INSTRUCTIONS

FOR THE USE OF

A. W. FABER'S

IMPROVED

"CASTELL"

PRECISION CALCULATING RULE

№ 361.

MANUFACTORY ESTABLISHED 1761.

Gold and First-class Prize Medals.

GRAND PRIX (highest award) PARIS 1900.

GRAND PRIZE (highest award) ST. LOUIS 1904.

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BRIEF INSTRUCTIONS FOR THE USE OF THE RULE.

Introduction.

By the aid of the Calculating Rule, multiplication and division and similar, often rather complicated calculations, can be effected with speed and certainty as well as a degree of accuracy, sufficient for practical purposes.

In addition, special Calculating Rules have been provided, for advantage of carrying out an entire series of algebraic and technical calculations, so that the Calculating Rule has now become indispensable to the student, engineer and the practical man.

The following brief instructions only indicate the fundamental calculations which can be carried out with the Calculating Rule. For special study the guide issued in book form is recommended; this contains numerous examples, with figures, furnishing the student with an excellent introduction to the practical application of the Calculating Rule.

Definitions.

In the following instructions, the several parts of the Calculating Rule will be briefly referred to as follows: The two parts firmly connected with each other is the "rule"; the part movable in the rule is the "slide", and the sliding aluminium frame, carrying a glass plate with a line across it, is the "cursor". The graduations on the rule and slide from 1 to 100 are called the "upper scales", and those from 1 to 10, on the lower part of the rule, the "lower scales".

The graduations on the rule represent graphically the logarithms of the numbers from 1 to 10 and from 1 to 100, as well as the logarithms of the trigonometrical functions. Multiplication and division can be carried out on the upper, as well as on the lower scales. In the upper scale, the distance, 1 to 10, is equal to that of 10 to 100, and the entire length of 1 to 100, is equal to the length of 1 to 10 on the lower scale. In consequence, the accuracy of the readings is greater by one decimal on the lower scale than on the upper one. The upper scale should be used chiefly where great accuracy is not important or for combined multiplication and division, which, however, can be executed also on the lower scales.

Multiplication.

Two numbers are multiplied together by adding the distances corresponding to the numbers on the rule and slide.

Example 1. Fig. 1: $2{\cdot}45 \times 3{\cdot}0 = 7{\cdot}35$.

Set 1 on the slide under 2·45 on the upper scale, place the line on the cursor over 3 on the slide, and read off the product, 7·35, on the upper scale of the rule under the line on the cursor.

If the calculation is to be made on the lower scale, place 1 on the slide above 2·45 on the lower scale, move the cursor until its line is above 3 on the lower scale on the slide, and read off the product, 7·35, on the lower scale of the rule.

From the arrangement of the graduations on the upper scale, from 1 to 10 eing equal to 10 to 100, and the whole, 1 to 100, being equal to 1 to 10 on ne lower scale, it is evident that above any number on the lower scale its quare can be read on the upper scale. Reversely, below each number on the pper scale is found its square root on the lower scale.

Example 4. Fig. 4: $3^2 = 9$.

Place the cursor line over 3 on the lower scale, and under the line, ead the square (9) on the upper scale.

Example 5. Fig. 4: $\sqrt{81} = 9$.

Place the cursor line over 81 on the upper scale, and read off under he cursor line, the square root (9) on the lower scale.

The numbers from 1 to 10 are to be placed on the left half, the numbers om 10 to 100 on the right half of the upper scales. If the number is less han 1 or more than 100, proceed as is shown in the following examples.

Example 6. $\sqrt{1922}$; $\sqrt{19 \cdot 22} = 4 \cdot 38$, $\sqrt{1922} = 43 \cdot 8$.

Example 7. $\sqrt{0 \cdot 746}$; $\sqrt{74 \cdot 6} = 8 \cdot 64$, $\sqrt{0 \cdot 746} = 0 \cdot 864$.

Example 8. $\sqrt{0 \cdot 000071}$; $\sqrt{71} = 8 \cdot 43$, $\sqrt{0 \cdot 000071} = 0 \cdot 00843$.

The raising of a number to its third power or the extraction of a cube oot will be most easily shown by an example:

Example 9. Fig. 4: $1 \cdot 4^3 = 2 \cdot 744$.

Set 1 on the lower scale of the slide to 1·4 on the lower scale of the ule; move the cursor line over 1·4 on the upper scale of the slide and read 744 on the upper scale of the rule, under the cursor line.

Example 10. Fig. 5: $\sqrt[3]{1 \cdot 728} = 1 \cdot 2$.

Set the cursor to 1·728 on the upper scale of the rule, move the slide n this case to the right) until the same number (1·2) appears simultaneously n the upper scale of the slide under the cursor line, and on the lower scale f the rule under 1 on the lower scale of the slide.

Example 11. $\sqrt[3]{558} = 8.23$.

Set the cursor to 558 on the upper scale of the rule, move the slide (in his case to the left) until the same number (8·23) appears simultaneously on ne upper scale of the slide and on the lower scale of the rule under 10 on ne lower scale of the slide.

Example 12. $\sqrt[3]{0 \cdot 00006}$; $\sqrt[3]{60} = 3 \cdot 915$, $\sqrt[3]{0 \cdot 00006} = 0 \cdot 03915$.

Example 2. Fig. 2: $7{\cdot}5 \times 2{\cdot}5 = 18{\cdot}75$.

In using the upper scale proceed exactly as in Example 1. When usin the lower scale, however, it will be found that the second factor 2·5 no longe falls within the rule, and reading as before is consequently not possible. I that case, set 10 on the lower scale of the slide above 7·5 on the lower scal of the rule, move the cursor line over 2·5 on the lower scale of the slide, an read under the cursor line 1·875; but, as the setting was made with 10, th correct reading is $1{\cdot}875 \times 10 = 18{\cdot}75$.

As will be evident from these examples, it is immaterial whether th setting is made with the right or the left end of the slide; this only affects th number of places in the result. It also follows from these examples, tha continued multiplication, that is to say, when more than two factors are involve can be carried out very easily, as the intermediate results need not be rea off, it being only necessary to set the cursor to the second factor as befor and to bring one end of the slide under the cursor, when the multiplication b the third factor can at once be made and read off, or further multiplications made

Two numbers are divided, one by the other, by subtracting from on another the distances corresponding to the numbers; the divisor being always subtracted from the dividend.

Example 3. Fig. 3: $8{\cdot}25 \div 5{\cdot}5 = 1{\cdot}5$.

Set the cursor to 8·25 on the lower scale, bring 5·5 on the lower scal of the slide under the cursor line and read 1·5 on the lower scale of the rul under 1 of the lower scale of the slide.

If the calculation is to be made with the upper scale, set the cursor t 8·25, bring 5·5 on the upper scale of the slide under the cursor line and rea 1·5 on the upper scale of the rule above 1 on the upper scale of the slid

Compound calculations, that is to say, multiplications and divisions i immediate sequence can easily be made with the Calculating Rule. The inter mediate results need not be read off if it is not necessary to know them, an after the last setting the correct final result will appear. It is best to begi such calculations with a division, then follow with a multiplication, then anothe division and again a multiplication and so on.

Practice is required in order to calculate quickly and with certainty b means of the Calculating Rule. The values of the separate graduations in th several scales must become impressed on the memory, more particularly thos that are not marked with numbers. The estimation of all those numerical value which are not marked on the rule, must be practised, that is to say, the valu of the spaces between adjacent graduations must be learnt. With some practic the requisite accuracy will be obtained, and it will be found that this est mating is not by any means as difficult as it appears at first sight.

The determination of the number of places in the result likewise require some consideration. In nearly all cases the number of figures in the result wi be known beforehand, and consequently only the numerical values come int question in these cases. It is only necessary to observe that the results wi appear correctly on the rule if the factors can be set without changing th slide as explained in Exercise 2. But in division the result must be divided b 10 or 100, when the reading is made with 10 or 100. In the same way, i multiplication, the result must be multiplied by 10 or 100, when the setting i made with 10 or 100, instead of 1. In all cases in which the factors ar greater or less than the readings on the Calculating Rule permit, they mu be brought by division or multiplication by 10, 100 or 1000 etc. to a valu which can be set on the Calculating Rule. Naturally the result has then t be multiplied or divided by 10, 100, 1000 etc. as the case may be.

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Fig. 2.

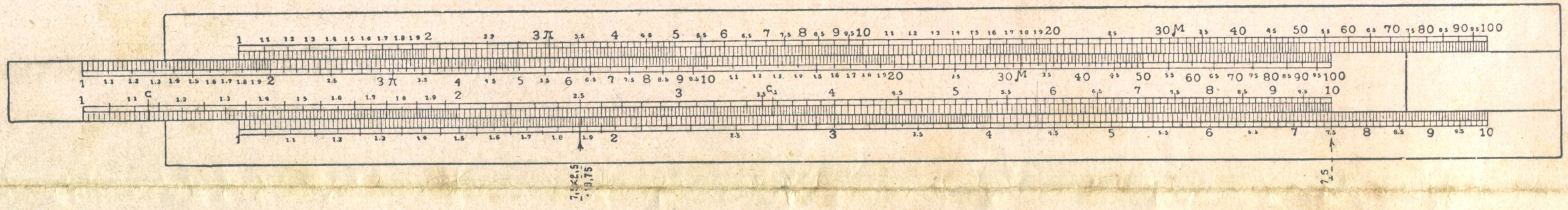

Fig. 3.

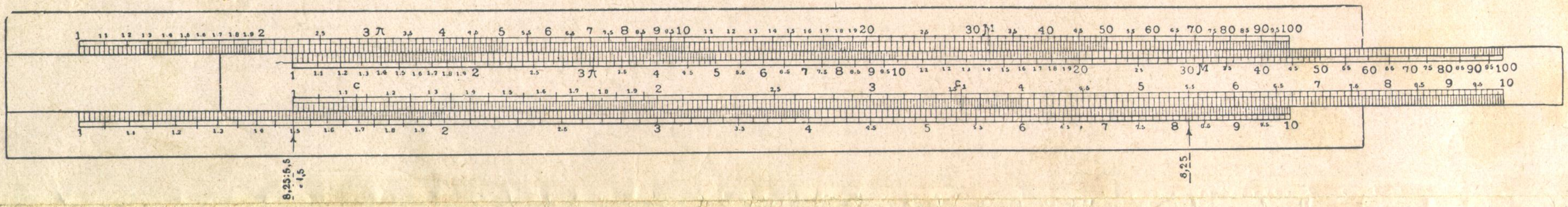

Fig. 4.

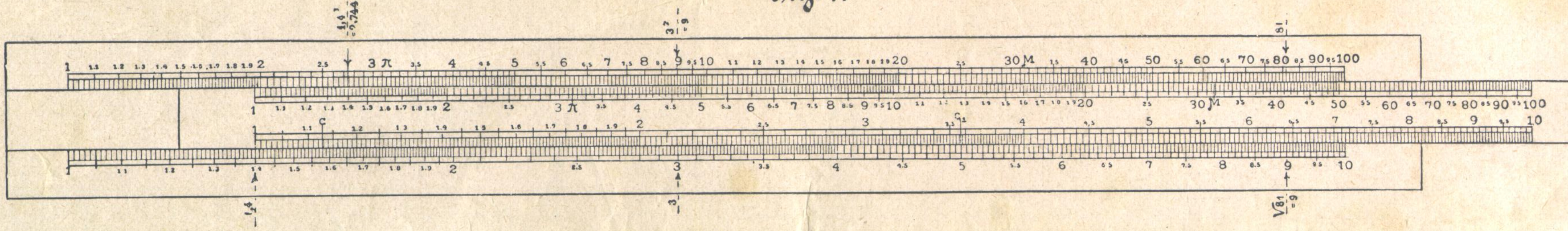

Fig. 5.