The Schnellkalkulator System Bloch:
A Mechanical Nomographic Table

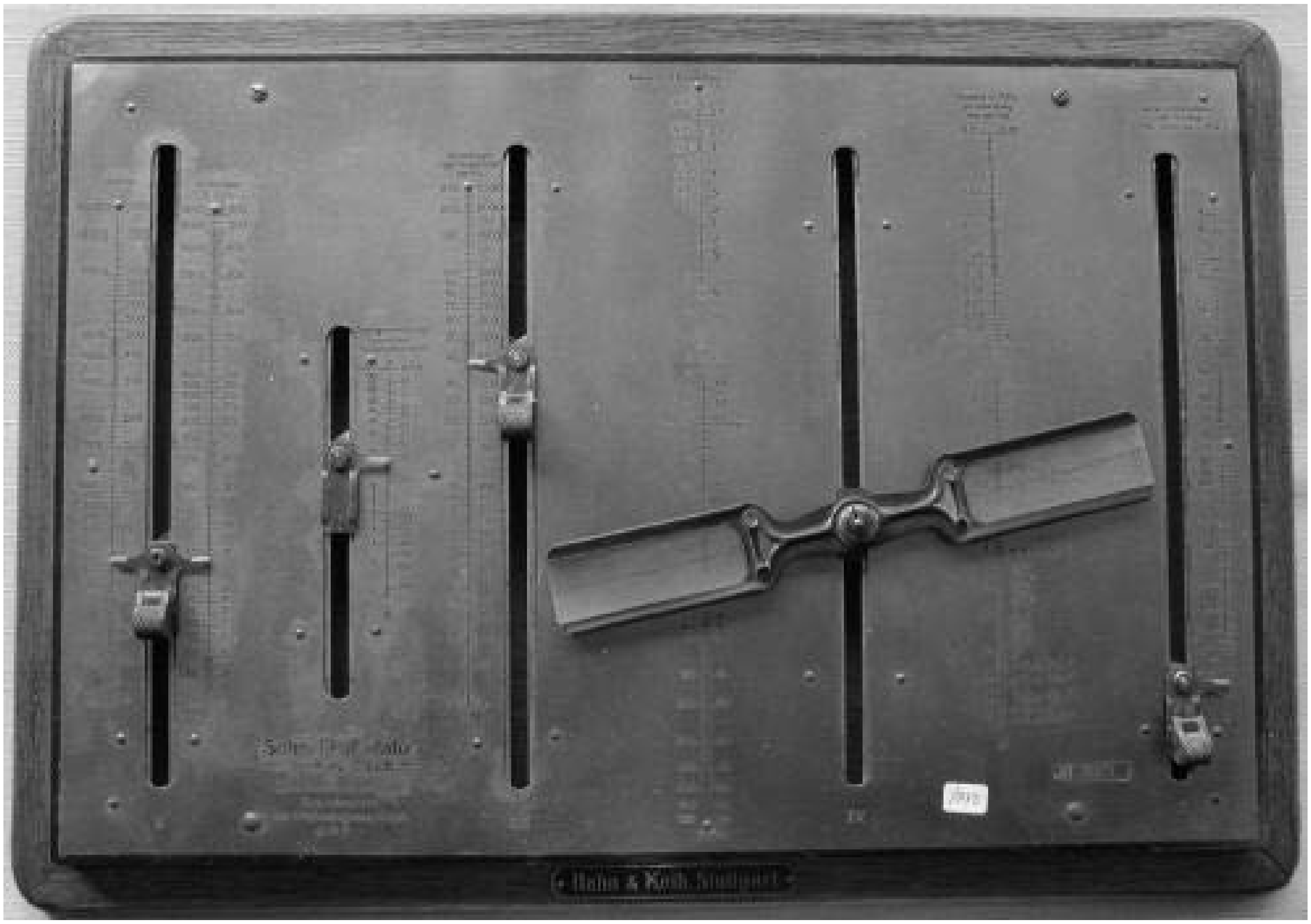


Figure 1.

Werner H. Rudowski

Introduction

Although nomographs contain mainly logarithmic scales, slide rule collectors do not take much notice of nomography. The reason may be that nomographic tables usually can only be found printed in books or on cardboard, and thus they are not very attractive. But there are some mechanical nomographic calculating devices which are rather sophisticated and fascinating. The "Schnellkalkulator" (Quick Calculator) by Bloch is such a device. It was also known under the name "Zeitrechner Kalkulus", as shown and discussed by Körwien [2].

It was used to determine the cutting time of machine tools. A thin metal sheet, golden coated, with the size 337 × 225mm is mounted on an oak plate. There are slits "I" to "V" where slides with grips and indicators can be moved. These slides are connected beneath the cover sheet by two bars (Figure 2 shows their position). A cover of oak, not seen in the photograph, protects the calculator from dirt.

It is not known who fabricated the calculator. The company "Hahn + Kolb, Stuttgart" on the label was a trading company that specialized in machine tools and many types of equipment for metal workshops. The company was founded in 1898 and is still active world-wide in the field of tools. Today they are part of the Würth-Group as "Hahn & Kolb Werkzeuge GmbH" in Stuttgart. It is likely that they initiated the fabrication and then sold the Schnellkalkulator.

In a sales catalog of the early 1920s Hahn & Kolb offered the Schnellkalkulator "System Bloch" as Nr. 5623 and mentioned a detailed leaflet Nr. 147. The photograph in the sales catalog shows the serial No. 2146 and "D.R.P.a" (Deutsches Reichs-Patent applied for).

My calculator is punched with the serial number 3211 and "D.R.P." (Deutsches Reichs-Patent). On 2 July, 1919 Georg Bloch in Oberndorf a.N. (located in Southwest Germany) applied for a patent for a Rechentafel (Calculating Table). The patent was granted on 27 January, 1922 by the Reichspatentamt under Patentschrift Nr. 347926 [3].

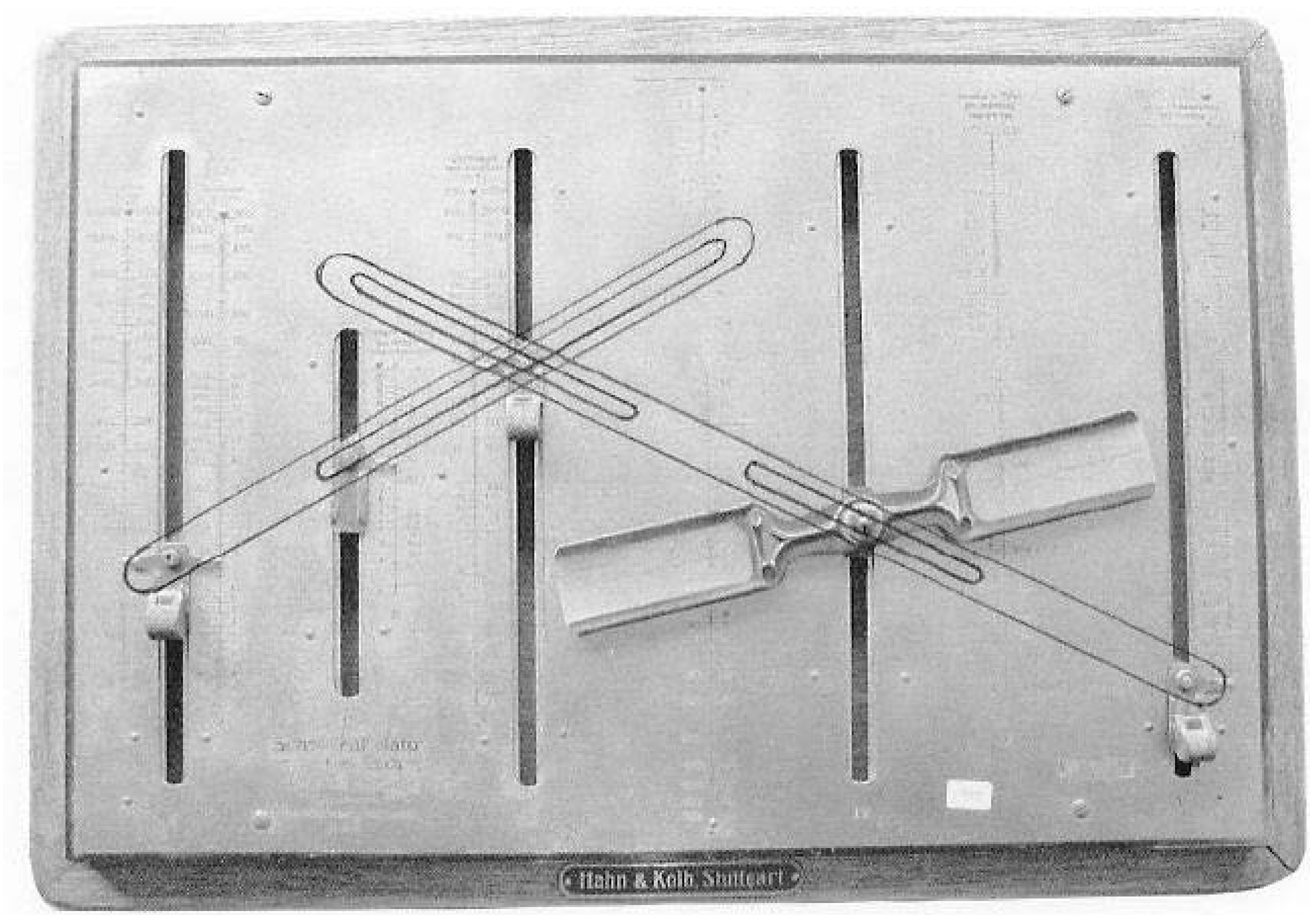


Figure 2.

Therefore this Schnellkalkulator must have been built in the 1920s. Another sample with the serial number 478 and "D.R.P.a" is known. It must have been built between 1919 and 1922. Figure 3 shows a drawing of the device that was part of the patent and is very nearly the same as the completed instrument (Fig. 2). The patent claims only the double pointer N and the bar M, because calculation devices with slits and connecting bars were already known.

The instrument was also offered by the well-known distributor Wichmann, Berlin, in the 1940 catalog (20th edition, p. 457) as number 1313 for a price of 55 Reichsmarks. As with all slide rules and other calculating aids offered by Wichmann, no original manufacturer is named, unfortunately.

Scales

Scales, numbers and inscriptions are engraved and then colored black and red. Scales (from left) *h, d, n,* and *z* show black numbers on the right side and red ones on the left. They differ by a factor of 10, which increases the range of application. In calculations, one always must use scales of the same color.

h = length of stroke in mm	red:	100 to 20,000↑
	black:	10 to 2,000↑
d = diameter in mm	red:	30 to 6,000↑
	black:	3 to 600↑
s = cutting velocity;		
or average velocity		
of table in m/min	left:	1 to 100↑
or m/sec	right:	0.002 to 1.6↑
n = Rounds or	red:	1 to 250↑
double strokes per min	black:	10 to 2,500 ↑
z = Working time in min.,	red:	700 to 0.25 min ↓
seconds	black:	70 min. to 1.5 sec ↓
v = Feed per round or per		
double stroke in mm		5 to 0.01↓
l = Length of work piece		
or drilling depth or		
cutting width in mm		1,000 to 5↓

Scales s are two-cycle; all others are one-cycle.

Left scales h give the single length of stroke where cutting is only done during forward motion, as with planing, shaping, etc. The total length of stroke is the length of the work piece plus some additional way for the tool.

Scales d indicate the diameter of a working piece for turning, or diameter of milling tool or drill.

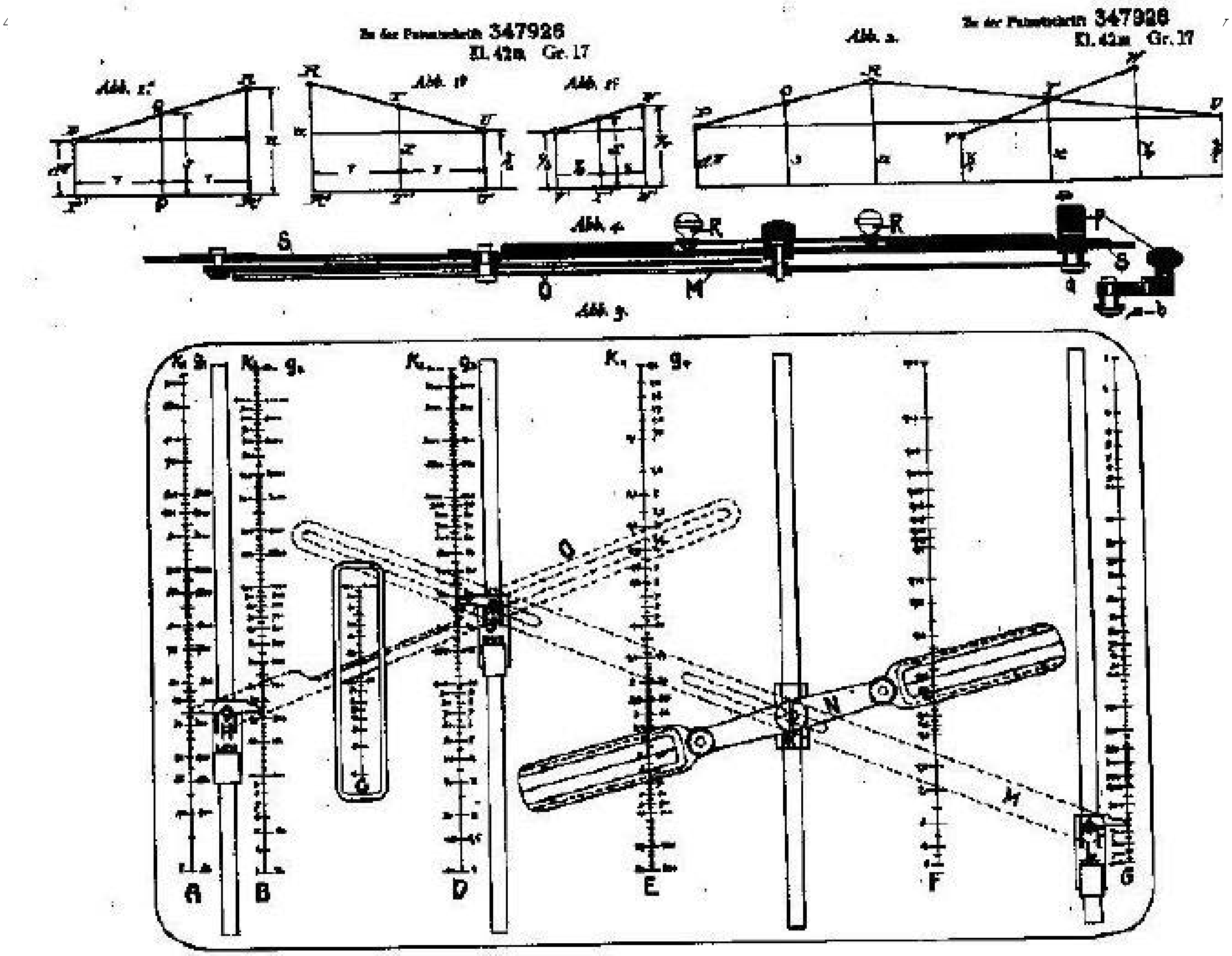


Figure 3.

Scale s means cutting speed in meters per minute for turning motion or average velocity of the table. Scale s is a square scale where all other scales are normal logarithmic.

Scale n gives rounds per minute of the spindle of a turning lathe, a milling or drilling machine or the number of double strokes per minute with planing or shaping machines.

Scale z gives working time in minutes and seconds.

Example: Turning Lathe Works

A shaft of 150mm diameter and a length of 850mm shall be roughly planed. Required are speed of rotation and working time. Depth of turnings (10mm), feed per round (0.5mm) and cutting speed (approximately 20m/min) must be chosen according to experience and the type of material. There are two simple formulas:

$$n = \frac{s \times 1000}{d \times \pi} \qquad (1)$$

or

$$s = \frac{d \times n \times \pi}{1000}$$

$$z = \frac{l}{n \times v} \qquad (2)$$

With an ordinary slide rule the required data can be calculated very easily:

$$n = \frac{20 \times 1000}{150 \times \pi} = 42.4/\text{min}$$

We choose 40 min^{-1} with a cutting speed of 18.85 m/min:

$$z = \frac{850}{40 \times 0.5} = 42.5/\text{min}$$

Side rule collectors know of a great number of special slide rules for machine time calculating. Therefore, why such a complicated, rather huge and certainly rather expensive “Schnellkalkulator”? The answer is obvious: In 1919 special slide rules for machine time calculating were not available in Germany, or at least not in common use, although the American slide rules designed long before by Taylor and Barth were known to experts [6]. In Germany Faber-Castell received the DRGM 773529 (registered design) in 1920 for their “Dr. Winkel” slide rule for machine time calculating (Nr. 348, later 1/48 and 111/48) [7].

Dennert & Pape in their 1919 catalog offered as Nr. 27 the “Betriebs-Rechenschieber, System Friedrich und Hippler, DRGM”. A little bit later in 1921 Dennert & Pape obtained the DRGM 818274 for System “Kresta” (52/23).

The Kresta looks more sophisticated than the Friedrich and Hippler, as can be seen from the 1924 catalog [8].

It is remarkable that all these patent applications fell into the years following the end of WWI, indicating a revolution in industrial fabrication and the need to make better use of machines and tools.

In the preface of the instructions [1] the inventor praised the advantages of the Schnellkalkulator as follows:

> The efficiency of machine tools shall be determined in advance and unforeseen occurrences or arbitrariness of foreman and workers shall be avoided. To fulfill such high requirements one had tried to make this calculation as effective as possible. Therefore one had introduced many expedients in order to avoid lengthy calculations with the given formula. But this had limited success, because curves, tables, etc., made calculation often troublesome and led to errors and inaccuracies, and because relationship of the different factors mostly is not clear, and thus control is very time consuming.
>
> All these disadvantages are completely avoided by the Schnellkalkulator. Handling is amazingly simple and allows immediate use even for unskilled staff. It is sufficient to set the pointers to the given values and to find immediately—without any other aids—the required information. Another advantage is the fact that the result can be checked, because all values used during the entire process of calculation remain.
>
> Due to the previously unrivalled rapidity for determining the required data, and due to the extraordinary simplicity of handling, and due to immediate control possibility, this Schnellkalkulator is one of the most important advantages in the field of workshop organization and thus is an essential aid for administration and workshop of any modern company.

But how did the inventor convert the two formulas into nomographic scales and how did he connect them? Georg Bloch explains that in detail in the patent [3]. The diagrams in the upper part of Fig. 3 refer to this description. The following is a short explanation:

If one uses two parallel logarithmic scales of one cycle each (ladders in nomography), and a third scale with two cycles which is placed exactly between the two other scales, the product of any two numbers can be found (Fig. 4) because:

$$\frac{\log a + \log b}{2} = \log c \quad \text{(arithmetic average)}$$

$$\log a + \log b = 2 \log c$$

Any constants–in formula (l) : $\pi/1000$--are taken into account by addition of their logarithms, i.e., shifting of the middle scale, here of the s scale.

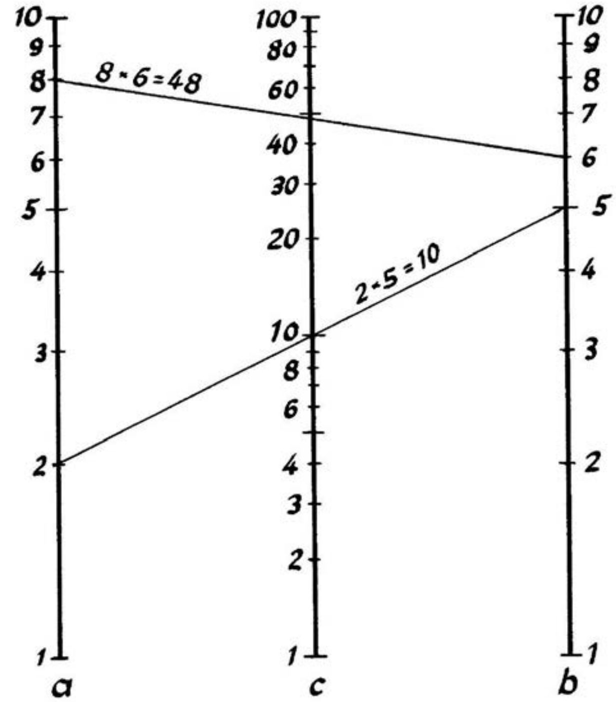


Figure 4.

For our example, first the diameter (150 mm) is set on scale d and then on scale s the allowed cutting velocity (20 m/min), i.e., strictly speaking the product $(d \times n \times \pi)/1000$. For this the grip for scale n has to be moved. On scale n one finds the accompanying speed of rotation (42.4 min -1). As 40 RPM shall be used, one sets this new value on scale n and finds 18.85 m/min on scale s.

If the chosen speed of rotation is fixed or stored on scale n, the design of the Schnellkalkulator prevents this value from being moved unintentionally when one sets a value on scale l, because the scale n indicator can only be moved when the grip is pushed down.

If formula (2) is rewritten as

$$z \times v = \frac{l}{n} \text{ or } z \times v = l \times \frac{1}{n}$$

one gets again a multiplication. The product $z \times v$ would appear in slit "V"; but is not shown because it is not of interest. However, by turning the double pointer, the product is split and one gets the required working time on z by choosing the feed on v (thickness of turnings). This example is shown on Figs. 1 and 2.

Besides the working step "Turning of a lengthy piece" also the speed of rotation and working times for other tasks can be determined, like turning of discs, grinding, milling, drilling, threading, planing, and shaping.

Georg Bloch received two additional patents which are improvements or alterations of the original patent for the

"Rechentafel" (Schnellkalkulator). It is not known, but is very unlikely that these alterations were ever produced. Should an example some day appear on the market it would certainly make a good article for this journal.

Patent Nr. 361708 [4] of Oct. 1922 allows reading of the double logarithmic scale more exactly, because with the help of a lever, the length of this scale is doubled on an additional scale.

Another improvement of the original patent was applied and granted as patent Nr. 363010 [5]. It is a cylindrical device, which permits the consideration of more variables and increases the precision.

Acknowledgements

Karl Kleine kindly provided the three patents and the address of Hahn & Kolb and Dieter von Jezierski helped with information on other machine-time calculators.

References

1. *Beschreibung des Schnellkalkulators,* (Groitzsch (Bez. Leipzig, Druck von G. Reichardt).

2. Dipl.-Ing. Dr. phil. Hanns Körwien, *Graphisches Rechnen – Nomographie,* Leipzig, Fachbuchverlag GmbH, 6. Auflage 1952.

3. Patentschrift Nr. 347926; 27 January, 1922.

4. Patentschrift Nr. 361708; 18 October, 1922.

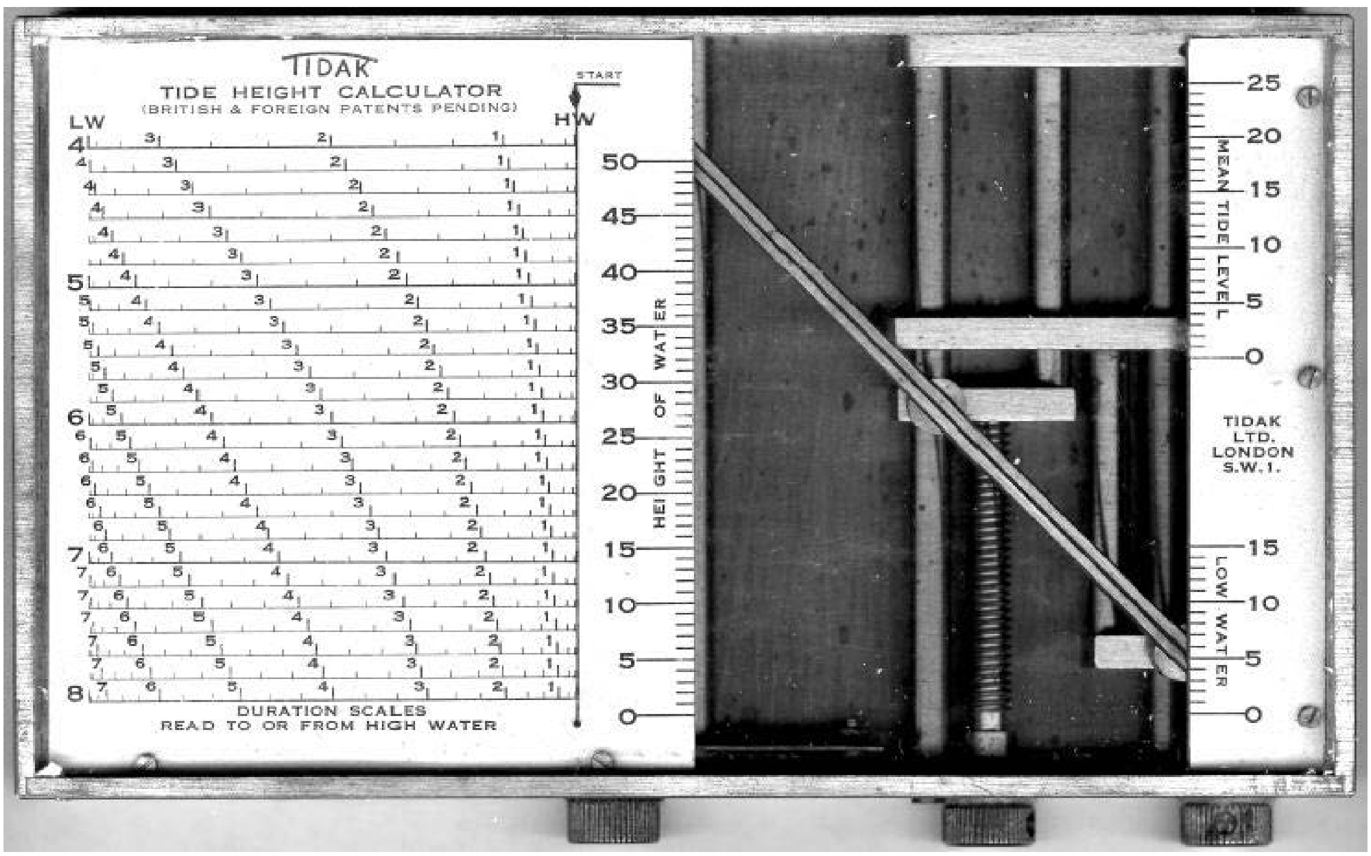
5. Patentschrift Nr. 363010; 6 November, 1922.

6. Dieter von Jezierski and Rodger Shepherd, "Taylor, Taylorism, and Machine-time Slide Rules", *Journal of the Oughtred Society* , 9:2, Fall 2000.

7. Dieter von Jezierski, *Slide Rules, A Journey Through Three Centuries* , New Jersey, Astragal Press, 2000.

8. CDRoMs included in the book by Dr. Klaus Kuehn and Prof. Karl Kleine, *Dennert & Pape/Aristo/ 1872–1978,* München, 2004.

An English Tide Calculator



A heavy, bronze instrument, about 7.1 by 4.4 inches. Alas, there are no instructions with it. The three knobs work the machine which apparently predicts the height of the high tide.