

Joys and virtues of obsolete technologies

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2007

Definition:

- 1 No longer produced; out of date.
 - 2 *Biology* Less developed (formly or related species); rudimentary; vestigial.
- I just bought a computer and now it is obsolete.
 - The dinosaurs disappeared from the historical record.
 - This antique is valuable because they stopped making them.
 - Vestigial organs like the appendix.

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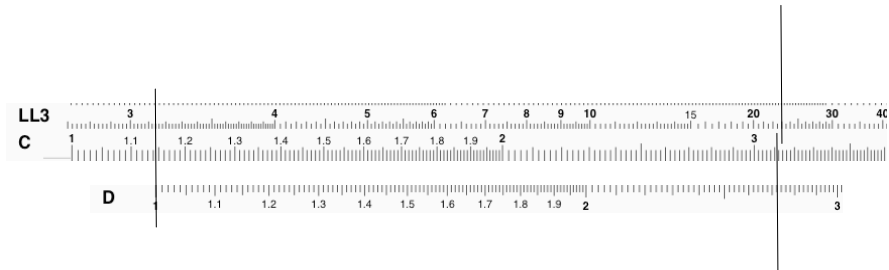
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Log-Log Duplex Deci-Trig



Slide Rule

- invented by Oughtred in 1622 just a few years after logarithms.
- Mannheim (1851) Modern slide rule with A, B, C and D scales.
- Made the trip to the moon with Apollo.
- essentially disappeared in 1970's when all the slide rule manufacturers silently quit, perhaps in response to the HP 35.
- now a collectors item.
- variations in size, circular, with microscope.
- Over 40 million produced.

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Virtues of the Slide Rule

- Scientific notation, estimation, no batteries required.
- Develops analog reading abilities. (Gauges, dials)
- Parallel computing.
- Wonderful application of Logs. Intermediate value theorem.
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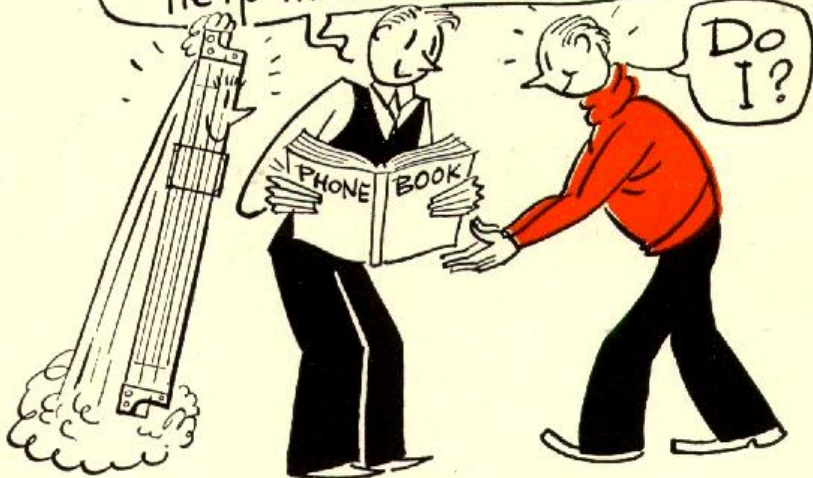
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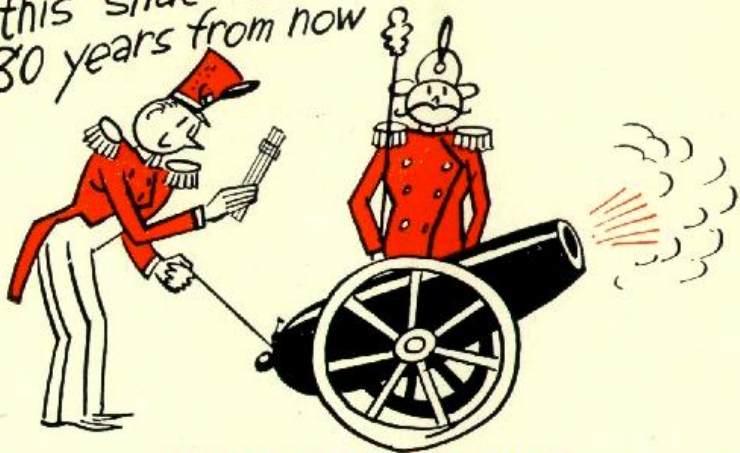
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Do you take this Slide Rule
as your lawfully-wedded
help mate for life?



They'll still use
this slide rule
80 years from now



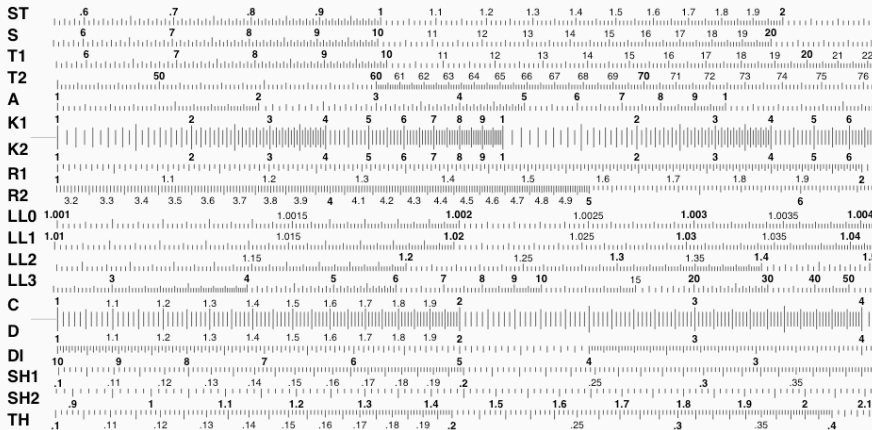
THE MANNHEIM RULE

When Napoleon set out to conquer the world in 1804, his artillery officers were using a simple form of slide rule to solve ballistics and gunnery problems. Their aim was excellent.

Slide Rule Scales

SAVARD SIMPLEX LOG-LOG SLIDE RULE

COPYRIGHT 2003 JOHN J. G. SAVARD



- **Napier's Bones 1617**
- Doubled the life of astronomers.
- Great application of the laws of exponents.
- Linear interpolation
- Table lookup also used for trig, factors, integrals, Laplace transforms . . .
- Which is larger $\log \log \pi + \log e$ or $\log \log e + \log \pi$?

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- Which was the correct way to introduce elementary age children to arithmetic. (US education 1990's)
- Which is the correct way to do arithmetic. (Algorists vs Abacists, the 400 years war)

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Abacists Use Roman numerals along with the abacus.

Algorists Use Hindu-Arabic numerals along with the appropriate algorithms for calculation.

Highlight: Florence 1299 forbid the use of the new numbers in financial procedures.

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- Letter stand for values: I for 1, V for 5, X for 10, L for 50, C for 100, D for 500, M for 1000.
- Arranged in decreasing size. (MCV and not CVM)
- Letters are repeated for missing values: III for 3, XX for 20, etc
- Sometimes shorthands: IV for 4, CM for 900.
- Other extensions.

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Virtues of Roman Numerals

- Forced one to use an abacus (matched too)
- Much harder to alter entries (try changing an id's XVIII to XXI)
- numeral vs number
- Look important? Use on clocks and movie copyright dates.

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- Counting table ancestor: some lines in the sand and some stones to count with. Indeed calculate comes from calculus which is latin for stone. Abacus comes from the greek abax, table covered with sand or fine dust
- positional representation. (1950's netherlands used them in education)
- paperless office (paper wasn't cheap in dark ages)
- add, subtract, multiply, divide

There is a on-line book on how to use the abacus
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Euler turns 300

Euler didn't have the technology to prove his analytical results with the same rigor required by today's standards. Or he lived before Cauchy invented ϵ - δ technology.

- The Basel problem $S = \sum n^{-2} = ?$ was first done numerically.
- Euler knew $\pi = 3.141592653589793238 \dots$
- Euler computed $S = 1.6449340668482264364 \dots$
- Euler came up with an argument that $S = \pi^2/6$ and the numbers above proved it. (It is better than the current experiments of quantum mechanics)
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Summing $\zeta(2)$

- Integral test $\sum_{N+1}^{\infty} n^{-2} \leq \int_N^{\infty} x^{-2} dx = \frac{1}{N}$, Euler needed to sum 10^{19} terms.
- The Euler-MacClaurin formula.
- Accelerating series convergence, Euler transformation $x = y/(1 - y)$ maps $y = 1/2$ to $x = 1$.
- Is this like turing completeness? Namely the fastest computer can't do anything a turing machine can do, nor any faster mod polynomial time.

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Abel on divergent series (1828):

... Divergent series are in general the work of the devil and it is shameful to base any demonstration whatever on them ... For the most part the results are valid, it is true, but it is a curious thing. I am looking for a reason and it is a very interesting problem.

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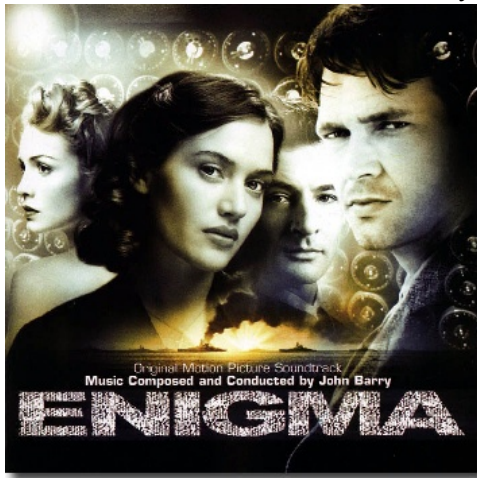
Human Calculators – Idiot Savant Dase

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Human Calculators – WW2

Calculator was a job title during World War II. Often female, she would do calculations for the military.



Slide Rule in High School Education circa 1964

- Taught in Chemistry class. Along with scientific notation, the ideal gas laws and molarity calculations.
- Getting the decimal point correct. (Estimation.)
- Percentage error, significant digits.
- Low cost items, roughly \$3 (\$15-\$20 in current money)
- No S or T scales, so the technology wasn't used in Trigonometry class. (Most Trig students had already taken Chemistry.) Trigonometry classes used tables of trig and log functions.
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- Low cost items, roughly \$3 (\$15-\$20 in current money)
- No S or T scales, so the technology wasn't used in Trigonometry class. (Most Trig students had already taken Chemistry.) Trigonometry classes used tables of trig and log functions.
- Drawing and reading graphs.

Success of the Calculus Reform

The rule of four:

- Graphs to replace reading scales (gauges)
- (Numerically) Tables to replace using log/trig tables
- Verbally to replace what?
- Formulas to replace what?

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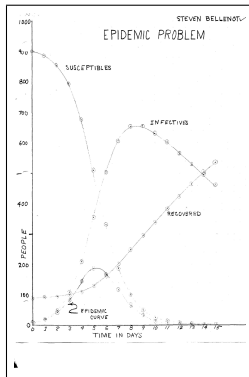
Programming Assignment #7

```

C 00110101. 0+ F** ENDR. 3 LAST QUIZ. JAN. 26. 1967
RC=0
T=0
Y=0
Z=0
R=0
1 PRINT, T, Y, Z, R
2 DO 4 J=1,10
R=R+0.03R**3
Y=Y+Y/14**
Z=Z+Y**2
R=R+R**2
Y=Y+Y**2
Z=Z+Y**2
3 CONTINUE
4 CONTINUE
END

```

COMPUTATION	Y(1)	Y(2)	Y(3)	Y(4)
1	0.000000	10.000000	0.000000	0.000000
2	0.000000	10.000000	22.737180	21.779814
3	0.000000	10.000000	50.762073	69.483284
4	0.000000	10.000000	108.77726	187.483284
5	0.000000	10.000000	213.21281	375.17128
6	0.000000	10.000000	427.78622	750.31406
7	0.000000	10.000000	857.18067	1481.11202
8	0.000000	10.000000	1712.39653	2942.22404
9	0.000000	10.000000	3424.79306	5884.44808
10	0.000000	10.000000	6849.58612	11768.89616
11	0.000000	10.000000	13699.17224	23537.79232
12	0.000000	10.000000	27398.34448	47075.58464
13	0.000000	10.000000	54796.68896	94151.16928
14	0.000000	10.000000	109593.37792	188302.33856
15	0.000000	10.000000	219186.75584	376604.67712
16	0.000000	10.000000	438373.51168	753209.35424
17	0.000000	10.000000	876747.02336	1506418.70848
18	0.000000	10.000000	1753494.04672	3012837.41696
19	0.000000	10.000000	3506988.09344	6025674.83392
20	0.000000	10.000000	7013976.18688	12051349.66784



Wag the dog

- Graphics Processors double in speed every 12 months (vs 18 for CPUs).
- But they are for games, hence only single precision.
- Slide rules disappeared because they were a small and not very profitable part of scientific instruments.
- HP quit making graphing calculators briefly. The TI-89 hasn't improved mathematically since 1999 and the price as gone up.

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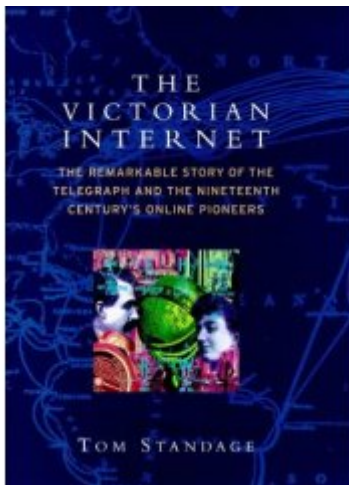
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Victorian Internet



Larger – revisited

$$\alpha^\beta < \beta^\alpha \iff \beta \ln \alpha < \alpha \ln \beta \iff \frac{\ln \alpha}{\alpha} < \frac{\ln \beta}{\beta}$$

Need to maximize $f(x) = \frac{\ln x}{x}$ which by calculus happens when $f'(x) = \frac{1 - \ln x}{x^2} = 0$ or $\ln x = 1$ or $x = e$ So $\alpha^e < e^\alpha$ for all $\alpha \neq e$ including π .

Larger – revisited

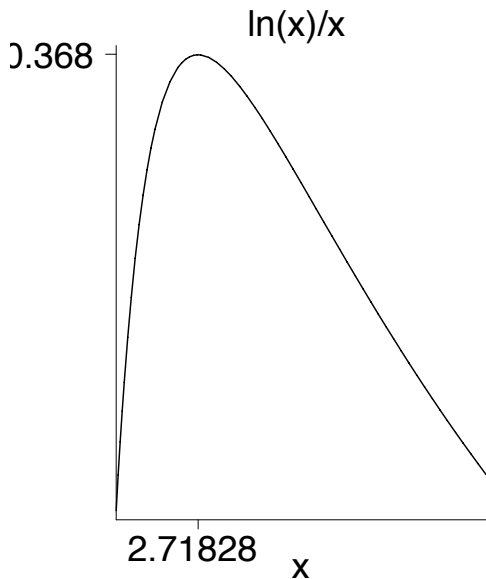
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