The "REKA Rechenapparat" and other Logarithmic Calculating Tablets[1]

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JOS Plus

Introduction

The precision of the regular "portable" slide rule, limited to three digits or less, has always been acceptable for engineers needing fast results. In other calculating occupations a higher precision was needed, commerce being one of the foremost examples. Longer logarithmic scales were required for increased precision and those long scales had to be "folded" to keep the size of the calculating instrument within practical limits.

Description

The German REKA calculator (1948 or perhaps earlier, during the war) was one of the cheaper versions of the long scale precision slide rule. The REKA calculator was called the "REKA Rechenapparat"[2], but it really is a plate of laminated wood, measuring 437 x 293 x 4 mm; in modern speak it might be called a "Calculating Tablet". A sheet of paper with the fixed logarithmic scales is glued onto the plate, covering most of the surface. The basic logarithmic scale is marked

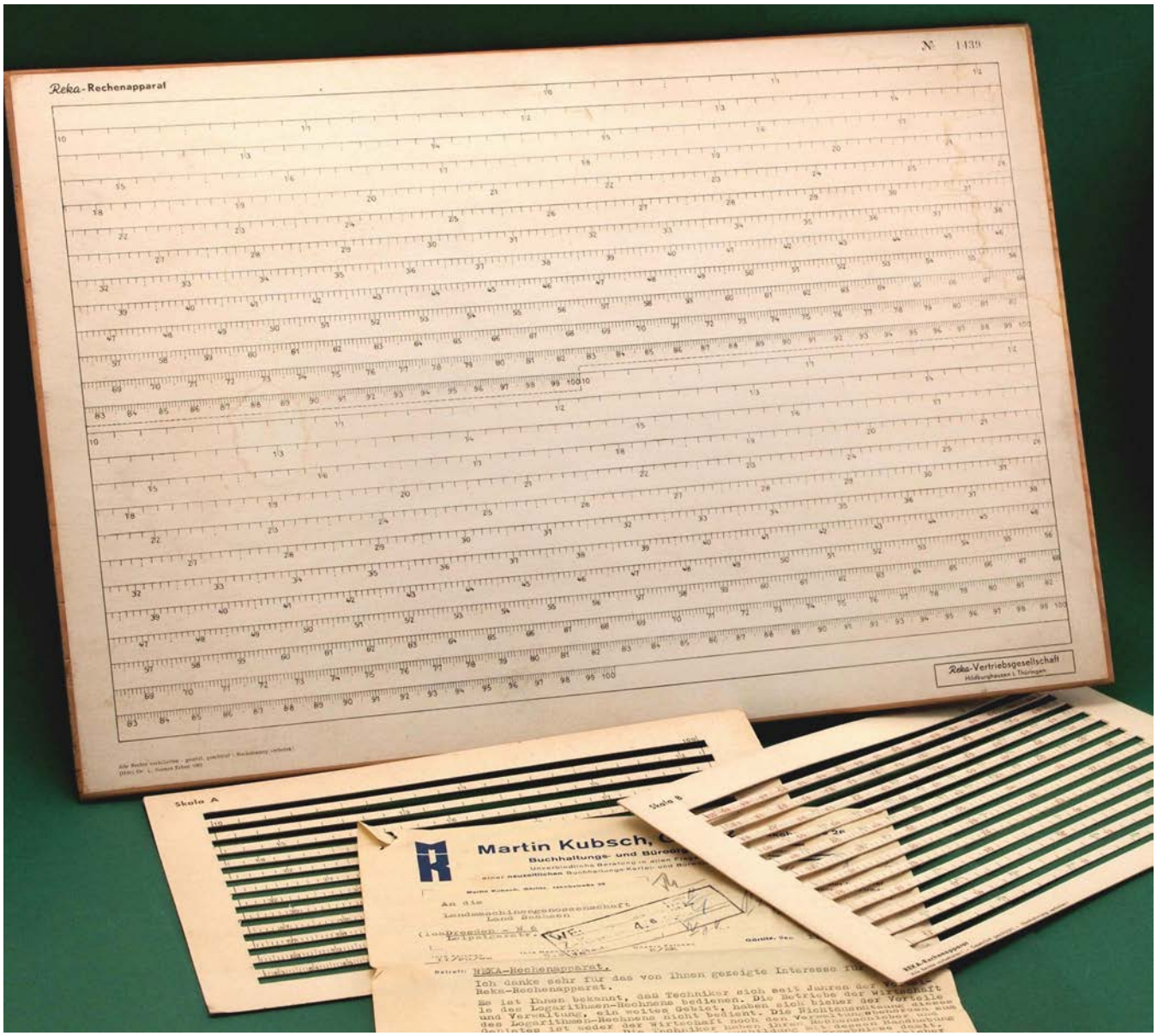

FIGURE 1. Overview of the REKA Rechenapparat

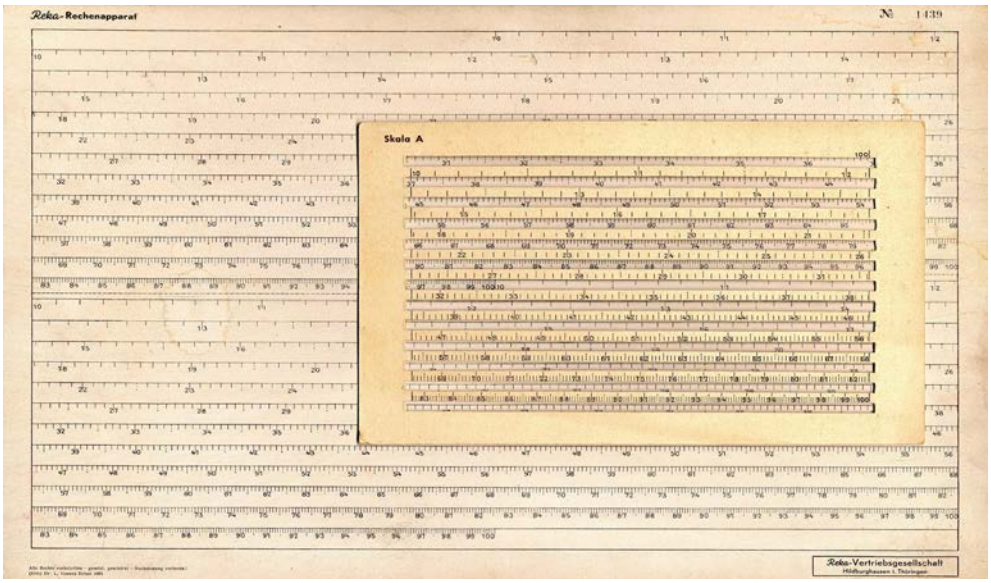

FIGURE 2. Fixed and sliding scales of the REKA

from 10 to 100, covers a total length of 240 cm, divided in 12 horizontal segments of 20 cm each, see Figures 1 and 2.

This scale length of 240 cm gives the REKA a higher over-all precision than a conventional precision slide rule with folded scales, for example, the Nestler Präzision 27 family with 2 folded 25 cm scales, or even the Sun Hemmi 200 with 6 folded 25 cm scales. On the other hand, a large calculating drum by LOGA or Thacher can give a higher precision, with a total drum scale length of up to 24 m (ten times the REKA scale length).

The REKA (and calculating tablets in general) have the distinctive feature that the sliding scale is a "trellis" or grid, a cardboard plate with slitted scales, to be moved freely by hand over the base (fixed) plate in both horizontal and vertical direction. This means there is no precise and expensive sliding mechanism needed to position the sliding scale over the fixed scale.

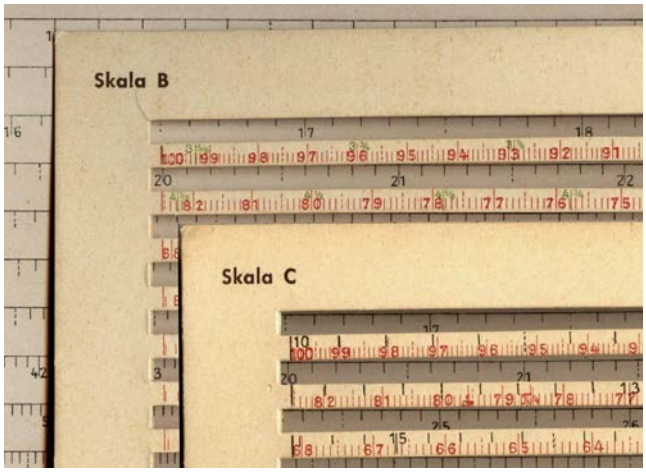

FIGURE 3. Details of SKALA B and C

The basic fixed scale 10-100 on the top left quarter of the base plate has been replicated both in horizontal and in vertical direction, to prevent the sliding scale on the grid moving out of the reach of the basic fixed scale (compare the non-overreaching calculations on the double-decade A and B scale of a regular slide rule). This approach of the REKA is identical to the scale structure on a LOGA or Thacher drum, only the cylinder surface of the drum has been "rolled out" to a flat plane. REKA's scale duplication in horizontal direction is identical to drum calculators, but the vertical scale replication is not needed on a drum - thanks to its endless circumvolution.

Three sliding scale plates are included in the REKA set:

SKALA "A", running from 10 to 100, has the same 12 x 20 cm scale as the base plate (but not replicated as on the base plate).

SKALA "B" is a shifted percentage scale in green from 1 to 10% in divisions of ⅛, starting at 3.6 % to allow conversion between day and year values, see Figure 3. For example, a capital sum of 2000 crowns in a savings account giving 3¾% interest per year, will yield a daily interest of 2000 x 0.0375 x 1/360 = 0.2083 crowns. See Figure 4 (20 on the

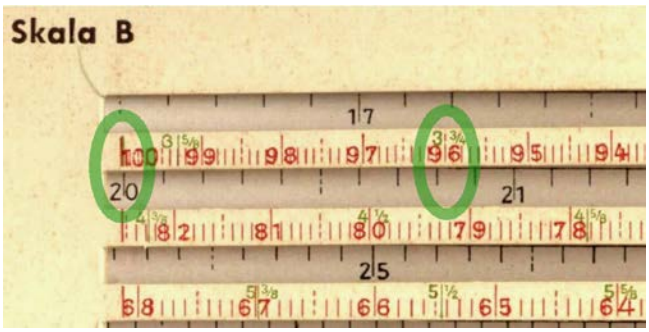

FIGURE 4. Example Interest Calculation

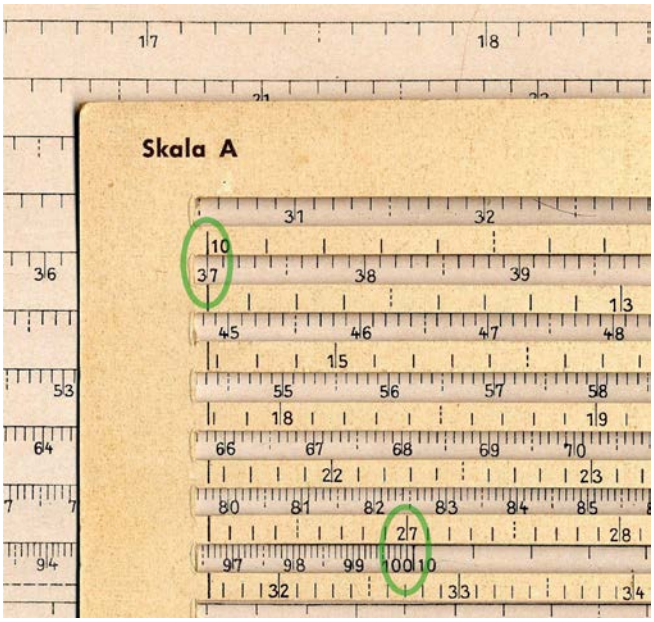

FIGURE 5. Test Multiplication 37 x 27 = 999

fixed scale, resulting in about 2083 on the fixed scale under the green 3¾% mark on SKALA B, coinciding with the red 96 mark). The red marks on SKALA B give the inverse values (from 100 down to 10) of SKALA A to allow continuation of the interest calculation for a given number of days.

SKALA "C" shows again Skala A in black, and in addition, the inverse values (from 100 down to 10) in red, to allow identical handling of multiplication and division, see again Figure 3.

Actually all scales SKALA A through C had an additional slit above the first scale section, probably to show the relative position of the unit value 10 with respect to higher, but also to lower counterpart values on the fixed scale plate.

The REKA in action

Figure 5 shows the well-known test multiplication 37 x 27 = 999 with this result exactly on a division mark, without need for visual interpolation; on desktop slide rules with 50 cm scales there are only division marks for 998 and 1000, so interpolation is needed there. If we define *precision* to be the "worst case" precision –at the serried high end of the decade- then desk top slide rules do not reach the *precision* of 3 digits (1 ‰), not even the Nestlers with 100 cm scale length. The REKA does have that 3-digit precision up to 999.

In general, the influence of scale length on precision is overestimated; as a rule of thumb an addition of one digit in precision requires a scale length multiplication by 10. For example, a LOGA drum scale of 1.2 m provides division marks for 3 digits over the full range, while the lowest LOGA drum scale size to fully provide 4 digits is 15 m!

Now the bad news on the REKA: if we reverse the sequence of our test multiplication, we see an erroneous 998 as result of 27 x 37. What has happened? The cardboard sliding scale grid of the REKA must have expanded due to temperature, humidity, and age, more than the wooden base plate (or shrunk less). In the vertical direction, one can clearly see that the sliding and fixed scale lines diverge in position. Figure 6 shows that in a multiplication with 2 we get inaccurate results at the far right of the sliding scales: for example, 20 x 21 gives a result closer to 419 than to 420. Our second (low-accuracy) test multiplication indeed used the multiplicand (37) at the right side of the scale, while in the first (accurate) test this was more to the left (27).

Reassuringly, most 20th century slide rules did not have a design error to use materials with different expansion characteristics for the sliding and the fixed (base) scale bearers.

Ease of Use

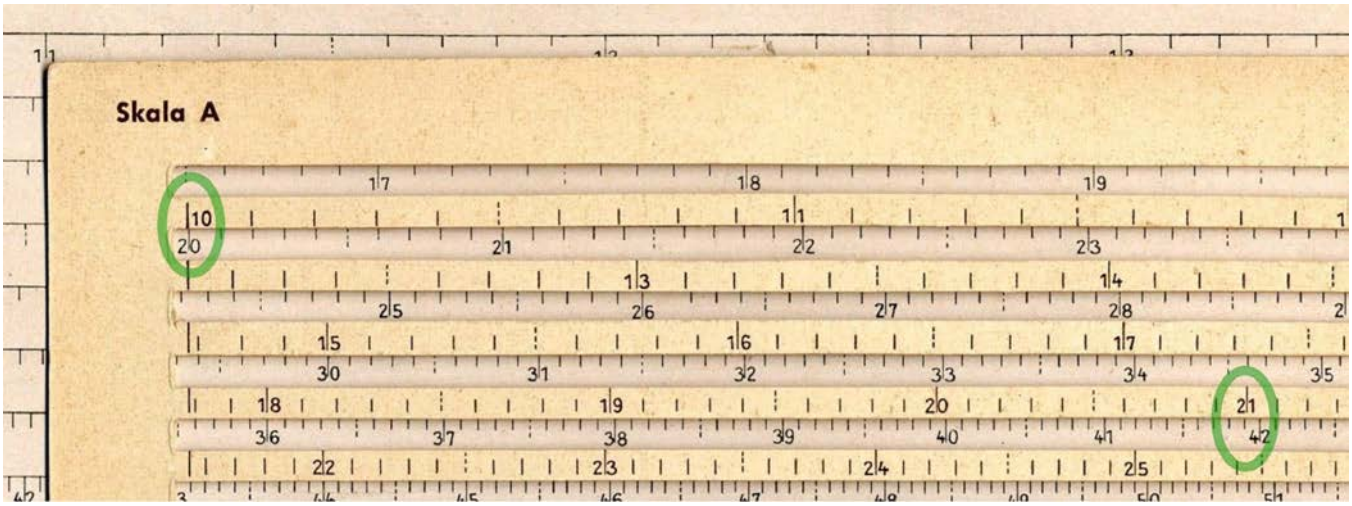

FIGURE 6.
Inaccuracy at the right side for multiplication by 2

The readability of the scales is good because the designers had chosen to keep the division increments constant (0.1) over the full range between 10 and 100. Therefore, spaces between divisions were relatively large in the lower value ranges (up to 1 cm). This same approach had been taken by LOGA for their drum calculators, presumably because commercial users (also REKA's target group) were not trusted to handle the three different division increments that were customary on the regular slide rules designed for engineers.

However, the REKA also had imperfections. There is no "memory" function that can be used in chain calculations, like the cursor hairline's position on a regular slide rule, or the special "tabs" that could be inserted on LOGA drums at scale positions of intermediate results. Moreover, the moving scale grid of the REKA lies free on the base plate, without any guidance, so the current setting of the REKA can easily be disturbed–even by just reaching for a pencil!

Other Calculating Tablets

The last mentioned inconvenience - disturbance of a given setting - was avoided by Major General Hannyngton's design of fixed and moving scales with interlocking grids (actually "racks"), allowing guided horizontal movements (1880s). Only for the vertical movement, the sliding scale plate had to be taken out of the grid to a higher or lower position. This so-called "gridiron" has been described by Ed Chamberlain in [1], one of a series of articles on Long Scale Slide Rules. In his research, he has found some 30 other types of gridirons as well as "unguided" calculating plates like the REKA. A small selection of unguided calculating tablets comparable to the REKA:

1. 1888, Billeter, Switzerland: *Julius Billeter's Rechentafel*, glass grid on metal base plate, 20 x 20 cm = 400 cm total 1-decade scale length [2]

2. 1890, Colyer, Australia: *Calculigraph – The Colyer-Noyer Slide Rule,* cardboard, 22 x 25 = 550 cm [3], also called the "Australian Slide Rule" in a 1909 slide rule manual by Kolesch & Co, USA; the Calculigraph was produced by John Sands, Sydney, from 1885 to 1895; a specimen of the Calculigraph is part of the collection in the Powerhouse Museum, Sydney, object nr. B1740

3. 1909, Friedrich Schneider, Munich, Germany: *Multiplex*, 5 x 10 = 50 cm with a very clever structure of scales to provide extra operations like squares, square roots, chain calculations [4]

4. 1910, Paul Illgen, Leipzig, Germany: *Illgen's Rechentafel*, metal & cardboard, grid on transparent (celluloid?), vertical scales, 10 x 20 = 200 cm [4]

5. 1915, Gilson, USA: *Pocket Slide Rule*, waterproof cardboard, 7 x 12.7 ≈ 89 cm [5]

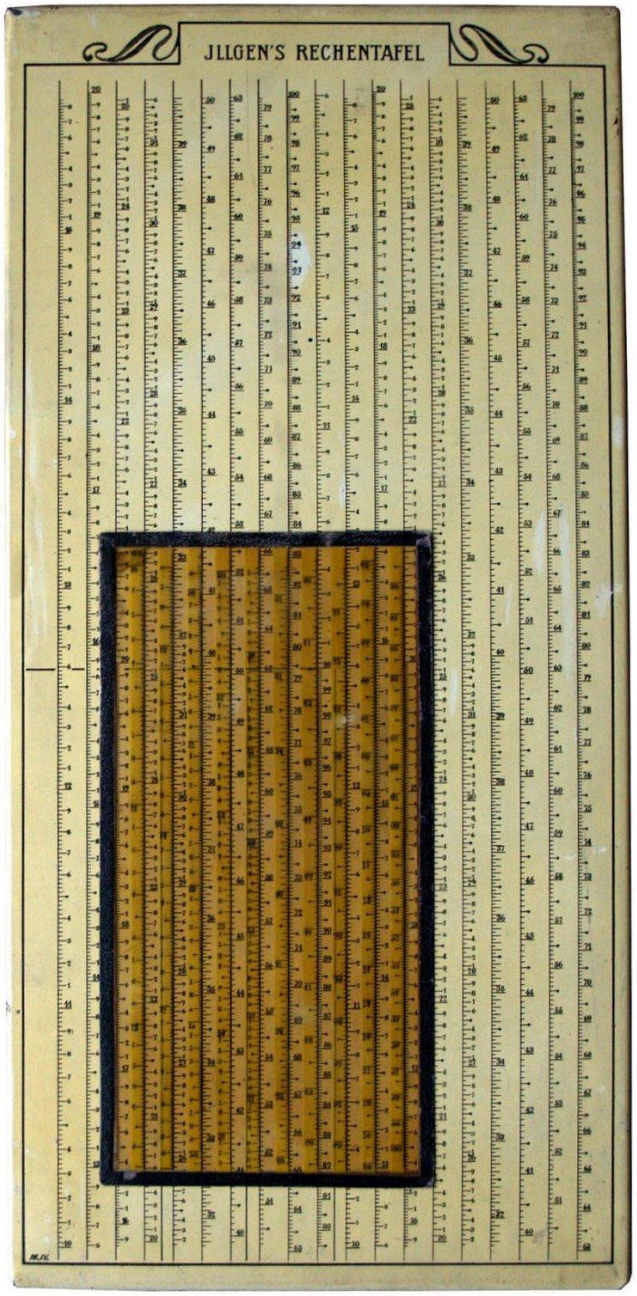

FIGURE 7. "Jllgen's Rechentafel"

6. 1943, Vaclav Jelinek, Czechoslovakia: *Logaritmal*, grid and base of cardboard, 10 x 15 = 150 cm [4]

Most of the tablets have a base plate larger than the sliding grid, the exception being the Billeter (nr. 1) and the Logaritmal (nr. 6). These have a base plate of the same dimensions as the sliding grid so that the choice of the unit value on a scale depends on the value of the other multiplicand and are not easy to use. The Illgen (nr. 4), see Figure 7, has a single scale decade replicated 4 times on the base plate, like the REKA has; still this Illgen looks very different because all scales have been drawn vertically – somewhat unusual for slide rule users.

See [4] for more information at Reinhard Atzbach's website on the Logaritmal, the Illgen, and the Multiplex. Especially nice on this website is a computer animation of the colorful Logaritmal (see Figure 8). However, this animation contains an improvement on the original design of the actual Logaritmal: a *4 times larger* backplane is moved with the mouse below the stationary upper grid, and the vertical movement falls in discrete steps so that the lower scales are always fully visible through the slits. The original Logaritmal had a postcard size (11 x 17 cm) for both sliding grid and the fixed scale plate.

Conclusion

The "REKA Rechenapparat" name was probably derived from "REchen-KArte"[3]. It was advertised as *a new calculating device for easy use in commerce and administration, in contrast to the more complicated slide rule for engineers*, in a letter dated February 11, 1948, by REKA's agent M. Kubsch, Görlitz. However, in the first half of the 20th century a number of other comparable calculating tablets had already been brought to market. The manufacturer of the REKA is not known.

The precision to 3 digits of the 240 cm scale REKA (up to 999) and the excellent readability by constant scale division steps were important advantages, but the "loose" grid positioning for a calculation and the inaccuracy caused by the cardboard material were disappointing.

Acknowledgments

Thanks to John Vossepoel for allowing me to study his REKA specimen, to Reinhard Atzbach for permission to use the information on his website [4], and to Ed Chamberlain for his long and far-reaching research and publications on Long Scale Slide Rules. I am grateful to Reinhard and Ed for the discussions we had on the subject and for their suggestions to improve this article.

Notes

1. JOS Plus indicates that supplemental material for this article is available at www.oughtred.org. For this article, the Aritmal computer animation by R. Atzbach is included. Adapted and translated into English by O. E. van Poelje from his original Dutch article in the Dutch KRING's MIR 58, 2011, p 29 – 31.
2. "Rechenapparat" roughly translates as "computational apparatus" and was also used for such devices as adding machines similar to the Addiator.
3. "Rechen-Karte" roughly translates as "computational map".

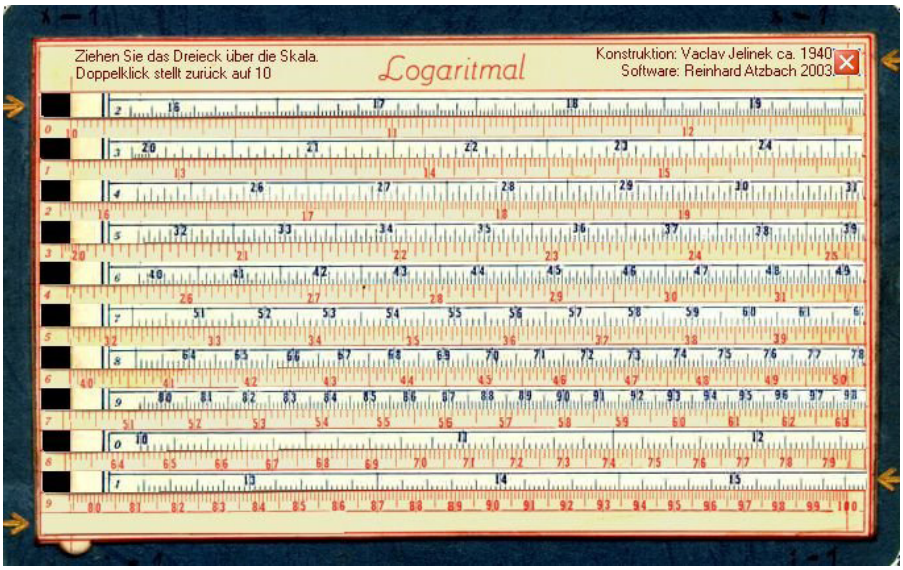

Figure 8 . The colorful Logaritmal

References

1. Chamberlain, E.J., *Long-Scale Slide Rules Revisited*, Journal of the Oughtred Society, Vol. 13:1, Spring 2004, p. 23-43
2. Joss, H., *A Tablet Slide Rule by Julius Billeter, Zurich*, Journal of the Oughtred Society, Vol. 9:2, Fall 2000, p. 27
3. Colyer, M.J.G., *the Calculigraph – a description of this new logarithmic calculating instrument and its use, with notes on the basis and evolution of such instruments*, published by Edward Waters, Sydney, 1890, 15 pages; online information is available at http://www.powerhousemuseum.com/collection/database/?irn=208683
4. Atzbach, R., http://www.rechenwerkzeug.de/, where the *Logaritmal, Illgen, and Multiplex* calculating tablets are described in the section "Rechenschieber"
5. Aldinger, H., Chamberlain, E.J., *Gilson Slide Rules - Part 1 – The Small Rules*, Journal of the Oughtred Society, Vol. 9:1, Spring 2000, p. 48