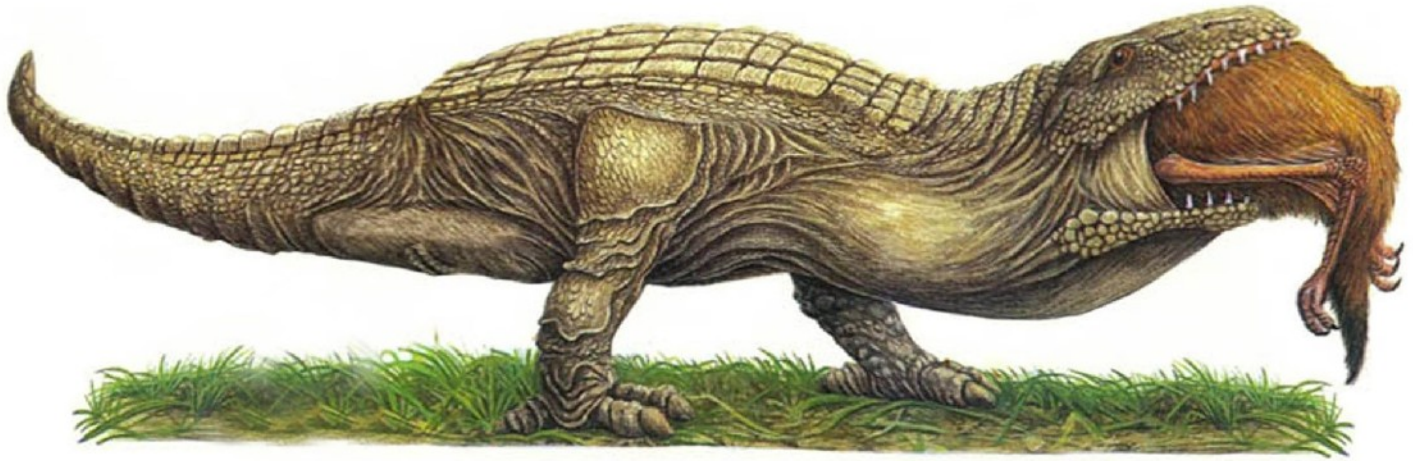
Calcolatoria Educational Solutions Nicola Marras
against mindless use of computers

Too Weak To Survive

reviving the electric slide rule, long ago eaten by digital technology



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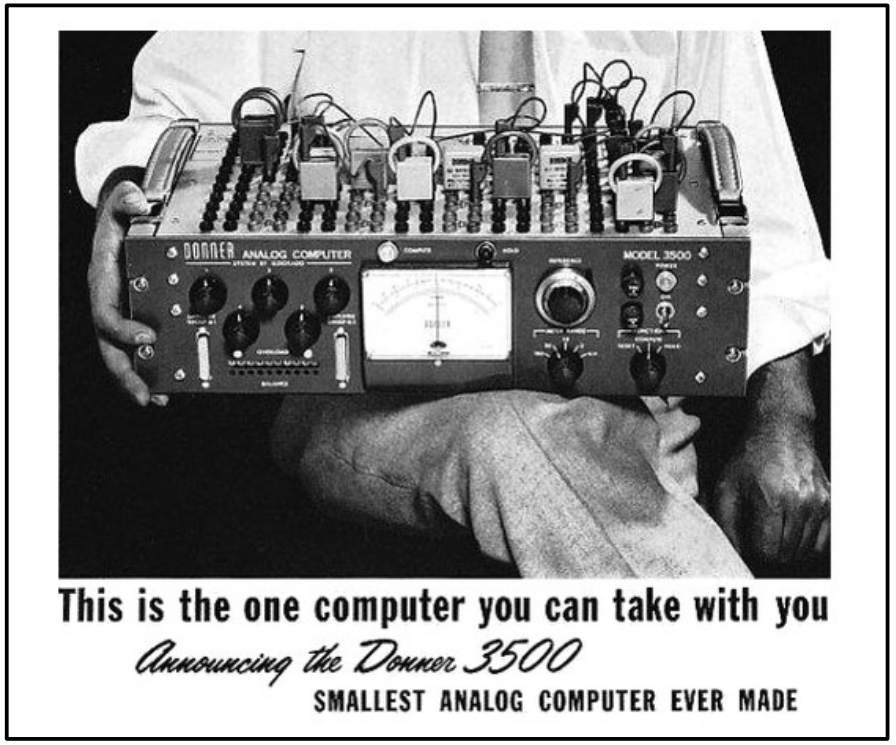
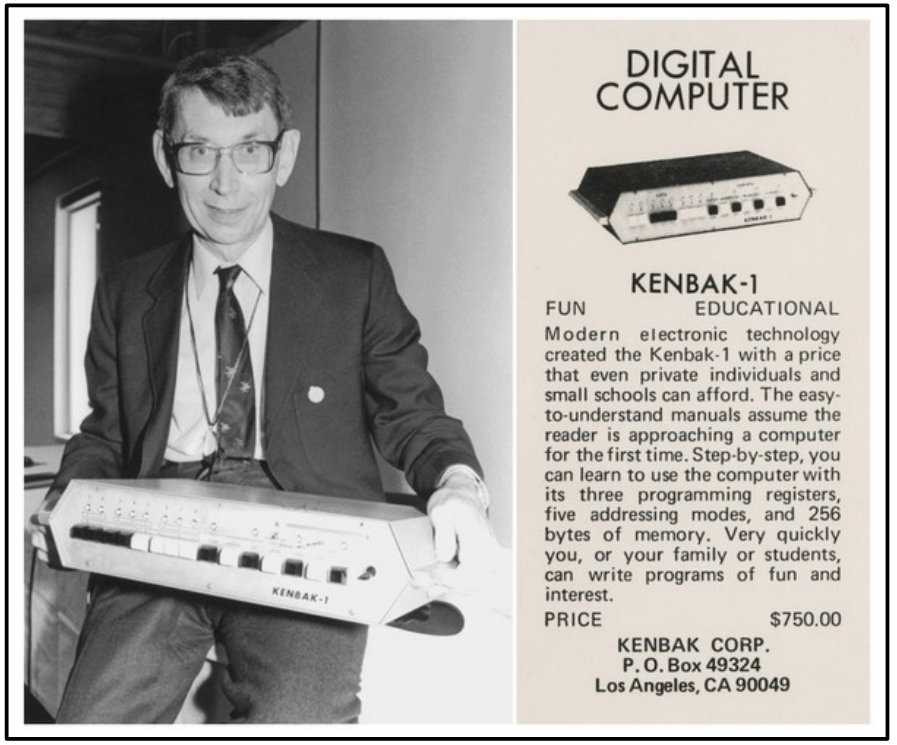
Here you can see the fossils of one *Ipodius* and one *Cellarus*. They both appeared later in the time-line and were short lived devices; they soon merged together to form the *Ego-Phonus*, which now dominates the personal communication chain.

As a matter of fact, also technologies become obsolete like living animals and lose the *Struggle for Life*.

For example, at the beginning of the information age, analog and digital processing fought for dominance.

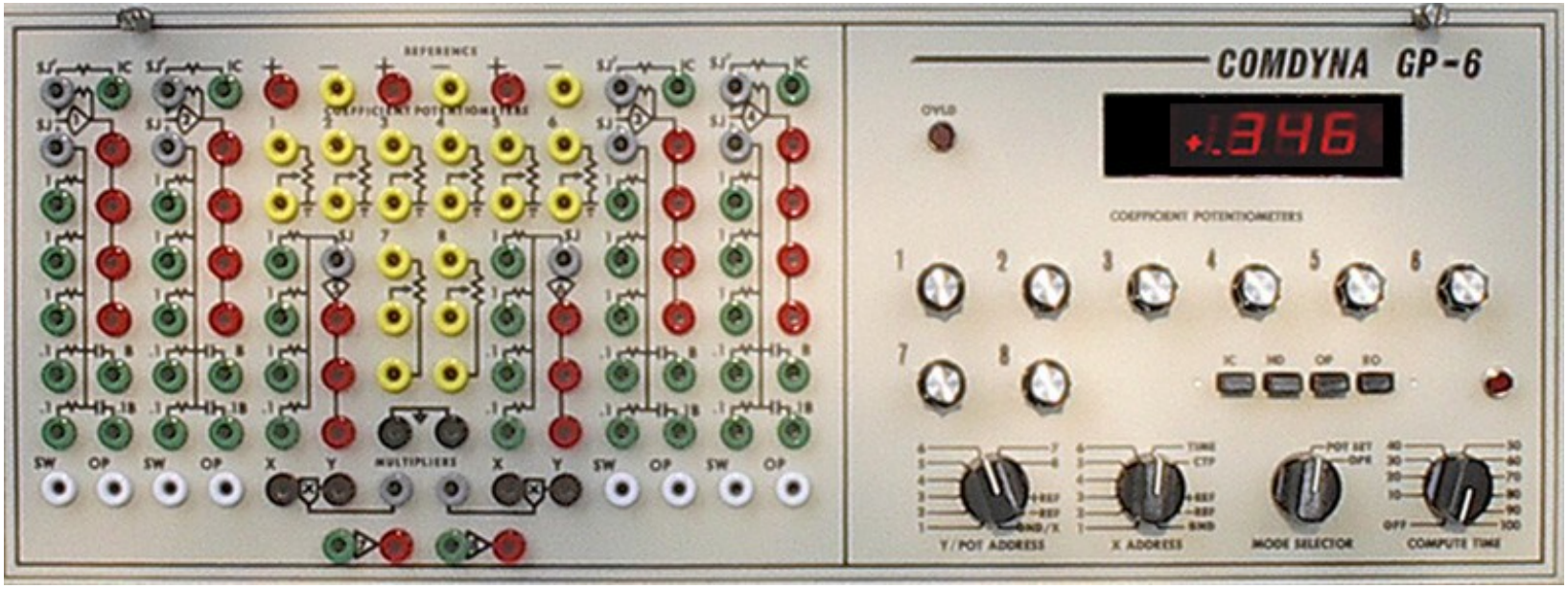




Today most computers are digital, but this technology dominated only after winning the *struggle for life*.

The dominance of digital technologies has led to the temporary dearth of analog computer. Although they are faster for specific unique tasks, digital computers are more practical for general and various tasks.

The Pentium type CPU is not the most efficient computer solution for a given specific problem, but is more effective for the wide variety of most problems.



Comdyna GP-6, an analog calculator build from 1968 to 2004

A few analog computers are still in use, mostly for specialized real-time tasks that need fast computing.

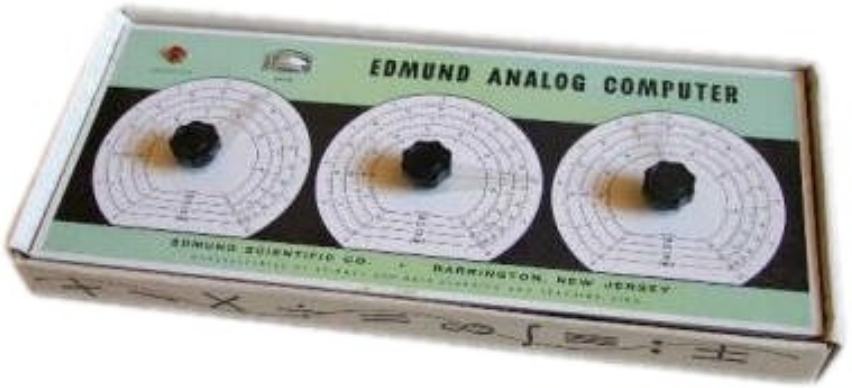
Their market presence is insignificant, but their potential to solve dynamic problems that are too challenging for today's digital processors may change with recent technology breakthroughs. They wait in the dark and we shall see: the competition is not yet over.

analog calculators wait their moment hidden inside the synthesizers

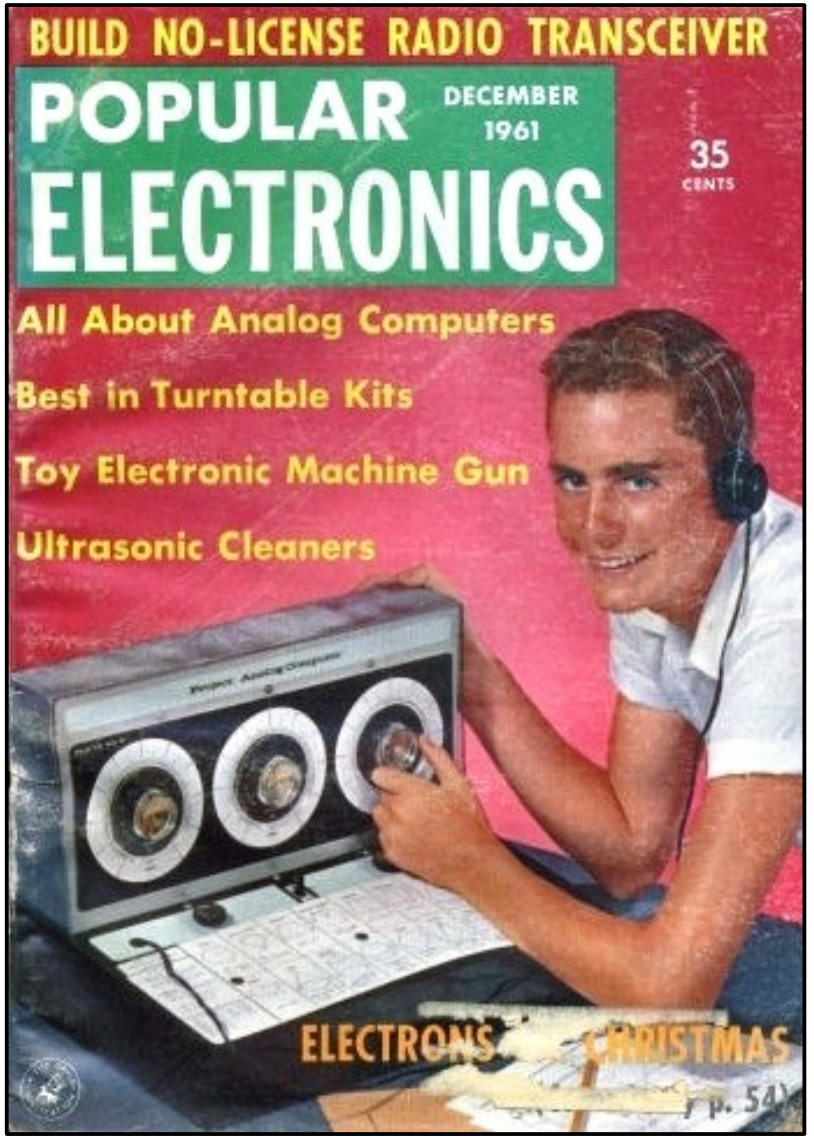
An adjunct of analog computers is a curious calculator that was developed in the 1960s; an evolutionary branch that is now definitely extinct after a brief golden age.

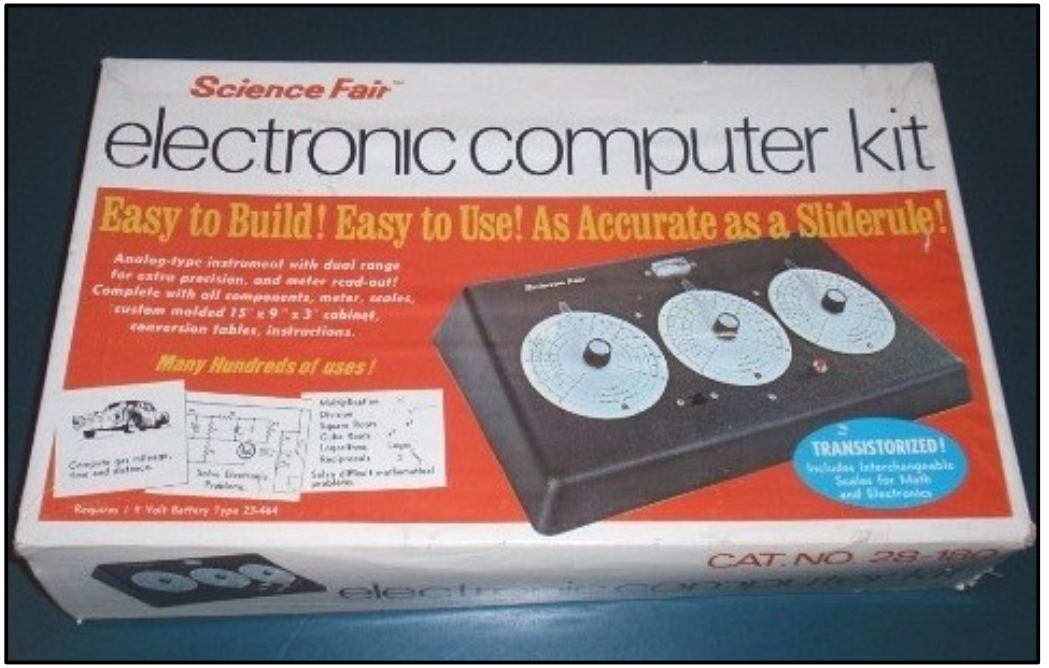
The publicity boasted: "*buy a sophisticated analog instrument that prepares you for the vital role computers will play in the future*".

An ambitious task: they were just *electric slide rules*, which arrived in the market too late to win the race against real electronic calculators.



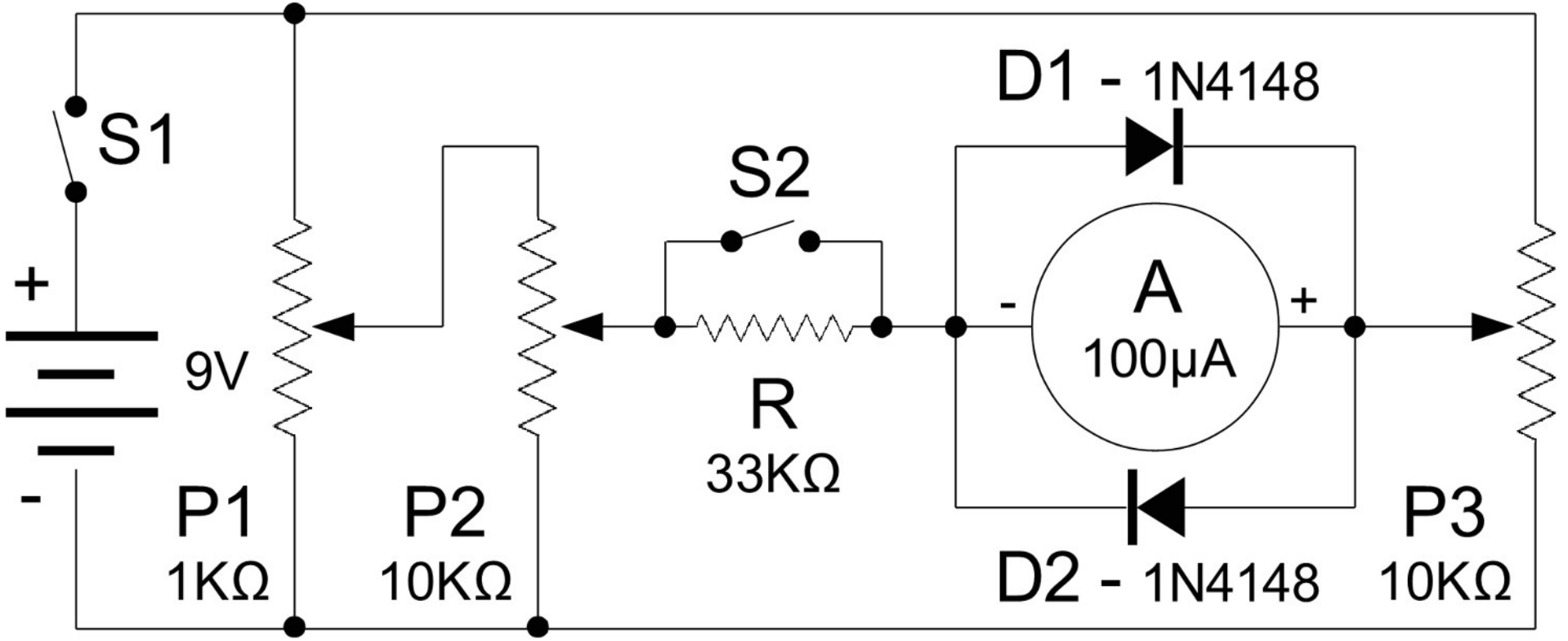
At the time, many were sold as self-building kits; hobbyists were once makers, not just users. Today obtaining one is difficult as only a few fossils have survived, but we can build one using my circuit, based on articles published in various magazines of the era.





Review this diagram: the center zero ammeter is connected to the battery on one side through potentiometers P1 and P2 and on the other side through P3. All potentiometers have a graduated scale from 1 to 10.

When the output of the two sets of potentiometers is equal the ammeter will read zero.



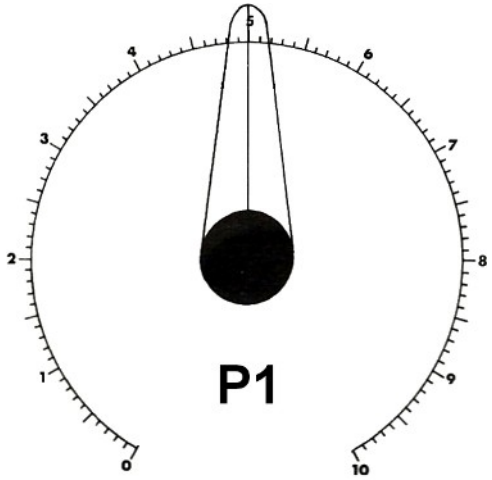
Remarks:

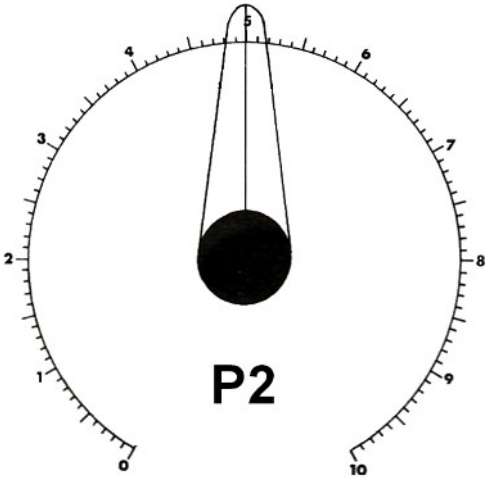
- the battery voltage and the pots' resistance value do not affects the results;
- the value of P2 and P3 must be 10 times that of P1 to limit the loss of linearity due to the load;
- the instrument is protected by a series resistance of 33 KΩ which limits the current, the two diodes protect further by limiting the voltage;
- the S2 button short-circuits the resistance and allows the amme-ter to calibrate to a precise zero.

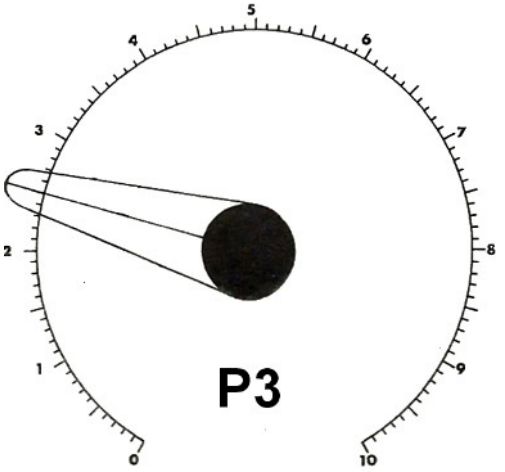
Photo © Prof. Mohamad Hassoun, Detroit, USA

To multiply 5x5 we have to set P1 on 5 (50% of the scale) and its output will be 50% of the voltage. This voltage feeds P2, positioned also on 5 (50% of the scale), so now we will have 25% of the original input.

This voltage moves the ammeter's needle from zero; now we rotate P3 until the needle goes back to zero: this will happen when P3 is at 2.5 (25% of the scale) because its output matches P1 and P2. We mentally set the decimals to find the correct result: 25.







The operations are similar to those of a slide rule; the decimal point location is mentally determined as usual.

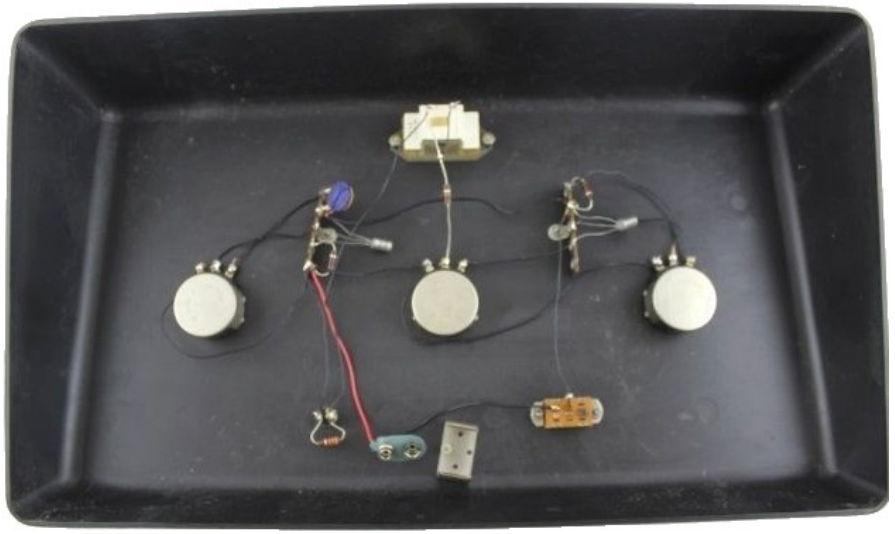
To perform a multiplication we need just to set multiplicand and multiplier on the P1 and P2 dials, turning P3 until the ammeter needle is at zero, push the S2 button for fine zeroing, and then read the result on the P3 dial.

To perform a division we have to use the same method, but dividend and divisor are set on the P3 and P2 and the result read on P1.

Powers, square and cube roots, logarithmic functions and reciprocal are also performed. There are many interchangeable scales to solve a wide range of problems.

In some models the ammeter has been replaced by a headset and the pots were powered by an audio signal generator. In this case null sound is equivalent to a zero reading from the ammeter.

Analog calculators operate by measurement of values rather than by counting and are simpler than a digital device: there is nothing inside; however, the battery has not been inserted!



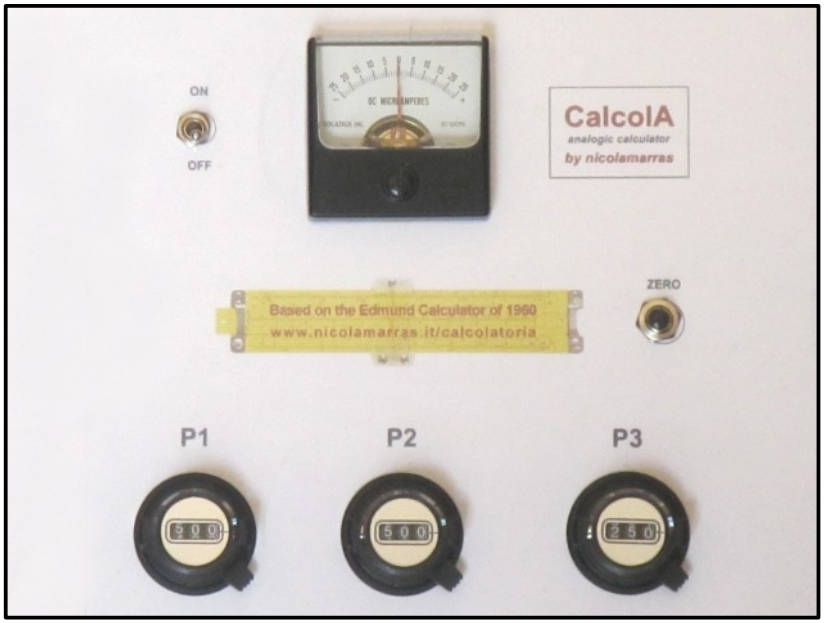
Like slide rules, they cannot add or subtract and the precision is of 2 or 3 digits.

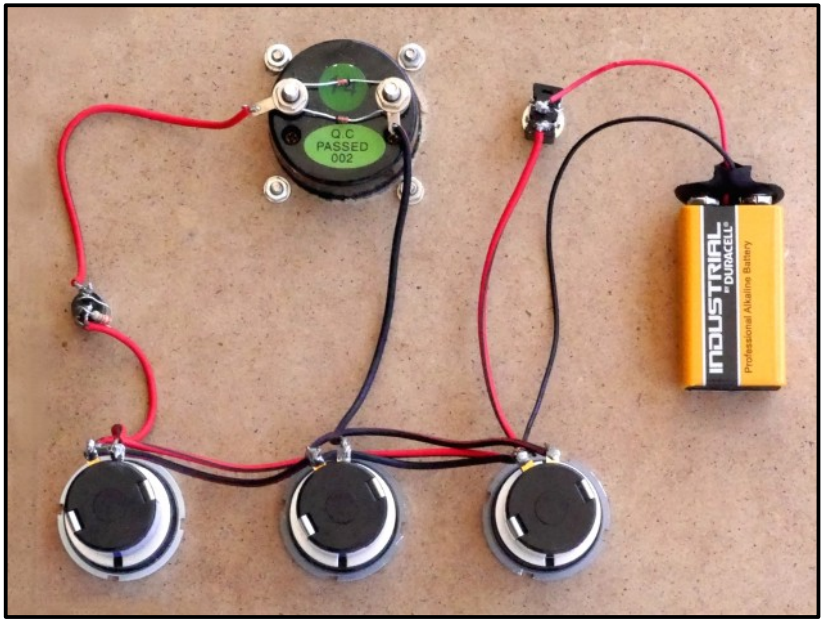
To build one require only a little soldering, we just need to buy three linear 10-turn pots with precision knobs:

- one 1 kΩ;
- two each 10 kΩ.

And:

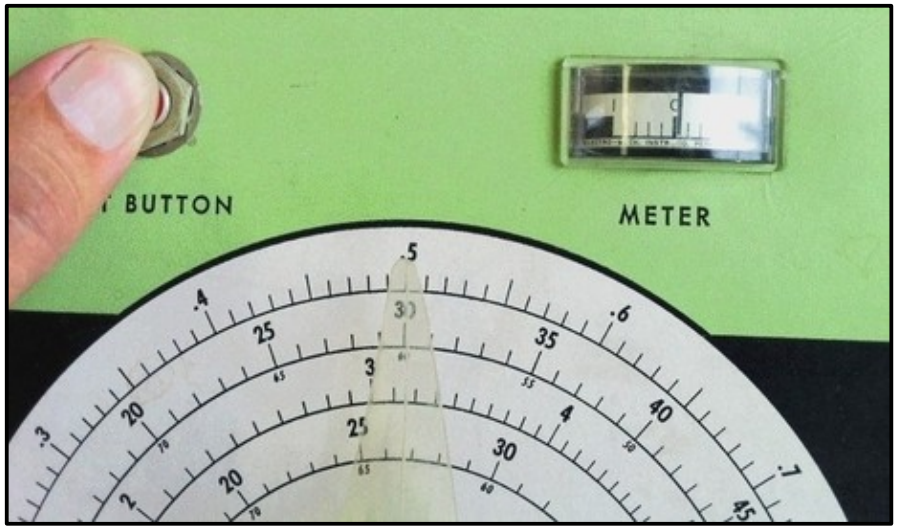
- one analog 100 μA ammeter with a center zero;
- two each 1N4148 diodes;
- one 33 kΩ resistor;
- one power switch;
- one push-button switch;
- one 9 v battery;
- one mounting base.





Such analog calculators are easy to build, but at the time precise potentiometers were so expensive that their marketing was not cost effective. Today instead we can have inexpensive multi-turn pots with a low linearity error and precision scales.

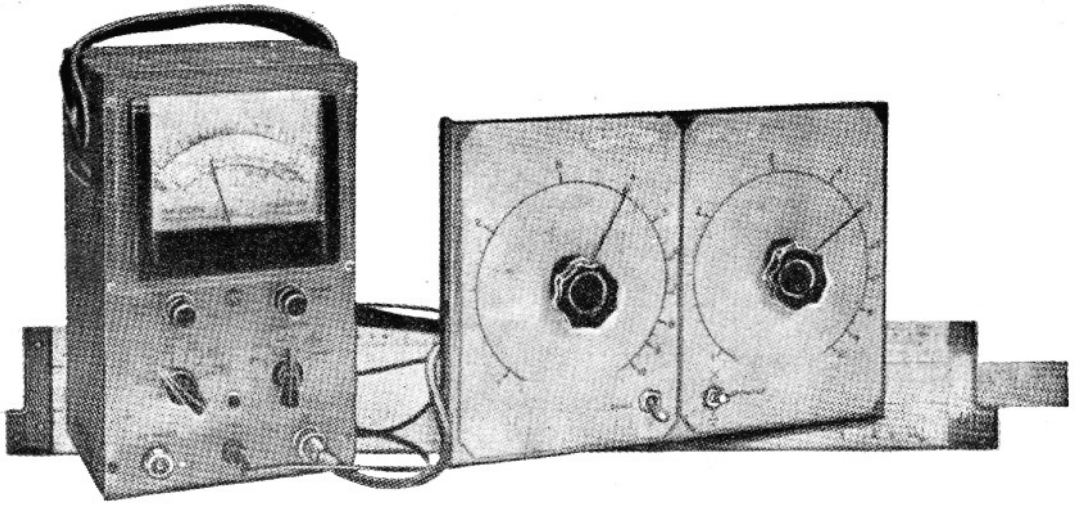
The components available permitted just a precision of ~±5%, while today we can reach ~±1%, but now we no longer need such devices. They evolved too late!



old dials were large, modern knobs have 3 digits precision

In the search to take the *sweat out of math*, this evolutionary endarkenment appears briefly: the two potentiometer calculator, where the operations are performed by adding or subtracting voltages and the results are read on a logarithmic voltmeter.

The precision depends of the voltage value and a stabilized power supply is required. It is highly unpractical, but somebody still tries to build one!



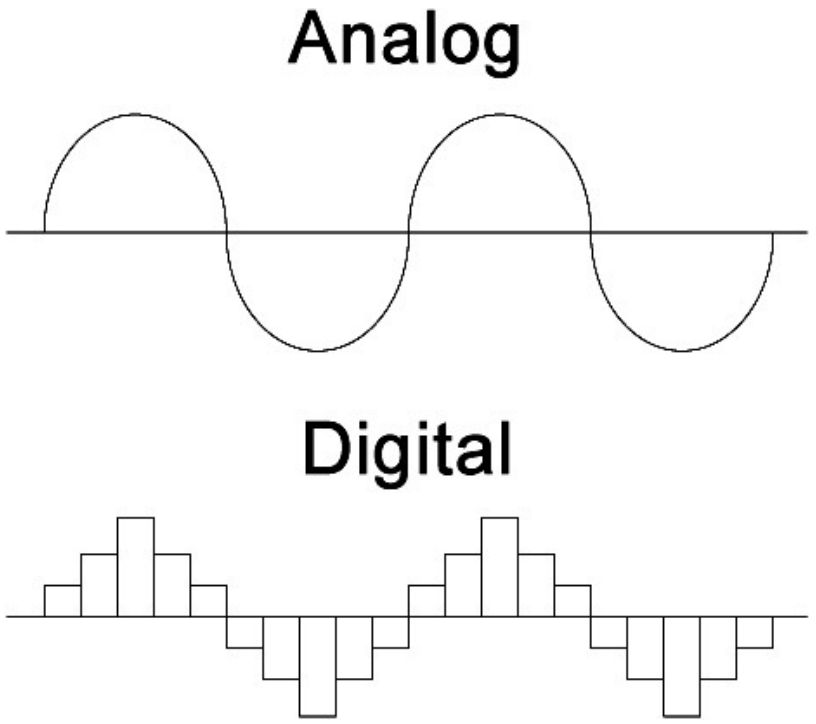
All these calculators were evolutionary dead ends, but they came equipped with blank dials so people could develop scales to fit their own needs. In this way many young people were helped through the arithmetic barrier.

They were easy to build and understand: students practiced soldering and so on. A blank dial wakes up the brain, an educational stepping-stone in the sunset of the Era of the Maker.

Now we are just simple consumers, sometimes *techno-wilds* with a clock around the neck who can only read it and charge it.

I don't know if this is a positive change, but evolution will tell us soon which is the best line!

The potentiometer-based calculator is now extinct, but maybe the analog computer will return as an evolutionary advancement, using voltage instead binary values and doing probabilistic math without forcing transistors into an absolute one-or-zero state.



Our world is ruled by only two states. Break this digital tyranny is possible: embrace approximation will be the solution?

It will be a long time before this system have a chance of real-world use, but nothing in evolutionary terms.

The past is coming: think different, think analog.

The '58 analog video game *tennis for two* has mutated into modern digital games, but the fight between analog and digital is not ended yet.

Perhaps they will merge into a new species: hybrids have more chance to survive!