NORTON & GREGORY'S

Calculating Slide Rule

Standard Pattern.

INSTRUCTIONS FOR USE.

TRADE MARK

REGISTERED

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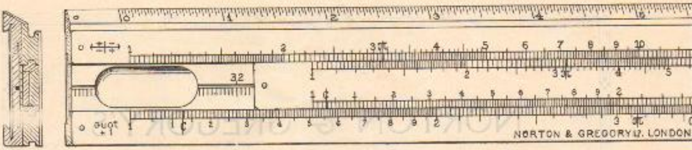


THE STANDARD SLIDE RULE.

ELEMENTARY INSTRUCTIONS

The Slide Rule is an instrument for facilitating calculations for practical purposes.

It consists of a stock, slide and runner.

The upper lines of graduations on the stock and slide are generally called the A and B scales, and the lower lines the C and D scales. The A and B scales are used in conjunction with the C and D scales to obtain Powers and Roots of Numbers. The A and B scales can be used for simple calculations but being only half the Logarithmic length of the C and D scales the results are not so easily read.

The Runner or Cursor is a piece of glass framed to run in grooves along the stock.

A hair line is marked vertically on the centre of the glass.

It is used in obtaining powers and roots of numbers, and also in marking intermediate results in extended calculations.

The A and B scales are usually marked 1 to 100 and C and D scales 1 to 10, but these values are purely relative. Any value (being multiples of 10) may be assigned to the indices.

For example if the left hand index (1) on the A and B scales is to represent 10 the values of the other graduations on the scale will be represented by 20, 30, 40, etc.

Again using the same value for the left hand index of the C and D scales the values of the other graduations will be represented by 20, 30, 40, etc.

But in these examples the top and bottom scales cannot be used in conjunction.

HOW TO USE THE SLIDE RULE.

Multiplication Rule.—Set the index of C to one of the factors on D, and under the other factor on C read the product on D.

Examples: $2{\cdot}5 \times 3{\cdot}4$. Set **left** hand index of C to **2·5 on D**, and at 3·4 on C, find 8·5 on D.

$3{\cdot}6 \times 8{\cdot}5$. Set **right** hand index of C to 3·6 on D **and at 8·5** on C, find 30·6 on D.

$2{\cdot}3 \times 2{\cdot}9 \times 6{\cdot}2$. Set left hand index of C to 2·3 on D, set line on Runner to 2·9 on C, set right hand index on C to runner and at 6·2 on C find 41·35 on D.

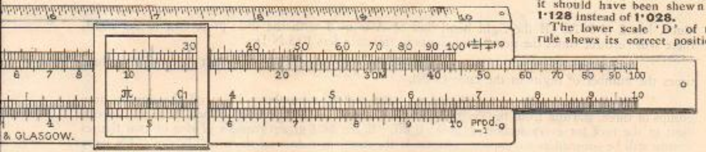
Division Rule.—Set divisor on C to dividend on D and under the index of C read quotient on D.

Combined Multiplication and Division.

Example: $\frac{1{\cdot}3 \times 6{\cdot}2 \times 7{\cdot}4}{4{\cdot}3 \times 3{\cdot}5}$ Set 4·3 on C, to 1·3 on D, set the runner to 6·2 on C, set 3·5 on C to runner and at 7·4 on C read **3·96** on D.

FIXING THE POSITION OF THE DECIMAL POINT.

The position of the decimal point may be found by a rough calculation, but for those who prefer rules the following is the method usually adopted:



NOTE.—The mark 'C' on the lower scale of the slide is incorrectly placed in the illustration: it should have been shewn at **1·128** instead of **1·028.**
The lower scale 'D' of the rule shews its correct position.

Multiplication. The number of digits in the result is equal to the **sum** of the number of digits in the factors, if the slide projects to the **left.**

If the slide projects to the **right** the number of digits in the result is equal to the **sum** of the number of digits in the factors **minus** 1.

Division. The number of digits in the quotient is equal to the difference (plus or minus) of the number of digits in dividend and divisor, if the slide projects to the **left.** But if the slide projects to the right **add** 1 to this difference.

If the **resulting number of digits** is minus, the resulting product or quotient will be a fraction with as many 0's after the decimal point as there are resulting minus digits. Care must be taken that all additions and subtractions of digits are done **algebraically.**

Examples:	2·4 × 3·2 × 7·68	Number of digits = 2 − 1 = 1
	3·6 × 4·8 = 17·28	„ „ „ −2
	3·5 × ·0012 = ·0042	„ „ „ −2 + 1 − 1 = −2
	7·2 ÷ 2·4 = 3	„ „ „ 1 − 1 + 1 = 1
	125 ÷ 8·4 = 14·9	„ „ „ 3 − 1 = 2
	·00043 ÷ ·012 = ·0358	„ „ „ −3 − (−1) + 1 = −1

The signs +1 −1 found at the ends of the scale are visible reminders of this rule.
Quot. Prod.

In the case of combined multiplication and division to avoid mistakes a good method is to change all the digit signs in the divisor then **add** (algebraically) to digits in dividend.

SQUARES AND SQUARE ROOTS.

If the runner is set to any value on D its square will be read off on A. Conversely, if the runner is set to any value on A, its square root will be read off on D.

To find the number of digits in the square of a number. If the square is read off on the left hand half of A it will contain twice the number of digits in the original number, **minus** 1; if read off on the **right hand** half of A there will be twice the number of digits in the original number.

Square Roots. Where the number contains an odd number of digits the **left hand** half of A is used. For even numbers use the **right hand** half of A.

CUBES AND CUBE ROOTS.

Cubes. To cube a number. Set either index as required of C to number on D, and at number on left hand half of B read cube on A.

Cube Roots. Set runner to number on A and adjust slide so that reading at runner on B is equal to reading on D under either index on C.

Point off number into groups of three starting from the **units place.** If the first or left hand group contains one figure the reading will be taken on the left hand half of A using the left hand index of C. If first group contains two figures the reading will be taken on right hand half of A using the left hand index of C. If first group contains three figures the reading will be taken on left hand half of A using the right hand index of C.

Note. Left hand half of B must always be used for **cubes and cube roots.**

To determine the number of digits in the cube of a number. If the left hand half of A is used with the slide projecting to the **right**, there will be three times the number of digits in the

Cube, less 2 (3 N-2). If the right hand half of A is used with the slide projecting to the **right**, there will be three times the number of digits in the cube less 1 (3 N-1).

If the left hand half of A is used with the slide projecting to the **left** there will be three times the number of digits in the cube (3 N).

To find the number of digits in the cube root of a number. Point off the number into groups of three, starting from the decimal point if the number is a decimal. Then there will be one digit in the root for every section so pointed off. If the **first** group consists of one or two figures it must still be counted as a complete section. If the number is decimal there will be one 0 for every **complete** group of three 0's immediately following the decimal point. If required, 0's must be added to make up a complete section of three figures. Thus 0·2—0·200, 0·0003—0·000300. This is to determine which scale is to be used as explained above.

LOGARITHMS.

On the reverse side of slide will be found an **evenly** divided scale. The graduations are the mantissæ of the numbers on the C and D scales.

To find the log of a number set left hand index of C to number on D and opposite indicator mark on notch at back of stock will be found mantissæ of number required. A convenient way is to reverse and invert the slide and read direct from the D scale. The indices of scales must coincide.

The Characteristic is found in the usual manner.

SINES AND TANGENTS.

The upper graduations on the reverse side of the slide are the logs of the **Sines** of angles, the lower graduations being the logs of the **Tangents** of angles.

To find the Sine of an angle. Reverse slide so that the Trigonometrical scales are uppermost, and the end divisions on the slide coincide with the end divisions on the stock. Then the **Sine** is read off on A over the given angle on S.

Results on the **right hand** half of A are prefixed by a decimal point only, whilst results on left hand half are preceded by an 0.

Example:—Sine 21° 10′—0·361 (R.H.) Sine 1° 40′ 0·029 (L.H.)

To find the Tangent of an angle. Reverse slide, as explained above. Then read off on D the **Tangent** of the given angle on T; the result found being wholly decimal.

For Tangents of angles of less than 5° 43′ use the scale of **Sines** prefixing a cypher to the result.

For Tangents of angles above 45° use the formula: $\text{Tan. } A = \dfrac{1}{\text{Tan. } (90^\circ - A)}$

The sign $\leftarrow \frac{+}{-} \mid \frac{-}{+} \rightarrow$ found at the ends of the A scale is a reminder of a method used in ascertaining the number of figures in a result. This and other methods are fully dealt with in Standard Books on the Slide Rule. The Gauge marks c and c′ are used in calculating the contents of cylinders, viz., set c on C to diameter on D, and over length on B read cubic contents on A. c′ is used when the slide has to be pulled out more than half way.

The Gauge Point M is used in finding the circumference and area of the curved surface of a cylinder, viz., set M on B to diameter on A, the circumference being read over 1 or 100 on B, and the area of curved surface over the length on B.

The Gauge Point π found at 3·1416 on both the Upper and Lower scales is used in determining the circumference of circles.