 350181   | 649819    | 350289   | 649711    | 0109 | 5  | 9891     | 43 |    |
| 33      | 355783   | 644217    | 355895   | 644105    | 0112 | 5  | 9888     | 42 |    |
| 34      | 361315   | 638685    | 361430   | 638570    | 0115 | 5  | 9885     | 41 |    |
| 35      | 366777   | 633223    | 366895   | 633105    | 0118 | 5  | 9882     | 88 | 40 |
| 36      | 8.372171 | 11.627829 | 8.372292 | 11.627708 | 0121 | 5  | 9.999879 | 39 |    |
| 37      | 377499   | 622501    | 377622   | 622378    | 0124 | 5  | 9876     | 38 |    |
| 38      | 382762   | 617238    | 382889   | 617111    | 0127 | 5  | 9873     | 37 |    |
| 39      | 387962   | 612038    | 388092   | 611908    | 0130 | 5  | 9870     | 36 |    |
| 40      | 393101   | 606899    | 393234   | 606766    | 0133 | 5  | 9867     | 35 |    |
| 41      | 398179   | 601821    | 398315   | 601685    | 0136 | 5  | 9864     | 34 |    |
| 42      | 403199   | 596801    | 403338   | 596662    | 0139 | 5  | 9861     | 33 |    |
| 43      | 408161   | 591839    | 408304   | 591696    | 0142 | 5  | 9858     | 32 |    |
| 44      | 413068   | 586932    | 413213   | 586787    | 0146 | 5  | 9854     | 31 |    |
| 45      | 417919   | 582081    | 418068   | 581932    | 0149 | 5  | 9851     | 88 | 30 |
|         | Cosine   | Secant    | Cotang.  | Tang.     | Cos. | D. | Sine     |    |    |
| 84 Deg. |          |           |          |           |      |    |          |    |    |

| 14 Deg.     |        | TABLE V.—LOG. SINES, ETC. |        |        |       |       |        |      |      |      |      | 24 Deg.     |  |
|-------------|--------|---------------------------|--------|--------|-------|-------|--------|------|------|------|------|-------------|--|
|             | Sine   | D.                        | Conc.  |        | Tang. | D.    | Cot.   |      | Sec. | D.   | Cos. |             |  |
|             |        |                           | 11'    | 8'     |       |       | 11'    | 10'' |      |      |      |             |  |
| 1 30        | 417919 |                           | 582c81 | 418c68 |       | 8cc2  | 581931 | 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  | 563038 | 0162 | 6    | 9838 |      | 26          |  |
| 35          | 441394 | 7657                      | 558606 | 441560 |       | 7663  | 558440 | 0166 | 6    | 9834 |      | 25          |  |
| 36          | 445941 | 7577                      | 554059 | 446110 |       | 7583  | 553890 | 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          |  |
| 1 39        | 459301 | 7346                      | 540699 | 459481 |       | 7352  | 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          |  |
| 1 48        | 497078 | 6731                      | 502922 | 497293 |       | 6738  | 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 | 520790 |       | 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           |  |
| 1 57        | 531828 | 6211                      | 468172 | 532080 |       | 6218  | 467920 | 0252 | 7    | 9748 |      | 3           |  |
| 58          | 535523 | 6158                      | 464477 | 535779 |       | 6165  | 464221 | 0256 | 7    | 9744 |      | 2           |  |
| 59          | 539186 | 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 | 546691 |       | 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 | 8    | 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          |  |
| 1 6         | 563999 | 5765                      | 436001 | 564291 |       | 5773  | 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          |  |
|             | Cos.   | D.                        | Sec.   | Cot.   | D.    | Tang. | Cos.   | D.   | Sine |      |      |             |  |
| 88 1/2 Deg. |        |                           |        |        |       |       |        |      |      |      |      | 87 1/2 Deg. |  |

24 Deg.

TABLE V.—LOG. SINES, ETC.

3 Deg.

| °    | Sine   | D.   | Cossec. | Tang.  | D.   | Cot.   | Sec.  | D. | Cos. |    |
|------|--------|------|---------|--------|------|--------|-------|----|------|----|
|      | 8.     |      | 11.     | 8.     |      | 11.    | 10.00 |    | 9.99 |    |
| 2 15 | 593948 | 5339 | 406052  | 594283 | 5347 | 405717 | 0335  | 8  | 9665 | 45 |
| 16   | 597152 | 5300 | 402848  | 597492 | 5308 | 402508 | 0340  | 8  | 9660 | 44 |
| 17   | 600332 | 5261 | 399668  | 600677 | 5270 | 399323 | 0345  | 8  | 9655 | 43 |
| 18   | 603489 | 5223 | 396511  | 603839 | 5232 | 396161 | 0350  | 8  | 9650 | 42 |
| 19   | 606623 | 5186 | 393377  | 606978 | 5194 | 393022 | 0355  | 8  | 9645 | 41 |
| 20   | 609734 | 5149 | 390266  | 610094 | 5158 | 389906 | 0360  | 9  | 9640 | 40 |
| 21   | 612823 | 5112 | 387177  | 613189 | 5121 | 386811 | 0365  | 9  | 9635 | 39 |
| 22   | 615891 | 5076 | 384109  | 616262 | 5085 | 383738 | 0371  | 9  | 9629 | 38 |
| 23   | 618937 | 5041 | 381063  | 619313 | 5050 | 380687 | 0376  | 9  | 9624 | 37 |
| 2 24 | 621962 | 5006 | 378038  | 622343 | 5015 | 377657 | 0381  | 9  | 9619 | 36 |
| 25   | 624965 | 4972 | 375035  | 625352 | 4981 | 374648 | 0386  | 9  | 9614 | 35 |
| 26   | 627948 | 4938 | 372052  | 628340 | 4947 | 371660 | 0392  | 9  | 9608 | 34 |
| 27   | 630911 | 4904 | 369089  | 631308 | 4913 | 368692 | 0397  | 9  | 9603 | 33 |
| 28   | 633854 | 4871 | 366146  | 634256 | 4880 | 365744 | 0403  | 9  | 9597 | 32 |
| 29   | 636776 | 4839 | 363224  | 637184 | 4848 | 362816 | 0408  | 9  | 9592 | 31 |
| 30   | 639680 | 4806 | 360320  | 640093 | 4816 | 359907 | 0414  | 9  | 9586 | 30 |
| 31   | 642563 | 4775 | 357437  | 642982 | 4784 | 357018 | 0419  | 9  | 9581 | 29 |
| 32   | 645428 | 4743 | 354572  | 645853 | 4753 | 354147 | 0425  | 9  | 9575 | 28 |
| 2 33 | 648274 | 4712 | 351726  | 648704 | 4722 | 351296 | 0430  | 9  | 9570 | 27 |
| 34   | 651102 | 4682 | 348898  | 651537 | 4691 | 348463 | 0436  | 9  | 9564 | 26 |
| 35   | 653911 | 4652 | 346089  | 654352 | 4661 | 345648 | 0442  | 10 | 9558 | 25 |
| 36   | 656702 | 4622 | 343298  | 657149 | 4631 | 342851 | 0447  | 10 | 9553 | 24 |
| 37   | 659475 | 4592 | 340525  | 659928 | 4601 | 340072 | 0453  | 10 | 9547 | 23 |
| 38   | 662230 | 4563 | 337770  | 662689 | 4573 | 337311 | 0459  | 10 | 9541 | 22 |
| 39   | 664968 | 4535 | 335032  | 665433 | 4544 | 334567 | 0465  | 10 | 9535 | 21 |
| 40   | 667689 | 4506 | 332311  | 668160 | 4517 | 331840 | 0471  | 10 | 9529 | 20 |
| 41   | 670393 | 4479 | 329607  | 670870 | 4488 | 329130 | 0476  | 10 | 9524 | 19 |
| 2 42 | 673080 | 4451 | 326920  | 673563 | 4461 | 326437 | 0482  | 10 | 9518 | 18 |
| 43   | 675751 | 4424 | 324249  | 676239 | 4434 | 323761 | 0488  | 10 | 9512 | 17 |
| 44   | 678405 | 4397 | 321595  | 678900 | 4407 | 321100 | 0494  | 10 | 9506 | 16 |
| 45   | 681043 | 4370 | 318957  | 681544 | 4380 | 318456 | 0500  | 10 | 9500 | 15 |
| 46   | 683665 | 4344 | 316335  | 684172 | 4354 | 315828 | 0507  | 10 | 9493 | 14 |
| 47   | 686272 | 4318 | 313728  | 686784 | 4328 | 313216 | 0513  | 10 | 9487 | 13 |
| 48   | 688863 | 4292 | 311137  | 689381 | 4303 | 310619 | 0519  | 10 | 9481 | 12 |
| 49   | 691438 | 4267 | 308562  | 691963 | 4277 | 308037 | 0525  | 10 | 9475 | 11 |
| 50   | 693998 | 4242 | 306002  | 694529 | 4252 | 305471 | 0531  | 10 | 9469 | 10 |
| 2 51 | 696543 | 4217 | 303457  | 697081 | 4228 | 302919 | 0537  | 11 | 9463 | 9  |
| 52   | 699073 | 4192 | 300927  | 699617 | 4203 | 300383 | 0544  | 11 | 9456 | 8  |
| 53   | 701589 | 4168 | 298411  | 702139 | 4179 | 297861 | 0550  | 11 | 9450 | 7  |
| 54   | 704090 | 4144 | 295910  | 704646 | 4155 | 295354 | 0557  | 11 | 9443 | 6  |
| 55   | 706577 | 4121 | 293423  | 707140 | 4132 | 292860 | 0563  | 11 | 9437 | 5  |
| 56   | 709049 | 4097 | 290951  | 709618 | 4108 | 290382 | 0569  | 11 | 9431 | 4  |
| 57   | 711507 | 4074 | 288493  | 712083 | 4085 | 287917 | 0576  | 11 | 9424 | 3  |
| 58   | 713952 | 4051 | 286048  | 714534 | 4062 | 285466 | 0582  | 11 | 9418 | 2  |
| 59   | 716383 | 4029 | 283617  | 716972 | 4040 | 283028 | 0589  | 11 | 9411 | 1  |
| 60   | 718800 |      | 281200  | 719396 |      | 280604 | 0596  |    | 9404 | 0  |
|      | Con.   | D.   | Sec.    | Cot.   | D.   | Tang.  | Con.  | D. | Sine |    |

87 Deg.

87 Deg.

3 Deg.

TABLE V.—LOG. SINES, ETC.

87 Deg.

| ° | '  | Sine    | D.   | Co-sec. | Tang.  | D.   | Cot.   | Sec.    | D. | Co-sec. |       |
|---|----|---------|------|---------|--------|------|--------|---------|----|---------|-------|
|   |    | 8°      |      | 11°     | 8°     |      | 11°    | 10°00   |    | 9°99    |       |
| 3 | 0  | 718800  | 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  |      | 184401  | 816529 |      | 183471 | 0931    | 14 | 9069    | 86 15 |
|   |    | Co-sec. | D.   | Sec.    | Cot.   | D.   | Tang.  | Co-sec. | D. | Sine    | °     |

87 Deg.

86 Deg.

| 3½ Deg. |    | TABLE V.—LOG. SINES, ETC. |      |        |        |      |        |       |    | 4½ Deg. |       |
|---------|----|---------------------------|------|--------|--------|------|--------|-------|----|---------|-------|
| °       | '  | Sine                      | D.   | Cosec. | Tang.  | D.   | Cot.   | Sec.  | D. | Cos.    |       |
|         |    | 8'                        |      | 11'    | 8'     |      | 11'    | 10'00 |    | 9'99    |       |
| 3       | 45 | 815599                    | 3205 | 184401 | 816529 | 3219 | 183471 | 0931  | —  | 9069    | 15    |
|         | 46 | 817522                    | 3191 | 182478 | 818461 | 3205 | 181539 | 0939  | 14 | 9061    | 14    |
|         | 47 | 819436                    | 3177 | 180564 | 820384 | 3191 | 179616 | 0947  | 14 | 9053    | 13    |
|         | 48 | 821343                    | 3163 | 178657 | 822298 | 3177 | 177702 | 0956  | 14 | 9044    | 12    |
|         | 49 | 823240                    | 3149 | 176760 | 824205 | 3163 | 175795 | 0964  | 14 | 9036    | 11    |
|         | 50 | 825130                    | 3135 | 174870 | 826103 | 3150 | 173897 | 0973  | 14 | 9027    | 10    |
|         | 51 | 827011                    | 3122 | 172989 | 827992 | 3136 | 172008 | 0981  | 14 | 9019    | 9     |
|         | 52 | 828884                    | 3108 | 171116 | 829874 | 3123 | 170126 | 0990  | 14 | 9010    | 8     |
|         | 53 | 830749                    | 3095 | 169251 | 831748 | 3108 | 168252 | 0998  | 14 | 9002    | 86 7  |
| 3       | 54 | 832607                    | 3082 | 167393 | 833613 | 3096 | 166387 | 1007  | 14 | 8993    | 6     |
|         | 55 | 834456                    | 3069 | 165544 | 835471 | 3083 | 164529 | 1016  | 14 | 8984    | 5     |
|         | 56 | 836297                    | 3056 | 163703 | 837321 | 3070 | 162679 | 1024  | 14 | 8976    | 4     |
|         | 57 | 838130                    | 3043 | 161870 | 839163 | 3057 | 160837 | 1033  | 14 | 8967    | 3     |
|         | 58 | 839956                    | 3030 | 160044 | 840998 | 3045 | 159002 | 1042  | 15 | 8958    | 2     |
|         | 59 | 841774                    | 3017 | 158226 | 842825 | 3032 | 157175 | 1050  | 15 | 8950    | 1     |
| 4       | 0  | 843585                    | 3005 | 156415 | 844644 | 3019 | 155356 | 1059  | 15 | 8941    | 88 0  |
|         | 1  | 845387                    | 2992 | 154613 | 846455 | 3007 | 153545 | 1068  | 15 | 8932    | 59    |
|         | 2  | 847183                    | 2980 | 152817 | 848260 | 2995 | 151740 | 1077  | 15 | 8923    | 58    |
| 4       | 3  | 848971                    | 2967 | 151029 | 850057 | 2982 | 149943 | 1086  | 15 | 8914    | 57    |
|         | 4  | 850751                    | 2955 | 149249 | 851846 | 2970 | 148154 | 1095  | 15 | 8905    | 56    |
|         | 5  | 852525                    | 2943 | 147475 | 853628 | 2958 | 146372 | 1104  | 15 | 8896    | 55    |
|         | 6  | 854291                    | 2931 | 145709 | 855403 | 2946 | 144597 | 1113  | 15 | 8887    | 54    |
|         | 7  | 856049                    | 2919 | 143951 | 857171 | 2935 | 142829 | 1122  | 15 | 8878    | 53    |
|         | 8  | 857801                    | 2908 | 142199 | 858932 | 2923 | 141068 | 1131  | 15 | 8869    | 52    |
|         | 9  | 859546                    | 2896 | 140454 | 860686 | 2911 | 139314 | 1140  | 15 | 8860    | 51    |
|         | 10 | 861283                    | 2884 | 138717 | 862433 | 2900 | 137567 | 1149  | 15 | 8851    | 50    |
|         | 11 | 863014                    | 2873 | 136986 | 864173 | 2888 | 135827 | 1159  | 15 | 8841    | 85 49 |
| 4       | 12 | 864738                    | 2861 | 135262 | 865906 | 2877 | 134094 | 1168  | 15 | 8832    | 48    |
|         | 13 | 866455                    | 2850 | 133545 | 867632 | 2866 | 132368 | 1177  | 16 | 8823    | 47    |
|         | 14 | 868165                    | 2839 | 131835 | 869351 | 2854 | 130649 | 1187  | 16 | 8813    | 46    |
|         | 15 | 869868                    | 2828 | 130132 | 871064 | 2843 | 128936 | 1196  | 16 | 8804    | 45    |
|         | 16 | 871565                    | 2817 | 128435 | 872770 | 2832 | 127230 | 1205  | 16 | 8795    | 44    |
|         | 17 | 873255                    | 2806 | 126745 | 874469 | 2821 | 125531 | 1215  | 16 | 8785    | 43    |
|         | 18 | 874938                    | 2795 | 125062 | 876162 | 2811 | 123838 | 1224  | 16 | 8776    | 42    |
|         | 19 | 876615                    | 2783 | 123385 | 877849 | 2800 | 122151 | 1234  | 16 | 8766    | 41    |
|         | 20 | 878285                    | 2773 | 121715 | 879529 | 2789 | 120471 | 1243  | 16 | 8757    | 85 40 |
| 4       | 21 | 879949                    | 2763 | 120051 | 881202 | 2779 | 118798 | 1253  | 16 | 8747    | 39    |
|         | 22 | 881607                    | 2752 | 118393 | 882869 | 2768 | 117131 | 1262  | 16 | 8738    | 38    |
|         | 23 | 883258                    | 2742 | 116742 | 884530 | 2758 | 115470 | 1272  | 16 | 8728    | 37    |
|         | 24 | 884903                    | 2731 | 115097 | 886185 | 2747 | 113815 | 1282  | 16 | 8718    | 36    |
|         | 25 | 886542                    | 2721 | 113458 | 887833 | 2737 | 112167 | 1292  | 16 | 8708    | 35    |
|         | 26 | 888174                    | 2711 | 111826 | 889476 | 2727 | 110524 | 1301  | 16 | 8699    | 34    |
|         | 27 | 889801                    | 2700 | 110199 | 891112 | 2717 | 108888 | 1311  | 16 | 8689    | 33    |
|         | 28 | 891421                    | 2690 | 108579 | 892742 | 2707 | 107258 | 1321  | 16 | 8679    | 32    |
|         | 29 | 893035                    | 2680 | 106965 | 894366 | 2697 | 105634 | 1331  | 17 | 8669    | 31    |
|         | 30 | 894643                    |      | 105357 | 895984 |      | 104016 | 1341  |    | 8659    | 85 30 |
|         |    | Con.                      | D.   | Sec.   | Cot.   | D.   | Tang.  | Con.  | D. | Sine    |       |

86½ Deg.

85½ Deg.

| 4½ Deg.  |    | TABLE V.—Loc. SINE, ETC. |      |        |        |      |        |       |    |      |          | 5½ Deg. |    |
|----------|----|--------------------------|------|--------|--------|------|--------|-------|----|------|----------|---------|----|
| °        | '  | Sine                     | D.   | Cosec. | Tang.  | D.   | Cot.   | Sec.  | D. | Coa. |          |         |    |
|          |    | 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 | 22       | 85      |    |
| 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 | 13       | 85      |    |
| 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 | 971341 | 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 | 4        | 85      |    |
| 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 | 0        | 8       |    |
|          | 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 | 55       | 84      |    |
| 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 | 2335 | 942326 | 1770  | 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 | 45       | 84      | 45 |
|          |    | Coa.                     | D.   | Sec.   | Cot.   | D.   | Tang.  | Coa.  | D. | Sine | °        | '       |    |
| 85½ Deg. |    |                          |      |        |        |      |        |       |    |      | 84½ Deg. |         |    |

| 64 Deg. |        | TABLE V.—LOG. SINUS, ETC. |         |        |      |        |      |    |      |    |  | 6 Deg.  |  |
|---------|--------|---------------------------|---------|--------|------|--------|------|----|------|----|--|---------|--|
|         | Sine   | D.                        | Consec. | Tang.  | D.   | Cot.   | Sec. | D. | Con. |    |  |         |  |
|         | 8.     |                           | 11.     | 8.     |      | 11.    | 1000 |    |      |    |  |         |  |
| 15      | 961429 | 2282                      | 038571  | 963255 |      | 036745 | 1826 |    | 999  |    |  |         |  |
| 16      | 962801 | 2280                      | 037199  | 964639 | 2307 | 035361 | 1837 | 19 | 8174 |    |  | 45      |  |
| 17      | 964170 | 2273                      | 035830  | 966019 | 2300 | 033981 | 1849 | 19 | 8163 |    |  | 44      |  |
| 18      | 965534 | 2266                      | 034466  | 967394 | 2293 | 032606 | 1861 | 19 | 8151 |    |  | 43      |  |
| 19      | 966893 | 2259                      | 033107  | 968766 | 2286 | 031234 | 1872 | 20 | 8139 |    |  | 42      |  |
| 20      | 968249 | 2252                      | 031751  | 970133 | 2279 | 029867 | 1884 | 20 | 8128 |    |  | 41      |  |
| 21      | 969600 | 2245                      | 030400  | 971496 | 2271 | 028504 | 1896 | 20 | 8116 |    |  | 40      |  |
| 22      | 970947 | 2238                      | 029053  | 972855 | 2265 | 027145 | 1908 | 20 | 8104 |    |  | 39      |  |
| 23      | 972289 | 2231                      | 027711  | 974209 | 2257 | 025791 | 1920 | 20 | 8092 |    |  | 38      |  |
| 24      | 973628 | 2224                      | 026372  | 975560 | 2251 | 024440 | 1932 | 20 | 8080 | 84 |  | 37      |  |
| 25      | 974962 | 2217                      | 025038  | 976906 | 2244 | 023094 | 1944 | 20 | 8068 |    |  | 36      |  |
| 26      | 976293 | 2210                      | 023707  | 978248 | 2237 | 021752 | 1956 | 20 | 8056 |    |  | 35      |  |
| 27      | 977619 | 2203                      | 022381  | 979586 | 2230 | 020414 | 1968 | 20 | 8044 |    |  | 34      |  |
| 28      | 978941 | 2197                      | 021059  | 980921 | 2223 | 019079 | 1980 | 20 | 8032 |    |  | 33      |  |
| 29      | 980259 | 2190                      | 019741  | 982251 | 2217 | 017749 | 1992 | 20 | 8020 |    |  | 32      |  |
| 30      | 981573 | 2183                      | 018427  | 983577 | 2210 | 016423 | 2004 | 20 | 8008 |    |  | 31      |  |
| 31      | 982883 | 2177                      | 017117  | 984899 | 2204 | 015101 | 2016 | 20 | 7996 |    |  | 30      |  |
| 32      | 984189 | 2170                      | 015811  | 986217 | 2197 | 013783 | 2028 | 20 | 7984 |    |  | 29      |  |
| 33      | 985491 | 2163                      | 014509  | 987532 | 2191 | 012468 | 2041 | 20 | 7972 | 84 |  | 28      |  |
| 34      | 986789 | 2157                      | 013211  | 988842 | 2184 | 011158 | 2053 | 20 | 7959 |    |  | 27      |  |
| 35      | 988083 | 2150                      | 011917  | 990149 | 2178 | 009851 | 2065 | 20 | 7947 |    |  | 26      |  |
| 36      | 989374 | 2144                      | 010626  | 991451 | 2171 | 008549 | 2078 | 21 | 7935 |    |  | 25      |  |
| 37      | 990660 | 2138                      | 009340  | 992750 | 2165 | 007250 | 2090 | 21 | 7922 |    |  | 24      |  |
| 38      | 991943 | 2131                      | 008057  | 994045 | 2158 | 005955 | 2103 | 21 | 7910 |    |  | 23      |  |
| 39      | 993222 | 2125                      | 006778  | 995337 | 2152 | 004663 | 2115 | 21 | 7897 |    |  | 22      |  |
| 40      | 994497 | 2119                      | 005503  | 996624 | 2146 | 003376 | 2128 | 21 | 7885 |    |  | 21      |  |
| 41      | 995768 | 2112                      | 004232  | 997908 | 2140 | 002092 | 2140 | 21 | 7872 |    |  | 20      |  |
| 42      | 997036 | 2106                      | 002964  | 999188 | 2134 | 000812 | 2153 | 21 | 7860 | 84 |  | 19      |  |
| 43      | 998299 | 2100                      | 001701  | 000465 | 2127 | 000535 | 2165 | 21 | 7847 |    |  | 18      |  |
| 44      | 999560 | 2094                      | 000440  | 001738 | 2121 | 000262 | 2178 | 21 | 7835 |    |  | 17      |  |
| 45      | 000816 | 2088                      | 000184  | 003007 | 2115 | 000993 | 2191 | 21 | 7822 |    |  | 16      |  |
| 46      | 002069 | 2082                      | 000793  | 004272 | 2109 | 001728 | 2203 | 21 | 7809 |    |  | 15      |  |
| 47      | 003318 | 2076                      | 001466  | 005534 | 2103 | 002466 | 2216 | 21 | 7797 |    |  | 14      |  |
| 48      | 004563 | 2070                      | 002137  | 006792 | 2097 | 003208 | 2229 | 21 | 7784 |    |  | 13      |  |
| 49      | 005805 | 2064                      | 002819  | 008047 | 2091 | 003953 | 2242 | 21 | 7771 |    |  | 12      |  |
| 50      | 007044 | 2058                      | 003506  | 009298 | 2085 | 004702 | 2255 | 21 | 7758 |    |  | 11      |  |
| 51      | 008278 | 2052                      | 004192  | 010546 | 2080 | 005454 | 2268 | 21 | 7745 | 84 |  | 10      |  |
| 52      | 009510 | 2046                      | 004879  | 011790 | 2074 | 006210 | 2281 | 21 | 7732 |    |  | 9       |  |
| 53      | 010737 | 2040                      | 005563  | 013031 | 2068 | 006969 | 2294 | 21 | 7719 |    |  | 8       |  |
| 54      | 011962 | 2034                      | 006248  | 014268 | 2062 | 007732 | 2307 | 22 | 7706 |    |  | 7       |  |
| 55      | 013182 | 2029                      | 006918  | 015502 | 2056 | 008498 | 2320 | 22 | 7693 |    |  | 6       |  |
| 56      | 014400 | 2023                      | 007560  | 016732 | 2051 | 009268 | 2333 | 22 | 7680 |    |  | 5       |  |
| 57      | 015613 | 2017                      | 008237  | 017959 | 2045 | 010041 | 2346 | 22 | 7667 |    |  | 4       |  |
| 58      | 016824 | 2012                      | 008916  | 019183 | 2040 | 010817 | 2359 | 22 | 7654 |    |  | 3       |  |
| 59      | 018031 | 2006                      | 009569  | 020403 | 2033 | 011597 | 2372 | 22 | 7641 |    |  | 2       |  |
| 60      | 019235 |                           | 010216  | 021620 | 2028 | 012380 | 2386 | 22 | 7628 |    |  | 1       |  |
|         | Con.   | D.                        | Sec.    | Cot.   | D.   | Tang.  | Con. | D. | Sine |    |  | 0       |  |
| 84 Deg. |        |                           |         |        |      |        |      |    |      |    |  | 84 Deg. |  |

6 Deg.

TABLE V.—LOG. SINES, ETC.

6 Deg.

| °  | Sine   | D.   | Co-sec. | Tang.  | D.   | Cot.   | Sec.  | D. | Co.  |    |
|----|--------|------|---------|--------|------|--------|-------|----|------|----|
|    | 9'     |      | 10'     | 9'     |      | 10'    | 10'00 |    | 9'99 |    |
| 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 | 52 |
| 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 | 43 |
| 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 | 34 |
| 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 | 25 |
| 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 | 15 |
|    | Coa.   | D.   | Sec.    | Cot.   | D.   | Tang.  | Coa.  | D. | Sine | °  |

84 Deg.

84 Deg.

TABLE V.—LOG. SINES, ETC.

| 6½ Deg. |        | TABLE V.—LOG. SINES, ETC. |         |        |      |        |       |    |      | 7½ Deg. |    |
|---------|--------|---------------------------|---------|--------|------|--------|-------|----|------|---------|----|
|         | Sine   | D.                        | Co-sec. | Tang.  | D.   | Col.   | Sec.  | D. | Com. |         |    |
|         | 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      | 58 |
| 3       | 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 |
| 12      | 098066 | 1665                      | 901934  | 101504 | 1691 | 898496 | 3438  | 27 | 6562 | 48      |    |
| 13      | 099065 | 1661                      | 900935  | 102519 | 1687 | 897481 | 3454  | 27 | 6546 | 47      |    |
| 14      | 100062 | 1657                      | 899938  | 103532 | 1684 | 896468 | 3470  | 27 | 6530 | 46      |    |
| 15      | 101056 | 1653                      | 898944  | 104542 | 1680 | 895458 | 3486  | 27 | 6514 | 45      |    |
| 16      | 102048 | 1649                      | 897952  | 105550 | 1676 | 894450 | 3502  | 27 | 6498 | 44      |    |
| 17      | 103037 | 1645                      | 896963  | 106556 | 1672 | 893444 | 3518  | 27 | 6482 | 43      |    |
| 18      | 104025 | 1642                      | 895975  | 107559 | 1669 | 892441 | 3535  | 27 | 6465 | 42      |    |
| 19      | 105010 | 1638                      | 894990  | 108560 | 1665 | 891440 | 3551  | 27 | 6449 | 41      |    |
| 20      | 105992 | 1634                      | 894008  | 109559 | 1661 | 890441 | 3567  | 27 | 6433 | 82      | 40 |
| 21      | 106973 | 1630                      | 893027  | 110556 | 1658 | 889444 | 3583  | 27 | 6417 | 39      |    |
| 22      | 107951 | 1627                      | 892049  | 111551 | 1654 | 888449 | 3600  | 27 | 6400 | 38      |    |
| 23      | 108927 | 1623                      | 891073  | 112543 | 1650 | 887457 | 3616  | 27 | 6384 | 37      |    |
| 24      | 109901 | 1619                      | 890099  | 113533 | 1647 | 886467 | 3632  | 27 | 6368 | 36      |    |
| 25      | 110873 | 1616                      | 889127  | 114521 | 1643 | 885479 | 3649  | 27 | 6351 | 35      |    |
| 26      | 111842 | 1612                      | 888158  | 115507 | 1639 | 884493 | 3665  | 27 | 6335 | 34      |    |
| 27      | 112809 | 1608                      | 887191  | 116491 | 1635 | 883509 | 3682  | 27 | 6318 | 33      |    |
| 28      | 113774 | 1605                      | 886226  | 117472 | 1632 | 882528 | 3698  | 28 | 6302 | 32      |    |
| 29      | 114737 | 1601                      | 885263  | 118452 | 1629 | 881548 | 3715  | 28 | 6285 | 31      |    |
| 30      | 115698 |                           | 884302  | 119429 |      | 880571 | 3731  | 28 | 6269 | 82      | 30 |
|         | Com.   | D.                        | Sec.    | Col.   | D.   | Tang.  | Com.  | D. | Sine |         |    |

83½ Deg.

82½ Deg.

TABLE V.—LOG. SINES, ETC.

| 7½ Deg. |    | TABLE V.—LOG. SINES, ETC. |      |         |        |      |        |       |    | 8½ Deg. |    |
|---------|----|---------------------------|------|---------|--------|------|--------|-------|----|---------|----|
| °       | '  | Sine                      | D.   | Consec. | Tang.  | D.   | Cot.   | Sec.  | D. | Con.    |    |
|         |    | 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    | 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    | 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    | 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    | 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    | 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    | 45 |
|         |    | Con.                      | D.   | Sec.    | Cot.   | D.   | Tang.  | Con.  | D. | Sine    |    |

82½ Deg.

81½ Deg.

| 8½ Deg. |        | TABLE V.—LOC SINUS, ETC. |         |        |      |        |       |    |      | 9 Deg. |    |
|---------|--------|--------------------------|---------|--------|------|--------|-------|----|------|--------|----|
| °       | Sine   | D.                       | Co-sec. | Tang.  | D.   | Cot.   | Sec.  | D. | Coa. |        |    |
|         | 9'     |                          | 10'     | 9'     |      | 10'    | 10'00 |    | 9'99 |        |    |
| 15      | 156830 | 1451                     | 843170  | 161347 | 1481 | 838653 | 4518  | 31 | 5482 | 45     |    |
| 16      | 157700 | 1448                     | 842300  | 162236 | 1479 | 837764 | 4536  | 31 | 5464 | 44     |    |
| 17      | 158569 | 1445                     | 841431  | 163123 | 1476 | 836877 | 4554  | 31 | 5446 | 43     |    |
| 18      | 159435 | 1442                     | 840565  | 164008 | 1473 | 835992 | 4573  | 31 | 5427 | 42     |    |
| 19      | 160301 | 1439                     | 839699  | 164892 | 1470 | 835108 | 4591  | 31 | 5409 | 41     |    |
| 20      | 161164 | 1436                     | 838836  | 165774 | 1467 | 834226 | 4610  | 31 | 5390 | 40     |    |
| 21      | 162025 | 1433                     | 837975  | 166654 | 1464 | 833346 | 4628  | 31 | 5372 | 39     |    |
| 22      | 162885 | 1430                     | 837115  | 167532 | 1461 | 832468 | 4647  | 31 | 5353 | 38     |    |
| 23      | 163743 | 1427                     | 836257  | 168409 | 1458 | 831591 | 4666  | 31 | 5334 | 37     | 81 |
| 24      | 164600 | 1424                     | 835400  | 169284 | 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 | 28     | 81 |
| 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 | 818640 | 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 | 19     | 81 |
| 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 | 10     | 81 |
| 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 | 0      | 81 |
|         | Coa.   | D.                       | Sec.    | Cot.   | D.   | Tang.  | Coa.  | D. | Sine |        |    |

81½ Deg.

81 Deg.

9 Deg.

TABLE V.—LOG. SINES, ETC.

9½ Deg.

| ° | '  | Sine   | D.   | Correc. | Tang.  | D.   | Cot.   | Sec.  | D. | Coa. |    |
|---|----|--------|------|---------|--------|------|--------|-------|----|------|----|
|   |    | 9'     |      | 10'     | 9'     |      | 10'    | 10'00 |    | 9'99 |    |
| 0 | 0  | 194332 | 1328 | 805668  | 199713 | 1361 | 800287 | 5380  | 33 | 4620 | 60 |
|   | 1  | 195129 | 1326 | 804871  | 200529 | 1359 | 799471 | 5400  | 33 | 4600 | 59 |
|   | 2  | 195925 | 1323 | 804075  | 201345 | 1356 | 798655 | 5420  | 33 | 4580 | 58 |
|   | 3  | 196719 | 1321 | 803281  | 202159 | 1354 | 797841 | 5440  | 34 | 4560 | 57 |
|   | 4  | 197511 | 1318 | 802489  | 202971 | 1352 | 797029 | 5460  | 34 | 4540 | 56 |
|   | 5  | 198302 | 1316 | 801698  | 203782 | 1349 | 796218 | 5481  | 34 | 4519 | 55 |
|   | 6  | 199091 | 1313 | 800909  | 204592 | 1347 | 795408 | 5501  | 34 | 4499 | 54 |
|   | 7  | 199879 | 1311 | 800121  | 205400 | 1345 | 794600 | 5521  | 34 | 4479 | 53 |
|   | 8  | 200666 | 1308 | 799334  | 206207 | 1342 | 793793 | 5541  | 34 | 4459 | 52 |
| 9 | 9  | 201451 | 1306 | 798549  | 207013 | 1340 | 792987 | 5562  | 34 | 4438 | 51 |
|   | 10 | 202234 | 1304 | 797766  | 207817 | 1338 | 792183 | 5582  | 34 | 4418 | 50 |
|   | 11 | 203017 | 1301 | 796983  | 208619 | 1335 | 791381 | 5603  | 34 | 4397 | 49 |
|   | 12 | 203797 | 1299 | 796203  | 209420 | 1333 | 790580 | 5623  | 34 | 4377 | 48 |
|   | 13 | 204577 | 1296 | 795423  | 210220 | 1331 | 789780 | 5643  | 34 | 4357 | 47 |
|   | 14 | 205354 | 1294 | 794646  | 211018 | 1328 | 788982 | 5664  | 34 | 4336 | 46 |
|   | 15 | 206131 | 1292 | 793869  | 211815 | 1326 | 788185 | 5684  | 34 | 4316 | 45 |
|   | 16 | 206906 | 1289 | 793094  | 212611 | 1324 | 787389 | 5705  | 34 | 4295 | 44 |
|   | 17 | 207679 | 1287 | 792321  | 213405 | 1321 | 786595 | 5726  | 35 | 4274 | 43 |
| 9 | 18 | 208452 | 1285 | 791548  | 214198 | 1319 | 785802 | 5746  | 35 | 4254 | 42 |
|   | 19 | 209222 | 1282 | 790778  | 214989 | 1317 | 785011 | 5767  | 35 | 4233 | 41 |
|   | 20 | 209992 | 1280 | 790008  | 215780 | 1315 | 784220 | 5788  | 35 | 4212 | 40 |
|   | 21 | 210760 | 1278 | 789240  | 216568 | 1312 | 783432 | 5809  | 35 | 4191 | 39 |
|   | 22 | 211526 | 1275 | 788474  | 217356 | 1310 | 782644 | 5829  | 35 | 4171 | 38 |
|   | 23 | 212291 | 1273 | 787709  | 218142 | 1308 | 781858 | 5850  | 35 | 4150 | 37 |
|   | 24 | 213055 | 1271 | 786945  | 218926 | 1305 | 781074 | 5871  | 35 | 4129 | 36 |
|   | 25 | 213818 | 1268 | 786182  | 219710 | 1303 | 780290 | 5892  | 35 | 4108 | 35 |
|   | 26 | 214579 | 1266 | 785421  | 220492 | 1301 | 779508 | 5913  | 35 | 4087 | 34 |
| 9 | 27 | 215338 | 1264 | 784662  | 221272 | 1299 | 778728 | 5934  | 35 | 4066 | 33 |
|   | 28 | 216097 | 1261 | 783903  | 222052 | 1297 | 777948 | 5955  | 35 | 4045 | 32 |
|   | 29 | 216854 | 1259 | 783146  | 222830 | 1294 | 777170 | 5976  | 35 | 4024 | 31 |
|   | 30 | 217609 | 1257 | 782391  | 223606 | 1292 | 776394 | 5997  | 35 | 4003 | 30 |
|   | 31 | 218363 | 1255 | 781637  | 224382 | 1290 | 775618 | 6019  | 35 | 3981 | 29 |
|   | 32 | 219116 | 1253 | 780884  | 225156 | 1288 | 774844 | 6040  | 35 | 3960 | 28 |
|   | 33 | 219868 | 1250 | 780132  | 225929 | 1286 | 774071 | 6061  | 35 | 3939 | 27 |
|   | 34 | 220618 | 1248 | 779382  | 226700 | 1284 | 773300 | 6082  | 35 | 3918 | 26 |
|   | 35 | 221367 | 1246 | 778633  | 227471 | 1281 | 772529 | 6104  | 36 | 3896 | 25 |
| 9 | 36 | 222115 | 1244 | 777885  | 228239 | 1279 | 771761 | 6125  | 36 | 3875 | 24 |
|   | 37 | 222861 | 1242 | 777139  | 229007 | 1277 | 770993 | 6146  | 36 | 3854 | 23 |
|   | 38 | 223606 | 1239 | 776394  | 229773 | 1275 | 770227 | 6168  | 36 | 3832 | 22 |
|   | 39 | 224349 | 1237 | 775651  | 230539 | 1273 | 769461 | 6189  | 36 | 3811 | 21 |
|   | 40 | 225092 | 1235 | 774908  | 231302 | 1271 | 768698 | 6211  | 36 | 3789 | 20 |
|   | 41 | 225833 | 1233 | 774167  | 232065 | 1269 | 767935 | 6232  | 36 | 3768 | 19 |
|   | 42 | 226573 | 1231 | 773427  | 232826 | 1267 | 767174 | 6254  | 36 | 3746 | 18 |
|   | 43 | 227311 | 1228 | 772689  | 233586 | 1265 | 766414 | 6275  | 36 | 3725 | 17 |
|   | 44 | 228048 | 1226 | 771952  | 234345 | 1262 | 765655 | 6297  | 36 | 3703 | 16 |
|   | 45 | 228784 |      | 771216  | 235103 |      | 764897 | 6319  | 36 | 3681 | 15 |
|   |    | Coa.   | D.   | Sec.    | Cot.   | D.   | Tang.  | Coa.  | D. | Sine |    |

81 Deg.

80½ Deg.

| 9½ Deg.  |        | TABLE V.—LOG. SINES, ETC. |        |        |        |        |        |       |      |      |          | 10½ Deg. |  |
|----------|--------|---------------------------|--------|--------|--------|--------|--------|-------|------|------|----------|----------|--|
| °        | '      | Sine                      | D.     | Cosec. | Tang.  | D.     | Cot.   | Sec.  | Δ    | Con. |          |          |  |
|          |        | 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        | 242526 | 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   | 37    | 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     | 254455                    | 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   | 39    | 2666 | 70   | 30       |          |  |
| 80½ Deg. |        | Con.                      | D.     | Sec.   | Cot.   | D.     | Tang.  | Con.  | D.   | Sine | 79½ Deg. |          |  |

104 Deg.

TABLE V.—LOG. SINES, ETC.

114 Deg.

| °  |    | Sine   | D.   | Cosec. | Tang.  | D.   | Cot.   | Sec.  | D. | Co.  |       |
|----|----|--------|------|--------|--------|------|--------|-------|----|------|-------|
|    |    | 9'     |      | 10'    | 9'     |      | 10'    | 10'00 |    | 9'99 |       |
| 10 | 30 | 260633 |      | 739367 | 267967 | 1174 | 732033 | 7334  | 39 | 2666 | 30    |
|    | 31 | 261314 | 1135 | 738686 | 268671 | 1172 | 731329 | 7357  | 39 | 2643 | 29    |
|    | 32 | 261994 | 1133 | 738006 | 269375 | 1170 | 730625 | 7381  | 39 | 2619 | 28    |
|    | 33 | 262673 | 1131 | 737327 | 270077 | 1169 | 729923 | 7404  | 39 | 2596 | 27    |
|    | 34 | 263351 | 1130 | 736649 | 270779 | 1167 | 729221 | 7428  | 39 | 2572 | 26    |
|    | 35 | 264027 | 1128 | 735973 | 271479 | 1165 | 728521 | 7451  | 39 | 2549 | 25    |
|    | 36 | 264703 | 1126 | 735297 | 272178 | 1164 | 727822 | 7475  | 39 | 2525 | 24    |
|    | 37 | 265377 | 1124 | 734623 | 272876 | 1162 | 727124 | 7499  | 39 | 2501 | 23    |
|    | 38 | 266051 | 1122 | 733949 | 273573 | 1160 | 726427 | 7522  | 40 | 2478 | 79 22 |
| 10 | 39 | 266723 | 1119 | 733277 | 274269 | 1158 | 725731 | 7546  | 40 | 2454 | 21    |
|    | 40 | 267395 | 1117 | 732605 | 274964 | 1157 | 725036 | 7570  | 40 | 2430 | 20    |
|    | 41 | 268065 | 1115 | 731935 | 275658 | 1155 | 724342 | 7594  | 40 | 2406 | 19    |
|    | 42 | 268734 | 1113 | 731266 | 276351 | 1153 | 723649 | 7618  | 40 | 2382 | 18    |
|    | 43 | 269402 | 1111 | 730598 | 277043 | 1151 | 722957 | 7641  | 40 | 2359 | 17    |
|    | 44 | 270069 | 1110 | 729931 | 277734 | 1150 | 722266 | 7665  | 40 | 2335 | 16    |
|    | 45 | 270735 | 1108 | 729265 | 278424 | 1148 | 721576 | 7689  | 40 | 2311 | 15    |
|    | 46 | 271400 | 1106 | 728600 | 279113 | 1147 | 720887 | 7713  | 40 | 2287 | 14    |
|    | 47 | 272064 | 1105 | 727936 | 279801 | 1145 | 720199 | 7737  | 40 | 2263 | 79 13 |
| 10 | 48 | 272726 | 1103 | 727274 | 280488 | 1143 | 719512 | 7761  | 40 | 2239 | 12    |
|    | 49 | 273388 | 1101 | 726612 | 281174 | 1141 | 718826 | 7786  | 40 | 2214 | 11    |
|    | 50 | 274049 | 1099 | 725951 | 281858 | 1140 | 718142 | 7810  | 40 | 2190 | 10    |
|    | 51 | 274708 | 1098 | 725292 | 282542 | 1138 | 717458 | 7834  | 40 | 2166 | 9     |
|    | 52 | 275367 | 1096 | 724633 | 283225 | 1136 | 716775 | 7858  | 40 | 2142 | 8     |
|    | 53 | 276024 | 1094 | 723976 | 283907 | 1135 | 716093 | 7883  | 40 | 2117 | 7     |
|    | 54 | 276681 | 1092 | 723319 | 284588 | 1133 | 715412 | 7907  | 41 | 2093 | 6     |
|    | 55 | 277337 | 1091 | 722663 | 285268 | 1131 | 714732 | 7931  | 41 | 2069 | 5     |
|    | 56 | 277991 | 1089 | 722009 | 285947 | 1130 | 714053 | 7956  | 41 | 2044 | 79 4  |
| 10 | 57 | 278644 | 1087 | 721356 | 286624 | 1128 | 713376 | 7980  | 41 | 2020 | 3     |
|    | 58 | 279297 | 1086 | 720703 | 287301 | 1126 | 712699 | 8004  | 41 | 1996 | 2     |
|    | 59 | 279948 | 1084 | 720052 | 287977 | 1125 | 712023 | 8029  | 41 | 1971 | 1     |
| 11 | 0  | 280599 | 1082 | 719401 | 288652 | 1123 | 711348 | 8053  | 41 | 1947 | 79 0  |
|    | 1  | 281248 | 1081 | 718752 | 289326 | 1122 | 710674 | 8078  | 41 | 1922 | 59    |
|    | 2  | 281897 | 1079 | 718103 | 289999 | 1120 | 710001 | 8103  | 41 | 1897 | 58    |
|    | 3  | 282544 | 1077 | 717456 | 290671 | 1118 | 709329 | 8127  | 41 | 1873 | 57    |
|    | 4  | 283190 | 1076 | 716810 | 291342 | 1117 | 708658 | 8152  | 41 | 1848 | 56    |
|    | 5  | 283836 | 1074 | 716164 | 292013 | 1115 | 707987 | 8177  | 41 | 1823 | 78 55 |
| 11 | 6  | 284480 | 1072 | 715520 | 292682 | 1114 | 707318 | 8201  | 41 | 1799 | 54    |
|    | 7  | 285124 | 1071 | 714876 | 293350 | 1112 | 706650 | 8226  | 41 | 1774 | 53    |
|    | 8  | 285766 | 1069 | 714234 | 294017 | 1111 | 705983 | 8251  | 42 | 1749 | 52    |
|    | 9  | 286408 | 1067 | 713592 | 294684 | 1109 | 705316 | 8276  | 42 | 1724 | 51    |
| 10 | 10 | 287048 | 1066 | 712952 | 295349 | 1107 | 704651 | 8301  | 42 | 1699 | 50    |
|    | 11 | 287687 | 1064 | 712313 | 296013 | 1106 | 703987 | 8326  | 42 | 1674 | 49    |
|    | 12 | 288326 | 1063 | 711674 | 296677 | 1104 | 703323 | 8351  | 42 | 1649 | 48    |
|    | 13 | 288964 | 1061 | 711036 | 297339 | 1103 | 702661 | 8376  | 42 | 1624 | 47    |
|    | 14 | 289600 | 1059 | 710400 | 298001 | 1101 | 702000 | 8401  | 42 | 1599 | 46    |
|    | 15 | 290236 |      | 709764 | 298662 |      | 701338 | 8426  | 42 | 1574 | 78 45 |
|    |    | Co.    | D.   | Sec.   | Cot.   | D.   | Tang.  | Co.   | D. | Sine |       |

784 Deg.

784 Deg.

| 11½ Deg. |    | TABLE V.—LOG. SINES, ETC. |      |         |        |      |        |       |    |      |    | 12 Deg. |  |
|----------|----|---------------------------|------|---------|--------|------|--------|-------|----|------|----|---------|--|
| °        | '  | Sine                      | D.   | Consec. | Tang.  | D.   | Cot.   | Sec.  | D. | Con. |    |         |  |
|          |    | 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 | 299034                    | 1036 | 700966  | 307815 | 1078 | 692185 | 8782  | 43 | 1218 |    | 31      |  |
|          | 30 | 299655                    | 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 | 1066 | 686392 | 9014  | 43 | 986  |    | 22      |  |
|          | 39 | 305207                    | 1020 | 694793  | 314247 | 1065 | 685753 | 9040  | 43 | 960  |    | 21      |  |
|          | 40 | 305819                    | 1019 | 694181  | 314885 | 1064 | 685115 | 9066  | 43 | 934  |    | 20      |  |
|          | 41 | 306430                    | 1017 | 693570  | 315523 | 1061 | 684477 | 9092  | 44 | 908  | 78 | 19      |  |
| 11       | 42 | 307041                    | 1016 | 692959  | 316159 | 1060 | 683841 | 9118  | 44 | 882  |    | 18      |  |
|          | 43 | 307650                    | 1014 | 692350  | 316795 | 1058 | 683205 | 9145  | 44 | 855  |    | 17      |  |
|          | 44 | 308259                    | 1013 | 691741  | 317430 | 1057 | 682570 | 9171  | 44 | 829  |    | 16      |  |
|          | 45 | 308867                    | 1011 | 691133  | 318064 | 1055 | 681936 | 9197  | 44 | 803  |    | 15      |  |
|          | 46 | 309474                    | 1010 | 690526  | 318697 | 1054 | 681303 | 9223  | 44 | 777  |    | 14      |  |
|          | 47 | 310080                    | 1008 | 689920  | 319329 | 1053 | 680671 | 9250  | 44 | 750  |    | 13      |  |
|          | 48 | 310685                    | 1007 | 689315  | 319961 | 1051 | 680039 | 9276  | 44 | 724  |    | 12      |  |
|          | 49 | 311289                    | 1005 | 688711  | 320592 | 1050 | 679408 | 9303  | 44 | 697  |    | 11      |  |
|          | 50 | 311893                    | 1004 | 688107  | 321222 | 1048 | 678778 | 9329  | 44 | 671  | 78 | 10      |  |
| 11       | 51 | 312495                    | 1003 | 687505  | 321851 | 1047 | 678149 | 9356  | 44 | 644  |    | 9       |  |
|          | 52 | 313097                    | 1001 | 686903  | 322479 | 1045 | 677521 | 9382  | 44 | 618  |    | 8       |  |
|          | 53 | 313698                    | 1000 | 686302  | 323106 | 1044 | 676894 | 9409  | 44 | 591  |    | 7       |  |
|          | 54 | 314297                    | 998  | 685703  | 323733 | 1043 | 676267 | 9435  | 44 | 565  |    | 6       |  |
|          | 55 | 314897                    | 997  | 685103  | 324358 | 1041 | 675642 | 9462  | 44 | 538  |    | 5       |  |
|          | 56 | 315495                    | 996  | 684505  | 324983 | 1040 | 675017 | 9489  | 44 | 511  |    | 4       |  |
|          | 57 | 316092                    | 994  | 683908  | 325607 | 1039 | 674393 | 9515  | 45 | 485  |    | 3       |  |
|          | 58 | 316689                    | 993  | 683311  | 326231 | 1037 | 673769 | 9542  | 45 | 458  |    | 2       |  |
|          | 59 | 317284                    | 991  | 682716  | 326853 | 1036 | 673147 | 9569  | 45 | 431  |    | 1       |  |
|          | 60 | 317879                    |      | 682121  | 327475 |      | 672525 | 9596  | 45 | 404  | 78 | 0       |  |
|          |    | Con.                      | D.   | Sec.    | Cot.   | D.   | Tang.  | Con.  | D. | Sine |    |         |  |
| 78½ Deg. |    |                           |      |         |        |      |        |       |    |      |    | 78 Deg. |  |

12 Deg.

TABLE V.—LOG. SINES, ETC.

12½ Deg.

| °  | '  | Sine  | D.  | Cosec. | Tang.  | D.   | Cot.   | Sec.  | D. | Cos.  |       |
|----|----|-------|-----|--------|--------|------|--------|-------|----|-------|-------|
|    |    | 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  | 651263 | 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 | 933 | 57321  | 353465 | 980  | 646535 | 10786 | 47 | 89214 | 17    |
|    | 44 | 43239 | 931 | 56761  | 354053 | 979  | 645947 | 10814 | 47 | 89186 | 16    |
|    | 45 | 43797 |     | 56203  | 354640 |      | 645360 | 10842 | 47 | 89157 | 77 15 |
|    |    | Con.  | D.  | Sec.   | Cot.   | D.   | Tang.  | Coa.  | D. | Sine  | °     |

78 Deg.

77½ Deg.

| 12½ Deg. |    | TABLE V.—LOG. SINE, ETC. |     |        |        |     |        |       |    | 13½ Deg. |       |
|----------|----|--------------------------|-----|--------|--------|-----|--------|-------|----|----------|-------|
| °        | '  | Sine                     | D.  | Cosec. | Tang.  | D.  | Cot.   | Sec.  | D. | Cos.     |       |
|          |    | 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 | 655088 | 355813 | 975 | 644187 | 0900  | 48 | 9100     | 13    |
|          | 48 | 345469                   | 926 | 654531 | 356398 | 974 | 643602 | 0929  | 48 | 9071     | 12    |
|          | 49 | 346024                   | 925 | 653976 | 356982 | 973 | 643018 | 0958  | 48 | 9042     | 11    |
|          | 50 | 346579                   | 924 | 653421 | 357566 | 971 | 642434 | 0986  | 48 | 9014     | 10    |
|          | 51 | 347134                   | 922 | 652866 | 358149 | 970 | 641851 | 1015  | 48 | 8985     | 9     |
|          | 52 | 347687                   | 921 | 652313 | 358731 | 969 | 641269 | 1044  | 48 | 8956     | 8     |
|          | 53 | 348240                   | 920 | 651760 | 359313 | 968 | 640687 | 1073  | 48 | 8927     | 77 7  |
| 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 | 963 | 638368 | 1189  | 48 | 8811     | 3     |
|          | 58 | 350992                   | 914 | 649008 | 362210 | 962 | 637790 | 1218  | 49 | 8782     | 2     |
|          | 59 | 351540                   | 913 | 648460 | 362787 | 961 | 637213 | 1247  | 49 | 8753     | 1     |
| 13       | 0  | 352088                   | 911 | 647912 | 363364 | 960 | 636636 | 1276  | 49 | 8724     | 77 0  |
|          | 1  | 352635                   | 910 | 647365 | 363940 | 959 | 636060 | 1305  | 49 | 8695     | 59    |
|          | 2  | 353181                   | 909 | 646819 | 364515 | 958 | 635485 | 1334  | 49 | 8666     | 76 58 |
| 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                   | 905 | 645185 | 366237 | 954 | 633763 | 1422  | 49 | 8578     | 55    |
|          | 6  | 355358                   | 904 | 644642 | 366810 | 953 | 633190 | 1452  | 49 | 8548     | 54    |
|          | 7  | 355901                   | 903 | 644099 | 367382 | 952 | 632618 | 1481  | 49 | 8519     | 53    |
|          | 8  | 356443                   | 902 | 643557 | 367953 | 951 | 632047 | 1511  | 49 | 8489     | 52    |
|          | 9  | 356984                   | 901 | 643016 | 368524 | 950 | 631476 | 1540  | 49 | 8460     | 51    |
|          | 10 | 357524                   | 899 | 642476 | 369094 | 949 | 630906 | 1570  | 49 | 8430     | 50    |
|          | 11 | 358064                   | 898 | 641936 | 369663 | 948 | 630337 | 1599  | 49 | 8401     | 76 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                   | 893 | 639785 | 371933 | 943 | 628067 | 1718  | 50 | 8282     | 45    |
|          | 16 | 360752                   | 892 | 639248 | 372499 | 942 | 627501 | 1748  | 50 | 8252     | 44    |
|          | 17 | 361287                   | 891 | 638713 | 373064 | 941 | 626936 | 1777  | 50 | 8223     | 43    |
|          | 18 | 361822                   | 890 | 638178 | 373629 | 940 | 626371 | 1807  | 50 | 8193     | 42    |
|          | 19 | 362356                   | 889 | 637644 | 374193 | 939 | 625807 | 1837  | 50 | 8163     | 41    |
|          | 20 | 362889                   | 888 | 637111 | 374756 | 938 | 625244 | 1867  | 50 | 8133     | 76 40 |
| 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 | 933 | 622997 | 1987  | 50 | 8013     | 36    |
|          | 25 | 365546                   | 882 | 634454 | 377563 | 932 | 622437 | 2017  | 50 | 7983     | 35    |
|          | 26 | 366075                   | 881 | 633925 | 378122 | 931 | 621878 | 2047  | 50 | 7953     | 34    |
|          | 27 | 366604                   | 880 | 633396 | 378681 | 930 | 621319 | 2078  | 50 | 7922     | 33    |
|          | 28 | 367131                   | 879 | 632869 | 379239 | 929 | 620761 | 2108  | 50 | 7892     | 32    |
|          | 29 | 367659                   | 877 | 632341 | 379797 | 928 | 620203 | 2138  | 50 | 7862     | 31    |
|          | 30 | 368185                   |     | 631815 | 380354 |     | 619646 | 2168  | 50 | 7832     | 76 30 |
|          |    | Con.                     | D.  | Sec.   | Cot.   | D.  | Tang.  | Con.  | D. | Sine     |       |
| 77½ Deg. |    |                          |     |        |        |     |        |       |    | 76½ Deg. |       |

| 18½ Deg. |    | TABLE V.—LOG. SINES, ETC. |     |        |        |     |        |       |    | 14½ Deg. |       |
|----------|----|---------------------------|-----|--------|--------|-----|--------|-------|----|----------|-------|
| °        |    | Sine                      | D.  | Cosec. | Tang.  | D.  | Cot.   | Sec.  | D. | Cos.     |       |
|          |    | 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 | 895 | 602691 | 3127  | 52 | 6873     | 59    |
|          | 2  | 384687                    | 842 | 615313 | 397846 | 894 | 602154 | 3159  | 53 | 6841     | 58    |
|          | 3  | 385192                    | 841 | 614808 | 398383 | 893 | 601617 | 3191  | 53 | 6809     | 57    |
|          | 4  | 385697                    | 840 | 614303 | 398919 | 892 | 601081 | 3222  | 53 | 6778     | 56    |
|          | 5  | 386201                    | 839 | 613799 | 399455 | 891 | 600545 | 3254  | 53 | 6746     | 75 55 |
| 14       | 6  | 386704                    | 838 | 613296 | 399990 | 890 | 600010 | 3286  | 53 | 6714     | 54    |
|          | 7  | 387207                    | 837 | 612793 | 400524 | 889 | 599476 | 3317  | 53 | 6683     | 53    |
|          | 8  | 387709                    | 836 | 612291 | 401058 | 888 | 598942 | 3349  | 53 | 6651     | 52    |
|          | 9  | 388210                    | 835 | 611790 | 401591 | 887 | 598409 | 3381  | 53 | 6619     | 51    |
|          | 10 | 388711                    | 834 | 611289 | 402124 | 886 | 597876 | 3413  | 53 | 6587     | 50    |
|          | 11 | 389211                    | 833 | 610789 | 402656 | 885 | 597344 | 3445  | 53 | 6555     | 49    |
|          | 12 | 389711                    | 832 | 610289 | 403187 | 884 | 596813 | 3477  | 53 | 6523     | 48    |
|          | 13 | 390210                    | 831 | 609790 | 403718 | 883 | 596282 | 3509  | 53 | 6491     | 47    |
|          | 14 | 390708                    | 830 | 609292 | 404249 | 882 | 595751 | 3541  | 53 | 6459     | 46    |
|          | 15 | 391206                    |     | 608794 | 404778 | 881 | 595222 | 3573  | 53 | 6427     | 75 45 |
|          |    | Coa.                      | D.  | Sec.   | Cot.   | D.  | Tang.  | Coa.  | D. | Sine     | °     |

76½ Deg.

76½ Deg.

14½ Deg.

TABLE V.—LOG. SINE, ETC.

15 Deg.

| °     | Sine   | D.  | Cosec. | Tang.  | D.  | Cot.   | Sec.  | D. | Cos. |       |
|-------|--------|-----|--------|--------|-----|--------|-------|----|------|-------|
|       | 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  | 53 | 6395 | 44    |
| 17    | 392199 | 826 | 607801 | 405836 | 880 | 594164 | 3637  | 53 | 6363 | 43    |
| 18    | 392695 | 825 | 607305 | 406364 | 879 | 593636 | 3669  | 54 | 6331 | 42    |
| 19    | 393191 | 824 | 606809 | 406892 | 878 | 593108 | 3701  | 54 | 6299 | 41    |
| 20    | 393685 | 823 | 606315 | 407419 | 877 | 592581 | 3734  | 54 | 6266 | 40    |
| 21    | 394179 | 822 | 605821 | 407945 | 876 | 592055 | 3766  | 54 | 6234 | 39    |
| 22    | 394673 | 821 | 605327 | 408471 | 875 | 591529 | 3798  | 54 | 6202 | 38    |
| 23    | 395166 | 820 | 604834 | 408997 | 874 | 591003 | 3831  | 54 | 6169 | 75 37 |
| 14 24 | 395658 | 819 | 604342 | 409521 | 874 | 590479 | 3863  | 54 | 6137 | 36    |
| 25    | 396150 | 818 | 603850 | 410045 | 873 | 589955 | 3896  | 54 | 6104 | 35    |
| 26    | 396641 | 817 | 603359 | 410569 | 872 | 589431 | 3928  | 54 | 6072 | 34    |
| 27    | 397132 | 817 | 602868 | 411092 | 871 | 588908 | 3961  | 54 | 6039 | 33    |
| 28    | 397621 | 816 | 602379 | 411615 | 870 | 588385 | 3993  | 54 | 6007 | 32    |
| 29    | 398111 | 815 | 601889 | 412137 | 869 | 587863 | 4026  | 54 | 5974 | 31    |
| 30    | 398600 | 814 | 601400 | 412658 | 868 | 587342 | 4058  | 54 | 5942 | 30    |
| 31    | 399088 | 813 | 600912 | 413179 | 867 | 586821 | 4091  | 54 | 5909 | 29    |
| 32    | 399575 | 812 | 600425 | 413699 | 866 | 586301 | 4124  | 55 | 5876 | 75 28 |
| 14 33 | 400062 | 811 | 599938 | 414219 | 865 | 585781 | 4157  | 55 | 5843 | 27    |
| 34    | 400549 | 810 | 599451 | 414738 | 864 | 585262 | 4189  | 55 | 5811 | 26    |
| 35    | 401035 | 809 | 598965 | 415257 | 864 | 584743 | 4222  | 55 | 5778 | 25    |
| 36    | 401520 | 808 | 598480 | 415775 | 863 | 584225 | 4255  | 55 | 5745 | 24    |
| 37    | 402005 | 807 | 597995 | 416293 | 862 | 583707 | 4288  | 55 | 5712 | 23    |
| 38    | 402489 | 806 | 597511 | 416810 | 861 | 583190 | 4321  | 55 | 5679 | 22    |
| 39    | 402972 | 805 | 597028 | 417326 | 860 | 582674 | 4354  | 55 | 5646 | 21    |
| 40    | 403455 | 804 | 596545 | 417842 | 859 | 582158 | 4387  | 55 | 5613 | 20    |
| 41    | 403938 | 803 | 596062 | 418358 | 858 | 581642 | 4420  | 55 | 5580 | 75 19 |
| 14 42 | 404420 | 802 | 595580 | 418873 | 857 | 581127 | 4453  | 55 | 5547 | 18    |
| 43    | 404901 | 801 | 595099 | 419387 | 856 | 580613 | 4486  | 55 | 5514 | 17    |
| 44    | 405382 | 800 | 594618 | 419901 | 855 | 580099 | 4520  | 55 | 5480 | 16    |
| 45    | 405862 | 799 | 594138 | 420415 | 855 | 579585 | 4553  | 55 | 5447 | 15    |
| 46    | 406341 | 798 | 593659 | 420927 | 854 | 579073 | 4586  | 55 | 5414 | 14    |
| 47    | 406820 | 797 | 593180 | 421440 | 853 | 578560 | 4620  | 56 | 5380 | 13    |
| 48    | 407299 | 796 | 592701 | 421952 | 852 | 578048 | 4653  | 56 | 5347 | 12    |
| 49    | 407777 | 795 | 592223 | 422463 | 851 | 577537 | 4686  | 56 | 5314 | 11    |
| 50    | 408254 | 794 | 591746 | 422974 | 850 | 577026 | 4720  | 56 | 5280 | 75 10 |
| 14 51 | 408731 | 794 | 591269 | 423484 | 849 | 576516 | 4753  | 56 | 5247 | 9     |
| 52    | 409207 | 793 | 590793 | 423993 | 848 | 576007 | 4787  | 56 | 5213 | 8     |
| 53    | 409682 | 792 | 590318 | 424503 | 848 | 575497 | 4820  | 56 | 5180 | 7     |
| 54    | 410157 | 791 | 589843 | 425011 | 847 | 574989 | 4854  | 56 | 5146 | 6     |
| 55    | 410632 | 790 | 589368 | 425519 | 846 | 574481 | 4887  | 56 | 5113 | 5     |
| 56    | 411106 | 789 | 588894 | 426027 | 845 | 573973 | 4921  | 56 | 5079 | 4     |
| 57    | 411579 | 788 | 588421 | 426534 | 844 | 573466 | 4955  | 56 | 5045 | 3     |
| 58    | 412052 | 787 | 587948 | 427041 | 843 | 572959 | 4989  | 56 | 5011 | 2     |
| 59    | 412524 | 786 | 587476 | 427547 | 843 | 572453 | 5022  | 56 | 4978 | 1     |
| 60    | 412996 |     | 587004 | 428052 |     | 571948 | 5056  |    | 4944 | 75 0  |
|       | Cos.   | D.  | Sec.   | Cot.   | D.  | Tang.  | Cos.  | D. | Sine | °     |

75½ 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  | 57 | 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 | °     |

75 Deg.

74½ Deg.

| 15½ Deg. |    | TABLE V.—LOG. SINES, ETC. |     |        |        |     |        |       |    |      |          | 16½ Deg. |  |
|----------|----|---------------------------|-----|--------|--------|-----|--------|-------|----|------|----------|----------|--|
| °        | '  | Sine                      | D.  | Cosec. | Tang.  | D.  | Cot.   | Sec.  | D. | Coa. |          |          |  |
|          |    | 9'                        |     | 10'    | 9'     |     | 10'    | 10'01 |    | 9'98 |          |          |  |
| 15       | 45 | 433675                    | 746 | 566325 | 450294 | 806 | 549706 | 6619  | 59 | 3381 | 15       |          |  |
|          | 46 | 434122                    | 745 | 565878 | 450777 | 805 | 549223 | 6655  | 59 | 3345 | 14       |          |  |
|          | 47 | 434569                    | 744 | 565431 | 451260 | 804 | 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                    | 739 | 562314 | 454628 | 799 | 545372 | 6942  | 60 | 3058 | 6        |          |  |
|          | 55 | 438129                    | 738 | 561871 | 455107 | 798 | 544893 | 6978  | 60 | 3022 | 5        |          |  |
|          | 56 | 438572                    | 737 | 561428 | 455586 | 797 | 544414 | 7014  | 60 | 2986 | 4        |          |  |
|          | 57 | 439014                    | 736 | 560986 | 456064 | 796 | 543936 | 7050  | 60 | 2950 | 3        |          |  |
|          | 58 | 439456                    | 736 | 560544 | 456542 | 796 | 543458 | 7086  | 60 | 2914 | 2        |          |  |
|          | 59 | 439897                    | 735 | 560103 | 457019 | 795 | 542981 | 7122  | 60 | 2878 | 1        |          |  |
| 16       | 0  | 440338                    | 734 | 559662 | 457496 | 794 | 542504 | 7158  | 60 | 2842 | 74       |          |  |
|          | 1  | 440778                    | 733 | 559222 | 457973 | 794 | 542027 | 7195  | 60 | 2805 | 59       |          |  |
|          | 2  | 441218                    | 732 | 558782 | 458449 | 793 | 541551 | 7231  | 61 | 2769 | 73       | 58       |  |
| 16       | 3  | 441658                    | 731 | 558342 | 458925 | 792 | 541075 | 7267  | 61 | 2733 | 57       |          |  |
|          | 4  | 442096                    | 731 | 557904 | 459400 | 791 | 540600 | 7304  | 61 | 2696 | 56       |          |  |
|          | 5  | 442535                    | 730 | 557465 | 459875 | 790 | 540125 | 7340  | 61 | 2660 | 55       |          |  |
|          | 6  | 442973                    | 729 | 557027 | 460349 | 790 | 539651 | 7376  | 61 | 2624 | 54       |          |  |
|          | 7  | 443410                    | 728 | 556590 | 460823 | 789 | 539177 | 7413  | 61 | 2587 | 53       |          |  |
|          | 8  | 443847                    | 727 | 556153 | 461297 | 788 | 538703 | 7449  | 61 | 2551 | 52       |          |  |
|          | 9  | 444284                    | 727 | 555716 | 461770 | 788 | 538230 | 7486  | 61 | 2514 | 51       |          |  |
|          | 10 | 444720                    | 726 | 555280 | 462242 | 787 | 537758 | 7523  | 61 | 2477 | 50       |          |  |
|          | 11 | 445155                    | 725 | 554845 | 462714 | 786 | 537286 | 7559  | 61 | 2441 | 73       | 49       |  |
| 16       | 12 | 445590                    | 724 | 554410 | 463186 | 785 | 536814 | 7596  | 61 | 2404 | 48       |          |  |
|          | 13 | 446025                    | 723 | 553975 | 463658 | 785 | 536342 | 7633  | 61 | 2367 | 47       |          |  |
|          | 14 | 446459                    | 723 | 553541 | 464129 | 784 | 535871 | 7669  | 61 | 2331 | 46       |          |  |
|          | 15 | 446893                    | 722 | 553107 | 464599 | 783 | 535401 | 7706  | 61 | 2294 | 45       |          |  |
|          | 16 | 447326                    | 721 | 552674 | 465069 | 783 | 534931 | 7743  | 61 | 2257 | 44       |          |  |
|          | 17 | 447759                    | 720 | 552241 | 465539 | 782 | 534461 | 7780  | 62 | 2220 | 43       |          |  |
|          | 18 | 448191                    | 720 | 551809 | 466008 | 781 | 533992 | 7817  | 62 | 2183 | 42       |          |  |
|          | 19 | 448623                    | 719 | 551377 | 466476 | 780 | 533524 | 7854  | 62 | 2146 | 41       |          |  |
|          | 20 | 449054                    | 718 | 550946 | 466945 | 780 | 533055 | 7891  | 62 | 2109 | 73       | 40       |  |
| 16       | 21 | 449485                    | 717 | 550515 | 467413 | 779 | 532587 | 7928  | 62 | 2072 | 39       |          |  |
|          | 22 | 449915                    | 716 | 550085 | 467880 | 778 | 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                    | 714 | 548796 | 469280 | 776 | 530720 | 8076  | 62 | 1924 | 35       |          |  |
|          | 26 | 451632                    | 713 | 548368 | 469746 | 775 | 530254 | 8114  | 62 | 1886 | 34       |          |  |
|          | 27 | 452060                    | 713 | 547940 | 470211 | 775 | 529789 | 8151  | 62 | 1849 | 33       |          |  |
|          | 28 | 452488                    | 712 | 547512 | 470676 | 774 | 529324 | 8188  | 62 | 1812 | 32       |          |  |
|          | 29 | 452915                    | 711 | 547085 | 471141 | 773 | 528859 | 8226  | 62 | 1774 | 31       |          |  |
|          | 30 | 453342                    |     | 546658 | 471605 |     | 528395 | 8263  | 62 | 1737 | 73       | 30       |  |
|          |    | Coa.                      | D.  | Sec.   | Cot.   | D.  | Tang.  | Coa.  | D. | Sine |          |          |  |
| 74½ Deg. |    |                           |     |        |        |     |        |       |    |      | 73½ Deg. |          |  |

16½ Deg.

TABLE V.—LOG. SINES, ETC.

17½ Deg.

| °  |    | Sine   | D.  | Co-sec. | Tang   | D.  | Cot.   | Sec.  | D. | Co-  |       |
|----|----|--------|-----|---------|--------|-----|--------|-------|----|------|-------|
|    |    | 9'     |     | 10'     | 9'     |     | 10'    | 10'01 |    | 9'98 |       |
| 16 | 30 | 453342 | 710 | 546658  | 471605 | 773 | 528395 | 8263  | 62 | 1737 | 30    |
|    | 31 | 453768 | 710 | 546232  | 472068 | 772 | 527932 | 8301  | 63 | 1699 | 29    |
|    | 32 | 454194 | 709 | 545806  | 472532 | 771 | 527468 | 8338  | 63 | 1662 | 28    |
|    | 33 | 454619 | 708 | 545381  | 472995 | 771 | 527005 | 8375  | 63 | 1625 | 27    |
|    | 34 | 455044 | 707 | 544956  | 473457 | 770 | 526543 | 8413  | 63 | 1587 | 26    |
|    | 35 | 455469 | 707 | 544531  | 473919 | 769 | 526081 | 8451  | 63 | 1549 | 25    |
|    | 36 | 455893 | 706 | 544107  | 474381 | 769 | 525619 | 8488  | 63 | 1512 | 24    |
|    | 37 | 456316 | 705 | 543684  | 474842 | 768 | 525158 | 8526  | 63 | 1474 | 23    |
|    | 38 | 456739 | 704 | 543261  | 475303 | 767 | 524697 | 8564  | 63 | 1436 | 73 22 |
| 16 | 39 | 457162 | 704 | 542838  | 475763 | 767 | 524237 | 8601  | 63 | 1399 | 21    |
|    | 40 | 457584 | 703 | 542416  | 476223 | 766 | 523777 | 8639  | 63 | 1361 | 20    |
|    | 41 | 458006 | 702 | 541994  | 476683 | 765 | 523317 | 8677  | 63 | 1323 | 19    |
|    | 42 | 458427 | 701 | 541573  | 477142 | 765 | 522858 | 8715  | 63 | 1285 | 18    |
|    | 43 | 458848 | 701 | 541152  | 477601 | 764 | 522399 | 8753  | 63 | 1247 | 17    |
|    | 44 | 459268 | 700 | 540732  | 478059 | 763 | 521941 | 8791  | 63 | 1209 | 16    |
|    | 45 | 459688 | 699 | 540312  | 478517 | 763 | 521483 | 8829  | 63 | 1171 | 15    |
|    | 46 | 460108 | 698 | 539892  | 478975 | 762 | 521025 | 8867  | 64 | 1133 | 14    |
|    | 47 | 460527 | 698 | 539473  | 479432 | 761 | 520568 | 8905  | 64 | 1095 | 73 13 |
| 16 | 48 | 460946 | 697 | 539054  | 479889 | 761 | 520111 | 8943  | 64 | 1057 | 12    |
|    | 49 | 461364 | 696 | 538636  | 480345 | 760 | 519655 | 8981  | 64 | 1019 | 11    |
|    | 50 | 461782 | 695 | 538218  | 480801 | 759 | 519199 | 9019  | 64 | 9981 | 10    |
|    | 51 | 462199 | 695 | 537801  | 481257 | 759 | 518743 | 9058  | 64 | 9942 | 9     |
|    | 52 | 462616 | 694 | 537384  | 481712 | 758 | 518288 | 9096  | 64 | 9904 | 8     |
|    | 53 | 463032 | 693 | 536968  | 482167 | 757 | 517833 | 9134  | 64 | 9866 | 7     |
|    | 54 | 463448 | 693 | 536552  | 482621 | 757 | 517379 | 9173  | 64 | 9827 | 6     |
|    | 55 | 463864 | 692 | 536136  | 483075 | 756 | 516925 | 9211  | 64 | 9789 | 5     |
|    | 56 | 464279 | 691 | 535721  | 483529 | 755 | 516471 | 9250  | 64 | 9750 | 73 4  |
| 16 | 57 | 464694 | 690 | 535306  | 483982 | 755 | 516018 | 9288  | 64 | 9712 | 3     |
|    | 58 | 465108 | 690 | 534892  | 484435 | 754 | 515565 | 9327  | 64 | 9673 | 2     |
|    | 59 | 465522 | 689 | 534478  | 484887 | 753 | 515113 | 9365  | 64 | 9635 | 1     |
| 17 | 0  | 465935 | 688 | 534065  | 485339 | 753 | 514661 | 9404  | 64 | 9596 | 73 0  |
|    | 1  | 466348 | 688 | 533652  | 485791 | 752 | 514209 | 9442  | 64 | 9558 | 59    |
|    | 2  | 466761 | 687 | 533239  | 486242 | 751 | 513758 | 9481  | 65 | 9519 | 58    |
|    | 3  | 467173 | 686 | 532827  | 486693 | 751 | 513307 | 9520  | 65 | 9480 | 57    |
|    | 4  | 467585 | 685 | 532415  | 487143 | 750 | 512857 | 9558  | 65 | 9442 | 56    |
|    | 5  | 467996 | 685 | 532004  | 487593 | 749 | 512407 | 9597  | 65 | 9403 | 72 55 |
| 17 | 6  | 468407 | 684 | 531593  | 488043 | 749 | 511957 | 9636  | 65 | 9364 | 54    |
|    | 7  | 468817 | 683 | 531183  | 488492 | 748 | 511508 | 9675  | 65 | 9325 | 53    |
|    | 8  | 469227 | 683 | 530773  | 488941 | 747 | 511059 | 9714  | 65 | 9286 | 52    |
|    | 9  | 469637 | 682 | 530363  | 489390 | 747 | 510610 | 9753  | 65 | 9247 | 51    |
|    | 10 | 470046 | 681 | 529954  | 489838 | 746 | 510162 | 9792  | 65 | 9208 | 50    |
|    | 11 | 470455 | 680 | 529545  | 490286 | 746 | 509714 | 9831  | 65 | 9169 | 49    |
|    | 12 | 470863 | 680 | 529137  | 490733 | 745 | 509267 | 9870  | 65 | 9130 | 48    |
|    | 13 | 471271 | 679 | 528729  | 491180 | 744 | 508820 | 9909  | 65 | 9091 | 47    |
|    | 14 | 471679 | 678 | 528321  | 491627 | 744 | 508373 | 9948  | 65 | 9052 | 46    |
|    | 15 | 472086 |     | 527914  | 492073 | 744 | 507927 | 9988  | 65 | 9012 | 72 45 |
|    |    | Coa.   | D.  | Sec.    | Cot.   | D.  | Tang.  | Coa.  | D. | Sine |       |

73½ Deg.

72½ Deg.

17½ Deg.

TABLE V.—LOG SINE, &amp;c.

18 Deg.

| °     | Sine  | D.  | Cosec. | Tang.  | D.  | Cot.   | Sec.  | D. | Coa.  |    |
|-------|-------|-----|--------|--------|-----|--------|-------|----|-------|----|
|       | 9'4   |     | 10'5   | 9'     |     | 10'    | 10'0  |    | 9'9   |    |
| 17 15 | 72086 | 678 | 27914  | 492073 | 743 | 507927 | 19988 |    | 80012 | 45 |
| 16    | 72492 | 677 | 27508  | 492519 | 743 | 507481 | 20027 | 65 | 79973 | 44 |
| 17    | 72898 | 677 | 27102  | 492965 | 742 | 507035 | 20066 | 65 | 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 | 739 | 504814 | 20263 | 66 | 79737 | 38 |
| 23    | 75327 | 672 | 24673  | 495630 | 738 | 504370 | 20303 | 66 | 79697 | 37 |
| 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 | 734 | 501718 | 20541 | 66 | 79459 | 31 |
| 30    | 78142 | 667 | 21858  | 498722 | 734 | 501278 | 20580 | 66 | 79419 | 30 |
| 31    | 78542 | 667 | 21458  | 499163 | 733 | 500837 | 20620 | 66 | 79380 | 29 |
| 32    | 78942 | 666 | 21058  | 499603 | 733 | 500397 | 20660 | 66 | 79340 | 28 |
| 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 | 497327 | 20941 | 67 | 79059 | 21 |
| 40    | 82128 | 661 | 17872  | 503109 | 728 | 496889 | 20981 | 67 | 79019 | 20 |
| 41    | 82525 | 660 | 17475  | 503546 | 727 | 496454 | 21021 | 67 | 78979 | 19 |
| 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 | 10 |
| 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    | 89983 |     | 10018  | 511776 |     | 488224 | 21794 |    | 78206 | 0  |
|       | Coa.  | D.  | Sec.   | Cot.   | D.  | Tang.  | Coa.  | D. | Sine  | °  |

72½ Deg.

72 Deg.

18 Deg.

TABLE V.—LOG. SINES, ETC.

18½ Deg.

| °  | Sine   | D.  | Cos. c. | Tang.  | D.  | Cot.   | Sec.  | D. | Cos. |       |
|----|--------|-----|---------|--------|-----|--------|-------|----|------|-------|
|    | 9'     |     | 10'     | 9'     |     | 10'    | 10'02 |    | 9'97 |       |
| 0  | 489982 | 648 | 510018  | 511776 | 716 | 488224 | 1794  | 68 | 8206 | 60    |
| 1  | 490371 | 648 | 509629  | 512206 | 716 | 487794 | 1835  | 68 | 8165 | 59    |
| 2  | 490759 | 647 | 509241  | 512635 | 715 | 487365 | 1876  | 68 | 8124 | 58    |
| 3  | 491147 | 646 | 508853  | 513064 | 714 | 486936 | 1917  | 69 | 8083 | 57    |
| 4  | 491535 | 646 | 508465  | 513493 | 714 | 486507 | 1958  | 69 | 8042 | 56    |
| 5  | 491922 | 645 | 508078  | 513921 | 713 | 486079 | 1999  | 69 | 8001 | 55    |
| 6  | 492308 | 644 | 507692  | 514349 | 713 | 485651 | 2041  | 69 | 7959 | 54    |
| 7  | 492695 | 644 | 507305  | 514777 | 712 | 485223 | 2082  | 69 | 7918 | 53    |
| 8  | 493081 | 643 | 506919  | 515204 | 712 | 484796 | 2123  | 69 | 7877 | 71 52 |
| 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 | 639 | 504612  | 517761 | 708 | 482239 | 2372  | 69 | 7628 | 46    |
| 15 | 495772 | 639 | 504228  | 518185 | 708 | 481815 | 2414  | 69 | 7586 | 45    |
| 16 | 496155 | 638 | 503846  | 518610 | 707 | 481390 | 2456  | 69 | 7544 | 44    |
| 17 | 496537 | 637 | 503463  | 519034 | 706 | 480966 | 2497  | 70 | 7503 | 71 43 |
| 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 | 635 | 501556  | 521151 | 704 | 478849 | 2707  | 70 | 7293 | 38    |
| 23 | 498825 | 634 | 501175  | 521573 | 703 | 478427 | 2749  | 70 | 7251 | 37    |
| 24 | 499204 | 634 | 500796  | 521995 | 703 | 478005 | 2791  | 70 | 7209 | 36    |
| 25 | 499584 | 633 | 500416  | 522417 | 702 | 477583 | 2833  | 70 | 7167 | 35    |
| 26 | 499963 | 632 | 500037  | 522838 | 702 | 477162 | 2875  | 70 | 7125 | 71 34 |
| 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 |
| 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 |     | 492901  | 530781 |     | 469219 | 3682  |    | 6318 | 71 15 |
|    | Cos.   | D.  | Sec.    | Cot.   | D.  | Tang.  | Cos.  | D. | Sine | °     |

72 Deg.

71½ Deg.

| 18½ Deg. |    | TABLE V.—LOG. SINES, ETC. |     |        |        |     |        |       |    |      |    | 19½ Deg. |    |
|----------|----|---------------------------|-----|--------|--------|-----|--------|-------|----|------|----|----------|----|
| °        | '  | Sine                      | D.  | Cosec. | Tang.  | D.  | Cot.   | Sec.  | D. | Cos. |    |          |    |
|          |    | 9'                        |     | 10'    | 9'     |     | 10'    | 10'02 |    | 9'97 |    |          |    |
| 18       | 45 | 507099                    | 620 | 492901 | 530781 | 691 | 469219 | 3082  | 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 | 466734 | 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 | 7  | 71       | 7  |
| 18       | 54 | 510434                    | 615 | 489566 | 534506 | 687 | 465496 | 4070  | 72 | 5930 | 6  |          |    |
|          | 55 | 510803                    | 615 | 489197 | 534919 | 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  |          |    |
| 19       | 0  | 512642                    | 612 | 487358 | 536972 | 684 | 463028 | 4330  | 72 | 5670 | 0  | 71       | 0  |
|          | 1  | 513009                    | 611 | 486991 | 537382 | 683 | 462618 | 4373  | 73 | 5627 | 59 |          |    |
|          | 2  | 513375                    | 611 | 486625 | 537792 | 683 | 462208 | 4417  | 73 | 5583 | 58 | 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 | 49 | 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  | 73 | 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 | 40 | 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 | 30 | 70       | 30 |
|          |    | Cos.                      | D.  | Sec.   | Cot.   | D.  | Tang.  | Cos.  | D. | Sine |    |          |    |
| 71½ Deg. |    |                           |     |        |        |     |        |       |    |      |    | 70½ Deg. |    |

10 $\frac{1}{2}$  Deg.

TABLE V.—LOG. SINES, ETC.

20 $\frac{1}{2}$  Deg.

| °  | Sine | D.     | Cos. | Tang.  | D.     | Cot. | Sec.   | D.   | Cot. |       |
|----|------|--------|------|--------|--------|------|--------|------|------|-------|
|    | 9'   |        | 10'  | 9'     |        | 10'  | 10'02  |      | 9'97 |       |
| 10 | 30   | 523495 | 595  | 476505 | 549149 | 669  | 450851 | 5653 | 4347 | 30    |
|    | 31   | 523852 | 594  | 476148 | 549550 | 668  | 450450 | 5698 | 4302 | 29    |
|    | 32   | 524208 | 594  | 475792 | 549951 | 668  | 450049 | 5743 | 4257 | 28    |
|    | 33   | 524564 | 594  | 475436 | 550352 | 667  | 449648 | 5788 | 4212 | 27    |
|    | 34   | 524920 | 593  | 475080 | 550752 | 667  | 449248 | 5833 | 4167 | 26    |
|    | 35   | 525275 | 593  | 474725 | 551152 | 666  | 448848 | 5878 | 4122 | 25    |
|    | 36   | 525630 | 592  | 474370 | 551552 | 666  | 448448 | 5923 | 4077 | 24    |
|    | 37   | 525984 | 591  | 474016 | 551952 | 665  | 448048 | 5968 | 4032 | 23    |
|    | 38   | 526339 | 591  | 473661 | 552351 | 665  | 447649 | 6013 | 3987 | 70 22 |
| 19 | 39   | 526693 | 590  | 473307 | 552750 | 665  | 447250 | 6058 | 3942 | 21    |
|    | 40   | 527046 | 589  | 472954 | 553149 | 664  | 446851 | 6103 | 3897 | 20    |
|    | 41   | 527400 | 589  | 472600 | 553548 | 664  | 446452 | 6148 | 3852 | 19    |
|    | 42   | 527753 | 588  | 472247 | 553946 | 663  | 446054 | 6193 | 3807 | 18    |
|    | 43   | 528105 | 588  | 471895 | 554344 | 663  | 445656 | 6239 | 3761 | 17    |
|    | 44   | 528458 | 587  | 471542 | 554741 | 662  | 445259 | 6284 | 3716 | 16    |
|    | 45   | 528810 | 587  | 471190 | 555139 | 662  | 444861 | 6329 | 3671 | 15    |
|    | 46   | 529161 | 586  | 470839 | 555536 | 661  | 444464 | 6375 | 3625 | 14    |
|    | 47   | 529513 | 586  | 470487 | 555933 | 661  | 444067 | 6420 | 3580 | 70 13 |
| 19 | 48   | 529864 | 585  | 470136 | 556329 | 660  | 443671 | 6465 | 3535 | 12    |
|    | 49   | 530215 | 585  | 469785 | 556725 | 660  | 443275 | 6511 | 3489 | 11    |
|    | 50   | 530565 | 584  | 469435 | 557121 | 659  | 442879 | 6556 | 3444 | 10    |
|    | 51   | 530915 | 584  | 469085 | 557517 | 659  | 442483 | 6602 | 3398 | 9     |
|    | 52   | 531265 | 583  | 468735 | 557913 | 659  | 442087 | 6648 | 3352 | 8     |
|    | 53   | 531614 | 582  | 468386 | 558308 | 658  | 441692 | 6693 | 3307 | 7     |
|    | 54   | 531963 | 582  | 468037 | 558702 | 658  | 441298 | 6739 | 3261 | 6     |
|    | 55   | 532312 | 581  | 467688 | 559097 | 657  | 440903 | 6785 | 3215 | 5     |
|    | 56   | 532661 | 581  | 467339 | 559491 | 657  | 440509 | 6831 | 3169 | 70 4  |
| 19 | 57   | 533009 | 580  | 466991 | 559885 | 656  | 440115 | 6876 | 3124 | 3     |
|    | 58   | 533357 | 580  | 466643 | 560279 | 656  | 439721 | 6922 | 3078 | 2     |
|    | 59   | 533704 | 579  | 466296 | 560673 | 655  | 439327 | 6968 | 3032 | 1     |
| 20 | 0    | 534052 | 579  | 465948 | 561066 | 655  | 438934 | 7014 | 2986 | 70 0  |
|    | 1    | 534399 | 578  | 465601 | 561459 | 654  | 438541 | 7060 | 2940 | 59    |
|    | 2    | 534745 | 577  | 465255 | 561851 | 654  | 438149 | 7106 | 2894 | 58    |
|    | 3    | 535092 | 577  | 464908 | 562244 | 653  | 437756 | 7152 | 2848 | 57    |
|    | 4    | 535438 | 576  | 464562 | 562636 | 653  | 437364 | 7198 | 2802 | 56    |
|    | 5    | 535783 | 576  | 464217 | 563028 | 653  | 436972 | 7245 | 2755 | 69 55 |
| 20 | 6    | 536129 | 575  | 463871 | 563419 | 652  | 436581 | 7291 | 2709 | 54    |
|    | 7    | 536474 | 574  | 463526 | 563811 | 652  | 436189 | 7337 | 2663 | 53    |
|    | 8    | 536818 | 574  | 463182 | 564202 | 651  | 435798 | 7383 | 2617 | 52    |
|    | 9    | 537163 | 573  | 462837 | 564592 | 651  | 435408 | 7430 | 2570 | 51    |
|    | 10   | 537507 | 573  | 462493 | 564983 | 650  | 435017 | 7476 | 2524 | 50    |
|    | 11   | 537851 | 572  | 462149 | 565373 | 650  | 434627 | 7522 | 2478 | 49    |
|    | 12   | 538194 | 572  | 461806 | 565763 | 649  | 434237 | 7569 | 2431 | 48    |
|    | 13   | 538538 | 571  | 461462 | 566153 | 649  | 433847 | 7615 | 2385 | 47    |
|    | 14   | 538880 | 571  | 461120 | 566542 | 649  | 433458 | 7662 | 2338 | 46    |
|    | 15   | 539223 | 571  | 460777 | 566932 | 649  | 433068 | 7709 | 2291 | 45    |
|    |      | Con.   | D.   | Sec.   | Cot.   | D.   | Tang.  | Con. | D.   | Sine  |

70 $\frac{1}{2}$  Deg.60 $\frac{1}{2}$  Deg.

| 20½ Deg. |    | TABLE V.—LOG. SINES, ETC. |     |        |        |     |        |       |    | 21 Deg. |       |
|----------|----|---------------------------|-----|--------|--------|-----|--------|-------|----|---------|-------|
| °        |    | Sine                      | D.  | Cosec. | Tang.  | D.  | Cot.   | Sec.  | D. | Cos.    |       |
|          |    | 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  | 78 | 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 | 0970    | 17    |
|          | 44 | 549027                    | 556 | 450973 | 578104 | 636 | 421896 | 9078  | 80 | 0922    | 16    |
|          | 45 | 549360                    | 555 | 450640 | 578486 | 635 | 421514 | 9126  | 80 | 0874    | 15    |
|          | 46 | 549693                    | 555 | 450307 | 578867 | 635 | 421133 | 9173  | 80 | 0827    | 14    |
|          | 47 | 550026                    | 554 | 449974 | 579248 | 634 | 420752 | 9221  | 80 | 0779    | 13    |
|          | 48 | 550359                    | 554 | 449641 | 579629 | 634 | 420371 | 9269  | 80 | 0731    | 12    |
|          | 49 | 550692                    | 553 | 449308 | 580009 | 634 | 419991 | 9317  | 80 | 0683    | 11    |
|          | 50 | 551024                    | 553 | 448976 | 580389 | 633 | 419611 | 9365  | 80 | 0635    | 69 10 |
| 20       | 51 | 551356                    | 552 | 448644 | 580769 | 633 | 419231 | 9414  | 80 | 0586    | 9     |
|          | 52 | 551687                    | 552 | 448313 | 581149 | 632 | 418851 | 9462  | 80 | 0538    | 8     |
|          | 53 | 552018                    | 552 | 447982 | 581528 | 632 | 418472 | 9510  | 80 | 0490    | 7     |
|          | 54 | 552349                    | 551 | 447651 | 581907 | 632 | 418093 | 9558  | 80 | 0442    | 6     |
|          | 55 | 552680                    | 551 | 447320 | 582286 | 631 | 417714 | 9606  | 80 | 0394    | 5     |
|          | 56 | 553010                    | 550 | 446990 | 582665 | 631 | 417335 | 9655  | 81 | 0345    | 4     |
|          | 57 | 553341                    | 550 | 446659 | 583043 | 630 | 416957 | 9703  | 81 | 0297    | 3     |
|          | 58 | 553670                    | 549 | 446330 | 583422 | 630 | 416578 | 9751  | 81 | 0249    | 2     |
|          | 59 | 554000                    | 549 | 446000 | 583800 | 629 | 416200 | 9800  | 81 | 0200    | 1     |
|          | 60 | 554329                    | 549 | 445671 | 584177 |     | 415823 | 9848  |    | 0152    | 00 0  |
|          |    | Con.                      | D.  | Sec.   | Cot.   | D.  | Tang.  | Con.  | D. | Sine    |       |

| 21 Deg. |    | TABLE V.—LOG. SINES, ETC. |     |         |        |     |        |       |    |       |    | 21½ Deg. |  |
|---------|----|---------------------------|-----|---------|--------|-----|--------|-------|----|-------|----|----------|--|
| °       | '  | Sine                      | D.  | Consec. | 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                     | 530 | 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  |    |          |  |
| 69 Deg. |    |                           |     |         |        |     |        |       |    |       |    | 68½ Deg. |  |

| TABLE V.—LOG. SINES, ETC. |        |     |        |          |     |        |      |    |      |       |
|---------------------------|--------|-----|--------|----------|-----|--------|------|----|------|-------|
| 21½ Deg.                  |        |     |        | 22½ Deg. |     |        |      |    |      |       |
| °                         | Sine   | D.  | Cosec. | Tang.    | D.  | Cot.   | Sec. | D. | Coa. |       |
|                           | 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 | 2834 | 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 13                     | 577309 | 516 | 422691 | 610759   | 602 | 389241 | 3450 | 86 | 6550 | 48    |
| 14                        | 577618 | 515 | 422382 | 611120   | 601 | 388880 | 3501 | 86 | 6499 | 47    |
| 15                        | 577927 | 515 | 422073 | 611480   | 601 | 388520 | 3553 | 86 | 6447 | 46    |
| 16                        | 578236 | 514 | 421764 | 611841   | 601 | 388159 | 3605 | 86 | 6395 | 45    |
| 17                        | 578545 | 514 | 421455 | 612201   | 600 | 387799 | 3656 | 86 | 6344 | 44    |
| 18                        | 578853 | 513 | 421147 | 612561   | 600 | 387439 | 3708 | 86 | 6292 | 43    |
| 19                        | 579162 | 513 | 420838 | 612921   | 600 | 387079 | 3760 | 86 | 6240 | 42    |
| 20                        | 579470 | 513 | 420530 | 613281   | 599 | 386719 | 3812 | 86 | 6188 | 41    |
| 21                        | 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 |
|                           | Coa.   | D.  | Sec.   | Cot.     | D.  | Tang.  | Coa. | D. | Sine |       |

68½ Deg.

67½ Deg.

22½ Deg.

TABLE V.—LOG. SINES, ETC.

23½ Deg.

| °     | Sine   | D.  | Cosec. | 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 | 595 | 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 | 594 | 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 |
|       | Co.    | D.  | Sec.   | Cot.   | D.  | Tang.  | Co.   | D. | Sine | °     |

67½ Deg.

68½ Deg.

23½ Deg.

TABLE V.—LOG. SINES, ETC.

24 Deg.

| °     | Sine   | D.  | Cosec. | Tang.  | D.  | Cot.   | Sec. | D. | Cot. |       |
|-------|--------|-----|--------|--------|-----|--------|------|----|------|-------|
|       | 9'     |     | 10'    | 9'     |     | 10'    | 1003 |    | 996  |       |
| 23 15 | 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 24 | 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 | 7383 | 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 33 | 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 | 573 | 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 42 | 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 51 | 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  | 66 0  |
|       | Con.   | D.  | Sec.   | Cot.   | D.  | Tang.  | Con. | D. | Sine |       |

66½ Deg.

66 Deg.

24 Deg.

TABLE V.—Loc. SINUS, etc.

24½ Deg.

| °  | '  | Sine  | D.  | Cosec. | Tang.  | D.  | Cot.   | Sec.  | D. | Con.  |    |
|----|----|-------|-----|--------|--------|-----|--------|-------|----|-------|----|
|    |    | 9'6   |     | 10'3   | 9'     |     | 10'    | 10'0  |    | 9'9   |    |
| 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 | 470 | 88988  | 650620 | 565 | 349380 | 39608 | 94 | 60392 | 54 |
|    | 7  | 11294 | 470 | 88706  | 650959 | 564 | 349041 | 39665 | 94 | 60335 | 53 |
|    | 8  | 11576 | 470 | 88424  | 651297 | 564 | 348703 | 39721 | 94 | 60279 | 52 |
| 24 | 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 | 95 | 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 | 467 | 86736  | 653326 | 562 | 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 |
| 24 | 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 | 559 | 343308 | 40632 | 95 | 59368 | 36 |
|    | 25 | 16338 | 464 | 83662  | 657028 | 559 | 342972 | 40690 | 96 | 59310 | 35 |
|    | 26 | 16616 | 463 | 83384  | 657364 | 559 | 342636 | 40747 | 96 | 59253 | 34 |
| 24 | 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 |
| 24 | 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 | 554 | 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.  | Cot.  | D. | Sine  |    |

66 Deg.

65½ Deg.

| 24½ Deg. |        | TABLE V.—LOG. SINE, ETC. |         |        |     |        |       |     |      | 25½ Deg. |    |
|----------|--------|--------------------------|---------|--------|-----|--------|-------|-----|------|----------|----|
| °        | Sine   | D.                       | Consec. | Tang.  | D.  | Cot.   | Sec.  | D.  | Cos. |          |    |
|          | 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  | 7334 | 1        |    |
| 25 0     | 625948 | 452                      | 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        | 628109 | 449                      | 371891  | 671306 | 547 | 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  | 100 | 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  |     | 5488 | 64       | 30 |
|          | Con.   | D.                       | Sec.    | Cot.   | D.  | Tang.  | Con.  | D.  | Sine | °        |    |

65½ Deg.

64½ Deg.



| 26½ Deg. |    | TABLE V.—LOG SINE, etc. |     |         |        |     |        |       |     | 27 Deg. |       |
|----------|----|-------------------------|-----|---------|--------|-----|--------|-------|-----|---------|-------|
| °        | '  | Sine                    | D.  | Co-sec. | Tang.  | D.  | Cot.   | Sec.  | D.  | Co.     |       |
|          |    | 9'                      |     | 10'     | 9'     |     | 10'    | 100   |     | 9'      |       |
| 20       | 15 | 45706                   | 427 | 54294   | 692975 | 531 | 307025 | 47269 | 104 | 52731   | 45    |
|          | 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 | 51413   | 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                   | 419 | 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                   | 417 | 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                   | 414 | 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                   | 413 | 43201   | 706854 | 521 | 293146 | 50055 | 107 | 49945   | 1     |
|          | 60 | 57047                   | 413 | 42953   | 707166 | 521 | 292834 | 50119 | 107 | 49881   | 63 0  |
|          |    | Co.                     | D.  | Sec.    | Cot.   | D.  | Tang.  | Co.   | D.  | Sine    | °     |

63½ Deg.

63 Deg.

27 Deg.

TABLE V.—Loc. Sines, etc.

27½ Deg.

| °  | '  | Sine   | D.  | Cosec. | Tang.  | D.  | Cot.   | Sec.  | D.  | Cos. | °  |
|----|----|--------|-----|--------|--------|-----|--------|-------|-----|------|----|
|    |    | 9'     |     | 10'    | 9'     |     | 10'    | 10'05 |     | 9'94 |    |
| 27 | 0  | 657047 |     | 342953 | 707166 |     | 292834 | 0119  | 107 | 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 | 412 | 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 | 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 | 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 | 407 | 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 | 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 | 514 | 282907 | 2203  | 110 | 7797 | 28 |
|    | 33 | 665133 | 403 | 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 | 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 | 332693 | 720169 | 511 | 279831 | 2864  | 111 | 7136 | 18 |
|    | 43 | 667546 | 401 | 332452 | 720476 | 511 | 279524 | 2930  | 111 | 7070 | 17 |
|    | 44 | 667786 | 400 | 332211 | 720783 | 511 | 279217 | 2996  | 111 | 7004 | 16 |
|    | 45 | 668027 | 400 | 331973 | 721089 | 511 | 278911 | 3063  | 111 | 6937 | 15 |
|    |    | Cos.   | D.  | Sec.   | Cot.   | D.  | Tang.  | Cos.  | D.  | Sine | °  |

63 Deg.

62½ Deg.

| 27½ Deg. |    | TABLE V.—LOG. SINES, ETC. |     |         |        |     |        |       |     |      |    | 28½ Deg. |   |
|----------|----|---------------------------|-----|---------|--------|-----|--------|-------|-----|------|----|----------|---|
| °        | '  | Sine                      | D.  | Co-sec. | Tang.  | D.  | Cot.   | Sec.  | D.  | Co.  |    | °        | ' |
|          |    | 2'                        |     | 10'     | 9'     |     | 10'    | 10'05 |     | 9'94 |    |          |   |
| 27       | 45 | 668027                    | 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 | 5622  | 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                    | 389 | 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       |   |
|          |    | Coa.                      | D.  | Sec.    | Cot.   | D.  | Tang.  | Coa.  | 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 | 501 | 264332 | 6307  | 115 | 3693     | 27    |
|          | 34 | 679592                    | 387 | 320408 | 735969 | 501 | 264031 | 6376  | 115 | 3624     | 26    |
|          | 35 | 679824                    | 386 | 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 | 500 | 261329 | 6997  | 115 | 3003     | 17    |
|          | 44 | 681905                    | 384 | 318095 | 738971 | 499 | 261029 | 7066  | 115 | 2934     | 16    |
|          | 45 | 682135                    | 384 | 317865 | 739271 | 499 | 260729 | 7136  | 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 | 258038 | 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 | 0975     | 48    |
|          | 13 | 688521                    | 376 | 311479 | 747616 | 494 | 252384 | 9095  | 118 | 0905     | 47    |
|          | 14 | 688747                    | 376 | 311253 | 747913 | 494 | 252087 | 9166  | 118 | 0834     | 46    |
|          | 15 | 688972                    | 376 | 311028 | 748209 | 494 | 251791 | 9237  | 118 | 0763     | 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.  | Cot.   | Sec.  | D.  | Co.   |    |    |         |  |
|          | 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 | 491 | 251199 | 59378 | 118 | 40623 |    |    | 43      |  |
| 18       | 89648 | 375                       | 10352   | 749097 | 491 | 250903 | 59449 | 118 | 40551 |    |    | 42      |  |
| 19       | 89873 | 375                       | 10127   | 749393 | 491 | 250607 | 59520 | 118 | 40480 |    |    | 41      |  |
| 20       | 90098 | 375                       | 9902    | 749689 | 491 | 250311 | 59591 | 118 | 40409 |    |    | 40      |  |
| 21       | 90323 | 375                       | 9677    | 749985 | 491 | 250015 | 59662 | 118 | 40338 |    |    | 39      |  |
| 22       | 90548 | 374                       | 9452    | 750281 | 491 | 249719 | 59733 | 118 | 40267 |    |    | 38      |  |
| 23       | 90772 | 374                       | 9228    | 750576 | 491 | 249424 | 59804 | 118 | 40195 | 60 | 37 |         |  |
| 24       | 90996 | 374                       | 9004    | 750872 | 491 | 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 |         |  |
| 33       | 93008 | 371                       | 6992    | 753526 | 491 | 246474 | 60518 | 119 | 39482 |    |    | 27      |  |
| 34       | 93231 | 371                       | 6769    | 753820 | 490 | 246180 | 60590 | 119 | 39410 |    |    | 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 |         |  |
| 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 | 367                       | 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 |         |  |
| 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  |         |  |
|          | Coa.  | D.                        | Sec.    | Cot.   | D.  | Tang.  | Coa.  | D.  | Sine  |    |    |         |  |

60½ Deg.

60 Deg.

| 30 Deg. |    | TABLE V.—LOG. SINES, ETC. |     |        |        |     |        |       |     |      |    | 30½ Deg. |  |
|---------|----|---------------------------|-----|--------|--------|-----|--------|-------|-----|------|----|----------|--|
| °       |    | Sine                      | D.  | Cosec. | Tang.  | D.  | Cot.   | Sec.  | D.  | Co.  |    |          |  |
|         |    | 2'                        |     | 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 | 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 | 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 | 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 | 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 | 15 |          |  |
|         |    | Co.                       | D.  | Sec.   | Cot.   | D.  | Tang.  | Co.   | D.  | Sine | °  |          |  |
| 60 Deg. |    |                           |     |        |        |     |        |       |     |      |    | 59½ Deg. |  |

30° Deg.

TABLE V.—LOG. SINUS, ETC.

31° Deg.

| °  | Sine | D.     | Cosec. | 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 | 478   | 224379 | 6102 | 126  | 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  |
| 30 | 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 | 50 0  |
|    | 1    | 712050 | 350    | 287950 | 779060 | 477   | 220940 | 7010 | 127  | 2990 | 59    |
|    | 2    | 712260 | 350    | 287740 | 779346 | 476   | 220654 | 7086 | 127  | 2914 | 58 58 |
| 31 | 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 |
| 31 | 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 | 346    | 284606 | 783626 | 474   | 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 |
| 31 | 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  | 843  | 31    |
|    | 30   | 718085 | 344    | 281915 | 787319 | 473   | 212681 | 9234 | 129  | 766  | 58 30 |
|    | Con. | D.     | Sec.   | Cot.   | D.     | Tang. | Con.   | D.   | Sine | °    |       |

59° Deg.

58° Deg.

31½ Deg.

TABLE V.—LOG. SINES, ETC.

32½ Deg.

| °  |    | Sine  | D.  | Cosec. | Tang.  | D.  | Cot.   | Sec.  | D.  | Cos.  |       |
|----|----|-------|-----|--------|--------|-----|--------|-------|-----|-------|-------|
|    |    | 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 | 212377 | 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 | 129 | 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 |
|    |    |       |     |        |        | 471 |        |       | 130 |       |       |
| 31 | 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 |
|    |    |       |     |        |        | 470 |        |       | 130 |       |       |
| 31 | 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  |
|    |    |       |     |        |        | 469 |        |       | 131 |       |       |
| 31 | 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 | 131 | 28420 | 58 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 |
|    |    |       |     |        |        | 468 |        |       | 132 |       |       |
| 32 | 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 | 133 | 27390 | 47    |
|    | 14 | 27027 | 334 | 72973  | 799717 | 467 | 200283 | 72690 | 133 | 27310 | 46    |
|    | 15 | 27228 | 334 | 72772  | 799997 | 467 | 200003 | 72769 | 133 | 27231 | 57 45 |
|    |    |       |     |        |        | 467 |        |       | 133 |       |       |
|    |    | Cos.  | D.  | Sec.   | Cot.   | D.  | Tang.  | Cos.  | D.  | Sine  | °     |

58½ Deg.

57½ Deg.

32½ Deg.

TABLE V.—LOG. SINES, ETC.

33 Deg.

| °     | Sine.  | D.  | Cosce. | Tang.  | D.  | Cot.   | Sec.  | D.  | Con. |       |
|-------|--------|-----|--------|--------|-----|--------|-------|-----|------|-------|
|       | 9'     |     | 10'    | 9'     |     | 10'    | 10.07 |     | 9.92 |       |
| 32 15 | 727228 | 334 | 272772 | 799997 | 466 | 200003 | 2769  |     | 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 | 57 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 | 57 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  | 135 | 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 | 57 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  | 135 | 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 | 57 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 | 57 0  |
|       | Con.   | D.  | Sec.   | Cot.   | D.  | Tang.  | Con.  | D.  | Sine |       |

57½ Deg.

57 Deg.

88 Deg.

TABLE V.—Loc. Sines, etc.

88 Deg.

| °  |    | Sine  | D.  | Cosec. | Tang.  | D.  | Cot.   | Sec.  | D.  | Coa.  |    |
|----|----|-------|-----|--------|--------|-----|--------|-------|-----|-------|----|
|    |    | 9'7   |     | 10'2   | 9'     |     | 10'    | 10'0  |     | 9'9   |    |
| 33 | 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 | 52 |
|    | 9  | 37855 | 322 | 62145  | 815004 | 460 | 184996 | 77149 | 137 | 22851 | 51 |
| 33 | 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 | 321 | 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 | 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 | 138 | 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 | 34 |
|    | 27 | 41316 | 319 | 58684  | 819959 | 458 | 180041 | 78643 | 139 | 21357 | 33 |
| 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 | 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 | 175655 | 79985 | 140 | 20015 | 17 |
|    | 44 | 44550 | 315 | 55450  | 824619 | 456 | 175381 | 80069 | 141 | 19931 | 16 |
|    | 45 | 44739 | 315 | 55261  | 824893 | 456 | 175107 | 80154 | 141 | 19846 | 15 |
|    |    | Coa.  | D.  | Sec.   | Cot.   | D.  | Tang.  | Coa.  | D.  | Sine  | °  |

87 Deg.

89 Deg.

33½ Deg. TABLE V.—LOG. SINES, ETC. 34½ Deg.

| °     | Sine   | D.  | Cosec. | Tang.  | D.  | Cot.   | Sec.  | D.  | Coa.  |       |
|-------|--------|-----|--------|--------|-----|--------|-------|-----|-------|-------|
|       | 9'     |     | 10'    | 9'     |     | 10'    | 10' 8 |     | 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 | 307 | 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  | 55 30 |
|       | Coa.   | D.  | Sec.   | Cot.   | D.  | Tang.  | Coa.  | D.  | Sine  |       |

50½ Deg.

55½ Deg.

34½ Deg.

TABLE V.—LOG. SINES, ETC.

35½ Deg.

| °     | Sine   | D.  | Cosec. | Tang.  | D.  | Cot.   | Sec.  | D.  | Cos. |       |
|-------|--------|-----|--------|--------|-----|--------|-------|-----|------|-------|
|       | 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  | 148 | 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 |
|       | Coa.   | D.  | Sec.   | Cot.   | D.  | Tang.  | Coa.  | D.  | Sine | °     |

55½ Deg.

54½ Deg.

35½ Deg.

TABLE V.—Loc. Sines, etc.

36 Deg.

|       | Sine  | D.  | Cosec. | Tang.  | D.  | Cot.   | Sec.  | D.  | Cos.  |    |
|-------|-------|-----|--------|--------|-----|--------|-------|-----|-------|----|
|       | 9'7   |     | 10'2   | 9'     |     | 10'    | 10'0  |     | 9'9   |    |
| 35 15 | 61285 | 298 | 38715  | 849254 | 447 | 150746 | 87969 | 149 | 12031 | 45 |
| 16    | 61464 | 298 | 38536  | 849522 | 447 | 150478 | 88058 | 149 | 11942 | 44 |
| 17    | 61642 | 297 | 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 | 296 | 37466  | 851129 | 446 | 148871 | 88595 | 149 | 11405 | 38 |
| 23    | 62712 | 296 | 37288  | 851396 | 446 | 148604 | 88685 | 150 | 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 | 151 | 10776 | 31 |
| 30    | 63954 | 295 | 36046  | 853268 | 445 | 146732 | 89314 | 151 | 10686 | 30 |
| 31    | 64131 | 295 | 35869  | 853535 | 445 | 146465 | 89404 | 151 | 10596 | 29 |
| 32    | 64308 | 295 | 35692  | 853802 | 445 | 146198 | 89494 | 151 | 10506 | 28 |
| 35 33 | 64485 | 294 | 35515  | 854069 | 445 | 145931 | 89585 | 151 | 10415 | 27 |
| 34    | 64662 | 294 | 35338  | 854336 | 445 | 145664 | 89675 | 151 | 10325 | 26 |
| 35    | 64839 | 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 | 292 | 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.

36 Deg.

TABLE V.—LOG. SINES, ETC.

36½ Deg.

| °  | '  | Sine   | D.  | Cosec. | Tang.  | D.  | Cot.   | Sec.  | D.  | Coa. |       |
|----|----|--------|-----|--------|--------|-----|--------|-------|-----|------|-------|
|    |    | 9'     |     | 10'    | 9'     |     | 10'    | 10'09 |     | 9'90 |       |
| 36 | 0  | 769219 | 290 | 230781 | 861261 | 443 | 138739 | 2042  | 153 | 7958 | 60    |
|    | 1  | 769393 | 289 | 230607 | 861527 | 443 | 138473 | 2134  | 153 | 7866 | 59    |
|    | 2  | 769566 | 289 | 230434 | 861792 | 442 | 138208 | 2226  | 153 | 7774 | 58    |
|    | 3  | 769740 | 289 | 230260 | 862058 | 442 | 137942 | 2318  | 153 | 7682 | 57    |
|    | 4  | 769913 | 289 | 230087 | 862323 | 442 | 137677 | 2410  | 153 | 7590 | 56    |
|    | 5  | 770087 | 289 | 229913 | 862589 | 442 | 137411 | 2502  | 153 | 7498 | 55    |
|    | 6  | 770260 | 288 | 229740 | 862854 | 442 | 137146 | 2594  | 153 | 7406 | 54    |
|    | 7  | 770433 | 288 | 229567 | 863119 | 442 | 136881 | 2686  | 153 | 7314 | 53    |
|    | 8  | 770606 | 288 | 229394 | 863385 | 442 | 136615 | 2778  | 154 | 7222 | 53 52 |
| 36 | 9  | 770779 | 288 | 229221 | 863650 | 442 | 136350 | 2871  | 154 | 7129 | 51    |
|    | 10 | 770952 | 288 | 229048 | 863915 | 442 | 136085 | 2963  | 154 | 7037 | 50    |
|    | 11 | 771125 | 288 | 228875 | 864180 | 442 | 135820 | 3055  | 154 | 6945 | 49    |
|    | 12 | 771298 | 287 | 228702 | 864445 | 442 | 135555 | 3148  | 154 | 6852 | 48    |
|    | 13 | 771470 | 287 | 228530 | 864710 | 442 | 135290 | 3240  | 154 | 6760 | 47    |
|    | 14 | 771643 | 287 | 228357 | 864975 | 442 | 135025 | 3333  | 154 | 6667 | 46    |
|    | 15 | 771815 | 287 | 228185 | 865240 | 441 | 134760 | 3425  | 154 | 6575 | 45    |
|    | 16 | 771987 | 287 | 228013 | 865505 | 441 | 134495 | 3518  | 154 | 6482 | 44    |
|    | 17 | 772159 | 287 | 227841 | 865770 | 441 | 134230 | 3611  | 154 | 6389 | 53 43 |
| 36 | 18 | 772331 | 286 | 227669 | 866035 | 441 | 133965 | 3704  | 155 | 6296 | 42    |
|    | 19 | 772503 | 286 | 227497 | 866300 | 441 | 133700 | 3796  | 155 | 6204 | 41    |
|    | 20 | 772675 | 286 | 227325 | 866564 | 441 | 133436 | 3889  | 155 | 6111 | 40    |
|    | 21 | 772847 | 286 | 227153 | 866829 | 441 | 133171 | 3982  | 155 | 6018 | 39    |
|    | 22 | 773018 | 286 | 226982 | 867094 | 441 | 132906 | 4075  | 155 | 5925 | 38    |
|    | 23 | 773190 | 286 | 226810 | 867358 | 441 | 132642 | 4168  | 155 | 5832 | 37    |
|    | 24 | 773361 | 285 | 226639 | 867623 | 441 | 132377 | 4261  | 155 | 5739 | 36    |
|    | 25 | 773533 | 285 | 226467 | 867887 | 441 | 132113 | 4355  | 155 | 5645 | 35    |
|    | 26 | 773704 | 285 | 226296 | 868152 | 440 | 131848 | 4448  | 155 | 5552 | 53 34 |
| 36 | 27 | 773875 | 285 | 226125 | 868416 | 440 | 131584 | 4541  | 155 | 5459 | 33    |
|    | 28 | 774046 | 285 | 225954 | 868680 | 440 | 131320 | 4634  | 155 | 5366 | 32    |
|    | 29 | 774217 | 285 | 225783 | 868945 | 440 | 131055 | 4728  | 156 | 5272 | 31    |
|    | 30 | 774388 | 284 | 225612 | 869209 | 440 | 130791 | 4821  | 156 | 5179 | 30    |
|    | 31 | 774558 | 284 | 225442 | 869473 | 440 | 130527 | 4915  | 156 | 5085 | 29    |
|    | 32 | 774729 | 284 | 225271 | 869737 | 440 | 130263 | 5008  | 156 | 4992 | 28    |
|    | 33 | 774899 | 284 | 225101 | 870001 | 440 | 129999 | 5102  | 156 | 4898 | 27    |
|    | 34 | 775070 | 284 | 224930 | 870265 | 440 | 129735 | 5196  | 156 | 4804 | 26    |
|    | 35 | 775240 | 284 | 224760 | 870529 | 440 | 129471 | 5289  | 156 | 4711 | 53 25 |
| 36 | 36 | 775410 | 283 | 224590 | 870793 | 440 | 129207 | 5383  | 156 | 4617 | 24    |
|    | 37 | 775580 | 283 | 224420 | 871057 | 440 | 128943 | 5477  | 156 | 4523 | 23    |
|    | 38 | 775750 | 283 | 224250 | 871321 | 440 | 128679 | 5571  | 157 | 4429 | 22    |
|    | 39 | 775920 | 283 | 224080 | 871585 | 440 | 128415 | 5665  | 157 | 4335 | 21    |
|    | 40 | 776090 | 283 | 223910 | 871849 | 439 | 128151 | 5759  | 157 | 4241 | 20    |
|    | 41 | 776259 | 283 | 223741 | 872112 | 439 | 127888 | 5853  | 157 | 4147 | 19    |
|    | 42 | 776429 | 282 | 223571 | 872376 | 439 | 127624 | 5947  | 157 | 4053 | 18    |
|    | 43 | 776598 | 282 | 223402 | 872640 | 439 | 127360 | 6041  | 157 | 3959 | 17    |
|    | 44 | 776768 | 282 | 223232 | 872903 | 439 | 127097 | 6136  | 157 | 3864 | 16    |
|    | 45 | 776937 | 282 | 223063 | 873167 | 439 | 126833 | 6230  | 157 | 3770 | 53 15 |
|    |    | Coa.   | D.  | Sec.   | Cot.   | D.  | Tang.  | Coa.  | D.  | Sine | °     |

54 Deg.

53½ Deg.

| 36½ Deg. |    | TABLE V.—LOG. SINES, ETC. |     |         |       |     |       |        |     | 37½ Deg. |       |
|----------|----|---------------------------|-----|---------|-------|-----|-------|--------|-----|----------|-------|
| °        | '  | Sine                      | D.  | Co-sec. | 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   | 15    |
|          | 46 | 77106                     | 282 | 22894   | 73430 | 439 | 26570 | 096324 | 157 | 903676   | 14    |
|          | 47 | 77275                     | 281 | 22725   | 73694 | 439 | 26306 | 096419 | 157 | 903581   | 13    |
|          | 48 | 77444                     | 281 | 22556   | 73957 | 439 | 26043 | 096513 | 157 | 903487   | 12    |
|          | 49 | 77613                     | 281 | 22387   | 74220 | 439 | 25780 | 096608 | 158 | 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 | 097081 | 158 | 902919   | 6     |
|          | 55 | 78624                     | 280 | 21376   | 75800 | 438 | 24200 | 097176 | 158 | 902824   | 5     |
|          | 56 | 78792                     | 280 | 21208   | 76063 | 438 | 23937 | 097271 | 158 | 902729   | 4     |
|          | 57 | 78960                     | 280 | 21040   | 76326 | 438 | 23674 | 097366 | 158 | 902634   | 3     |
|          | 58 | 79128                     | 280 | 20872   | 76589 | 438 | 23411 | 097461 | 159 | 902539   | 2     |
|          | 59 | 79295                     | 279 | 20705   | 76851 | 438 | 23149 | 097556 | 159 | 902444   | 1     |
| 37       | 0  | 79463                     | 279 | 20537   | 77114 | 438 | 22886 | 097651 | 159 | 902349   | 53 0  |
|          | 1  | 79631                     | 279 | 20369   | 77377 | 438 | 22623 | 097747 | 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 | 098224 | 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 | 098798 | 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                     | 276 | 17702   | 81576 | 437 | 18424 | 099278 | 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 | 099663 | 161 | 900337   | 39    |
|          | 22 | 83127                     | 276 | 16873   | 82887 | 436 | 17113 | 099760 | 161 | 900240   | 38    |
|          | 23 | 83292                     | 275 | 16708   | 83148 | 436 | 16852 | 099856 | 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     | °     |

53½ Deg.

52½ Deg.

| 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 |          |  |
|          |    |                           | 273 |         |        | 435 |        |       |     |      |       |          |  |
| 37       | 39 | 785925                    | 273 | 214075  | 887333 | 435 | 112667 | 1408  | 162 | 8592 | 21    |          |  |
|          | 40 | 786089                    | 273 | 213911  | 887594 | 435 | 112406 | 1506  | 162 | 8494 | 20    |          |  |
|          | 41 | 786252                    | 273 | 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                    | 272 | 212768  | 889421 | 435 | 110579 | 2190  | 163 | 7810 | 52 13 |          |  |
|          |    |                           | 271 |         |        | 435 |        |       |     |      |       |          |  |
| 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 | 435 | 109796 | 2484  | 163 | 7516 | 10    |          |  |
|          | 51 | 787883                    | 271 | 212117  | 890465 | 434 | 109535 | 2582  | 163 | 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                    | 271 | 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  |          |  |
|          |    |                           | 270 |         |        | 434 |        |       |     |      |       |          |  |
| 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 | 55    |          |  |
|          |    |                           | 269 |         |        | 434 |        |       |     |      |       |          |  |
| 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 |          |  |
|          |    |                           | 267 |         |        | 433 |        |       |     |      |       |          |  |
|          |    | Con.                      | D.  | Sec.    | Cot.   | D.  | Tang.  | Con.  | 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 | 103238 | 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 | 999914 | 6255   | 167 | 3745  | 32    |
| 29    | 793991 | 265 | 206009 | 900346 | 432 | 999654 | 6355   | 167 | 3645  | 31    |
| 30    | 794150 | 264 | 205850 | 900605 | 432 | 999395 | 6456   | 167 | 3544  | 30    |
| 31    | 794308 | 264 | 205692 | 900864 | 432 | 999136 | 6556   | 168 | 3444  | 29    |
| 32    | 794467 | 264 | 205533 | 901124 | 432 | 998876 | 6657   | 168 | 3343  | 51 28 |
| 38 33 | 794626 | 264 | 205374 | 901383 | 432 | 998617 | 6757   | 168 | 3243  | 27    |
| 34    | 794784 | 264 | 205216 | 901642 | 432 | 998358 | 6858   | 168 | 3142  | 26    |
| 35    | 794942 | 264 | 205058 | 901901 | 432 | 998099 | 6959   | 168 | 3041  | 25    |
| 36    | 795101 | 264 | 204899 | 902160 | 432 | 997840 | 7060   | 168 | 2940  | 24    |
| 37    | 795259 | 263 | 204741 | 902419 | 432 | 997581 | 7161   | 168 | 2839  | 23    |
| 38    | 795417 | 263 | 204583 | 902679 | 432 | 997321 | 7261   | 168 | 2739  | 22    |
| 39    | 795575 | 263 | 204425 | 902938 | 432 | 997062 | 7362   | 168 | 2638  | 21    |
| 40    | 795733 | 263 | 204267 | 903197 | 431 | 996803 | 7462   | 168 | 2536  | 20    |
| 41    | 795891 | 263 | 204109 | 903455 | 431 | 996545 | 7565   | 169 | 2435  | 51 19 |
| 38 42 | 796049 | 263 | 203951 | 903714 | 431 | 996286 | 7666   | 169 | 2334  | 18    |
| 43    | 796206 | 263 | 203794 | 903973 | 431 | 996027 | 7767   | 169 | 2233  | 17    |
| 44    | 796364 | 262 | 203636 | 904232 | 431 | 995768 | 7868   | 169 | 2132  | 16    |
| 45    | 796521 | 262 | 203479 | 904491 | 431 | 995509 | 7970   | 169 | 2030  | 15    |
| 46    | 796679 | 262 | 203321 | 904750 | 431 | 995250 | 8071   | 169 | 1929  | 14    |
| 47    | 796836 | 262 | 203164 | 905008 | 431 | 994992 | 8173   | 169 | 1827  | 13    |
| 48    | 796993 | 262 | 203007 | 905267 | 431 | 994733 | 8274   | 169 | 1726  | 12    |
| 49    | 797150 | 261 | 202850 | 905526 | 431 | 994474 | 8376   | 169 | 1624  | 11    |
| 50    | 797307 | 261 | 202693 | 905784 | 431 | 994216 | 8477   | 170 | 1523  | 51 10 |
| 38 51 | 797464 | 261 | 202536 | 906043 | 431 | 993957 | 8579   | 170 | 1421  | 9     |
| 52    | 797621 | 261 | 202379 | 906302 | 431 | 993698 | 8681   | 170 | 1319  | 8     |
| 53    | 797777 | 261 | 202223 | 906560 | 431 | 993440 | 8783   | 170 | 1217  | 7     |
| 54    | 797934 | 261 | 202066 | 906819 | 431 | 993181 | 8885   | 170 | 1115  | 6     |
| 55    | 798091 | 261 | 201909 | 907077 | 431 | 992923 | 8987   | 170 | 1013  | 5     |
| 56    | 798247 | 261 | 201753 | 907336 | 431 | 992664 | 9089   | 170 | 911   | 4     |
| 57    | 798403 | 260 | 201597 | 907594 | 431 | 992406 | 9191   | 170 | 809   | 3     |
| 58    | 798560 | 260 | 201440 | 907852 | 431 | 992148 | 9293   | 170 | 707   | 2     |
| 59    | 798716 | 260 | 201284 | 908111 | 431 | 991889 | 9395   | 170 | 605   | 1     |
| 60    | 798872 | 260 | 201128 | 908369 | 430 | 991631 | 9497   | 170 | 503   | 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'     | 9'9   |     | 10'0  | 10'1  |     | 9'8   |    |          |  |
| 39      | 0  | 798872                    | 260 | 201128  | 08369 | 430 | 91631 | 09497 | 170 | 90503 |    | 60       |  |
|         | 1  | 799028                    | 260 | 200972  | 08628 | 430 | 91372 | 09700 | 171 | 90400 |    | 59       |  |
|         | 2  | 799184                    | 260 | 200816  | 08886 | 430 | 91114 | 09902 | 171 | 90298 |    | 58       |  |
|         | 3  | 799339                    | 259 | 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 | 50 | 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       |  |
| 39      | 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       |  |
| 39      | 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       |  |
| 39      | 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                    | 253 | 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  |    |          |  |
| 51 Deg. |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |
|         |    |                           |     |         |       |     |       |       |     |       |    |          |  |

| 39½ Deg. |    | TABLE V.—LOG. SINUS, ETC. |     |        |        |     |        |       |     |      |          | 40½ Deg. |  |
|----------|----|---------------------------|-----|--------|--------|-----|--------|-------|-----|------|----------|----------|--|
| °        | '  | Sine                      | D.  | Coec.  | Tang.  | D.  | Cot.   | Sec.  | D.  | Coa. |          |          |  |
|          |    | 9'                        |     | 10'    | 9'     |     | 10'    | 10.11 |     | 9.88 |          |          |  |
| 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 | 192384 | 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       | 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                    |     | 187456 | 931499 | 426 | 068501 | 8954  |     | 1046 | 40       | 30       |  |
|          |    | Coa.                      | D.  | Sec.   | Cot.   | D.  | Tang.  | Coa.  | D.  | Sine |          |          |  |
| 50½ Deg. |    |                           |     |        |        |     |        |       |     |      | 49½ Deg. |          |  |

40½ Deg.

TABLE V.—Log. Sines, etc.

41½ Deg.

| °     | Sine.   | D.  | Co-sec. | Tang.  | D.  | Cot.   | Sec.    | D.  | Co-sec. |    |
|-------|---------|-----|---------|--------|-----|--------|---------|-----|---------|----|
|       | 9' 8    |     | 10' 1   | 9'     |     | 10'    | 10' 1   |     | 9' 8    |    |
| 40 30 | 12544   | 246 | 87456   | 931429 | 426 | 068501 | 18954   | 180 | 81046   | 30 |
| 31    | 12692   | 246 | 87308   | 931755 | 426 | 068245 | 19062   | 180 | 80938   | 29 |
| 32    | 12840   | 246 | 87160   | 932010 | 426 | 067990 | 19170   | 180 | 80830   | 28 |
| 33    | 12988   | 246 | 87012   | 932266 | 426 | 067734 | 19278   | 180 | 80722   | 27 |
| 34    | 13135   | 246 | 86865   | 932522 | 426 | 067478 | 19387   | 180 | 80613   | 26 |
| 35    | 13283   | 246 | 86717   | 932778 | 426 | 067222 | 19495   | 180 | 80505   | 25 |
| 36    | 13430   | 246 | 86570   | 933033 | 426 | 066967 | 19603   | 180 | 80397   | 24 |
| 37    | 13578   | 245 | 86422   | 933289 | 426 | 066711 | 19711   | 180 | 80289   | 23 |
| 38    | 13725   | 245 | 86275   | 933545 | 426 | 066455 | 19820   | 181 | 80180   | 22 |
| 40 39 | 13872   | 245 | 86128   | 933800 | 426 | 066200 | 19928   | 181 | 80072   | 21 |
| 40    | 14019   | 245 | 85981   | 934056 | 426 | 065944 | 20037   | 181 | 79963   | 20 |
| 41    | 14166   | 245 | 85834   | 934311 | 426 | 065689 | 20145   | 181 | 79855   | 19 |
| 42    | 14313   | 245 | 85687   | 934567 | 426 | 065433 | 20254   | 181 | 79746   | 18 |
| 43    | 14460   | 244 | 85540   | 934823 | 426 | 065177 | 20363   | 181 | 79637   | 17 |
| 44    | 14607   | 244 | 85393   | 935078 | 426 | 064922 | 20471   | 181 | 79529   | 16 |
| 45    | 14753   | 244 | 85247   | 935333 | 426 | 064667 | 20580   | 181 | 79420   | 15 |
| 46    | 14900   | 244 | 85100   | 935589 | 426 | 064411 | 20689   | 181 | 79311   | 14 |
| 47    | 15046   | 244 | 84954   | 935844 | 426 | 064156 | 20798   | 182 | 79202   | 13 |
| 40 48 | 15193   | 244 | 84807   | 936100 | 426 | 063900 | 20907   | 182 | 79093   | 12 |
| 49    | 15339   | 244 | 84661   | 936355 | 426 | 063645 | 21016   | 182 | 78984   | 11 |
| 50    | 15485   | 243 | 84515   | 936610 | 426 | 063390 | 21125   | 182 | 78875   | 10 |
| 51    | 15632   | 243 | 84368   | 936866 | 426 | 063134 | 21234   | 182 | 78766   | 9  |
| 52    | 15778   | 243 | 84222   | 937121 | 425 | 062879 | 21344   | 182 | 78656   | 8  |
| 53    | 15924   | 243 | 84076   | 937376 | 425 | 062624 | 21453   | 182 | 78547   | 7  |
| 54    | 16069   | 243 | 83931   | 937632 | 425 | 062368 | 21562   | 182 | 78438   | 6  |
| 55    | 16215   | 243 | 83785   | 937887 | 425 | 062113 | 21672   | 182 | 78328   | 5  |
| 56    | 16361   | 243 | 83639   | 938142 | 425 | 061858 | 21781   | 183 | 78219   | 4  |
| 40 57 | 16507   | 242 | 83493   | 938398 | 425 | 061602 | 21891   | 183 | 78109   | 3  |
| 58    | 16652   | 242 | 83348   | 938653 | 425 | 061347 | 22001   | 183 | 77999   | 2  |
| 59    | 16798   | 242 | 83202   | 938908 | 425 | 061092 | 22110   | 183 | 77890   | 1  |
| 41 0  | 16943   | 242 | 83057   | 939163 | 425 | 060837 | 22220   | 183 | 77780   | 0  |
| 1     | 17088   | 242 | 82912   | 939418 | 425 | 060582 | 22330   | 183 | 77670   | 59 |
| 2     | 17233   | 242 | 82767   | 939673 | 425 | 060327 | 22440   | 183 | 77560   | 58 |
| 3     | 17379   | 242 | 82621   | 939928 | 425 | 060072 | 22550   | 183 | 77450   | 57 |
| 4     | 17524   | 241 | 82476   | 940183 | 425 | 059817 | 22660   | 183 | 77340   | 56 |
| 5     | 17668   | 241 | 82332   | 940438 | 425 | 059562 | 22770   | 184 | 77230   | 55 |
| 41 6  | 17813   | 241 | 82187   | 940694 | 425 | 059306 | 22880   | 184 | 77120   | 54 |
| 7     | 17958   | 241 | 82042   | 940949 | 425 | 059051 | 22990   | 184 | 77010   | 53 |
| 8     | 18103   | 241 | 81897   | 941204 | 425 | 058796 | 23101   | 184 | 76899   | 52 |
| 9     | 18247   | 241 | 81753   | 941458 | 425 | 058542 | 23211   | 184 | 76789   | 51 |
| 10    | 18392   | 241 | 81608   | 941714 | 425 | 058286 | 23322   | 184 | 76678   | 50 |
| 11    | 18536   | 240 | 81464   | 941968 | 425 | 058032 | 23432   | 184 | 76568   | 49 |
| 12    | 18681   | 240 | 81319   | 942223 | 425 | 057777 | 23543   | 184 | 76457   | 48 |
| 13    | 18825   | 240 | 81175   | 942478 | 425 | 057522 | 23653   | 184 | 76347   | 47 |
| 14    | 18969   | 240 | 81031   | 942733 | 425 | 057267 | 23764   | 185 | 76236   | 46 |
| 15    | 19113   | 240 | 80887   | 942988 | 425 | 057012 | 23875   | 185 | 76125   | 45 |
|       | Co-sec. | D.  | Sec.    | Cot.   | D.  | Tang.  | Co-sec. | D.  | Sine    | °  |

49½ Deg.

48½ Deg.

| 31½ Deg. |        | TABLE V.—Loc. Sines, etc. |         |        |     |        |        |     |       |    |    | 42 Deg. |  |
|----------|--------|---------------------------|---------|--------|-----|--------|--------|-----|-------|----|----|---------|--|
| °        | Sine   | D.                        | Co-sec. | Tang.  | D.  | Cot.   | Sec.   | D.  | Coa.  |    |    |         |  |
|          | 9'     |                           | 10'     | 9'     |     | 10'    | 10' 12 |     | 9' 87 |    |    |         |  |
| 43       | 819113 | 240                       | 180887  | 942988 | 425 | 057012 | 3875   | 185 | 6125  | 45 |    |         |  |
| 16       | 819257 | 240                       | 180743  | 943243 | 425 | 056757 | 3986   | 185 | 6014  | 44 |    |         |  |
| 17       | 819401 | 240                       | 180599  | 943498 | 425 | 056502 | 4096   | 185 | 5904  | 43 |    |         |  |
| 18       | 819545 | 239                       | 180455  | 943752 | 425 | 056248 | 4207   | 185 | 5793  | 42 |    |         |  |
| 19       | 819689 | 239                       | 180311  | 944007 | 425 | 055993 | 4318   | 185 | 5682  | 41 |    |         |  |
| 20       | 819832 | 239                       | 180168  | 944262 | 425 | 055738 | 4429   | 185 | 5571  | 40 |    |         |  |
| 21       | 819976 | 239                       | 180024  | 944517 | 425 | 055483 | 4541   | 185 | 5459  | 39 |    |         |  |
| 22       | 820120 | 239                       | 179880  | 944771 | 425 | 055229 | 4652   | 185 | 5348  | 38 |    |         |  |
| 23       | 820263 | 239                       | 179737  | 945026 | 424 | 054974 | 4763   | 185 | 5237  | 48 | 37 |         |  |
| 41       | 820406 | 239                       | 179594  | 945281 | 424 | 054719 | 4874   | 186 | 5126  | 36 |    |         |  |
| 25       | 820550 | 238                       | 179450  | 945535 | 424 | 054465 | 4986   | 186 | 5014  | 35 |    |         |  |
| 26       | 820693 | 238                       | 179307  | 945790 | 424 | 054210 | 5097   | 186 | 4903  | 34 |    |         |  |
| 27       | 820836 | 238                       | 179164  | 946045 | 424 | 053955 | 5209   | 186 | 4791  | 33 |    |         |  |
| 28       | 820979 | 238                       | 179021  | 946299 | 424 | 053701 | 5320   | 186 | 4682  | 32 |    |         |  |
| 29       | 821122 | 238                       | 178878  | 946554 | 424 | 053446 | 5432   | 186 | 4568  | 31 |    |         |  |
| 30       | 821265 | 238                       | 178735  | 946808 | 424 | 053192 | 5544   | 186 | 4456  | 30 |    |         |  |
| 31       | 821407 | 238                       | 178593  | 947063 | 424 | 052937 | 5656   | 186 | 4344  | 29 |    |         |  |
| 32       | 821550 | 238                       | 178450  | 947318 | 424 | 052682 | 5768   | 187 | 4232  | 48 | 28 |         |  |
| 41       | 821693 | 237                       | 178307  | 947572 | 424 | 052428 | 5879   | 187 | 4121  | 27 |    |         |  |
| 34       | 821835 | 237                       | 178165  | 947826 | 424 | 052174 | 5991   | 187 | 4009  | 26 |    |         |  |
| 35       | 821977 | 237                       | 178023  | 948081 | 424 | 051919 | 6104   | 187 | 3896  | 25 |    |         |  |
| 36       | 822120 | 237                       | 177880  | 948336 | 424 | 051664 | 6216   | 187 | 3784  | 24 |    |         |  |
| 37       | 822262 | 237                       | 177738  | 948590 | 424 | 051410 | 6328   | 187 | 3672  | 23 |    |         |  |
| 38       | 822404 | 237                       | 177596  | 948844 | 424 | 051156 | 6440   | 187 | 3560  | 22 |    |         |  |
| 39       | 822546 | 237                       | 177454  | 949099 | 424 | 050901 | 6552   | 187 | 3448  | 21 |    |         |  |
| 40       | 822688 | 236                       | 177312  | 949353 | 424 | 050647 | 6665   | 187 | 3335  | 20 |    |         |  |
| 41       | 822830 | 236                       | 177170  | 949607 | 424 | 050393 | 6777   | 187 | 3223  | 48 | 19 |         |  |
| 41       | 822972 | 236                       | 177028  | 949862 | 424 | 050138 | 6890   | 188 | 3110  | 18 |    |         |  |
| 43       | 823114 | 236                       | 176886  | 950116 | 424 | 049884 | 7002   | 188 | 2998  | 17 |    |         |  |
| 44       | 823255 | 236                       | 176745  | 950370 | 424 | 049630 | 7115   | 188 | 2885  | 16 |    |         |  |
| 45       | 823397 | 236                       | 176603  | 950625 | 424 | 049375 | 7228   | 188 | 2772  | 15 |    |         |  |
| 46       | 823539 | 236                       | 176461  | 950879 | 424 | 049121 | 7341   | 188 | 2659  | 14 |    |         |  |
| 47       | 823680 | 235                       | 176320  | 951133 | 424 | 048867 | 7453   | 188 | 2547  | 13 |    |         |  |
| 48       | 823821 | 235                       | 176179  | 951388 | 424 | 048612 | 7566   | 188 | 2434  | 12 |    |         |  |
| 49       | 823963 | 235                       | 176037  | 951642 | 424 | 048358 | 7679   | 188 | 2321  | 11 |    |         |  |
| 50       | 824104 | 235                       | 175896  | 951896 | 424 | 048104 | 7792   | 188 | 2208  | 48 | 10 |         |  |
| 41       | 824245 | 235                       | 175755  | 952150 | 424 | 047850 | 7905   | 189 | 2095  | 9  |    |         |  |
| 52       | 824386 | 235                       | 175614  | 952405 | 424 | 047595 | 8019   | 189 | 1981  | 8  |    |         |  |
| 53       | 824527 | 235                       | 175473  | 952659 | 424 | 047341 | 8132   | 189 | 1868  | 7  |    |         |  |
| 54       | 824668 | 234                       | 175332  | 952913 | 424 | 047087 | 8245   | 189 | 1755  | 6  |    |         |  |
| 55       | 824808 | 234                       | 175192  | 953167 | 424 | 046833 | 8359   | 189 | 1641  | 5  |    |         |  |
| 56       | 824949 | 234                       | 175051  | 953421 | 423 | 046579 | 8472   | 189 | 1528  | 4  |    |         |  |
| 57       | 825090 | 234                       | 174910  | 953675 | 423 | 046325 | 8586   | 189 | 1414  | 3  |    |         |  |
| 58       | 825230 | 234                       | 174770  | 953929 | 423 | 046071 | 8699   | 189 | 1301  | 2  |    |         |  |
| 59       | 825371 | 234                       | 174629  | 954183 | 423 | 045817 | 8813   | 189 | 1187  | 1  |    |         |  |
| 60       | 825511 | 234                       | 174489  | 954437 | 423 | 045563 | 8927   | 189 | 1073  | 48 | 0  |         |  |
|          | Coa.   | D.                        | Sec.    | Cot.   | D.  | Tang.  | Coa.   | D.  | Sine  |    |    |         |  |
| 48½ Deg. |        |                           |         |        |     |        |        |     |       |    |    | 48 Deg. |  |

42 Deg. TABLE V.—Loc. Sinus, &c. 42 Deg.

| °  | '  | Size  | D.  | Consec. | Tang. | D.  | Oct.  | Sec.  | D.  | Coa.  |       |
|----|----|-------|-----|---------|-------|-----|-------|-------|-----|-------|-------|
|    |    | 9'8   |     | 10'1    | 9'9   |     | 10'0  | 10'1  |     | 9'8   |       |
| 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 | 28439 | 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 | 31675 | 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 | 423 | 35412 | 33530 | 194 | 66470 | 20    |
|    | 41 | 31195 | 228 | 68805   | 64842 | 423 | 35158 | 33647 | 194 | 66353 | 19    |
|    | 42 | 31332 | 228 | 68668   | 65095 | 423 | 34905 | 33763 | 194 | 66237 | 18    |
|    | 43 | 31469 | 228 | 68531   | 65349 | 423 | 34651 | 33880 | 194 | 66120 | 17    |
|    | 44 | 31606 | 228 | 68394   | 65602 | 423 | 34398 | 33996 | 195 | 66004 | 16    |
|    | 45 | 31743 | 228 | 68257   | 65855 | 423 | 34145 | 34112 | 195 | 65887 | 47 15 |
|    |    | Con.  | D.  | Sec.    | Oct.  | D.  | Tang. | Con.  | D.  | Size  |       |

42 Deg.

42 Deg.

49° Deg.

TABLE V.—Loc. SINUS, &amp;c.

49° Deg.

|       | Sine  | D.  | Co-sec. | Tang. | D.  | Cot.  | Sec.  | D.  | Coa.  |       |
|-------|-------|-----|---------|-------|-----|-------|-------|-----|-------|-------|
|       | 9'8   |     | 10'1    | 9'9   |     | 10'0  | 10'1  |     | 9'8   |       |
| 42 45 | 31742 | 228 | 68258   | 63855 | 422 | 34145 | 34113 | 195 | 65887 | 13    |
| 46    | 31879 | 228 | 68121   | 66109 | 422 | 33891 | 34230 | 195 | 65770 | 14    |
| 47    | 32015 | 227 | 67985   | 66362 | 422 | 33638 | 34347 | 195 | 65653 | 15    |
| 48    | 32152 | 227 | 67848   | 66616 | 422 | 33384 | 34464 | 195 | 65536 | 16    |
| 49    | 32288 | 227 | 67712   | 66869 | 422 | 33131 | 34581 | 195 | 65419 | 17    |
| 50    | 32425 | 227 | 67575   | 67123 | 422 | 32877 | 34698 | 195 | 65302 | 18    |
| 51    | 32561 | 227 | 67439   | 67376 | 422 | 32624 | 34815 | 195 | 65185 | 19    |
| 52    | 32697 | 227 | 67303   | 67629 | 422 | 32371 | 34932 | 195 | 65068 | 20    |
| 53    | 32833 | 227 | 67167   | 67883 | 422 | 32117 | 35050 | 195 | 64950 | 47 7  |
| 42 54 | 32969 | 226 | 67031   | 68136 | 422 | 31864 | 35167 | 196 | 64833 | 6     |
| 55    | 33105 | 226 | 66895   | 68389 | 422 | 31611 | 35284 | 196 | 64716 | 5     |
| 56    | 33241 | 226 | 66759   | 68643 | 422 | 31357 | 35402 | 196 | 64598 | 4     |
| 57    | 33377 | 226 | 66623   | 68896 | 422 | 31104 | 35519 | 196 | 64481 | 3     |
| 58    | 33512 | 226 | 66488   | 69149 | 422 | 30851 | 35637 | 196 | 64363 | 2     |
| 59    | 33648 | 226 | 66352   | 69403 | 422 | 30597 | 35755 | 196 | 64245 | 1     |
| 43 0  | 33783 | 226 | 66217   | 69656 | 422 | 30344 | 35873 | 196 | 64127 | 47 0  |
| 1     | 33919 | 225 | 66081   | 69909 | 422 | 30091 | 35990 | 196 | 64010 | 59    |
| 2     | 34054 | 225 | 65946   | 70162 | 422 | 29838 | 36108 | 197 | 63892 | 46 58 |
| 43 3  | 34189 | 225 | 65811   | 70416 | 422 | 29584 | 36226 | 197 | 63774 | 57    |
| 4     | 34325 | 225 | 65675   | 70669 | 422 | 29331 | 36344 | 197 | 63656 | 56    |
| 5     | 34460 | 225 | 65540   | 70922 | 422 | 29078 | 36462 | 197 | 63538 | 55    |
| 6     | 34595 | 225 | 65405   | 71175 | 422 | 28825 | 36581 | 197 | 63419 | 54    |
| 7     | 34730 | 225 | 65270   | 71429 | 422 | 28571 | 36699 | 197 | 63301 | 53    |
| 8     | 34865 | 225 | 65135   | 71682 | 422 | 28318 | 36817 | 197 | 63183 | 52    |
| 9     | 34999 | 224 | 65001   | 71935 | 422 | 28065 | 36936 | 197 | 63064 | 51    |
| 10    | 35134 | 224 | 64866   | 72188 | 422 | 27812 | 37054 | 198 | 62946 | 50    |
| 11    | 35269 | 224 | 64731   | 72441 | 422 | 27559 | 37173 | 198 | 62827 | 46 49 |
| 43 12 | 35403 | 224 | 64597   | 72694 | 422 | 27306 | 37291 | 198 | 62709 | 48    |
| 13    | 35538 | 224 | 64462   | 72948 | 422 | 27052 | 37410 | 198 | 62590 | 47    |
| 14    | 35672 | 224 | 64328   | 73201 | 422 | 26799 | 37529 | 198 | 62471 | 46    |
| 15    | 35807 | 224 | 64193   | 73454 | 422 | 26546 | 37647 | 198 | 62353 | 45    |
| 16    | 35941 | 224 | 64059   | 73707 | 422 | 26293 | 37766 | 198 | 62234 | 44    |
| 17    | 36075 | 223 | 63925   | 73960 | 422 | 26040 | 37885 | 198 | 62115 | 43    |
| 18    | 36209 | 223 | 63791   | 74213 | 422 | 25787 | 38004 | 198 | 61996 | 42    |
| 19    | 36343 | 223 | 63657   | 74466 | 422 | 25534 | 38123 | 198 | 61877 | 41    |
| 20    | 36477 | 223 | 63523   | 74719 | 422 | 25281 | 38242 | 199 | 61758 | 46 40 |
| 43 21 | 36611 | 223 | 63389   | 74973 | 422 | 25027 | 38362 | 199 | 61638 | 39    |
| 22    | 36745 | 223 | 63255   | 75226 | 422 | 24774 | 38481 | 199 | 61519 | 38    |
| 23    | 36878 | 223 | 63122   | 75479 | 422 | 24521 | 38600 | 199 | 61400 | 37    |
| 24    | 37012 | 222 | 62988   | 75732 | 422 | 24268 | 38720 | 199 | 61280 | 36    |
| 25    | 37146 | 222 | 62854   | 75985 | 422 | 24015 | 38839 | 199 | 61161 | 35    |
| 26    | 37279 | 222 | 62721   | 76238 | 422 | 23762 | 38959 | 199 | 61041 | 34    |
| 27    | 37412 | 222 | 62588   | 76491 | 422 | 23509 | 39078 | 199 | 60922 | 33    |
| 28    | 37546 | 222 | 62454   | 76744 | 422 | 23256 | 39198 | 199 | 60802 | 32    |
| 29    | 37679 | 222 | 62321   | 76997 | 422 | 23003 | 39318 | 199 | 60682 | 31    |
| 30    | 37812 | 222 | 62188   | 77250 | 422 | 22750 | 39438 | 200 | 60562 | 40 30 |
|       | Con.  | D.  | Sec.    | Cot.  | D.  | Tang. | Con.  | D.  | Sine  |       |

47° Deg.

48° Deg.

43½ Deg.

TABLE V.—LOG. SINES, ETC.

44½ Deg.

|      | Sine  | D.  | Co-sec. | Tang. | D.  | Cot.  | Sec.  | D.  | Coa.  |       |
|------|-------|-----|---------|-------|-----|-------|-------|-----|-------|-------|
|      | 9°8'  |     | 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 | 421 | 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   | 41117 | 218 | 58884   | 83573 | 421 | 16427 | 42457 | 203 | 57543 | 5     |
| 56   | 41248 | 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   | 87113 | 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 |
|      | Coa.  | D.  | Sec.    | Cot.  | D.  | Tang. | Coa.  | D.  | Sine  |       |

46½ Deg.

45½ Deg.

| 44½ Deg. |       | TABLE V.—LOG. SINUS, ETC. |         |           |     |       |       |     |       | 45 Deg. |  |
|----------|-------|---------------------------|---------|-----------|-----|-------|-------|-----|-------|---------|--|
|          | Sine  | D.                        | Co-sec. | Tang.     | D.  | Cot.  | Sec.  | D.  | Co-   |         |  |
|          | 9° 84 |                           | 10° 1   |           |     | 10° 0 | 10° 1 |     | 9° 8  |         |  |
| 44 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.    | Cot.      | D.  | Tang. | Con.  | D.  | Sine  |         |  |
| 45½ Deg. |       |                           |         |           |     |       |       |     |       | 46 Deg. |  |

TABLE VI.—MERIDIONAL PARTS.

| 0  | 1  | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14  | 15  | 16   | 17   | 18   | 19   | 20   | 21   | 22   | 23   | 24   |
|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|------|------|
| 0  | 60 | 20  | 180 | 240 | 300 | 361 | 421 | 482 | 542 | 603 | 664 | 725 | 787 | 848 | 910 | 973  | 1035 | 1098 | 1161 | 1225 | 1289 | 1354 | 1419 | 1484 |
| 1  | 61 | 121 | 181 | 241 | 301 | 362 | 422 | 483 | 543 | 604 | 665 | 726 | 788 | 850 | 911 | 974  | 1036 | 1099 | 1163 | 1228 | 1293 | 1358 | 1423 | 1488 |
| 2  | 62 | 122 | 182 | 242 | 302 | 363 | 423 | 484 | 544 | 605 | 666 | 727 | 789 | 851 | 913 | 975  | 1037 | 1100 | 1164 | 1229 | 1294 | 1359 | 1424 | 1489 |
| 3  | 63 | 123 | 183 | 243 | 303 | 364 | 424 | 485 | 545 | 606 | 667 | 728 | 790 | 852 | 914 | 976  | 1038 | 1101 | 1165 | 1230 | 1295 | 1360 | 1425 | 1490 |
| 4  | 64 | 124 | 184 | 244 | 304 | 365 | 425 | 486 | 546 | 607 | 668 | 729 | 791 | 853 | 915 | 977  | 1039 | 1102 | 1166 | 1231 | 1296 | 1361 | 1426 | 1491 |
| 5  | 65 | 125 | 185 | 245 | 305 | 366 | 426 | 487 | 547 | 608 | 669 | 730 | 792 | 854 | 916 | 978  | 1041 | 1103 | 1167 | 1232 | 1297 | 1362 | 1427 | 1492 |
| 6  | 66 | 126 | 186 | 246 | 306 | 367 | 427 | 488 | 548 | 609 | 670 | 731 | 793 | 855 | 917 | 979  | 1042 | 1105 | 1168 | 1233 | 1298 | 1363 | 1428 | 1493 |
| 7  | 67 | 127 | 187 | 247 | 307 | 368 | 428 | 489 | 549 | 610 | 671 | 732 | 794 | 856 | 918 | 980  | 1043 | 1106 | 1169 | 1234 | 1299 | 1364 | 1429 | 1494 |
| 8  | 68 | 128 | 188 | 248 | 308 | 369 | 429 | 490 | 550 | 611 | 672 | 733 | 795 | 857 | 919 | 981  | 1044 | 1107 | 1170 | 1235 | 1299 | 1365 | 1430 | 1495 |
| 9  | 69 | 129 | 189 | 249 | 309 | 370 | 430 | 491 | 551 | 612 | 673 | 735 | 796 | 858 | 920 | 982  | 1045 | 1108 | 1171 | 1235 | 1299 | 1365 | 1430 | 1495 |
| 10 | 70 | 130 | 190 | 250 | 310 | 371 | 431 | 492 | 552 | 613 | 674 | 736 | 797 | 859 | 921 | 983  | 1046 | 1109 | 1172 | 1236 | 1300 | 1366 | 1431 | 1496 |
| 11 | 71 | 131 | 191 | 251 | 311 | 372 | 432 | 493 | 553 | 614 | 675 | 737 | 798 | 860 | 922 | 984  | 1047 | 1110 | 1173 | 1237 | 1301 | 1366 | 1431 | 1496 |
| 12 | 72 | 132 | 192 | 252 | 312 | 373 | 433 | 494 | 554 | 615 | 676 | 738 | 799 | 861 | 923 | 985  | 1048 | 1111 | 1174 | 1238 | 1302 | 1367 | 1432 | 1497 |
| 13 | 73 | 133 | 193 | 253 | 313 | 374 | 434 | 495 | 555 | 616 | 677 | 739 | 800 | 862 | 924 | 986  | 1049 | 1112 | 1175 | 1239 | 1303 | 1368 | 1433 | 1498 |
| 14 | 74 | 134 | 194 | 254 | 314 | 375 | 435 | 496 | 556 | 617 | 678 | 740 | 801 | 863 | 925 | 987  | 1050 | 1113 | 1176 | 1240 | 1304 | 1369 | 1434 | 1499 |
| 15 | 75 | 135 | 195 | 255 | 315 | 376 | 436 | 497 | 557 | 618 | 679 | 741 | 802 | 864 | 926 | 988  | 1051 | 1114 | 1177 | 1241 | 1305 | 1370 | 1435 | 1500 |
| 16 | 76 | 136 | 196 | 256 | 316 | 377 | 437 | 498 | 558 | 619 | 680 | 742 | 803 | 865 | 927 | 989  | 1052 | 1115 | 1178 | 1242 | 1306 | 1371 | 1436 | 1501 |
| 17 | 77 | 137 | 197 | 257 | 317 | 378 | 438 | 499 | 559 | 620 | 681 | 743 | 804 | 866 | 928 | 990  | 1053 | 1116 | 1179 | 1243 | 1307 | 1372 | 1437 | 1502 |
| 18 | 78 | 138 | 198 | 258 | 318 | 379 | 439 | 500 | 560 | 621 | 682 | 744 | 805 | 867 | 929 | 991  | 1054 | 1117 | 1181 | 1244 | 1308 | 1373 | 1438 | 1503 |
| 19 | 79 | 139 | 199 | 259 | 319 | 380 | 440 | 501 | 561 | 622 | 683 | 745 | 806 | 868 | 930 | 993  | 1055 | 1118 | 1182 | 1245 | 1310 | 1374 | 1439 | 1504 |
| 20 | 80 | 140 | 200 | 260 | 320 | 381 | 441 | 502 | 562 | 623 | 684 | 746 | 807 | 869 | 931 | 994  | 1056 | 1119 | 1183 | 1246 | 1311 | 1375 | 1440 | 1505 |
| 21 | 81 | 141 | 201 | 261 | 321 | 382 | 442 | 503 | 563 | 624 | 685 | 747 | 808 | 870 | 932 | 995  | 1057 | 1120 | 1184 | 1247 | 1312 | 1376 | 1441 | 1506 |
| 22 | 82 | 142 | 202 | 262 | 322 | 383 | 443 | 504 | 564 | 625 | 686 | 748 | 809 | 871 | 933 | 996  | 1058 | 1121 | 1185 | 1249 | 1313 | 1377 | 1442 | 1507 |
| 23 | 83 | 143 | 203 | 263 | 323 | 384 | 444 | 505 | 565 | 626 | 687 | 749 | 810 | 872 | 934 | 997  | 1059 | 1122 | 1186 | 1250 | 1314 | 1379 | 1443 | 1508 |
| 24 | 84 | 144 | 204 | 264 | 324 | 385 | 445 | 506 | 566 | 627 | 688 | 750 | 811 | 873 | 935 | 998  | 1060 | 1123 | 1187 | 1251 | 1315 | 1380 | 1444 | 1509 |
| 25 | 85 | 145 | 205 | 265 | 325 | 386 | 446 | 507 | 567 | 628 | 689 | 751 | 812 | 874 | 936 | 999  | 1061 | 1124 | 1188 | 1252 | 1316 | 1381 | 1445 | 1510 |
| 26 | 86 | 146 | 206 | 266 | 326 | 387 | 447 | 508 | 568 | 629 | 690 | 752 | 813 | 875 | 937 | 1000 | 1062 | 1125 | 1189 | 1253 | 1317 | 1382 | 1446 | 1511 |
| 27 | 87 | 147 | 207 | 267 | 327 | 388 | 448 | 509 | 569 | 630 | 691 | 753 | 814 | 876 | 938 | 1001 | 1063 | 1126 | 1190 | 1254 | 1318 | 1383 | 1447 | 1512 |
| 28 | 88 | 148 | 208 | 268 | 328 | 389 | 449 | 510 | 570 | 631 | 692 | 754 | 815 | 877 | 939 | 1002 | 1064 | 1127 | 1191 | 1255 | 1319 | 1384 | 1448 | 1513 |
| 29 | 89 | 149 | 209 | 269 | 329 | 390 | 450 | 511 | 571 | 632 | 693 | 755 | 816 | 878 | 940 | 1003 | 1065 | 1128 | 1192 | 1256 | 1320 | 1385 | 1449 | 1514 |
| 30 | 90 | 150 | 210 | 270 | 330 | 391 | 451 | 512 | 572 | 633 | 694 | 756 | 817 | 879 | 941 | 1004 | 1066 | 1129 | 1193 | 1257 | 1321 | 1386 | 1450 | 1515 |

TABLE VI.—MERIDIONAL PARTS.

|    | 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 | 1185 | 1247 | 1309 | 1371 | 1433 | 1495 |
| 31 | 91  | 151 | 211 | 271 | 331 | 391 | 452 | 513 | 574 | 635 | 696 | 757 | 819 | 880 | 941 | 1002 | 1063 | 1124 | 1186 | 1248 | 1310 | 1372 | 1434 | 1496 |
| 32 | 92  | 152 | 212 | 272 | 332 | 392 | 453 | 514 | 575 | 636 | 697 | 758 | 820 | 881 | 942 | 1003 | 1064 | 1125 | 1187 | 1249 | 1311 | 1373 | 1435 | 1497 |
| 33 | 93  | 153 | 213 | 273 | 333 | 393 | 454 | 515 | 576 | 637 | 698 | 759 | 821 | 882 | 943 | 1004 | 1065 | 1126 | 1188 | 1250 | 1312 | 1374 | 1436 | 1498 |
| 34 | 94  | 154 | 214 | 274 | 334 | 394 | 455 | 516 | 577 | 638 | 699 | 760 | 822 | 883 | 944 | 1005 | 1066 | 1127 | 1189 | 1251 | 1313 | 1375 | 1437 | 1499 |
| 35 | 95  | 155 | 215 | 275 | 335 | 395 | 456 | 517 | 578 | 639 | 700 | 761 | 823 | 884 | 945 | 1006 | 1067 | 1128 | 1190 | 1252 | 1314 | 1376 | 1438 | 1500 |
| 36 | 96  | 156 | 216 | 276 | 336 | 396 | 457 | 518 | 579 | 640 | 701 | 762 | 824 | 885 | 946 | 1007 | 1068 | 1129 | 1191 | 1253 | 1315 | 1377 | 1439 | 1501 |
| 37 | 97  | 157 | 217 | 277 | 337 | 397 | 458 | 519 | 580 | 641 | 702 | 763 | 825 | 886 | 947 | 1008 | 1069 | 1130 | 1192 | 1254 | 1316 | 1378 | 1440 | 1502 |
| 38 | 98  | 158 | 218 | 278 | 338 | 398 | 459 | 520 | 581 | 642 | 703 | 764 | 826 | 887 | 948 | 1009 | 1070 | 1131 | 1193 | 1255 | 1317 | 1379 | 1441 | 1503 |
| 39 | 99  | 159 | 219 | 279 | 339 | 400 | 460 | 521 | 582 | 643 | 704 | 765 | 827 | 888 | 949 | 1010 | 1071 | 1132 | 1194 | 1256 | 1318 | 1380 | 1442 | 1504 |
| 40 | 100 | 160 | 220 | 280 | 340 | 401 | 461 | 522 | 583 | 644 | 705 | 766 | 828 | 889 | 950 | 1011 | 1072 | 1133 | 1195 | 1257 | 1319 | 1381 | 1443 | 1505 |
| 41 | 101 | 161 | 221 | 281 | 341 | 402 | 462 | 523 | 584 | 645 | 706 | 767 | 829 | 890 | 951 | 1012 | 1073 | 1134 | 1196 | 1258 | 1320 | 1382 | 1444 | 1506 |
| 42 | 102 | 162 | 222 | 282 | 342 | 403 | 463 | 524 | 585 | 646 | 707 | 768 | 830 | 891 | 952 | 1013 | 1074 | 1135 | 1197 | 1259 | 1321 | 1383 | 1445 | 1507 |
| 43 | 103 | 163 | 223 | 283 | 343 | 404 | 464 | 525 | 586 | 647 | 708 | 769 | 831 | 892 | 953 | 1014 | 1075 | 1136 | 1198 | 1260 | 1322 | 1384 | 1446 | 1508 |
| 44 | 104 | 164 | 224 | 284 | 344 | 405 | 465 | 526 | 587 | 648 | 709 | 770 | 832 | 893 | 954 | 1015 | 1076 | 1137 | 1199 | 1261 | 1323 | 1385 | 1447 | 1509 |
| 45 | 105 | 165 | 225 | 285 | 345 | 406 | 466 | 527 | 588 | 649 | 710 | 771 | 833 | 894 | 955 | 1016 | 1077 | 1138 | 1200 | 1262 | 1324 | 1386 | 1448 | 1510 |
| 46 | 106 | 166 | 226 | 286 | 346 | 407 | 467 | 528 | 589 | 650 | 711 | 772 | 834 | 895 | 956 | 1017 | 1078 | 1139 | 1201 | 1263 | 1325 | 1387 | 1449 | 1511 |
| 47 | 107 | 167 | 227 | 287 | 347 | 408 | 468 | 529 | 590 | 651 | 712 | 773 | 835 | 896 | 957 | 1018 | 1079 | 1140 | 1202 | 1264 | 1326 | 1388 | 1450 | 1512 |
| 48 | 108 | 168 | 228 | 288 | 348 | 409 | 469 | 530 | 591 | 652 | 713 | 774 | 836 | 897 | 958 | 1019 | 1080 | 1141 | 1203 | 1265 | 1327 | 1389 | 1451 | 1513 |
| 49 | 109 | 169 | 229 | 289 | 349 | 410 | 470 | 531 | 592 | 653 | 714 | 775 | 837 | 898 | 959 | 1020 | 1081 | 1142 | 1204 | 1266 | 1328 | 1390 | 1452 | 1514 |
| 50 | 110 | 170 | 230 | 290 | 350 | 411 | 471 | 532 | 593 | 654 | 715 | 776 | 838 | 899 | 960 | 1021 | 1082 | 1143 | 1205 | 1267 | 1329 | 1391 | 1453 | 1515 |
| 51 | 111 | 171 | 231 | 291 | 351 | 412 | 472 | 533 | 594 | 655 | 716 | 777 | 839 | 900 | 961 | 1022 | 1083 | 1144 | 1206 | 1268 | 1330 | 1392 | 1454 | 1516 |
| 52 | 112 | 172 | 232 | 292 | 352 | 413 | 473 | 534 | 595 | 656 | 717 | 778 | 840 | 901 | 962 | 1023 | 1084 | 1145 | 1207 | 1269 | 1331 | 1393 | 1455 | 1517 |
| 53 | 113 | 173 | 233 | 293 | 353 | 414 | 474 | 535 | 596 | 657 | 718 | 779 | 841 | 902 | 963 | 1024 | 1085 | 1146 | 1208 | 1270 | 1332 | 1394 | 1456 | 1518 |
| 54 | 114 | 174 | 234 | 294 | 354 | 415 | 475 | 536 | 597 | 658 | 719 | 780 | 842 | 903 | 964 | 1025 | 1086 | 1147 | 1209 | 1271 | 1333 | 1395 | 1457 | 1519 |
| 55 | 115 | 175 | 235 | 295 | 355 | 416 | 476 | 537 | 598 | 659 | 720 | 781 | 843 | 904 | 965 | 1026 | 1087 | 1148 | 1210 | 1272 | 1334 | 1396 | 1458 | 1520 |
| 56 | 116 | 176 | 236 | 296 | 356 | 417 | 477 | 538 | 599 | 660 | 721 | 782 | 844 | 905 | 966 | 1027 | 1088 | 1149 | 1211 | 1273 | 1335 | 1397 | 1459 | 1521 |
| 57 | 117 | 177 | 237 | 297 | 357 | 418 | 478 | 539 | 600 | 661 | 722 | 783 | 845 | 906 | 967 | 1028 | 1089 | 1150 | 1212 | 1274 | 1336 | 1398 | 1460 | 1522 |
| 58 | 118 | 178 | 238 | 298 | 358 | 419 | 480 | 540 | 601 | 662 | 723 | 784 | 846 | 907 | 968 | 1029 | 1090 | 1151 | 1213 | 1275 | 1337 | 1399 | 1461 | 1523 |
| 59 | 119 | 179 | 239 | 299 | 359 | 420 | 481 | 541 | 602 | 663 | 724 | 785 | 847 | 908 | 969 | 1030 | 1091 | 1152 | 1214 | 1276 | 1338 | 1400 | 1462 | 1524 |

TABLE VI.—MEMORIAL PART.

|    | 25   | 26   | 27   | 28   | 29   | 30   | 31   | 32   | 33   | 34   | 35   | 36   | 37   | 38   | 39   | 40   | 41   | 42   | 43   | 44   | 45   |
|----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 0  | 1550 | 1616 | 1684 | 1751 | 1819 | 1886 | 1953 | 2020 | 2086 | 2151 | 2216 | 2281 | 2345 | 2409 | 2472 | 2535 | 2598 | 2660 | 2722 | 2783 | 2844 |
| 1  | 1551 | 1618 | 1685 | 1752 | 1821 | 1890 | 1959 | 2027 | 2094 | 2161 | 2228 | 2294 | 2360 | 2425 | 2490 | 2555 | 2620 | 2684 | 2748 | 2811 | 2874 |
| 2  | 1552 | 1619 | 1686 | 1753 | 1822 | 1891 | 1960 | 2028 | 2095 | 2162 | 2229 | 2295 | 2361 | 2426 | 2491 | 2556 | 2621 | 2685 | 2749 | 2812 | 2875 |
| 3  | 1553 | 1620 | 1687 | 1754 | 1823 | 1892 | 1961 | 2029 | 2096 | 2163 | 2230 | 2296 | 2362 | 2427 | 2492 | 2557 | 2622 | 2686 | 2750 | 2813 | 2876 |
| 4  | 1554 | 1621 | 1688 | 1755 | 1824 | 1893 | 1962 | 2030 | 2097 | 2164 | 2231 | 2297 | 2363 | 2428 | 2493 | 2558 | 2623 | 2687 | 2751 | 2814 | 2877 |
| 5  | 1555 | 1622 | 1689 | 1756 | 1825 | 1894 | 1963 | 2031 | 2098 | 2165 | 2232 | 2298 | 2364 | 2429 | 2494 | 2559 | 2624 | 2688 | 2752 | 2815 | 2878 |
| 6  | 1556 | 1623 | 1690 | 1757 | 1826 | 1895 | 1964 | 2032 | 2100 | 2166 | 2233 | 2299 | 2365 | 2430 | 2495 | 2560 | 2625 | 2689 | 2753 | 2816 | 2879 |
| 7  | 1557 | 1624 | 1691 | 1758 | 1827 | 1896 | 1965 | 2033 | 2101 | 2167 | 2234 | 2300 | 2366 | 2431 | 2496 | 2561 | 2626 | 2690 | 2754 | 2817 | 2880 |
| 8  | 1558 | 1625 | 1692 | 1759 | 1828 | 1897 | 1966 | 2034 | 2102 | 2168 | 2235 | 2301 | 2367 | 2432 | 2497 | 2562 | 2627 | 2691 | 2755 | 2818 | 2881 |
| 9  | 1559 | 1626 | 1693 | 1760 | 1829 | 1898 | 1967 | 2035 | 2103 | 2169 | 2236 | 2302 | 2368 | 2433 | 2498 | 2563 | 2628 | 2692 | 2756 | 2819 | 2882 |
| 10 | 1560 | 1627 | 1694 | 1761 | 1830 | 1899 | 1968 | 2036 | 2104 | 2170 | 2237 | 2303 | 2369 | 2434 | 2499 | 2564 | 2629 | 2693 | 2757 | 2820 | 2883 |
| 11 | 1561 | 1628 | 1695 | 1762 | 1831 | 1900 | 1969 | 2037 | 2105 | 2171 | 2238 | 2304 | 2370 | 2435 | 2500 | 2565 | 2630 | 2694 | 2758 | 2821 | 2884 |
| 12 | 1562 | 1629 | 1696 | 1763 | 1832 | 1901 | 1970 | 2038 | 2106 | 2172 | 2239 | 2305 | 2371 | 2436 | 2501 | 2566 | 2631 | 2695 | 2759 | 2822 | 2885 |
| 13 | 1563 | 1630 | 1697 | 1764 | 1833 | 1902 | 1971 | 2039 | 2107 | 2173 | 2240 | 2306 | 2372 | 2437 | 2502 | 2567 | 2632 | 2696 | 2760 | 2823 | 2886 |
| 14 | 1564 | 1631 | 1698 | 1765 | 1834 | 1903 | 1972 | 2040 | 2108 | 2174 | 2241 | 2307 | 2373 | 2438 | 2503 | 2568 | 2633 | 2697 | 2761 | 2824 | 2887 |
| 15 | 1565 | 1632 | 1699 | 1766 | 1835 | 1904 | 1973 | 2041 | 2109 | 2175 | 2242 | 2308 | 2374 | 2439 | 2504 | 2569 | 2634 | 2698 | 2762 | 2825 | 2888 |
| 16 | 1566 | 1633 | 1700 | 1767 | 1836 | 1905 | 1974 | 2042 | 2110 | 2176 | 2243 | 2309 | 2375 | 2440 | 2505 | 2570 | 2635 | 2699 | 2763 | 2826 | 2889 |
| 17 | 1567 | 1634 | 1701 | 1768 | 1837 | 1906 | 1975 | 2043 | 2111 | 2177 | 2244 | 2310 | 2376 | 2441 | 2506 | 2571 | 2636 | 2700 | 2764 | 2827 | 2890 |
| 18 | 1568 | 1635 | 1702 | 1769 | 1838 | 1907 | 1976 | 2044 | 2112 | 2178 | 2245 | 2311 | 2377 | 2442 | 2507 | 2572 | 2637 | 2701 | 2765 | 2828 | 2891 |
| 19 | 1569 | 1636 | 1703 | 1770 | 1839 | 1908 | 1977 | 2045 | 2113 | 2179 | 2246 | 2312 | 2378 | 2443 | 2508 | 2573 | 2638 | 2702 | 2766 | 2829 | 2892 |
| 20 | 1570 | 1637 | 1704 | 1771 | 1840 | 1909 | 1978 | 2046 | 2114 | 2180 | 2247 | 2313 | 2379 | 2444 | 2509 | 2574 | 2639 | 2703 | 2767 | 2830 | 2893 |
| 21 | 1571 | 1638 | 1705 | 1772 | 1841 | 1910 | 1979 | 2047 | 2115 | 2181 | 2248 | 2314 | 2380 | 2445 | 2510 | 2575 | 2640 | 2704 | 2768 | 2831 | 2894 |
| 22 | 1572 | 1639 | 1706 | 1773 | 1842 | 1911 | 1980 | 2048 | 2116 | 2182 | 2249 | 2315 | 2381 | 2446 | 2511 | 2576 | 2641 | 2705 | 2769 | 2832 | 2895 |
| 23 | 1573 | 1640 | 1707 | 1774 | 1843 | 1912 | 1981 | 2049 | 2117 | 2183 | 2250 | 2316 | 2382 | 2447 | 2512 | 2577 | 2642 | 2706 | 2770 | 2833 | 2896 |
| 24 | 1574 | 1641 | 1708 | 1775 | 1844 | 1913 | 1982 | 2050 | 2118 | 2184 | 2251 | 2317 | 2383 | 2448 | 2513 | 2578 | 2643 | 2707 | 2771 | 2834 | 2897 |
| 25 | 1575 | 1642 | 1709 | 1776 | 1845 | 1914 | 1983 | 2051 | 2119 | 2185 | 2252 | 2318 | 2384 | 2449 | 2514 | 2579 | 2644 | 2708 | 2772 | 2835 | 2898 |
| 26 | 1576 | 1643 | 1710 | 1777 | 1846 | 1915 | 1984 | 2052 | 2120 | 2186 | 2253 | 2319 | 2385 | 2450 | 2515 | 2580 | 2645 | 2709 | 2773 | 2836 | 2899 |
| 27 | 1577 | 1644 | 1711 | 1778 | 1847 | 1916 | 1985 | 2053 | 2121 | 2187 | 2254 | 2320 | 2386 | 2451 | 2516 | 2581 | 2646 | 2710 | 2774 | 2837 | 2900 |
| 28 | 1578 | 1645 | 1712 | 1779 | 1848 | 1917 | 1986 | 2054 | 2122 | 2188 | 2255 | 2321 | 2387 | 2452 | 2517 | 2582 | 2647 | 2711 | 2775 | 2838 | 2901 |
| 29 | 1579 | 1646 | 1713 | 1780 | 1849 | 1918 | 1987 | 2055 | 2123 | 2189 | 2256 | 2322 | 2388 | 2453 | 2518 | 2583 | 2648 | 2712 | 2776 | 2839 | 2902 |
| 30 | 1580 | 1647 | 1714 | 1781 | 1850 | 1919 | 1988 | 2056 | 2124 | 2190 | 2257 | 2323 | 2389 | 2454 | 2519 | 2584 | 2649 | 2713 | 2777 | 2840 | 2903 |
| 31 | 1581 | 1648 | 1715 | 1782 | 1851 | 1920 | 1989 | 2057 | 2125 | 2191 | 2258 | 2324 | 2390 | 2455 | 2520 | 2585 | 2650 | 2714 | 2778 | 2841 | 2904 |
| 32 | 1582 | 1649 | 1716 | 1783 | 1852 | 1921 | 1990 | 2058 | 2126 | 2192 | 2259 | 2325 | 2391 | 2456 | 2521 | 2586 | 2651 | 2715 | 2779 | 2842 | 2905 |
| 33 | 1583 | 1650 | 1717 | 1784 | 1853 | 1922 | 1991 | 2059 | 2127 | 2193 | 2260 | 2326 | 2392 | 2457 | 2522 | 2587 | 2652 | 2716 | 2780 | 2843 | 2906 |
| 34 | 1584 | 1651 | 1718 | 1785 | 1854 | 1923 | 1992 | 2060 | 2128 | 2194 | 2261 | 2327 | 2393 | 2458 | 2523 | 2588 | 2653 | 2717 | 2781 | 2844 | 2907 |
| 35 | 1585 | 1652 | 1719 | 1786 | 1855 | 1924 | 1993 | 2061 | 2129 | 2195 | 2262 | 2328 | 2394 | 2459 | 2524 | 2589 | 2654 | 2718 | 2782 | 2845 | 2908 |
| 36 | 1586 | 1653 | 1720 | 1787 | 1856 | 1925 | 1994 | 2062 | 2130 | 2196 | 2263 | 2329 | 2395 | 2460 | 2525 | 2590 | 2655 | 2719 | 2783 | 2846 | 2909 |
| 37 | 1587 | 1654 | 1721 | 1788 | 1857 | 1926 | 1995 | 2063 | 2131 | 2197 | 2264 | 2330 | 2396 | 2461 | 2526 | 2591 | 2656 | 2720 | 2784 | 2847 | 2910 |
| 38 | 1588 | 1655 | 1722 | 1789 | 1858 | 1927 | 1996 | 2064 | 2132 | 2198 | 2265 | 2331 | 2397 | 2462 | 2527 | 2592 | 2657 | 2721 | 2785 | 2848 | 2911 |
| 39 | 1589 | 1656 | 1723 | 1790 | 1859 | 1928 | 1997 | 2065 | 2133 | 2199 | 2266 | 2332 | 2398 | 2463 | 2528 | 2593 | 2658 | 2722 | 2786 | 2849 | 2912 |
| 40 | 1590 | 1657 | 1724 | 1791 | 1860 | 1929 | 1998 | 2066 | 2134 | 2200 | 2267 | 2333 | 2399 | 2464 | 2529 | 2594 | 2659 | 2723 | 2787 | 2850 | 2913 |
| 41 | 1591 | 1658 | 1725 | 1792 | 1861 | 1930 | 1999 | 2067 | 2135 | 2201 | 2268 | 2334 | 2400 | 2465 | 2530 | 2595 | 2660 | 2724 | 2788 | 2851 | 2914 |
| 42 | 1592 | 1659 | 1726 | 1793 | 1862 | 1931 | 2000 | 2068 | 2136 | 2202 | 2269 | 2335 | 2401 | 2466 | 2531 | 2596 | 2661 | 2725 | 2789 | 2852 | 2915 |
| 43 | 1593 | 1660 | 1727 | 1794 | 1863 | 1932 | 2001 | 2069 | 2137 | 2203 | 2270 | 2336 | 2402 | 2467 | 2532 | 2597 | 2662 | 2726 | 2790 | 2853 | 2916 |
| 44 | 1594 | 1661 | 1728 | 1795 | 1864 | 1933 | 2002 | 2070 | 2138 | 2204 | 2271 | 2337 | 2403 | 2468 | 2533 | 2598 | 2663 | 2727 | 2791 | 2854 | 2917 |
| 45 | 1595 | 1662 | 1729 | 1796 | 1865 | 1934 | 2003 | 2071 | 2139 | 2205 | 2272 | 2338 | 2404 | 2469 | 2534 | 2599 | 2664 | 2728 | 2792 | 2855 | 2918 |
| 46 | 1596 | 1663 | 1730 | 1797 | 1866 | 1935 | 2004 | 2072 | 2140 | 2206 | 2273 | 2339 | 2405 | 2470 | 2535 | 2600 | 2665 | 2729 | 2793 | 2856 | 2919 |
| 47 | 1597 | 1664 | 1731 | 1798 | 1867 | 1936 | 2005 | 2073 | 2141 | 2207 | 2274 | 2340 | 2406 | 2471 | 2536 | 2601 | 2666 | 2730 | 2794 | 2857 | 2920 |
| 48 | 1598 | 1665 | 1732 | 1799 | 1868 | 1937 | 2006 | 2074 | 2142 | 2208 | 2275 | 2341 | 2407 | 2472 | 2537 | 2602 | 2667 | 2731 | 2795 | 2858 | 2921 |
| 49 | 1599 | 1666 | 1733 | 1800 | 1869 | 1938 | 2007 | 2075 | 2143 | 2209 | 2276 | 2342 | 2408 | 2473 | 2538 | 2603 | 2668 | 2732 | 2796 | 2859 | 2922 |
| 50 | 1600 | 1667 | 1734 | 1801 | 1870 | 1939 | 2008 | 2076 | 2144 | 2210 | 2277 | 2343 | 2409 | 2474 | 2539 | 2604 | 2669 | 2733 | 2797 | 2860 | 2923 |

TABLE VI.—MERIDIONAL PARTS.

|    | 1° 35' | 1° 36' | 1° 37' | 1° 38' | 1° 39' | 1° 40' | 1° 41' | 1° 42' | 1° 43' | 1° 44' | 1° 45' |      |      |      |      |      |      |      |      |      |      |    |
|----|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|------|------|------|------|------|------|------|------|------|----|
| 30 | 1583   | 1600   | 1717   | 1785   | 1854   | 1923   | 1993   | 2064   | 2135   | 2208   | 2281   | 2355 | 2430 | 2506 | 2584 | 2663 | 2743 | 2824 | 2904 | 2988 | 3073 | 31 |
| 31 | 1584   | 1601   | 1718   | 1786   | 1855   | 1924   | 1994   | 2065   | 2137   | 2209   | 2282   | 2356 | 2431 | 2507 | 2585 | 2664 | 2744 | 2825 | 2905 | 2989 | 3074 | 32 |
| 32 | 1585   | 1602   | 1720   | 1788   | 1857   | 1926   | 1996   | 2067   | 2139   | 2211   | 2284   | 2358 | 2433 | 2509 | 2587 | 2666 | 2746 | 2827 | 2907 | 2991 | 3075 | 33 |
| 33 | 1586   | 1603   | 1721   | 1789   | 1858   | 1927   | 1997   | 2068   | 2140   | 2212   | 2285   | 2359 | 2434 | 2510 | 2588 | 2667 | 2747 | 2828 | 2908 | 2992 | 3076 | 34 |
| 34 | 1588   | 1605   | 1723   | 1790   | 1859   | 1928   | 1998   | 2069   | 2141   | 2213   | 2286   | 2360 | 2435 | 2511 | 2589 | 2668 | 2748 | 2829 | 2909 | 2993 | 3077 | 35 |
| 35 | 1589   | 1606   | 1724   | 1791   | 1860   | 1929   | 1999   | 2070   | 2142   | 2214   | 2287   | 2361 | 2436 | 2512 | 2590 | 2669 | 2749 | 2830 | 2910 | 2994 | 3078 | 36 |
| 36 | 1590   | 1607   | 1725   | 1792   | 1861   | 1930   | 2000   | 2071   | 2143   | 2215   | 2288   | 2362 | 2437 | 2513 | 2591 | 2670 | 2750 | 2831 | 2911 | 2995 | 3079 | 37 |
| 37 | 1591   | 1608   | 1725   | 1793   | 1862   | 1931   | 2001   | 2072   | 2144   | 2216   | 2289   | 2363 | 2438 | 2514 | 2592 | 2671 | 2751 | 2832 | 2912 | 2996 | 3080 | 38 |
| 38 | 1592   | 1609   | 1726   | 1794   | 1863   | 1932   | 2002   | 2073   | 2145   | 2217   | 2290   | 2364 | 2439 | 2515 | 2593 | 2672 | 2752 | 2833 | 2913 | 2997 | 3081 | 39 |
| 39 | 1593   | 1610   | 1727   | 1795   | 1864   | 1933   | 2003   | 2074   | 2146   | 2218   | 2291   | 2365 | 2440 | 2516 | 2594 | 2673 | 2753 | 2834 | 2914 | 2998 | 3082 | 40 |
| 40 | 1594   | 1611   | 1729   | 1797   | 1865   | 1934   | 2004   | 2075   | 2147   | 2219   | 2292   | 2366 | 2441 | 2517 | 2595 | 2674 | 2754 | 2835 | 2915 | 2999 | 3083 | 41 |
| 41 | 1595   | 1612   | 1730   | 1798   | 1866   | 1935   | 2005   | 2076   | 2147   | 2220   | 2293   | 2367 | 2442 | 2518 | 2596 | 2675 | 2755 | 2836 | 2916 | 3000 | 3084 | 42 |
| 42 | 1596   | 1613   | 1731   | 1799   | 1867   | 1936   | 2006   | 2077   | 2149   | 2221   | 2294   | 2368 | 2443 | 2519 | 2597 | 2676 | 2756 | 2837 | 2917 | 3001 | 3085 | 43 |
| 43 | 1598   | 1614   | 1732   | 1800   | 1868   | 1937   | 2007   | 2078   | 2150   | 2222   | 2295   | 2369 | 2444 | 2520 | 2598 | 2677 | 2757 | 2838 | 2918 | 3002 | 3086 | 44 |
| 44 | 1599   | 1615   | 1733   | 1801   | 1869   | 1938   | 2008   | 2079   | 2151   | 2223   | 2296   | 2370 | 2445 | 2521 | 2599 | 2678 | 2758 | 2839 | 2919 | 3003 | 3087 | 45 |
| 45 | 1600   | 1616   | 1734   | 1802   | 1870   | 1939   | 2010   | 2081   | 2152   | 2224   | 2297   | 2371 | 2446 | 2522 | 2600 | 2679 | 2759 | 2840 | 2920 | 3004 | 3088 | 46 |
| 46 | 1601   | 1617   | 1735   | 1803   | 1871   | 1940   | 2011   | 2082   | 2153   | 2225   | 2298   | 2372 | 2447 | 2523 | 2601 | 2680 | 2760 | 2841 | 2921 | 3005 | 3089 | 47 |
| 47 | 1602   | 1618   | 1736   | 1804   | 1872   | 1941   | 2012   | 2083   | 2154   | 2226   | 2299   | 2373 | 2448 | 2524 | 2602 | 2681 | 2761 | 2842 | 2922 | 3006 | 3090 | 48 |
| 48 | 1603   | 1619   | 1737   | 1805   | 1873   | 1942   | 2013   | 2084   | 2155   | 2227   | 2300   | 2374 | 2449 | 2525 | 2603 | 2682 | 2762 | 2843 | 2923 | 3007 | 3091 | 49 |
| 49 | 1604   | 1620   | 1738   | 1806   | 1874   | 1943   | 2014   | 2085   | 2156   | 2228   | 2301   | 2375 | 2450 | 2526 | 2604 | 2683 | 2763 | 2844 | 2924 | 3008 | 3092 | 50 |
| 50 | 1605   | 1621   | 1739   | 1807   | 1875   | 1944   | 2015   | 2086   | 2157   | 2229   | 2302   | 2376 | 2451 | 2527 | 2605 | 2684 | 2764 | 2845 | 2925 | 3009 | 3093 | 51 |
| 51 | 1606   | 1622   | 1740   | 1808   | 1876   | 1945   | 2016   | 2087   | 2158   | 2230   | 2303   | 2377 | 2452 | 2528 | 2606 | 2685 | 2765 | 2846 | 2926 | 3010 | 3094 | 52 |
| 52 | 1607   | 1623   | 1741   | 1809   | 1877   | 1946   | 2017   | 2088   | 2159   | 2231   | 2304   | 2378 | 2453 | 2529 | 2607 | 2686 | 2766 | 2847 | 2927 | 3011 | 3095 | 53 |
| 53 | 1608   | 1624   | 1742   | 1810   | 1878   | 1947   | 2018   | 2089   | 2160   | 2232   | 2305   | 2379 | 2454 | 2530 | 2608 | 2687 | 2767 | 2848 | 2928 | 3012 | 3096 | 54 |
| 54 | 1609   | 1625   | 1743   | 1811   | 1879   | 1948   | 2019   | 2090   | 2161   | 2233   | 2306   | 2380 | 2455 | 2531 | 2609 | 2688 | 2768 | 2849 | 2929 | 3013 | 3097 | 55 |
| 55 | 1610   | 1626   | 1744   | 1812   | 1880   | 1949   | 2020   | 2091   | 2162   | 2234   | 2307   | 2381 | 2456 | 2532 | 2610 | 2689 | 2769 | 2850 | 2930 | 3014 | 3098 | 56 |
| 56 | 1611   | 1627   | 1745   | 1813   | 1881   | 1950   | 2021   | 2092   | 2163   | 2235   | 2308   | 2382 | 2457 | 2533 | 2611 | 2690 | 2770 | 2851 | 2931 | 3015 | 3099 | 57 |
| 57 | 1612   | 1628   | 1746   | 1814   | 1882   | 1951   | 2022   | 2093   | 2164   | 2236   | 2309   | 2383 | 2458 | 2534 | 2612 | 2691 | 2771 | 2852 | 2932 | 3016 | 3100 | 58 |
| 58 | 1613   | 1629   | 1747   | 1815   | 1883   | 1952   | 2023   | 2094   | 2165   | 2237   | 2310   | 2384 | 2459 | 2535 | 2613 | 2692 | 2772 | 2853 | 2933 | 3017 | 3101 | 59 |
| 59 | 1614   | 1630   | 1748   | 1816   | 1884   | 1953   | 2024   | 2095   | 2166   | 2238   | 2311   | 2385 | 2460 | 2536 | 2614 | 2693 | 2773 | 2854 | 2934 | 3018 | 3102 | 60 |
| 60 | 1615   | 1631   | 1749   | 1817   | 1885   | 1954   | 2025   | 2096   | 2167   | 2239   | 2312   | 2386 | 2461 | 2537 | 2615 | 2694 | 2774 | 2855 | 2935 | 3019 | 3103 | 61 |
| 61 | 1616   | 1632   | 1750   | 1818   | 1886   | 1955   | 2026   | 2097   | 2168   | 2240   | 2313   | 2387 | 2462 | 2538 | 2616 | 2695 | 2775 | 2856 | 2936 | 3020 | 3104 | 62 |
| 62 | 1617   | 1633   | 1751   | 1819   | 1887   | 1956   | 2027   | 2098   | 2169   | 2241   | 2314   | 2388 | 2463 | 2539 | 2617 | 2696 | 2776 | 2857 | 2937 | 3021 | 3105 | 63 |
| 63 | 1618   | 1634   | 1752   | 1820   | 1888   | 1957   | 2028   | 2099   | 2170   | 2242   | 2315   | 2389 | 2464 | 2540 | 2618 | 2697 | 2777 | 2858 | 2938 | 3022 | 3106 | 64 |
| 64 | 1619   | 1635   | 1753   | 1821   | 1889   | 1958   | 2029   | 2100   | 2171   | 2243   | 2316   | 2390 | 2465 | 2541 | 2619 | 2698 | 2778 | 2859 | 2939 | 3023 | 3107 | 65 |
| 65 | 1620   | 1636   | 1754   | 1822   | 1890   | 1959   | 2030   | 2101   | 2172   | 2244   | 2317   | 2391 | 2466 | 2542 | 2620 | 2699 | 2779 | 2860 | 2940 | 3024 | 3108 | 66 |
| 66 | 1621   | 1637   | 1755   | 1823   | 1891   | 1960   | 2031   | 2102   | 2173   | 2245   | 2318   | 2392 | 2467 | 2543 | 2621 | 2700 | 2780 | 2861 | 2941 | 3025 | 3109 | 67 |
| 67 | 1622   | 1638   | 1756   | 1824   | 1892   | 1961   | 2032   | 2103   | 2174   | 2246   | 2319   | 2393 | 2468 | 2544 | 2622 | 2701 | 2781 | 2862 | 2942 | 3026 | 3110 | 68 |
| 68 | 1623   | 1639   | 1757   | 1825   | 1893   | 1962   | 2033   | 2104   | 2175   | 2247   | 2320   | 2394 | 2469 | 2545 | 2623 | 2702 | 2782 | 2863 | 2943 | 3027 | 3111 | 69 |
| 69 | 1624   | 1640   | 1758   | 1826   | 1894   | 1963   | 2034   | 2105   | 2176   | 2248   | 2321   | 2395 | 2470 | 2546 | 2624 | 2703 | 2783 | 2864 | 2944 | 3028 | 3112 | 70 |
| 70 | 1625   | 1641   | 1759   | 1827   | 1895   | 1964   | 2035   | 2106   | 2177   | 2249   | 2322   | 2396 | 2471 | 2547 | 2625 | 2704 | 2784 | 2865 | 2945 | 3029 | 3113 | 71 |
| 71 | 1626   | 1642   | 1760   | 1828   | 1896   | 1965   | 2036   | 2107   | 2178   | 2250   | 2323   | 2397 | 2472 | 2548 | 2626 | 2705 | 2785 | 2866 | 2946 | 3030 | 3114 | 72 |
| 72 | 1627   | 1643   | 1761   | 1829   | 1897   | 1966   | 2037   | 2108   | 2179   | 2251   | 2324   | 2398 | 2473 | 2549 | 2627 | 2706 | 2786 | 2867 | 2947 | 3031 | 3115 | 73 |
| 73 | 1628   | 1644   | 1762   | 1830   | 1898   | 1967   | 2038   | 2109   | 2180   | 2252   | 2325   | 2399 | 2474 | 2550 | 2628 | 2707 | 2787 | 2868 | 2948 | 3032 | 3116 | 74 |
| 74 | 1629   | 1645   | 1763   | 1831   | 1899   | 1968   | 2039   | 2110   | 2181   | 2253   | 2326   | 2400 | 2475 | 2551 | 2629 | 2708 | 2788 | 2869 | 2949 | 3033 | 3117 | 75 |
| 75 | 1630   | 1646   | 1764   | 1832   | 1900   | 1969   | 2040   | 2111   | 2182   | 2254   | 2327   | 2401 | 2476 | 2552 | 2630 | 2709 | 2789 | 2870 | 2950 | 3034 | 3118 | 76 |
| 76 | 1631   | 1647   | 1765   | 1833   | 1901   | 1970   | 2041   | 2112   | 2183   | 2255   | 2328   | 2402 | 2477 | 2553 | 2631 | 2710 | 2790 | 2871 | 2951 | 3035 | 3119 | 77 |
| 77 | 1632   | 1648   | 1766   | 1834   | 1902   | 1971   | 2042   | 2113   | 2184   | 2256   | 2329   | 2403 | 2478 | 2554 | 2632 | 2711 | 2791 | 2872 | 2952 | 3036 | 3120 | 78 |
| 78 | 1633   | 1649   | 1767   | 1835   | 1903   | 1972   | 2043   | 2114   | 2185   | 2257   | 2330   | 2404 | 2479 | 2555 | 2633 | 2712 | 2792 | 2873 | 2953 | 3037 | 3121 | 79 |
| 79 | 1634   | 1650   | 1768   | 1836   | 1904   | 1973   | 2044   | 2115   | 2186   | 2258   | 2331   | 2405 | 2480 | 2556 | 2634 | 2713 | 2793 | 2874 | 2954 | 3038 | 3122 | 80 |
| 80 | 1635   | 1651   | 1769   | 1837   | 1905   | 1974   | 2045   | 2116   | 2187   | 2259   | 2332   | 2406 | 2481 | 2557 | 2635 | 2714 | 2794 | 2875 | 2955 | 3039 | 3123 | 81 |
| 81 | 1636   | 1652   | 1770   | 1838   | 1906   | 1975   | 2046   | 2117   | 2188   | 2260   | 2333   | 2407 | 2482 | 2558 | 2636 | 2715 | 2795 | 2876 | 2956 | 3040 | 3124 | 82 |
| 82 | 1637   | 1653   | 1771   | 1839   | 1907   | 1976   | 2047   | 2118   | 2189   | 2261   | 2334   | 2408 | 2483 | 2559 | 2637 | 2716 | 2796 | 2877 | 2957 | 3041 | 3125 | 83 |
| 83 | 1638   | 1654   | 1772   | 1840   | 1908   | 1977   | 2048   | 2119   | 2190   | 2262   | 2335   | 2409 | 2484 | 2560 | 2638 | 2717 | 2797 | 2878 | 2958 | 3042 | 3126 | 84 |
| 84 | 1639   | 1655   | 1773   | 1841   | 1909   | 1978   | 2049   | 2120   | 2191   | 2263   | 2336   | 2410 | 2485 | 2561 | 2639 | 2718 | 2798 | 2879 | 2959 | 3043 | 3127 | 85 |
| 85 | 1640   | 1656   | 1774   | 1842   | 1910   | 1979   | 2050   | 2121   | 2192   | 2264   | 2337   | 2411 | 2486 | 2562 | 2640 | 2719 | 2799 | 2880 | 2960 | 3044 | 3128 | 86 |
| 86 | 1641   | 1657   | 1775   | 1843   | 1911   | 1980   | 2051   | 2122   | 2193   | 2265   | 2338   | 2412 | 2487 | 2563 | 2641 | 2720 | 2800 | 2881 | 2961 | 3045 | 3129 | 87 |
| 87 | 1642   | 1658   | 1776   | 1844   | 1912   | 1981   | 2052   | 2123   | 2194   | 2266   | 2339   | 2413 | 2488 | 2564 | 2642 | 2721 | 2801 | 2882 | 2962 | 3046 | 3130 | 88 |
| 88 | 1643   | 1659   | 1777   | 1845   | 1913   | 1982   | 2053   | 2124   | 2195   | 226    |        |      |      |      |      |      |      |      |      |      |      |    |

TABLE VI.—MERIDIONAL PARTS.

|    | 40   | 41   | 42   | 43   | 44   | 45   | 46   | 47   | 48   | 49   | 50   | 51   | 52   | 53   | 54   | 55   | 56   | 57   | 58   | 59   | 60   | 61 | 62 | 63 | 64 | 65 | 66 |  |
|----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|----|----|----|----|----|----|--|
| 0  | 3116 | 3203 | 3292 | 3382 | 3474 | 3569 | 3665 | 3764 | 3865 | 3968 | 4074 | 4183 | 4294 | 4409 | 4527 | 4649 | 4775 | 4905 | 5039 | 5179 | 5324 |    |    |    |    |    |    |  |
| 1  | 3117 | 3204 | 3293 | 3384 | 3476 | 3570 | 3667 | 3765 | 3866 | 3970 | 4076 | 4184 | 4295 | 4411 | 4530 | 4651 | 4777 | 4907 | 5041 | 5181 | 5326 |    |    |    |    |    |    |  |
| 2  | 3118 | 3206 | 3295 | 3386 | 3478 | 3572 | 3668 | 3767 | 3868 | 3971 | 4077 | 4185 | 4296 | 4413 | 4532 | 4653 | 4779 | 4909 | 5044 | 5184 | 5328 |    |    |    |    |    |    |  |
| 3  | 3120 | 3207 | 3296 | 3387 | 3479 | 3573 | 3670 | 3769 | 3870 | 3973 | 4079 | 4187 | 4298 | 4415 | 4534 | 4655 | 4781 | 4911 | 5046 | 5186 | 5331 |    |    |    |    |    |    |  |
| 4  | 3121 | 3209 | 3298 | 3389 | 3481 | 3575 | 3672 | 3770 | 3871 | 3974 | 4081 | 4189 | 4300 | 4417 | 4536 | 4657 | 4782 | 4912 | 5049 | 5188 | 5333 |    |    |    |    |    |    |  |
| 5  | 3123 | 3210 | 3299 | 3390 | 3482 | 3577 | 3673 | 3772 | 3873 | 3976 | 4083 | 4191 | 4302 | 4419 | 4538 | 4659 | 4784 | 4914 | 5051 | 5191 | 5336 |    |    |    |    |    |    |  |
| 6  | 3124 | 3212 | 3301 | 3392 | 3484 | 3578 | 3675 | 3774 | 3875 | 3978 | 4085 | 4193 | 4304 | 4421 | 4540 | 4661 | 4786 | 4916 | 5053 | 5193 | 5338 |    |    |    |    |    |    |  |
| 7  | 3126 | 3213 | 3302 | 3393 | 3485 | 3580 | 3677 | 3775 | 3877 | 3980 | 4087 | 4195 | 4306 | 4423 | 4542 | 4663 | 4788 | 4918 | 5055 | 5195 | 5341 |    |    |    |    |    |    |  |
| 8  | 3127 | 3214 | 3303 | 3394 | 3487 | 3582 | 3678 | 3777 | 3878 | 3981 | 4088 | 4196 | 4307 | 4424 | 4543 | 4664 | 4790 | 4920 | 5057 | 5197 | 5343 |    |    |    |    |    |    |  |
| 9  | 3129 | 3216 | 3305 | 3396 | 3489 | 3583 | 3680 | 3779 | 3880 | 3983 | 4090 | 4198 | 4309 | 4426 | 4545 | 4666 | 4792 | 4922 | 5059 | 5199 | 5345 |    |    |    |    |    |    |  |
| 10 | 3130 | 3217 | 3306 | 3397 | 3490 | 3585 | 3681 | 3780 | 3881 | 3984 | 4091 | 4200 | 4311 | 4428 | 4547 | 4668 | 4794 | 4924 | 5061 | 5201 | 5347 |    |    |    |    |    |    |  |
| 11 | 3131 | 3219 | 3308 | 3399 | 3492 | 3586 | 3683 | 3782 | 3883 | 3987 | 4094 | 4203 | 4315 | 4432 | 4551 | 4672 | 4798 | 4928 | 5065 | 5205 | 5351 |    |    |    |    |    |    |  |
| 12 | 3133 | 3220 | 3309 | 3400 | 3493 | 3588 | 3685 | 3784 | 3885 | 3989 | 4096 | 4205 | 4317 | 4434 | 4553 | 4674 | 4801 | 4931 | 5067 | 5207 | 5353 |    |    |    |    |    |    |  |
| 13 | 3134 | 3222 | 3311 | 3402 | 3495 | 3590 | 3687 | 3786 | 3887 | 3991 | 4098 | 4207 | 4319 | 4436 | 4555 | 4676 | 4803 | 4934 | 5069 | 5209 | 5355 |    |    |    |    |    |    |  |
| 14 | 3136 | 3223 | 3312 | 3403 | 3496 | 3591 | 3688 | 3787 | 3889 | 3992 | 4099 | 4208 | 4321 | 4438 | 4557 | 4678 | 4805 | 4936 | 5071 | 5212 | 5358 |    |    |    |    |    |    |  |
| 15 | 3137 | 3225 | 3314 | 3405 | 3498 | 3593 | 3690 | 3789 | 3891 | 3994 | 4101 | 4210 | 4323 | 4440 | 4559 | 4680 | 4807 | 4938 | 5074 | 5214 | 5361 |    |    |    |    |    |    |  |
| 16 | 3139 | 3226 | 3316 | 3407 | 3499 | 3594 | 3691 | 3790 | 3892 | 3995 | 4102 | 4211 | 4324 | 4441 | 4560 | 4681 | 4808 | 4939 | 5075 | 5215 | 5362 |    |    |    |    |    |    |  |
| 17 | 3140 | 3228 | 3317 | 3408 | 3501 | 3596 | 3693 | 3792 | 3894 | 3997 | 4104 | 4213 | 4326 | 4443 | 4562 | 4683 | 4810 | 4941 | 5077 | 5217 | 5364 |    |    |    |    |    |    |  |
| 18 | 3142 | 3229 | 3318 | 3409 | 3502 | 3597 | 3694 | 3793 | 3895 | 3998 | 4105 | 4214 | 4327 | 4444 | 4563 | 4684 | 4811 | 4942 | 5078 | 5218 | 5365 |    |    |    |    |    |    |  |
| 19 | 3143 | 3231 | 3320 | 3411 | 3504 | 3599 | 3696 | 3795 | 3897 | 4000 | 4107 | 4216 | 4329 | 4446 | 4565 | 4686 | 4813 | 4944 | 5080 | 5220 | 5367 |    |    |    |    |    |    |  |
| 20 | 3144 | 3232 | 3321 | 3412 | 3505 | 3600 | 3697 | 3796 | 3898 | 4001 | 4108 | 4217 | 4330 | 4447 | 4566 | 4687 | 4814 | 4945 | 5081 | 5221 | 5368 |    |    |    |    |    |    |  |
| 21 | 3146 | 3234 | 3323 | 3414 | 3507 | 3602 | 3699 | 3798 | 3901 | 4004 | 4111 | 4220 | 4333 | 4450 | 4569 | 4690 | 4817 | 4948 | 5084 | 5224 | 5371 |    |    |    |    |    |    |  |
| 22 | 3147 | 3235 | 3324 | 3415 | 3508 | 3603 | 3700 | 3799 | 3902 | 4005 | 4112 | 4221 | 4334 | 4451 | 4570 | 4691 | 4818 | 4949 | 5085 | 5225 | 5372 |    |    |    |    |    |    |  |
| 23 | 3149 | 3237 | 3326 | 3417 | 3510 | 3605 | 3702 | 3801 | 3904 | 4007 | 4114 | 4223 | 4336 | 4453 | 4572 | 4693 | 4820 | 4951 | 5087 | 5227 | 5374 |    |    |    |    |    |    |  |
| 24 | 3150 | 3238 | 3327 | 3418 | 3511 | 3606 | 3703 | 3802 | 3905 | 4008 | 4115 | 4224 | 4337 | 4454 | 4573 | 4694 | 4821 | 4952 | 5088 | 5228 | 5375 |    |    |    |    |    |    |  |
| 25 | 3152 | 3240 | 3329 | 3420 | 3513 | 3607 | 3704 | 3803 | 3906 | 4009 | 4116 | 4225 | 4338 | 4455 | 4574 | 4695 | 4822 | 4953 | 5089 | 5229 | 5376 |    |    |    |    |    |    |  |
| 26 | 3153 | 3241 | 3330 | 3422 | 3514 | 3608 | 3705 | 3804 | 3907 | 4010 | 4117 | 4226 | 4339 | 4456 | 4575 | 4696 | 4823 | 4954 | 5090 | 5230 | 5377 |    |    |    |    |    |    |  |
| 27 | 3155 | 3242 | 3331 | 3423 | 3515 | 3609 | 3706 | 3805 | 3908 | 4011 | 4118 | 4227 | 4340 | 4457 | 4576 | 4697 | 4824 | 4955 | 5091 | 5231 | 5378 |    |    |    |    |    |    |  |
| 28 | 3156 | 3243 | 3332 | 3424 | 3516 | 3610 | 3707 | 3806 | 3909 | 4012 | 4119 | 4228 | 4341 | 4458 | 4577 | 4698 | 4825 | 4956 | 5092 | 5232 | 5379 |    |    |    |    |    |    |  |
| 29 | 3157 | 3245 | 3333 | 3425 | 3517 | 3611 | 3708 | 3807 | 3910 | 4013 | 4120 | 4229 | 4342 | 4459 | 4578 | 4699 | 4826 | 4957 | 5093 | 5233 | 5380 |    |    |    |    |    |    |  |

TABLE VI.—MERIDIONAL PARTS.

|    | 46°  | 47°  | 48°  | 49°  | 50°  | 51°  | 52°  | 53°  | 54°  | 55°  | 56°  | 57°  | 58°  | 59°  | 60°  | 61°  | 62°  | 63°  | 64°  | 65°  | 66°  |
|----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 30 | 3139 | 3047 | 3337 | 3048 | 3531 | 3617 | 3714 | 3814 | 3916 | 4021 | 4128 | 4238 | 4351 | 4468 | 4588 | 4712 | 4839 | 4972 | 5108 | 5250 | 5398 |
| 31 | 3160 | 3068 | 3358 | 3069 | 3552 | 3638 | 3735 | 3835 | 3938 | 4043 | 4150 | 4259 | 4372 | 4489 | 4609 | 4733 | 4861 | 4994 | 5132 | 5275 | 5423 |
| 32 | 3186 | 3094 | 3384 | 3095 | 3577 | 3664 | 3762 | 3862 | 3965 | 4070 | 4177 | 4286 | 4399 | 4516 | 4636 | 4759 | 4886 | 5019 | 5157 | 5300 | 5448 |
| 33 | 3213 | 3121 | 3411 | 3122 | 3603 | 3691 | 3790 | 3890 | 3993 | 4100 | 4208 | 4318 | 4431 | 4548 | 4668 | 4791 | 4918 | 5050 | 5187 | 5329 | 5476 |
| 34 | 3240 | 3148 | 3438 | 3149 | 3629 | 3718 | 3817 | 3917 | 4020 | 4127 | 4235 | 4345 | 4458 | 4575 | 4695 | 4818 | 4945 | 5077 | 5214 | 5356 | 5503 |
| 35 | 3266 | 3174 | 3464 | 3175 | 3654 | 3744 | 3843 | 3943 | 4046 | 4153 | 4261 | 4371 | 4484 | 4599 | 4718 | 4840 | 4965 | 5094 | 5227 | 5364 | 5506 |
| 36 | 3293 | 3201 | 3491 | 3202 | 3680 | 3771 | 3870 | 3969 | 4072 | 4179 | 4287 | 4397 | 4509 | 4624 | 4742 | 4863 | 4987 | 5115 | 5247 | 5383 | 5524 |
| 37 | 3319 | 3227 | 3517 | 3228 | 3705 | 3796 | 3895 | 3993 | 4100 | 4208 | 4317 | 4427 | 4539 | 4653 | 4770 | 4890 | 5013 | 5139 | 5269 | 5403 | 5542 |
| 38 | 3346 | 3254 | 3544 | 3255 | 3731 | 3822 | 3921 | 4019 | 4127 | 4235 | 4344 | 4454 | 4565 | 4678 | 4793 | 4911 | 5032 | 5157 | 5286 | 5419 | 5556 |
| 39 | 3372 | 3280 | 3570 | 3281 | 3756 | 3847 | 3946 | 4044 | 4152 | 4260 | 4369 | 4479 | 4589 | 4701 | 4815 | 4932 | 5051 | 5174 | 5300 | 5430 | 5564 |
| 40 | 3399 | 3307 | 3597 | 3308 | 3782 | 3873 | 3971 | 4069 | 4177 | 4285 | 4394 | 4503 | 4613 | 4723 | 4834 | 4947 | 5062 | 5180 | 5301 | 5426 | 5555 |
| 41 | 3425 | 3333 | 3623 | 3334 | 3807 | 3898 | 3995 | 4093 | 4199 | 4307 | 4415 | 4524 | 4633 | 4743 | 4854 | 4966 | 5080 | 5197 | 5317 | 5441 | 5569 |
| 42 | 3452 | 3360 | 3650 | 3361 | 3833 | 3924 | 4021 | 4119 | 4226 | 4334 | 4442 | 4550 | 4659 | 4768 | 4878 | 4989 | 5101 | 5216 | 5334 | 5456 | 5582 |
| 43 | 3478 | 3386 | 3676 | 3387 | 3858 | 3949 | 4046 | 4144 | 4251 | 4359 | 4467 | 4575 | 4684 | 4793 | 4903 | 5014 | 5126 | 5240 | 5358 | 5480 | 5606 |
| 44 | 3505 | 3413 | 3703 | 3414 | 3884 | 3975 | 4072 | 4170 | 4277 | 4384 | 4491 | 4600 | 4708 | 4817 | 4927 | 5037 | 5148 | 5261 | 5377 | 5495 | 5621 |
| 45 | 3531 | 3439 | 3729 | 3440 | 3909 | 4000 | 4097 | 4195 | 4292 | 4399 | 4506 | 4614 | 4722 | 4830 | 4939 | 5048 | 5158 | 5269 | 5383 | 5500 | 5624 |
| 46 | 3558 | 3466 | 3756 | 3467 | 3935 | 4026 | 4123 | 4220 | 4317 | 4414 | 4511 | 4618 | 4725 | 4832 | 4940 | 5049 | 5158 | 5268 | 5380 | 5495 | 5614 |
| 47 | 3584 | 3492 | 3782 | 3493 | 3960 | 4051 | 4148 | 4245 | 4342 | 4439 | 4536 | 4633 | 4740 | 4847 | 4955 | 5063 | 5172 | 5282 | 5393 | 5507 | 5624 |
| 48 | 3611 | 3519 | 3809 | 3520 | 3986 | 4077 | 4174 | 4271 | 4368 | 4465 | 4562 | 4659 | 4756 | 4853 | 4951 | 5050 | 5150 | 5251 | 5353 | 5457 | 5564 |
| 49 | 3637 | 3545 | 3835 | 3546 | 4011 | 4102 | 4199 | 4296 | 4393 | 4490 | 4587 | 4684 | 4781 | 4878 | 4975 | 5073 | 5172 | 5272 | 5374 | 5478 | 5584 |
| 50 | 3664 | 3572 | 3862 | 3573 | 4037 | 4128 | 4225 | 4322 | 4419 | 4516 | 4613 | 4710 | 4807 | 4904 | 5001 | 5100 | 5199 | 5299 | 5399 | 5501 | 5606 |
| 51 | 3690 | 3598 | 3888 | 3599 | 4062 | 4153 | 4250 | 4347 | 4444 | 4541 | 4638 | 4735 | 4832 | 4929 | 5026 | 5125 | 5224 | 5324 | 5425 | 5528 | 5633 |
| 52 | 3717 | 3625 | 3915 | 3626 | 4080 | 4171 | 4268 | 4365 | 4462 | 4559 | 4656 | 4753 | 4850 | 4947 | 5044 | 5143 | 5242 | 5342 | 5443 | 5546 | 5651 |
| 53 | 3743 | 3651 | 3941 | 3652 | 4105 | 4196 | 4293 | 4390 | 4487 | 4584 | 4681 | 4778 | 4875 | 4972 | 5069 | 5168 | 5268 | 5368 | 5469 | 5572 | 5677 |
| 54 | 3770 | 3678 | 3968 | 3679 | 4131 | 4222 | 4319 | 4416 | 4513 | 4610 | 4707 | 4804 | 4901 | 4998 | 5095 | 5194 | 5294 | 5395 | 5496 | 5599 | 5704 |
| 55 | 3796 | 3704 | 3994 | 3705 | 4156 | 4247 | 4344 | 4441 | 4538 | 4635 | 4732 | 4829 | 4926 | 5023 | 5120 | 5219 | 5319 | 5419 | 5520 | 5623 | 5728 |
| 56 | 3823 | 3731 | 4021 | 3732 | 4182 | 4273 | 4370 | 4467 | 4564 | 4661 | 4758 | 4855 | 4952 | 5049 | 5146 | 5245 | 5345 | 5445 | 5546 | 5649 | 5754 |
| 57 | 3849 | 3757 | 4047 | 3758 | 4207 | 4298 | 4395 | 4492 | 4589 | 4686 | 4783 | 4880 | 4977 | 5074 | 5171 | 5269 | 5368 | 5468 | 5569 | 5671 | 5775 |
| 58 | 3876 | 3784 | 4074 | 3785 | 4233 | 4324 | 4421 | 4518 | 4615 | 4712 | 4809 | 4906 | 5003 | 5100 | 5197 | 5295 | 5394 | 5494 | 5595 | 5697 | 5800 |
| 59 | 3902 | 3810 | 4100 | 3811 | 4258 | 4349 | 4446 | 4543 | 4640 | 4737 | 4834 | 4931 | 5028 | 5125 | 5222 | 5320 | 5419 | 5519 | 5619 | 5720 | 5823 |

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 | 5531 | 5595 | 5666 | 5746 | 5834 | 5931 | 6038 | 6156 | 6284 | 6422 | 6570 | 6728 | 6896 | 7074 | 7262 | 7460 | 7668 | 7886 | 0  |
| 1  | 5477 | 5534 | 5598 | 5669 | 5749 | 5837 | 5934 | 6041 | 6159 | 6287 | 6425 | 6573 | 6731 | 6899 | 7077 | 7265 | 7463 | 7671 | 7889 | 1  |
| 2  | 5479 | 5536 | 5600 | 5671 | 5751 | 5839 | 5936 | 6043 | 6161 | 6289 | 6427 | 6575 | 6733 | 6901 | 7079 | 7267 | 7465 | 7673 | 7891 | 2  |
| 3  | 5482 | 5539 | 5603 | 5674 | 5754 | 5842 | 5939 | 6046 | 6164 | 6292 | 6430 | 6578 | 6736 | 6904 | 7082 | 7270 | 7468 | 7676 | 7894 | 3  |
| 4  | 5484 | 5541 | 5605 | 5676 | 5756 | 5844 | 5941 | 6048 | 6166 | 6294 | 6432 | 6580 | 6738 | 6906 | 7084 | 7272 | 7470 | 7678 | 7896 | 4  |
| 5  | 5487 | 5544 | 5608 | 5679 | 5759 | 5847 | 5944 | 6051 | 6169 | 6297 | 6435 | 6583 | 6741 | 6909 | 7087 | 7275 | 7473 | 7681 | 7900 | 5  |
| 6  | 5489 | 5546 | 5610 | 5681 | 5761 | 5849 | 5946 | 6053 | 6171 | 6300 | 6438 | 6586 | 6744 | 6912 | 7090 | 7278 | 7476 | 7684 | 7903 | 6  |
| 7  | 5492 | 5549 | 5613 | 5684 | 5764 | 5852 | 5949 | 6056 | 6174 | 6303 | 6441 | 6589 | 6747 | 6915 | 7093 | 7281 | 7479 | 7687 | 7906 | 7  |
| 8  | 5495 | 5552 | 5616 | 5687 | 5767 | 5855 | 5952 | 6059 | 6177 | 6306 | 6444 | 6592 | 6750 | 6918 | 7096 | 7284 | 7482 | 7690 | 7909 | 8  |
| 9  | 5497 | 5554 | 5618 | 5689 | 5769 | 5857 | 5954 | 6061 | 6179 | 6308 | 6446 | 6594 | 6752 | 6920 | 7098 | 7286 | 7484 | 7692 | 7911 | 9  |
| 10 | 5500 | 5557 | 5621 | 5692 | 5772 | 5860 | 5957 | 6064 | 6182 | 6311 | 6449 | 6597 | 6755 | 6923 | 7101 | 7289 | 7487 | 7695 | 7914 | 10 |
| 11 | 5502 | 5559 | 5623 | 5694 | 5774 | 5862 | 5959 | 6066 | 6184 | 6313 | 6451 | 6600 | 6758 | 6926 | 7104 | 7292 | 7490 | 7698 | 7917 | 11 |
| 12 | 5505 | 5562 | 5626 | 5697 | 5777 | 5865 | 5962 | 6069 | 6187 | 6316 | 6454 | 6603 | 6761 | 6929 | 7107 | 7295 | 7493 | 7701 | 7920 | 12 |
| 13 | 5507 | 5564 | 5628 | 5699 | 5779 | 5867 | 5964 | 6071 | 6189 | 6318 | 6456 | 6605 | 6763 | 6931 | 7109 | 7297 | 7495 | 7703 | 7922 | 13 |
| 14 | 5510 | 5567 | 5631 | 5702 | 5782 | 5870 | 5967 | 6074 | 6192 | 6321 | 6459 | 6608 | 6766 | 6934 | 7112 | 7300 | 7498 | 7706 | 7925 | 14 |
| 15 | 5513 | 5570 | 5634 | 5705 | 5785 | 5873 | 5970 | 6077 | 6195 | 6324 | 6462 | 6611 | 6769 | 6937 | 7115 | 7303 | 7501 | 7709 | 7928 | 15 |
| 16 | 5515 | 5572 | 5636 | 5707 | 5787 | 5875 | 5972 | 6079 | 6197 | 6326 | 6464 | 6613 | 6771 | 6939 | 7117 | 7305 | 7503 | 7711 | 7930 | 16 |
| 17 | 5518 | 5575 | 5639 | 5710 | 5790 | 5878 | 5975 | 6082 | 6200 | 6329 | 6467 | 6616 | 6774 | 6942 | 7120 | 7308 | 7506 | 7714 | 7933 | 17 |
| 18 | 5520 | 5577 | 5641 | 5712 | 5792 | 5880 | 5977 | 6084 | 6202 | 6331 | 6469 | 6618 | 6776 | 6944 | 7122 | 7310 | 7508 | 7716 | 7935 | 18 |
| 19 | 5523 | 5580 | 5644 | 5715 | 5795 | 5883 | 5980 | 6087 | 6205 | 6334 | 6472 | 6621 | 6779 | 6947 | 7125 | 7313 | 7511 | 7719 | 7938 | 19 |
| 20 | 5526 | 5583 | 5647 | 5718 | 5798 | 5886 | 5983 | 6090 | 6208 | 6337 | 6475 | 6624 | 6782 | 6950 | 7128 | 7316 | 7514 | 7722 | 7941 | 20 |
| 21 | 5528 | 5585 | 5649 | 5720 | 5800 | 5888 | 5985 | 6092 | 6210 | 6339 | 6477 | 6626 | 6784 | 6952 | 7130 | 7318 | 7516 | 7724 | 7943 | 21 |
| 22 | 5531 | 5588 | 5652 | 5723 | 5803 | 5891 | 5988 | 6095 | 6213 | 6342 | 6480 | 6629 | 6787 | 6955 | 7133 | 7321 | 7519 | 7727 | 7946 | 22 |
| 23 | 5533 | 5590 | 5654 | 5725 | 5805 | 5893 | 5990 | 6097 | 6215 | 6344 | 6482 | 6631 | 6789 | 6957 | 7135 | 7323 | 7521 | 7729 | 7948 | 23 |
| 24 | 5536 | 5593 | 5657 | 5728 | 5808 | 5896 | 5993 | 6100 | 6218 | 6347 | 6485 | 6634 | 6792 | 6960 | 7138 | 7326 | 7524 | 7732 | 7950 | 24 |
| 25 | 5539 | 5596 | 5660 | 5731 | 5811 | 5899 | 5996 | 6103 | 6221 | 6350 | 6488 | 6637 | 6795 | 6963 | 7141 | 7329 | 7527 | 7735 | 7953 | 25 |
| 26 | 5541 | 5598 | 5662 | 5733 | 5813 | 5901 | 5998 | 6105 | 6223 | 6352 | 6490 | 6639 | 6797 | 6965 | 7143 | 7331 | 7529 | 7737 | 7955 | 26 |
| 27 | 5544 | 5601 | 5665 | 5736 | 5816 | 5904 | 6001 | 6108 | 6226 | 6355 | 6493 | 6642 | 6800 | 6968 | 7146 | 7334 | 7532 | 7740 | 7958 | 27 |
| 28 | 5546 | 5603 | 5667 | 5738 | 5818 | 5906 | 6003 | 6110 | 6228 | 6357 | 6495 | 6644 | 6802 | 6970 | 7148 | 7336 | 7534 | 7742 | 7960 | 28 |
| 29 | 5549 | 5606 | 5670 | 5741 | 5821 | 5909 | 6006 | 6113 | 6231 | 6360 | 6498 | 6647 | 6805 | 6973 | 7150 | 7338 | 7536 | 7744 | 7962 | 29 |

TABLE VI.—MERIDIONAL PARTS.

| '  | 67°  | 68°  | 69°  | 70°  | 71°  | 72°  | 73°  | 74°  | 75°  | 76°  | 77°  | 78°  | 79°  | 80°  | 81°  | 82°  | 83°  | 84°   | 85°   | '  |
|----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-------|-------|----|
| 30 | 5552 | 5712 | 5879 | 6055 | 6239 | 6433 | 6639 | 6856 | 7082 | 7336 | 7633 | 7982 | 8207 | 8522 | 8936 | 9368 | 9861 | 10437 | 11127 | 30 |
| 31 | 5554 | 5715 | 5882 | 6058 | 6242 | 6437 | 6643 | 6860 | 7092 | 7341 | 7638 | 7987 | 8212 | 8558 | 8943 | 9376 | 9870 | 10447 | 11140 | 31 |
| 32 | 5557 | 5717 | 5885 | 6061 | 6245 | 6440 | 6646 | 6864 | 7096 | 7345 | 7642 | 7991 | 8216 | 8562 | 8947 | 9380 | 9874 | 10451 | 11144 | 32 |
| 33 | 5559 | 5719 | 5888 | 6064 | 6248 | 6443 | 6649 | 6867 | 7100 | 7349 | 7646 | 7995 | 8220 | 8566 | 8951 | 9384 | 9878 | 10454 | 11147 | 33 |
| 34 | 5562 | 5722 | 5891 | 6067 | 6251 | 6447 | 6653 | 6871 | 7104 | 7353 | 7650 | 7999 | 8224 | 8570 | 8955 | 9388 | 9882 | 10457 | 11150 | 34 |
| 35 | 5565 | 5725 | 5894 | 6070 | 6255 | 6450 | 6656 | 6874 | 7107 | 7356 | 7653 | 7999 | 8224 | 8570 | 8955 | 9388 | 9882 | 10457 | 11150 | 35 |
| 36 | 5567 | 5728 | 5896 | 6073 | 6258 | 6453 | 6660 | 6879 | 7112 | 7359 | 7656 | 7999 | 8224 | 8570 | 8955 | 9388 | 9882 | 10457 | 11150 | 36 |
| 37 | 5570 | 5731 | 5899 | 6076 | 6261 | 6457 | 6663 | 6882 | 7115 | 7362 | 7659 | 7999 | 8224 | 8570 | 8955 | 9388 | 9882 | 10457 | 11150 | 37 |
| 38 | 5573 | 5734 | 5902 | 6079 | 6264 | 6460 | 6667 | 6886 | 7118 | 7365 | 7662 | 7999 | 8224 | 8570 | 8955 | 9388 | 9882 | 10457 | 11150 | 38 |
| 39 | 5575 | 5736 | 5905 | 6082 | 6268 | 6463 | 6670 | 6889 | 7121 | 7368 | 7665 | 7999 | 8224 | 8570 | 8955 | 9388 | 9882 | 10457 | 11150 | 39 |
| 40 | 5578 | 5739 | 5908 | 6085 | 6271 | 6467 | 6674 | 6893 | 7124 | 7371 | 7668 | 7999 | 8224 | 8570 | 8955 | 9388 | 9882 | 10457 | 11150 | 40 |
| 41 | 5580 | 5742 | 5911 | 6088 | 6274 | 6470 | 6677 | 6896 | 7127 | 7374 | 7671 | 7999 | 8224 | 8570 | 8955 | 9388 | 9882 | 10457 | 11150 | 41 |
| 42 | 5583 | 5745 | 5914 | 6091 | 6277 | 6473 | 6681 | 6900 | 7130 | 7377 | 7674 | 7999 | 8224 | 8570 | 8955 | 9388 | 9882 | 10457 | 11150 | 42 |
| 43 | 5586 | 5747 | 5917 | 6094 | 6280 | 6477 | 6685 | 6904 | 7133 | 7380 | 7677 | 7999 | 8224 | 8570 | 8955 | 9388 | 9882 | 10457 | 11150 | 43 |
| 44 | 5588 | 5750 | 5919 | 6097 | 6283 | 6480 | 6688 | 6907 | 7136 | 7383 | 7680 | 7999 | 8224 | 8570 | 8955 | 9388 | 9882 | 10457 | 11150 | 44 |
| 45 | 5591 | 5753 | 5922 | 6100 | 6287 | 6483 | 6692 | 6911 | 7139 | 7386 | 7683 | 7999 | 8224 | 8570 | 8955 | 9388 | 9882 | 10457 | 11150 | 45 |
| 46 | 5594 | 5756 | 5925 | 6103 | 6290 | 6487 | 6695 | 6914 | 7142 | 7389 | 7686 | 7999 | 8224 | 8570 | 8955 | 9388 | 9882 | 10457 | 11150 | 46 |
| 47 | 5596 | 5758 | 5928 | 6106 | 6293 | 6490 | 6699 | 6917 | 7145 | 7392 | 7689 | 7999 | 8224 | 8570 | 8955 | 9388 | 9882 | 10457 | 11150 | 47 |
| 48 | 5599 | 5761 | 5931 | 6109 | 6296 | 6494 | 6702 | 6920 | 7148 | 7395 | 7692 | 7999 | 8224 | 8570 | 8955 | 9388 | 9882 | 10457 | 11150 | 48 |
| 49 | 5602 | 5764 | 5934 | 6112 | 6299 | 6497 | 6706 | 6923 | 7151 | 7398 | 7695 | 7999 | 8224 | 8570 | 8955 | 9388 | 9882 | 10457 | 11150 | 49 |
| 50 | 5604 | 5767 | 5937 | 6115 | 6303 | 6500 | 6710 | 6932 | 7154 | 7401 | 7698 | 7999 | 8224 | 8570 | 8955 | 9388 | 9882 | 10457 | 11150 | 50 |
| 51 | 5607 | 5770 | 5940 | 6118 | 6306 | 6504 | 6713 | 6936 | 7157 | 7404 | 7701 | 7999 | 8224 | 8570 | 8955 | 9388 | 9882 | 10457 | 11150 | 51 |
| 52 | 5610 | 5773 | 5943 | 6121 | 6309 | 6507 | 6717 | 6940 | 7160 | 7407 | 7704 | 7999 | 8224 | 8570 | 8955 | 9388 | 9882 | 10457 | 11150 | 52 |
| 53 | 5613 | 5775 | 5946 | 6124 | 6312 | 6511 | 6720 | 6943 | 7163 | 7410 | 7707 | 7999 | 8224 | 8570 | 8955 | 9388 | 9882 | 10457 | 11150 | 53 |
| 54 | 5615 | 5778 | 5948 | 6127 | 6315 | 6514 | 6724 | 6947 | 7166 | 7413 | 7710 | 7999 | 8224 | 8570 | 8955 | 9388 | 9882 | 10457 | 11150 | 54 |
| 55 | 5617 | 5781 | 5951 | 6130 | 6319 | 6517 | 6728 | 6951 | 7169 | 7416 | 7713 | 7999 | 8224 | 8570 | 8955 | 9388 | 9882 | 10457 | 11150 | 55 |
| 56 | 5620 | 5784 | 5954 | 6133 | 6322 | 6521 | 6731 | 6955 | 7172 | 7419 | 7716 | 7999 | 8224 | 8570 | 8955 | 9388 | 9882 | 10457 | 11150 | 56 |
| 57 | 5623 | 5786 | 5957 | 6136 | 6325 | 6524 | 6735 | 6959 | 7175 | 7422 | 7719 | 7999 | 8224 | 8570 | 8955 | 9388 | 9882 | 10457 | 11150 | 57 |
| 58 | 5625 | 5789 | 5960 | 6139 | 6328 | 6528 | 6738 | 6962 | 7178 | 7425 | 7722 | 7999 | 8224 | 8570 | 8955 | 9388 | 9882 | 10457 | 11150 | 58 |
| 59 | 5628 | 5792 | 5963 | 6142 | 6331 | 6531 | 6742 | 6966 | 7181 | 7428 | 7725 | 7999 | 8224 | 8570 | 8955 | 9388 | 9882 | 10457 | 11150 | 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        | 27'24           |
| 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. |       |
|----------------|------|-----------------|-------|
| 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 | 92              | 9 22  |
| 23             | 4 43 | 95              | 9 26  |
| 24             | 4 49 | 98              | 9 36  |
| 25             | 4 55 | 100             | 9 45  |
| 26             | 5 1  | 101             | 9 52  |
| 27             | 5 7  | 104             | 9 54  |
| 28             | 5 13 | 107             | 10 2  |
| 29             | 5 18 | 110             | 10 11 |
| 30             | 5 24 |                 | 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<br>miles. | HEIGHT OF EYE. |             |             |             |             |             |
|-----------------------|----------------|-------------|-------------|-------------|-------------|-------------|
|                       | feet.<br>5     | feet.<br>10 | feet.<br>15 | feet.<br>20 | feet.<br>25 | feet.<br>30 |
| 0 $\frac{1}{4}$       | 11             | 22          | 34          | 45          | 56          | 68          |
| 0 $\frac{1}{2}$       | 6              | 11          | 17          | 22          | 28          | 34          |
| 0 $\frac{3}{4}$       | 4              | 8           | 12          | 15          | 19          | 23          |
| 1                     | 4              | 6           | 9           | 12          | 15          | 18          |
| 1 $\frac{1}{4}$       | 3              | 5           | 7           | 9           | 12          | 14          |
| 1 $\frac{1}{2}$       | 3              | 4           | 6           | 8           | 10          | 12          |
| 2                     | 2              | 3           | 5           | 6           | 8           | 10          |
| 2 $\frac{1}{2}$       | 2              | 3           | 5           | 6           | 7           | 8           |
| 3                     | 2              | 3           | 4           | 5           | 6           | 7           |
| 3 $\frac{1}{2}$       | 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**  
**SEMI-DIAMETER.**

| Altitude. | HORIZONTAL SEMI-DIAMETER. |        |         |        |         |        |
|-----------|---------------------------|--------|---------|--------|---------|--------|
|           | 14° 30'                   | 15° 0' | 15° 30' | 16° 0' | 16° 30' | 17° 0' |
| 0         | "                         | "      | "       | "      | "       | "      |
| 0         | 0                         | 0      | 0       | 0      | 0       | 0      |
| 2         | 1                         | 1      | 1       | 1      | 1       | 1      |
| 4         | 1                         | 1      | 1       | 1      | 1       | 1      |
| 6         | 2                         | 2      | 2       | 2      | 2       | 2      |
| 8         | 2                         | 2      | 2       | 2      | 3       | 3      |
| 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. |
|-------|----------|-------|----------|-------|-------|
| °     | H. M. S. | °     | H. M. S. | "     | Secs. |
| 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. |
|-------|-------|-----------|-------|-------|-------|
| H.    | °     | Min. Sec. | ° ' " | Sec.  | "     |
| 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.            | App. Alt.              | Refraction.            |
|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| 0 1 2 3 4 5 6 7 8 9 10 | 0 1 2 3 4 5 6 7 8 9 10 | 0 1 2 3 4 5 6 7 8 9 10 | 0 1 2 3 4 5 6 7 8 9 10 | 0 1 2 3 4 5 6 7 8 9 10 | 0 1 2 3 4 5 6 7 8 9 10 | 0 1 2 3 4 5 6 7 8 9 10 | 0 1 2 3 4 5 6 7 8 9 10 | 0 1 2 3 4 5 6 7 8 9 10 | 0 1 2 3 4 5 6 7 8 9 10 |
| 1 0                    | 24 21.2                | 10 0                   | 5 19.8                 | 19 0                   | 2 47.7                 | 28 0                   | 1 49.2                 | 37 0                   | 1 17.2                 |
| 10                     | 23 9.6                 | 10                     | 5 15.1                 | 10                     | 2 46.3                 | 10                     | 1 48.4                 | 10                     | 1 16.7                 |
| 20                     | 22 3.4                 | 20                     | 5 10.4                 | 20                     | 2 44.8                 | 20                     | 1 47.6                 | 20                     | 1 16.2                 |
| 30                     | 21 1.9                 | 30                     | 5 5.7                  | 30                     | 2 43.3                 | 30                     | 1 46.9                 | 30                     | 1 15.8                 |
| 40                     | 20 4.8                 | 40                     | 5 1.0                  | 40                     | 2 41.8                 | 40                     | 1 46.2                 | 40                     | 1 15.3                 |
| 50                     | 19 11.5                | 50                     | 4 56.3                 | 50                     | 2 40.3                 | 50                     | 1 45.5                 | 50                     | 1 14.8                 |
| 2 0                    | 18 22.8                | 11 0                   | 4 51.7                 | 20 0                   | 2 38.8                 | 29 0                   | 1 44.8                 | 30 0                   | 1 14.4                 |
| 10                     | 17 36.3                | 10                     | 4 47.7                 | 10                     | 2 37.4                 | 10                     | 1 44.1                 | 10                     | 1 14.0                 |
| 20                     | 16 53.2                | 20                     | 4 43.7                 | 20                     | 2 36.0                 | 20                     | 1 43.4                 | 20                     | 1 13.5                 |
| 30                     | 16 13.4                | 30                     | 4 39.7                 | 30                     | 2 34.6                 | 30                     | 1 42.7                 | 30                     | 1 13.1                 |
| 40                     | 15 36.0                | 40                     | 4 35.7                 | 40                     | 2 33.2                 | 40                     | 1 42.0                 | 40                     | 1 12.7                 |
| 50                     | 15 0.9                 | 50                     | 4 31.8                 | 50                     | 2 31.9                 | 50                     | 1 41.3                 | 50                     | 1 12.2                 |
| 3 0                    | 14 28.1                | 12 0                   | 4 27.9                 | 21 0                   | 2 30.6                 | 30 0                   | 1 40.6                 | 39 0                   | 1 11.8                 |
| 10                     | 13 57.3                | 10                     | 4 24.5                 | 10                     | 2 29.3                 | 10                     | 1 39.9                 | 10                     | 1 11.3                 |
| 20                     | 13 28.5                | 20                     | 4 21.1                 | 20                     | 2 28.1                 | 20                     | 1 39.3                 | 20                     | 1 10.9                 |
| 30                     | 13 1.3                 | 30                     | 4 17.7                 | 30                     | 2 26.9                 | 30                     | 1 38.6                 | 30                     | 1 10.5                 |
| 40                     | 12 35.6                | 40                     | 4 14.3                 | 40                     | 2 25.6                 | 40                     | 1 38.0                 | 40                     | 1 10.1                 |
| 50                     | 12 11.3                | 50                     | 4 10.5                 | 50                     | 2 24.4                 | 50                     | 1 37.3                 | 50                     | 1 9.7                  |
| 4 0                    | 11 48.3                | 13 0                   | 4 7.5                  | 22 0                   | 2 23.2                 | 31 0                   | 1 36.7                 | 40 0                   | 1 9.3                  |
| 10                     | 11 26.6                | 10                     | 4 4.5                  | 10                     | 2 22.1                 | 10                     | 1 36.1                 | 10                     | 1 8.9                  |
| 20                     | 11 6.1                 | 20                     | 4 1.5                  | 20                     | 2 20.9                 | 20                     | 1 35.5                 | 20                     | 1 8.5                  |
| 30                     | 10 46.7                | 30                     | 3 58.6                 | 30                     | 2 19.8                 | 30                     | 1 34.9                 | 30                     | 1 8.1                  |
| 40                     | 10 28.3                | 40                     | 3 55.7                 | 40                     | 2 18.7                 | 40                     | 1 34.3                 | 40                     | 1 7.7                  |
| 50                     | 10 10.9                | 50                     | 3 52.7                 | 50                     | 2 17.6                 | 50                     | 1 33.7                 | 50                     | 1 7.3                  |
| 5 0                    | 9 54.3                 | 14 0                   | 3 49.8                 | 28 0                   | 2 16.5                 | 32 0                   | 1 33.1                 | 42 0                   | 1 6.9                  |
| 10                     | 9 38.4                 | 10                     | 3 47.2                 | 10                     | 2 15.4                 | 10                     | 1 32.5                 | 10                     | 1 6.5                  |
| 20                     | 9 23.4                 | 20                     | 3 44.6                 | 20                     | 2 14.4                 | 20                     | 1 31.9                 | 20                     | 1 6.1                  |
| 30                     | 9 4.0                  | 30                     | 3 42.0                 | 30                     | 2 13.3                 | 30                     | 1 31.3                 | 30                     | 1 5.7                  |
| 40                     | 8 55.3                 | 40                     | 3 39.4                 | 40                     | 2 12.3                 | 40                     | 1 30.7                 | 40                     | 1 5.3                  |
| 50                     | 8 42.3                 | 50                     | 3 36.8                 | 50                     | 2 11.2                 | 50                     | 1 30.2                 | 50                     | 1 4.9                  |
| 6 0                    | 8 29.9                 | 15 0                   | 3 34.3                 | 24 0                   | 2 10.2                 | 33 0                   | 1 29.6                 | 42 0                   | 1 4.6                  |
| 10                     | 8 18.2                 | 10                     | 3 32.1                 | 10                     | 2 9.2                  | 10                     | 1 29.0                 | 10                     | 1 4.2                  |
| 20                     | 8 6.6                  | 20                     | 3 29.8                 | 20                     | 2 8.2                  | 20                     | 1 28.4                 | 20                     | 1 3.8                  |
| 30                     | 7 55.6                 | 30                     | 3 27.5                 | 30                     | 2 7.2                  | 30                     | 1 27.8                 | 30                     | 1 3.5                  |
| 40                     | 7 44.9                 | 40                     | 3 25.2                 | 40                     | 2 6.2                  | 40                     | 1 27.3                 | 40                     | 1 3.1                  |
| 50                     | 7 34.7                 | 50                     | 3 22.9                 | 50                     | 2 5.2                  | 50                     | 1 26.7                 | 50                     | 1 2.8                  |
| 7 0                    | 7 24.7                 | 16 0                   | 3 20.7                 | 26 0                   | 2 4.3                  | 34 0                   | 1 26.2                 | 42 0                   | 1 2.4                  |
| 10                     | 7 15.3                 | 10                     | 3 18.5                 | 10                     | 2 3.4                  | 10                     | 1 25.6                 | 10                     | 1 2.0                  |
| 20                     | 7 6.3                  | 20                     | 3 16.5                 | 20                     | 2 2.5                  | 20                     | 1 25.1                 | 20                     | 1 1.7                  |
| 30                     | 6 57.7                 | 30                     | 3 14.5                 | 30                     | 2 1.6                  | 30                     | 1 24.6                 | 30                     | 1 1.3                  |
| 40                     | 6 49.6                 | 40                     | 3 12.5                 | 40                     | 2 0.7                  | 40                     | 1 24.1                 | 40                     | 1 1.0                  |
| 50                     | 6 41.9                 | 50                     | 3 10.5                 | 50                     | 1 59.8                 | 50                     | 1 23.6                 | 50                     | 1 0.6                  |
| 8 0                    | 6 34.4                 | 17 0                   | 3 8.5                  | 29 0                   | 1 58.9                 | 35 0                   | 1 23.1                 | 44 0                   | 1 0.3                  |
| 10                     | 6 27.1                 | 10                     | 3 6.6                  | 10                     | 1 58.0                 | 10                     | 1 22.6                 | 10                     | 1 0.0                  |
| 20                     | 6 20.0                 | 20                     | 3 4.8                  | 20                     | 1 57.2                 | 20                     | 1 22.1                 | 20                     | 0 59.6                 |
| 30                     | 6 13.1                 | 30                     | 3 3.0                  | 30                     | 1 56.4                 | 30                     | 1 21.6                 | 30                     | 0 59.2                 |
| 40                     | 6 6.4                  | 40                     | 3 1.2                  | 40                     | 1 55.6                 | 40                     | 1 21.1                 | 40                     | 0 58.9                 |
| 50                     | 5 59.9                 | 50                     | 2 59.4                 | 50                     | 1 54.7                 | 50                     | 1 20.6                 | 50                     | 0 58.5                 |
| 9 0                    | 5 53.5                 | 18 0                   | 2 57.6                 | 27 0                   | 1 53.9                 | 36 0                   | 1 20.1                 | 45 0                   | 0 58.2                 |
| 10                     | 5 47.4                 | 10                     | 2 55.9                 | 10                     | 1 53.2                 | 10                     | 1 19.6                 | 10                     | 0 57.8                 |
| 20                     | 5 41.5                 | 20                     | 2 54.3                 | 20                     | 1 52.4                 | 20                     | 1 19.1                 | 20                     | 0 57.5                 |
| 30                     | 5 35.9                 | 30                     | 2 52.8                 | 30                     | 1 51.6                 | 30                     | 1 18.6                 | 30                     | 0 57.2                 |
| 40                     | 5 30.4                 | 40                     | 2 51.0                 | 40                     | 1 50.8                 | 40                     | 1 18.1                 | 40                     | 0 56.9                 |
| 50                     | 5 25.1                 | 50                     | 2 49.3                 | 50                     | 1 50.0                 | 50                     | 1 17.6                 | 50                     | 0 56.2                 |

TABLE XV.—REFRACTION OF THE SUN AND STARS.

| App.<br>Alt. | Refrac-<br>tion. | App.<br>Alt. | Refrac-<br>tion. | App.<br>Alt. | Refrac-<br>tion. | App.<br>Alt. | Refrac-<br>tion. | App.<br>Alt. | Refrac-<br>tion. |   |      |    |   |     |
|--------------|------------------|--------------|------------------|--------------|------------------|--------------|------------------|--------------|------------------|---|------|----|---|-----|
| 0            | 1                | 0            | 1                | 0            | 1                | 0            | 1                | 0            | 1                |   |      |    |   |     |
| 46           | 0                | 56.2         | 55               | 0            | 40.8             | 64           | 0                | 28.4         | 73               | 0 | 17.8 | 82 | 0 | 8.2 |
| 10           | 0                | 55.8         | 10               | 0            | 40.5             | 10           | 0                | 28.2         | 10               | 0 | 17.6 | 10 | 0 | 8.1 |
| 20           | 0                | 55.5         | 20               | 0            | 40.3             | 20           | 0                | 28.0         | 20               | 0 | 17.4 | 20 | 0 | 7.9 |
| 30           | 0                | 55.2         | 30               | 0            | 40.0             | 30           | 0                | 27.8         | 30               | 0 | 17.2 | 30 | 0 | 7.8 |
| 40           | 0                | 54.9         | 40               | 0            | 39.8             | 40           | 0                | 27.6         | 40               | 0 | 17.0 | 40 | 0 | 7.6 |
| 50           | 0                | 54.6         | 50               | 0            | 39.5             | 50           | 0                | 27.4         | 50               | 0 | 16.8 | 50 | 0 | 7.4 |
| 47           | 0                | 54.3         | 56               | 0            | 39.3             | 65           | 0                | 27.2         | 74               | 0 | 16.7 | 83 | 0 | 7.3 |
| 10           | 0                | 54.0         | 10               | 0            | 39.0             | 10           | 0                | 26.9         | 10               | 0 | 16.5 | 10 | 0 | 7.0 |
| 20           | 0                | 53.6         | 20               | 0            | 38.8             | 20           | 0                | 26.7         | 20               | 0 | 16.3 | 20 | 0 | 6.9 |
| 30           | 0                | 53.3         | 30               | 0            | 38.5             | 30           | 0                | 26.5         | 30               | 0 | 16.1 | 30 | 0 | 6.7 |
| 40           | 0                | 53.0         | 40               | 0            | 38.3             | 40           | 0                | 26.3         | 40               | 0 | 16.0 | 40 | 0 | 6.5 |
| 50           | 0                | 52.7         | 50               | 0            | 38.0             | 50           | 0                | 26.1         | 50               | 0 | 15.8 | 50 | 0 | 6.3 |
| 48           | 0                | 52.4         | 57               | 0            | 37.8             | 66           | 0                | 25.9         | 75               | 0 | 15.6 | 84 | 0 | 6.1 |
| 10           | 0                | 52.1         | 10               | 0            | 37.6             | 10           | 0                | 25.7         | 10               | 0 | 15.4 | 10 | 0 | 5.9 |
| 20           | 0                | 51.8         | 20               | 0            | 37.3             | 20           | 0                | 25.5         | 20               | 0 | 15.2 | 20 | 0 | 5.8 |
| 30           | 0                | 51.5         | 30               | 0            | 37.1             | 30           | 0                | 25.3         | 30               | 0 | 15.0 | 30 | 0 | 5.6 |
| 40           | 0                | 51.2         | 40               | 0            | 36.9             | 40           | 0                | 25.1         | 40               | 0 | 14.8 | 40 | 0 | 5.5 |
| 50           | 0                | 50.9         | 50               | 0            | 36.6             | 50           | 0                | 24.9         | 50               | 0 | 14.7 | 50 | 0 | 5.3 |
| 49           | 0                | 50.6         | 58               | 0            | 36.4             | 67           | 0                | 24.7         | 76               | 0 | 14.5 | 85 | 0 | 5.1 |
| 10           | 0                | 50.4         | 10               | 0            | 36.2             | 10           | 0                | 24.5         | 10               | 0 | 14.3 | 10 | 0 | 4.9 |
| 20           | 0                | 50.1         | 20               | 0            | 36.0             | 20           | 0                | 24.3         | 20               | 0 | 14.2 | 20 | 0 | 4.8 |
| 30           | 0                | 49.8         | 30               | 0            | 35.7             | 30           | 0                | 24.1         | 30               | 0 | 14.0 | 30 | 0 | 4.6 |
| 40           | 0                | 49.5         | 40               | 0            | 35.5             | 40           | 0                | 23.9         | 40               | 0 | 13.8 | 40 | 0 | 4.5 |
| 50           | 0                | 49.2         | 50               | 0            | 35.2             | 50           | 0                | 23.7         | 50               | 0 | 13.7 | 50 | 0 | 4.3 |
| 50           | 0                | 48.9         | 59               | 0            | 35.0             | 68           | 0                | 23.5         | 77               | 0 | 13.5 | 86 | 0 | 4.1 |
| 10           | 0                | 48.6         | 10               | 0            | 34.8             | 10           | 0                | 23.4         | 10               | 0 | 13.4 | 10 | 0 | 3.9 |
| 20           | 0                | 48.3         | 20               | 0            | 34.6             | 20           | 0                | 23.2         | 20               | 0 | 13.2 | 20 | 0 | 3.7 |
| 30           | 0                | 48.1         | 30               | 0            | 34.3             | 30           | 0                | 23.0         | 30               | 0 | 13.0 | 30 | 0 | 3.6 |
| 40           | 0                | 47.8         | 40               | 0            | 34.1             | 40           | 0                | 22.8         | 40               | 0 | 12.8 | 40 | 0 | 3.4 |
| 50           | 0                | 47.5         | 50               | 0            | 33.8             | 50           | 0                | 22.6         | 50               | 0 | 12.6 | 50 | 0 | 3.3 |
| 51           | 0                | 47.2         | 60               | 0            | 33.6             | 69           | 0                | 22.4         | 78               | 0 | 12.4 | 87 | 0 | 3.1 |
| 10           | 0                | 46.9         | 10               | 0            | 33.4             | 10           | 0                | 22.2         | 10               | 0 | 12.2 | 10 | 0 | 2.9 |
| 20           | 0                | 46.6         | 20               | 0            | 33.1             | 20           | 0                | 22.0         | 20               | 0 | 12.0 | 20 | 0 | 2.8 |
| 30           | 0                | 46.3         | 30               | 0            | 32.9             | 30           | 0                | 21.8         | 30               | 0 | 11.9 | 30 | 0 | 2.6 |
| 40           | 0                | 46.1         | 40               | 0            | 32.7             | 40           | 0                | 21.6         | 40               | 0 | 11.7 | 40 | 0 | 2.4 |
| 50           | 0                | 45.8         | 50               | 0            | 32.5             | 50           | 0                | 21.4         | 50               | 0 | 11.5 | 50 | 0 | 2.2 |
| 52           | 0                | 45.6         | 61               | 0            | 32.3             | 70           | 0                | 21.2         | 79               | 0 | 11.3 | 88 | 0 | 2.0 |
| 10           | 0                | 45.2         | 10               | 0            | 32.0             | 10           | 0                | 21.0         | 10               | 0 | 11.2 | 10 | 0 | 1.9 |
| 20           | 0                | 45.0         | 20               | 0            | 31.8             | 20           | 0                | 20.8         | 20               | 0 | 11.0 | 20 | 0 | 1.7 |
| 30           | 0                | 44.6         | 30               | 0            | 31.6             | 30           | 0                | 20.6         | 30               | 0 | 10.8 | 30 | 0 | 1.5 |
| 40           | 0                | 44.4         | 40               | 0            | 31.4             | 40           | 0                | 20.4         | 40               | 0 | 10.7 | 40 | 0 | 1.3 |
| 50           | 0                | 44.1         | 50               | 0            | 31.2             | 50           | 0                | 20.2         | 50               | 0 | 10.5 | 50 | 0 | 1.1 |
| 53           | 0                | 43.9         | 62               | 0            | 31.0             | 71           | 0                | 20.0         | 80               | 0 | 10.3 | 89 | 0 | 1.0 |
| 10           | 0                | 43.6         | 10               | 0            | 30.8             | 10           | 0                | 19.8         | 10               | 0 | 10.1 | 10 | 0 | 0.9 |
| 20           | 0                | 43.3         | 20               | 0            | 30.6             | 20           | 0                | 19.6         | 20               | 0 | 10.0 | 20 | 0 | 0.7 |
| 30           | 0                | 43.1         | 30               | 0            | 30.4             | 30           | 0                | 19.4         | 30               | 0 | 9.8  | 30 | 0 | 0.5 |
| 40           | 0                | 42.8         | 40               | 0            | 30.2             | 40           | 0                | 19.2         | 40               | 0 | 9.6  | 40 | 0 | 0.3 |
| 50           | 0                | 42.6         | 50               | 0            | 30.0             | 50           | 0                | 19.0         | 50               | 0 | 9.4  | 50 | 0 | 0.1 |
| 54           | 0                | 42.3         | 63               | 0            | 29.7             | 72           | 0                | 18.9         | 81               | 0 | 9.2  |    |   |     |
| 10           | 0                | 42.0         | 10               | 0            | 29.4             | 10           | 0                | 18.8         | 10               | 0 | 9.0  |    |   |     |
| 20           | 0                | 41.8         | 20               | 0            | 29.2             | 20           | 0                | 18.6         | 20               | 0 | 8.9  |    |   |     |
| 30           | 0                | 41.5         | 30               | 0            | 29.0             | 30           | 0                | 18.4         | 30               | 0 | 8.7  |    |   |     |
| 40           | 0                | 41.3         | 40               | 0            | 28.8             | 40           | 0                | 18.2         | 40               | 0 | 8.6  |    |   |     |
| 50           | 0                | 41.0         | 50               | 0            | 28.6             | 50           | 0                | 18.0         | 50               | 0 | 8.4  |    |   |     |

TABLE XVI.—CORRECTION FOR TABLE OF REFRACTION.

| Apparent<br>altitude. |   | HEIGHT OF THE THERMOMETER. |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |   |    |   |    |   |    |   |    |
|-----------------------|---|----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---|----|---|----|---|----|---|----|
|                       |   | 20<br>+                    | 24<br>+ | 28<br>+ | 32<br>+ | 36<br>+ | 40<br>+ | 44<br>+ | 48<br>+ | 52<br>+ | 56<br>+ | 60<br>+ | 64<br>+ | 68<br>+ | 72<br>+ | 76<br>+ | 80<br>+ |   |    |   |    |   |    |   |    |
| 1                     | 0 | 1                          | 59      | 1       | 43      | 1       | 25      | 1       | 9       | 53      | 38      | 23      | 8       | 7       | 21      | 36      | 50      | 1 | 3  | 1 | 17 | 1 | 30 | 1 | 43 |
| 10                    | 1 | 53                         | 1       | 38      | 1       | 21      | 1       | 6       | 50      | 36      | 22      | 7       | 7       | 7       | 20      | 34      | 48      | 1 | 0  | 1 | 13 | 1 | 26 | 1 | 38 |
| 20                    | 1 | 48                         | 1       | 33      | 1       | 17      | 1       | 3       | 48      | 34      | 21      | 7       | 6       | 6       | 19      | 32      | 45      | 0 | 57 | 1 | 9  | 1 | 21 | 1 | 33 |
| 30                    | 1 | 43                         | 1       | 29      | 1       | 14      | 1       | 0       | 46      | 32      | 20      | 7       | 6       | 6       | 18      | 31      | 43      | 0 | 54 | 1 | 6  | 1 | 18 | 1 | 29 |
| 40                    | 1 | 39                         | 1       | 25      | 1       | 11      | 0       | 57      | 44      | 31      | 18      | 6       | 6       | 6       | 18      | 30      | 41      | 0 | 52 | 1 | 4  | 1 | 15 | 1 | 25 |
| 50                    | 1 | 35                         | 1       | 21      | 1       | 8       | 0       | 55      | 42      | 30      | 17      | 6       | 6       | 6       | 17      | 28      | 39      | 0 | 50 | 1 | 1  | 1 | 11 | 1 | 21 |
| 2                     | 0 | 31                         | 1       | 18      | 1       | 5       | 0       | 53      | 39      | 29      | 17      | 6       | 5       | 5       | 16      | 27      | 37      | 0 | 48 | 0 | 58 | 1 | 8  | 1 | 18 |
| 20                    | 1 | 23                         | 1       | 11      | 0       | 0       | 0       | 48      | 37      | 26      | 16      | 5       | 5       | 5       | 15      | 25      | 35      | 0 | 44 | 0 | 54 | 1 | 3  | 1 | 11 |
| 40                    | 1 | 17                         | 1       | 6       | 0       | 55      | 0       | 44      | 34      | 24      | 14      | 5       | 5       | 5       | 14      | 23      | 32      | 0 | 41 | 0 | 50 | 0 | 58 | 1 | 6  |
| 3                     | 0 | 11                         | 1       | 1       | 0       | 51      | 0       | 41      | 32      | 22      | 13      | 4       | 4       | 4       | 13      | 21      | 30      | 0 | 38 | 0 | 46 | 0 | 54 | 1 | 1  |
| 20                    | 1 | 6                          | 0       | 57      | 0       | 47      | 0       | 38      | 29      | 21      | 13      | 4       | 4       | 4       | 12      | 20      | 28      | 0 | 35 | 0 | 43 | 0 | 50 | 0 | 57 |
| 40                    | 1 | 2                          | 0       | 53      | 0       | 44      | 0       | 36      | 28      | 20      | 12      | 4       | 4       | 4       | 11      | 18      | 26      | 0 | 33 | 0 | 40 | 0 | 47 | 0 | 53 |
| 4                     | 0 | 58                         | 0       | 49      | 0       | 41      | 0       | 33      | 26      | 18      | 11      | 4       | 4       | 4       | 10      | 17      | 24      | 0 | 31 | 0 | 37 | 0 | 44 | 0 | 50 |
| 20                    | 0 | 54                         | 0       | 46      | 0       | 39      | 0       | 31      | 24      | 17      | 10      | 3       | 3       | 3       | 10      | 16      | 22      | 0 | 30 | 0 | 35 | 0 | 41 | 0 | 46 |
| 40                    | 0 | 51                         | 0       | 43      | 0       | 37      | 0       | 29      | 23      | 16      | 10      | 3       | 3       | 3       | 9       | 15      | 21      | 0 | 28 | 0 | 33 | 0 | 38 | 0 | 43 |
| 5                     | 0 | 48                         | 0       | 41      | 0       | 35      | 0       | 28      | 22      | 16      | 9       | 3       | 3       | 3       | 9       | 14      | 20      | 0 | 26 | 0 | 31 | 0 | 36 | 0 | 40 |
| 30                    | 0 | 45                         | 0       | 38      | 0       | 32      | 0       | 26      | 20      | 14      | 9       | 3       | 3       | 3       | 8       | 13      | 19      | 0 | 24 | 0 | 29 | 0 | 34 | 0 | 38 |
| 6                     | 0 | 41                         | 0       | 35      | 0       | 30      | 0       | 24      | 19      | 13      | 8       | 3       | 2       | 2       | 7       | 12      | 17      | 0 | 22 | 0 | 26 | 0 | 31 | 0 | 35 |
| 30                    | 0 | 38                         | 0       | 33      | 0       | 28      | 0       | 22      | 17      | 12      | 7       | 2       | 2       | 2       | 6       | 11      | 15      | 0 | 20 | 0 | 24 | 0 | 29 | 0 | 33 |
| 7                     | 0 | 36                         | 0       | 31      | 0       | 26      | 0       | 21      | 16      | 12      | 7       | 2       | 2       | 2       | 6       | 10      | 14      | 0 | 19 | 0 | 23 | 0 | 27 | 0 | 31 |
| 30                    | 0 | 34                         | 0       | 29      | 0       | 24      | 0       | 20      | 15      | 11      | 6       | 2       | 2       | 2       | 6       | 9       | 13      | 0 | 17 | 0 | 21 | 0 | 25 | 0 | 29 |
| 8                     | 0 | 32                         | 0       | 27      | 0       | 23      | 0       | 19      | 15      | 10      | 6       | 2       | 2       | 2       | 5       | 9       | 13      | 0 | 16 | 0 | 20 | 0 | 24 | 0 | 27 |
| 9                     | 0 | 28                         | 0       | 24      | 0       | 20      | 0       | 16      | 13      | 9       | 5       | 2       | 2       | 2       | 5       | 8       | 11      | 0 | 14 | 0 | 18 | 0 | 21 | 0 | 24 |
| 10                    | 0 | 26                         | 0       | 22      | 0       | 18      | 0       | 15      | 12      | 8       | 5       | 2       | 1       | 4       | 7       | 10      | 13      | 0 | 13 | 0 | 16 | 0 | 19 | 0 | 22 |
| 11                    | 0 | 23                         | 0       | 20      | 0       | 17      | 0       | 14      | 11      | 8       | 5       | 2       | 1       | 4       | 7       | 9       | 12      | 0 | 12 | 0 | 15 | 0 | 18 | 0 | 20 |
| 12                    | 0 | 21                         | 0       | 18      | 0       | 15      | 0       | 13      | 10      | 7       | 4       | 1       | 1       | 4       | 6       | 9       | 11      | 0 | 11 | 0 | 13 | 0 | 16 | 0 | 18 |
| 13                    | 0 | 20                         | 0       | 17      | 0       | 14      | 0       | 12      | 9       | 7       | 4       | 1       | 1       | 3       | 6       | 8       | 10      | 0 | 10 | 0 | 12 | 0 | 15 | 0 | 17 |
| 14                    | 0 | 18                         | 0       | 16      | 0       | 13      | 0       | 11      | 8       | 6       | 4       | 1       | 1       | 3       | 5       | 7       | 9       | 0 | 9  | 0 | 11 | 0 | 14 | 0 | 16 |
| 15                    | 0 | 17                         | 0       | 15      | 0       | 12      | 0       | 10      | 8       | 6       | 3       | 1       | 1       | 3       | 5       | 7       | 8       | 0 | 9  | 0 | 11 | 0 | 13 | 0 | 15 |
| 16                    | 0 | 16                         | 0       | 14      | 0       | 11      | 0       | 9       | 7       | 5       | 3       | 1       | 1       | 3       | 5       | 6       | 8       | 0 | 8  | 0 | 10 | 0 | 12 | 0 | 14 |
| 17                    | 0 | 15                         | 0       | 13      | 0       | 11      | 0       | 9       | 7       | 5       | 3       | 1       | 1       | 3       | 4       | 6       | 7       | 0 | 8  | 0 | 9  | 0 | 11 | 0 | 13 |
| 18                    | 0 | 14                         | 0       | 12      | 0       | 10      | 0       | 8       | 6       | 5       | 3       | 1       | 1       | 2       | 4       | 6       | 6       | 0 | 7  | 0 | 9  | 0 | 10 | 0 | 12 |
| 19                    | 0 | 13                         | 0       | 11      | 0       | 9       | 0       | 8       | 6       | 4       | 3       | 1       | 1       | 2       | 4       | 5       | 5       | 0 | 7  | 0 | 8  | 0 | 10 | 0 | 11 |
| 20                    | 0 | 13                         | 0       | 11      | 0       | 9       | 0       | 7       | 6       | 4       | 2       | 1       | 1       | 2       | 4       | 5       | 5       | 0 | 6  | 0 | 8  | 0 | 9  | 0 | 11 |
| 22                    | 0 | 11                         | 0       | 10      | 0       | 8       | 0       | 7       | 5       | 4       | 2       | 1       | 1       | 2       | 3       | 5       | 5       | 0 | 6  | 0 | 7  | 0 | 8  | 0 | 10 |
| 24                    | 0 | 10                         | 0       | 9       | 0       | 7       | 0       | 6       | 5       | 3       | 2       | 1       | 1       | 2       | 3       | 4       | 5       | 0 | 5  | 0 | 6  | 0 | 8  | 0 | 9  |
| 26                    | 0 | 9                          | 0       | 8       | 0       | 7       | 0       | 6       | 4       | 3       | 2       | 1       | 1       | 2       | 3       | 4       | 5       | 0 | 5  | 0 | 6  | 0 | 7  | 0 | 8  |
| 28                    | 0 | 9                          | 0       | 7       | 0       | 6       | 0       | 5       | 4       | 3       | 2       | 1       | 0       | 1       | 2       | 3       | 4       | 0 | 5  | 0 | 5  | 0 | 6  | 0 | 7  |
| 30                    | 0 | 8                          | 0       | 7       | 0       | 6       | 0       | 5       | 4       | 3       | 2       | 1       | 0       | 1       | 2       | 3       | 4       | 0 | 5  | 0 | 5  | 0 | 6  | 0 | 7  |
| 35                    | 0 | 7                          | 0       | 6       | 0       | 5       | 0       | 4       | 3       | 2       | 1       | 1       | 0       | 1       | 2       | 3       | 4       | 0 | 4  | 0 | 4  | 0 | 5  | 0 | 6  |
| 40                    | 0 | 6                          | 0       | 5       | 0       | 4       | 0       | 3       | 3       | 2       | 1       | 0       | 0       | 1       | 2       | 3       | 4       | 0 | 3  | 0 | 3  | 0 | 4  | 0 | 5  |
| 45                    | 0 | 5                          | 0       | 4       | 0       | 3       | 0       | 3       | 2       | 2       | 1       | 0       | 0       | 1       | 1       | 2       | 3       | 0 | 2  | 0 | 3  | 0 | 3  | 0 | 4  |
| 50                    | 0 | 4                          | 0       | 3       | 0       | 3       | 0       | 2       | 2       | 1       | 1       | 0       | 0       | 1       | 1       | 2       | 3       | 0 | 2  | 0 | 2  | 0 | 3  | 0 | 3  |
| 55                    | 0 | 3                          | 0       | 3       | 0       | 2       | 0       | 2       | 2       | 1       | 1       | 0       | 0       | 1       | 1       | 1       | 2       | 0 | 2  | 0 | 2  | 0 | 2  | 0 | 3  |
| 60                    | 0 | 3                          | 0       | 2       | 0       | 2       | 0       | 2       | 1       | 1       | 1       | 0       | 0       | 0       | 1       | 1       | 1       | 0 | 1  | 0 | 2  | 0 | 2  | 0 | 2  |
| 65                    | 0 | 2                          | 0       | 2       | 0       | 2       | 0       | 1       | 1       | 1       | 1       | 0       | 0       | 0       | 1       | 1       | 1       | 0 | 1  | 0 | 1  | 0 | 2  | 0 | 2  |
| 70                    | 0 | 2                          | 0       | 1       | 0       | 1       | 0       | 1       | 1       | 1       | 1       | 0       | 0       | 0       | 0       | 1       | 1       | 0 | 1  | 0 | 1  | 0 | 1  | 0 | 1  |
| 80                    | 0 | 1                          | 0       | 1       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0 | 0  | 0 | 0  | 0 | 0  | 0 | 0  |

Height  
of

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TABLE XVII.—CORRECTION OF THE MOON'S ALTITUDE.

| MOON'S HORIZONTAL PARALLAX. |                        |       |       |       |       |       |       |       |       |                      |  |  |
|-----------------------------|------------------------|-------|-------|-------|-------|-------|-------|-------|-------|----------------------|--|--|
| P. P.<br>for<br>Alt.        | Moon's<br>App.<br>Alt. | 54'   | 55'   | 56'   | 57'   | 58'   | 59'   | 60'   | 61'   | P. P.<br>for<br>Par. |  |  |
|                             | 0                      | 35 36 | 36 36 | 37 36 | 38 36 | 39 36 | 40 36 | 41 36 | 42 36 |                      |  |  |
| +                           | 10                     | 36 22 | 37 22 | 38 22 | 39 22 | 40 22 | 41 22 | 42 22 | 43 22 |                      |  |  |
| 1 4                         | 20                     | 37 4  | 38 4  | 39 4  | 40 4  | 41 4  | 42 4  | 43 4  | 44 4  | 1 10                 |  |  |
| 2 7                         | 30                     | 37 44 | 38 44 | 39 44 | 40 44 | 41 44 | 42 44 | 43 44 | 44 44 | 2 20                 |  |  |
| 3 11                        | 40                     | 38 20 | 39 20 | 40 20 | 41 20 | 42 20 | 43 20 | 44 20 | 45 20 | 3 30                 |  |  |
| 4 15                        | 50                     | 38 55 | 39 55 | 40 55 | 41 55 | 42 55 | 43 55 | 44 55 | 45 55 | 4 40                 |  |  |
| 5 18                        | 3                      | 39 28 | 40 27 | 41 27 | 42 27 | 43 27 | 44 27 | 45 27 | 46 27 | 5 50                 |  |  |
| 6 22                        | 10                     | 39 58 | 40 58 | 41 58 | 42 58 | 43 58 | 44 58 | 45 58 | 46 58 | 6 60                 |  |  |
| 7 26                        | 20                     | 40 26 | 41 26 | 42 26 | 43 25 | 44 25 | 45 25 | 46 25 | 47 25 | 7 70                 |  |  |
| 8 29                        | 30                     | 40 53 | 41 53 | 42 53 | 43 52 | 44 52 | 45 52 | 46 52 | 47 52 | 8 80                 |  |  |
| 9 33                        | 40                     | 41 17 | 42 17 | 43 17 | 44 17 | 45 17 | 46 17 | 47 17 | 48 17 | 9 90                 |  |  |
|                             | 50                     | 41 42 | 42 42 | 43 41 | 44 41 | 45 41 | 46 41 | 47 41 | 48 41 |                      |  |  |
|                             | 4                      | 42 4  | 43 4  | 44 4  | 45 4  | 46 4  | 47 4  | 48 3  | 49 3  |                      |  |  |
| 1                           | 10                     | 42 25 | 43 24 | 44 24 | 45 24 | 46 24 | 47 24 | 48 23 | 49 23 | 1 10                 |  |  |
| 1 2                         | 20                     | 42 45 | 43 44 | 44 44 | 45 44 | 46 44 | 47 44 | 48 44 | 49 44 | 2 20                 |  |  |
| 2 4                         | 30                     | 43 3  | 44 3  | 45 3  | 46 2  | 47 2  | 48 2  | 49 2  | 50 2  | 3 30                 |  |  |
| 3 5                         | 40                     | 43 21 | 44 21 | 45 21 | 46 21 | 47 21 | 48 20 | 49 20 | 50 20 | 4 40                 |  |  |
| 4 7                         | 50                     | 43 38 | 44 37 | 45 37 | 46 37 | 47 36 | 48 36 | 49 36 | 50 36 | 5 50                 |  |  |
| 5 9                         | 5                      | 43 53 | 44 53 | 45 53 | 46 53 | 47 53 | 48 53 | 49 52 | 50 52 | 6 60                 |  |  |
| 6 11                        | 10                     | 44 9  | 45 9  | 46 8  | 47 8  | 48 8  | 49 8  | 50 8  | 51 7  | 7 70                 |  |  |
| 7 12                        | 20                     | 44 23 | 45 23 | 46 23 | 47 22 | 48 22 | 49 21 | 50 21 | 51 21 | 8 80                 |  |  |
| 8 14                        | 30                     | 44 36 | 45 36 | 46 35 | 47 35 | 48 35 | 49 35 | 50 34 | 51 34 | 9 90                 |  |  |
| 9 16                        | 40                     | 44 49 | 45 49 | 46 49 | 47 48 | 48 48 | 49 48 | 50 48 | 51 47 |                      |  |  |
|                             | 50                     | 45 1  | 46 1  | 47 1  | 48 0  | 49 0  | 49 59 | 50 59 | 51 59 |                      |  |  |
|                             | 6                      | 45 12 | 46 12 | 47 11 | 48 11 | 49 11 | 50 11 | 51 10 | 52 10 |                      |  |  |
| 1                           | 10                     | 45 23 | 46 23 | 47 23 | 48 22 | 49 22 | 50 22 | 51 21 | 52 21 | 1 10                 |  |  |
| 1 1                         | 20                     | 45 33 | 46 33 | 47 33 | 48 32 | 49 32 | 50 31 | 51 31 | 52 31 | 2 20                 |  |  |
| 2 2                         | 30                     | 45 43 | 46 43 | 47 42 | 48 42 | 49 42 | 50 41 | 51 41 | 52 41 | 3 30                 |  |  |
| 3 3                         | 40                     | 45 53 | 46 53 | 47 52 | 48 52 | 49 52 | 50 51 | 51 50 | 52 50 | 4 40                 |  |  |
| 4 4                         | 50                     | 46 2  | 47 2  | 48 1  | 49 1  | 50 0  | 51 0  | 51 59 | 52 59 | 5 50                 |  |  |
| 5 5                         | 7                      | 46 11 | 47 10 | 48 10 | 49 10 | 50 9  | 51 9  | 52 8  | 53 8  | 6 60                 |  |  |
| 6 6                         | 10                     | 46 20 | 47 19 | 48 19 | 49 18 | 50 18 | 51 17 | 52 17 | 53 16 | 7 70                 |  |  |
| 7 7                         | 20                     | 46 28 | 47 27 | 48 26 | 49 26 | 50 26 | 51 25 | 52 25 | 53 24 | 8 80                 |  |  |
| 8 8                         | 30                     | 46 34 | 47 34 | 48 33 | 49 33 | 50 32 | 51 32 | 52 31 | 53 31 | 9 90                 |  |  |
| 9 9                         | 40                     | 46 41 | 47 41 | 48 40 | 49 39 | 50 39 | 51 38 | 52 38 | 53 37 |                      |  |  |
|                             | 50                     | 46 48 | 47 47 | 48 47 | 49 46 | 50 46 | 51 45 | 52 44 | 53 44 |                      |  |  |
|                             | 8                      | 46 54 | 47 54 | 48 53 | 49 53 | 50 52 | 51 52 | 52 51 | 53 51 |                      |  |  |
| 1                           | 10                     | 47 0  | 47 59 | 48 59 | 49 58 | 50 58 | 51 57 | 52 56 | 53 56 | 1 10                 |  |  |
| 1 1                         | 20                     | 47 6  | 48 5  | 49 5  | 50 4  | 51 3  | 52 3  | 53 2  | 54 2  | 2 20                 |  |  |
| 2 2                         | 30                     | 47 12 | 48 11 | 49 10 | 50 9  | 51 9  | 52 8  | 53 7  | 54 7  | 3 30                 |  |  |
| 3 2                         | 40                     | 47 17 | 48 16 | 49 16 | 50 15 | 51 14 | 52 14 | 53 13 | 54 13 | 4 40                 |  |  |
| 4 2                         | 50                     | 47 22 | 48 21 | 49 20 | 50 19 | 51 19 | 52 18 | 53 17 | 54 17 | 5 50                 |  |  |
| 5 3                         | 9                      | 47 26 | 48 25 | 49 25 | 50 24 | 51 23 | 52 22 | 53 22 | 54 21 | 6 60                 |  |  |
| 6 3                         | 10                     | 47 32 | 48 31 | 49 30 | 50 29 | 51 29 | 52 28 | 53 27 | 54 26 | 7 70                 |  |  |
| 7 4                         | 20                     | 47 35 | 48 34 | 49 34 | 50 33 | 51 32 | 52 31 | 53 31 | 54 30 | 8 80                 |  |  |
| 8 4                         | 30                     | 47 40 | 48 39 | 49 38 | 50 37 | 51 36 | 52 35 | 53 35 | 54 34 | 9 90                 |  |  |
| 9 5                         | 40                     | 47 44 | 48 43 | 49 42 | 50 41 | 51 41 | 52 40 | 53 39 | 54 38 |                      |  |  |
|                             | 50                     | 47 48 | 48 46 | 49 46 | 50 45 | 51 44 | 52 43 | 53 42 | 54 41 |                      |  |  |

TABLE XVII.—CORRECTION OF THE MOON'S ALTITUDE.

| P. P.<br>for<br>Alt. | Moon's<br>App.<br>Alt. | MOON'S HORIZONTAL PARALLAX. |       |       |       |       |       |       |       |   |     | P. P.<br>for<br>Par. |
|----------------------|------------------------|-----------------------------|-------|-------|-------|-------|-------|-------|-------|---|-----|----------------------|
|                      |                        | 54'                         | 55'   | 56'   | 57'   | 58'   | 59'   | 60'   | 61'   |   |     |                      |
|                      | 0                      | 47 51                       | 48 50 | 49 49 | 50 48 | 51 47 | 52 46 | 53 45 | 54 44 |   |     |                      |
| +                    | 10                     | 47 54                       | 48 53 | 49 52 | 50 52 | 51 50 | 52 49 | 53 49 | 54 47 |   | "   |                      |
| 1                    | 0                      | 47 57                       | 48 57 | 49 55 | 50 55 | 51 54 | 52 52 | 53 52 | 54 51 | 1 | 1'0 |                      |
| 2                    | 0                      | 48 1                        | 49 0  | 49 59 | 50 58 | 51 57 | 52 56 | 53 55 | 54 54 | 2 | 2'0 |                      |
| 3                    | 0                      | 48 4                        | 49 3  | 50 2  | 51 1  | 52 0  | 52 59 | 53 58 | 54 57 | 3 | 2'9 |                      |
| 4                    | 1                      | 48 6                        | 49 5  | 50 4  | 51 3  | 52 2  | 53 1  | 54 0  | 54 59 | 4 | 3'9 |                      |
| 5                    | 1                      | 48 9                        | 49 7  | 50 6  | 51 5  | 52 4  | 53 3  | 54 2  | 55 1  | 5 | 4'9 |                      |
| 6                    | 1                      | 48 11                       | 49 10 | 50 8  | 51 7  | 52 6  | 53 5  | 54 4  | 55 3  | 6 | 5'9 |                      |
| 7                    | 1                      | 48 13                       | 49 12 | 50 11 | 51 9  | 52 8  | 53 7  | 54 6  | 55 5  | 7 | 6'9 |                      |
| 8                    | 2                      | 48 15                       | 49 14 | 50 13 | 51 12 | 52 10 | 53 9  | 54 8  | 55 7  | 8 | 7'9 |                      |
| 9                    | 2                      | 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 |   |     |                      |
|                      | 12 0                   | 48 21                       | 49 20 | 50 19 | 51 17 | 52 16 | 53 15 | 54 13 | 55 12 |   |     |                      |
|                      | 10                     | 48 23                       | 49 22 | 50 20 | 51 19 | 52 18 | 53 16 | 54 15 | 55 14 |   | "   |                      |
| 1                    | 0                      | 48 24                       | 49 23 | 50 22 | 51 20 | 52 19 | 53 17 | 54 16 | 55 15 | 1 | 1'0 |                      |
| 2                    | 0                      | 48 26                       | 49 25 | 50 23 | 51 22 | 52 21 | 53 19 | 54 17 | 55 16 | 2 | 2'0 |                      |
| 3                    | 0                      | 48 27                       | 49 26 | 50 24 | 51 23 | 52 21 | 53 20 | 54 18 | 55 17 | 3 | 2'9 |                      |
| 4                    | 0                      | 48 28                       | 49 27 | 50 25 | 51 24 | 52 22 | 53 21 | 54 19 | 55 18 | 4 | 3'9 |                      |
| 5                    | 1                      | 48 29                       | 49 27 | 50 26 | 51 24 | 52 23 | 53 21 | 54 20 | 55 19 | 5 | 4'9 |                      |
| 6                    | 1                      | 48 31                       | 49 29 | 50 28 | 51 26 | 52 25 | 53 23 | 54 21 | 55 19 | 6 | 5'9 |                      |
| 7                    | 1                      | 48 31                       | 49 30 | 50 28 | 51 27 | 52 25 | 53 24 | 54 22 | 55 20 | 7 | 6'9 |                      |
| 8                    | 1                      | 48 33                       | 49 30 | 50 29 | 51 27 | 52 26 | 53 24 | 54 22 | 55 20 | 8 | 7'9 |                      |
| 9                    | 1                      | 48 32                       | 49 31 | 50 29 | 51 28 | 52 26 | 53 24 | 54 22 | 55 21 | 9 | 8'8 |                      |
|                      | 50                     | 48 33                       | 49 31 | 50 30 | 51 28 | 52 26 | 53 24 | 54 23 | 55 21 |   |     |                      |
|                      | 14 0                   | 48 34                       | 49 32 | 50 30 | 51 29 | 52 27 | 53 25 | 54 23 | 55 21 |   |     |                      |
|                      | 10                     | 48 34                       | 49 33 | 50 31 | 51 29 | 52 27 | 53 26 | 54 24 | 55 22 |   | "   |                      |
| 1                    | 0                      | 48 34                       | 49 32 | 50 31 | 51 29 | 52 27 | 53 25 | 54 24 | 55 22 | 1 | 1'0 |                      |
| 2                    | 0                      | 48 35                       | 49 33 | 50 31 | 51 29 | 52 27 | 53 25 | 54 24 | 55 22 | 2 | 1'9 |                      |
| 3                    | 0                      | 48 35                       | 49 34 | 50 32 | 51 29 | 52 28 | 53 26 | 54 23 | 55 22 | 3 | 2'9 |                      |
| 4                    | 0                      | 48 35                       | 49 33 | 50 31 | 51 29 | 52 27 | 53 25 | 54 23 | 55 21 | 4 | 3'9 |                      |
| 5                    | 0                      | 48 36                       | 49 34 | 50 31 | 51 30 | 52 27 | 53 25 | 54 23 | 55 21 | 5 | 4'8 |                      |
| 6                    | 0                      | 48 35                       | 49 33 | 50 31 | 51 29 | 52 27 | 53 25 | 54 23 | 55 21 | 6 | 5'8 |                      |
| 7                    | 0                      | 48 35                       | 49 33 | 50 31 | 51 29 | 52 28 | 53 26 | 54 24 | 55 22 | 7 | 6'8 |                      |
| 8                    | 0                      | 48 35                       | 49 33 | 50 31 | 51 28 | 52 26 | 53 24 | 54 22 | 55 20 | 8 | 7'7 |                      |
| 9                    | 0                      | 48 34                       | 49 33 | 50 30 | 51 28 | 52 26 | 53 24 | 54 21 | 55 19 | 9 | 8'7 |                      |
|                      | 50                     | 48 34                       | 49 32 | 50 30 | 51 27 | 52 25 | 53 23 | 54 20 | 55 18 |   |     |                      |
|                      | 16 0                   | 48 34                       | 49 31 | 50 29 | 51 26 | 52 24 | 53 22 | 54 20 | 55 17 |   |     |                      |
|                      | 10                     | 48 33                       | 49 31 | 50 28 | 51 26 | 52 24 | 53 21 | 54 19 | 55 16 |   | "   |                      |
| 1                    | 0                      | 48 32                       | 49 30 | 50 27 | 51 25 | 52 23 | 53 20 | 54 18 | 55 15 | 1 | 1'0 |                      |
| 2                    | 0                      | 48 32                       | 49 29 | 50 26 | 51 24 | 52 22 | 53 19 | 54 17 | 55 14 | 2 | 1'9 |                      |
| 3                    | 0                      | 48 31                       | 49 28 | 50 26 | 51 24 | 52 21 | 53 18 | 54 16 | 55 13 | 3 | 2'9 |                      |
| 4                    | 0                      | 48 30                       | 49 27 | 50 25 | 51 23 | 52 20 | 53 17 | 54 15 | 55 12 | 4 | 3'9 |                      |
| 5                    | 1                      | 48 29                       | 49 27 | 50 24 | 51 22 | 52 19 | 53 16 | 54 14 | 55 11 | 5 | 4'8 |                      |
| 6                    | 1                      | 48 28                       | 49 26 | 50 24 | 51 21 | 52 18 | 53 15 | 54 13 | 55 10 | 6 | 5'8 |                      |
| 7                    | 1                      | 48 28                       | 49 25 | 50 23 | 51 20 | 52 17 | 53 14 | 54 12 | 55 9  | 7 | 6'8 |                      |
| 8                    | 1                      | 48 27                       | 49 24 | 50 22 | 51 19 | 52 16 | 53 13 | 54 10 | 55 8  | 8 | 7'7 |                      |
| 9                    | 1                      | 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.<br>for<br>AM. | Moon's<br>App.<br>AM. | Moon's Horizontal Parallax. |       |       |       |       |       |       |       |       |       | P. P.<br>for<br>PM. |
|---------------------|-----------------------|-----------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---------------------|
|                     |                       | 54'                         | 55'   | 56'   | 57'   | 58'   | 59'   | 60'   | 61'   |       |       |                     |
|                     | 18                    | 0                           | 48 24 | 49 21 | 50 18 | 51 15 | 52 12 | 53 9  | 54 6  | 55 3  |       |                     |
|                     |                       | 10                          | 48 23 | 49 20 | 50 17 | 51 14 | 52 11 | 53 8  | 54 5  | 55 2  |       |                     |
| 1                   | 0                     | 20                          | 48 22 | 49 19 | 50 16 | 51 13 | 52 10 | 53 7  | 54 3  | 55 0  | 1 0.9 |                     |
| 2                   | 0                     | 30                          | 48 20 | 49 17 | 50 14 | 51 10 | 52 7  | 53 4  | 54 1  | 54 58 | 2 1.9 |                     |
| 3                   | 0                     | 40                          | 48 19 | 49 16 | 50 12 | 51 9  | 52 6  | 53 3  | 53 59 | 54 56 | 3 2.8 |                     |
| 4                   | 1                     | 50                          | 48 18 | 49 15 | 50 11 | 51 8  | 52 4  | 53 1  | 53 58 | 54 55 | 4 3.8 |                     |
| 5                   | 1                     | 19                          | 0     | 48 16 | 49 13 | 50 9  | 51 5  | 52 2  | 52 59 | 53 56 | 5 4.7 |                     |
| 6                   | 1                     | 10                          | 48 15 | 49 12 | 50 8  | 51 4  | 52 1  | 52 58 | 53 54 | 54 51 | 6 5.7 |                     |
| 7                   | 1                     | 20                          | 48 12 | 49 9  | 50 5  | 51 2  | 51 59 | 52 55 | 53 52 | 54 49 | 7 6.7 |                     |
| 8                   | 1                     | 30                          | 48 11 | 49 8  | 50 4  | 51 1  | 51 57 | 52 54 | 53 51 | 54 47 | 8 7.6 |                     |
| 9                   | 1                     | 40                          | 48 9  | 49 5  | 50 2  | 50 58 | 51 55 | 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 |       |                     |
|                     | 20                    | 0                           | 48 5  | 49 1  | 49 58 | 50 55 | 51 51 | 52 47 | 53 44 | 54 40 |       |                     |
|                     |                       | 10                          | 48 3  | 49 0  | 49 56 | 50 53 | 51 48 | 52 45 | 53 42 | 54 38 |       |                     |
| 1                   | 0                     | 20                          | 48 2  | 48 58 | 49 55 | 50 51 | 51 47 | 52 43 | 53 40 | 54 36 | 1 0.9 |                     |
| 2                   | 1                     | 30                          | 48 0  | 48 56 | 49 52 | 50 48 | 51 45 | 52 41 | 53 37 | 54 33 | 2 1.9 |                     |
| 3                   | 1                     | 40                          | 47 58 | 48 54 | 49 50 | 50 46 | 51 42 | 52 38 | 53 34 | 54 30 | 3 2.8 |                     |
| 4                   | 1                     | 50                          | 47 56 | 48 52 | 49 48 | 50 44 | 51 41 | 52 36 | 53 32 | 54 28 | 4 3.7 |                     |
| 5                   | 1                     | 21                          | 0     | 47 54 | 48 50 | 49 46 | 50 42 | 51 38 | 52 34 | 53 30 | 5 4.7 |                     |
| 6                   | 1                     | 10                          | 47 53 | 48 48 | 49 44 | 50 40 | 51 35 | 52 32 | 53 27 | 54 23 | 6 5.6 |                     |
| 7                   | 2                     | 20                          | 47 50 | 48 46 | 49 42 | 50 37 | 51 34 | 52 30 | 53 25 | 54 21 | 7 6.6 |                     |
| 8                   | 2                     | 30                          | 47 47 | 48 43 | 49 39 | 50 35 | 51 31 | 52 27 | 53 22 | 54 19 | 8 7.5 |                     |
| 9                   | 2                     | 40                          | 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 |       |                     |
|                     | 22                    | 0                           | 47 41 | 48 37 | 49 32 | 50 28 | 51 24 | 52 19 | 53 15 | 54 11 |       |                     |
|                     |                       | 10                          | 47 39 | 48 34 | 49 30 | 50 25 | 51 21 | 52 16 | 53 12 | 54 7  |       |                     |
| 1                   | 0                     | 20                          | 47 36 | 48 31 | 49 27 | 50 22 | 51 18 | 52 13 | 53 9  | 54 4  | 1 0.9 |                     |
| 2                   | 1                     | 30                          | 47 33 | 48 29 | 49 24 | 50 20 | 51 15 | 52 11 | 53 6  | 54 2  | 2 1.8 |                     |
| 3                   | 1                     | 40                          | 47 31 | 48 26 | 49 21 | 50 16 | 51 12 | 52 6  | 53 2  | 53 57 | 3 2.8 |                     |
| 4                   | 1                     | 50                          | 47 28 | 48 23 | 49 19 | 50 14 | 51 9  | 52 5  | 53 0  | 53 55 | 4 3.8 |                     |
| 5                   | 1                     | 23                          | 0     | 47 26 | 48 21 | 49 16 | 50 11 | 51 6  | 52 2  | 52 57 | 5 4.7 |                     |
| 6                   | 2                     | 10                          | 47 24 | 48 19 | 49 14 | 50 9  | 51 4  | 51 59 | 52 54 | 53 50 | 6 5.6 |                     |
| 7                   | 2                     | 20                          | 47 21 | 48 16 | 49 11 | 50 6  | 51 2  | 51 56 | 52 51 | 53 47 | 7 6.5 |                     |
| 8                   | 2                     | 30                          | 47 18 | 48 13 | 49 9  | 50 3  | 50 58 | 51 54 | 52 48 | 53 43 | 8 7.4 |                     |
| 9                   | 2                     | 40                          | 47 16 | 48 10 | 49 5  | 50 5  | 51 50 | 52 45 | 53 40 | 54 35 | 9 8.3 |                     |
|                     |                       | 50                          | 47 13 | 48 8  | 49 2  | 49 57 | 50 52 | 51 47 | 52 42 | 53 37 |       |                     |
|                     | 24                    | 0                           | 47 10 | 48 5  | 49 0  | 49 54 | 50 49 | 51 44 | 52 39 | 53 34 |       |                     |
|                     |                       | 10                          | 47 7  | 48 2  | 48 56 | 49 51 | 50 46 | 51 41 | 52 36 | 53 30 |       |                     |
| 1                   | 0                     | 20                          | 47 4  | 47 59 | 48 54 | 49 48 | 50 43 | 51 38 | 52 33 | 53 27 | 1 0.9 |                     |
| 2                   | 1                     | 30                          | 47 1  | 47 56 | 48 51 | 49 46 | 50 41 | 51 35 | 52 29 | 53 23 | 2 1.8 |                     |
| 3                   | 1                     | 40                          | 46 58 | 47 53 | 48 47 | 49 42 | 50 37 | 51 32 | 52 25 | 53 20 | 3 2.7 |                     |
| 4                   | 1                     | 50                          | 46 56 | 47 50 | 48 44 | 49 39 | 50 33 | 51 27 | 52 22 | 53 17 | 4 3.6 |                     |
| 5                   | 1                     | 25                          | 0     | 46 53 | 47 47 | 48 41 | 49 36 | 50 30 | 51 24 | 52 19 | 5 4.5 |                     |
| 6                   | 2                     | 10                          | 46 49 | 47 44 | 48 38 | 49 32 | 50 26 | 51 21 | 52 15 | 53 10 | 6 5.4 |                     |
| 7                   | 2                     | 20                          | 46 46 | 47 40 | 48 34 | 49 28 | 50 22 | 51 17 | 52 11 | 53 5  | 7 6.4 |                     |
| 8                   | 2                     | 30                          | 46 42 | 47 36 | 48 30 | 49 24 | 50 19 | 51 13 | 52 7  | 53 2  | 8 7.3 |                     |
| 9                   | 2                     | 40                          | 46 39 | 47 33 | 48 27 | 49 21 | 50 16 | 51 10 | 52 4  | 53 58 | 9 8.2 |                     |
|                     |                       | 50                          | 46 36 | 47 30 | 48 24 | 49 18 | 50 12 | 51 6  | 52 0  | 53 54 |       |                     |

TABLE XVII.—CORRECTION OF THE MOON'S ALTITUDE.

| P.P.<br>for<br>Alt. | Moon's<br>App.<br>Alt. | MOON'S HORIZONTAL PARALLAX. |       |       |       |       |       |       |       | P.P.<br>for<br>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 | 1 0.9               |
| 2 1                 | 20                     | 45 45                       | 46 38 | 47 30 | 48 23 | 49 16 | 50 9  | 51 2  | 51 54 | 2 1.8               |
| 3 1                 | 30                     | 45 41                       | 46 34 | 47 27 | 48 19 | 49 12 | 50 5  | 50 58 | 51 51 | 3 2.6               |
| 4 2                 | 40                     | 45 37                       | 46 31 | 47 23 | 48 16 | 49 8  | 50 1  | 50 54 | 51 46 | 4 3.5               |
| 5 2                 | 50                     | 45 33                       | 46 26 | 47 19 | 48 11 | 49 4  | 49 56 | 50 49 | 51 41 | 5 4.4               |
| 6 2                 | 29 0                   | 45 29                       | 46 21 | 47 14 | 48 6  | 48 59 | 49 51 | 50 44 | 51 36 | 6 5.3               |
| 7 3                 | 10                     | 45 25                       | 46 18 | 47 10 | 48 2  | 48 55 | 49 47 | 50 39 | 51 32 | 7 6.2               |
| 8 3                 | 20                     | 45 22                       | 46 14 | 47 6  | 47 58 | 48 51 | 49 43 | 50 36 | 51 28 | 8 7.0               |
| 9 4                 | 30                     | 45 17                       | 46 9  | 47 1  | 47 54 | 48 46 | 49 38 | 50 30 | 51 23 | 9 7.9               |
|                     | 40                     | 45 13                       | 46 5  | 46 58 | 47 50 | 48 42 | 49 34 | 50 26 | 51 18 |                     |
|                     | 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  | 1 0.9               |
| 2 1                 | 20                     | 44 58                       | 45 49 | 46 41 | 47 33 | 48 25 | 49 16 | 50 8  | 51 0  | 2 1.7               |
| 3 1                 | 30                     | 44 53                       | 45 44 | 46 36 | 47 28 | 48 19 | 49 11 | 50 3  | 50 55 | 3 2.6               |
| 4 2                 | 40                     | 44 49                       | 45 41 | 46 32 | 47 24 | 48 15 | 49 7  | 49 59 | 50 50 | 4 3.4               |
| 5 2                 | 50                     | 44 44                       | 45 36 | 46 27 | 47 18 | 48 10 | 49 2  | 49 53 | 50 45 | 5 4.3               |
| 6 3                 | 31 0                   | 44 40                       | 45 31 | 46 23 | 47 15 | 48 6  | 48 57 | 49 49 | 50 40 | 6 5.2               |
| 7 3                 | 10                     | 44 36                       | 45 27 | 46 18 | 47 9  | 48 1  | 48 52 | 49 43 | 50 35 | 7 6.1               |
| 8 4                 | 20                     | 44 31                       | 45 23 | 46 14 | 47 5  | 47 56 | 48 48 | 49 39 | 50 30 | 8 6.8               |
| 9 4                 | 30                     | 44 27                       | 45 19 | 46 10 | 47 1  | 47 52 | 48 44 | 49 35 | 50 26 | 9 7.7               |
|                     | 40                     | 44 24                       | 45 15 | 46 6  | 46 57 | 47 48 | 48 39 | 49 30 | 50 21 |                     |
|                     | 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  | 1 0.8               |
| 2 1                 | 20                     | 44 6                        | 44 56 | 45 47 | 46 38 | 47 29 | 48 19 | 49 10 | 50 0  | 2 1.7               |
| 3 1                 | 30                     | 44 0                        | 44 51 | 45 42 | 46 33 | 47 23 | 48 14 | 49 4  | 49 55 | 3 2.5               |
| 4 2                 | 40                     | 43 57                       | 44 47 | 45 37 | 46 28 | 47 19 | 48 9  | 49 0  | 49 50 | 4 3.3               |
| 5 2                 | 50                     | 43 51                       | 44 42 | 45 32 | 46 23 | 47 13 | 48 3  | 48 54 | 49 45 | 5 4.2               |
| 6 3                 | 33 0                   | 43 47                       | 44 38 | 45 28 | 46 18 | 47 8  | 47 59 | 48 49 | 49 40 | 6 5.0               |
| 7 3                 | 10                     | 43 43                       | 44 33 | 45 24 | 46 14 | 47 4  | 47 54 | 48 44 | 49 35 | 7 5.9               |
| 8 4                 | 20                     | 43 39                       | 44 29 | 45 19 | 46 9  | 47 0  | 47 49 | 48 40 | 49 30 | 8 6.7               |
| 9 4                 | 30                     | 43 34                       | 44 24 | 45 14 | 46 4  | 46 54 | 47 44 | 48 34 | 49 24 | 9 7.5               |
|                     | 40                     | 43 29                       | 44 20 | 45 10 | 45 59 | 46 49 | 47 39 | 48 29 | 49 19 |                     |
|                     | 50                     | 43 25                       | 44 14 | 45 4  | 45 54 | 46 44 | 47 34 | 48 23 | 49 13 |                     |

## TABLE XVII.—CONTINUATION OF THE MOON'S ALTITUDE.

| P. P.<br>for<br>LAT. | Moon's<br>Age<br>for<br>LAT. | MOON'S HORIZONTAL PARALLAX. |       |       |       |       |       |       |       |       |  | P. P.<br>for<br>LAT. |
|----------------------|------------------------------|-----------------------------|-------|-------|-------|-------|-------|-------|-------|-------|--|----------------------|
|                      |                              | 54'                         | 55'   | 56'   | 57'   | 58'   | 59'   | 60'   | 61'   |       |  |                      |
| 1                    | 0                            | 43 20                       | 44 10 | 45 0  | 45 50 | 46 39 | 47 29 | 48 18 | 49 8  | 1 0'8 |  |                      |
|                      | 10                           | 43 15                       | 44 5  | 44 54 | 45 44 | 46 33 | 47 23 | 48 12 | 49 2  |       |  |                      |
|                      | 20                           | 43 10                       | 44 0  | 44 49 | 45 39 | 46 28 | 47 18 | 48 8  | 48 57 |       |  |                      |
|                      | 30                           | 43 5                        | 43 55 | 44 44 | 45 34 | 46 23 | 47 12 | 48 2  | 48 51 |       |  |                      |
|                      | 40                           | 43 1                        | 43 50 | 44 40 | 45 29 | 46 18 | 47 8  | 47 57 | 48 46 |       |  |                      |
|                      | 50                           | 42 55                       | 43 45 | 44 34 | 45 23 | 46 13 | 47 2  | 47 51 | 48 40 |       |  |                      |
|                      | 3 35                         | 42 51                       | 43 40 | 44 29 | 45 18 | 46 8  | 46 57 | 47 46 | 48 35 |       |  |                      |
|                      | 4 10                         | 42 45                       | 43 35 | 44 24 | 45 13 | 46 2  | 46 51 | 47 40 | 48 29 |       |  |                      |
|                      | 5 20                         | 42 41                       | 43 30 | 44 19 | 45 8  | 45 57 | 46 46 | 47 35 | 48 24 |       |  |                      |
|                      | 6 30                         | 42 36                       | 43 25 | 44 13 | 45 2  | 45 51 | 46 40 | 47 29 | 48 18 |       |  |                      |
| 2                    | 0                            | 42 31                       | 43 20 | 44 9  | 45 58 | 46 46 | 47 35 | 48 24 | 49 13 | 2 1'6 |  |                      |
|                      | 10                           | 42 26                       | 43 14 | 44 3  | 45 52 | 46 40 | 47 29 | 48 17 | 49 6  |       |  |                      |
|                      | 20                           | 42 21                       | 43 9  | 43 58 | 44 47 | 45 35 | 46 24 | 47 12 | 48 1  |       |  |                      |
|                      | 30                           | 42 15                       | 43 4  | 43 53 | 44 41 | 45 29 | 46 18 | 47 6  | 47 55 |       |  |                      |
|                      | 40                           | 42 11                       | 42 59 | 43 48 | 44 36 | 45 24 | 46 13 | 47 1  | 47 49 |       |  |                      |
|                      | 50                           | 42 6                        | 42 54 | 43 42 | 44 30 | 45 18 | 46 7  | 46 55 | 47 43 |       |  |                      |
|                      | 3 37                         | 42 1                        | 42 49 | 43 37 | 44 25 | 45 13 | 46 1  | 46 50 | 47 38 |       |  |                      |
|                      | 4 10                         | 41 55                       | 42 43 | 43 31 | 44 19 | 45 7  | 45 55 | 46 43 | 47 31 |       |  |                      |
|                      | 5 20                         | 41 51                       | 42 39 | 43 26 | 44 14 | 45 2  | 45 50 | 46 38 | 47 26 |       |  |                      |
|                      | 6 30                         | 41 45                       | 42 33 | 43 21 | 44 8  | 44 56 | 45 44 | 46 32 | 47 20 |       |  |                      |
| 3                    | 0                            | 41 40                       | 42 28 | 43 16 | 44 3  | 44 51 | 45 39 | 46 27 | 47 14 | 3 2'4 |  |                      |
|                      | 10                           | 41 34                       | 42 22 | 43 10 | 43 57 | 44 45 | 45 33 | 46 20 | 47 7  |       |  |                      |
|                      | 20                           | 41 30                       | 42 17 | 43 5  | 43 52 | 44 40 | 45 27 | 46 14 | 47 2  |       |  |                      |
|                      | 30                           | 41 24                       | 42 11 | 42 59 | 43 46 | 44 34 | 45 21 | 46 8  | 46 56 |       |  |                      |
|                      | 40                           | 41 19                       | 42 6  | 42 54 | 43 41 | 44 28 | 45 15 | 46 3  | 46 51 |       |  |                      |
|                      | 50                           | 41 14                       | 42 0  | 42 48 | 43 35 | 44 22 | 45 9  | 45 56 | 46 44 |       |  |                      |
|                      | 3 39                         | 41 8                        | 41 54 | 42 42 | 43 29 | 44 16 | 45 3  | 45 50 | 46 37 |       |  |                      |
|                      | 4 10                         | 41 2                        | 41 43 | 42 36 | 43 23 | 44 9  | 44 56 | 45 43 | 46 30 |       |  |                      |
|                      | 5 20                         | 40 57                       | 41 43 | 42 30 | 43 18 | 44 4  | 44 51 | 45 38 | 46 25 |       |  |                      |
|                      | 6 30                         | 40 51                       | 41 37 | 42 24 | 43 11 | 43 58 | 44 45 | 45 31 | 46 18 |       |  |                      |
| 4                    | 0                            | 40 46                       | 41 32 | 42 19 | 43 6  | 43 52 | 44 39 | 45 26 | 46 13 | 4 3'1 |  |                      |
|                      | 10                           | 40 40                       | 41 26 | 42 13 | 42 59 | 43 46 | 44 33 | 45 19 | 46 6  |       |  |                      |
|                      | 20                           | 40 35                       | 41 21 | 42 8  | 42 54 | 43 41 | 44 27 | 45 14 | 46 0  |       |  |                      |
|                      | 30                           | 40 29                       | 41 15 | 42 2  | 42 48 | 43 34 | 44 21 | 45 7  | 45 53 |       |  |                      |
|                      | 40                           | 40 24                       | 41 10 | 41 57 | 42 43 | 43 29 | 44 15 | 45 1  | 45 48 |       |  |                      |
|                      | 50                           | 40 18                       | 41 4  | 41 50 | 42 36 | 43 22 | 44 9  | 44 54 | 45 30 |       |  |                      |
|                      | 3 42                         | 40 13                       | 40 59 | 41 45 | 42 31 | 43 17 | 44 3  | 44 49 | 45 35 |       |  |                      |
|                      | 4 10                         | 40 7                        | 40 53 | 41 38 | 42 25 | 43 10 | 43 56 | 44 42 | 45 28 |       |  |                      |
|                      | 5 20                         | 40 1                        | 40 47 | 41 32 | 42 18 | 43 4  | 43 49 | 44 35 | 45 21 |       |  |                      |
|                      | 6 30                         | 39 55                       | 40 40 | 41 26 | 42 11 | 42 57 | 43 43 | 44 28 | 45 14 |       |  |                      |
| 5                    | 0                            | 39 49                       | 40 35 | 41 21 | 42 6  | 42 51 | 43 37 | 44 23 | 45 8  | 5 3'3 |  |                      |
|                      | 10                           | 39 44                       | 40 29 | 41 14 | 42 0  | 42 45 | 43 30 | 44 16 | 45 1  |       |  |                      |
|                      | 20                           | 39 38                       | 40 24 | 41 9  | 41 54 | 42 39 | 43 25 | 44 10 | 44 55 |       |  |                      |
|                      | 30                           | 39 32                       | 40 17 | 41 3  | 41 48 | 42 33 | 43 18 | 44 3  | 44 48 |       |  |                      |
|                      | 40                           | 39 27                       | 40 12 | 40 57 | 41 42 | 42 27 | 43 12 | 43 57 | 44 42 |       |  |                      |
|                      | 50                           | 39 21                       | 40 6  | 40 50 | 41 35 | 42 20 | 43 5  | 43 50 | 44 35 |       |  |                      |
|                      | 3 44                         | 39 15                       | 40 0  | 40 45 | 41 30 | 42 15 | 43 0  | 43 44 | 44 29 |       |  |                      |
|                      | 4 10                         | 39 9                        | 39 54 | 40 39 | 41 23 | 42 8  | 42 53 | 43 38 | 44 23 |       |  |                      |
|                      | 5 20                         | 39 3                        | 39 48 | 40 33 | 41 17 | 42 2  | 42 47 | 43 32 | 44 17 |       |  |                      |
|                      | 6 30                         | 39 0                        | 39 42 | 40 27 | 41 11 | 41 56 | 42 41 | 43 26 | 44 11 |       |  |                      |

TABLE XVII.—CORRECTION OF THE MOON'S ALTITUDE.

| P. P.<br>for<br>Alt. | Moon's<br>App.<br>Alt. | Moon's Horizontal PARALLAX. |       |       |       |       |       |       |       |       |     | P. P.<br>for<br>Par. |
|----------------------|------------------------|-----------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-----|----------------------|
|                      |                        | 54'                         | 55'   | 56'   | 57'   | 58'   | 59'   | 60'   | 61'   |       |     |                      |
| "                    | 43                     | 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 36 | 40 20 | 41 4  | 41 49 | 42 33 | 43 17 | 44 1  | 1     | 0.7 |                      |
| 2                    | 30                     | 38 45                       | 39 29 | 40 13 | 40 57 | 41 42 | 42 26 | 43 10 | 43 54 | 2     | 1.5 |                      |
| 3                    | 40                     | 38 40                       | 39 25 | 40 8  | 40 52 | 41 36 | 42 20 | 43 4  | 43 48 | 3     | 2.3 |                      |
| 4                    | 50                     | 38 33                       | 39 17 | 40 1  | 40 45 | 41 29 | 42 13 | 42 57 | 43 41 | 4     | 2.9 |                      |
| 5                    | 43                     | 0                           | 38 27 | 39 11 | 39 56 | 40 39 | 41 23 | 42 7  | 42 51 | 5     | 3.6 |                      |
| 6                    | 10                     | 38 21                       | 39 5  | 39 48 | 40 32 | 41 16 | 42 0  | 42 44 | 43 27 | 6     | 4.4 |                      |
| 7                    | 20                     | 38 15                       | 38 59 | 39 42 | 40 26 | 41 9  | 41 53 | 42 36 | 43 20 | 7     | 5.1 |                      |
| 8                    | 30                     | 38 8                        | 38 52 | 39 35 | 40 19 | 41 2  | 41 46 | 42 29 | 43 13 | 8     | 5.8 |                      |
| 9                    | 40                     | 38 3                        | 38 46 | 39 30 | 40 13 | 40 57 | 41 40 | 42 23 | 43 7  | 9     | 6.6 |                      |
|                      | 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 2  | 42 46 | "     |     |                      |
| 1                    | 20                     | 37 38                       | 38 20 | 39 4  | 39 46 | 40 29 | 41 12 | 41 55 | 42 38 | 1     | 0.7 |                      |
| 2                    | 30                     | 37 31                       | 38 14 | 38 56 | 39 40 | 40 22 | 41 5  | 41 48 | 42 31 | 2     | 1.4 |                      |
| 3                    | 40                     | 37 26                       | 38 8  | 38 51 | 39 33 | 40 16 | 40 59 | 41 41 | 42 24 | 3     | 2.1 |                      |
| 4                    | 50                     | 37 18                       | 38 1  | 38 44 | 39 26 | 40 9  | 40 51 | 41 34 | 42 17 | 4     | 2.8 |                      |
| 5                    | 45                     | 0                           | 37 13 | 37 55 | 38 3  | 39 21 | 40 3  | 40 45 | 41 28 | 5     | 3.5 |                      |
| 6                    | 10                     | 37 7                        | 37 49 | 38 3  | 39 14 | 39 56 | 40 39 | 41 21 | 42 3  | 6     | 4.2 |                      |
| 7                    | 20                     | 37 0                        | 37 42 | 38 24 | 39 6  | 39 48 | 40 31 | 41 13 | 41 55 | 7     | 4.9 |                      |
| 8                    | 30                     | 36 53                       | 37 35 | 38 17 | 38 59 | 39 41 | 40 23 | 41 5  | 41 48 | 8     | 5.6 |                      |
| 9                    | 40                     | 36 47                       | 37 29 | 38 11 | 38 53 | 39 35 | 40 17 | 40 59 | 41 41 | 9     | 6.3 |                      |
|                      | 50                     | 36 40                       | 37 22 | 38 4  | 38 46 | 39 28 | 40 10 | 40 51 | 41 33 |       |     |                      |
| "                    | 46                     | 0                           | 36 35 | 37 17 | 37 58 | 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     | 0.7 |                      |
| 2                    | 30                     | 36 14                       | 36 56 | 37 37 | 38 18 | 38 59 | 39 41 | 40 22 | 41 3  | 2     | 1.4 |                      |
| 3                    | 40                     | 36 9                        | 36 49 | 37 31 | 38 12 | 38 53 | 39 34 | 40 15 | 40 57 | 3     | 2.0 |                      |
| 4                    | 50                     | 36 1                        | 36 43 | 37 24 | 38 5  | 38 46 | 39 27 | 40 8  | 40 49 | 4     | 2.7 |                      |
| 5                    | 47                     | 0                           | 35 56 | 36 37 | 37 17 | 37 58 | 38 40 | 39 20 | 40 1  | 5     | 3.4 |                      |
| 6                    | 10                     | 35 49                       | 36 29 | 37 10 | 37 51 | 38 32 | 39 13 | 39 53 | 40 24 | 6     | 4.1 |                      |
| 7                    | 20                     | 35 42                       | 36 23 | 37 3  | 37 44 | 38 25 | 39 5  | 39 46 | 40 26 | 7     | 4.8 |                      |
| 8                    | 30                     | 35 35                       | 36 16 | 36 56 | 37 37 | 38 17 | 38 58 | 39 38 | 40 19 | 8     | 5.5 |                      |
| 9                    | 40                     | 35 29                       | 36 9  | 36 50 | 37 30 | 38 11 | 38 51 | 39 32 | 40 12 | 9     | 6.2 |                      |
|                      | 50                     | 35 22                       | 36 3  | 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     | 0.6 |                      |
| 2                    | 30                     | 34 55                       | 35 34 | 36 15 | 36 54 | 37 34 | 38 13 | 38 54 | 39 33 | 2     | 1.3 |                      |
| 3                    | 40                     | 34 49                       | 35 28 | 36 8  | 36 47 | 37 28 | 38 7  | 38 47 | 39 26 | 3     | 1.9 |                      |
| 4                    | 50                     | 34 42                       | 35 21 | 36 1  | 36 40 | 37 20 | 37 59 | 38 39 | 39 18 | 4     | 2.6 |                      |
| 5                    | 49                     | 0                           | 34 35 | 35 14 | 35 53 | 36 33 | 37 12 | 37 52 | 38 31 | 5     | 3.2 |                      |
| 6                    | 10                     | 34 28                       | 35 7  | 35 46 | 36 25 | 37 4  | 37 44 | 38 23 | 39 2  | 6     | 3.9 |                      |
| 7                    | 20                     | 34 21                       | 35 0  | 35 39 | 36 18 | 36 58 | 37 37 | 38 16 | 38 55 | 7     | 4.6 |                      |
| 8                    | 30                     | 34 14                       | 34 53 | 35 32 | 36 11 | 36 50 | 37 29 | 38 8  | 38 47 | 8     | 5.2 |                      |
| 9                    | 40                     | 34                          | 34 46 | 35 26 | 36 4  | 36 43 | 37 22 | 38 1  | 38 40 | 9     | 5.9 |                      |
|                      | 50                     | 34                          | 34 40 | 35 18 | 35 57 | 36 36 | 37 15 | 37 53 | 38 32 |       |     |                      |

TABLE XVII.—CORRECTION OF THE MOON'S ALTITUDE.

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

TABLE XVII.—CORRECTION OF THE MOON'S ALTITUDE.

| P. P.<br>for<br>Alt. | Moon's<br>App.<br>Alt. | Moon's Horizontal Parallax. |       |       |       |       |       |       |       | P. P.<br>for<br>Par. |
|----------------------|------------------------|-----------------------------|-------|-------|-------|-------|-------|-------|-------|----------------------|
|                      |                        | 54'                         | 55'   | 56'   | 57'   | 58'   | 59'   | 60'   | 61'   |                      |
|                      | 0                      | "                           | "     | "     | "     | "     | "     | "     | "     |                      |
|                      | 58                     | 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 |                      |
| 1                    | 20                     | 27 45                       | 28 16 | 28 48 | 29 19 | 29 51 | 30 22 | 30 54 | 31 25 | 1 0.5                |
| 2                    | 30                     | 27 37                       | 28 8  | 28 40 | 29 11 | 29 42 | 30 14 | 30 45 | 31 16 | 2 1.0                |
| 3                    | 40                     | 27 29                       | 28 0  | 28 31 | 29 2  | 29 34 | 30 5  | 30 36 | 31 7  | 3 1.5                |
| 4                    | 50                     | 27 22                       | 27 53 | 28 24 | 28 55 | 29 26 | 29 57 | 30 28 | 30 59 | 4 2.1                |
| 5                    | 59                     | 0 27 14                     | 27 45 | 28 15 | 28 47 | 29 17 | 29 48 | 30 19 | 30 50 | 5 2.6                |
| 6                    | 10                     | 27 6                        | 27 36 | 28 7  | 28 38 | 29 9  | 29 39 | 30 10 | 30 41 | 6 3.1                |
| 7                    | 20                     | 26 58                       | 27 29 | 28 0  | 28 30 | 29 1  | 29 31 | 30 2  | 30 33 | 7 3.6                |
| 8                    | 30                     | 26 51                       | 27 21 | 27 51 | 28 22 | 28 52 | 29 22 | 29 53 | 30 24 | 8 4.1                |
| 9                    | 40                     | 26 43                       | 27 13 | 27 43 | 28 13 | 28 43 | 29 14 | 29 44 | 30 15 | 9 4.6                |
|                      | 50                     | 26 34                       | 27 4  | 27 34 | 28 4  | 28 35 | 29 5  | 29 35 | 30 5  |                      |
|                      | 60                     | 0 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 |                      |
| 1                    | 20                     | 26 11                       | 26 40 | 27 10 | 27 40 | 28 10 | 28 39 | 29 9  | 29 38 | 1 0.5                |
| 2                    | 30                     | 26 2                        | 26 32 | 27 2  | 27 31 | 28 1  | 28 30 | 29 0  | 29 29 | 2 1.0                |
| 3                    | 40                     | 25 54                       | 26 23 | 26 53 | 27 22 | 27 52 | 28 21 | 28 50 | 29 20 | 3 1.4                |
| 4                    | 50                     | 25 46                       | 26 16 | 26 45 | 27 15 | 27 44 | 28 13 | 28 42 | 29 12 | 4 1.9                |
| 5                    | 59                     | 0 25 39                     | 26 8  | 26 37 | 27 6  | 27 35 | 28 4  | 28 33 | 29 2  | 5 2.4                |
| 6                    | 10                     | 25 30                       | 25 59 | 26 29 | 26 57 | 27 26 | 27 55 | 28 24 | 28 53 | 6 2.9                |
| 7                    | 20                     | 25 22                       | 25 51 | 26 20 | 26 48 | 27 17 | 27 46 | 28 15 | 28 44 | 7 3.4                |
| 8                    | 30                     | 25 14                       | 25 42 | 26 11 | 26 40 | 27 9  | 27 37 | 28 6  | 28 35 | 8 3.8                |
| 9                    | 40                     | 25 6                        | 25 34 | 26 2  | 26 31 | 27 0  | 27 28 | 27 57 | 28 25 | 9 4.3                |
|                      | 50                     | 24 58                       | 25 27 | 25 55 | 26 24 | 26 52 | 27 20 | 27 48 | 28 16 |                      |
|                      | 62                     | 0 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 |                      |
| 1                    | 20                     | 24 34                       | 25 1  | 25 30 | 25 58 | 26 26 | 26 54 | 27 22 | 27 49 | 1 0.4                |
| 2                    | 30                     | 24 26                       | 24 54 | 25 22 | 25 49 | 26 17 | 26 44 | 27 12 | 27 40 | 2 0.9                |
| 3                    | 40                     | 24 17                       | 24 45 | 25 13 | 25 40 | 26 8  | 26 35 | 27 3  | 27 31 | 3 1.3                |
| 4                    | 50                     | 24 10                       | 24 37 | 25 4  | 25 32 | 25 59 | 26 26 | 26 53 | 27 21 | 4 1.8                |
| 5                    | 59                     | 0 24 1                      | 24 28 | 24 55 | 25 23 | 25 50 | 26 17 | 26 44 | 27 11 | 5 2.2                |
| 6                    | 10                     | 23 53                       | 24 20 | 24 47 | 25 14 | 25 41 | 26 8  | 26 35 | 27 2  | 6 2.7                |
| 7                    | 20                     | 23 45                       | 24 12 | 24 39 | 25 6  | 25 33 | 26 0  | 26 27 | 26 54 | 7 3.1                |
| 8                    | 30                     | 23 36                       | 24 3  | 24 30 | 24 57 | 25 24 | 25 51 | 26 17 | 26 44 | 8 3.6                |
| 9                    | 40                     | 23 28                       | 23 55 | 24 21 | 24 48 | 25 15 | 25 41 | 26 8  | 26 35 | 9 4.0                |
|                      | 50                     | 23 21                       | 23 47 | 24 14 | 24 40 | 25 7  | 25 33 | 26 0  | 26 26 |                      |
|                      | 64                     | 0 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  |                      |
| 1                    | 20                     | 22 55                       | 23 21 | 23 48 | 24 13 | 24 39 | 25 5  | 25 31 | 25 57 | 1 0.4                |
| 2                    | 30                     | 22 47                       | 23 13 | 23 39 | 24 4  | 24 30 | 24 56 | 25 22 | 25 48 | 2 0.8                |
| 3                    | 40                     | 22 39                       | 23 4  | 23 30 | 23 55 | 24 21 | 24 47 | 25 12 | 25 38 | 3 1.2                |
| 4                    | 50                     | 22 31                       | 22 56 | 23 22 | 23 47 | 24 13 | 24 38 | 25 4  | 25 29 | 4 1.7                |
| 5                    | 59                     | 0 22 22                     | 22 47 | 23 13 | 23 38 | 24 4  | 24 29 | 24 55 | 25 20 | 5 2.1                |
| 6                    | 10                     | 22 14                       | 22 39 | 23 4  | 23 29 | 23 55 | 24 20 | 24 45 | 25 10 | 6 2.5                |
| 7                    | 20                     | 22 5                        | 22 30 | 23 55 | 23 20 | 23 46 | 24 10 | 24 35 | 25 1  | 7 2.9                |
| 8                    | 30                     | 21 56                       | 22 22 | 22 46 | 23 11 | 23 36 | 24 1  | 24 26 | 24 51 | 8 3.3                |
| 9                    | 40                     | 21 48                       | 22 13 | 22 37 | 23 2  | 23 27 | 23 52 | 24 16 | 24 41 | 9 3.7                |
|                      | 50                     | 21 41                       | 22 5  | 22 30 | 22 54 | 23 18 | 23 42 | 24 8  | 24 32 |                      |

TABLE XVII.—CORRECTION OF THE MOON'S ALTITUDE.

| P. P.<br>L. &<br>Alt. | Moon's<br>App.<br>Alt. | MOON'S HORIZONTAL PARALLAX. |       |       |       |       |       |       |       |       |       | P. P.<br>L. &<br>Par. |
|-----------------------|------------------------|-----------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-----------------------|
|                       |                        | 54'                         | 55'   | 56'   | 57'   | 58'   | 59'   | 60'   | 61'   |       |       |                       |
| 1                     | 0                      | 21 32                       | 21 56 | 22 21 | 22 45 | 23 9  | 23 34 | 23 58 | 24 23 |       |       |                       |
| 1                     | 10                     | 21 23                       | 21 48 | 22 13 | 22 36 | 23 0  | 23 24 | 23 48 | 24 13 |       |       |                       |
| 2                     | 20                     | 21 16                       | 21 40 | 22 4  | 22 28 | 22 52 | 23 16 | 23 40 | 24 4  | 1 0.4 |       |                       |
| 2                     | 30                     | 21 7                        | 21 31 | 21 55 | 22 19 | 22 43 | 23 7  | 23 31 | 23 54 | 2 0.8 |       |                       |
| 3                     | 40                     | 20 58                       | 21 22 | 21 46 | 22 10 | 22 33 | 22 57 | 23 21 | 23 45 | 3 1.1 |       |                       |
| 4                     | 50                     | 20 49                       | 21 13 | 21 37 | 22 0  | 22 24 | 22 48 | 23 11 | 23 35 | 4 1.5 |       |                       |
| 5                     | 56.7                   | 20 41                       | 21 4  | 21 28 | 21 51 | 22 15 | 22 38 | 23 1  | 23 25 | 5 1.9 |       |                       |
| 6                     | 10                     | 20 32                       | 20 55 | 21 19 | 21 42 | 22 6  | 22 29 | 22 52 | 23 15 | 6 2.3 |       |                       |
| 7                     | 20                     | 20 23                       | 20 48 | 21 11 | 21 34 | 21 57 | 22 20 | 22 43 | 23 7  | 7 2.7 |       |                       |
| 8                     | 30                     | 20 16                       | 20 39 | 21 2  | 21 25 | 21 48 | 22 11 | 22 34 | 22 56 | 8 3.0 |       |                       |
| 9                     | 40                     | 20 7                        | 20 30 | 20 53 | 21 16 | 21 38 | 22 1  | 22 24 | 22 47 | 9 3.4 |       |                       |
|                       | 50                     | 19 58                       | 20 21 | 20 44 | 21 7  | 21 29 | 21 52 | 22 14 | 22 37 |       |       |                       |
| 1                     | 68                     | 0                           | 19 50 | 20 12 | 20 35 | 20 57 | 21 20 | 21 42 | 22 5  | 22 27 |       |                       |
| 1                     | 10                     | 19 41                       | 20 3  | 20 26 | 20 48 | 21 11 | 21 32 | 21 55 | 22 17 |       |       |                       |
| 2                     | 20                     | 19 33                       | 19 56 | 20 18 | 20 39 | 21 2  | 21 24 | 21 46 | 22 8  | 1 0.4 |       |                       |
| 2                     | 30                     | 19 24                       | 19 47 | 20 8  | 20 30 | 20 53 | 21 14 | 21 36 | 21 59 | 2 0.7 |       |                       |
| 3                     | 40                     | 19 15                       | 19 38 | 19 59 | 20 21 | 20 43 | 21 3  | 21 25 | 21 49 | 3 1.1 |       |                       |
| 4                     | 50                     | 19 8                        | 19 30 | 19 51 | 20 13 | 20 34 | 20 56 | 21 18 | 21 40 | 4 1.5 |       |                       |
| 5                     | 56.9                   | 0                           | 18 59 | 19 21 | 19 42 | 20 4  | 20 25 | 20 46 | 21 8  | 21 30 | 5 1.8 |                       |
| 6                     | 10                     | 18 51                       | 19 12 | 19 33 | 19 54 | 20 16 | 20 36 | 20 58 | 21 19 | 6 2.2 |       |                       |
| 7                     | 20                     | 18 42                       | 19 3  | 19 24 | 19 45 | 20 6  | 20 27 | 20 49 | 21 10 | 7 2.5 |       |                       |
| 8                     | 30                     | 18 33                       | 18 54 | 19 15 | 19 36 | 19 57 | 20 18 | 20 39 | 21 08 | 8 2.9 |       |                       |
| 9                     | 40                     | 18 24                       | 18 45 | 19 6  | 19 27 | 19 46 | 20 8  | 20 29 | 20 50 | 9 3.3 |       |                       |
|                       | 50                     | 18 16                       | 18 37 | 18 58 | 19 18 | 19 39 | 19 59 | 20 20 | 20 41 |       |       |                       |
| 1                     | 70                     | 0                           | 18 7  | 18 28 | 18 48 | 19 9  | 19 29 | 19 50 | 20 10 | 20 31 |       |                       |
| 1                     | 10                     | 17 58                       | 18 19 | 18 39 | 18 59 | 19 20 | 19 40 | 20 1  | 20 21 |       |       |                       |
| 2                     | 20                     | 17 49                       | 18 10 | 18 30 | 18 50 | 19 10 | 19 31 | 19 50 | 20 11 | 1 0.3 |       |                       |
| 2                     | 30                     | 17 41                       | 18 1  | 18 20 | 18 41 | 19 1  | 19 20 | 19 41 | 20 12 | 2 0.7 |       |                       |
| 3                     | 40                     | 17 33                       | 17 53 | 18 12 | 18 32 | 18 52 | 19 12 | 19 32 | 19 51 | 3 1.0 |       |                       |
| 4                     | 50                     | 17 24                       | 17 44 | 18 3  | 18 23 | 18 42 | 19 2  | 19 22 | 19 42 | 4 1.2 |       |                       |
| 5                     | 56.7                   | 0                           | 17 15 | 17 35 | 17 54 | 18 14 | 18 33 | 18 53 | 19 12 | 19 32 | 5 1.7 |                       |
| 6                     | 10                     | 17 6                        | 17 25 | 17 45 | 18 4  | 18 23 | 18 43 | 19 2  | 19 21 | 6 2.0 |       |                       |
| 7                     | 20                     | 16 57                       | 17 16 | 17 35 | 17 54 | 18 14 | 18 33 | 18 52 | 19 11 | 7 2.3 |       |                       |
| 8                     | 30                     | 16 48                       | 17 7  | 17 26 | 17 45 | 18 4  | 18 23 | 18 42 | 19 2  | 8 2.6 |       |                       |
| 9                     | 40                     | 16 40                       | 16 59 | 17 18 | 17 37 | 17 55 | 18 15 | 18 33 | 18 52 | 9 3.0 |       |                       |
|                       | 50                     | 16 31                       | 16 50 | 17 9  | 17 27 | 17 46 | 18 5  | 18 24 | 18 42 |       |       |                       |
| 1                     | 72                     | 0                           | 16 22 | 16 41 | 16 59 | 17 18 | 17 36 | 17 55 | 18 13 | 18 32 |       |                       |
| 1                     | 10                     | 16 13                       | 16 31 | 16 50 | 17 9  | 17 27 | 17 45 | 18 3  | 18 22 |       |       |                       |
| 2                     | 20                     | 16 4                        | 16 22 | 16 41 | 16 59 | 17 17 | 17 36 | 17 54 | 18 12 | 1 0.3 |       |                       |
| 2                     | 30                     | 15 55                       | 16 13 | 16 31 | 16 49 | 17 7  | 17 25 | 17 43 | 18 12 | 2 0.6 |       |                       |
| 3                     | 40                     | 15 47                       | 16 5  | 16 23 | 16 41 | 16 59 | 17 17 | 17 35 | 17 52 | 3 0.9 |       |                       |
| 4                     | 50                     | 15 38                       | 15 56 | 16 14 | 16 31 | 16 49 | 17 7  | 17 25 | 17 42 | 4 1.2 |       |                       |
| 5                     | 56.7                   | 0                           | 15 29 | 15 47 | 16 4  | 16 22 | 16 40 | 16 57 | 17 14 | 17 32 | 5 1.5 |                       |
| 6                     | 10                     | 15 20                       | 15 38 | 15 55 | 16 13 | 16 30 | 16 47 | 17 5  | 17 22 | 6 1.8 |       |                       |
| 7                     | 20                     | 15 11                       | 15 28 | 15 46 | 16 3  | 16 20 | 16 37 | 16 55 | 17 12 | 7 2.1 |       |                       |
| 8                     | 30                     | 15 2                        | 15 19 | 15 36 | 15 53 | 16 10 | 16 28 | 16 44 | 17 2  | 8 2.4 |       |                       |
| 9                     | 40                     | 14 54                       | 15 11 | 15 28 | 15 45 | 16 2  | 16 18 | 16 35 | 16 52 | 9 2.7 |       |                       |
|                       | 50                     | 14 45                       | 15 2  | 15 18 | 15 35 | 15 52 | 16 9  | 16 26 | 16 42 |       |       |                       |

TABLE XVII.—CORRECTION OF THE MOON'S ALTITUDE.

| P. P.<br>for<br>Alt. |  | Moon's<br>App.<br>Alt. | MOON'S HORIZONTAL PARALLAX. |       |       |       |       |       |       |       | P. P.<br>For. |       |
|----------------------|--|------------------------|-----------------------------|-------|-------|-------|-------|-------|-------|-------|---------------|-------|
|                      |  |                        | 54                          | 55    | 56    | 57    | 58    | 59    | 60    | 61    |               |       |
| 1                    |  | 74                     | 0                           | 14 36 | 14 53 | 15 9  | 15 26 | 15 42 | 15 59 | 16 15 | 16 32         |       |
| 2                    |  | 10                     | 14 27                       | 14 44 | 15 0  | 15 16 | 15 32 | 15 49 | 16 5  | 16 21 | 16 38         |       |
| 3                    |  | 20                     | 14 18                       | 14 34 | 14 50 | 15 6  | 15 23 | 15 39 | 15 55 | 16 11 | 16 28         | 1 0.3 |
| 4                    |  | 30                     | 14 9                        | 14 25 | 14 41 | 14 57 | 15 13 | 15 29 | 15 45 | 16 1  | 16 18         | 1 0.5 |
| 5                    |  | 40                     | 14 1                        | 14 16 | 14 33 | 14 48 | 15 4  | 15 20 | 15 36 | 15 52 | 16 8          | 1 0.8 |
| 6                    |  | 50                     | 13 52                       | 14 7  | 14 23 | 14 39 | 14 54 | 15 10 | 15 26 | 15 42 | 16 14         | 1 1.1 |
| 7                    |  | 75                     | 0                           | 13 43 | 13 58 | 14 13 | 14 29 | 14 45 | 15 0  | 15 16 | 15 31         | 1 1.3 |
| 8                    |  | 10                     | 13 33                       | 13 49 | 14 4  | 14 19 | 14 35 | 14 50 | 15 6  | 15 21 | 15 36         | 1 1.6 |
| 9                    |  | 20                     | 13 24                       | 13 40 | 13 55 | 14 10 | 14 25 | 14 40 | 14 55 | 15 10 | 15 26         | 1 1.8 |
| 1                    |  | 30                     | 13 15                       | 13 30 | 13 45 | 14 0  | 14 15 | 14 30 | 14 45 | 15 0  | 15 15         | 2 0.1 |
| 2                    |  | 40                     | 13 7                        | 13 22 | 13 37 | 13 52 | 14 7  | 14 22 | 14 36 | 14 51 | 15 6          | 2 0.4 |
| 3                    |  | 50                     | 12 58                       | 13 13 | 13 28 | 13 42 | 13 57 | 14 11 | 14 26 | 14 41 | 15 0          |       |
| 4                    |  | 76                     | 0                           | 12 49 | 13 4  | 13 18 | 13 32 | 13 47 | 14 1  | 14 16 | 14 31         |       |
| 5                    |  | 10                     | 12 40                       | 12 54 | 13 8  | 13 23 | 13 37 | 13 52 | 14 6  | 14 20 | 14 35         |       |
| 6                    |  | 20                     | 12 31                       | 12 44 | 12 59 | 13 13 | 13 27 | 13 41 | 13 56 | 14 10 | 14 25         | 1 0.2 |
| 7                    |  | 30                     | 12 22                       | 12 35 | 12 49 | 13 4  | 13 17 | 13 31 | 13 46 | 13 59 | 14 14         | 1 0.5 |
| 8                    |  | 40                     | 12 13                       | 12 27 | 12 41 | 12 55 | 13 9  | 13 23 | 13 36 | 13 50 | 14 5          | 1 0.7 |
| 9                    |  | 50                     | 12 4                        | 12 18 | 12 32 | 12 45 | 12 59 | 13 12 | 13 26 | 13 39 | 14 0          | 1 0.9 |
| 1                    |  | 77                     | 0                           | 11 55 | 12 8  | 12 22 | 12 35 | 12 49 | 13 2  | 13 16 | 13 29         | 1 1.1 |
| 2                    |  | 10                     | 11 45                       | 11 59 | 12 12 | 12 26 | 12 40 | 12 53 | 13 7  | 13 20 | 13 34         | 1 1.4 |
| 3                    |  | 20                     | 11 37                       | 11 51 | 12 3  | 12 16 | 12 30 | 12 43 | 12 57 | 13 10 | 13 24         | 1 1.6 |
| 4                    |  | 30                     | 11 28                       | 11 41 | 11 54 | 12 7  | 12 21 | 12 34 | 12 47 | 13 0  | 13 13         | 1 1.8 |
| 5                    |  | 40                     | 11 19                       | 11 32 | 11 45 | 11 58 | 12 11 | 12 24 | 12 37 | 12 49 | 13 2          | 2 0.1 |
| 6                    |  | 50                     | 11 11                       | 11 23 | 11 36 | 11 49 | 12 1  | 12 14 | 12 26 | 12 39 | 12 51         |       |
| 7                    |  | 78                     | 0                           | 11 2  | 11 14 | 11 26 | 11 39 | 11 51 | 12 4  | 12 16 | 12 29         |       |
| 8                    |  | 10                     | 10 52                       | 11 5  | 11 17 | 11 29 | 11 42 | 11 54 | 12 6  | 12 19 | 12 32         |       |
| 9                    |  | 20                     | 10 43                       | 10 55 | 11 8  | 11 20 | 11 32 | 11 44 | 11 56 | 12 8  | 12 19         | 1 0.2 |
| 1                    |  | 30                     | 10 34                       | 10 46 | 10 58 | 11 10 | 11 22 | 11 34 | 11 46 | 11 58 | 12 0          | 1 0.4 |
| 2                    |  | 40                     | 10 26                       | 10 38 | 10 49 | 11 1  | 11 12 | 11 24 | 11 36 | 11 48 | 12 0          | 1 0.6 |
| 3                    |  | 50                     | 10 17                       | 10 28 | 10 39 | 10 51 | 11 3  | 11 14 | 11 26 | 11 38 | 12 0          | 1 0.8 |
| 4                    |  | 79                     | 0                           | 10 7  | 10 18 | 10 30 | 10 41 | 10 53 | 11 4  | 11 16 | 11 27         | 1 1.0 |
| 5                    |  | 10                     | 9 58                        | 10 9  | 10 21 | 10 32 | 10 43 | 10 54 | 11 6  | 11 17 | 11 28         | 1 1.2 |
| 6                    |  | 20                     | 9 48                        | 10 0  | 10 11 | 10 22 | 10 33 | 10 44 | 10 56 | 11 7  | 11 18         | 1 1.4 |
| 7                    |  | 30                     | 9 39                        | 9 50  | 10 2  | 10 13 | 10 24 | 10 35 | 10 46 | 10 57 | 11 8          | 1 1.6 |
| 8                    |  | 40                     | 9 31                        | 9 42  | 9 53  | 10 3  | 10 14 | 10 25 | 10 35 | 10 46 | 10 57         | 1 1.8 |
| 9                    |  | 50                     | 9 22                        | 9 33  | 9 43  | 9 53  | 10 4  | 10 15 | 10 25 | 10 36 | 10 46         |       |
| 1                    |  | 80                     | 0                           | 9 13  | 9 23  | 9 33  | 9 44  | 9 54  | 10 5  | 10 15 | 10 25         |       |
| 2                    |  | 10                     | 9 3                         | 9 14  | 9 24  | 9 34  | 9 44  | 9 55  | 10 5  | 10 15 | 10 25         |       |
| 3                    |  | 20                     | 8 54                        | 9 4   | 9 15  | 9 25  | 9 35  | 9 45  | 9 55  | 10 5  | 10 15         | 1 0.2 |
| 4                    |  | 30                     | 8 45                        | 8 55  | 9 5   | 9 15  | 9 25  | 9 35  | 9 45  | 9 55  | 10 5          | 1 0.3 |
| 5                    |  | 40                     | 8 36                        | 8 46  | 8 56  | 9 5   | 9 15  | 9 25  | 9 34  | 9 44  | 9 54          | 1 0.5 |
| 6                    |  | 50                     | 8 27                        | 8 37  | 8 46  | 8 56  | 9 5   | 9 15  | 9 24  | 9 34  | 9 44          | 1 0.6 |
| 7                    |  | 81                     | 0                           | 8 18  | 8 27  | 8 37  | 8 46  | 8 55  | 9 5   | 9 14  | 9 24          | 1 0.8 |
| 8                    |  | 10                     | 8 9                         | 8 18  | 8 27  | 8 36  | 8 45  | 8 55  | 9 4   | 9 13  | 9 23          | 1 1.0 |
| 9                    |  | 20                     | 8 0                         | 8 9   | 8 18  | 8 27  | 8 36  | 8 45  | 8 54  | 9 3   | 9 12          | 1 1.2 |
| 1                    |  | 30                     | 7 50                        | 7 59  | 8 8   | 8 17  | 8 26  | 8 35  | 8 44  | 8 53  | 9 2           | 1 1.4 |
| 2                    |  | 40                     | 7 41                        | 7 50  | 7 59  | 8 7   | 8 16  | 8 25  | 8 33  | 8 42  | 8 51          | 1 1.6 |
| 3                    |  | 50                     | 7 32                        | 7 41  | 7 49  | 7 58  | 8 6   | 8 15  | 8 23  | 8 32  | 8 41          | 1 1.8 |

TABLE XVII.—CORRECTION OF THE MOON'S ALTITUDE.

| P. P. |   | Moon's HORIZONTAL PARALLAX. |     |      |      |      |      |      |      |      |      | P. P. |      |
|-------|---|-----------------------------|-----|------|------|------|------|------|------|------|------|-------|------|
| AR.   |   | AR.                         | 34' | 55'  | 56'  | 57'  | 58'  | 59'  | 60'  | 61'  |      | Sec.  | Par. |
|       |   | 82                          | 0   | 7 23 | 7 31 | 7 40 | 7 48 | 7 56 | 8 5  | 8 13 | 8 21 |       |      |
|       |   |                             | 10  | 7 14 | 7 22 | 7 30 | 7 38 | 7 46 | 7 55 | 8 3  | 8 11 |       |      |
| 1     | 1 |                             | 20  | 7 5  | 7 13 | 7 21 | 7 29 | 7 37 | 7 45 | 7 53 | 8 1  | 1 0'1 |      |
| 2     | 2 |                             | 30  | 6 55 | 7 3  | 7 11 | 7 19 | 7 27 | 7 35 | 7 43 | 7 50 | 2 0'3 |      |
| 3     | 3 |                             | 40  | 6 46 | 6 54 | 7 2  | 7 9  | 7 17 | 7 25 | 7 32 | 7 40 | 3 0'4 |      |
| 4     | 4 |                             | 50  | 6 37 | 6 45 | 6 52 | 7 0  | 7 7  | 7 14 | 7 22 | 7 29 | 4 0'5 |      |
| 5     | 5 | 83                          | 0   | 6 28 | 6 35 | 6 42 | 6 50 | 6 57 | 7 4  | 7 12 | 7 19 | 5 0'6 |      |
| 6     | 6 |                             | 10  | 6 19 | 6 26 | 6 33 | 6 40 | 6 47 | 6 54 | 7 2  | 7 9  | 6 0'8 |      |
| 7     | 7 |                             | 20  | 6 9  | 6 16 | 6 23 | 6 30 | 6 37 | 6 44 | 6 51 | 6 58 | 7 0'9 |      |
| 8     | 8 |                             | 30  | 6 0  | 6 7  | 6 14 | 6 21 | 6 27 | 6 34 | 6 41 | 6 48 | 8 1'0 |      |
| 9     | 9 |                             | 40  | 5 51 | 5 58 | 6 4  | 6 11 | 6 18 | 6 24 | 6 31 | 6 37 | 9 1'2 |      |
|       |   |                             | 50  | 5 42 | 5 48 | 5 55 | 6 1  | 6 8  | 6 14 | 6 21 | 6 27 |       |      |
|       |   | 84                          | 0   | 5 33 | 5 39 | 5 45 | 5 52 | 5 58 | 6 4  | 6 10 | 6 17 |       |      |
|       |   |                             | 10  | 5 23 | 5 30 | 5 36 | 5 42 | 5 48 | 5 54 | 6 0  | 6 6  |       |      |
| 1     | 1 |                             | 20  | 5 14 | 5 20 | 5 26 | 5 32 | 5 38 | 5 44 | 5 50 | 5 56 | 1 0'1 |      |
| 2     | 2 |                             | 30  | 5 5  | 5 11 | 5 17 | 5 22 | 5 28 | 5 34 | 5 40 | 5 45 | 2 0'2 |      |
| 3     | 3 |                             | 40  | 4 56 | 5 1  | 5 7  | 5 13 | 5 18 | 5 24 | 5 29 | 5 35 | 3 0'3 |      |
| 4     | 4 |                             | 50  | 4 47 | 4 52 | 4 57 | 5 3  | 5 8  | 5 14 | 5 19 | 5 24 | 4 0'4 |      |
| 5     | 5 | 85                          | 0   | 4 37 | 4 43 | 4 48 | 4 53 | 4 58 | 5 4  | 5 9  | 5 14 | 5 0'5 |      |
| 6     | 6 |                             | 10  | 4 28 | 4 33 | 4 38 | 4 43 | 4 48 | 4 53 | 4 59 | 5 4  | 6 0'6 |      |
| 7     | 7 |                             | 20  | 4 19 | 4 24 | 4 29 | 4 34 | 4 38 | 4 43 | 4 48 | 4 53 | 7 0'6 |      |
| 8     | 8 |                             | 30  | 4 10 | 4 14 | 4 19 | 4 24 | 4 29 | 4 33 | 4 38 | 4 43 | 8 0'7 |      |
| 9     | 9 |                             | 40  | 4 0  | 4 5  | 4 10 | 4 14 | 4 19 | 4 23 | 4 28 | 4 32 | 9 0'8 |      |
|       |   |                             | 50  | 3 51 | 3 56 | 4 0  | 4 4  | 4 9  | 4 13 | 4 17 | 4 22 |       |      |
|       |   | 86                          | 0   | 3 42 | 3 46 | 3 50 | 3 55 | 3 59 | 4 3  | 4 7  | 4 11 |       |      |
|       |   |                             | 10  | 3 33 | 3 37 | 3 41 | 3 45 | 3 49 | 3 53 | 3 57 | 4 1  |       |      |
| 1     | 1 |                             | 20  | 3 24 | 3 27 | 3 31 | 3 35 | 3 39 | 3 43 | 3 47 | 3 50 | 1 0'1 |      |
| 2     | 2 |                             | 30  | 3 14 | 3 18 | 3 22 | 3 25 | 3 29 | 3 33 | 3 36 | 3 40 | 2 0'1 |      |
| 3     | 3 |                             | 40  | 3 5  | 3 9  | 3 12 | 3 16 | 3 19 | 3 23 | 3 26 | 3 30 | 3 0'2 |      |
| 4     | 4 |                             | 50  | 2 56 | 2 59 | 3 2  | 3 6  | 3 9  | 3 12 | 3 16 | 3 19 | 4 0'2 |      |
| 5     | 5 | 87                          | 0   | 2 46 | 2 50 | 2 53 | 2 56 | 2 59 | 3 2  | 3 5  | 3 9  | 5 0'3 |      |
| 6     | 6 |                             | 10  | 2 37 | 2 40 | 2 43 | 2 46 | 2 49 | 2 52 | 2 55 | 2 58 | 6 0'4 |      |
| 7     | 7 |                             | 20  | 2 28 | 2 31 | 2 34 | 2 36 | 2 39 | 2 42 | 2 45 | 2 48 | 7 0'4 |      |
| 8     | 8 |                             | 30  | 2 19 | 2 21 | 2 24 | 2 27 | 2 29 | 2 32 | 2 35 | 2 37 | 8 0'5 |      |
| 9     | 9 |                             | 40  | 2 10 | 2 12 | 2 14 | 2 17 | 2 19 | 2 22 | 2 24 | 2 27 | 9 0'5 |      |
|       |   |                             | 50  | 2 0  | 2 3  | 2 5  | 2 7  | 2 9  | 2 12 | 2 14 | 2 16 |       |      |
|       |   | 88                          | 0   | 1 51 | 1 53 | 1 55 | 1 57 | 1 59 | 2 2  | 2 4  | 2 6  |       |      |
|       |   |                             | 10  | 1 42 | 1 44 | 1 46 | 1 48 | 1 50 | 1 51 | 1 53 | 1 55 |       |      |
| 1     | 1 |                             | 20  | 1 33 | 1 34 | 1 36 | 1 38 | 1 40 | 1 41 | 1 43 | 1 45 | 1 0'0 |      |
| 2     | 2 |                             | 30  | 1 23 | 1 25 | 1 26 | 1 28 | 1 30 | 1 31 | 1 33 | 1 34 | 2 0'1 |      |
| 3     | 3 |                             | 40  | 1 14 | 1 15 | 1 17 | 1 18 | 1 20 | 1 21 | 1 22 | 1 24 | 3 0'1 |      |
| 4     | 4 |                             | 50  | 1 5  | 1 6  | 1 7  | 1 8  | 1 10 | 1 11 | 1 12 | 1 13 | 4 0'1 |      |
| 5     | 5 | 89                          | 0   | 0 36 | 0 37 | 0 38 | 0 39 | 0 40 | 0 41 | 0 42 | 0 43 | 5 0'1 |      |
| 6     | 6 |                             | 10  | 0 26 | 0 27 | 0 28 | 0 29 | 0 30 | 0 31 | 0 32 | 0 33 | 6 0'2 |      |
| 7     | 7 |                             | 20  | 0 17 | 0 18 | 0 19 | 0 20 | 0 21 | 0 22 | 0 23 | 0 24 | 7 0'2 |      |
| 8     | 8 |                             | 30  | 0 8  | 0 9  | 0 10 | 0 11 | 0 12 | 0 13 | 0 14 | 0 15 | 8 0'2 |      |
| 9     | 9 |                             | 40  | 0 18 | 0 19 | 0 20 | 0 21 | 0 22 | 0 23 | 0 24 | 0 25 | 9 0'2 |      |
|       |   |                             | 50  | 0 9  | 0 9  | 0 10 | 0 10 | 0 10 | 0 10 | 0 10 | 0 10 |       |      |

## TABLE XVII.

LOGARITHMS FOR FINDING THE HORIZONTAL ANGLE OR APPARENT TIME.

| Min. | 2 Hours. | Diff. | 3 Hours. | Diff. | 4 Hours. | Diff. | 5 Hours. | Diff. | 6 Hours. | Diff. | 7 Hours. | Diff. | 8 Hours. | Diff. | 9 Hours. | Diff. | 10 Hours. | Diff. | 11 Hours. | Diff. | 12 Hours. | Diff. | 13 Hours. | Diff. | 14 Hours. | Diff. | 15 Hours. | Diff. | 16 Hours. | Diff. | 17 Hours. | Diff. | 18 Hours. | Diff. | 19 Hours. | Diff. | 20 Hours. | Diff. | 21 Hours. | Diff. | Min.    |       |         |       |         |       |         |       |         |       |         |       |         |       |         |       |         |       |         |       |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |   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  |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |         |        |   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 |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |        |
|------|----------|-------|----------|-------|----------|-------|----------|-------|----------|-------|----------|-------|----------|-------|----------|-------|-----------|-------|-----------|-------|-----------|-------|-----------|-------|-----------|-------|-----------|-------|-----------|-------|-----------|-------|-----------|-------|-----------|-------|-----------|-------|-----------|-------|---------|-------|---------|-------|---------|-------|---------|-------|---------|-------|---------|-------|---------|-------|---------|-------|---------|-------|---------|-------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|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| 0    | 9455992  | 11737 | 9165679  | 7608  | 9197940  | 5457  | 9168894  | 4107  | 9169870  | 3152  | 9170933  | 2418  | 9172084  | 1803  | 9173324  | 1203  | 9174654   | 603   | 9176074   | 0     | 9177584   | -381  | 9179184   | -781  | 9180874   | -1281 | 9182654   | -1781 | 9184524   | -2281 | 9186484   | -2781 | 9188534   | -3281 | 9190674   | -3781 | 9192904   | -4281 | 9195224   | -4781 | 9197634 | -5281 | 9200134 | -5781 | 9202724 | -6281 | 9205404 | -6781 | 9208174 | -7281 | 9211034 | -7781 | 9213984 | -8281 | 9217024 | -8781 | 9220154 | -9281 | 9223374 | -9781 | 9226684 | -10281 | 9230084 | -10781 | 9233574 | -11281 | 9237154 | -11781 | 9240824 | -12281 | 9244584 | -12781 | 9248434 | -13281 | 9252374 | -13781 | 9256404 | -14281 | 9260524 | -14781 | 9264734 | -15281 | 9269034 | -15781 | 9273424 | -16281 | 9277904 | -16781 | 9282474 | -17281 | 9287134 | -17781 | 9291884 | -18281 | 9296724 | -18781 | 9301654 | -19281 | 9306674 | -19781 | 9311784 | -20281 | 9317084 | -20781 | 9322474 | -21281 | 9327954 | -21781 | 9333524 | -22281 | 9339184 | -22781 | 9344934 | -23281 | 9350774 | -23781 | 9356704 | -24281 | 9362724 | -24781 | 9368834 | -25281 | 9375034 | -25781 | 9381324 | -26281 | 9387704 | -26781 | 9394174 | -27281 | 9400734 | -27781 | 9407384 | -28281 | 9414124 | -28781 | 9420954 | -29281 | 9427874 | -29781 | 9434884 | -30281 | 9441984 | -30781 | 9449174 | -31281 | 9456454 | -31781 | 9463824 | -32281 | 9471284 | -32781 | 9478834 | -33281 | 9486474 | -33781 | 9494204 | -34281 | 9502024 | -34781 | 9509934 | -35281 | 9517934 | -35781 | 9526024 | -36281 | 9534204 | -36781 | 9542474 | -37281 | 9550834 | -37781 | 9559284 | -38281 | 9567824 | -38781 | 9576454 | -39281 | 9585174 | -39781 | 9593984 | -40281 | 9602884 | -40781 | 9611874 | -41281 | 9620954 | -41781 | 9630124 | -42281 | 9639384 | -42781 | 9648734 | -43281 | 9658174 | -43781 | 9667704 | -44281 | 9677324 | -44781 | 9687034 | -45281 | 9696834 | -45781 | 9706724 | -46281 | 9716704 | -46781 | 9726774 | -47281 | 9736934 | -47781 | 9747184 | -48281 | 9757524 | -48781 | 9767954 | -49281 | 9778474 | -49781 | 9789084 | -50281 | 9799784 | -50781 | 9806574 | -51281 | 9813454 | -51781 | 9820424 | -52281 | 9827484 | -52781 | 9834634 | -53281 | 9841874 | -53781 | 9849204 | -54281 | 9856624 | -54781 | 9864134 | -55281 | 9871734 | -55781 | 9879424 | -56281 | 9887204 | -56781 | 9895074 | -57281 | 9903034 | -57781 | 9911084 | -58281 | 9919224 | -58781 | 9927454 | -59281 | 9935774 | -59781 | 9944184 | -60281 | 9952684 | -60781 | 9961274 | -61281 | 9969954 | -61781 | 9978724 | -62281 | 9987584 | -62781 | 9996534 | -63281 | 1000684 | -63781 | 1001934 | -64281 | 1003184 | -64781 | 1004534 | -65281 | 1005884 | -65781 | 1007334 | -66281 | 1008784 | -66781 | 1010334 | -67281 | 1011884 | -67781 | 1013434 | -68281 | 1015084 | -68781 | 1016734 | -69281 | 1018384 | -69781 | 1020034 | -70281 | 1021684 | -70781 | 1023334 | -71281 | 1024984 | -71781 | 1026634 | -72281 | 1028284 | -72781 | 1029934 | -73281 | 1031584 | -73781 | 1033234 | -74281 | 1034884 | -74781 | 1036534 | -75281 | 1038184 | -75781 | 1039834 | -76281 | 1041484 | -76781 | 1043134 | -77281 | 1044784 | -77781 | 1046434 | -78281 | 1048084 | -78781 | 1049734 | -79281 | 1051384 | -79781 | 1053034 | -80281 | 1054684 | -80781 | 1056334 | -81281 | 1057984 | -81781 | 1059634 | -82281 | 1061284 | -82781 | 1062934 | -83281 | 1064584 | -83781 | 1066234 | -84281 | 1067884 | -84781 | 1069534 | -85281 | 1071184 | -85781 | 1072834 | -86281 | 1074484 | -86781 | 1076134 | -87281 | 1077784 | -87781 | 1079434 | -88281 | 1081084 | -88781 | 1082734 | -89281 | 1084384 | -89781 | 1086034 | -90281 | 1087684 | -90781 | 1089334 | -91281 | 1090984 | -91781 | 1092634 | -92281 | 1094284 | -92781 | 1095934 | -93281 | 1097584 | -93781 | 1099234 | -94281 | 1100884 | -94781 | 1102534 | -95281 | 1104184 | -95781 | 1105834 | -96281 | 1107484 | -96781 | 1109134 | -97281 | 1110784 | -97781 | 1112434 | -98281 | 1114084 | -98781 | 1115734 | -99281 | 1117384 | -99781 | 1119034 | -100281 | 1120684 | -100781 | 1122334 | -101281 | 1123984 | -101781 | 1125634 | -102281 | 1127284 | -102781 | 1128934 | -103281 | 1130584 | -103781 | 1132234 | -104281 | 1133884 | -104781 | 1135534 | -105281 | 1137184 | -105781 | 1138834 | -106281 | 1140484 | -106781 | 1142134 | -107281 | 1143784 | -107781 | 1145434 | -108281 | 1147084 | -108781 | 1148734 | -109281 | 1150384 | -109781 | 1152034 | -110281 | 1153684 | -110781 | 1155334 | -111281 | 1156984 | -111781 | 1158634 | -112281 | 1160284 | -112781 | 1161934 | -113281 | 1163584 | -113781 | 1165234 | -114281 | 1166884 | -114781 | 1168534 | -115281 | 1170184 | -115781 | 1171834 | -116281 | 1173484 | -116781 | 1175134 | -117281 | 1176784 | -117781 | 1178434 | -118281 | 1180084 | -118781 | 1181734 | -119281 | 1183384 | -119781 | 1185034 | -120281 | 1186684 | -120781 | 1188334 | -121281 | 1189984 | -121781 | 1191634 | -122281 | 1193284 | -122781 | 1194934 | -123281 | 1196584 | -123781 | 1198234 | -124281 | 1199884 | -124781 | 1201534 | -125281 | 1203184 | -125781 | 1204834 | -126281 | 1206484 | -126781 | 1208134 | -127281 | 1209784 | -127781 | 1211434 | -128281 | 1213084 | -128781 | 1214734 | -129281 | 1216384 | -129781 | 1218034 | -130281 | 1219684 | -130781 | 1221334 | -131281 | 1222984 | -131781 | 1224634 | -132281 | 1226284 | -132781 | 1227934 | -133281 | 1229584 | -133781 | 1231234 | -134281 | 1232884 | -134781 | 1234534 | -135281 | 1236184 | -135781 | 1237834 | -136281 | 1239484 | -136781 | 1241134 | -137281 | 1242784 | -137781 | 1244434 | -138281 | 1246084 | -138781 | 1247734 | -139281 | 1249384 | -139781 | 1251034 | -140281 | 1252684 | -140781 | 1254334 | -141281 | 1255984 | -141781 | 1257634 | -142281 | 1259284 | -142781 | 1260934 | -143281 | 1262584 | -143781 | 1264234 | -144281 | 1265884 | -144781 | 1267534 | -145281 | 1269184 | -145781 | 1270834 | -146281 | 1272484 | -146781 | 1274134 | -147281 | 1275784 | -147781 | 1277434 | -148281 | 1279084 | -148781 | 1280734 | -149281 | 1282384 | -149781 | 1284034 | -150281 | 1285684 | -150781 | 1287334 | -151281 | 1288984 | -151781 | 1290634 | -152281 | 1292284 | -152781 | 1293934 | -153281 | 1295584 | -153781 | 1297234 | -154281 | 1298884 | -154781 | 1300534 | -155281 | 1302184 | -155781 | 1303834 | -156281 | 1305484 | -156781 | 1307134 | -157281 | 1308784 | -157781 | 1310434 | -158281 | 1312084 | -158781 | 1313734 | -159281 | 1315384 | -159781 | 1317034 | -160281 | 1318684 | -160781 | 1320334 | -161281 | 1321984 | -161781 | 1323634 | -162281 | 1325284 | -162781 | 1326934 | -163281 | 1328584 | -163781 | 1330234 | -164281 | 1331884 | -164781 | 1333534 | -165281 | 1335184 | -165781 | 1336834 | -166281 | 1338484 | -166781 | 1340134 | -167281 | 1341784 | -167781 | 1343434 | -168281 | 1345084 | -168781 | 1346734 | -169281 | 1348384 | -169781 | 1350034 | -170281 | 1351684 | -170781 | 1353334 | -171281 | 1354984 | -171781 | 1356634 | -172281 | 1358284 | -172781 | 1359934 | -173281 | 1361584 | -173781 | 1363234 | -174281 | 1364884 | -174781 | 1366534 | -175281 | 1368184 | -175781 | 1369834 | -176281 | 1371484 | -176781 | 1373134 | -177281 | 1374784 | -177781 | 1376434 | -178281 | 1378084 | -178781 | 1379734 | -179281 | 1381384 | -179781 | 1383034 | -180281 | 1384684 | -180781 | 1386334 | -181281 | 1387984 | -181781 | 1389634 | -182281 | 1391284 | -182781 | 1392934 | -183281 | 1394584 | -183781 | 1396234 | -184281 | 1397884 | -184781 | 1399534 | -185281 | 1401184 | -185781 | 1402834 | -186281 | 1404484 | -186781 | 1406134 | -187281 | 1407784 | -187781 | 1409434 | -188281 | 1411084 | -188781 | 1412734 | -189281 | 1414384 | -189781 | 1416034 | -190281 | 1417684 | -190781 | 1419334 | -191281 | 1420984 | -191781 | 1422634 | -192281 | 1424284 | -192781 | 1425934 | -193281 | 1427584 | -193781 | 1429234 | -194281 | 1430884 | -194781 | 1432534 | -195281 | 1434184 | -195781 | 1435834 | -196281 | 1437484 | -196781 | 1439134 | -197281 | 1440784 | -197781 | 1442434 | -198281 | 1444084 | -198781 | 1445734 | -199281 | 1447384 | -199781 | 1449034 | -200281 | 1450684 | -200781 | 1452334 | -201281 | 1453984 | -201781 | 1455634 | -202281 | 1457284 | -202781 | 1458934 | -203281 | 1460584 | -203781 | 1462234 | -204281 | 1463884 | -204781 | 1465534 | -205281 | 1467184 | -205781 | 1468834 | -206281 | 1470484 | -206781 | 1472134 | -207281 | 1473784 | -207781 | 1475434 | -208281 | 1477084 | -208781 | 1478734 | -209281 | 1480384 | -209781 | 1482034 | -210281 | 1483684 | -210781 | 1485334 | -211281 | 1486984 | -211781 | 1488634 | -212281 | 1490284 | -212781 | 1491934 | -213281 | 1493584 | -213781 | 1495234 | -214281 | 1496884 | -214781 | 1498534 | -215281 | 1500184 | -215781 | 1501834 | -216281 | 1503484 | -216781 | 1505134 | -217281 | 1506784 | -217781 | 1508434 | -218281 | 1510084 | -218781 | 1511734 | -219281 | 1513384 | -219781 | 1515034 | -220281 | 1516684 | -220781 | 1518334 | -221281 | 1519984 | -221781 | 1521634 | -222281 | 1523284 | -222781 | 1524934 | -223281 | 1526584 | -223781 | 1528234 | -224281 | 1529884 | -224781 | 1531534 | -225281 | 1533184 | -225781 | 1534834 | -226281 | 1536484 | -226781 | 1538134 | -227281 | 1539784 | -227781 | 1541434 | -228281 | 1543084 | -228781 | 1544734 | -229281 | 1546384 | -229781 | 1548034 | -230281 | 1549684 | -230781 | 1551334 | -231281 | 1552984 | -231781 | 1554634 | -232281 | 1556284 | -232781 | 1557934 | -233281 | 1559584 | -233781 | 1561234 | -234281 | 1562884 | -234781 | 1564534 | -235281 | 1566184 | -235781 | 1567834 | -236281 | 1569484 | -236781 | 1571134 | -237281 | 1572784 | -237781 | 1574434 | -238281 | 1576084 | -238781 | 1577734 | -239281 | 1579384 | -239781 | 1581034 | -240281 | 1582684 | -240781 | 1584334 | -241281 | 1585984 | -241781 | 1587634 | -242281 | 1589284 | -242781 | 1590934 | -243281 | 1592584 | -243781 | 1594234 | -244281 | 1595884 | -244781 | 1597534 | -245281 | 1599184 | -245781 | 1600834 | -246281 | 1602484 | -246781 | 1604134 | -247281 | 1605784 | -247781 | 1607434 | -248281 | 1609084 | -248781 | 1610734 | -249281 | 1612384 | -249781 | 1614034 | -250281 | 1615684 | -250781 | 1617334 | -251281 | 1618984 | -251781 | 1620634 | -252281 | 1622284 | -252781 | 1623934 | -253281 | 1625584 | -253781 | 1627234 | -254281 | 1628884 | -254781 | 1630534 | -255281 | 1632184 | -255781 | 1633834 | -256281 | 1635484 | -256781 | 1637134 | -257281 | 1638784 | -257781 | 1640434 | -258281 | 1642084 | -258781 | 1643734 | -259281 | 1645384 | -25978 |

## TABLE XVIII.

LOGARITHMS FOR FINDING THE HORARY ANGLE OR APPARENT TIME.

| Min. | 2 Hours. | Diff. | 3 Hours. | Diff. | 4 Hours. | Diff. | 5 Hours. | Diff. | 6 Hours. | Diff. | 7 Hours. | Diff. | Min. |
|------|----------|-------|----------|-------|----------|-------|----------|-------|----------|-------|----------|-------|------|
| 30   | 8°56'24  | 9879  | 9°31'27  | 6753  | 9°46'43  | 4945  | 9°51'13  | 3756  | 9°73'56  | 2887  | 9°28'29  | 2206  | 40   |
| 31   | 8°56'27  | 9904  | 9°35'49  | 6715  | 9°46'40  | 4921  | 9°51'38  | 3740  | 9°73'59  | 2875  | 9°28'33  | 2196  | 39   |
| 32   | 8°56'28  | 9928  | 9°39'78  | 6678  | 9°46'35  | 4898  | 9°51'45  | 3721  | 9°73'79  | 2863  | 9°28'37  | 2186  | 38   |
| 33   | 8°56'29  | 9952  | 9°43'15  | 6640  | 9°46'30  | 4875  | 9°51'52  | 3707  | 9°74'03  | 2850  | 9°28'40  | 2176  | 37   |
| 34   | 8°56'30  | 9975  | 9°46'50  | 6602  | 9°46'25  | 4852  | 9°52'00  | 3690  | 9°74'14  | 2837  | 9°28'44  | 2166  | 36   |
| 35   | 8°56'31  | 9998  | 9°50'25  | 6566  | 9°46'20  | 4828  | 9°52'07  | 3674  | 9°74'25  | 2825  | 9°28'48  | 2155  | 35   |
| 36   | 8°56'32  | 10000 | 9°54'00  | 6530  | 9°46'15  | 4805  | 9°52'14  | 3658  | 9°74'36  | 2813  | 9°28'52  | 2145  | 34   |
| 37   | 8°56'33  | 10000 | 9°57'45  | 6493  | 9°46'10  | 4782  | 9°52'21  | 3642  | 9°74'47  | 2800  | 9°28'56  | 2135  | 33   |
| 38   | 8°56'34  | 10000 | 9°61'30  | 6457  | 9°46'05  | 4760  | 9°52'28  | 3626  | 9°74'58  | 2788  | 9°29'00  | 2125  | 32   |
| 39   | 8°56'35  | 10000 | 9°65'15  | 6422  | 9°46'00  | 4738  | 9°52'35  | 3610  | 9°75'09  | 2776  | 9°29'04  | 2115  | 31   |
| 40   | 8°56'36  | 10000 | 9°69'00  | 6387  | 9°45'55  | 4715  | 9°52'42  | 3593  | 9°75'20  | 2763  | 9°29'08  | 2105  | 30   |
| 31   | 8°56'37  | 10000 | 9°72'45  | 6352  | 9°45'50  | 4693  | 9°52'49  | 3577  | 9°75'31  | 2750  | 9°29'12  | 2095  | 29   |
| 32   | 8°56'38  | 10000 | 9°76'30  | 6317  | 9°45'45  | 4672  | 9°52'56  | 3562  | 9°75'42  | 2738  | 9°29'16  | 2085  | 28   |
| 33   | 8°56'39  | 10000 | 9°80'15  | 6283  | 9°45'40  | 4650  | 9°53'03  | 3547  | 9°75'53  | 2727  | 9°29'20  | 2076  | 27   |
| 34   | 8°56'40  | 10000 | 9°84'00  | 6249  | 9°45'35  | 4628  | 9°53'10  | 3532  | 9°76'04  | 2715  | 9°29'24  | 2066  | 26   |
| 35   | 8°56'41  | 10000 | 9°87'45  | 6216  | 9°45'30  | 4607  | 9°53'17  | 3516  | 9°76'15  | 2703  | 9°29'28  | 2056  | 25   |
| 36   | 8°56'42  | 10000 | 9°91'30  | 6182  | 9°45'25  | 4585  | 9°53'24  | 3500  | 9°76'26  | 2692  | 9°29'32  | 2046  | 24   |
| 37   | 8°56'43  | 10000 | 9°95'15  | 6148  | 9°45'20  | 4563  | 9°53'31  | 3485  | 9°76'37  | 2680  | 9°29'36  | 2036  | 23   |
| 38   | 8°56'44  | 10000 | 9°99'00  | 6115  | 9°45'15  | 4542  | 9°53'38  | 3469  | 9°76'48  | 2668  | 9°29'40  | 2026  | 22   |
| 39   | 8°56'45  | 10000 | 10°02'45 | 6083  | 9°45'10  | 4521  | 9°53'45  | 3453  | 9°76'59  | 2657  | 9°29'44  | 2017  | 21   |
| 40   | 8°56'46  | 10000 | 10°06'30 | 6050  | 9°45'05  | 4500  | 9°53'52  | 3437  | 9°77'10  | 2645  | 9°29'48  | 2007  | 20   |

TABLE XVII.

ALGORITHM FOR FINDING THE HORARY ANGLE OR APPARENT TIME.

| Min. | 2 Hours.      | 3 Hours. | 4 Hours.     | 5 Hours.    | 6 Hours.  | 7 Hours.    | DIE.  | Min. |
|------|---------------|----------|--------------|-------------|-----------|-------------|-------|------|
| 40   | 9° 06' 58.103 | 86.48    | 9° 31' 7.183 | 9° 59' 36.7 | 344.0     | 9° 76' 50.8 | 264.5 | 20   |
| 41   | 07° 12.92     | 85.90    | 51° 9.883    | 66° 14.30   | 345.5     | 77° 00.94   | 263.5 | 19   |
| 42   | 07° 14.46     | 85.32    | 52° 25.70    | 66° 34.35   | 346.5     | 77° 16.74   | 262.5 | 18   |
| 43   | 08° 33.05     | 84.77    | 53° 24.45    | 66° 55.30   | 347.9     | 77° 32.47   | 261.0 | 17   |
| 44   | 08° 46.51     | 84.19    | 54° 29.08    | 67° 16.7    | 349.5     | 77° 48.12   | 259.8 | 16   |
| 45   | 09° 31.702    | 83.63    | 55° 30.559   | 67° 36.594  | 350.5     | 77° 63.71   | 258.6 | 15   |
| 46   | 09° 47.20     | 83.08    | 56° 31.97    | 67° 56.13   | 351.5     | 77° 79.22   | 257.5 | 14   |
| 47   | 10° 17.06     | 82.54    | 57° 32.23    | 68° 16.23   | 352.5     | 77° 94.67   | 256.5 | 13   |
| 48   | 10° 46.58     | 82.01    | 58° 32.47    | 68° 36.51   | 353.5     | 78° 10.05   | 255.2 | 12   |
| 49   | 11° 13.579    | 81.48    | 59° 32.67    | 68° 57.17   | 354.5     | 78° 25.36   | 254.1 | 11   |
| 50   | 11° 42.68     | 80.95    | 60° 32.70    | 69° 17.601  | 355.5     | 78° 40.61   | 253.0 | 10   |
| 51   | 12° 33.95     | 80.43    | 61° 32.08    | 69° 37.6    | 356.5     | 78° 55.78   | 251.8 | 9    |
| 52   | 12° 43.51     | 79.92    | 62° 31.42    | 69° 57.75   | 357.5     | 79° 10.89   | 250.7 | 8    |
| 53   | 13° 39.46     | 79.42    | 63° 30.53    | 70° 17.601  | 358.5     | 79° 25.93   | 249.5 | 7    |
| 54   | 13° 47.11     | 78.92    | 64° 29.54    | 70° 37.450  | 359.5     | 79° 40.90   | 248.4 | 6    |
| 55   | 14° 44.46     | 78.42    | 65° 28.46    | 70° 57.391  | 360.5     | 79° 55.80   | 247.3 | 5    |
| 56   | 14° 51.51     | 77.93    | 66° 27.26    | 71° 17.324  | 361.5     | 80° 10.64   | 246.2 | 4    |
| 57   | 15° 18.66     | 77.44    | 67° 26.03    | 71° 37.248  | 362.5     | 80° 25.41   | 245.1 | 3    |
| 58   | 15° 46.73     | 76.96    | 68° 24.77    | 71° 57.163  | 363.5     | 80° 40.12   | 244.0 | 2    |
| 59   | 16° 14.90     | 76.48    | 69° 23.49    | 72° 17.071  | 364.5     | 80° 54.76   | 242.8 | 1    |
| 60   | 16° 50.79     |          | 70° 22.19    | 72° 36.970  | 365.5     | 81° 9.33    |       | 0    |
|      |               | DIE.     | 19 Hours.    | 18 Hours.   | 17 Hours. | 16 Hours.   | DIE.  |      |
|      |               |          | 5688.94      | 412.5       | 316.5     | 242.8       |       |      |

TABLE XIX.  
COMMON AND HYPERBOLIC LOGARITHMS.

|    | Common<br>Logarithms. | Hyp. Logarithms. |    | Hyperbolic<br>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<br>in<br>Chains. | Curvature. | Curvature<br>and<br>Refraction. | Distance<br>in<br>Miles. | Curvature. | Curvature<br>and<br>Refraction. |
|---------------------------|------------|---------------------------------|--------------------------|------------|---------------------------------|
|                           | Feet.      | Feet.                           |                          | Feet.      | Feet.                           |
| 1                         | °00010     | °00009                          | 1                        | °67        | °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                          |
| 25                        | °16685     | °14302                          | 25                       | 416°28     | 357°32                          |
| 30                        | °37519     | °32173                          | 30                       | 600°30     | 514°39                          |

TABLE XXI.—TRIGONOMETRICAL EQUIVALENTS.

(Arc  $c$  = half the arc  $a$ .)

$$\begin{aligned}
 (1.) \sin a &= \cos a \cdot \tan a = \frac{\cos a}{\cot a} = \sqrt{1 - (\cos a)^2} = \frac{1}{\operatorname{cosec} a} \\
 &= \frac{1}{\sqrt{1 + (\cot a)^2}} = \frac{\tan a}{\sqrt{1 + (\tan a)^2}} = 2 \sin c \cdot \cos c \\
 &= \sqrt{\frac{1 - \cos 2a}{2}} = \frac{2 \tan c}{1 + (\tan c)^2} = \frac{2}{\cot c + \tan c} \\
 &= \frac{1}{\cot a + \tan c} = 2 \{ \sin (45^\circ + c) \}^2 - 1 = 1 - 2 \{ \sin (45^\circ - c) \}^2 \\
 &= \frac{1 - \{ \tan (45^\circ - c) \}^2}{1 + \{ \tan (45^\circ - c) \}^2} = \sin (60^\circ + a) - \sin (60^\circ - a).
 \end{aligned}$$

$$\begin{aligned}
 (2.) \cos a &= \sin a \cdot \cot a = \frac{\sin a}{\tan a} = \sqrt{1 - (\sin a)^2} = \frac{1}{\sec a} \\
 &= \frac{1}{\sqrt{1 + (\tan a)^2}} = \frac{\cot a}{\sqrt{1 + (\cot a)^2}} = (\cos c)^2 - (\sin c)^2 \\
 &= 1 - 2 (\sin c)^2 = 2 (\cos c)^2 - 1 = \sqrt{\frac{1 + \cos 2a}{2}} \\
 &= \frac{1 - (\tan c)^2}{1 + (\tan c)^2} = \frac{\cot c - \tan c}{\cot c + \tan c} = \frac{1}{1 + \tan a \cdot \tan c}
 \end{aligned}$$

$$\begin{aligned}
 (3.) \tan a &= \frac{\sin a}{\cos a} = \frac{1}{\cot a} = \sqrt{\frac{1}{(\cos a)^2} - 1} = \sqrt{(\sec a)^2 - 1} \\
 &= \frac{\sec a}{\operatorname{cosec} a} = \frac{\sin a}{\sqrt{1 - (\sin a)^2}} = \frac{\sin a \cdot \cos a}{\cot a} = \frac{\sqrt{1 - (\cos a)^2}}{\cos a} \\
 &= \frac{2 \tan c}{1 - (\tan c)^2} = \frac{2 \cot c}{(\cot c)^2 - 1} = \frac{2}{\cot c - \tan c} = \frac{1 - \cos 2a}{\sin 2a} \\
 &= \cot a - 2 \cot 2a = \frac{\sin 2a}{1 + \cos 2a} \text{ or } \sqrt{\frac{1 - \cos 2a}{1 + \cos 2a}}
 \end{aligned}$$

$$(4.) \cot a = \sqrt{(\operatorname{cosec} a)^2 - 1} = \frac{\cos a}{\sin a} = \frac{1}{\tan a} = \text{the reciprocals of the above expressions for the tangent.}$$

$$(5.) \sec a = \sqrt{1 + (\tan a)^2} = \frac{\tan a}{\sin a} = \frac{1}{\cos a} = \text{the reciprocals of the above expressions for the cosine.}$$

$$(6.) \operatorname{cosec} a = \sqrt{1 + (\cot a)^2} = \frac{\sec a}{\tan a} = \sec a \cdot \cot a = \frac{1}{\sin a} = \text{the reciprocals of the above expressions for the sine.}$$

$$(7.) \operatorname{versin} a = \frac{(\sin a)^2}{1 + \cos a} \quad \quad (8.) \operatorname{coversin} a = \frac{(\cos a)^2}{1 + \sin a}$$

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.)  $\sin na = 2^{n-1} \cdot \sin \beta \cdot \sin \left( \beta + \frac{\pi}{n} \right) \cdot \sin \left( \beta + \frac{2\pi}{n} \right) + \dots$   
 (7.)  $= \cos a \{ (2 \sin a)^{n-1} - \frac{n-2}{1} (2 \sin a)^{n-3} \}$ .

- (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.)  $\cos na = \dots$

$\dots + \&c. \}$ .

- (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 XXVI.—FORMULÆ RELATING TO TWO ARCS OR ANGLES.

- (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.)  $\frac{\cos (\alpha + \beta)}{\cos (\alpha - \beta)} = \frac{\cot \beta - \tan \alpha}{\cot \beta + \tan \alpha} = \frac{\cot \alpha - \tan \beta}{\cot \alpha + \tan \beta}.$
  - (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  $a$ .

$$(1.) \sin a = a - \frac{a^3}{1 \cdot 2 \cdot 3} + \frac{a^5}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5} - \frac{a^7}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6 \cdot 7} + \&c.$$

$$= a \left(1 - \frac{a^2}{6}\right) \cdot \left(1 - \frac{a^2}{40}\right) \cdot \left(1 - \frac{a^2}{840}\right) \&c.$$

$$(2.) \cos a = 1 - \frac{a^2}{1 \cdot 2} + \frac{a^4}{1 \cdot 2 \cdot 3 \cdot 4} - \frac{a^6}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6} + \&c.$$

$$= \left(1 - \frac{a^2}{2}\right) \cdot \left(1 - \frac{a^2}{24}\right) \cdot \left(1 - \frac{a^2}{720}\right) \cdot \&c.$$

$$(3.) \tan a = \frac{3a}{a^3 - 4a^5} + \frac{8a}{9a^3 - 4a^5} + \frac{2a}{25a^3 - 4a^5} + \&c.$$

$$(4.) \cot a = \frac{1}{a} - \frac{2a}{a^3 - a^5} - \frac{2a}{4a^3 - a^5} - \&c.$$

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.

$$(7.) 2(\sin a)^2 = 1 - \cos 2a,$$

$$(8.) 4(\sin a)^3 = 3 \sin a - \sin 3a,$$

$$(9.) 8(\sin a)^4 = 3 - 4 \cos 2a + \cos 4a,$$

$$(10.) 16(\sin a)^5 = \sin 5a - 5 \sin 3a + 10 \sin a,$$

$$(11.) 2^n (\sin a)^n = \pm 2 \sin na + 2n \cdot \sin (n-2)a \pm \frac{2n(n-1)}{1 \cdot 2} \sin (n-4)a$$

$$+ \frac{2n(n-1) \cdot (n-2)}{1 \cdot 2 \cdot 3} \sin (n-6)a \pm \&c.$$

$$(12.) \text{Or, } 2^n (\sin a)^n = \pm 2 \cos na + 2n \cdot \cos (n-2)a \pm \frac{2n(n-1)}{1 \cdot 2} \cos (n-4)a$$

$$+ \frac{2n(n-1) \cdot (n-2)}{1 \cdot 2 \cdot 3} \cos (n-6)a \pm \&c.$$

When  $n$  is of the form  $4m+1$ , use series (11) with the upper signs." " " "  $4m-1$ , " (11) " lower signs." " " "  $4m$ , " (12) " upper signs." " " "  $4m+2$ , " (12) " lower signs.

$$(13.) 2(\cos a)^2 = \cos 2a + 1,$$

$$(14.) 4(\cos a)^3 = \cos 3a + 3 \cos a,$$

$$(15.) 8(\cos a)^4 = \cos 4a + 2 \cos 2a + 3,$$

$$(16.) 16(\cos a)^5 = \cos 5a + 5 \cos 3a + 10 \cos a.$$

$$(17.) 2^n (\cos a)^n = 2 \cos na + 2n \cdot \cos (n-2)a + \frac{2n(n-1)}{1 \cdot 2} \cos (n-4)a$$

$$+ \frac{2n(n-1) \cdot (n-2)}{1 \cdot 2 \cdot 3} \cos (n-6)a + \&c.$$

The formula ending in  $\frac{2n(n-1) \cdot (n-2)}{1 \cdot 2 \cdot 3} \cdot \&c. \cos (n-n)a$ , or in  $2n(n-1) \cdot (n-2) \cdot \&c. \cos a$ , 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.

$$(1.) A = \frac{B \cdot \sin a}{\sin \beta}.$$

$$(2.) = \frac{C \cdot \sin a}{\sin \gamma}.$$

$$(3.) = \frac{B}{\cos \gamma + \sin \gamma \cdot \cot a}.$$

$$(4.) = \frac{C}{\cos \beta + \sin \beta \cdot \cot a}.$$

$$(5.) = B \cdot \cos \gamma + B \cdot \sin \gamma \cdot \cot \beta.$$

$$(6.) = C \cdot \cos \beta + C \cdot \sin \beta \cdot \cot \gamma.$$

$$(7.) = \sqrt{B^2 + C^2 - 2 B \cdot C \cdot \cos a}.$$

$$(8.) = B \cdot \cos \gamma \pm \sqrt{C^2 - B^2 \cdot (\sin \gamma)^2}.$$

$$(9.) = C \cdot \cos \beta \pm \sqrt{B^2 - C^2 \cdot (\sin \beta)^2}.$$



Value of the sin of any angle, as  $\beta$ .

$$(10.) \sin \beta = \frac{B \cdot \sin a}{A}.$$

$$(11.) = \frac{B \cdot \sin \gamma}{C}.$$

$$(12.) = \sin (\gamma + a).$$

$$(13.) = \sin \gamma \cdot \cos a + \cos \gamma \cdot \sin a.$$

$$(14.) = \frac{B \cdot \sin a}{\sqrt{B^2 + C^2 - 2 B \cdot C \cdot \cos a}}.$$

$$(15.) = \frac{B \cdot \sin \gamma}{\sqrt{B^2 + A^2 - 2 B \cdot A \cdot \cos \gamma}}.$$

$$(16.) = \sqrt{1 - \left( \frac{A^2 + C^2 - B^2}{2 A \cdot C} \right)^2}.$$

$$(17.) = \frac{\sin a \{ C \cdot \cos a \pm \sqrt{A^2 - C^2 \cdot (\sin a)^2} \}}{A}.$$

$$(18.) = \frac{\sin \gamma \{ A \cdot \cos \gamma \pm \sqrt{C^2 - A^2 \cdot (\sin \gamma)^2} \}}{C}.$$

TABLE XXVI.—TRIGONOMETRICAL FORMULÆ FOR THE SOLUTION OF QUADRATES AND CUBES.

## EQUATIONS OF THE SECOND DEGREE.

(1.)  $x^2 + px = q$ .

Let  $\tan a = \frac{2}{p} \sqrt{q}$ .

Root  $x = \sqrt{q} \cdot \tan \frac{1}{2} a$ .

and Root  $x = -\sqrt{q} \cdot \cot \frac{1}{2} a$ .

(2.)  $x^2 - px = q$ .

$\tan a = \frac{2}{p} \sqrt{q}$ .

$x = -\sqrt{q} \cdot \tan \frac{1}{2} a$ .

$x = \sqrt{q} \cdot \cot \frac{1}{2} a$ .

(3.)  $x^2 + px = -q$ .

$\sin a = \frac{2}{p} \sqrt{q}$ .

$x = -\sqrt{q} \cdot \tan \frac{1}{2} a$ .

$x = \sqrt{q} \cdot \cot \frac{1}{2} a$ .

## EQUATIONS OF THE THIRD DEGREE.

(4.)  $x^3 + px + q = 0$ .

Let  $\tan a = \frac{p}{3q} \pm \sqrt{\frac{p^2}{3}}$ .

Let  $\tan \beta = \sqrt[3]{\tan \frac{1}{2} a}$ .

Only real root  $x = -2\sqrt{\frac{p}{3}} \cdot \cot \frac{1}{2} \beta$ .

(5.)  $x^3 - px + q = 0$ .

$\tan a = \frac{p}{3q} \pm \sqrt{\frac{p^2}{3}}$ .

$\tan \beta = \sqrt[3]{\tan \frac{1}{2} a}$ .

$x = -2\sqrt{\frac{p}{3}} \cdot \tan \frac{1}{2} \beta$ .

(6.)  $x^3 - px - q = 0$ .

$\sin a = \frac{p}{3q} \pm \sqrt{\frac{p^2}{3}}$ .

$\tan a = \sqrt[3]{\tan \frac{1}{2} a}$ .

$x = 2\sqrt{\frac{p}{3}} \cdot \frac{1}{\sin \frac{1}{2} \beta}$ .

(7.)  $x^3 + px - q = 0$ .

When  $4p^3 \leq 27q^2$ .

(8.)  $x^3 + px - q = 0$ .

When  $4p^3 > 27q^2$ .

(9.)  $x^3 - px - q = 0$ .

When  $4p^3 > 27q^2$ , the following will be the solution of the two real cases.

Let  $\tan \frac{1}{2} a = \frac{p}{3q} \pm \sqrt{\frac{p^2}{3}}$ .

Root  $x = 2\sqrt{\frac{p}{3}} \cdot \sin a$ .

2nd root  $x = 2\sqrt{\frac{p}{3}} \cdot \sin (60^\circ - a)$ .

3rd root  $x = -2\sqrt{\frac{p}{3}} \cdot \sin (60^\circ + a)$ .

$\sin \frac{1}{2} a = \frac{p}{3q} \pm \sqrt{\frac{p^2}{3}}$ .

$x = -2\sqrt{\frac{p}{3}} \cdot \sin a$ .

$x = -2\sqrt{\frac{p}{3}} \cdot \sin (50^\circ - a)$ .

$x = 2\sqrt{\frac{p}{3}} \cdot \sin (60^\circ + a)$ .

TABLE XXVII.—DIFFERENTIAL COEFFICIENTS.

| Value of $u$ .                                    | Value of $\frac{du}{dx}$ .                                                                                                                       |
|---------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| (1.) $x$ .                                        | 1.                                                                                                                                               |
| (2.) $nx$                                         | $n$ .                                                                                                                                            |
| (3.) $x^n$ .                                      | $nx^{n-1}$ .                                                                                                                                     |
| (4.) $\log_b x$ .                                 | $\frac{m}{x}$ { in which $m$ is the modulus of the<br>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.) $(\tan x)^2$ .                              | $\frac{2 \tan x}{(\cos x)^4}$ .                                                                                                                  |
| (14.) $(\cot x)^2$ .                              | $\frac{2 \cot x}{(\sin x)^4}$ .                                                                                                                  |
| (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.) $\phi x \pm \psi x$ .                       | $\frac{d(\phi x)}{dx} \pm \frac{d(\psi x)}{dx}$ .                                                                                                |
| (19.) $\frac{\phi x}{\psi x}$ .                   | $\frac{\psi x \cdot \frac{d(\phi x)}{dx} - \phi x \cdot \frac{d(\psi x)}{dx}}{(\psi x)^2}$ .                                                     |
| (20.) $f x \cdot \phi x \cdot \psi x$ .           | $\phi x \cdot \psi x \cdot \frac{d(f x)}{dx} + f x \cdot \psi x \cdot \frac{d(\phi x)}{dx}$<br>$+ f x \cdot \phi x \cdot \frac{d(\psi x)}{dx}$ . |
| (21.) $\phi \psi$ , in which<br>$\psi = \psi x$ . | $\frac{d(\psi x)}{dx} \cdot \frac{d(\phi \psi)}{d\psi}$ .                                                                                        |

**TABLE XXVIII.**  
**USEFUL NUMBERS, WITH THEIR LOGARITHMS.**

|                                                                            | Number.      | Logarithm. | Complement<br>of Logarithm |
|----------------------------------------------------------------------------|--------------|------------|----------------------------|
| Circumference of a circle } $= \pi =$<br>whose dia. = 1                    | 3.1415927    | 0.4971499  | 9.5028501                  |
| Area of the same } $= \frac{\pi}{4} =$                                     | 0.7853982    | 1.8950899  | 10.1049101                 |
| Diameter of a circle } $= \sqrt{\frac{4}{\pi}} =$<br>whose area = 1        | 1.1283791    | 0.0524551  | 9.9475449                  |
| Surface of a sphere whose<br>dia. = 1                                      | 3.1415927    | 0.4971499  | 9.5028501                  |
| Solidity of the same } $= \frac{\pi}{6} =$                                 | 0.5235988    | 1.7189986  | 10.2810014                 |
| Diameter of a sphere } $= \sqrt[3]{\frac{6}{\pi}} =$<br>whose solidity = 1 | 1.2407010    | 0.0936672  | 9.9063328                  |
| Length of arc 1" = sin 1" (rad<br>being unity)                             | 0.000004848  | 6.6855749  | 15.3144251                 |
| Length of arc 2" = sin 2" (rad<br>being unity)                             | 0.000009696  | 6.9366049  | 15.0133951                 |
| Length of arc 3" = sin 3" (rad<br>being unity)                             | 0.000014544  | 5.1626961  | 14.8373039                 |
| Length of arc 1' = sin 1' (rad<br>being unity)                             | 0.0000290888 | 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                                                             | 3437.74677   | 3.5362739  | 6.4637261                  |
| " " to degrees                                                             | 57.295780    | 1.7581226  | 8.2418774                  |
| 360. 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 loga-<br>rithm is 1                                   | 2.718281829  | 0.4342944  | 9.5657056                  |
| Modulus of common logarithms                                               | 2.302585093  | 0.3617579  | 9.6382421                  |
| No. of French metres in a toise                                            | 1.949040     | 0.2898127  | 9.7101873                  |
| No. of English yards in a French<br>toise                                  | 2.1315308    | 0.3286916  | 9.6713084                  |
| No. of English feet in a French<br>toise                                   | 6.3945925    | 0.8058128  | 9.1941872                  |
| No. of English yards in a French<br>metre                                  | 1.0936331    | 0.0388716  | 9.9611284                  |
| No. of English feet in a French<br>metre                                   | 3.2808992    | 0.5159929  | 9.4840071                  |
| No. of English inches in a French<br>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   | 2.3928978  | 11.6071022                 |
| No. of imp. lbs. Troy in a French<br>gramme                                | 0.00268098   | 3.4282936  | 12.5717064                 |

**TABLE XXVIII.**  
**USEFUL NUMBERS, WITH THEIR LOGARITHMS.**

|                                                                                                        | Number.                 | Logarithm. | Complement<br>of Logarithm. |
|--------------------------------------------------------------------------------------------------------|-------------------------|------------|-----------------------------|
| No. of imp. lbs. Avoid. 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  | 10.4894550                  |
| Weight of a cubic foot of pure water in lbs. Avoid. the Bar. being 30, and the Ther. 62                | = 62.5212606            | 1.7946348  | 8.2053652                   |
| Length in inches of a pendulum which vibrates seconds in the latitude of Greenwich                     | = 39.1393               | 1.5926130  | 8.4073860                   |
| Velocity (in feet per second) acquired in a second by a body falling in vacuo in the lat. of Greenwich | = $\sqrt{g}$ = 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 (= $23^h 56^m 4^s.091$ ) 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 $45^\circ$                                          | = 364.5435              | 5.5617474  | 4.4382506                   |





















