

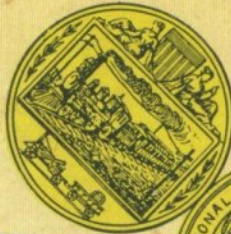
NEW YORK  
1869



BUFFALO 1901  
GOLD MEDAL  
PACIFIC AMERICAN EXHIBITION



CHICAGO  
1883



GRAND PRIZE

GOLD MEDAL



ST. LOUIS  
1904

CATALOGUE OF

# KEUFFEL & ESSER CO.

MANUFACTURERS AND IMPORTERS

## DRAWING MATERIALS

## SURVEYING INSTRUMENTS

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SAN FRANCISCO  
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PHILADELPHIA  
1876



36 EDITION



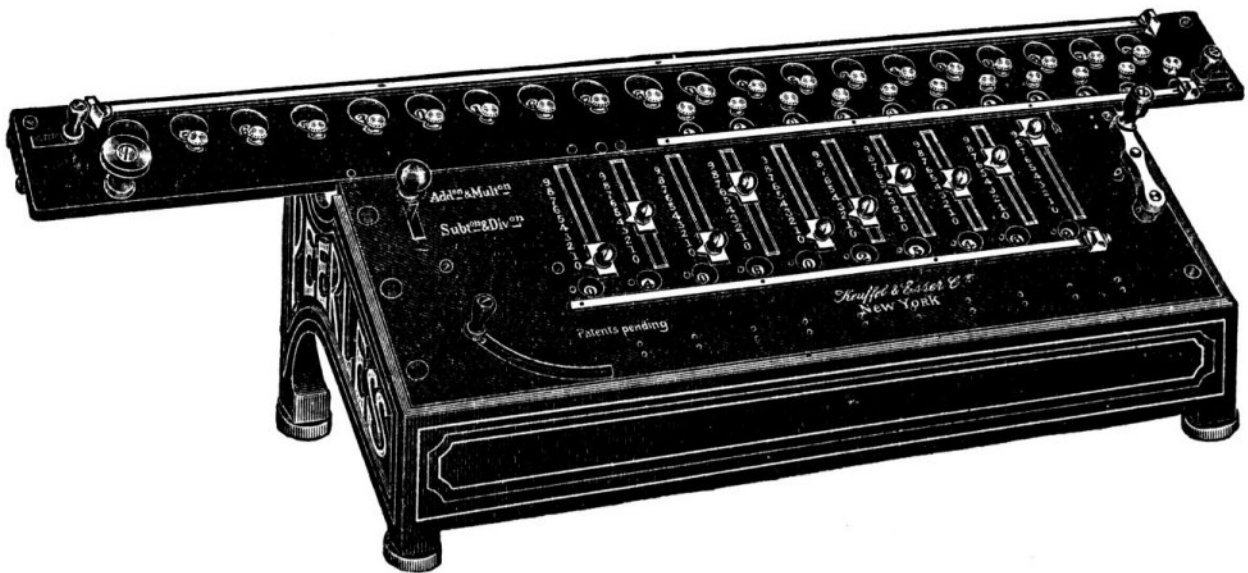
CHICAGO  
1893





# THE IMPROVED RECKONING MACHINE.

A PERFECT MECHANICAL CALCULATOR.



No. 4007.

- 4005. Reckoning Machine, 6 figures for Multiplicand or Divisor,  
7 figures for Multiplier or Quotient, 12 figures for  
Product or Dividend; with Directions . . . . . each \$
  
- 4006. do. do. 8 figures for Multiplicand or Divisor,  
9 figures for Multiplier or Quotient, 16 figures for  
Product or Dividend; with Directions . . . . . each \$
  
- 4007. do. do. 10 figures for Multiplicand or Divisor,  
11 figures for Multiplier or Quotient, 20 figures for  
Product or Dividend; with Directions . . . . . each \$

The K & E Improved Reckoning Machines which we now offer, represent the most advanced progress in the art of making mechanical calculators. They embody the latest improvements, which fact considerably increases their value as savers of time and mental drudgery, and is a guarantee of accuracy. They are perfect instruments, both mechanically and in their functions.

**Send us your machines for repairs. Estimates cheerfully submitted.**



### Any arithmetical problem

from multiplication, division, simple addition and subtraction to the most intricate calculations, can be solved with this instrument, without mental effort, and with unfailing accuracy and surprising rapidity.

The tiresome mental labor of calculating in the ordinary way, is reduced by the Reckoning Machine to a simple jotting down of the results obtained.

Squaring, Cubing, Extracting square roots, Percentage, Conversion of moneys, weights and measures, Prorating, any kind of Commercial, Statistical, or Scientific calculation can be done by the Reckoning Machine with the greatest precision and extreme rapidity.

The Machine is built in the most substantial manner so that it will retain its efficiency and accuracy for a very long time. It is supported at a convenient working angle on a metal frame, which is open at the sides and back, and is provided with rubber bumpers to reduce the noise of the mechanism. The wooden cover and the wooden base are not shown in the cut.

There are a good many of these Machines in use in public and private offices and scientific laboratories, and they are giving the greatest satisfaction.

The valuable patented improvements which we have recently added to our Reckoning Machines are :

The **new cancelling device**, which at one shift of the handle sets all the keys in the grooves of the key plate back to zero, thus saving the time lost in moving each key to the zero position separately.

A **line of windows below the grooves** of the key plate, in which the settings of the several keys are indicated by figures, so that on our Machines, the two factors of a calculation and their product each appear in one straight line of figures. This feature is a safeguard against error in reading the settings of the keys, which otherwise often present a very irregular line.

**Decimal pointers**, arranged to slide on bars so that they may be set quickly and permanently wherever a decimal point is to be indicated. This device will be found much handier and safer than the old method of using pegs, which are inconvenient to handle, liable to drop out, and easily lost.

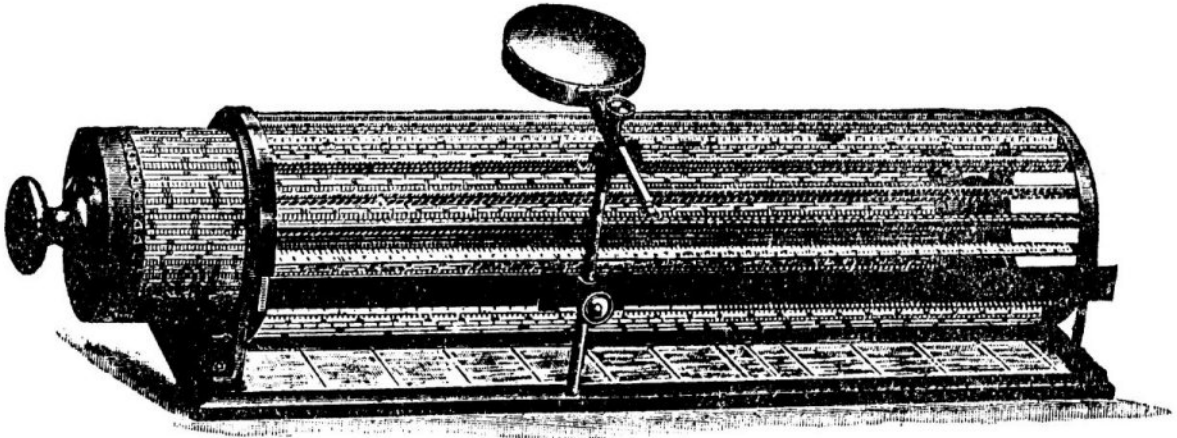
**Additional safety devices** in connection with the tens-carrying mechanism, eliminate the possibility of "sticking", or error in the rapid operation of the machine.

A book containing a full description, all the necessary rules for operating, and numerous examples, both general and special, accompanies each one of our Reckoning Machines.

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## THACHER'S CALCULATING INSTRUMENT.



No. 4013.

4012. Thacher's Calculating Instrument, cylinder 18 in.; in polished mahogany Box, with full Directions . . . . . each \$
4013. do. do. do. with 3-in. reading glass sliding on brass bar, adjustable to any part of the instrument and for focus . . . . . “
- Extra copy of directions . . . . . “

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 usually to the fifth place of figures, with a surprising degree of accuracy, 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 an 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

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

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.)

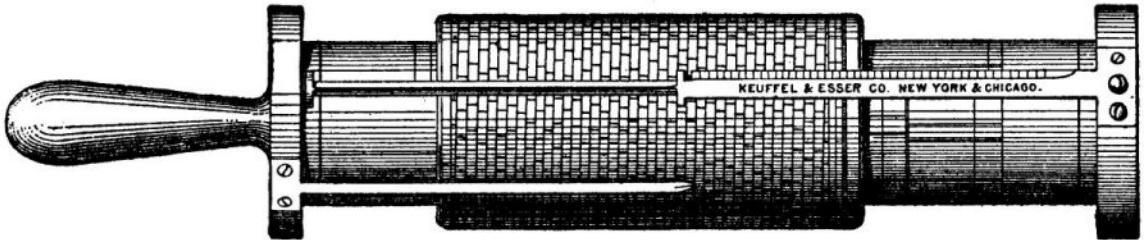
\$541.36 are to be divided prorata among various accounts amounting to \$7436.00. Required, the amount, going to account of \$427.50, \$763.80, etc. (The several amounts are each found in one setting.)

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.)



## FULLER'S SLIDE RULE.



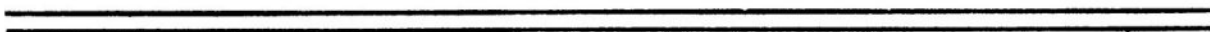
No. 4015.

**4015.** Fuller's Spiral Slide Rule, in mahogany Box, with  
 Directions . . . . . each \$

Fuller's Spiral Slide Rule consists of a hollow cylinder which can be moved up, down, or around an inner cylinder provided with a handle. A single logarithmic scale, nearly 42 feet long, is wound spirally around the outer cylinder. There are two indexes: a fixed one attached to the handle, and a movable one attached to a brass tube sliding in the inner cylinder. This latter bears two indexes (whose distance apart is the axial length of the complete spiral) and a scale of equal parts for the rapid finding of logarithms. On the inner cylinder, there are a number of valuable tables and settings.

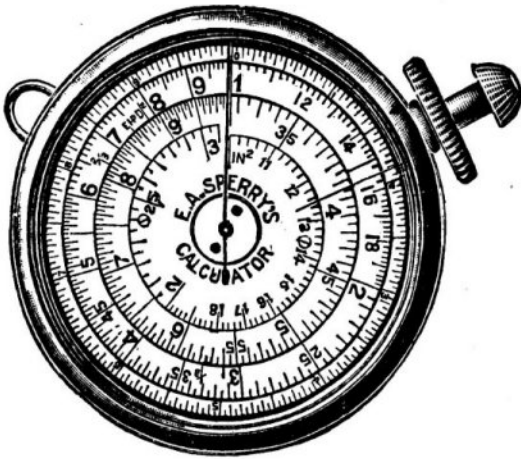
Ratios are established by setting a given number to the fixed index, setting the movable index to another given number, bringing any other number to the fixed index, and reading the fourth term at the movable index. Hence the Fuller Rule requires setting each time the third term of a proportion changes, and it does not give a complete series of equal ratios at sight, like the Thacher, Mannheim and Polyphase Duplex Rules. We furnish a holder which can be screwed on to a table to support the rule.

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## SPERRY'S POCKET CALCULATORS.



S dial



L dial

No. 4017.

**4017.** Sperry's Pocket Calculator, watch pattern, 2½ in. diam.,  
 two glass covered, engraved, metal dials, with  
 Directions. . . . . each \$

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, however, owing to the arrangement of the scales, allows of reading results nearly as close as on the C D scales of a 20-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.

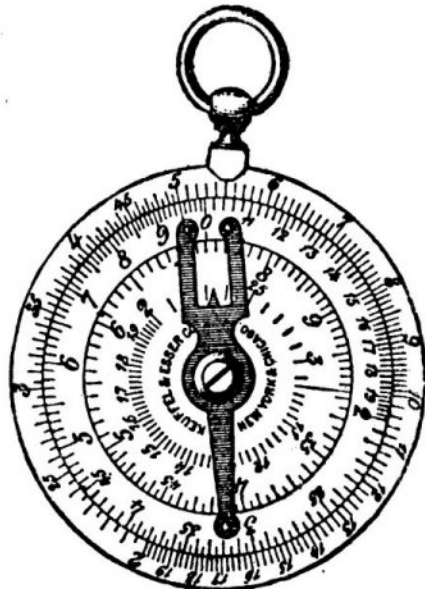
Sperry's Pocket Calculator can neither warp nor shrink as it is entirely of metal. The scales are circular and are, therefore, practically endless, so that they can be used "around and around," each "re-set" multiplying or dividing the value of the reading without loss of time or interruption. The result never lies beyond the end of the scales as it sometimes does in the straight slide rule.



**K & E CIRCULAR CALCULATORS.  
CHARPENTIER CALCULATORS.**



No. 4018.



4020.

**4018.** K & E Calculator, patented, watch pattern, 2½ in. diam., two glass covered, engraved, metal dials, with Directions, each \$

The K & E Calculator is practically a circular Mannheim Rule. It has two dials, one of them revolving, the other stationary.

The revolving dial has a scale of logarithmic numbers corresponding to the C D scales of the straight Mannheim rule, and a scale of squares corresponding to the A B scales of the straight rule. There is a reading line (index) engraved on the glass of the movable dial.

The stationary dial has a scale of tangents, scale of equal parts, and a scale of sines, the latter on a two-turn spiral line.

The pointers (hands) of the two dials move simultaneously. The movable dial and the pointers are revolved respectively, by a concentric thumb nut and knob. There is a small ring on the case for attaching the instrument to the watch chain.

This form of Mannheim rule has an advantage over the straight rule in that the scales are practically endless, so that they can be used "around and around," each "re-set" multiplying or dividing the value of the readings without loss of time or interruption. The result never lies beyond the end of the scale, as it sometimes does in the straight slide rule.

**4020.** Charpentier Calculator . . . . . each \$

The Charpentier Calculator is a circular slide rule 2¾ 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 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.



## K & E SLIDE RULES.

The slide Rule in its present perfected form has become an indispensable not only to the engineer and scientist, but also to the manufacturer, the merchant, accountant, and all others whose occupation or business involves calculations.

We manufacture slide rules and devote to them a separate department of our factory which is thoroughly equipped with the most improved special machinery.

Several of our improvements are protected by patents, and are, therefore, not embodied in other Rules.

### MANNHEIM STYLE OF SLIDE RULES.

This form of slide rule was originated by Lieut. Mannheim. The lower scales (on the rule and on the slide) are single while the two upper scales are double. There is an indicator (runner) for finding coinciding points on the scales, which admits of working out extensive calculations without taking intermediate readings.

On the under face of the slide are scales of sines, tangents and equal parts. The index mark on the under side of the body of the rule permits of reading the scales on the under face of the slide without reversing it. The under surface of the rule has tables giving a number of settings and ratios.

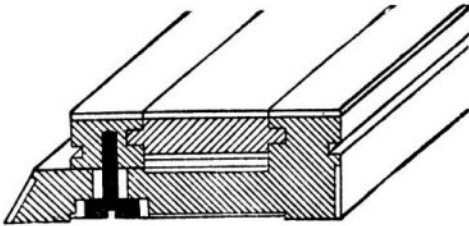
### DUPLEX STYLE OF SLIDE RULES.

In the "DUPLEX" SLIDE RULES the slide is of the same thickness as the rule and has its two faces flush with those of the rule. The rule and slide are fully graduated on both sides.

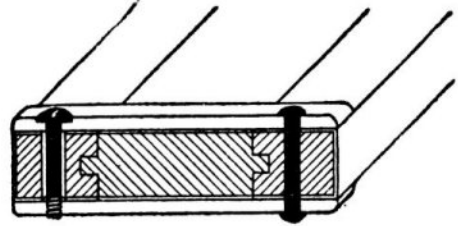
### K & E SLIDE ADJUSTMENT.

It is well known that the materials of which most slide rules are made, (wood, xylonite or celluloid) are affected by atmospheric changes incidental to the different seasons, notwithstanding previous treatment or seasoning. Even in the best rules, except those of metal, the slide is liable to work too tight or too loose from such changes in constituent materials. Various means have been devised to overcome this condition but each of them has some serious drawback. A number of so-called automatic adjustments have been devised but none have proved to be practical in use. In those in which the base or stock is cut length-wise into halves which are held together by springs, there is danger of their shrinking unevenly, and they do not afford a rigid bed for the slide. In those which have springs to hold one edge of the slide against the rule, there is a corresponding gap at the other edge of the slide.

### K & E SLIDE ADJUSTMENT.



Mannheim Rules.



Duplex-type Rules.

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

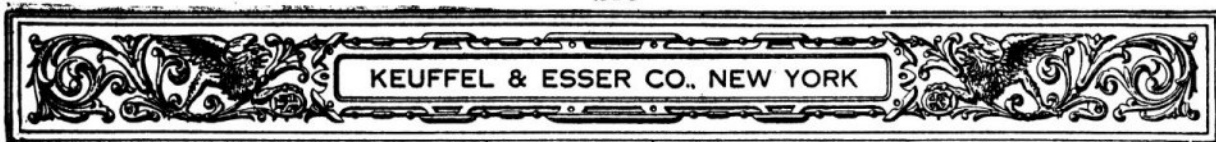
The K & E Slide Adjustment has successfully overcome these various drawbacks and solves the problem perfectly. In the Mannheim Rules, one of the grooved guide pieces in which the slide moves is kept in place by setscrews which hold it rigidly but still permit of quick and exact adjustment when these screws are released, as they pass through oblong slots giving ample play. If adjusting should become necessary, it is effected by loosening the screws and bringing the movable guide piece against the slide, according to the friction desired, when the screws are again tightened.

In the Duplex-Type Slide Rule, the nickel silver bars which join the two side bars of the rule are provided with setscrews moving in slots. On releasing these screws, one side piece of the rule can be shifted towards or away from the slide, to obtain the desired friction; it is clamped into place by tightening the setscrews.

### Numbering of Slide Rules.

Great care has been bestowed on the numbering of our Rules to make them as clear, distinct, and as permanent as possible. We prefer not to number the subdivisions throughout, as is done on some of the printed rules. The sub numbers are not required by the adept; they are confusing and interfere with rapid and accurate reading. Should they be desired for any special purpose, we will put them on without extra charge.





## MANNHEIM SLIDE RULES, K & E ADJUSTABLE.

### 5-INCH RULE.

- 4031.** 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 \$

This rule is subdivided as closely as the 10-in. rule, No. 4041.

### 8-INCH RULE.

- 4035.** K & E Adjustable (Mannheim) Slide Rule, 8-in., engine divided, divisions on white facings, with "Frameless" Glass Indicator; in sewed Leather Case, with Directions . . . . . "

This rule is subdivided as closely as the 10-inch rule, No. 4041.

### 10-INCH RULE.

- 4041.** K & E Adjustable (Mannheim) Slide Rule, 10-in., engine divided, divisions on white facings, with "Frameless" Glass Indicator; in Case, with Directions. . . . . "

- 4041 F.** K & E Adjustable (Mannheim) Slide Rule, like 4041, but subdivided as closely as the 20-in. rule . . . . . "

### 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 . . . . . "

### 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 . . . . . "

Rules 4041 F., 4045 and 4051 are divided more closely than the others. 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 by at least one figure.

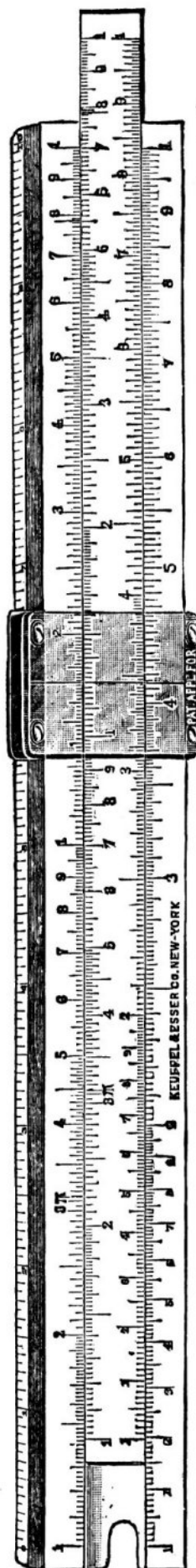
- 4052 D. L.** "Frameless" Glass Indicator, with two Hairlines (instead of one) . extra "

- do. do. but with the two Hairlines spaced to a stated ratio . . . extra "

(For Indicator with Decimal Pointer, see No. 4086, page 247.)

For Magnifiers and Books on the Slide Rule, see page 247.

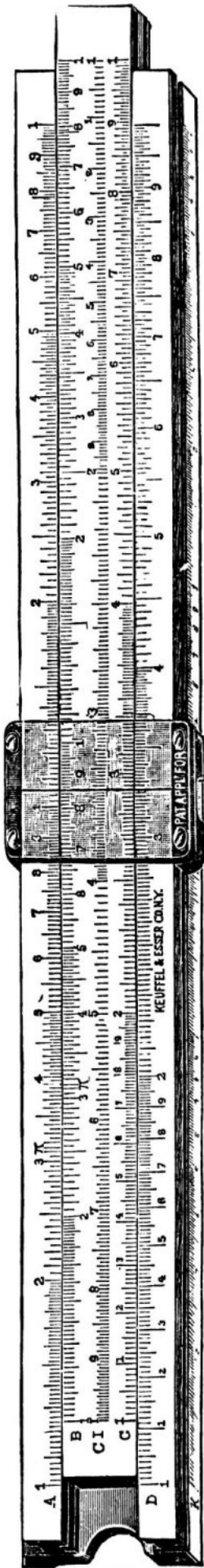
For Leather Cases, see page 238.



No. 4041.



## POLYPHASE SLIDE RULES, MANNHEIM TYPE K & E ADJUSTABLE.



No. 4053-3.

The Polyphase Slide Rule has, in addition to the regular scales of the Mannheim, a scale of cubes on the vertical edge of the rule 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 Rule with the regular Mannheim type.

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

$$\begin{aligned} & \sqrt{a^3} \quad ; \quad \sqrt[3]{a^2} \quad ; \quad \frac{1}{\sqrt[3]{a^2}} \quad ; \\ & a^5 \quad ; \quad a^6 \quad ; \quad a^9 \quad ; \quad \sqrt{a^5} \quad ; \quad \sqrt[3]{a^5} \quad ; \\ & \sqrt[6]{a^5} \quad ; \quad \sqrt[3]{a^4} \quad ; \quad \frac{a}{\sqrt[3]{b^2}} \quad ; \\ & a^2 \times \sqrt[3]{b^2} \quad ; \quad \frac{\sqrt{a^3} \times b^3}{c^3} \end{aligned}$$

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

### 8-INCH RULE.

- 4053-2.** 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 \$

### 10-INCH RULES.

- 4053-3.** Polyphase (Mannheim) Slide Rule, K & E Adjustable, 10 in., engine divided, divisions on white facings, "Frameless" Glass Indicator; in Case, with Directions . . . . . "
- 4053-3F.** Polyphase (Mannheim) Slide Rule, like No. 4053-3, 10 in., but subdivided as closely as the 20-in. rule . . . . . "

### 20-INCH RULE.

- 4053-5.** Polyphase (Mannheim) Slide Rule, K & E Adjustable, 20-in., engine divided, divisions on white facings, "Frameless" Glass Indicator; in Case, with Directions . . . . . "

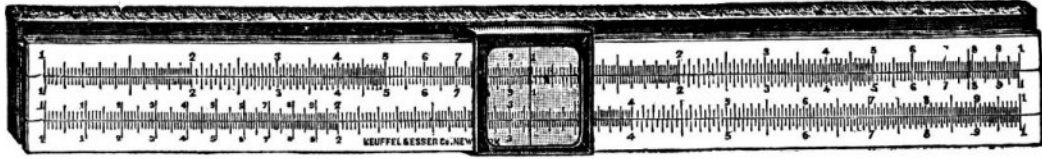
For Magnifiers and Books on the Slide Rule, see page 247.

For Leather Cases, see page 238.



## FAVORITE SLIDE RULES.

MANNHEIM TYPE.



No. 4054.

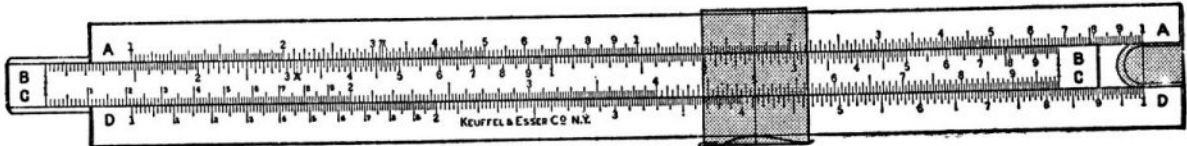
- 4054. Favorite (Mannheim) Slide Rule, 10 in., divided on white facings, with glass Indicator; in Case, with Directions . each \$
- 4056. Favorite (Mannheim) Slide Rule, 10 in., polished boxwood, with glass Indicator; in Case, with Directions . . . . “

FOR SUB NUMBERING, SEE PAGE 235.

The Favorite Slide Rules are of the same pattern as No. 4041, but they are not adjustable. They are an improvement over the imported rules, being made of materials seasoned here and, therefore, less liable to warp or shrink.

For Magnifiers and Books on the Slide Rule, see page 247.

## STUDENT'S SLIDE RULE.



No. 4058.

- 4058. Student's Slide Rule, (Mannheim), 10 in., transparent Xylo-nite Indicator, with steel spring, with Directions . . . each \$

The Student's 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.

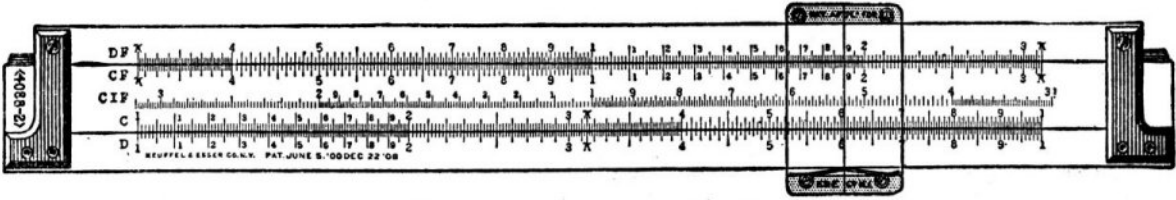
It is similar to our Mannheim Slide Rule. The graduations are printed on light-colored wood, and plain Directions are furnished with each rule.

## CASES FOR SLIDE RULES.

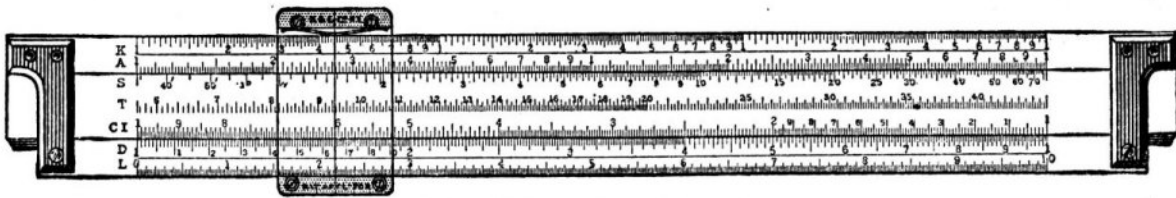
Case for		10	16	20 in. rule
	each \$			
Sewed leather Case for	5	8	10	16
each \$				20 in. rule
Sewed leather Case, with space for Magnifier No. 4085,				
for	5	8	10	16
each \$				20 in. rule



## POLYPHASE DUPLEX SLIDE RULES, K & E ADJUSTABLE.



No. 4088-2 (front) fig. 1.



No. 4088-2 (back) fig. 2.

- 4088-2.** Polyphase Duplex Slide Rule, K & E Adjustable, 8 in., engine divided, divisions on white facings, "Frameless" Glass Indicator; in sewed Leather Case, with Directions . . . . . each \$
- 4088-3.** Polyphase Duplex Slide Rule, K & E Adjustable, 10 in., engine divided, divisions on white facings, "Frameless" Glass Indicator; in Case, with Directions . . . . . "
- 4088-5.** Polyphase Duplex Slide Rule, K & E Adjustable, 20 in., engine divided, divisions on white facings, "Frameless" Glass Indicator; in Case, with Directions . . . . . "

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 formulæ.

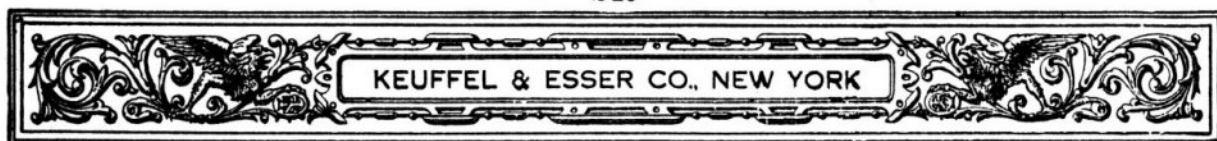
The Polyphase Duplex is of the same pattern as the Duplex Rule, being graduated on both sides, and has our slide adjustment.

On one face (fig. 1) are the following scales :

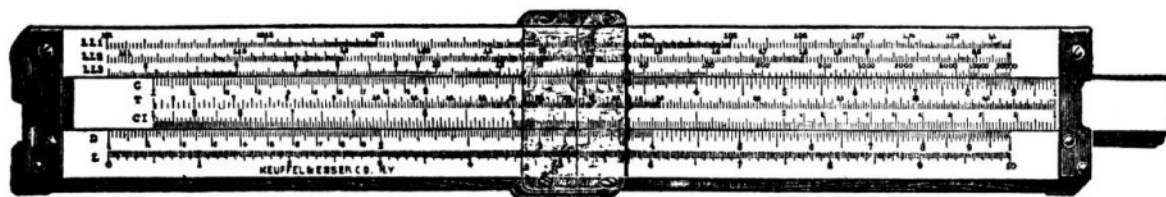
- DF, a full length D scale, folded. (The graduations begin and end approximately at the center of the rule, the scales being so placed as to bring the division 3.1416 ( $\pi$ ) in line with both indexes of the lower D scale.)
- CF, a full length C scale, folded like the DF scale.
- CIF, a full length inverted folded C scale on the center line of the slide.
- C, a full length regular C scale.
- D, a full length regular D scale.

On the other face of the rule (fig. 2) are the following scales:

- K, a scale consisting of three complete logarithmic scales. (Used in connection with the D scale for cubes and cube roots.)
- A, two complete logarithmic scales (used in connection with the D scale for squares and square roots).
- S and T, the usual trigonometrical scales of sines and tangents.
- CI, a full length C scale inverted.
- D, a full length regular D scale.
- L, a scale of equal parts (for finding logarithms of numbers).



## LOG LOG DUPLEX SLIDE RULE, K & E ADJUSTABLE.



No. 4092.

- 4092.** Log Log Duplex Slide Rule, K & E Adjustable, 10 in.,  
engine divided, divisions on white facings, "Frameless"  
Glass Indicator; in Case, with Directions . . . . . each \$

The Log Log Duplex Slide Rule has, in addition to the scales of the regular Duplex slide rule, a Log Log scale, three fold, graduated from 1.01 to 22000, with which any root or power of any quantity up to 22000, may be determined by direct operation at one setting of the slide.

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

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.

The scales are arranged as follows :

- On the front face are the regular A, B, C and D scales, and a scale of sines, in the usual order.
- On the reverse face there are, in the order named:
  - Log Log scale, in three parts,
  - The C scale,
  - The scale of tangents,
  - The CI scale (C Inverted),
  - The D scale,
  - The scale of equal parts.

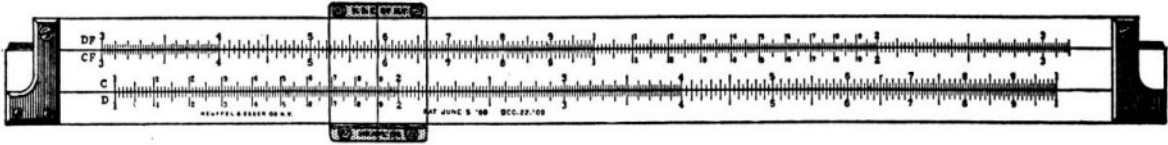
By the arrangement of the C and CI scales on the slide with the scale of tangents between, the tangent or co-tangent of any angle from 5° 43' to 84° 17' can be read on the slide, or used as a factor if so required.

**For Magnifiers and Books on the Slide Rule, see page 247.**

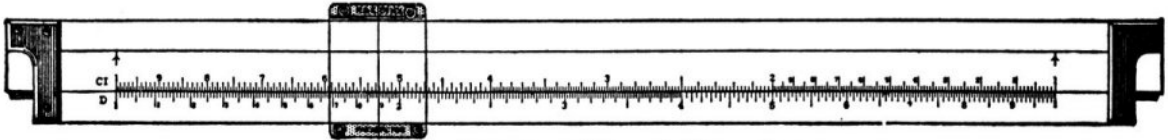
**For Leather Cases, see page 238.**



## MERCHANT'S SLIDE RULE, K & E ADJUSTABLE.



Front, showing DF, CF, C and D scales.



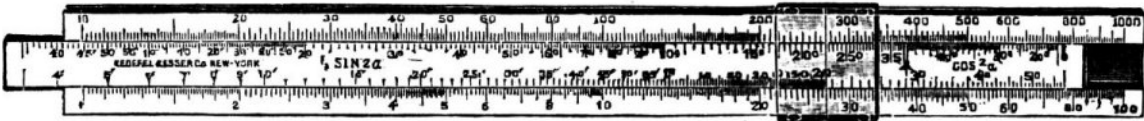
Back, showing CI and D scales.

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

Epecially 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.

## STADIA SLIDE RULES, K & E ADJUSTABLE.



No. 4100.

- 4100.** K & E Stadia Slide Rule, engine divided, 10 in., divisions on white facings, "Frameless" Glass indicator; in Case . . . . . each \$
- 4101.** K & E Stadia Slide Rule, like No. 4100, but 20 in.; in Case . . . . . "

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 (always to the left), the horizontal distance and vertical height can be obtained at once, in every case where the Stadia rod reading and elevation of the telescope are known. The two equations thus solved are those generally used for inclined stadia measurements, viz.: Horizontal Distance = Rod reading  $\times$  Cos.<sup>2</sup> $\alpha$ . Vertical Height =

$$\text{Rod Reading} \times \frac{\text{Sin } 2\alpha}{2}$$

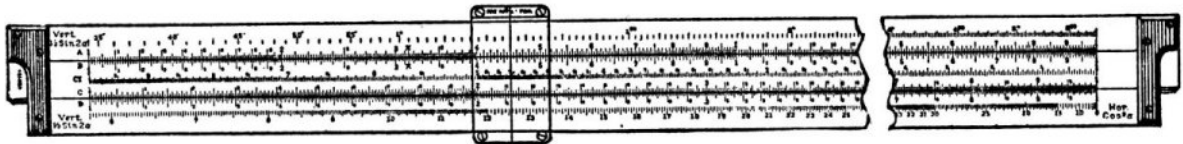
The under side of the slide has a scale corresponding to the lower scale of the rule and resembling the A and B scales of the Mannheim and Duplex rules, so that the rule can be used also for ordinary slide rule computations.



# SURVEYOR'S DUPLEX SLIDE RULE. K & E ADJUSTABLE.



Front.



Back.

No. 4102.

**4102.** Surveyor's Duplex Slide Rule, K & E Adjustable, 20 in., Duplex type, engine divided, divisions on white facings, "Frameless" Glass Indicator; in Case, with Directions . . . . . each \$

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 Surveyor's 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.

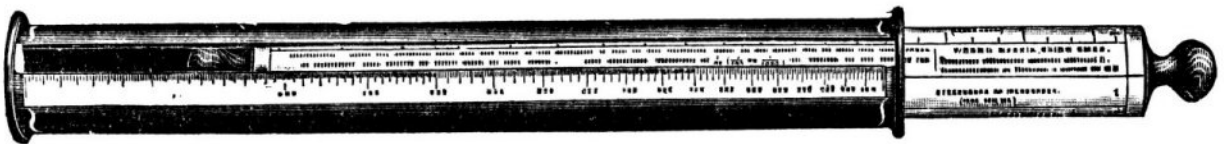
One face is arranged for the determination of the meridian by direct solar observations; it also carries the sine and cosine scales used in computing the latitudes and departures of the course.

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 page 238.

FOR MAGNIFIERS, see page 247.

## WEBB'S STADIA SLIDE RULE.



No. 4105.

**4105.** Webb's Stadia Slide Rule (cylindrical). . . . . each \$

The Webb Stadia Slide Rule is so designed that its capacity is equal to that of a straight slide rule of a length of more than four feet, but it has been compacted in a cylindrical form about 15 inches long, diameter 1½ inches.

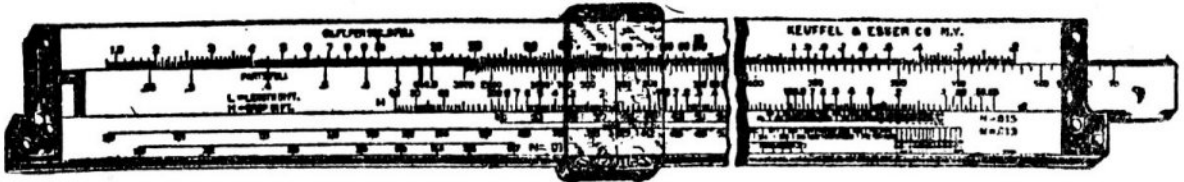
It is, therefore, of a convenient size to carry and use in the field, thus facilitating the drawing of field maps. The desired quantities are given with a degree of accuracy which is commensurate with the probable accuracy of the observations as read, the "logarithmic unit" being 12½ inches long.

The graduations on the wooden cylinder and the metal sleeve are on paper, protected by a hard transparent coating. The directions, which are very simple, are printed on the rule.



# NORDELL SEWER SLIDE RULE, K & E ADJUSTABLE.

DUPLEX TYPE.

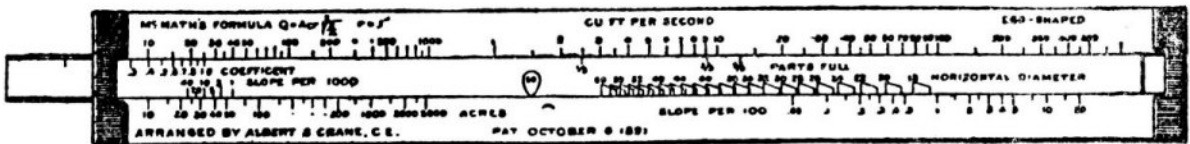


No. 4128.

- 4128. Nordell Sewer Slide Rule, K & E Adjustable, 20 in., Duplex type, engine divided, divisions on white facings, "Frameless" Glass Indicator; in Case, with Directions, . . . . . each \$

This slide rule is based on Kutter's formula for circular sewers. It greatly simplifies the method of determining the time of flow, and is adapted for the ready solution of problems involving sizes, capacities, drops, and velocities of sewers. The reverse face has the regular Mannheim 20 in. A, B, C and D scales for general computations.

# CRANE'S SEWER SLIDE RULE.



No. 4132.

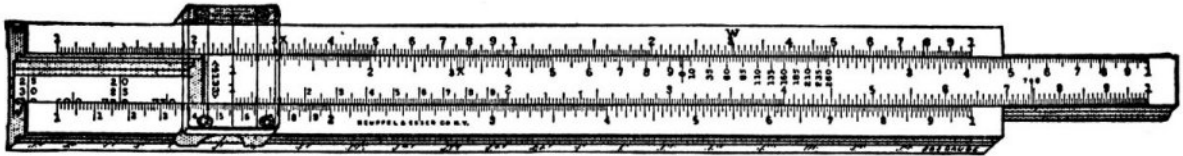
- 4132. Crane's Sewer Slide Rule, 10 in., printed graduations, with Directions . . . . . each \$

Crane's Sewer Slide Rule is based on McMath's formula for amount of storm water and Kutter's formula for capacities; for circular sewers from 6 to 180 in. diam. and eggshaped sewers from 18 to 60 in. horizontal diameter; ratio of radii 3:2.





## THE ROYLANCE ELECTRICAL SLIDE RULE, K & E ADJUSTABLE.



No. 4133.

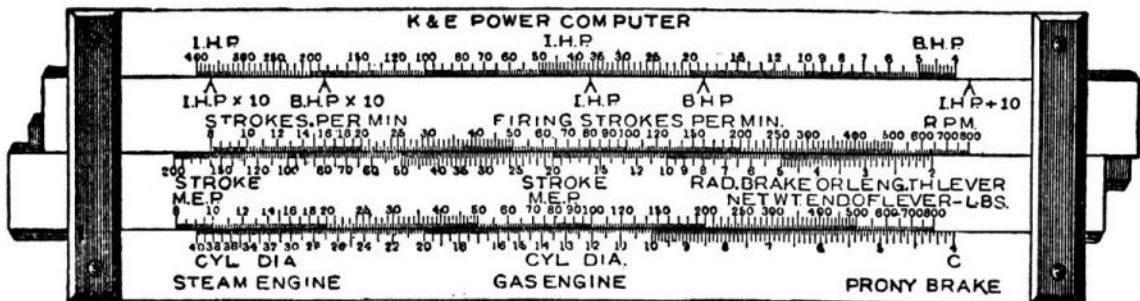
- 4133. Roylance Electrical Slide Rule, K & E Adjustable, 8 in., Mannheim Type, engine divided on white facings, "Frameless" Glass Indicator; in Leather Case, with Directions . . . each \$**

The Roylance Electrical Slide Rule is a modification of our regular Mannheim Slide Rule No. 4035 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. Scales showing the carrying capacity for different kinds and sizes of wire are placed in the groove in the body of the Rule beneath the Slide. The upper row of figures shows the ampere carrying capacity of rubber covered wire; the second row, weather proof wire; third row, rubber covered cable; fourth row, weather proof cable. For the third and fourth rows, the gauge marks read hundred thousand circular mils; No. 8 reads 800,000 cm., No. 14, 1,400,000 cm., etc. These scales are also read in connection with the gauge marks by means of the indicator.

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, and a special set of figures giving the temperature of wire in degrees Centigrade corresponding to resistance in ohms per 1000 feet. In other respects the Slide Rule is our regular Mannheim type, and the general directions for its use may be applied.

## POWER COMPUTING SLIDE RULE, K & E ADJUSTABLE.

DUPLIX TYPE



No. 4135.

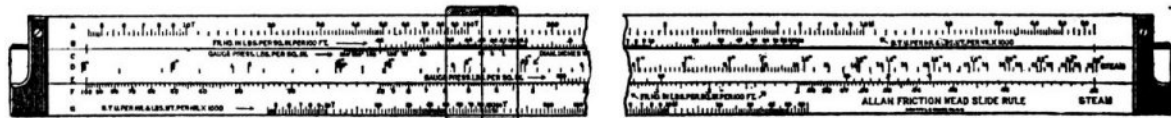
- 4135. K & E Power Computing Slide Rule, Patented, 7 1/4 in., Duplex Type, engine divided, divisions on white facings; in sewed Leather Case, with Directions . . . . . each \$**

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.

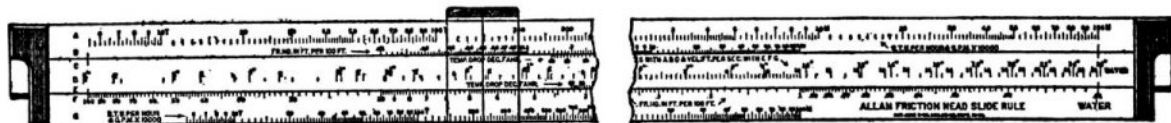
The face of the rule shown carries five series of special graduations, to be used in determining B. H. P., I. H. P., or principal Dimensions of Steam, Gas and Oil Engines of any size. On the reverse face of the Rule are engraved the A, B, C and D scales usually found on the Mannheim Slide Rule.



## ALLAN FRICTION HEAD SLIDE RULE, K & E ADJUSTABLE.



Front.



Back.

No. 4142.

- 4142.** Allan Friction Head Slide Rule, K & E Adjustable, 20 in., Duplex Type, engine divided, divisions on white facings; new K & E "Frameless" Glass Indicator; in Case, with clear and comprehensive directions, . . . . . each \$
- Separate copies of the Manual . . . . . "

This Slide Rule is offered to the engineering profession as a means whereby systems of steam and hot water heating and steam power piping may be designed to meet the growing demand for correct pipe sizing. It was made possible by an invention, protected by U. S. patent, for which we hold the exclusive manufacturing license; this invention covers an arrangement of logarithmic scales (applicable to our regular type of slide rule and having the same simplicity of operation), by means of which the relationship between **five variable quantities** can be determined.

As applied to the subject matter, these variables are the volume of flow, loss of pressure due to friction, diameter of pipe, velocity of flow, and the gauge pressure in steam work or temperature drop in water work. The following tabulation gives the range of information covered:

STEAM:	VOLUME	4500 to 65,000,000 B. T. U. per hr. (Heating)
		4.5 " 65,000 lbs. wgt. " (Power)
	FRICTION	.01 to 100 lbs. per sq. in. per 100 ft. pipe
	DIAMETER	½ in. to 26 in. O. D. (Commercial sizes)
	VELOCITY	7 to 250 ft. per sec.
GAUGE PRESS.		1 to 10 lbs. (Heating)
		50 " 250 " (Power)
WATER:	VOLUME	6500 to 100,000,000 B. T. U. per hr. (Heating)
		0.65 to 10,000 gal. per min. (Water supply)
	FRICTION	.01 to 100 ft. head per 100 ft. pipe
	DIAMETER	½ in. to 26 in. O. D. (Commercial sizes)
	VELOCITY	0.7 to 25 ft. per sec.
TEMP. DROP		10 to 40 deg. F.

Unusual care has been taken to make the Manual of Instructions clear and comprehensive.

The arrangement of logarithmic scales is based on equations which, after a thorough and painstaking research of all available data, seemed to offer the best assurance of permanency and consistent results, and these equations are given in full in the Manual.

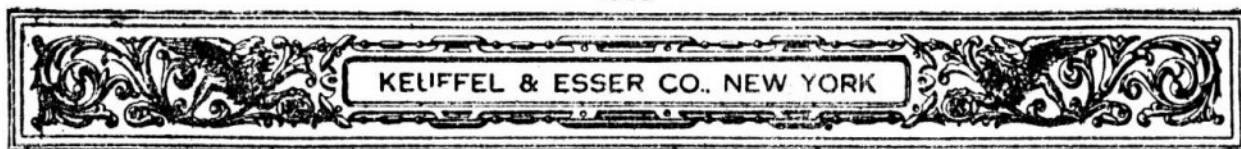
Practical examples and piping diagrams covering all applications of the principles involved are fully worked out and explained for both steam and water.

The resistance of valves, fittings, etc., is tabulated in accordance with the best available information.

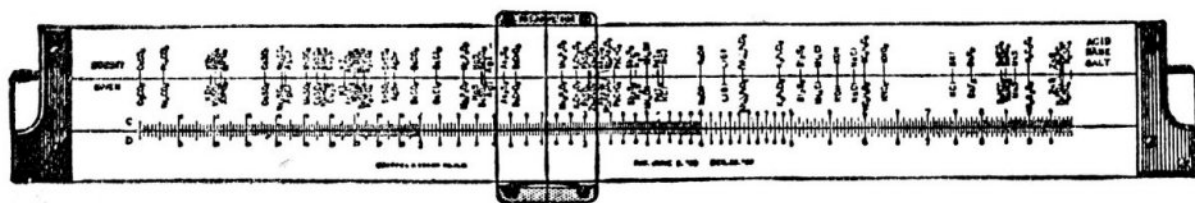
The Manual fully covers the use of the rule in ordinary gravity work, as well as its application to large installations of hot water heating under forced circulation,—installations which have recently become very popular for manufacturing plants and institutions.

The rule is made in the 20 in. Duplex type only, and is provided with our new "Frameless" Glass Indicator, the steam scales being on one face and the water scales on the other.

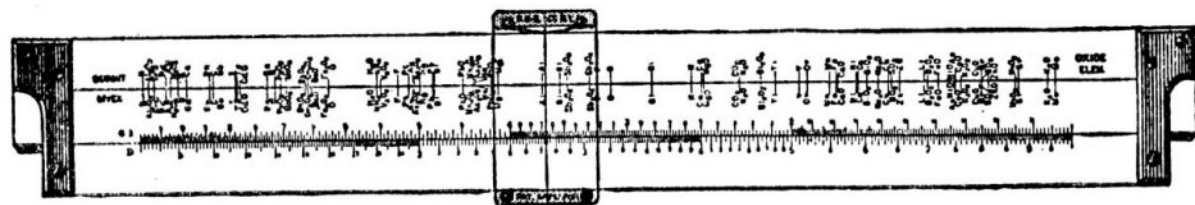
Commercial sizes of steel and wrought iron pipe are indicated in red figures; theoretical diameters and all other figures and lettering are in black.



# CHEMIST'S DUPLEX SLIDE RULE, K & E ADJUSTABLE.



Front.



Back.  
No 4160.

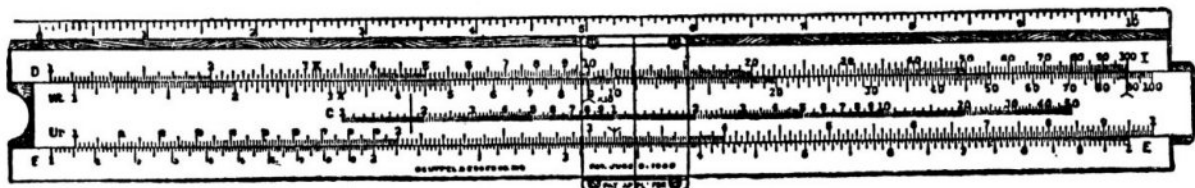
**4160.** Chemist's Duplex Slide Rule, K & E Adjustable, 10 in., engine divided, divisions on white facings, "Frameless" glass Indicator; in Case, with Directions . . . . . \$

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.

## UREA INDEX SLIDE RULE

A Slide Rule Modified for Calculation of Urea Index and Sodium Chloride Formulæ, as described in the Journal of Experimental Medicine, 1915, vol. XXII, pp. 212-236, by Franklin C. Mc Lean, Ph. D., M. D., Rockefeller Institute for Medical Research.

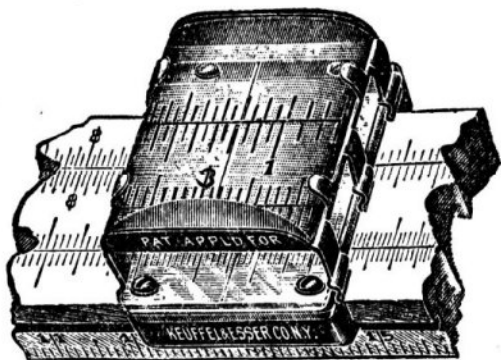


No. 4165.

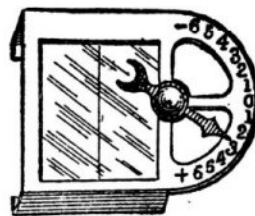
**4165.** Slide Rule (Mannheim Type) modified for calculations of Urea Index and Sodium Chloride Formulæ; K & E Adjustable, 10 in., engine divided, divisions on white facings, "Frameless" Glass Indicator; in sewed Leather Case, with Directions . . . . . each \$



## MAGNIFIERS FOR SLIDE RULES. INDICATOR WITH DECIMAL POINTER.



No. 4085 B.



No. 4086.

- 4085 A. Magnifiers for Mannheim Slide Rules, 5 in., 8 in. . . . . each \$
- 4085 B. Magnifiers for the following Slide Rules: Mannheim, 10 in., 16 in., 20 in.; Polyphase, Favorite, Polyphase Duplex 8 in., 10 in.; Stadia 10 in., 20 in. . . . . “
- 4085 C. Magnifiers for Polyphase Duplex 20 in., and Log Log Slide Rules . . . . . “

When ordering please indicate kind of slide rule for which the magnifier is wanted.

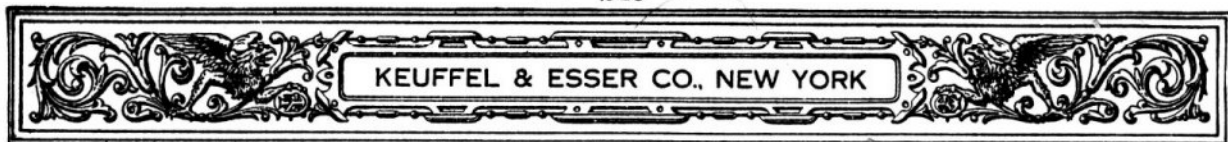
The Magnifiers are mounted in a metal frame and are applied to the rule by springing them on the glass indicator. The lens is thus always in position for reading and is always in focus. The magnification is ample for even the finest graduations, the field covers the full area of the indicator, and the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

- 4086. Glass Indicator, with Decimal Pointer . . . . . each \$
- do. do. in place of plain Glass Indicator, add . . . . . “
- No. 4086 is furnished for the Mannheim style of Slide Rules only.
- The Magnifiers No. 4085 do not fit these Indicators.

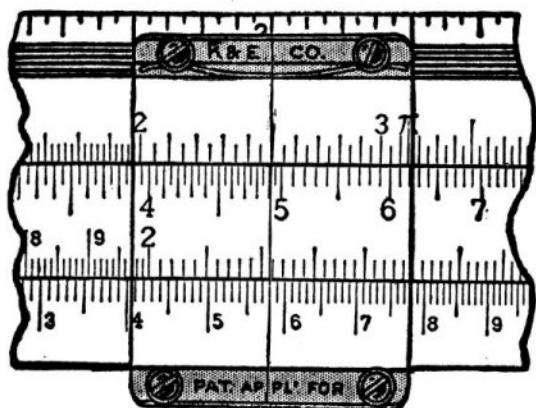
## BOOKS ON THE SLIDE RULE.

PUBLISHED BY KEUFFEL & ESSER CO.

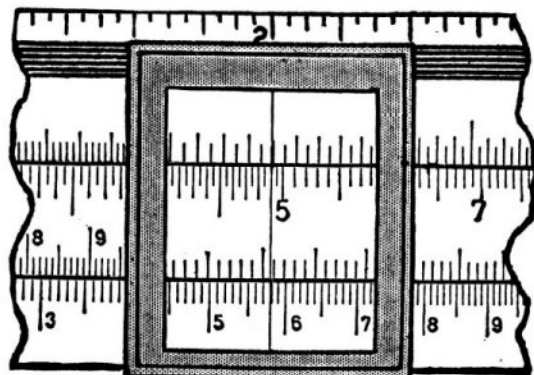
- BK 25. The Use of the Slide Rule, a Practical Manual of Slide Rule Instruction; by Prof. Allan R. Cullimore, formerly Dean of Toledo University; 8 vo. 36 pages. Bound in Cloth . . . each \$
- 4087 B. The Mannheim and Polyphase Slide Rules (Mannheim Type); complete manual; by Wm. Cox. Bound in Paper . . . each \$
- 4087 E. The Mannheim (Polyphase) and the Duplex (Polyphase Duplex) Slide Rules; complete manual, bound together. . . . . each \$
- 4087 D. Manual 4087 E, but in stiff linen cover. . . . . each \$
- 4087 F. The Mannheim and Polyphase Slide Rules; a self teaching manual with numerous illustrations and examples for practice; suitable for use in classes studying Algebra, Trigonometry, and practical mathematics, containing adequate formulæ and technical matter for engineers; by Wm. E. Breckenridge, A. M., Columbia University, 8 vo., 80 pages, . . . . . each \$



## THE NEW "FRAMELESS" INDICATOR FOR K & E SLIDE RULES.



**No. 1. New Type Indicator**  
(Never hides any figures)



**No. 2. Old Type Indicator**  
(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 new K & E "Frameless" Indicator entirely obviates this difficulty, and vastly increases the ease and rapidity of using the Slide Rule.

### "FRAMELESS" GLASS INDICATORS FOR THE FOLLOWING K & E SLIDE RULES:

Complete Indicators for Mannheim, Nos. 4031 to 4041 F . . . \$	each	Complete Indicators for Stadia, No. 4100 . . . . . \$	each
"    "    4045 and 4051 . . . . .		"    "    4101 . . . . .	
Polyphase, Nos. 4053-2 to -5 . . . . .		Surveyor's Duplex, No. 4102 . . . . .	
Polyphase Duplex, No. 4088-2, -3 . . . . .		Nordell, No. 4128 . . . . .	
"    "    "    4088-5 . . . . .		Roylance Electrical, No. 4133 . . . . .	
Log Log Duplex, No. 4092 . . . . .		Allan Friction Head, No. 4142 . . . . .	
Merchants, No. 4095 . . . . .		Chemist's Duplex, No. 4160 . . . . .	
		Urea Index, No. 4165 . . . . .	

The above have one hairline, except the indicator for No. 4133, (Roylance Electrical Slide Rule) which has three hairlines.

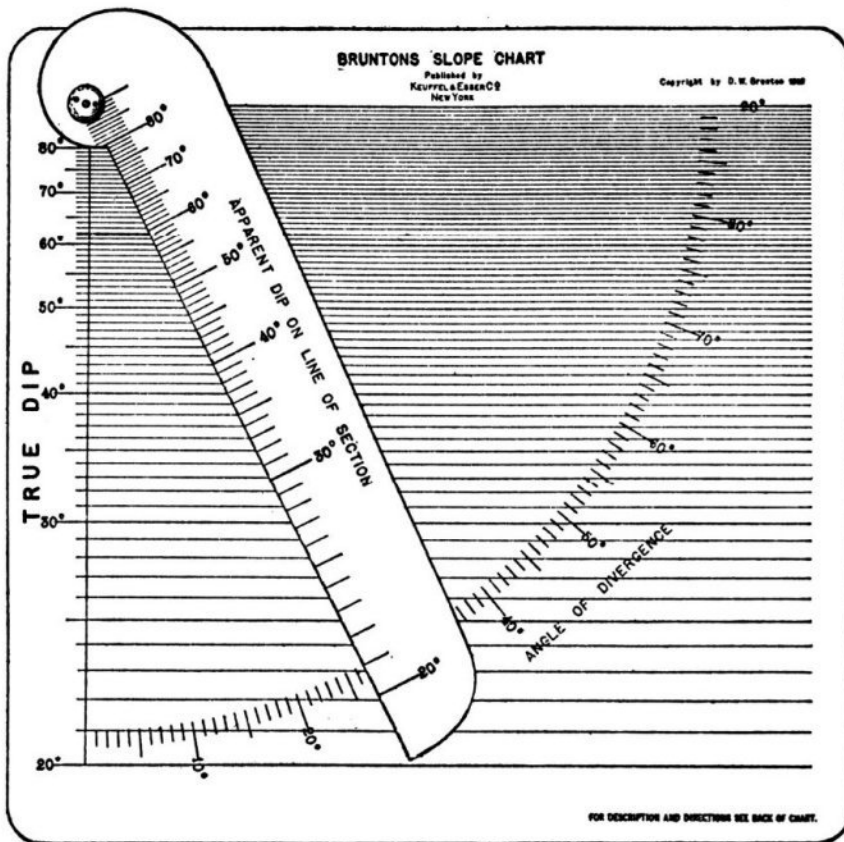
"Frameless" Glass Indicator, but with two hairlines (instead of one) extra \$  
Do. but with two hairlines spaced to a stated ratio . . . . . "

#### For glasses only (one hairline), the prices are:

For Mannheim, Nos. 4031 to 4041-F )	Glass only . . . . . each \$
Stadia No. 4100 . . . . . )	" fitted . . . . . "
Urea Index, No. 4165 . . . . . )	
Mannheim, Nos. 4045 and 4051 )	" only . . . . . "
Stadia, No. 4101 . . . . . )	" fitted . . . . . "
Polyphase, Nos. 4053-2 to -5 . . . . . )	
Roylance, No. 4133 (Three Hairlines)	Glass only . . . . . "
	" fitted . . . . . "
Polyphase Duplex, Nos. 4088-2 )	" only . . . . . "
and -3 . . . . . )	" fitted . . . . . "
Merchants, No. 4095 . . . . . )	
Polyphase Duplex, No. 4088-5 )	
Log Log, No. 4092 . . . . . )	Glass only . . . . . "
Surveyor's Duplex, No. 4102 . . . . . )	" fitted . . . . . "
Nordell, No. 4128 . . . . . )	
Allan Friction Head, No. 4142 . . . . . )	
Chemist's Duplex, No. 4160 . . . . . )	



# BRUNTON SLOPE CHART.



**4185.** Brunton Slope Chart, heavy cardboard sheet  $11\frac{1}{2} \times 11$  in., with horizontal scale from  $20^\circ$  to  $90^\circ$  ("True Dip" scale); quadrant scale, divided to degrees ("Angle of Divergence"); a swinging arm with scale from  $20^\circ$  to  $90^\circ$  on its radial edge ("Apparent Dip on Line of Section"); full Directions printed on back of Chart . . . . . each \$

The Brunton Slope Chart enables the user instantly to obtain the apparent dip from the true dip, or vice versa; mechanically solving the equation:  $\text{Tan } C^\circ = \text{Cosine } A^\circ \text{ Tan } B^\circ$ , in which C is the apparent dip, A, the angle of divergence, and B, the true dip.

In addition to its use in the preparation of maps and geological sections, the chart is also extremely useful for giving the valley angles in hoppers, ore bins, etc.