Joys and virtues of obsolete technologies

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Obsolete

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 No longer produced; out of date.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- I just bought a computer and now it is obsolete.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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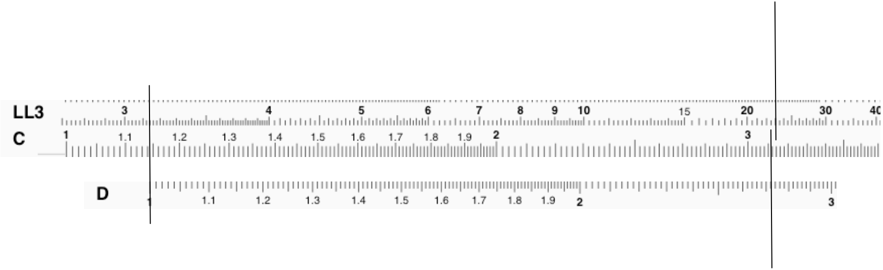
Log-Log Duplex Deci-Trig



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.
- essentually disappeared in 1970's when all the slide rule manufactors silently quit, perhaps in response to the HP 35.
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- variations in size, circular, with microscope.
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Virtues of the Slide Rule

- Scientific notation, estimation, no batteries required.
- Develops analog reading abilities. (Gauges, dials)
- Parallel computing.
- Wonderfull applicaton of Logs. Intermediate value theorem.
- Intermediate results were stored.
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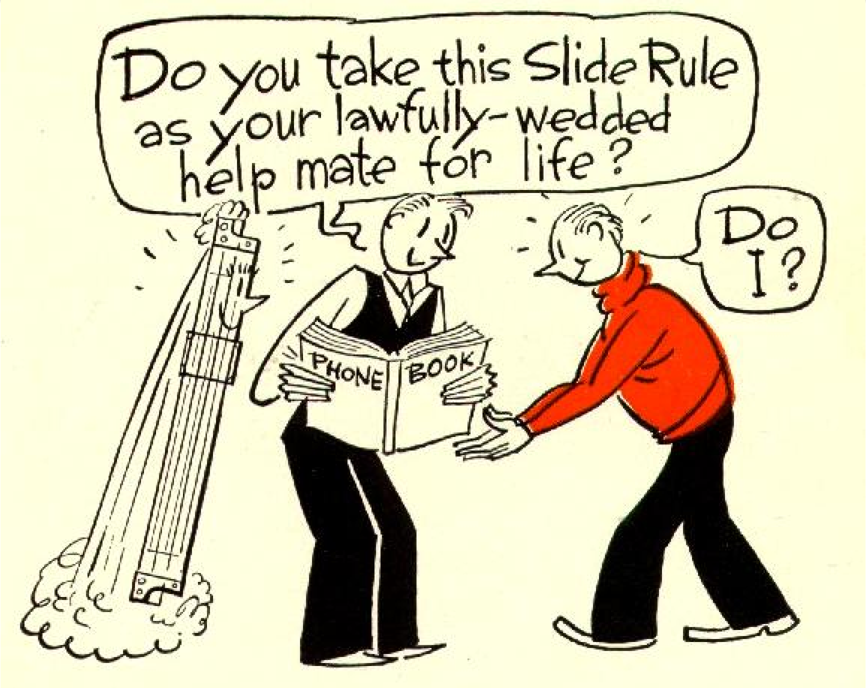
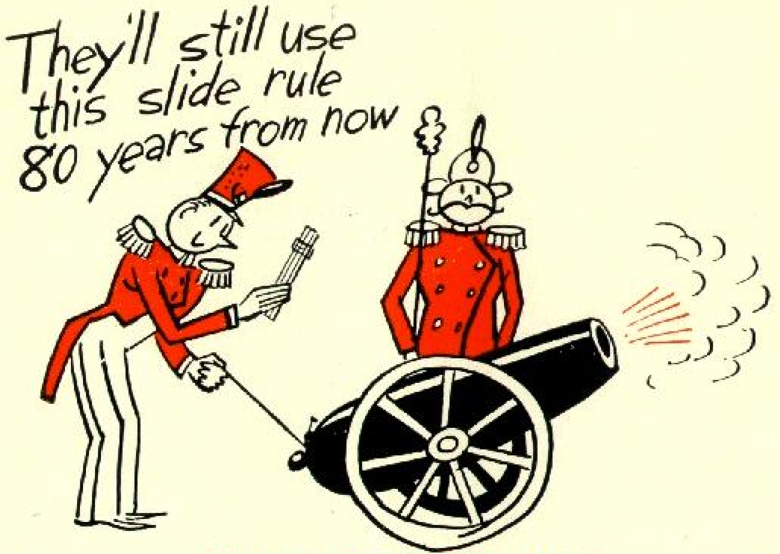
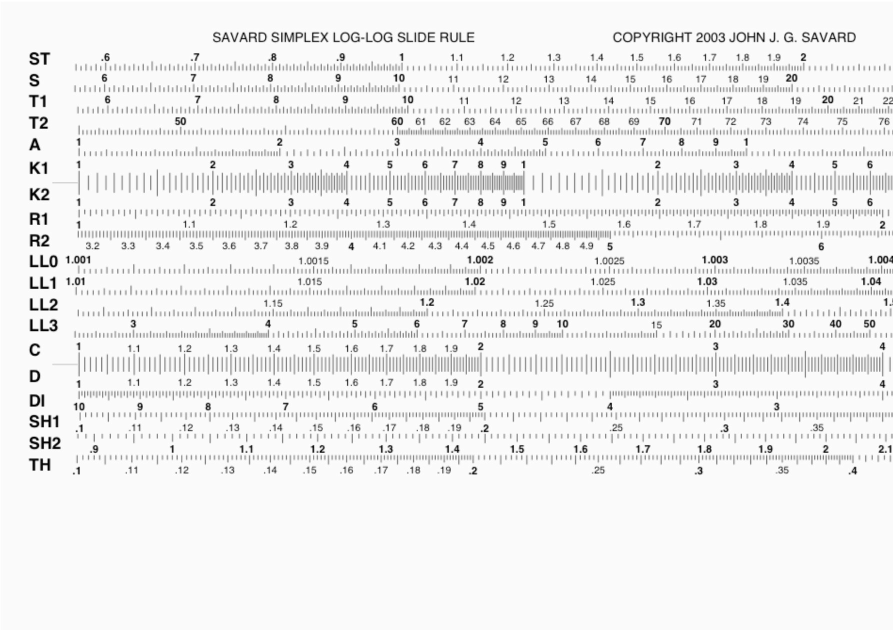

Do you take this Slide Rule as your lawfully-wedded help mate for life?
Do I?
PHONE BOOK



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



Logarithm Tables

- 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)
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400 Years War

From roughly 1100 to 1500 there was a battle between:

Abacists Use Roman numerals along with the abacus.
Algorists Use Hindu-Arabic numerals along with the appropiate 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
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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 http://www.tux.org/ bagleyd/takashikojima1.pdf

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- Euler knew $\pi = 3.14159265358979323\ldots$
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- Euler came up with an agruement 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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Divergent Series

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.

Modern theory starts with Frobenius(1880).A good source is Hardy's book (1948) [Now printed by AMS (1992).]

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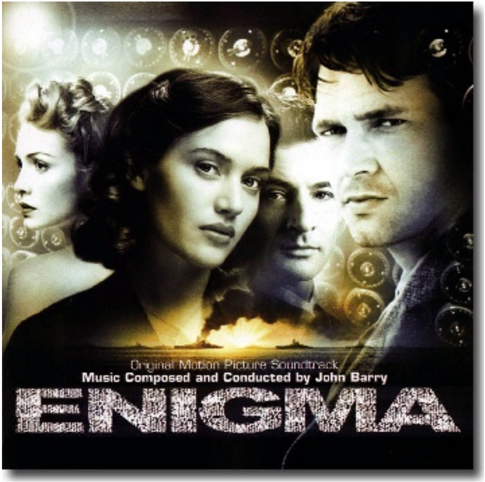
Calculator was a job title during World War II. Often female, she would do calculations for the military.



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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- 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.
- Drawing and reading graphs.

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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?
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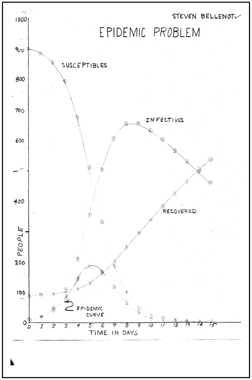
Programing Assignment #7

```
C  BELLENOT, S. F., ENGR. 5 LAST QUIZ, JAN. 26, 1967
READ ,A
H=.1
T=.0
X=900.
Y=10.
Z=90.
XA=9.
1  PRINT, T,X,Y,Z,XA
IF(T-15.) 2,5,5
2  DO 4 J=1,10
XD=-.001*X*Y
YD=-XD-Y/14.
ZD=Y/14.
XB=X+H*XD
YB=Y+H*YD
ZB=Z+H*ZD
 DO 3 I=1,4
XT=-.001*XB*YB
YT=-XT-YB/14.
ZT=YB/14.
XB=X+H*.5*(XD+XT)
YB=Y+H*.5*(YD+YT)
ZB=Z+H*.5*(ZD+ZT)
3  CONTINUE
T=T+.1
X=XB
Y=YB
Z=ZB
4  CONTINUE
XA=.001*X*Y
GO TO 1
5 END
T        T            X(T)            Y(T)            Z(T)
 5.0 .484
```

COMPILATION
EXECUTION

T	X(T)	Y(T)	Z(T)	-DX/DT
0.0000000	900.00000	10.000000	90.000000	9.0000000
1.0000000	886.11684	22.772747	91.110462	20.179314
2.0000000	855.61905	50.768712	93.612326	43.438677
3.0000000	792.75879	108.17776	99.063554	85.758870
4.0000000	678.61100	211.21780	110.17128	143.33472
5.0000000	511.88742	357.79653	130.31606	183.15154
6.0000000	331.47795	507.16067	161.36133	168.11257
7.0000000	188.68401	609.70600	201.60989	115.04177
8.0000000	99.898670	653.07910	247.02211	65.241733
9.0000000	51.813775	654.28781	293.89827	33.901121
10.000000	27.182746	632.86063	339.95648	17.202889
11.000000	14.654808	601.27656	384.06849	8.8115925
12.000000	8.1722871	566.05895	425.76861	4.6259962
13.000000	4.7227583	530.35358	464.92352	2.5047317
14.000000	2.8274235	495.61538	501.55706	1.4013145
15.000000	1.7512533	462.48424	535.76439	.80992705

END



Wag the dog

- Graphics Processors double in speed every 12 months (vs 18 for CPUs).
- But they are for games, hence only single percision.
- 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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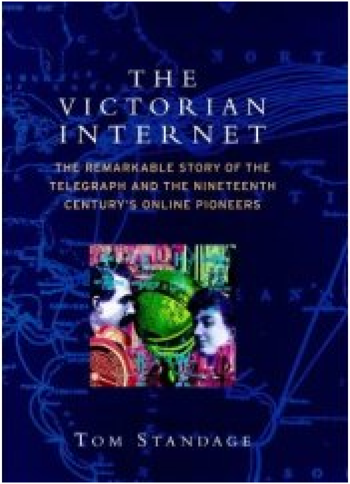
Victorian Internet



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.

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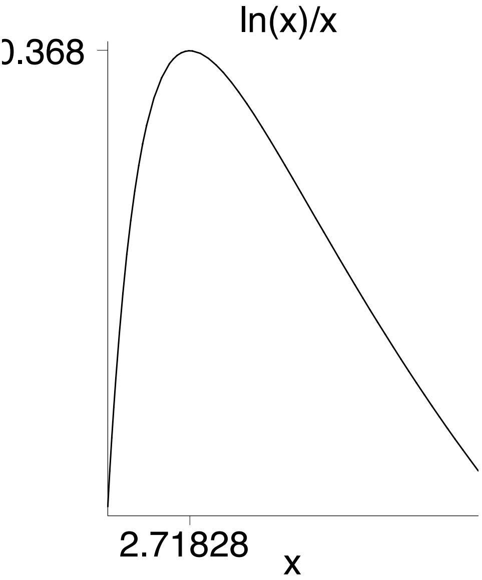
e^{π} Wins



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