SLIDE RULES

& Calculating Instruments

KEUFFEL & ESSER CO.
NEW YORK

KEUFFEL & ESSER CO., NEW YORK

K & E
SLIDE RULES
and
Calculating Instruments



KEUFFEL & ESSER CO.

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K & E
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SLIDE RULES.

CALCULATING INSTRUMENTS.

The **Slide Rule** is an instrument for performing various arithmetical, algebraical and trigonometrical calculations by mechanical means. The theory of the rule is simple and easily learned and but little practice is necessary to attain proficiency in its use.

As a time saver the Slide Rule is unequalled, and for all practical purposes it gives results with a degree of accuracy and rapidity that soon make its use indispensable to the Engineer, Scientist, Merchant or Student. Calculations of the type $\frac{16.7\times4.93\times7.61}{2.35\times3.19}$ can be solved as quickly and readily as $\frac{2\times4\times6}{3\times7}$, and either problem can be solved in a fraction of the time required by the usual arithmetical processes.

The first Slide Rules to be put to practical use, were of the type No. N4041, page 5. This type is known as the **Mannheim Slide Rule.** The upper face of this rule carries two single and two double logarithmic scales and a runner or indicator for finding coinciding points on the scales. On the under face of the slide are scales of Sines, Tangents and equal parts. The back of the Rule carries a table of settings and ratios.

The first radical departure from this type of Slide Rule is shown in the K&E **Duplex Slide Rule** (see Polyphase Duplex Slide Rules, pages 8 and 9). In this Slide Rule, the bodies of the rule and the slide are of the same thickness and flush on both sides, thus allowing for the addition of a number of extra scales and giving the Slide Rule a much wider field of use.

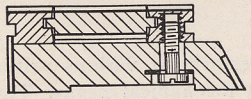
K & E Slide Rules are made of the finest obtainable materials, and an entire department of our large factory is devoted exclusively to their manufacture. Numerous features are patented and are not found in other Rules.

K & E SLIDE RULES.

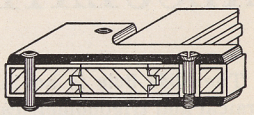
K & E SLIDE ADJUSTMENT.

It is well known that the materials of which most slide rules are made (wood, xylonite or celluloid) are affected by atmospheric changes. Under ordinary conditions these changes have no effect upon K & E slide rules; in which the liability of shrinking and swelling has become a nearly negligible factor, due to the use of the most approved processes in the seasoning treatments of the materials employed. Under extreme conditions, however, shrinkage or swelling may become so marked as to interfere with the smoothness of operation of the slide. Consequently, some means is required to readjust the rule.

Before the K & E slide rule adjustment was devised, various means had been adopted to take care of appreciable shrinkage and swelling; but each of these had some serious drawback. None of the so-called "automatic" adjustments, for instance, has proved practicable in use. Those in which the base or stock, cut lengthwise into halves, is held together by springs, soon become useless through uneven shrinkage, and do not afford a rigid bed for the slide; while those which depend upon springs to hold one edge of the slide against the rule, become objectionable because of the gap which appears between the rule and the opposite edge of the slide.



Mannheim Rules.



Duplex-type Rules.

Cross section of K & E Slide Rules showing Slide Adjustment.

The **K & E Slide Adjustment.** by successfully overcoming these drawbacks, has solved the problem perfectly. In the Mannheim type rules, one of the grooved guide pieces (in which the slide moves) is in a separate piece from the body of the rule, to which it is secured by means of set screws. These setscrews pass through oblong slots in the body of the rule into threaded metal bushings in the adjustable guide piece. This construction, while insuring that the guide piece will be held rigidly in place when the screws are tight, permits it to be moved away from or toward the slide when the screws are loosened. Hence, should adjustment become desirable, it is only necessary to loosen the screws, bring the guide piece against the slide according to the friction desired, and tighten the screws again.

In the **Duplex** type slide rule, the nickel silver end pieces, which join the two side bars of the stock, are provided with set screws which pass through oblong slots in one of the side bars. Adjustments is made by releasing the setscrew at each end of the bar, shifting the bar toward or away from the slide to give the desired friction, and then tightening the screws.

NUMBERING OF SLIDE RULES.

Great care has been taken to make the numbering of the graduations as distinct and permanent as possible. Since *sub-numbers* are not required by the adept, and tend to confuse and hinder beginners, we do not regularly number the sub-divisions throughout. Should they be desired for any special purpose, *we will quote prices on request.*

MANNHEIM SLIDE RULES.

K & E ADJUSTABLE.

5-INCH RULE.

4031S. K & E Adjustable (**Mannheim**) Slide Rule, 5-in., engine divided, divisions on white facings, with "Frameless" Glass Indicator; in sewed Leather case, with Directions . . . . . each $ 5.50

The 5 inch rule has from 10 to 50 subdivisions between the prime numbers, whereas the ordinary 10 inch rule has from 20 to 100.

8-INCH RULE.

N4035S. K & E Adjustable (**Mannheim**) Slide Rule, 8-in., engine divided, divisions on white facings, with "Frameless" Glass Indicator; in sewed Leather Case, with Directions . . . . . " 6.20

The 8 inch rule is as closely divided as the ordinary 10 inch rule, except on the scale of equal parts, and the lower range of the sine scale.

10-INCH RULE.

N4041. K & E Adjustable (**Mannheim**) Slide Rule, 10-in., engine divided, divisions on white facings, with "Frameless" Glass Indicator; in Case, with Directions. . . . . " 5.50

N4041S. Same as No. N4041 but in sewed Leather Case " 6.35

N4041F. K & E Adjustable (**Mannheim**) Slide Rule, like N4041, but subdivided as closely as the 20-in. rule . . . . . " 12.00

N4041FS. Same as No. 4041F but in sewed Leather Case. . . . . " 12.85

16-INCH RULE.

4045. K & E Adjustable (**Mannheim**) Slide Rule, 16-in., engine divided, divisions on white facings, with "Frameless" Glass Indicator; in Case, with Directions . . " 13.00

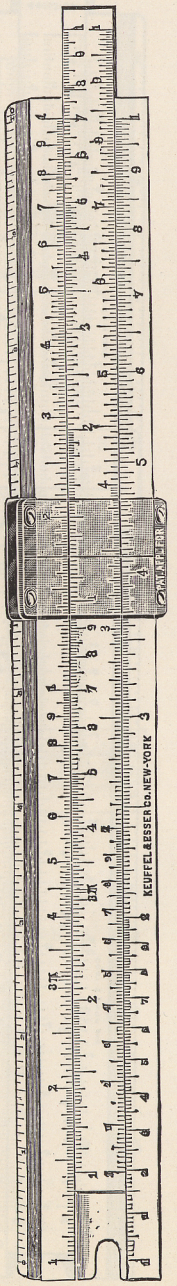
4045S. Same as No. 4045 but in sewed Leather Case " 14.50

20-INCH RULE.

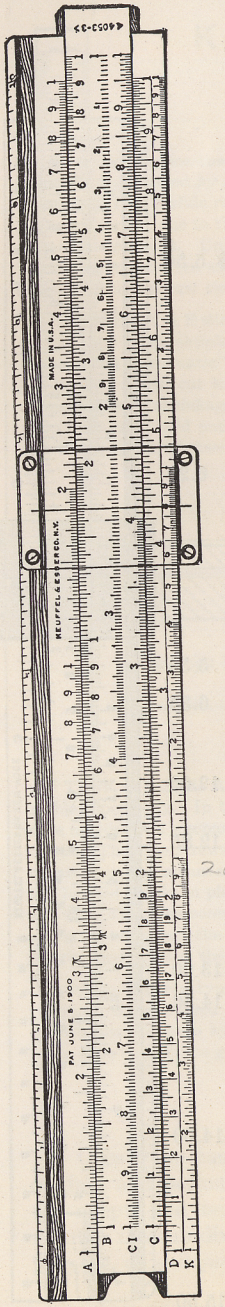
4051. K & E Adjustable (**Mannheim**) Slide Rule, 20-in., engine divided, divisions on white facings, with "Frameless" Glass Indicator; in Case, with Directions . . " 14.00

Rules N4041 F., 4045 and 4051 are divided more closely than the ordinary 10 inch rule. They have from 200 to 50 subdivisions between the prime numbers, while the other rules have from 100 to 20, so that reading is closer than on the ordinary 10 inch rules, often to the extent of one additional significant figure.

4051S. Same as No. 4051 but in sewed Leather Case " 15.50



No. N4041.



No. N4053-3.

POLYPHASE SLIDE RULES

REG. U. S. PAT. OFF.

MANNHEIM TYPE

K & E ADJUSTABLE

The Polyphase Slide Rule has, in addition to the regular scales of the Mannheim, a scale of cubes on the face of the rule below the D scale and an **inverted** scale (CI) on the face of the slide, which scales may readily be used in conjunction with the other scales, by means of the indicator. This arrangement combines some of the features of the Duplex type with the regular Mannheim Rule.

The inverted scale enables the operator to take three factors at one setting of the slide, and to read reciprocals by means of the indicator. Such expressions as

$$\sqrt{a^3} \quad ; \quad \sqrt[3]{a^2} \quad ; \quad \sqrt[3]{\frac{1}{a^4}} \quad ;$$

$$a^5 \quad ; \quad a^6 \quad ; \quad a^9 \quad ; \quad \sqrt{a^5} \quad ; \quad \sqrt[3]{a^5} \quad ;$$

$$\sqrt[6]{a^5} \quad ; \quad \sqrt[3]{a^4} \quad ; \quad \sqrt[3]{\frac{a}{b^2}} \quad ;$$

$$a^2 \times \sqrt[3]{b^2} \quad ; \quad \frac{\sqrt{a^3 \times b^3}}{c^3}$$

may be read by means of the indicator, and almost any combination of three factors involving squares, square root, cubes and cube root, may be solved at one setting of the slide.

8-INCH RULE.

N 4053-2S. Polyphase (Mannheim) Slide Rule, K & E Adjustable, 8 in., engine divided, divisions on white facings, "Frameless" Glass Indicator; in sewed Leather Case, with Directions . . . . . each $ 6.95
(See note under N4035S, page 5.)

10-INCH RULES.

N 4053-3. Polyphase (Mannheim) Slide Rule, K & E Adjustable, 10 in., engine divided, divisions on white facings, "Frameless" Glass Indicator; in Case, with Directions . . . . . " 6.25

N 4053-3 S. Same as No. N4053-3 but in sewed Leather Case . . . . . " 7.10

N 4053-3F. Polyphase (Mannheim) Slide Rule, like No. N4053-3, 10 in., but subdivided as closely as the 20-in. rule . . . " 13.50
(See note under 4051, page 5.)

N 4053-3FS. Same as No. N4053-3F but in sewed Leather Case . . . . . " 14.35

20-INCH RULE.

N 4053-5. Polyphase (Mannheim) Slide Rule, K & E Adjustable, 20-in., engine divided, divisions on white facings, "Frameless" Glass Indicator; in Case, with Directions . . . . . " 16.00
(See note under 4051, page 5.)

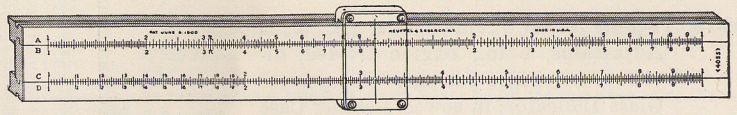
N 4053-5S. Same as No. N4053-5 but in sewed Leather Case . . . . . " 17.50

FAVORITE SLIDE RULES.

TRADE MARK

MANNHEIM TYPE.

K & E ADJUSTABLE.



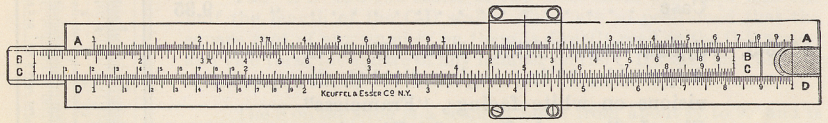
No. 4055.

4055. Favorite Adjustable (Mannheim) Slide Rule, 10 in., divisions on white facings, with "Frameless" glass Indicator; in Case, with Directions . . . . . each $ 3.50

The Favorite Slide Rules are of the same pattern as No. N4041, except for the omission of the centimeter and inch scales.

For Magnifiers and Books on the Slide Rule, see pages 18, 19 and 20.

BEGINNERS' SLIDE RULES.



No. N4058C.

4058. Beginners' Slide Rule, (Mannheim), 10 in., transparent Xylonite Indicator, in plain box with Directions . . . . each $ .75

N4058C. Like 4058, but with "Frameless" Glass Indicator, in case with Directions . . . . . $ 1.00

The graduations of Nos. N4058 and N4058C are printed on light-colored wood.

4058W. Like N4058C, but with graduations on white finish, in case with Directions . . . . . $ 1.25

The Beginners' Slide Rule is intended only for the use of beginners to enable them to become familiar with the slide rule without incurring the expense of obtaining the regular rule intended for professional use.

It is similar to our Mannheim Slide Rule except that the edges are not graduated. Plain Directions are furnished with each rule.

POLYPHASE DUPLEX

REG. U. S. PAT. OFF.

SLIDE RULES

DUPLEX TYPE

K & E ADJUSTABLE

4088-1S. Polyphase Duplex Slide Rule, K & E Adjustable, 5 in., engine divided, divisions on white facings, "Frameless" Glass Indicator; in sewed Leather Case without flap with Directions . . . . . each $ 8.50

(See note under 4031 S, page 5.)

4088-2S. Polyphase Duplex Slide Rule, K & E Adjustable, 8 in., engine divided, divisions on white facings, "Frameless" Glass Indicator, in sewed Leather Case, with Directions . . . . . " 9.20

(See note under N4035 S, page 5.)

4088-3. Polyphase Duplex Slide Rule, K & E Adjustable, 10 in., engine divided, divisions on white facings, "Frameless" Glass Indicator; in Case, with Directions " 8.50

4088-3S. Same as No. 4088-3, but in sewed Leather Case . . . . . " 9.35

4088-5. Polyphase Duplex Slide Rule, K & E Adjustable, 20 in., engine divided, divisions on white facings, "Frameless" Glass Indicator; in Case, with Directions " 20.00

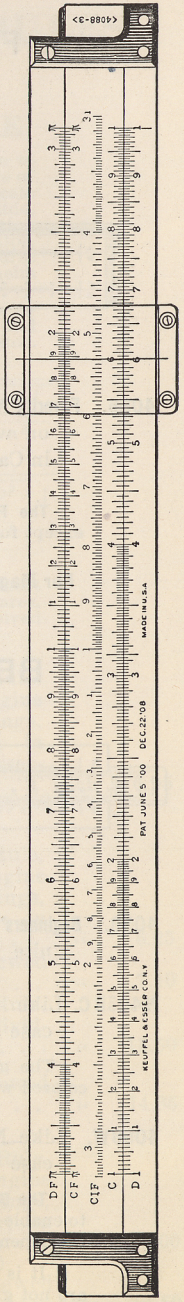
(See note under 4051, page 5.)

4088-5S. Same as No. 4088-5, but in sewed Leather Case . . . . . " 21.50

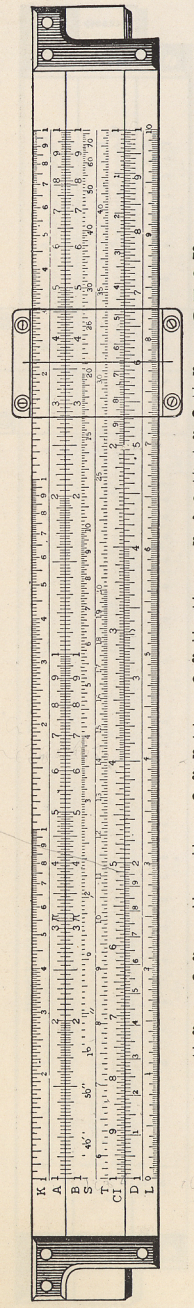
The Polyphase Duplex Slide Rule is a combination of the Polyphase and the Duplex Rules, with the addition of several special scales. It is very valuable for the solution of problems involving exponentials, reciprocals and extended combinations of factors. Involved computations may be performed with a minimum number of settings, decreasing the possibility of error in reading, and reducing the time required to perform calculations. Any one of the scales may be read in connection with any other one by means of the indicator which encircles the rule.

In introducing the various changes and innovations enumerated, great care has been exercised to avoid complicating the rule, so that the Polyphase Duplex Rule can be used efficiently for the simpler problems of multiplication and division as well as for the more complicated operations encountered in the solution of various empirical formula.

The Polyphase Duplex is of the Duplex type, being graduated on both sides, and has the K & E slide adjustment.



4088-3.-Front



4088-3.-Back

POLYPHASE DUPLEX

REG. U. S. PAT. OFF.

SLIDE RULES.

DUPLEX TYPE

K & E ADJUSTABLE.

The **Polyphase Duplex Slide Rule** has all of the scales of the Polyphase Slide Rule, with the addition of three others known as the CF, DF and CIF or folded scales. **The function of the folded scales is to enable factors to be taken without resetting, which would be off the rule when using the regular C-D scales.**

The folded scales correspond in all respects to the C, D and CI scales, except that each has but one index which is located close to the middle of the rules. Each folded scale is thus divided into two sections: one, at the right of the index, running from 1 to π (3.1416), and the other, at the left of the index, running from π to 1. The arrangement is such that π is brought into alignment with the two indexes of the corresponding scales C, D or CI. Consequently, it enables the user to find the diameters and circumferences of circles without setting the slide; and π to be taken as a factor or divisor in any formula without an additional setting.

On the other side of the rule the scales, in order downward, are K, A-B, S, T, CI, D and L. The "K" is a scale of three units, each unit being of one third the unit length of the C-D scales, to which it is referred. It gives directly the cube of any number on the C-D scale; and vice versa the cube root of any number on the K scale is read directly on the C-D scales.

The "A-B" are two scales of two units each, with each unit one half the length of the C-D scales. They are so positioned that the square root of any number on them is directly read on the C-D scales; and vice versa the square of any number on the C-D scales may be read directly upon them.

The S on the slide is a scale of Sines from about 35′ to 90° and is referred to A-B scales.

The T on the slide is a scale of Tangents from about 5° 44′ to 45° referred to C-D scales.

The CI on the slide is an inverted scale of full unit length and is adjacent to and used in conjunction with the D scale on the lower body of the rule.

The lower edge of the rule carries a scale of equal parts known as the L scale which is used for obtaining the common logarithms of numbers. This scale is referred to the D scale.

LOG LOG DUPLEX

REG. U. S. PAT. OFF.

SLIDE RULES.

DUPLEX TYPE.

K & E ADJUSTABLE.

N4092-3. **Log Log Duplex Slide Rule,** K & E Adjustable, 10 in., engine divided, divisions on white facings, "Frameless" Glass Indicator; in Case, with Directions . . each $10.00

N4092-3S. Same as No. N4092-3 but in sewed Leather Case . . . . . " 10.85

N4092-5. Same as No. N4092-3 but 20 in. . . . . " 23.00

N4092-5S. Same as No. N4092-5, but in sewed Leather Case . . . . . " 24.50

The **Log Log Duplex Slide Rule** has, in addition to the scales of the Polyphase Duplex Slide Rule, a Log Log scale (representing the Logarithms of the Logarithms of a series of natural numbers) of quantities greater than unity, three fold, graduated from 1.01 to 22,000, with which any root or power of any quantity may be rapidly determined, in general by direct operation at one setting of the slide. The hyperbolic or natural logarithm of a quantity with its characteristic may be read by means of the indicator without setting the slide, or may be used directly as a factor when required in any formula.

Also a Log Log scale of decimal quantities, called LLO, which has a range of .97 to .05. It is referred to the A-B scales and is so proportioned that the hyperbolic co-logarithms of numbers on it are read directly on scale A.

Exponentials generally, and the many formulae in electrical and mechanical engineering involving fractional powers or roots, hyperbolic logarithms, etc., are readily handled with the help of this rule.

On one face (see illustration to right) are the following scales:

K, three complete logarithmic scales, giving directly cubes and cube roots.

DF, a full length D scale folded. The graduations begin and end approximately at the center of the rule, the scales being so placed as to bring the division π in line with both indexes of the lower D scale **This arrangement admits of the handling of factors which, in rules without these scales, would frequently require the slide to be reset.** Incidentally, it enables the user to find the diameters and circumferences of circles without setting the slide; and π to be taken as a factor or divisor in any formula without an additional setting.

CF, a full length C scale, folded like the DF scale.

CIF, a full length inverted folded C scale, whose index is in line with the indexes of the DF and CF scales.

CI, a full length C scale inverted.

C, a full length C scale.

D, a full length D scale.

L, a scale of equal parts (for finding common logarithms of numbers).

On the other face of the rule (see illustration on opposite page) are the following scales:

LLO, a Log Log scale of decimal quantities.

A, two complete logarithmic scales, giving directly squares and square roots.

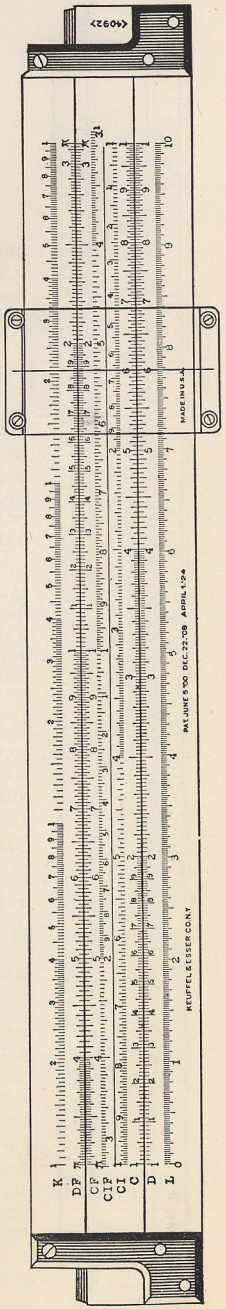
B, two complete logarithmic scales, exactly like A.

S, the usual trigonometric scale of sines.

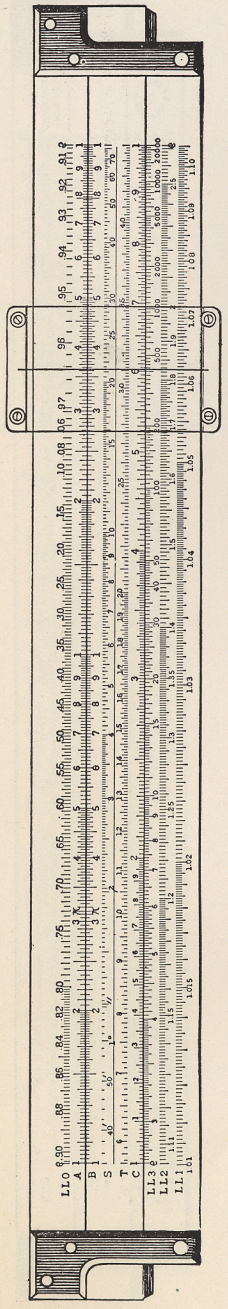
T, the usual trigonometric scale of tangents.

C, a full length C scale.

LL1, LL2, LL3, a continuous Log Log Scale in three parts.



No. N4092 Front



No. 4092 Back

LOG LOG DUPLEX

REG. U. S. PAT. OFF.

SLIDE RULE.

The **value of the Log Log Scales** is best appreciated in determining powers and extracting roots. The number whose power or root is desired is taken on the Log Log Scale, while the exponent or root index is taken on the C scale for quantities greater than unity, and on the B scale for quantities less than unity. Hence, the solution of these problems involves **no more work than would be required in ordinary multiplication or division on other slide rules. Powers and roots may be found in this way by those who are not acquainted with the ordinary mathematical processes employed in similar cases.**

The saving in time and labor through the use of the Log Log Scales is best illustrated in finding a numerical expression for x^n or $x^{\frac{1}{n}}$. With the ordinary slide rule the logarithm of x is first determined on one scale, then log x is multiplied or divided by n through the manipulation of two other scales, and the result referred back to the original scale. This involves 4 settings of the indicator, one setting of the slide, and 3 scales. With the Log Log scales, x is either multiplied or divided by n directly; involving only 2 settings of the indicator, one setting of the slide, and 2 scales. No inspection of the result is necessary where the Log Log scales are employed, since **the answer as found is already pointed off.**

When the indexes of the Log Log scales of quantities greater than unity are in alignment with those of the slide, the Hyperbolic or Natural Logarithm of any number on the Log Log scales may be directly read upon the C scale. Logarithms to any other base are made instantly available through setting the index of the slide to the number representing the required base on the Log Log scale.

On the Log Log scale of quantities less than unity, problems involving powers and roots of fractions are easily solved by processes which are exactly like those of multiplication and division on the common scales of all slide rules. The limits of this scale are .05 and .97; but problems involving quantities below .05 and between .97 and 1.01 are easily and rapidly solved by simple methods explained in the book of instructions.

While simple problems involving powers, roots and logarithms are almost instantly solved by means of the Log Log scales, it also true that equations like the following:

$$y = \frac{a}{2}\left(e^{\frac{x}{a}} + e^{-\frac{x}{a}}\right) \qquad C = \frac{l}{2\,\mathrm{Log}_e \frac{l}{r}} \qquad R = \frac{It}{C\,(\mathrm{Log}_e E_1 - \mathrm{Log}_e E_2)}$$

and similar ones found in Electrical Engineering and other calculations, are solved much more easily and rapidly by means of the same scales than by any other mathematical process.

LOG LOG VECTOR
TRADE MARK

SLIDE RULES.

DUPLEX TYPE

K & E ADJUSTABLE

4093-3. **Log Log Vector Slide Rule,** K & E Adjustable, 10 in., Duplex Type, engine divided, divisions on white facings, "Frameless" Glass Indicator; in Case, with Directions. each $14.00

4093-3S. Same as No. 4093-3 but in sewed Leather Case . . . . . " 14.85

4093-5. Same as No. 4093-3 but 20 in. . . . . " 32.00

4093-5S. Same as No. 4093-5 but in sewed Leather Case . . . . . " 33 50

The **Log Log Vector Slide Rule** is of particular value to electrical engineers and students of electrical engineering.

Vector computations, graphically represented by right triangles, involve frequent changes from polar to rectangular co-ordinates, and vice versa. By ordinary methods, using logarithmic and trigonometric tables, the solution of right triangles is tedious and time consuming; but becomes easy and rapid when the Log Log Vector Slide Rule is employed.

The **Log Log Vector Slide Rule,** in addition to the usual scales of the K & E Log Log rule, has scales of circular and hyperbolic functions, so arranged that the right triangle can be solved at one setting of the slide. The rule is thus well adapted to all calculations ordinarily encountered by the engineer.

On one face are the following scales:

L, a scale of equal parts (for finding common logarithms of numbers).

LLO, a Log Log scale of decimal quantities.

DF, a full length D scale folded. The graduations begin and end approximately at the center of the rule, the scales being so placed as to bring the divison π in line with both indexes of the lower D scale. This arrangement admits of the handling of factors which, in rules without these scales, would frequently require the slide to be reset. Incidentally, it enables the user to find the diameters and circumferences of circles without setting the slide; and π to be taken as a factor or divisor in any formula without an additional setting.

CF, a full length C scale, folded like the DF scale.

B, Two complete logarithmic scales, giving directly squares and square roots.

CI, a full length C scale inverted.

C, a single logarithmic scale.

D, a single logarithmic scale.

LL2, LL3, a continuous Log Log Scale in two parts.

On the other face of the rule (see illustration at right) are the following scales:

Sh1, Sh2, a continuous scale of Hyperbolic Sines in two parts.

Th, a scale of Hyperbolic Tangents.

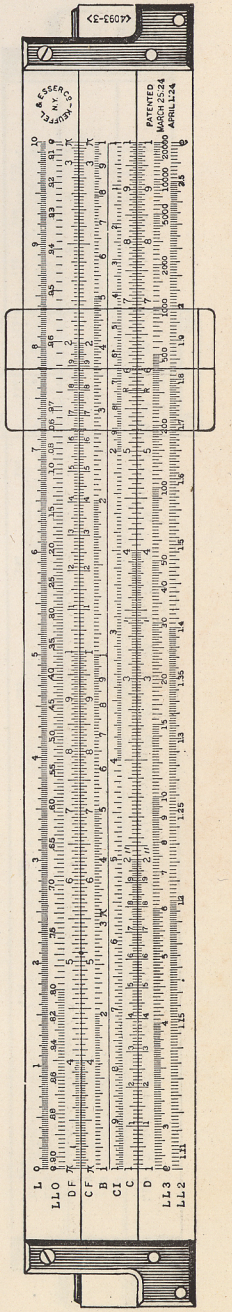
SI1, SI2, a continuous scale of Sines inverted, decimally divided, double numbered, in two parts.

TI, a scale of Tangents, inverted, decimally divided, double numbered.

D, a single logarithmic scale.

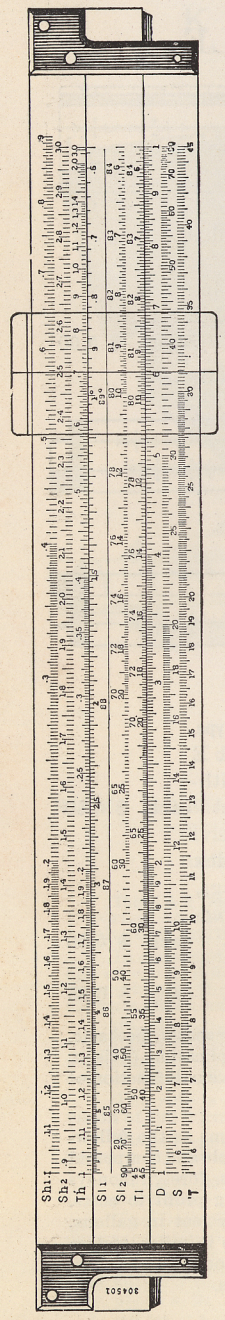
S, a scale of Sines, decimally divided.

T, a scale of Tangents, decimally divided.



No. 4093-3. Front

KEUFFEL & ESSER CO., NEW YORK



No. 4093-3. Back

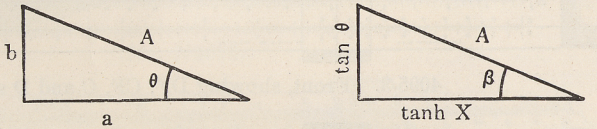
LOG LOG VECTOR
TRADE MARK

SLIDE RULE

Designed by
Professor M. P. Weinbach
University of Missouri
and
Professor A. F. Puchstein
Ohio State University

The **value of the Log Log Vector Slide Rule** will best be appreciated by those who have had to solve their vector problems by other more laborious and tedious means. The saving in time and labor through the use of the Log Log Vector Slide Rule is exemplified in the general rules for the use of the rule and the few examples given below.

Vectors and their components are conveniently expressed algebraically in complex notation thus, $a+jb=Ae^{j\theta}=A\angle\theta$. In this expression $a+jb$ represents the rectangular components of the vector $A\angle\theta$, and $Ae^{j\theta}$ is an exponential expression of the vector in polar co-ordinates.



GENERAL RULES AND EXAMPLES.

Given a+jb: find A∠θ.

Rule: To the smallest side b (or a) on scale D, set an index of the slide. Over the other side a (or b) on scale D read angle Θ on scale TI. Move indicator to angle Θ on scale SI, and read A on scale D.

If side a is the smaller, then angle Θ is greater than 45°, and must be so read by means of the co-numbers in black on scales SI and TI.

Example: a+jb=1.2+j.5. Find A∠θ.

Set right index of slide to .5 on scale D. Over 1.2 on D read Θ=22.6° on TI. Move indicator to 22.6 on SI2, and read A=1.3 on scale D.

Given A∠θ. Find a+jb.

Rule: To A on scale D set angle Θ on scale SI. At index 1 of the slide read the smaller side b (or a) on scale D. At angle Θ on scale TI read the other side a (or b) on scale D.

Example: A∠θ=2.5 /16.27°. Find a+jb.

To 2.5 on D set 16.27° on SI2. At index read the small side b=.7 on D. At 16.27° on TI read a=2.4 on D.

Given Tanh X +j tan θ. Find Vector angle β and side A.

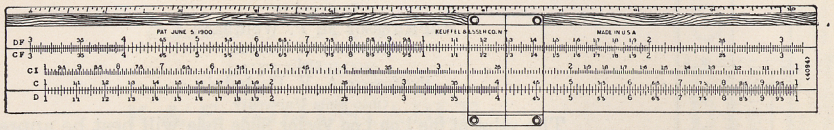
Rule: Any side of the triangle may be expressed in terms of hyperbolic or any other function, which is referred to scale D, and the triangle may be solved in the same way, at a single setting of the slide.

Example: Tanh .24 +j tan 28.2°

Inspection of the numerical values of the given functions, show that tan 28.2° > tanh .24, hence angle β > 45°

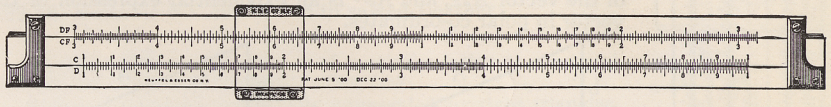
Set left index of the slide to .24 on scale Th. Move indicator to 28.2° on scale T and read β=66.3° on scale TI red. Move indicator to 66.3° on scale SI red, and read A=.586 on scale D.

MERCHANTS' SLIDE RULE.

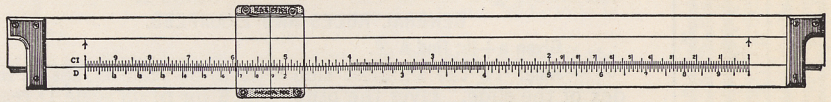


4094. Front showing all scales DF, (F, CI, C and D)

4094. **Merchants'** (**Mannheim**) Slide Rule, **K & E Adjustable,** 10 in., engine divided, divisions on white facings, K & E "Frameless" Indicator; in Case with Directions . . . each $ 5.00



4095-3. Front, showing DF, CF, C and D scales.



4095-3. Back, showing CI and D scales.

4095-1S. **Merchants'** Slide Rule, **K & E Adjustable,** 5 in., **Duplex Type,** engine divided, divisions on white facings, K & E "Frameless" Indicator: in sewed Leather Case, without flap, with Directions, ... each $ 5.50

4095-3. **Merchants'** Slide Rule, **K & E Adjustable,** 10 in., Duplex Type, engine divided, divisions on white facings, K & E "Frameless" Indicator; in Case, with Directions, ... each $ 5.50

4095-3S. Same as No. 4095-3, but in sewed Leather Case . . . . . each $ 6 35

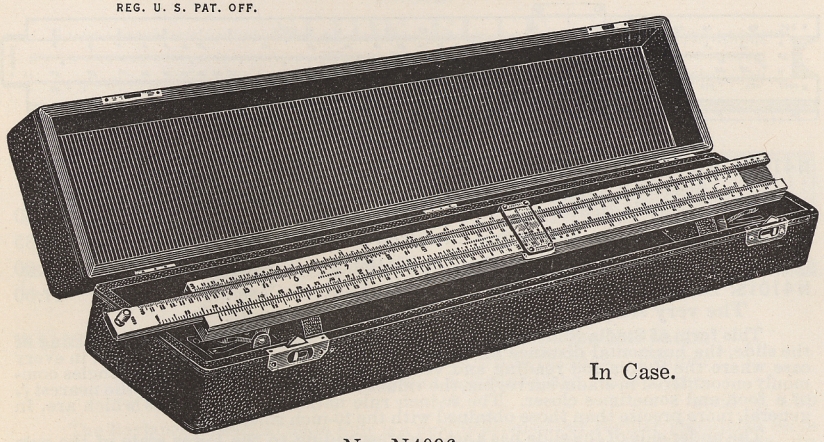
Especially designed for the **merchant, importer, exporter, accountant, manager, mechanic, foreman, etc.** By means of it, all manner of problems involving multiplication, division and proportion can be correctly solved without mental strain and in a small fraction of the time required to work them out by the usual "figuring".

For instance, rapid calculation is made possible of such problems as the following, which are of every day occurrence in office and shop: Discounts, simple and compound interest, pro-rating, converting feet into meters, pounds into kilograms, foreign moneys into U S. money, taking of a series of discounts from list prices, adding profit to costs, while dozens of equivalents are instantly shown, such as: cubic inches or feet in gallons, and vice versa; centimeters in inches, inches in yards, or feet; kilometers in miles, square centimeters in square inches, litres in cubic feet, kilograms in pounds; pounds in gallons; feet per second in miles, per hour; circumference and diameter of circles.

KEUFFEL & ESSER CO., NEW YORK

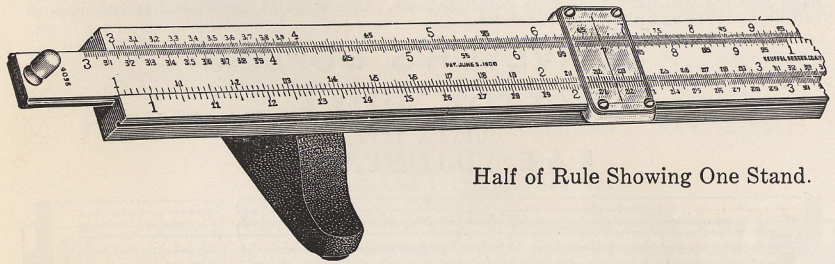
K & E DESK SLIDE RULE

REG. U. S. PAT. OFF.



In Case.

No. N4096.



Half of Rule Showing One Stand.

N4096. **Desk Slide Rule, K & E Adjustable,** 20 in., **Mannheim Type,** engine divided, divisions on white facings, "Frameless" Glass Indicator; on metal stands; in leatheret covered case with directions . . each $18.00

The K & E Desk Slide Rule has been especially designed for the Merchant, Importer, Exporter, Accountant, Manager, Mechanic, Foreman, and others, whose computations involve only multiplication, division, proportion and percentage.

In construction, the rule is of the Mannheim Type, but has only two types of scales; one of which differs from the other only in that the graduations begin and end close to the middle of the rule. **This arrangement admits of the handling of factors which, in rules without these scales, would frequently require the slide to be reset.**

The Slide Rule (about 20½ inches long overall) is firmly fastened to two metal stands, which are sufficiently heavy to prevent the rule from shifting about when the slide is manipulated. These stands keep the face of the rule elevated about 1⅝ inches above the desk or table. The bottom of each stand is provided with three solid rubber buffers.

The rule is so inclined upon the stands that its face is perpendicular to the line of vision of the normal observer.

The slide, near the left end, is provided with a nickel silver knob, which makes proper setting with one hand a very convenient operation.

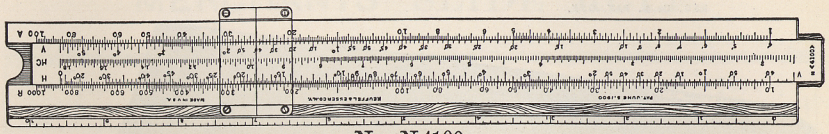
The graduations are very distinct and the numbers large, thus reducing eye- strain to a minimum.

The Desk Slide Rule is furnished in a strong, handsome case. Two strong spring clips are fastened to the bottom of the case inside. Each clip engages a lug on the metal stands, and holds the rule immovably in the case. A pressure of the thumb releases each clip, freeing the rule for immediate removal from the case. The entire design is such that, the rule may be operated as readily in the case as out of it. Total weight, rule and case, about 3¼ lb.

In our latest type we have added the CI (inverted C) scale, not shown in the illustration.

KEUFFEL & ESSER CO., NEW YORK

STADIA SLIDE RULES.



No. N4100.

N4100. **K & E Stadia Slide Rule, K & E Adjustable,** engine divided, 10 in. **Mannheim Type,** divisions on white facings, "Frameless" Glass indicator; in Case, ... each $ 6.50

N4100S. Same as No. N4100 but in sewed Leather Case . . . . " 7.35

N4101. **K & E Stadia Slide Rule,** like No. N4100, but 20 in.; in Case, " 16.00

N4101S. Same as No. N4101 but in sewed Leather Case . . . . " 17.50

The very simple Directions are printed on the rule.

This form of Stadia Slide Rule is remarkable for its simplicity. By **one** setting of the slide, the horizontal distance and vertical height can be obtained at once, in every case where the Stadia rod reading and vertical angle are known. For the angles commonly encountered in stadia surveying, the values thus found are correct to the nearest 1/10 of a foot, and sometimes closer. The 20-inch rule naturally gives values which are, in general, more precise than those obtained with the 10-inch rule.

The under side of the slide has a scale corresponding to the lower scale of the rule and resembling the **A and B scales of the Mannheim and Duplex rules,** so that the rule can be used also for ordinary slide rule computations. One edge is graduated to inches and tenths, to serve as a scale for distances.

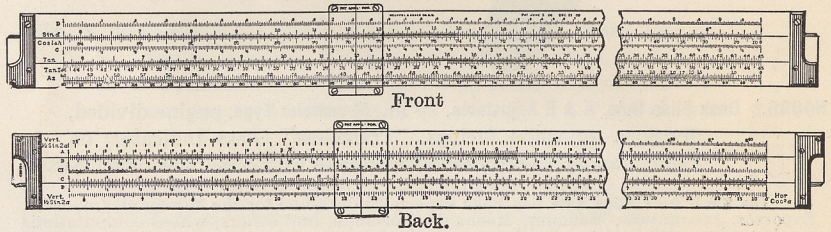
SURVEYOR'S DUPLEX

REG. U. S. PAT. OFF.

SLIDE RULE.

DUPLEX TYPE.

K & E ADJUSTABLE.



Front

Back.

No. N 4102.

N4102. **Surveyors' Duplex** Slide Rule, K & E Adjustable, 20 in., Duplex type, engine divided, divisions on white facings, "Frameless" Glass Indicator; in Case, with Directions . . . . . each $24.00

N4102S. Same as No. N 4102 but in sewed Leather Case . . . . " 25.50

The fact that all astronomical data essential to surveying, such as azimuth, time, latitude, etc., can be ascertained by means of the usual type of Transit with vertical circle but without solar attachment, while generally known, is rather seldom utilized in this country. The main reason for this surprising condition is the difficulty of computing, in the field, by spherical trigonometry, the results of observations.

The new K & E Surveyors' Slide Rule entirely eliminates this difficulty by reducing the hitherto complicated calculations to mere mechanical operations, thereby rendering the method of field astronomy with the regular Engineer's Transit extremely simple and practical.

One face is arranged for the determination of the meridian by direct solar observations; it also carries the sine and cosine scales used in computing the latitudes and departures of the course.

The other face has the usual scales A, B, CI, C and D, for all general numerical calculating, as well as two full length stadia scales for computing horizontal distances and vertical heights.

FOR LEATHER CASES FOR SLIDE RULES, see pages 19 and 20.
FOR MAGNIFIERS, see pages 18 and 20.

KEUFFEL & ESSER CO., NEW YORK

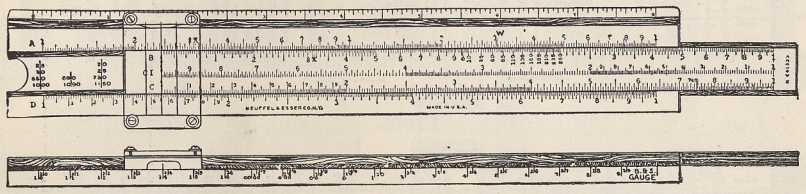
THE ROYLANCE ELECTRICAL

(IMPROVED).

SLIDE RULE.

MANNHEIM TYPE.

K & E ADJUSTABLE.



No. N 4133 S.

N4133S. **Roylance Electrical Slide Rule,** K & E Adjustable, 8 in., Mannheim Type, engine divided, divisions on white facings, "Frameless" Glass Indicator; in sewed Leather Case, with Directions . . . . . each $ 8.50

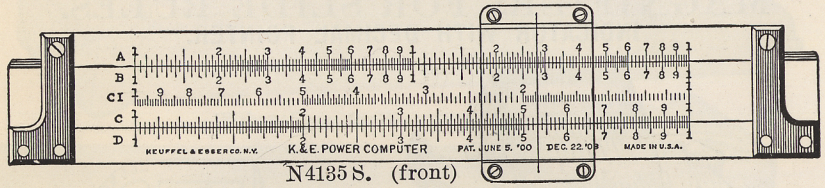
The Roylance Electrical Slide Rule is a modification of our regular Mannheim Slide Rule No. N 4035 S and **can be used for all the calculations made with the ordinary Slide Rule.** In addition to the usual Mannheim scales it carries a series of scales or gauge marks by means of which the different properties of copper wire, such as size, conductivity, weight, etc., may be determined without the use of tables.

Other features embodied in the rule are the extra hair lines on the Indicator for the calculation of circular areas, the special gauge mark (746) for the conversion of Horse-power and Kilowatts, a special set of figures giving the temperature of wire in degrees Centigrade corresponding to resistance in ohms per 1000 feet, and the inverted C (CI) scale.

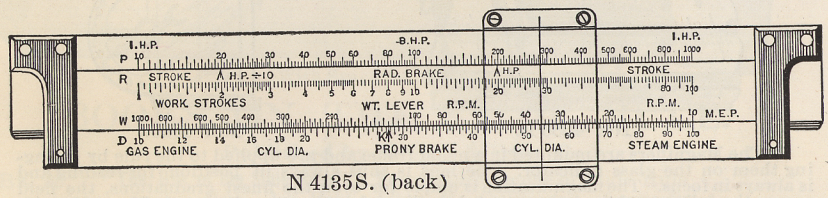
POWER COMPUTING SLIDE RULE.

DUPLEX TYPE.

K & E ADJUSTABLE.



N4135 S. (front)



N 4135 S. (back)

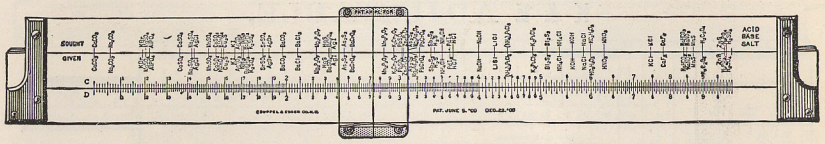
N 4135S. **K & E Power Computing** Slide Rule, "Duplex" Type, K & E Patent Adjustable, 5 inch, engine divided, divisions on white facings, "Frameless" Glass Indicator; in sewed Leather Case without flap, with Directions . . . . . each $10.00

This Slide Rule is specially designed for use in computing Power and Dimensions of Steam, Gas and Oil Engines; it gives all data for finding speed, length of stroke, dimensions of cylinder, etc.

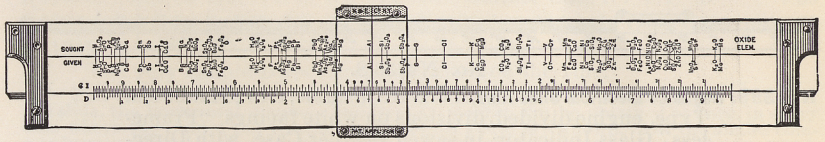
The front face of the rule carries the usual A, B, C, D and C. I. scales the same as on the front face of the K & E Polyphase Slide Rule.

The reverse face carries a series of special graduations for use in computing power and dimensions of Steam, Gas and Oil Engines; it gives all data for finding speed, length of stroke, dimensions of cylinder, B. H. P., I. H. P. etc.

CHEMIST'S DUPLEX
REG. U. S. PAT. OFF.
SLIDE RULE.
DUPLEX TYPE.
K & E ADJUSTABLE.



Front.



Back.

No. 4160.

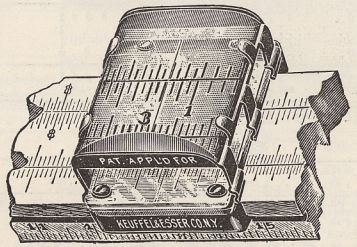
4160. **Chemist's Duplex Slide Rule,** K & E Adjustable, 10 in., engine divided, divisions on white facings, "Frameless" glass Indicator; in Case, with Directions $12.00

4160S. Same as No. 4160 but in sewed Leather Case 12.85

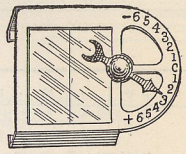
The Chemist's Duplex Slide Rule designed by Dr. R. Harman Ashley, makes possible the rapid solution of problems in Stoichiometry, such as **Gravimetric Analysis, Volumetric Analysis, Equivalents, Percentage Composition, Conversion Factors, Volume of Gas** from a given weight of substance at different temperatures and pressures, and many other analogous problems.

Aside from the solution of the chemical problems above referred to, any arithmetical problems solvable by logarithms are readily and accurately done with a minimum number of settings.

MAGNIFIERS FOR SLIDE RULES.
INDICATOR WITH DECIMAL POINTER.



No. 4085 B.



No. 4086.

The Magnifiers are mounted in a metal frame and are applied to the rule by springing them on the glass indicator. The lens is thus always in position for reading and is always in focus. The magnification is ample for even the finest graduations, the field covers the full area of the indicator, and the lines do not appear distorted. These Magnifiers cannot be used on glass indicators with two hairlines.

When ordering please indicate kind of slide rule for which the magnifier is wanted. See Table, Page 20.

4085 A. **Magnifiers** for Slide Rules, ... each $ 2.25

4085 B. **Magnifiers** for Slide Rules, ... " 2.50

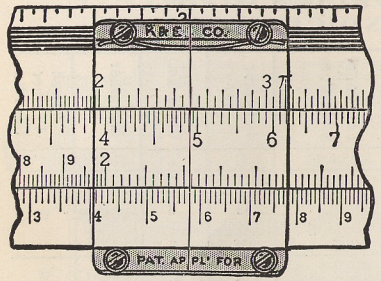
4085 C. **Magnifiers** for Slide Rules, ... " 2.75

4086. Glass Indicator, with **Decimal Pointer** . . . . . " 1.00

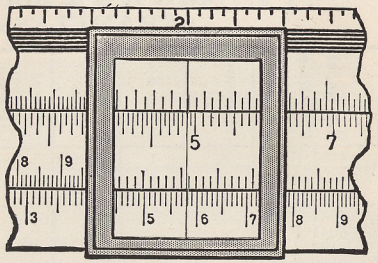
do. do. in place of plain Glass Indicator, add . . . . . " .50

No. 4086 is furnished for the Mannheim style of Slide Rules **only.** The Magnifiers No 4085 do not fit these Indicators.

THE K & E "FRAMELESS" INDICATOR.
PATENTED
FOR K & E SLIDE RULES.



Frameless Indicator
(*Never hides any figures*)

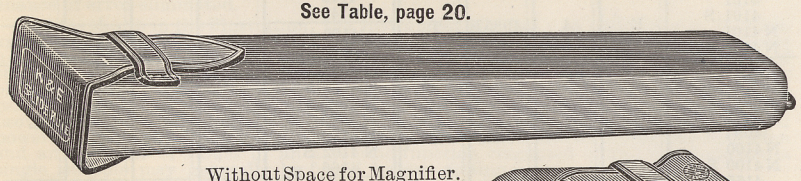


Indicator with Frame
(*Showing how it hides important figures*)

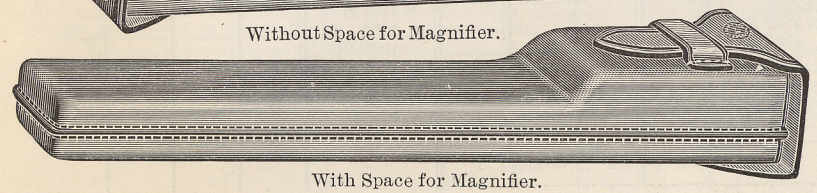
K & E **adjustable** Slide Rules of the Mannheim and Duplex type are now equipped with our patent "Frameless" Indicator. Every figure on the rule is clearly visible at all times, there being no side pieces to the holder of the glass indicator, and, therefore, nothing to hide any of the figures on the rule. Many times, after setting the old type Indicator or Runner, the user would find that he could not read the result because important figures were hidden by the indicator frame. The K & E "Frameless" Indicator entirely obviates this difficulty, and vastly increases the ease and rapidity of using the Slide Rule.

For Indicators and Glasses, see Table, page 20.

SEWED LEATHER CASES FOR SLIDE RULES.
See Table, page 20.



Without Space for Magnifier.



With Space for Magnifier.

BOOKS ON THE SLIDE RULE.
Published by Keuffel & Esser Co.

BK 25. **"The Use of the Slide Rule",** a Practical Manual of Slide Rule Instruction, by Prof. Allan R. Cullimore, formerly Dean of Toledo University; 8 vo. 36 pages. Bound in cloth . . . . . each $1.00

The following are Self-Teaching Manuals, with Tables of Settings, Equivalents and Gauge Points; by Wm. E. Breckenridge, A. M., Columbia University,

4087 G. **"The Mannheim Slide Rule",** . . . . . each $ .50

4087 H. **"The Polyphase Slide Rule",** . . . . . each $ .50

4087 I. **"The Polyphase-Duplex Slide Rule",** . . . . . each $ .50

4087 J. **"The Log Log Slide Rule"** . . . . . each $ .50

GLASSES, INDICATORS, MAGNIFIERS AND CASES

FOR K & E SLIDE RULES WITH "FRAMELESS" INDICATORS.

Cat. No. of Slide Rule	Indicator No.	Glass No.	Magnifier No.	*Sewed Leather Case No.
4031 S	A	1	4085 A	O
4035 S	B	2	None	P
4133 S	C	2a		
4041	D	3	4085 B	R
4041 F				
4100				
4100 S				
N 4133 S	Ea	4a	4085 B	P
N 4035 S	E	4		
4045	E	4	4085 B	S
4045 S				
4051	E	4	4085 B	T
4051 S				
N 4053-2S	E	4	4085 B	P
N 4053-3	E	4	4085 B	R
N 4053-3S				
N 4053-3F				
N 4053-3FS				
N 4053-5	E	4	4085 B	T
N 4053-5S				
4055	E	4	4085 B	None
4096				None
4101	E	4	4085 B	T
4101 S				
N 4101				
N 4101 S				
N 4041	E	4	4085 B	R
N 4041 S				
N 4041 F				
N 4041 FS				
4094				
N 4100				
N 4100 S				
4165 S				
4053-2S	F	4	4085 B	P
4053-3	F	4	4085 B	R
4053-3S				
4053-3F				
4053-3FS				
4053-5	F	4	4085 B	T
4053-5S				
4088-2S	G	6	4085 B	V
4088-3	G	6	4085 B	W
4088-3S				
4095-3				
4095-3S				
4095	H	5		
4088-5	I	7	4085 C	Z
4088-5S				
4092	I	7	4085 C	X
N 4092-3				
N 4092-3S				
4093-3				
4093-3S				
4092-5	I	7	4085 C	Z
4092-5S				
4093-5				
4093-5S				
4095-5	I	7	4085 C	Z
4095-5S				
4102	I	7	4085 C	Z
4102 S				
4128				
4128 S				
4142				
4142 S				
4160	I	7	4085 C	X
4160 S				
N 4088-5	Ia	7	4085 C	Z
N 4088-5 S				
N 4092-5				
N 4092-5 S				
N 4102				
N 4102 S				
4166				
4088-1S	K	8	None	U
4095-1S				
N 4135 S				
N 4058 C	M	None	None	None
40?8W				
N 4096	J	7	4085 C	None

Indicators

A, B, D	each	$ .60
C, Ea	"	.80
E	"	.65
F	"	.75
G, H, K	"	1.20
I, Ia	"	1.35
J	"	.90
M	"	.25

Glasses

Glass only

1, 2, 3, 4	each	$.25
2a, 4a	"	.40
7	"	.35
5, 6, 8	"	.25

Sewed Leather Cases

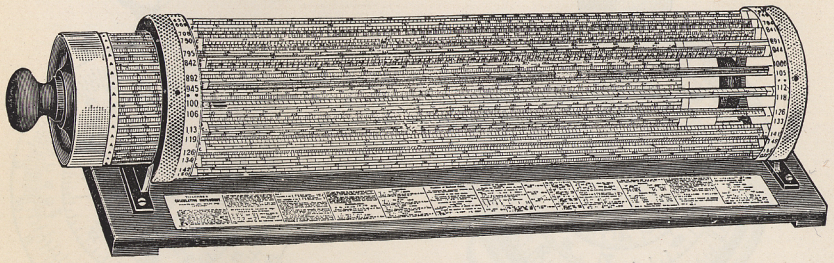
Plain			Space For Magnifier		
O	each	$1.15	OM	each	$2.50
U	"	.65	PM, VM	"	2.75
P, V	"	1.35	RM, WM, XM	"	3.00
R, W, X	"	1.50	SM	"	4.00
S	"	2.50	TM, ZM	"	4.25
T, Z	"	2.75			

***NOTE. Whenever an empty sewed leather case with space for magnifier is desired, add the letter "M" to the letter in the column headed Sewed Leather Case No., as "OM", "PM", "TM" etc.**

Where indicators are sent in to have a glass fitted, an additional charge will be made for each glass: Nos. 1, 2, 2a, 3, 4, 4a.....extra $ .10 Nos. 5, 6, 7 8.....extra $ .20

"Frameless" Glass Indicator, with two hairlines spaced to a stated ratio, extra.....Each $ 50

THACHER'S CALCULATING INSTRUMENT.



No. N 4012.

N 4012. Thacher's Calculating Instrument, cylinder 18 in.; in polished mahogany Box, with full Directions . . . . . each $70.00

N 4013. do. do. do. **with 3-in. reading glass** sliding on brass bar, adjustable to any part of the instrument and for focus . . . . . " 80.00

Extra copy of directions . . . . . " 1.00

Thacher's Calculating Instrument is a device for performing a great variety of useful arithmetical calculations with rapidity and accuracy. Its operation is simple and is readily learned. By its use the tedious drudgery of calculation is avoided and the chance of error eliminated.

As is shown in the illustration, the instrument consists of a cylinder 4 in. in diam. and 18 in. long, which revolves in an open framework composed of 20 angular bars held between two metal rings. The cylinder bears a scale corresponding to the scale of the Slide Rule, which is duplicated on the exposed sides of the bars. Results can be obtained to the fourth, and often to the fifth place of figures, and are correct to about one part in 10,000 (.01 of 1 per cent), which is sufficient for nearly every requirement of the professional or business man. Examples in multiplication, division, proportion and powers or roots involving not more than three quantities, are solved by one operation and any number of values of one algebraic function composed of two constants and a single variable may generally be found by one setting.

The useful applications of the instrument are almost unlimited; among them may be mentioned: finding the stresses and sections in trusses and girders, mensuration, estimates of work and material, solving trigonometrical formulæ, making and applying tables, problems in mechanical powers, machinery and hydraulics, problems in simple and compound interest, discount, prorating, the conversion of weights and measures, cost of merchandise with per cent. of duty or profit added.

For example, any of the formulæ

$$\frac{ax}{b}, \quad \frac{ax^2}{b}, \quad \frac{ax}{b^2}, \quad \frac{ax^2}{b^2}, \quad \sqrt{\frac{ax}{b}}, \quad \sqrt{\frac{a^2x}{b}}$$

in which a and b may have any values and x any number of values, are readily solved by one setting. Squares, square roots, cube roots and reciprocals are also readily worked.

The following are a few problems which may be readily solved by the use of Thacher's Calculating Instrument:

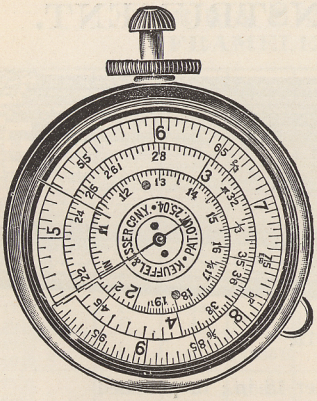
A 15-in. "I" beam, resting upon supports 14.5 ft. apart sustains a load of 17500 lbs. at the center. What weight of beam is required if S = 10000 lbs. per sq. in.? (This problem is solved in three settings of the instrument.)

$541.36 are to be divided prorata among various accounts amounting to $7436 00 Required, the amount going to account of $427.50, $763.80, etc. (The several amounts are each found in one setting.)

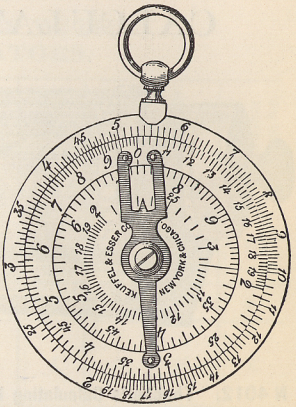
A train weighing 2500 lbs. per lineal foot passes over a bridge on a 4° curve at a speed of 30 miles an hour; required, its effect upon the lateral system. (This problem is solved in one setting.)

What will be the amount of $250.00 placed at compound interest for 10 years at 6%? (This problem is solved in one setting.)

POCKET CALCULATORS.



No. 4017.



4020.

4017. Sperry's Pocket Calculator, watch pattern, 2⅛ in. diam., two glass covered, engraved, metal dials, with Directions. each $27.50

Sperry's Pocket Calculator, represents a new departure in pocket calculators, as by its construction the length of the logarithmic scale is increased from about 6½ in (in other calculators) to an actual length of about 12½ inches, which allows of reading results some what closer than on the C-D scales of a 10-in. straight slide rule. The instrument has the form of a watch, with an engraved, glass covered metal dial on each side. Each dial has an index hand and a stationary pointer, which together take the place of the indicator (runner) of a straight slide rule. There is a small ring on the case for attaching the instrument to the watch chain. The two dials are revolved together by a milled thumbnut which is concentric with the knob which revolves the two indexes (hands) together.

The S dial bears a scale of equal parts, a circular logarithmic scale, and a scale of square roots. It corresponds to the two outer scales and the scale of equal parts of the straight slide rule. The L dial bears a logarithmic scale arranged in three spiral rings beginning and ending on the same radial line.

Sperry's Pocket Calculator, being made of metal, is but slightly affected by atmospheric changes. The scales are circular and are, therefore, practically endless, so that they can be used "around and around," each "re-set" multiplying or dividing the value of the reading without loss of time or interruption. The result never lies beyond the end of the scales as it sometimes does in the straight slide rules of the Mannheim type.

4020. Charpentier Calculator . . . . . each $ 5.00

The **Charpentier Calculator** is a circular slide rule 2⅜ in. diameter, with a circular slide which is revolved and set by the handle. This instrument being made of metal is but slightly affected by atmospheric variations. On the face of the calculator (shown in cut) there is a logarithmic scale (equivalent to a straight scale about 6 in. long) on the slide corresponding to another scale, external to it on the body of the rule. On the surface within the slide are the square roots in two circles, one from 0 to 3.162, the other from 3.162 to 10. These are made to coincide with the outermost scale by means of an index. On the other side of the rule there are three scales; an outer one of equal parts and two inner ones of angles from 0 to 90 and from 0 to 45 respectively; the latter two give the sines of the first and the tangents of the second on the scale of equal parts, by means of an index. The indexes on the two faces correspond, so that the logarithms of the numbers on the logarithmic scale can be read on the scale of equal parts.



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