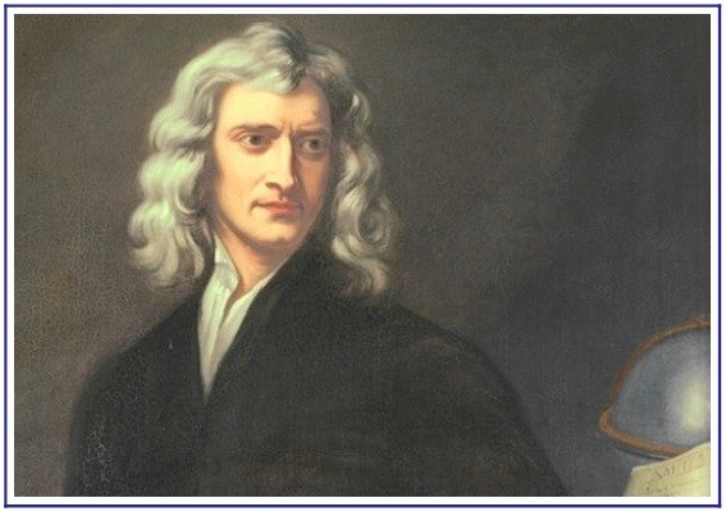
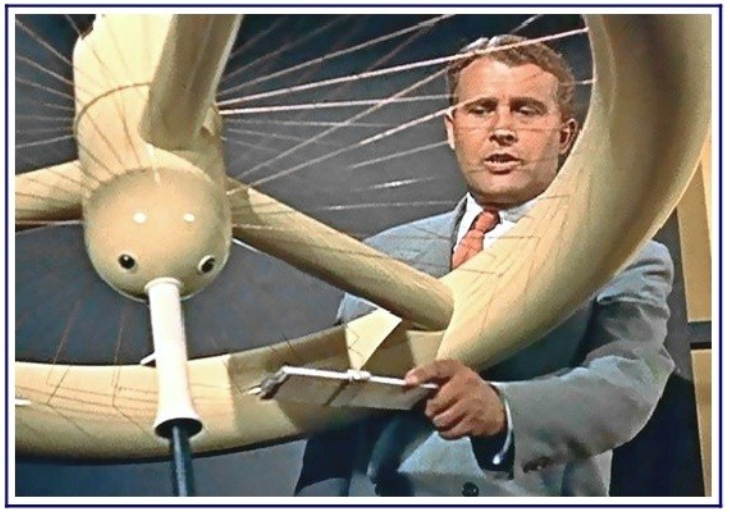
Unplugged: the world before the digital age

a new life for the old calculators: ensuring the future by preserving the past





Newton and von Braun shared the same calculators, unchanged since the birth of the classical mechanics to the Moon landing, which memory disappeared with the digital revolution. Calculate with their help implied a worldview very different from today, but they still have something to teach us. Without memory our technology can became insane.

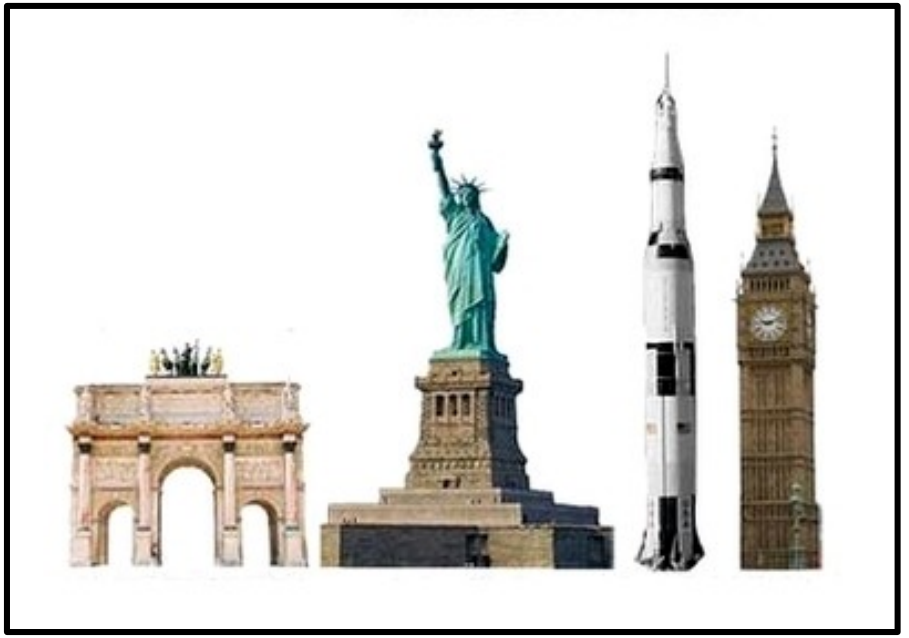
In 1953 there were no computers for civilian use, but the technology was already very advanced.

Until few years ago everything was designed with calculators conceived in the 17th century, but nobody remember these instruments that anticipated our technology.

The climax of the traditional calculation was the vector Saturn V, used in the lunar missions, designed almost without computers: at the time there were no PCs, but only a few Mainframe of difficult and limited use.

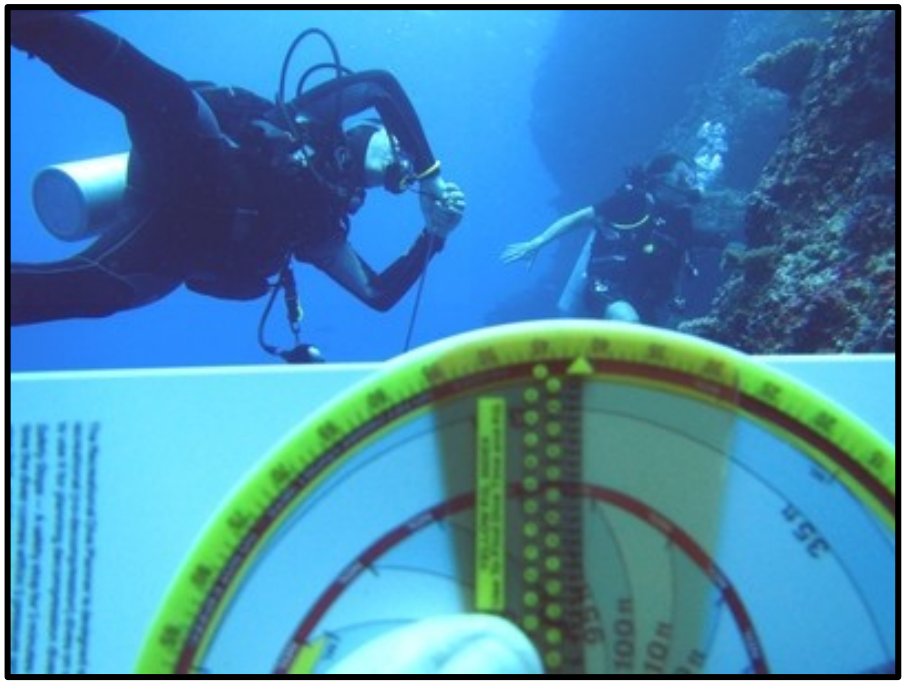
It is the powerful machine ever built, ca. 200 millions HP: its launch caused an earthquake of magntudo 4.6!

Let's see which calculators they used to design it.



Their history is divided into two categories: the digital mechanical calculators, that carry out only the four operations, and the analog computers that carry out all the functions of a modern scientific calculator, except for the addition and subtraction.

Reliable and accurate are still useful in extreme situations.



Analog scuba diving calculator

Modern ad for a slide rule watch

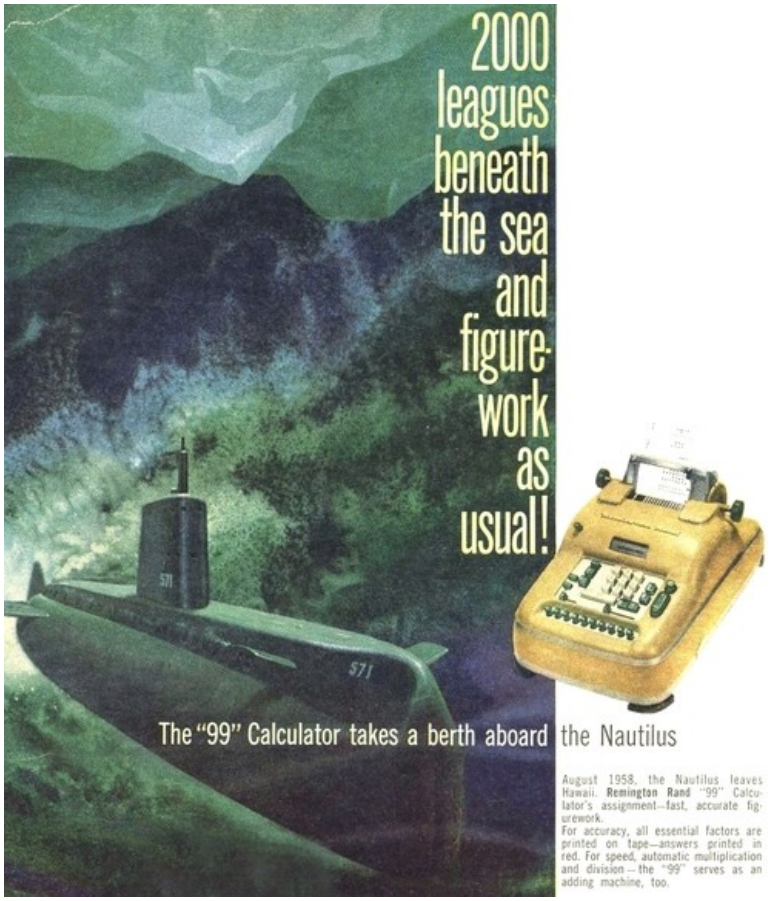
1- Digital calculators before the digital era

Blaise Pascal's calculator, ca. 1900

The calculator on board the first nuclear submarine was an evolution of the Leibniz's model of 1671, but the digital calculator had already been invented by Pascal in 1642.

All mechanic calculators up to 1970 are derived from these models.

Pascal and his calculator

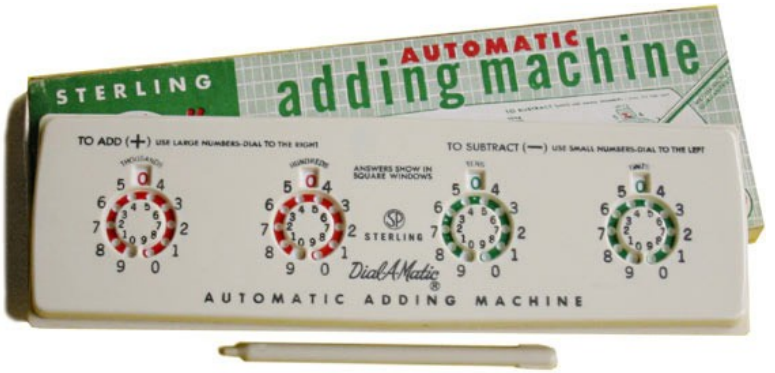


Remington 99, 1958

In 1642, at just 19 years old, Blaise Pascal patented the first digital calculator, called *the pascaline*, able to perform only addition and subtraction. The numbers are entered with a stylus on wheels similar to a phone dialer, the results can be read on the mechanical display.

The invention of Pascal could not be built due to the poor technology of the era. Only in 1901 did the first practical model appear that, copied by all, remained in production through 1975.

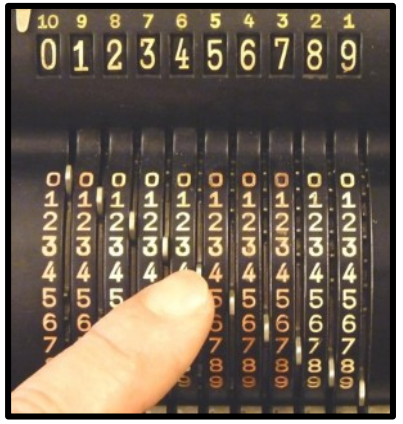
Pascalina, 1642

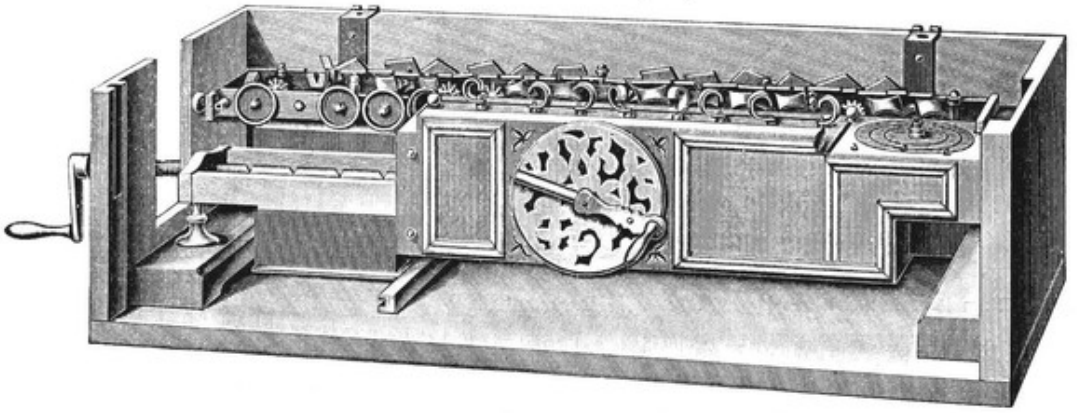


Dial-A-Matic, 1975

Leibniz in 1671, taking up the idea of Pascal, invented a calculator that could also multiply and divide.

This invention, based on a complex mechanical memory, met the same productions difficulties of the pascaline. In late 1800's Odhner simplified the system, producing a series of machines characterized by the entering of the numbers with cursors. The last, very small, was produced in 1971, three centuries later. Operated with only one hand, a Curta was used for years by the rally drivers.

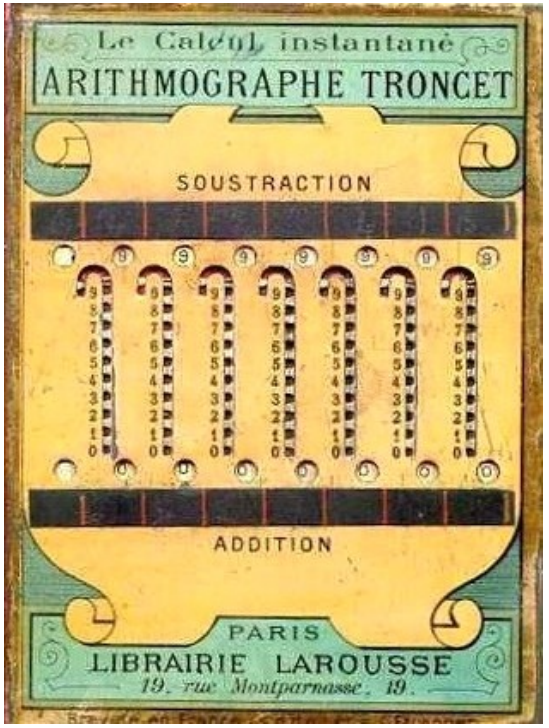




The Curta calculator, 1971; the cursors; the Leibniz calculator, 1671

The traditional calculators were very bulky and in 1670 the French Perrault, the architect of the Louvre, invented a pocket size adding machine.

Only by 1889 was the technology possible for industrial production. The pocket adder was marketed without changes until 1986.



Aritmographe, 1887

how to insert the numbers

Arithma, 1970

From these inventions derived all models of calculators. There were many innovations, such as keyboards with many keys, but until 1940 they could not perform well all four operations. Only the Olivetti Divisumma of 1948, designed with a new theory, could multiply very quickly but it had the price of a good car!

Comptometer, 1887 - 1970

Olivetti Divisumma, 1948 - 1970

In 1970 the firm Busicom, that build calculators derived from the Leibniz project, commissioned Intel, at the time a start-up, to manufacture a chip for an electronic calculator.

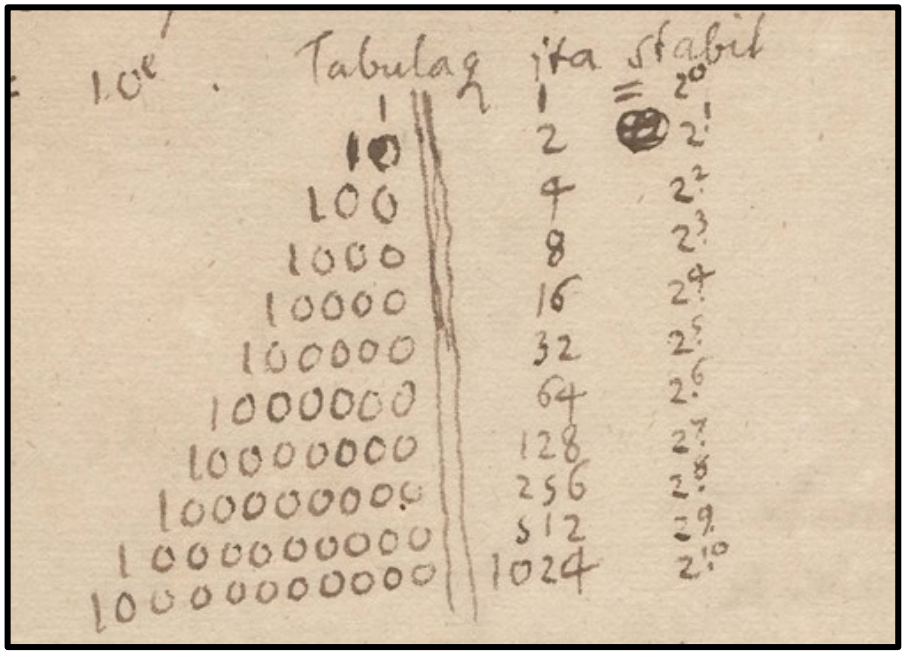
Federico Faggin and his staff created in just nine months, hand drawn, the first microprocessor (the Intel 4004 with 2300 transistors), signed with his initials as a work of art. After 328 years, the saga of the mechanical calculators ended.

Busicom HL-21, 1970

Busicom 141-PF, 1971

Mechanical calculators performed slowly multiplications and divisions and were only used for accounting. Until 1972, technology development was based only on an analog calculating device: the slide rule.

In fact, although the binary system was discovered by Leibniz in 1679, were impossible to use it in a working calculator for nearly 300 years.



1679, born of the binary system

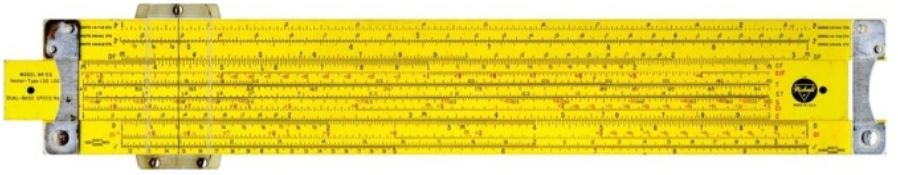
Human computers at work, 1930

2 - Scientific calculators in the analog era

The slide rule of the Apollo 11, 1969

The Endeavour of Captain Cook (1764) and the B-52 (1952) were designed with the same type of calculator, an invention of 1622. No other technological device has been so unchanged over the centuries.

Coggeshall slide rule, 1730



Pickett N4 slide rule, 1949

The slide rule scientific calculation period began in 1614 with the invention of logarithms by John Napier.

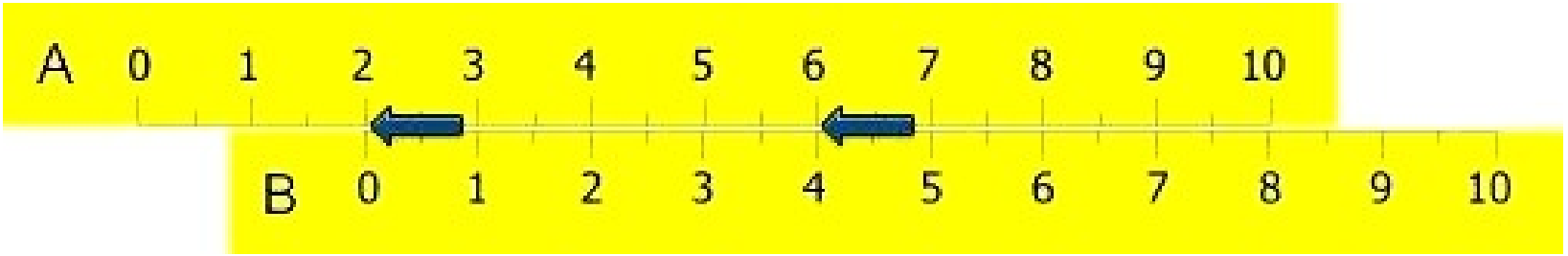
Logarithms are capable of expressing any positive number using a base and exponent. Because the product of two numbers with the same base is given by the sum of their exponents, with logarithms multiplication and division can be made as simple as the addition and subtraction of exponents: 10^2 (100) x 10^3 (1.000) = 10^5 (100.000).

Published in the form of tables to be consulted, logarithms were immediately used by Kepler, who claimed to have saved more than 400 years of hand calculations.

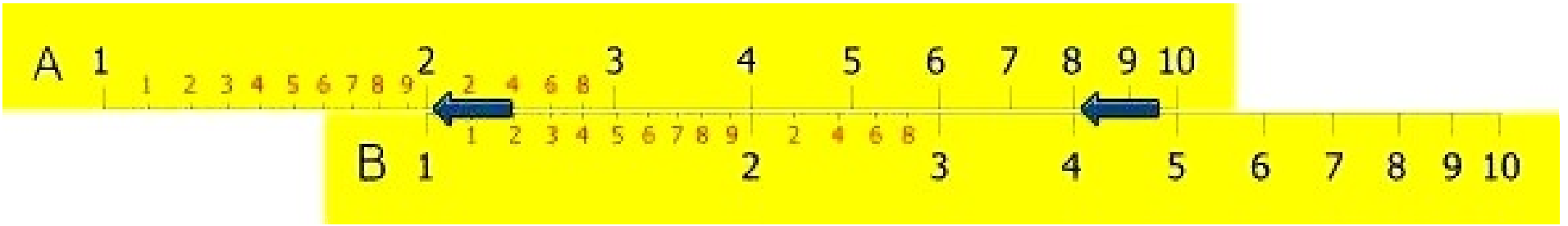
Logarithm table use is slow and difficult, but for their precision were used up to 40 years ago in astronomy. A new tool, much more practical, was about to born.

In 1622,William Oughtred designed the logarithmic scale, marking the numbers at a distance from the origin proportional to the value of their logarithm.

By overlaying two scales we replace the digital operations with continuous linear measurements, calculating in a way that is analogue to a normal mathematical operation.

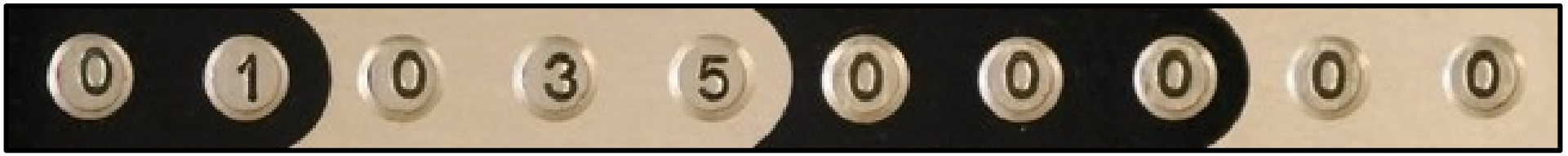


With the metric scale we can only add

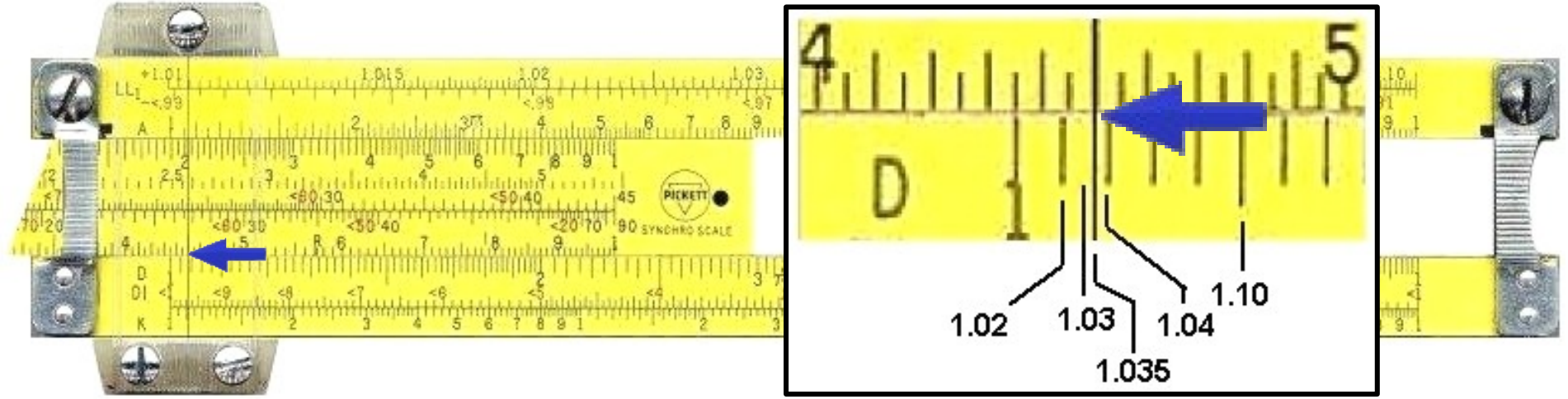


With the logarithmic scale the sums become multiplications

The difficulty lies in reading the result: the digital display is obvious, while the analog display is a measurement and has to be interpreted/interpolated.
Below we see 1,035,000 on a mechanical calculator.

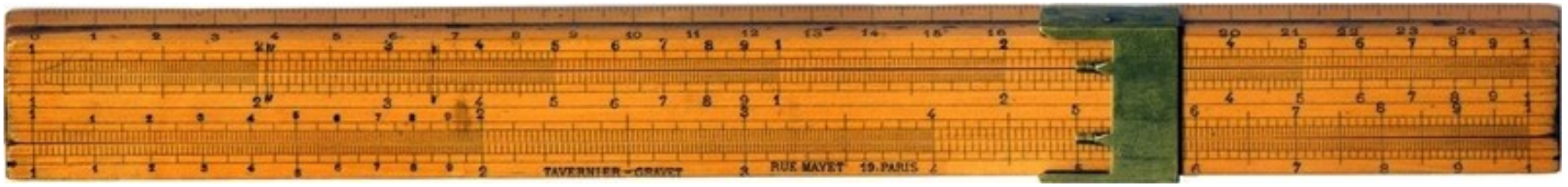


We now see the same number displayed on the slide rule: the reading is less accurate, but operators had enough practice that errors rarely exceeded 2%.



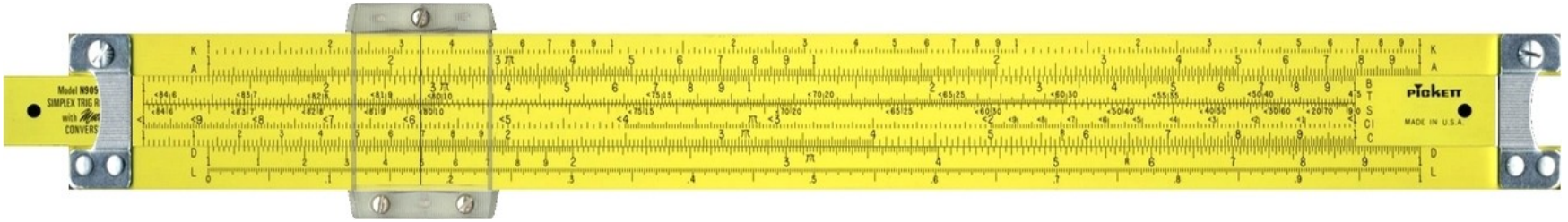
This anemometer shows the same data, represented in two different ways. The analog reading is less accurate than the digital, but you can immediately evaluate it: the position of the pointer indicates a strong wind, with no need to interpret the numeric value. Indeed, airplanes still have analog instrument panels, although simulated.

Everard's pattern slide rule, 18th century



Tavernier Gravet, the first cursor, ca. 1880

Nestler 23R, the favorite of Einstein and von Braun, ca. 1940



Pickett trig N-909 eye saver color, ca. 1970

To design the structures of the great works the engineers worked months. Everything was done by hand and there was no time to try new ideas.

Today we can input to a computer a 1,000 generic ideas and see the optimum solution in a few minutes: in the past there were *many* experienced engineers; now just *one* programmer and many simple users.

Building of the Golden Gate, 1934

Building of the AirShip Macon, 1931

The analog calculator also accompanied pilots, from the beginning of flight through the first Jumbo Jets.

Accurate and easy to use, no one imagined that it would be replaced, even in the future. It would always be essential in aircraft as a backup tool.

1972, slide rule on the Boeing 707

2267, slide rule on the Enterprise

“Houston,Tranquility Base here: The Eagle has landed.” With these words Neil Armstrong announced in 1969 the landing on the Moon. One of the on-board computers was a pocket slide rule, supplied to all the Apollo missions.

Only 40 years ago, this was considered a cutting-edge technology and the advertising boasted: *Used in 5 Moon Flights!* Below you can see a slide rule levitating with Buzz Aldrin on the Apollo 11: really a long career but ..

.. in 1972 Hewlett Packard put on sale the first handy and economic scientific calculator. Advertised as *"Electronic slide rule"* is today named as one of the 20 products that have changed the world. Shortly before the president of a slide rules factory had declared:

"whatever the challenges of the future we will always provide the calculators to deal with"

Two years later his company closed and the slide rules, produced through the ages with more than 60 million copies, disappeared from history, and a few years later were forgotten.

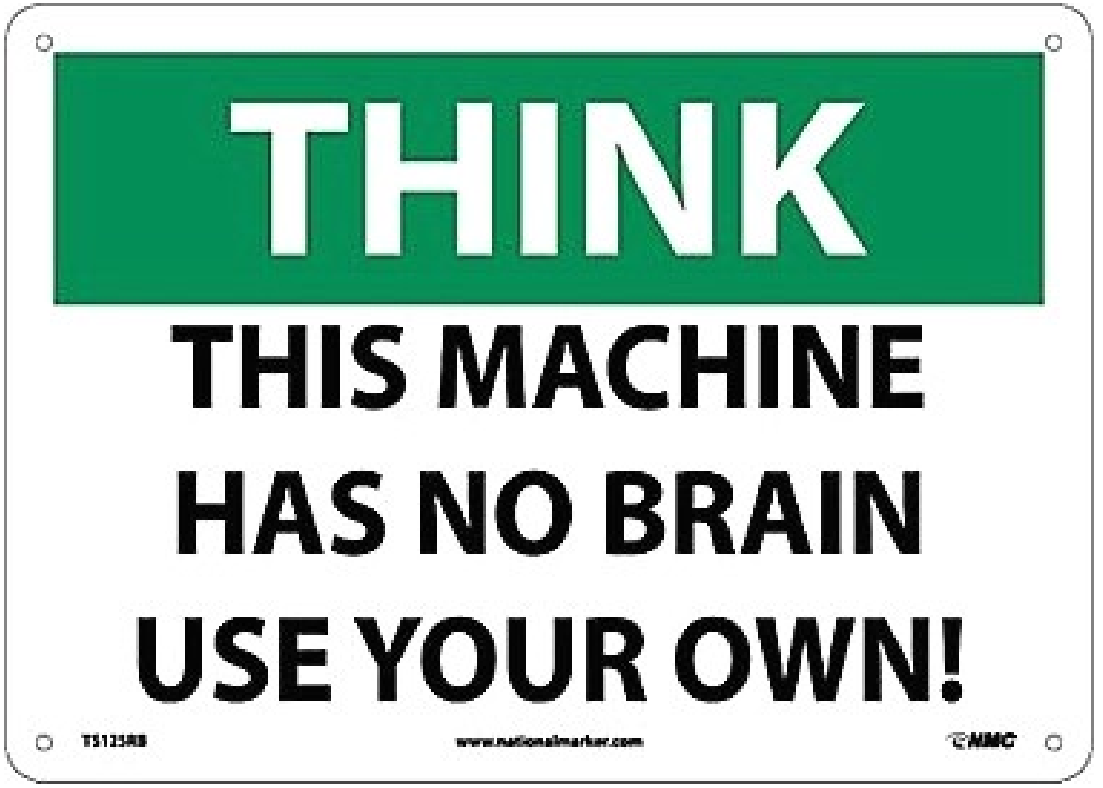
Between 1970 and 1972 electronic calculators became accessible. They allowed everyone to calculate without preparation and the classical instruments disappeared instantly. In 1980 they were forgotten, the dream of Leibniz had come true:

> *"it is unworthy of excellent men to lose hours like slaves in the labor of calculation which could be relegated to anyone else if machines were used"*

No invention ever had a similar impact: railways and horse drawn carriages lived together for over 100 years, but the electronic overcame in a snap its competitors. A true revolution.

Rediscovering these ancient instruments ask yourself: what our technology will be tomorrow? Yet in 1965 the N.A.S.A. had not foreseen the death of the slide rules!

3 - Final thoughts



Standard safety sign

Nowadays calculations are delegated to electronic devices and the results often uncritically read on the display, without any idea of how they are produced.

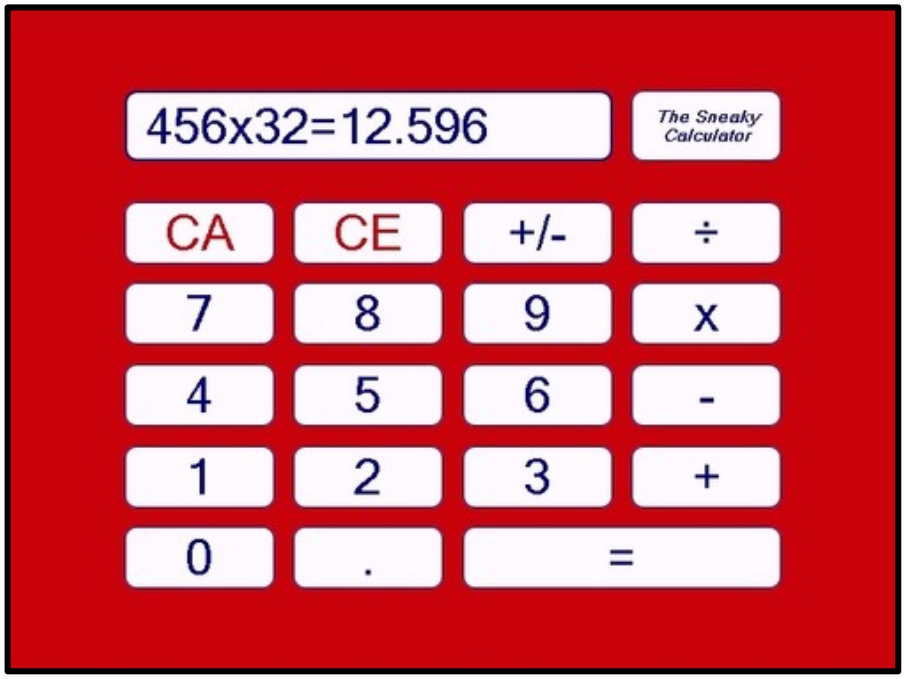
Most people punch numbers into a calculator and expect it to provide the correct answer.

The *Art of Numeracy* is no longer practiced, the world before computers is almost forgotten: students learn mathematics being illiterate about its history, a false start.

We are becoming just mere consumers, with a technological clock around the neck. We can only read and charge our electronic devices, ignoring how they work. By this way anyone can cheat us.

Before it was different: the old calculators do not provide direct results but just aid the operator, helping develop a mentality of review that extends to all aspects of living.

This calculator is wrong: any engineer of the past would have noticed that 6x2 cannot give 6. He was used to check but today, sadly, many believe without verify.



The correct answer is 14,592

Not everyone is used to check

The thinking that *"if an expert says it, then it must be true"* is the base of the Authority Principle, which leads to mental slavery and makes us vulnerable. The wide-spread acceptance of hoaxes is a clear sign of this.

Not by chance was democracy born in Greece: scientific thinking and an open mind are not a natural product of evolution, but must be cultivated steadily.

A simple lesson about traditional calculation may help: *a rational mind produces better decisions, better citizens and a better world*.

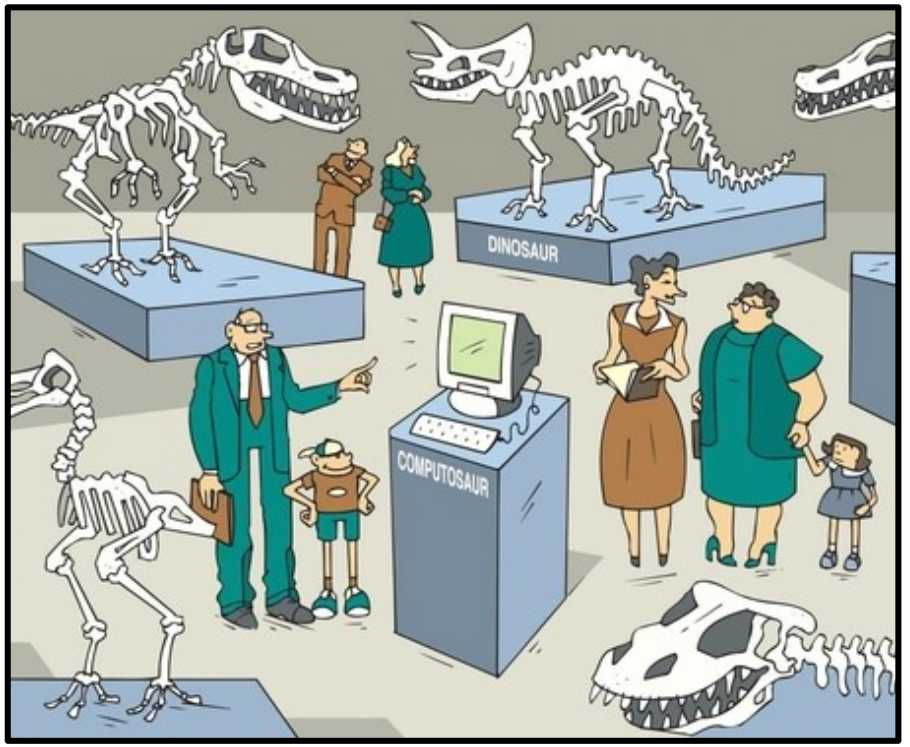
Let us remember these instruments and those who created the modern world using technology, not depending on it for survival. Today, instead, we often use the electronic aids as a drunk man relies on lamp posts: for support rather than illumination.

Fermi and von Braun used calculators less powerful than any mobile phone, but now the calculation is available to everyone: who will be able to do better?

Progress cannot be stopped, yet the old instruments may still be useful to keep awake our abilities, considering that ..

.. learn their use is not difficult, they were once known by everybody. If Tom Cat does, you can do it!

We must keep memory of the past: a museum would not be complete without a display of dinosaur bones. It would also be incomplete without a display of old calculating devices, for these are the fossils of today!



The power of the first computers was compared to that of slide rules

The history of the calculators, with the teaching aids to understand how they works, can be *freely* downloaded from my web.

Modern technology has ancient roots: ignoring how calculations were performed before the digital era is comparable to only knowing history from the first moon visit. Not so smart!