NESTLER

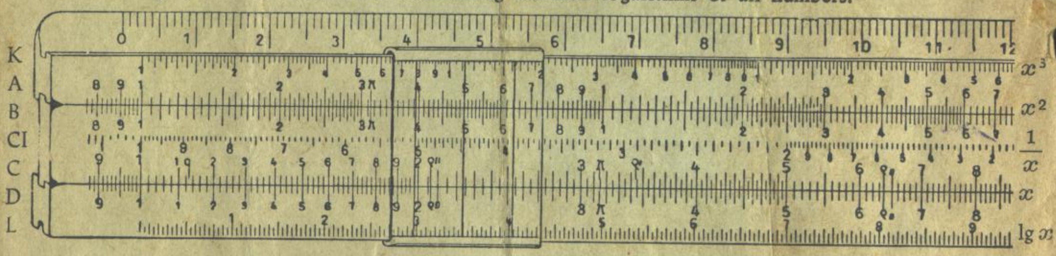
BRIEF INSTRUCTIONS
FOR USING
NESTLER SLIDE RULES

With the NESTLER slide rule you have an instrument of precision which will be both useful and indispensable for all computations as soon as you are familiar with it. In the following we deal only with a few simple examples in order to show how the slide rule is used.

The slide rule consists of the fixed **Rule or Stock**, the movable **Slide**, and the **Cursor**. The latter is provided with 3 hair-lines for exact setting.

DESIGNATION OF SCALES

K = x^3, Cubic Scale
A = x^2. Upper scale of the rule 1—100 which corresponds with
B = x^2, Upper scale of the slide 1—100
CI = $\frac{1}{x}$, Reciprocal or Inverse Scale
C = x, Lower scale of the slide 1—10 which corresponds with
D = x, Lower scale of the rule 1—10.
L = lg x, Mantissae-Scale for determining common logarithms of all numbers.



EXPLANATION OF DIVISIONS

On an ordinary ruler, the centimeters are marked and numbered, while their sub-divisions, the millimeters, are only indicated by strokes; the tenths of millimeters have to be estimated. It is the same with the slide rule, since we are concerned not only with whole numbers, 1, 2, 3 etc., but with decimal fractions e. g. 1·1, 1·2, 1·8, 2·75, 3·14, 5·41, 0·074, and the like. But, whereas on an ordinary ruler the divisions representing each a unit of length are all the same, the divisions of the scale of the slide rule we are looking at, get smaller and smaller and more crowded as we go to the right, so that to avoid eyestrain, some of them have to be ommitted.

The section 1—2 of scale "C" and "D" is subdivided into 10 principal distances which are marked by the figures 1·1, 1·2 up to 1·9 and 2. Each of these primary divisions is again subdivided into 5 parts. They read 1·02, 1·04, 1·06, 1·08, 1·10, 1·12, etc. up to 1·98 and 2·00. The graduations between 2 and 5 are read 2·05, 2·10, 2·15, 2·20 etc. up to 4·95 and 5·00. From 5 to 10 the subdivisions progress by tenths, and we read 5·10, 5·20 up to 9·90 and 10·0.

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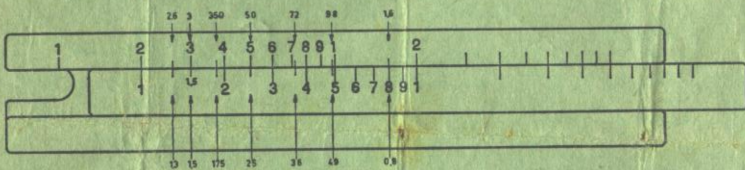
After some practice it is easy to estimate the intermediary values not marked by a stroke. They are fixed with the hair-line of the cursor. We can thus set 3·16, 7·83 etc.; one can generally work to three figures.

The above examples refer to the pocket slide rule of 5". The 10" type has more subdivisions according to the greater length; one reads there in the section 1 to 2 the graduations as 1·00, 1·01, 1·02, 1·03 . . . . . 1·10, 1·11 up to 1·99, and 2·00, and in the section 2 to 4 as 2·00, 2·02, 2·04 up to 3·98, and 4·00, whereas in the section 4 to 10 the subdivisions progress by 0·5 and read as 4·00, 4·05, 4·10 to 9·95, 10·0, and the 20" slide rule has even more subdivisions.

Note: No indication as to the setting of the decimal point is given by the slide rule. The value of 2·15 for instant can also be read as 21·5, 215 or 0·215, etc. A mistake can, however, not be overlooked as the result could only be read as 10 times too large or too small and this will be noted by simple estimation. What the slide rule gives, is the figures; the position of the decimal point, or the number of noughts which decide the magnitude have to be estimated.

MULTIPLICATION $(a \cdot b = c)$

Rule: Place "1" of "B" in coincidence with multiplicand "a" of scale "A", set hair-line over multiplier "b" on scale "B" and read the product "c" opposite to it on "A". We take quite a simple example: $c = 2 \times 3$. Shift the slide towards the right until the "1" of scale "B" coincides with the "2" of scale "A". Set cursor line in coincidence with "3" on "B" and read below it on "A" the product "6".



Note: that the slide rule in addition to the solution of the problem 2×3 also indicates a complete table for the multiplier "2".

We read:

the product on scale "A"	2·6	3	350	4	50	6	72	8	98	1·6
opposite to the multiplicand scale "B".	1·3	1·5	175	2	25	3	36	4	49	0·8

We may, of course, also use scales "C" and "D" for these operations, but we find then that not all the values can be read because the slide projects at the right hand side over the stock. In this case we set the right end "1" of scale "C" opposite the "2" of "D" and so find all the products which cannot be read with the previous setting.

Note: The slide must always be set so that the greatest part of it is adjacent to the stock scale.

The middle of the slide, approximately 3 of scale "C" or scale "CI" should not project over "1" or "10" of scale "D".

DIVISION $\left(\frac{a}{b} = c\right)$

The division is the inverse operation of the multiplication.

Rule: Place dividend "a" of scale "A" (or "D") and divisor "b" of scale "B" (or "C"), opposite each other and read in face of "1" of the slide the quotient "c".

Example $6:3 = 2$. Given are "a" = 6 and "b" = 3. With the setting explained above we find "c" = 2 opposite 1 of the slide. We also find with the same setting.

on A	4	8	5·2	3·14	quotient = 2
on B	2	4	2·6	1·57	

Using scales "C" and "D" we set the denominator on "C" and the numerator on "D".

COMBINED MULTIPLICATION AND DIVISION — PROPORTIONS

In practical computation we are often confronted with problems where groups of 2 numbers in relation to each other and a third number are known and where we have to find the fourth value. The solution is obtained by applying „the rule of three".

Example: 6·55 meters of cloth cost $ 55.—. What is the price for 3·5 meters? We fix on "A" 55 with the hair line of the cursor and set 655 on "B" in coincidence. Without taking notice of the result of this division opposite the end "1" of "B", which gives us the price for 1 meter, we read the result opposite 3·5 of "B" = 29·40 on "A".

Note: By this setting of the slide we have obtained not only the price for 3·5 meters but a whole table with corresponding values. Opposite any length of cloth of "B" we find the respective price on "A".

We thus obtain:

Length (Scale "B")	6·55	3·50	30	0·45	8
Price (Scale "A").	55	29·40	252	3·78	67·20

Note: The two scales "B" and "A" being identical may be used inversely fixing the lengths on "A" and reading the prices on "B".

THE RECIPROCAL OR INVERSE SCALE "CI"

(Multiplication of more than 2 factors)

Some slide rules have engraved in the middle of the slide a scale which runs from right to left i. e. inversely. We read on it the reciprocal values to scale C.

Note: Scale CI permits two successive multiplications with a single setting of the slide. The simple example 2 × 3 × 4 may show this. We set cursor line on "2" of "D", shift the slide with the 3 of scale CI beneath it, and read opposite 4 of "C" on scale "D" the result 24.

This method can be applied for all multiplications with more than 2 factors.

CALCULATION OF PERCENTAGE

This is a mere multiplication in which the number 100 % represents one factor whereas the percentage expressed as a decimal fractions is the other one, i. e. what is 70 % of 650? 650 = 100 %; we set the final "1" of "B" (= 100 %) in coincidence with 650 and read opposite 0·70 of "B" on scale "A" 455.

With the same setting of the slide we read also all the other percentages of 650 as 80 % = 520, 60 % = 390, 50 % = 325. We may also use scale "C" and "D" but we then find that with the above setting the results for 10 % to 15 % cannot be read because the slide projects at the left hand side over the stock. In this case we shift the slide to the right and set the initial "1" of "C" over 650. We find then 12 % = 78, 14 % = 91 etc.

Example: For a clearance-sale the prices are to be reduced by 15 %. An article marked up to now with 100.— $ costs now only 85.— $. We set the final "1" of "B" (or "C") opposite 85 of "A" (or "D") = 100 % less 15 %, and have so the complete table which gives us on "A" (resp. "D") the new prices in coincidence with the old prices of "B" (resp. "C").

"B" old price $	90	70	40	11	10.70	9
"A" new price $	76.50	59.90	34	9.35	9.10	7.65

SQUARES AND SQUARE ROOTS

Whereas we have on scale "C" and "D" one logarithmic distance 1—10 we have on scale "A" and "B", over the same length, two such distances, viz. 1—10 and 10—100. We thus obtain on A and B the squares to all numbers of C and D, and, vice versa, we have on C and D the square roots of the numbers of A and B. The setting is done with the cursor line.

Note: When extracting a square root take care that the radicand be properly set on the upper scales (A and B); it is important that you set in the first or in the second logarithmic unit of these scales.

Example:	Radicand	4	40	9	90
	Square root	2	6·33	3	9·487

CUBES AND CUBE ROOTS

The K scale is thus arranged that if the cursor line is set over a number on "D" its cube will be read on K under the cursor line.

We find the cube root of a number setting on K the radicand with the cursor line and reading the cube root on "D" under cursor line.

THE TRIGONOMETRICAL SCALES

The S- and T-Scales on the reverse side of the slide are used in conjunction with scales A, B, C and D.

On the slide rules where the S-Scale begins with $0^\circ 34'$ reaching to 90° on the right end we set any angle of the S-Scale in line with the upper index of the right hand slot and read the sine of this angle on scale B opposite "100" of "A" — on pocket slide rules marked as "1".

On the slide rule system Rietz we read the sine with the same setting as above on the C-Scale. The S-Scale of this type begins only at $5^\circ 44'$.

Note: from $0^\circ 34'$ up to $5^\circ 44'$ sine x begins with 0·0 . . . and from here to 90° with 0·...

angle	$1^\circ 30'$	5°	$7^\circ 10'$	30°	50°
sine	0·0262	0·0872	0·1248	0·5	0·766

T-Scale gives the value for the angles of $5^\circ 43'$ up to 45°. The values for tang. and sin. of angles lower then $5^\circ 43'$ are practically identical.

To obtain the tangents we set the angle of T-Scale in line with the index of the left hand slot and read the respective value on "C" in coincidence with the initial "1" of "D"

angle	7°	11°	30°
tangents	0·1228	0·194	0·577

THE MANTISSAE-SCALE "L"

We find on this scale by means of the hair line of the cursor the mantissae of the decimal logarithms to any number of scale D. The characteristic is determined in the usual way and set before the decimal point. We find thus f. i. lg 2 = 0·301 and lg 20 = 1·301 etc.

SURFACE OF CIRCLE

$$\text{Surface} = \frac{d^2 \cdot \pi}{4}$$

Set the right-hand hair-line of the cursor on scale D in coincidence with the diameter and read the surface on scale "A" below the center hair-line. With this setting, and if the lines of the cursor are equidistant, we obtain below the left hand hair-line on scale "A" the weight of a round iron bar of the same diameter (spec. gravity 7·85) and of the length "1". Multiplying the value thus obtained on scales A—B by the length of any round iron bar we get its weight.

We hope the above few examples will have given you an indication of the time saving possibilities of our slide rules, the usefulness of which can only be appreciated after careful practice of the simple rules involved.

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