F. H. NESTELLE

K&E

TRADEMARK

SLIDE
RULES

and

Calculating

Instruments

KEUFFEL & ESSER CO.

10,406. cc, y, ai. chM.

PRINTED IN U.S.A.

K & E
REG. U. S. PAT. OFF.

SLIDE RULES

and

Calculating Instruments

TRADE MARK

KEUFFEL & ESSER CO.

NEW YORK, 127 Fulton Street,   General Office and Factories, **HOBOKEN, N. J.**

CHICAGO   ST. LOUIS   SAN FRANCISCO   DETROIT   MONTREAL
516-20 S. Dearborn St.   817 Locust St.   30-34 Second Street   77 W. Elizabeth St.   7-9 Notre Dame St., W.

Drawing Materials, Mathematical and Surveying Instruments, Measuring Tapes.

K & E

REG. U. S. PAT. OFF.

SLIDE RULES.

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. Problems can be solved in a fraction of the time required by the usual arithmetical processes.

Particular attention is called to the slide rules described on pages 313 d to 313 i inclusive, in which all of the scales have been so arranged that anyone understanding the method governing the operation of the usual scales, will be able to employ the rule for all operations involving arithmetic, evolution, involution, trigonometry, and logarithms to any base, either separately or in conjunction with one another, without being troubled to remember a different method for each different type of problem.

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.
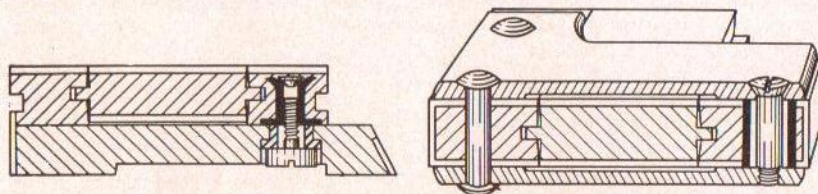
K & E SLIDE RULES.

REG. U. S. PAT. OFF.

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* 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*** 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. Adjustment 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.
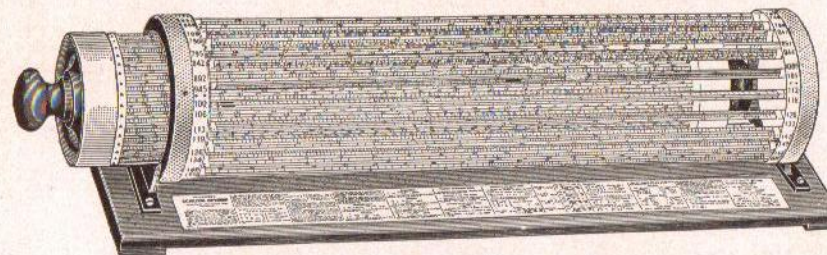
NUMBERING OF SLIDE RULES.

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.

* REG. U. S. PAT. OFF.

THACHER'S
CALCULATING INSTRUMENT.

No. N4012.

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

N 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 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 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.)

POCKET CALCULATORS.
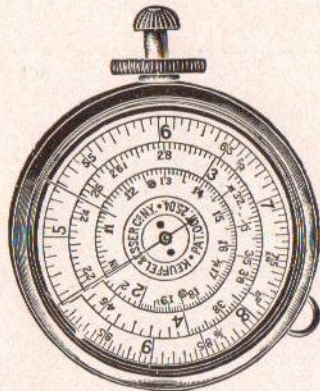
No. 4017.

4017. Sperry's Pocket Calculator, watch pattern 2⅛ 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 allows of reading results somewhat closer than on the C-D scales of 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 dial 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, 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.

MANNHEIM SLIDE RULES.

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

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 improved Glass Indicator; in sewed Leather Case, with Directions   "

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 improved Glass Indicator; in Case, with Directions . . . .   "

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

The front face of each of these slide rules carries the following scales:

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

B, two complete logarithmic scales, exactly like A.

C, a single logarithmic scale.

D, a single logarithmic scale, like C.

On the back of the slide are the following scales:

S, a trigonometric scale of sines, referred to the A and B scales.

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

T, a trigonometric scale of tangents, referred to the C and D scales.

The beveled edge of the slide rule is a handy measuring scale, since it is divided to inches in sixteenths. The other edge, being divided to centimeters in millimeters, serves the same useful purpose, where measurements in the metric system are involved.

The back of the rule carries a table of equivalents and the setting on the rule applying to each; so that inches may be rapidly reduced to centimeters; square yards to square miles, inches of mercury to feet of water; and many other useful conversions.
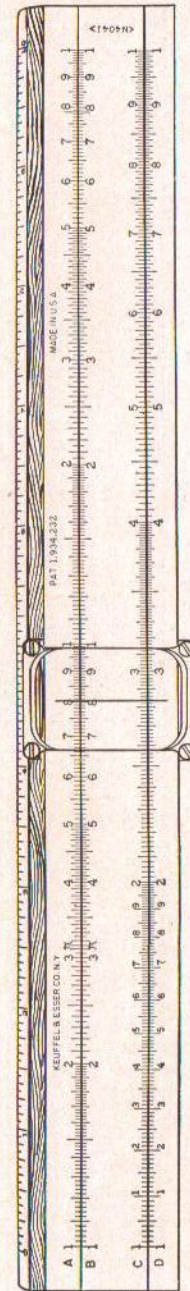
No. N4041.
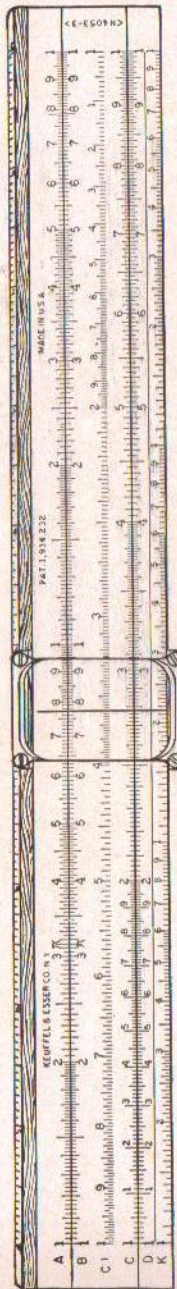
POLYPHASE SLIDE RULES.

REG. U. S. PAT. OFF.

MANNHEIM TYPE

The **POLYPHASE Slide Rule** has, in addition to the regular features of the Mannheim (page 311a), the following scales:

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

CI, an inverted or reciprocal C scale, which enables the operator to take three factors at one setting of the slide, and to read reciprocals by means of the indicator. Consequently, on this rule, almost any combination of three factors involving squares, square roots, cubes and cube roots, may be solved at one setting of the slide.

10-INCH RULES.

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

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

N 4053-3 F. POLYPHASE (Mannheim) Slide Rule, like No. N4053-3, 10 in., but more closely subdivided . . . .   "

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

20-INCH RULE.

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

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

Nos. **N4053-3F** and **N4053-5** have from 200 to 20 sub-divisions between the prime numbers on the C and D scales, while the other 10 in. rules have from 100 to 20; so that the reading is closer, often to the extent of one additional significant figure.
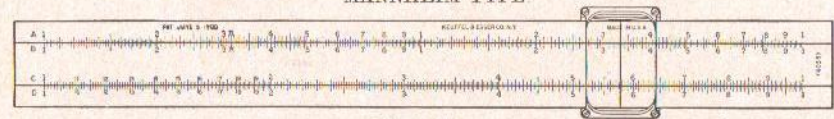
* REG. U. S. PAT. OFF.

No. N4053-3.
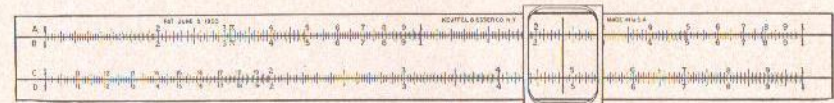
FAVORITE SLIDE RULES.

TRADE MARK

MANNHEIM TYPE

No. 4055.

4055. FAVORITE (Mannheim) Slide Rule, **K & E Adjustable,** 10 in., engine divided, divisions on white facings, with improved Glass Indicator; in Case, with Directions . .   each

No. 4056.

4056. FAVORITE (Mannheim) Slide Rule, **K & E Adjustable,** 10 in., divisions on white facings, with plain frame Glass Indicator; in plain Case, with Directions . . . .   each

The **FAVORITE Slide Rules** have all the scales of No. N4041 page 311a, except the centimeter and inch scales.

BEGINNERS' SLIDE RULES.

TRADE MARK
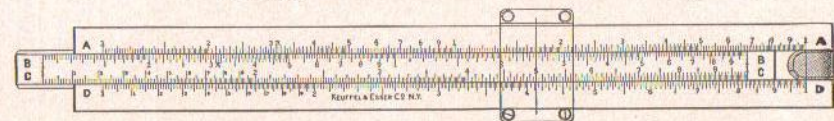
No. 4058C.

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

The graduations of No. 4058 are printed on light colored wood.

4058 C. Like 4058, but with "Frameless" Glass Indicator, in plain case with Directions . . . .   each

4058W. BEGINNERS' Slide Rule (Mannheim), 10 in., graduations on white finish, with plain frame Glass Indicator, in plain case with Directions . . . .   "

Nos. 4058, 4058C and 4058W have all the scales of No. N4041 (page 311a) except the centimeter and inch scales.

4059 BEGINNERS' Slide Rule, 8 in. transparent Xylonite Indicator, in folding carton, with Directions . . . . . .   each

No. 4059 has the A, B, C and D scales, together with a table of equivalents, with their settings (see page 311a), all printed on light colored wood.

The **BEGINNERS' Slide Rules** are 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.

POLYPHASE DUPLEX TRIG
TRADE MARK
AND
POLYPHASE DUPLEX DECITRIG
TRADE MARK

SLIDE RULES.

**4070-3.** **POLYPHASE DUPLEX TRIG** Slide Rule, K & E Adjustable, 10 in., engine divided, divisions on white facings, improved Glass Indicator; with **Trigonometrical Scales divided to represent degrees and minutes**; in Case, with Directions. . . . . **each**

4070-3S. Same as No. 4070-3, but in sewed Leather Case. . . . . "

4071-3. **POLYPHASE DUPLEX DECITRIG** Slide Rule, Like No. 4070-3 but with **Trigonometrical Scales divided to represent degrees and decimals of a degree.** . . . . "

**4071-3S.** Same as No. 4071-3, but in sewed Leather Case. . . . . "

These slide rules, which are graduated on both sides, have all the scales of the **POLYPHASE*** Slide Rule (see page 312a), with the addition of four others—three of which (CF, DF and CIF) are known as the folded scales, and one (DI) as the inverted D scale. The trigonometrical scales have been expanded and rearranged. **Nos. 4070** and **4071** are alike, except that the trigonometrical scales of **No. 4070** are divided to represent degrees and minutes, whereas those of **No. 4071** are divided to represent degrees and decimals of a degree.

On one face are the following scales:

DF, a full length D scale folded. This arrangement admits of the handling of factors which, in rules without these scales, would frequently require the slide to be reset. Since the constant π is in alignment with the indices of the C and D scales, π can 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 scale, giving reciprocals of numbers on the CF scale. The inverted scale in connection with the direct scales admits of handling three factors with one setting of the slide, or four factors if π is included.

CI, a full length C scale inverted.

C, a single logarithmic scale.

D, a single logarithmic scale like C.

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

On the reverse face are the following scales:

K, a three unit logarithmic scale, giving directly cubes and cube roots.

A, a two unit logarithmic scale giving directly squares and square roots.

B, a two unit logarithmic scale exactly like A.

T, a full length scale of Tangents and Cotangents, double numbered from 5°43' or 5.72° to 84°17' or 84.28°.

ST, a full length scale of Sines and Cosines, numbered from 0°34' or 0.58° to 5°44' or 5.73°.

S, a full length scale of Sines and Cosines, double numbered from 5°44' or 5.73° to 90° for sines, and from 0° to 84°16' or 84.26° for cosines.

D, a single logarithmic scale.

DI, a full length D scale inverted.
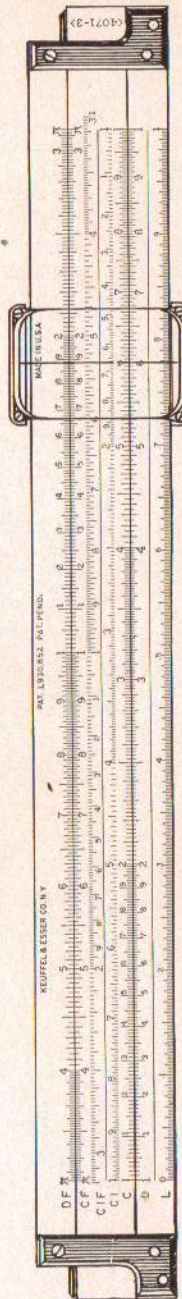
* REG. U. S. PAT. OFF.

No. 4071-3. Front.

POLYPHASE DUPLEX TRIG
TRADE MARK
AND
POLYPHASE DUPLEX DECITRIG
### TRADE MARK

SLIDE RULES.

The great improvements which these slide rules exhibit lie not only in the addition of the folded scales (see page 313b,) but, in the fact that while the trigonometrical scales are on the slide, as in most slide rules, they are all referred to the C, D, CI and DI scales. Hence, it is possible to take all the trigonometric functions as factors in any operation, without paying attention to their numerical values; so that, in multiplication, division, etc.. the trigonometrical scales can be handled exactly like the C and CI scales. Also, due to the double numbering of the scales, all six usual trigonometric functions can be handled in the same problem by direct means and continuous operation, as follows:

Example: $x = \dfrac{4 \sin 38°}{\tan 42°}$

To 4 on scale D set 42° on scale T.
At 38° on scale S read x=2.735 on scale D.

Example: $x = \dfrac{555 \cos 75° \sqrt[1]{193}}{5.5 \cot 81°30'}$

To 555 on scale D set 81°30' on scale T.
Indicator to 75° (red) on scale S.
5.5 on scale C to Indicator.
Indicator to 193 on scale B.
Under Indicator read 2425 on scale D.
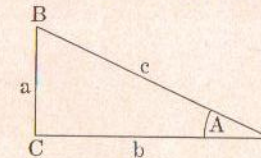
The rearrangement of the trigonometrical scales is of great convenience in solving the right triangle (on which vector problems are based), including the determination of both acute angles, by the use of familiar methods, as follows:

Example: Given a=3, b=4. Find A and c.

To 4 on D set index of slide.
At 3 on D read A=36.9° on T.
To 3 on D set 36.9° on S.
At index of slide read c=5 on D.
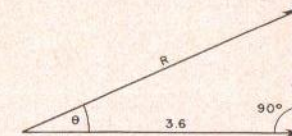
Example: Find the magnitude and the angle of the vector representing the complex number 3.6 + j1.63 where $j = \sqrt{-1}$.

To 3.6 on D set index of slide.
At 1.63 on D read θ=24.4° on T.
To 1.63 on D set 24.4° on S.
At index of slide read R=3.96 on D.

The preceding methods can be applied most conveniently to all problems dealing with the right triangle. By means of scale DI another method can be used to solve most right triangles, with but one setting of the slide.

The above solutions of the right triangle apply to the scales on No. 4071-3, but the operation on No. 4070-3 is exactly the same, except that the angles are given in degrees and minutes.

No. 4071-3 Back.

LOG LOG DUPLEX TRIG
TRADE MARK
AND
LOG LOG DUPLEX DECITRIG
REG. U. S. PAT. OFF.
SLIDE RULES.

4080-3. LOG LOG DUPLEX TRIG Slide Rule, K&E Adjustable, 10 in., engine divided, divisions on white facings, improved Glass Indicator; with Trigonometrical Scales divided to represent degrees and minutes; in Case, with Directions. . . . . each

4080-3S. Same as No. 4080-3, but in sewed Leather Case "

4080-5. Similar to No. 4080-3, but 20 in. . . . . . . "

4080-5S. Same as No. 4080-5, but in sewed Leather Case "

4081-3. LOG LOG DUPLEX DECITRIG Slide Rule, like No. 4080-3, but with Trigonometrical Scales divided to represent degrees and decimals of a degree. "

4081-3S. Same as No. 4081-3, but in sewed Leather Case "

4081-5. Similar to No. 4081-3, but 20 in. . . . . . . "

4081-5S. Same as No. 4081-5, but in sewed Leather Case "

Nos. **4080** and **4081** are alike except that the trigonometrical scales of **No. 4080** are divided to represent degrees and minutes, whereas those of **No. 4081** are divided to represent degrees and decimals of a degree.

On one face are the following scales:

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

LL1, a Log Log scale.

DF, a full length D scale folded. This arrangement admits of the handling of factors which, in rules without these scales, would frequently require the slide to be reset. Since the constant π is in alignment with the indices of the C and D scales, π can 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 scale, giving reciprocals of numbers on the CF scale. The inverted scale, in connection with the direct scales, admits of handling three factors with one setting of the slide, or four factors if π is included.

CI, a full length C scale inverted.

C, a single logarithmic scale.

D, a single logarithmic scale like C.

LL3, **LL2,** full unit length Log Log scales, which with LL1 form a continuous log log scale from 1.01 $(e^{.01})$ to 22,000 (e^{10}).

On the reverse face are the following scales:

LLO, a Log Log scale of decimal quantities from 0.999 to 0.905, referred to the A and B scales.

LLOO, a Log Log scale of decimal quantities from 0.905 to 0.0000454. It is continuous with LLO.

A, a two unit logarithmic scale giving directly squares and square roots.

B, a two unit logarithmic scale exactly like A.

T, a full length scale of Tangents and Cotangents, double numbered from 5°44′ or 5.73° to 84°17′ or 84.28°.

ST, a full length scale of Sines and Cosines, numbered from 0°34′ or 0.58° to 5°44′ or 5.73°.

S, a full length scale of Sines and Cosines, double numbered from 5°44′ or 5.73° to 90° for Sines, and from 0° to 84°16′ or 84.26° for Cosines.

D, a single logarithmic scale.

DI, a full length D scale inverted.

K, a three unit logarithmic scale, giving directly cubes and cube roots.

No. 4080-3. Front.

LOG LOG DUPLEX TRIG
TRADE MARK
AND
LOG LOG DUPLEX DECITRIG
TRADE MARK
SLIDE RULE.

Since these slide rules have all the scales of **Nos. 4070** and **4071**, they can be employed for exactly the same purposes, and in exactly the same manner, as described on pages 313b and 313c. However, since they are also equipped with the Log Log Scales, their scope is considerably increased.

The **value of the Log Log Scales** is best appreciated in determining powers and extracting roots. 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 this involves 4 settings of the indicator, one setting of the slide, and 3 scales. With the Log Log scales, only 2 settings of the indicator, one setting of the slide, and 2 scales are required. No inspection of the result is necessary where the Log Log scales are employed, since the answer as found is already pointed off.

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. An improvement has been made through the addition of scale LLOO, which, together with scale LLO forms one continuous scale of decimal quantities from 0.0000454 to 0.999, thus giving a wider range than the usual LLO scale (0.05 to 0.97) by direct reading, and without requiring any recourse to calculation to determine the values not included in the LLO scale.

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

$$y = \frac{a}{2}\left(e^{\frac{x}{a}} + e^{-\frac{x}{a}}\right) \qquad C = \frac{l}{2\log_e \frac{l_1}{r}} \qquad R = \frac{It}{C\,(\log_e E_1 - \log_e E_2)}$$

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.

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

No. 4080-3 Back.

LOG LOG DUPLEX VECTOR
REG. U. S. PAT. OFF.
SLIDE RULES.

4083-3. LOG LOG DUPLEX VECTOR Slide Rule, **K & E**
Adjustable, 10 in., engine divided, divisions
on white facings, improved Glass Indica-
tor; in Case, with Directions . . . . . each

4083-3S. Same as No. 4083-3 but in sewed Leather
Case . . . . "

4083-5. Similar to No. 4083-3 but 20 in . . . . . "
(See note under No. N4053-5S page 312a).

4083-5S. Same as No. 4083-5 but in sewed Leather
Case . . . . "

The **LOG LOG DUPLEX VECTOR Slide Rule** is of particular value to
electrical engineers and students of electrical engineering.

On one face are the following scales:

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

LL1, a Log Log scale.

DF, a full length D scale folded. This arrangement admits of
the handling of factors which, in rules without these scales,
would frequently require the slide to be reset. Since the
constant π is in alignment with the indices of the C and D
scales, π can 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 scale, giving reciprocals of
numbers on the CF scale. The inverted scale, in connection
with the direct scales, admits of handling three factors with
one setting of the slide, or four factors if π is included.

CI, a full length C scale inverted.

C, a single logarithmic scale.

D, a single logarithmic scale like C.

LL3, LL2, full unit length Log Log scales, which with LL1 form
a continuous log log scale from 1.01 (e^{.01}) to 22,000 (e^{10}).

On the other face of the rule are the following scales:

LLO, a Log Log scale of decimal quantities from 0.999 to 0.905, re-
ferred to the A and B scales.

LLOO, a Log Log scale of decimal quantities from 0.905 to 0.0000454.
It is continuous with LLO.

A, a two unit logarithmic scale giving directly squares and
square roots.

B, a two unit logarithmic scale exactly like A.

T, a full length scale of Tangent and Cotangents, double
numbered from 5.73° to 84.28°.

ST, a full length scale of Sines and Cosines, numbered from
0.58° to 5.73°.

S, a full length scale of Sines and Cosines, double numbered
from 5.73° to 90° for sines, and from 0° to 84.26° for cosines.

D, a single logarithmic scale

Th, a scale of Hyperbolic Tangents.

Sh1, Sh2, a continuous scale of Hyperbolic Sines in two parts.
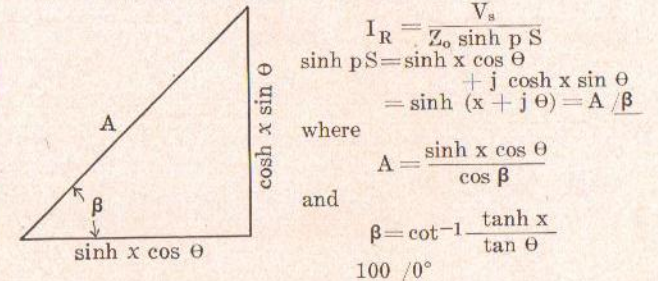
No. 4083-3. Front.

LOG LOG DUPLEX VECTOR
REG. U. S. PAT. OFF.
SLIDE RULE

The value of the Hyperbolic Functions will best be appreciated
by Electrical Engineers dealing with steady-state power or telephone
transmission. For instance, where the constants and terminal con-
ditions of an alternating-current line-conductor are known, the po-
tential, current, and power can be computed, through the use of these
scales, in a fraction of the time (and with far less labor) required
by any other means.

The following example indicates the ease of the slide rule
solution:

Find the steady-state current flowing into the short circuit at
the end of a transmission line of No. 10 B & S gauge copper wire
whose length S=25 miles; whose propagation constant p=0.0292 $\underline{/71.8°}$
complex hyperbolic radians; whose characteristic impedance
Z_0=723 $\underline{/-11.1°}$ vector ohms; and whose difference of potential impressed
at the sending end, V_S=100 $\underline{/0°}$ volts at a frequency of 800 cycles per
second.

The steady-state current flowing into the short circuit at the
end of the transmission line, is represented by

$$I_R = \frac{V_s}{Z_o \sinh p S}$$

$$\sinh pS = \sinh x \cos \Theta$$
$$+ j \cosh x \sin \Theta$$
$$= \sinh (x + j \Theta) = A \underline{/\beta}$$

where

$$A = \frac{\sinh x \cos \Theta}{\cos \beta}$$

and

$$\beta = \cot^{-1} \frac{\tanh x}{\tan \Theta}$$

$$I_R = \frac{100 \underline{/0°}}{723 \underline{/-11.1°} \sinh (25 \times 0.0292 \underline{/71.8°})}$$

To 0.0292 on D set left index of C.
Move indicator to 25 on C.
To indicator set right index of slide.
At 71.8° on S (black) read 0.694 on D.
At 71.8° on S (red) read 0.228 on D.
Consequently,
pS=25×0.0292 $\underline{/71.8°}$ = 0.228 ÷ j 0.694 radians
To π on DF set 180 on CF.
At 0.694 on DF read 39.76° on CF.
sinh pS= sinh (0.228 + j 39.76°)
Θ = 39.76° is less than 45°, but greater than 5.75°.
To 0.228 on scale Th set 39.76° on T (black).
Since the slide protrudes to the left, β is greater than 45°
and should be read on scale T (red).
Set indicator to right index of slide, and match the indexes
of the body and slide.
At indicator read β=74.92° on T (red).
To x = 0.228 on scale Sh1 set β=74.92° on scale S (red).
At Θ = 39.76° on scale S (red) read A=0.680 on scale D.
sinh pS = 0.680 $\underline{/74.92°}$
Consequently,
$$I_R = \frac{100 \underline{/0°}}{723 \underline{/-11.1°} \times 0.680 \underline{/74.92°}}$$

To right index (100) of D set 723 on C.
At 0.680 on CI read 0.2032 on D.
I_R =0.2032 $\underline{/-63.82°}$ amperes with respect to the phase
of the impressed voltage.

Problems involving complex hyperbolic cosines and hyperbolic
tangents can be solved by similar methods. The determination of
inverse hyperbolic functions of complex numbers is also greatly
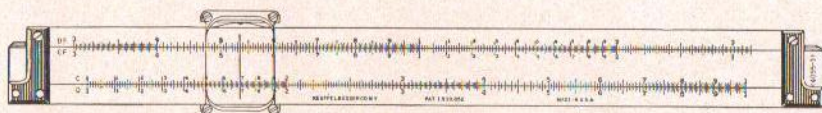facilitated.

No. 4083-3. Back.
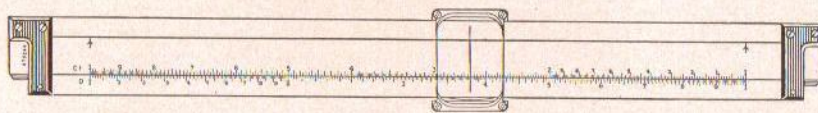
MERCHANTS' SLIDE RULE.
TRADE MARK

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

4094. **MERCHANTS'** (Mannheim) Slide Rule, **K & E Adjustable,** 10 in.,
engine divided, divisions on white facings, improved
Glass Indicator; in Case with Directions . . . . each

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***
engine divided, divisions on white facings, K & E
"Frameless" Indicator: in sewed Leather Case, with-
out flap, with Directions, ... each

4095-3. MERCHANTS' Slide Rule, **K & E Adjustable,** 10 in., **DUPLEX,***
engine divided, divisions on white facings, improved
Glass Indicator; in Case, with Directions, ... each

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

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.

* REG. U. S. PAT. OFF.

K & E DESK SLIDE RULE
REG. U. S. PAT. OFF.
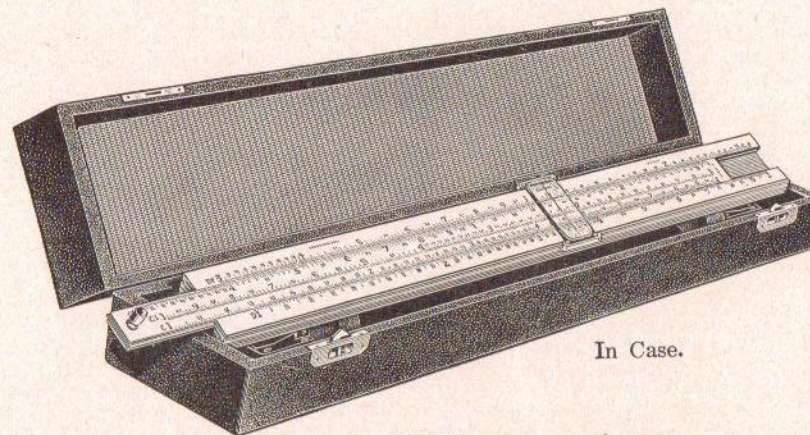
In Case.

No. N4096.
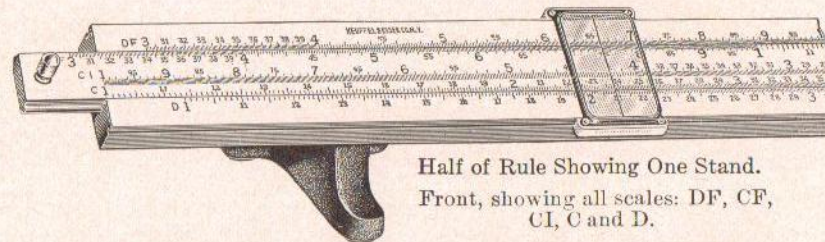
Half of Rule Showing One Stand.
Front, showing all scales: DF, CF,
CI, C and D.

N4096. Desk Slide Rule (Mannheim), **K & E Adjustable,** 20 in., engine divided, divisions on white facings, improved Glass Indicator; on metal stands; in leatheret covered case with directions . . . each

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. The arrangement of the scales admits of the handling of factors which, in rules without this arrangement, 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 1¾ 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 3¾ lb.

4096M. Desk Slide Rule (Mannheim), 20 in., similar to No. N4096 but without stands, without the nickel silver knob, and in plain morocco-covered case, with directions. . . . . each

KEUFFEL & ESSER CO. NEW YORK

KEUFFEL & ESSER CO. NEW YORK

EVER-THERE SLIDE RULES.
REG. U. S. PAT. OFF.

The **EVER-THERE Slide Rules** are made entirely of white Xylonite, a strong, tough material. On this base the graduations are engine-divided. The handiness of the **EVER-THERE** slide rules is evident from the fact that they weigh no more than a fountain pen, and are much less bulky in the pocket.

The **Ever-There Slide Rules** Nos. 4097B, C and D are pre-eminently pocket instruments, as the following dimensions will indicate:

Length over all.........6 inches.   Width over all....................1 9/32 inches.
Thickness ....1/8 inch.   Thickness of Indicator..........7/16 inch.
                  Weight...................about 3/4 ounce.

No 4097B

4097B.   EVER-THERE Slide Rule, 5 in., white Xylonite, engine divided, improved Glass Indicator, in high-grade leather sheath, with Directions...each

No. 4097B is old No. 4097

The calculating scales of No. 4097B are all upon the front face. The CF and DF are folded scales, the function of which is to enable factors to be taken without resetting, which would be off the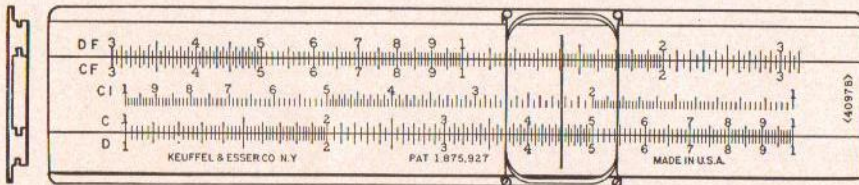 rule when using the regular C and D scales. These folded scales correspond in all respects to the C and D scales, except that each has but one index which is located close to the middle of the rule. The CI scale, an inverted C scale, when used in conjunction with the other scales, enables the operator to take three factors at one setting of the slide and to read reciprocals. The back of the rule has a five inch scale divided in inches to 16ths, and a 13 cm. scale divided in centimeters to millimeters.
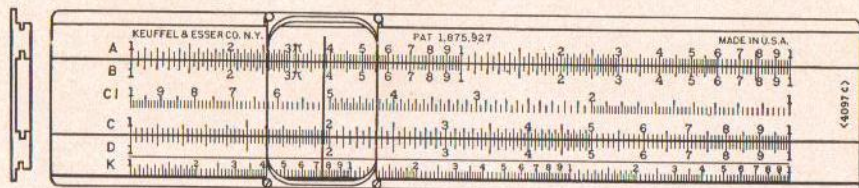
No. 4097C

4097C.   EVER-THERE Slide Rule, 5 in., white Xylonite, engine divided, improved Glass Indicator, **with Logarithmic and Trigonometrical Scales**; in high-grade leather sheath, with Directions....... each

No. 4097C is old No. 4098.

The size, form, weight and handiness of the No. 4097C **EVER-THERE** Slide Rule are identical with those of No. 4097B, as described above. The scales are the same as those described under the **Polyphase*** Slide Rule No. N4053-3, page 312 and are, on the front face, A, B, CI, C, D and K, and on the back of the slide, S, L and T. It has also the inch and centimeter scales as described under No. 4097B above. The slide is reversible.

EVER-THERE SLIDE RULES.
REG. U. S. PAT. OFF.
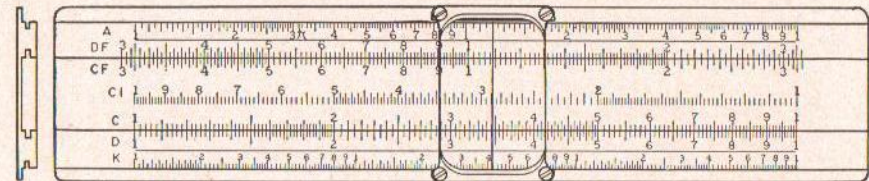
No. 4097D.

4097D.   EVER-THERE Slide Rule, 5 in., white Xylonite, engine divided, improved Glass Indicator; **with Logarithmic, Trigonometrical and Folded Scales**; in high-grade leather sheath, with Directions, each

No. 4097D has the same size, form and weight, as Nos. 4097 B and C. On the front face it carries the A, DF, CF, CI, C, D and K scales, and, on the back of the reversible slide, the B, S, L and T scales. Hence, it has all the scales of the **Polyphase Duplex*** rule (see page 314), except the CIF scale. It also has the inch and centimeter scales on the back of the rule, as described under No. 4097B.

K & E POCKET SLIDE RULE.
REG. U. S. PAT. OFF.
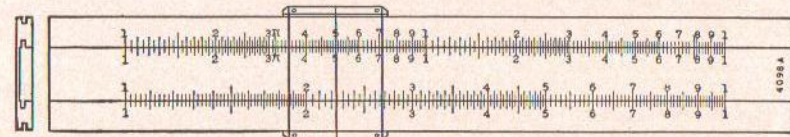
No. 4098A.

4098A.   K & E Pocket Silde Rule, 5 in., white Xylonite, "Frameless" transparent Xylonite Indicator, with **Mannheim Scales**, in leather sheath, with Directions.......................each

The K & E Pocket Slide Rule is made entirely of white Xylonite, a strong, tough material. It weighs less than a fountain pen, and is much less bulky in the pocket. It is pre-eminently a pocket instrument, as the following dimensions will indicate:

Length over all..........6 inches   Width over all ....1 5/32 inches
Thickness ....1/8 inch   Thickness over indicator ......7/16 inch
                 Weight.................about 5/8 ounce

The front face of this rule carries the A, B, C and D scales. The Trigonometric scales S and T, and the Logarithmic Scale L are on the back of the slide, which is not reversible.

The back of the rule has a five inch scale divided in inches to 16ths, and a 13 cm. scale divided in centimeters to millimeters.

KEUFFEL & ESSER CO., NEW YORK

STADIA SLIDE RULES.
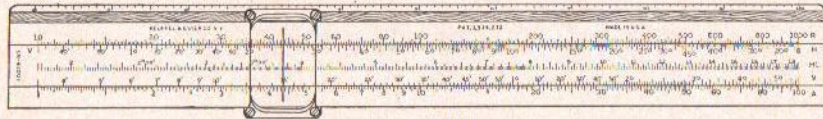
No. N 4100.

N4100. **K & E STADIA** (Mannheim) Slide Rule **K & E Adjustable,**
    engine divided, 10 in. divisions on white facings, im-
    proved Glass Indicator; in Case, ... each
N4100S. Same as No. N4100 but in sewed Leather Case . . . .   "
N4101. **K & E STADIA** Slide Rule like No. N4100, but 20 in.; in
    Case, ...   "
N4101S. Same as No. N4101 but in sewed Leather 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, 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 $\frac{1}{10}$ 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.

Front

Back

No. N 4102

N4102. **SURVEYORS' DUPLEX** Slide Rule, **K & E Adjustable** 20 in.,
    engine divided, divisions on white facings, improved
    Glass Indicator; in Case, with Directions . . . . . . each
N4102S. Same as No. N 4102 but in sewed Leather Case . . . . .   "

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 the observations may be made with great rapidity, the computations are tedious and require a great deal of time.

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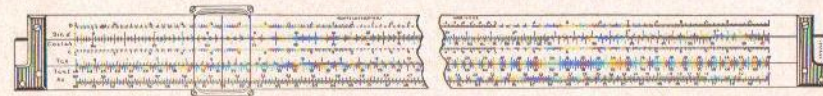
The other face has the usual scales A, B, CI, C and D, for all general numerical calculating, as well as two full length stadia scales for computing horizontal distances and vertical heights.

* REG. U. S. PAT. OFF.

THE ROYLANCE ELECTRICAL
SLIDE RULE.

No. N 4133 S.

N4133S. **ROYLANCE ELECTRICAL** (Mannheim) Slide Rule, **K & E Adjust-
    able,** 8 in., engine divided, divisions on white facings,
    improved Glass Indicator; in sewed Leather Case,
    with Directions . . . . each

The **Roylance Electrical Slide Rule** is a modification of the regular **K & E POLYPHASE*** Slide Rule (page 312a) and **can be used for all the calculations made with the ordinary Slide Rule.** In addition to the usual **POLYPHASE*** 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, and a special set of figures giving the temperature of wire in degrees Centigrade corresponding to resistance in ohms per 1000 feet.

MORRISON RADIO ENGINEER'S
SLIDE RULE.

No. 4138 (front)
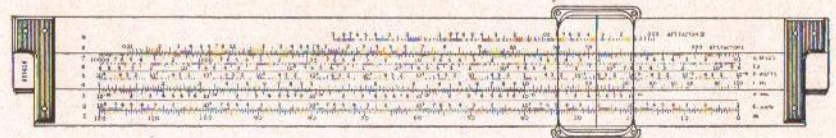
No. 4138 (back)

4138. **MORRISON RADIO ENGINEER'S** Slide Rule, **K & E Adjustable,**
    10 inch, engine divided, divisions on white facings,
    Improved Glass Indicator; in Case with Directions each

4138S. Same as No. 4138, but in sewed Leather Case . . . . . .   "

This Slide Rule was designed primarily for solving the problems most frequently encountered in radio engineering. The nine scales on the back are devoted almost exclusively to the solution of radio propagation over a plane earth for the conductivity case. With two settings of the slide, corresponding values of field intensity for wide ranges of distance, frequency, power, and soil conductivity are obtained. In the Directions are included maps and tables, based upon the most recent data available, showing the average soil conductivity for the various regions of the United States, and some regions in Canada.

The front of the rule is equipped with a special frequency scale, which facilitates the computation of the LC product for a given frequency. The value of inductance, or capacity required to resonate a reactive circuit, as well as the reactance of an inductance or capacity at a given frequency, may be obtained with one setting of the slide.

The front also carries the conventional A, B, C, D, CI, L, and trigonometric scales. The transformation of vectors is accomplished with one setting of the slide.

CHEMIST'S DUPLEX
REG. U. S. PAT. OFF.
SLIDE RULE.
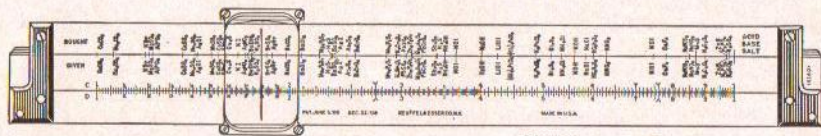
Front.
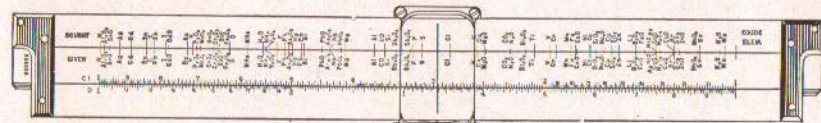
Back.

No. 4160.

4160. **CHEMIST'S DUPLEX** Slide Rules **K & E Adjustable**, 10 in., engine divided, divisions on white facings, improved Glass Indicator; in Case, with Directions . . . . each

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

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.

KURTZ PSYCHROMETRIC
SLIDE RULE.
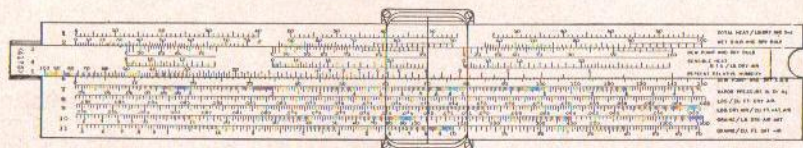
No. 4175.

4175. **KURTZ PSYCHROMETRIC** Slide Rule, 10 in., graduations on white finish, improved Glass Indicator; in Case with Directions each

The calculation of all air conditioning problems, heretofore figured by means of the burdensome psychrometric charts or tables, can now be accomplished by the new **Kurtz Psychrometric Slide Rule**. This rule entirely replaces the psychrometric chart, and it affords a simpler and more accurate means of determining any or all of the necessary air conditioning factors.

One or two settings of the slide on this Slide Rule provide for the determination of the unknown fundamental factors, when two or more of the following fundamental factors are known, viz.: dry bulb temperature, wet bulb temperature, dew point temperature, relative humidity.

In addition, the following properties of air can be read at a glance: vapor pressure in inches of mercury; weight of dry air per cubic foot; weight per cubic foot of saturated air; grains of moisture per pound of dry air; grains of moisture per cubic foot of dry air saturated; total heat (b. t. u.) per pound of dry air saturated with moisture (above 0°); sensible heat (b. t. u.) per pound of dry air (above 0°).

An additional feature is the group of tables and fundamental formulas, pertinent to air conditioning in general, printed on the back of the rule as a handy reference for the user.
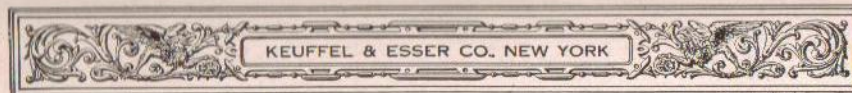
K & E SLIDE RULES.
REG. U. S. PAT. OFF.

IMPROVED GLASS INDICATOR
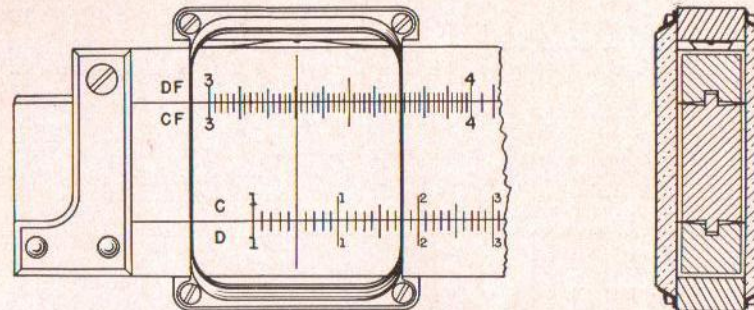
K & E Adjustable Slide Rules, with few exceptions, are now equipped with the K & E Improved Glass Indicator, in which the glass is surrounded and protected by a frame formed from one piece of stainless steel. This metal frame has flanges through which the screws pass to hold the glass to the ends or sliding pieces of the indicator. The frame surrounding the glass does not overlap its faces; hence, every number on the rule is visible at all times. Consequently, the improved indicator offers the chief advantage of the "Frameless" indicator— i.e. visibility—and, in addition, a much greater insurance against damage to the glass.

SEWED LEATHER CASES FOR SLIDE RULES.
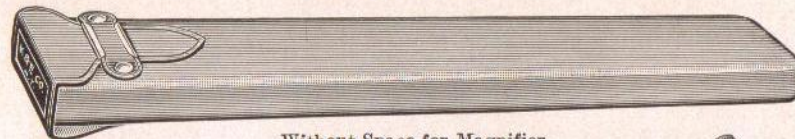
Without Space for Magnifier.
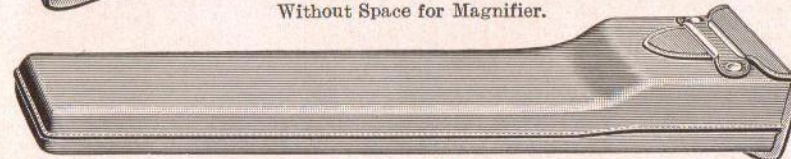
With Space for Magnifier.

Sewed leather cases are made of the best top-grain cowhide, handsewed; and are lined with real chamois. The loop on the case through which the tongue passes has friction springs. These springs insure that the flap will not open accidentally.

KEUFFEL & ESSER CO. NEW YORK

GLASSES,* INDICATORS,* MAGNIFIERS AND CASES

Cat. No. of Slide Rule	Indicator No.	Glass No. Improved	Glass No. "Frameless"	Magnifier No.	Sewed Leather Case No.	Cat. No. of Slide Rule	Indicator No.	Glass No. Improved	Glass No. "Frameless"	Magnifier No.	Sewed Leather Case No.
4031 S	A	......	1	4185 A	O	N 4088-5S	IaL	7L	7	4185 C	Z
4035 S	B	......	2	......	P	4090-3 / 4090-3S / 4091-3 / 4091-3S	IL	7L	7	4185 C	X
N 4035 S	EL	4L	4	4185 B	P						
4041	D	......	3	4185 B	R						
N 4041 / N 4041 S	EL	4L	4	4185 B	R	4092-3 / 4092-3S	IL	7L	7	4185 C	X
4041 F	D	......	3	4185 B	R	4092-5	IL	7L	7	4185 C	Z
N 4041 F / N 4041 FS	EL	4L	4	4185 B	R	N 4092-5	IaL	7L	7	4185 C	Z
						4092-5S	IL	7L	7	4185 C	Z
4045 / 4045 S	EL	4L	4	4185 B	S	N 4092-5S	IaL	7L	7	4185 C	Z
4051 / 4051 S	EL	4L	4	4185 B	T	4093-3 / 4093-3S	IL	7L	7	4185 C	X
4053-2S	FL	4L	4	4185 B	P	4093-5 / 4093-5S	IaL	7L	7	4185 C	Z
N 4053-2S	EL	4L	4	4185 B	P	4094	EL	4L	4	4185 B	R
4053-3	FL	4L	4	4185 B	R	4095	H	......	5	4185 B	W
N 4053-3	EL	4L	4	4185 B	R	4095-1S	K	......	8	......	U‡
4053-3F	FL	4L	4	4185 B	R	4095-3 / 4095-3S	GL	6L	6	4185 B	W
N 4053-3F	EL	4L	4	4185 B	R	4095-5 / 4095-5S	IL	7L	7	4185 C	Z
4053-3FS	FL	4L	4	4185 B	R	4096	EL	4L	4	4185 B	......
N 4053-3FS	EL	4L	4	4185 B	R	N 4096	JL	7L	7	4185 C	......
4053-3S	FL	4L	4	4185 B	R	4096 M	JL	7L	7	4185 C	......
N 4053-3S	EL	4L	4	4185 B	R	4097	N2	......	......	......	AA‡
4053-5	FL	4L	4	4185 B	T	4097 B / 4097 C / 4097 D	N2	......	......	......	AA‡
N 4053-5	EL	4L	4	4185 B	T						
4053-5S	FL	4L	4	4185 B	T	4098	N2	......	......	......	AA‡
N 4053-5S	EL	4L	4	4185 B	T	4098 A	N3	......	......	......	BB‡
4055	EL	4L	4	4185 B	......	4100	D	......	3	4185 B	R
4056	M2	......	......	......	......	N 4100	EL	4L	4	4185 B	R
4058	Cell.	......	......	......	......	4100 S	D	......	3	4185 B	R
4058 C	M1	......	......	......	......	N 4100 S	EL	4L	4	4185 B	R
4058 W	M2	......	......	......	......	4101 / 4101 S / N 4101 / N 4101 S	EL	4L	4	4185 B	T
4059	Cell.	......	......	......	......						
4070-3 / 4070-3S / 4071-3 / 4071-3S	PL	9L	...	4185 D	W						
						4102	IL	7L	7	4185 C	Z
4080-3 / 4080-3S / 4081-3 / 4081-3S	IL	7L	...	4185 C	X	N 4102	IaL	7L	7	4185 C	Z
						4102 S	IL	7L	7	4185 C	Z
4080-5 / 4080-5S / 4081-5 / 4081-5S	IaL	7L	...	4185 C	Z	N 4102 S	IaL	7L	7	4185 C	Z
						4128 / 4128 S	IL	7L	7	4185 C	Z
4083-3 / 4083-3S	IL	7L	...	4185 C	X	4133 S	C	......	2a	......	P
4083-5 / 4083-5S	IaL	7L	...	4185 C	Z	N 4133 S	EaL	4aL	4a	4185 B	P
4088-1S	K	......	8	......	U‡	N 4135 S	K	......	8	......	U‡
4088-2S	GL	6L	6	4185 B	V	4138 / 4138 S	IL	7L	...	4185 C	X
4088-3 / 4088-3S	GL	6L	6	4185 B	W	4142 / 4142 S	IL	7L	7	4185 C	Z
4088-5	IL	7L	7	4185 C	Z	4160 / 4160 S	IL	7L	7	4185 C	X
N 4088-5	IaL	7L	7	4185 C	Z	4165	EL	4L	4	4185 B	R
4088-5S	IL	7L	7	4185 C	Z	4166	IaL	7L	7	4185 C	Z
						4175	JL	7L	...	4185 C	......

*In many cases indicator glasses are listed for both the Improved and "Frameless" indicators to enable replacements to be made by those who have the "Frameless" Indicators. Where a complete indicator is needed, only the Improved one will be supplied.   ‡Sewed leather sheath.

†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,

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GLASSES, INDICATORS, MAGNIFIERS AND CASES.

(continued)

In many cases indicator glasses are listed for both the Improved reinforced and "Frameless" indicators to enable replacements to be made by those who have the "Frameless" indicators. Where a complete indicator is needed, only the improved one will be supplied.

Indicators	Glasses	Sewed Leather Cases	
A, B, D.....each	**Glass only**	**Plain**	**Space For Magnifier**
C......... "	1, 2, 3, 4...each	O........each	OM......each
EL......... "	2a 4a...... "	U......... "	PM, VM.. "
EaL......... "	5, 6, 8...... "	P, V...... "	RM...... "
FL......... "	7.......... "	R......... "	XM...... "
GL,......... "	4L, 6L..... "	S......... "	SM........ "
H, K.... "	4aL........ "	T......... "	TM...... "
IL, IaL.... "	7L.......... "	W, X...... "	WM...... "
JL......... "	9L.......... "	Z......... "	ZM...... "
M1......... "		‡AA....... "	
M2......... "		‡BB....... "	
N......... "			
N2......... "		‡Sewed leather sheath	
N3......... "			
P......... "			

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, 4L, 4a, 4aL..............extra

    Nos. 5, 6, 6L, 7, 7L, 8, 9L................. "

Improved Glass Indicator, with two additional hairlines spaced to a stated ratio,.......................................extra each

MAGNIFIERS FOR SLIDE RULES.

PAT. J. 9
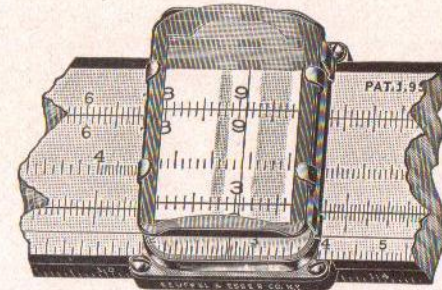
No. 4185 B.

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 330b.

4185 A.   Magnifier for Slide Rules, ... each
4185 B.   Magnifier for Slide Rules, ... "
4185 C.   Magnifier for Slide Rules, ... "
4185 D.   Magnifier for Slide Rules, ... "

BOOKS ON THE SLIDE RULE.

The following are Self-Teaching Manuals, with Tables of Settings, Equivalents and Gauge Points; prepared by competent authorities, and applying specifically to K & E Slide Rules:

4187 G.	"The Mannheim Slide Rule",	each
4187 H.	"The Polyphase Slide Rule",	"
4187 I.	"The Polyphase Duplex Slide Rule",	"
4187 J.	"The Log Log Duplex Slide Rule",	"
4187 L.	"The Log Log Trig Slide Rule",	"
4187 P.	"The Log Log Decitrig Slide Rule",	"
4187 R.	"The Log Log Duplex Trig Slide Rule",	"
4187 S.	"The Log Log Duplex Decitrig Slide Rule",	"
4187 T.	"The Polyphase Duplex Trig Slide Rule",	"
4187 U.	"The Polyphase Duplex Decitrig Slide Rule",	"
4187 V.	"The Log Log Duplex Vector Slide Rule",	"
Special	"The Morrison Radio Engineer's Slide Rule",	"

May 15th, 1939.

PRICE LIST OF

K & E SLIDE RULES
REG. U. S. PAT. OFF.

THACHER	each
N4012	$70.00
N4013	80.00
SPERRY	
4017	27.50
MANNHEIM	
4031S	4.00
N4035S	7.00
N4041	6.20
N4041S	7.00
POLYPHASE*	
N4053-3	7.00
N4053-3S	7.80
N4053-3F	15.00
N4053-3FS	15.80
N4053-5	17.50
N4053-5S	19.00
FAVORITE	
4055	3.50
4056	2.50
BEGINNERS'	
4058	.75
4058C	1.00
4058W	1.25
4059	.50
POLYPHASE DUPLEX* TRIG	
4070-3	10.25
4070-3S	11.25
POLYPHASE DUPLEX DECITRIG*	
4071-3	10.25
4071-3S	11.25
LOG LOG DUPLEX* TRIG	
4080-3	11.75
4080-3S	12.75
4080-5	25.30
4080-5S	27.00
LOG LOG DUPLEX DECITRIG*	
4081-3	11.75
4081-3S	12.75
4081-5	25.30
4081-5S	27.00

LOG LOG DUPLEX VECTOR*	each
4083-3	13.00
4083-3S	14.00
4083-5	30.00
4083-5S	31.70
4085A-C (new No. 4185A-C)	
4087G-J (" " 4187G-J)	
POLYPHASE DUPLEX*	
4088-2S	5.00
LOG LOG TRIG	
4090-3	7.00
4090-3S	8.00
MERCHANTS'	
4094	5.50
4095-1S	3.00
4095-3	6.00
4095-3S	7.00
DESK	
N4096	20.00
4096M	15.00
EVER-THERE*	
4097 (new No. 4097B)	
4097B (old 4097)	3.00
4097C (old 4098)	3.75
4097D	4.25
4098 (new No. 4097C)	
POCKET	
4098A	1.75
STADIA	
N4100	7.00
N4100S	7.80
N4101	16.00
N4101S	17.50
SURVEYOR'S DUPLEX*	
N4102	26.00
N4102S	27.70
ROYLANCE ELECTRICAL	
N4133S	9.00
MORRISON RADIO ENGINEER'S	
4138	20.00
4138S	21.00

*REG. U. S. PAT. OFF.

CHEMIST'S DUPLEX*		each
4160	....	$12.00
4160S	....	13.00

KURTZ PSYCHROMETRIC

| 4175 | .... | 5.00 |

MAGNIFIERS

4185A (old 4085A)	....	2.25
4185B (old 4085B)	....	2.50
4185C (old 4085C)	....	2.75
4185D	....	2.50

BOOKS

| 4187G to 4187V | | |
| (old 4087G etc.) | .... | .50 |

CASES

Sewed Leather

O	....	1.15
P	....	1.35
R	....	1.50
S	....	2.50
T	....	2.80
U	....	.65
V	....	1.35
W—X	....	1.70
Z	....	3.00
AA	....	.40
BB	....	.30

CASES

Sewed Leather with space
 for Magnifier

O M	....	2.50
P M	....	2.75
R M	....	3.00
S M	....	4.00
T M	....	4.30
V M	....	2.75
WM—XM	....	3.20
Z M	....	4.50

INDICATORS		each
A—B	....	$ .60
C	....	.80
D	....	.60
EL	....	.65
EaL	....	.80
FL	....	.75
GL, H	....	1.20
IL—IaL	....	1.35
JL	....	.90
K	....	1.20
M1 (old M)	....	.25
M2	....	.35
N2	....	.50
N3	....	.35
PL	....	1.25

GLASSES

No. 1—2	....	.25
2a	....	.40
3, 4, 4L	....	.25
4a—4aL	....	.40
5, 6, 6L	....	.25
7—7L	....	.35
8	....	.25
9L	....	.30

Glasses No. 1, 2, 2a, 3, 4, 4L,
 4a, 4aL fitted, extra .... .10

Glasses No. 5, 6, 6L, 7, 7L, 8, 9L
 fitted extra .... .20

Improved Glass Indicator with
two additional hairlines
spaced to a stated ratio,
extra .... .50