SIX PLACE LOGARITHMIC TABLES, TOGETHER WITH A TABLE OF NATURAL SINES, COSINES, TANGENTS, AND COTANGENTS

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WEBSTER WELLS

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LOGARITHMIC TABLES,

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TABLE OF NATURAL SINES, COSINES, TANGENTS, AND COTANGENTS.

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INTRODUCTION.

I. USE OF THE TABLE OF LOGARITHMS OF NUMBERS.

This table (pages 2 to 16) gives the mantissæ of the logarithms of all numbers of four figures from 1000 to 10000, calculated to six places of decimals.

To find the logarithm of any number of four figures.

Find in the column N. the first three figures of the given number. Then the required mantissa will be found in the corresponding horizontal line, in the vertical column headed by the fourth figure of the number.

If only the last four figures of the mantissa are found, the first two may be obtained from the nearest mantissa above, in the same column, which contains six figures.

Finally, prefix the proper characteristic.

For example, $\log 140.8 = 2.148603$;

$\log .05837 = 8.766190 - 10.$

For numbers of one, two, or three figures, the column headed 0 may be used; for log 167 has the same mantissa as log 1670, log 8.3 the same mantissa as log 8300, and log .9 the same mantissa as log 9000; thus,

$\log 167 = 2.222716$, $\log 8.3 = 0.919078$, and $\log .9 = 9.954243 - 10.$

To find the logarithm of a number of more than four figures.

Required the logarithm of 3296.78.

We find from the table, $\log 3296 = 3.517987$;

$\log 3297 = 3.518119.$

That is, an increase of one unit in the number produces an increase of .000132 in the logarithm.

Then an increase of .78 of a unit in the number will produce an increase of $.78 \times .000132$ in the logarithm, or .000103 to the nearest sixth decimal place.

Whence, $\log 3296.78 = 3.517987 + .000103 = 3.518090.$

Note I. The foregoing method is based on the assumption that the differences of logarithms are proportional to the differences of their corresponding numbers, which, though not strictly accurate, is sufficiently exact for practical purposes.

Note II. The difference between any mantissa in the table and the mantissa of the next higher number of four figures, is called the *tabular difference.*

The following rule is derived from the above:

Find from the table the mantissa of the first four significant figures, and the tabular difference. (See Note III.)

Multiply the latter by the remaining figures of the number with a decimal point before them. (See Note IV.)

Add the result to the mantissa of the first four figures, and prefix the proper characteristic.

Example. Find the logarithm of .002243076.

Mantissa of 2243 = 350829	Tabular difference = 194
15	.076
350844	1 164
	13 58
	Correction = 14.744
Result, 7.350844 − 10.	= 15, nearly.

Note III. The tabular difference may be conveniently found as follows:

Subtract the last figure of the mantissa from the last figure of the next greater, and then take the nearest integer, ending in that figure, to the number in the column D. in the same line.

Thus, in the above example, the last figure of the mantissa of 2243 is 9, and of the next greater mantissa, 3; 9 from 13 leaves 4, and the nearest integer, ending in 4, to 193, the number in the column D., is 194, the proper tabular difference.

Note IV. In finding the correction to the nearest unit's figure, the decimal portion may be omitted provided that, if it is greater than .5, the unit's figure is increased by 1.

Thus, 13.26 would be taken as 13; 30.5 as 30; and 22.503 as 23.

To find the number corresponding to a logarithm.

1. Required the number whose logarithm is 1.693551.

Find in the table the mantissa 693551.

In the corresponding line, in the column N., we find 493, the first three figures of the required number, and at the head of the column we find 8, the fourth figure.

Since the characteristic is 1, there must be two figures to the left of the decimal point.

Whence, number corresponding to 1.693551 = 49.38.

2. Required the number whose logarithm is 3.950185.

We find in the table the mantissa 950170, whose corresponding number is 8916, and the mantissa 950219, whose corresponding number is 8917.

That is, an increase of 49 in the mantissa produces an increase of one unit in the number corresponding.

Then an increase of 15 in the mantissa will produce an increase of $\frac{15}{49}$ of a unit in the number corresponding, or .31 nearly.

Whence, number corresponding = 8916 + .31 = 8916.31.

The following rule is derived from the above:

Find from the table the next less mantissa, the four figures corresponding, and the tabular difference. (See Note III.)

Subtract the next less mantissa from the given mantissa, and divide the remainder by the tabular difference. (See Note VI.)

Annex the quotient to the first four figures of the number, and point off the result. (See Note V.)

Note V. The rules for pointing off are the reverse of the rules for characteristic; they may be stated as follows:

I. *If* -10 *is not written after the mantissa, add* 1 *to the characteristic, giving the number of places to the left of the decimal point.*

II. *If* -10 *is written after the mantissa, subtract the positive part of the characteristic from* 9, *giving the number of ciphers to be placed between the decimal point and first significant figure.*

Example. Find the number whose logarithm is 7.427662 − 10.

427662

Next less mantissa = 427648; four figures corresponding = 2677.

Tabular difference = 163)14.000(.0858 = .086, nearly.

13 04

960

815

1450

Result, .002677086.

Note VI. The correction can usually be depended upon to as many decimal places as there are figures in the tabular difference; the division should be carried out to one more place in order to determine the last figure accurately. (See Note IV.)

II. USE OF THE TABLE OF LOGARITHMIC SINES, COSINES, ETC.

This table (pages 18 to 62) gives the logarithms of the sines, cosines, tangents, and cotangents of all angles at intervals of one minute from 0° to 90°.

For angles between 0° and 45°, the degrees will be found at the *top* of the page, the minutes in the *left-hand* column, and the functions in the columns designated by the names at the *top;* that is, sines in the first column, cosines in the second, tangents in the third, and cotangents in the fourth.

For angles between 45° and 90°, the degrees will be found at the *foot* of the page, the minutes in the *right-hand* column, and the functions in the columns designated by the names at the *foot;* that is, cosines in the first column, sines in the second, cotangents in the third, and tangents in the fourth.

The sines and cosines of all acute angles, the tangents of angles between 0° and 45°, and the cotangents of angles between 45° and 90°, being less than unity, the characteristics of their logarithms have been increased by 10, and -10 must be written after their mantissæ; in all other cases, the true value of the characteristic is given in the table.

Thus, $\log \sin 38° 37' = 9.795259 - 10;$

$\log \tan 66° 20' = 0.358253;$

$\log \cot 79° 3' = 9.286624 - 10;$

$\log \cos 85° 51' = 8.859546 - 10.$

To find the logarithmic sine, cosine, tangent, or cotangent of any acute angle expressed in degrees, minutes, and seconds.

Find from the table the logarithmic sine, cosine, tangent, or cotangent of the degrees and minutes, and the difference for 1" corresponding. (See Note VII. below.)

Multiply this difference by the number of seconds. (See Note IV.)

If sine or tangent, add } *this correction.*
If cosine or cotangent, subtract }

Note VII. The columns immediately to the right of those headed "Sin.," "Cos.," and "Tan.," contain the respective differences for 1"; the right-hand column of differences is also to be used with the column headed "Cot."

It will be observed that the differences do not stand in the same horizontal line with the logarithms, but opposite the intervals between consecutive logarithms. With the degrees at the *top* of the page, the difference next *below* should be taken; with the degrees at the *foot* of the page, the difference next *above*.

Note VIII. The rule given above assumes that the differences of the logarithmic functions are proportional to the differences of their corresponding angles, which, unless the angle is very near to 0° or 90°, is in general sufficiently exact for practical purposes. (See page x.)

1. Find log tan 17° 13′ 51″.

log tan 17° 13′ = 9.491180 − 10 D. 1″ = 7.45
380 51
Result, 9.491560 − 10 7 45
372 5
379.95 = 380, nearly.

2. Find log cos 66° 38′ 23″.

log cos 66° 38′ = 9.598368 − 10 D. 1″ = 4.88
112 23
Result, 9.598256 − 10 14 64
97 6
112.24 = 112, nearly.

To find the acute angle corresponding to a given logarithmic sine, cosine, tangent, or cotangent.

Take from the table, if sine or tangent, the next less, if cosine or cotangent, the next greater, logarithmic function, the degrees and minutes corresponding, and the difference for 1″. (See Note IX. below.)

Find the difference between the given logarithm and that taken from the table, and divide it by the difference for 1″, *giving the correction in seconds.*

Add the result to the degrees and minutes.

Note IX. In searching for the next less (or greater) logarithm, attention must be paid to the fact that the functions are found in different columns according as the angle is below or above 45°.

If, for example, the next less logarithmic sine is found in the column with "Sin." at the *top*, the degrees must be taken from the *top* of the page, and the minutes from the *left-hand* column; but if it is found in the column with "Sin." at the *foot*, the degrees must be taken from the *foot* of the page, and the minutes from the *right-hand* column. Similar considerations hold with respect to the other three functions.

1. Find the angle whose log sin = 9.959345 − 10.

9.959345 − 10
Next less log sin = 9.959310 − 10; angle corresponding = 65° 35′.
D. 1″ = .97)35 (36.08 = 36.1, nearly.
291
590
582
Result, 65° 35′ 36.1″. 800