**Early calculating devices**

The earliest known calculating device is probably the [abacus](http://www.britannica.com/EBchecked/topic/340/abacus). It dates back at least to 1100 BC and is still in use today, particularly in Asia. Now, as then, it typically consists of a rectangular frame with thin parallel *rods* strung with *beads*. Long before any systematic positional notation was adopted for the writing of numbers, the abacus assigned different units, or weights, to each rod. This scheme allowed a wide range of numbers to be represented by just a few beads and, together with the invention of zero in India, may have inspired the invention of the Hindu-Arabic [number system](http://www.britannica.com/EBchecked/topic/682032/numeral" \o "number system). In any case, abacus beads can be readily manipulated to perform the common arithmetical operations—addition, subtraction, multiplication, and division—that are useful for [commercial transactions](http://www.britannica.com/EBchecked/topic/127986/commercial-transaction) and in *bookkeeping*.

The abacus is a digital device; that is, it represents values discretely. A bead is either in one predefined position or another, representing unambiguously, say, one or zero.

Calculating devices took a different turn when [John Napier](http://www.britannica.com/EBchecked/topic/402857/John-Napier" \o "John Napier), a Scottish mathematician, published his discovery of [logarithms](http://www.britannica.com/EBchecked/topic/346146/logarithm" \o "logarithms) in 1614. As any person can attest, adding two 10-digit numbers is much simpler than multiplying them together, and the transformation of a multiplication problem into an addition problem is exactly what logarithms enable. This simplification is possible because of the following logarithmic property: the logarithm of the product of two numbers is equal to the sum of the logarithms of the numbers. By 1624, tables with 14 significant digits were available for the logarithms of numbers from 1 to 20,000, and scientists quickly adopted the new labour-saving tool for tedious astronomical calculations.

Most significant for the development of computing, the transformation of multiplication into addition greatly simplified the possibility of mechanization. Analog calculating devices based on Napier’s logarithms—representing digital values with analogous physical lengths—soon appeared. In 1620 [Edmund Gunter](http://www.britannica.com/EBchecked/topic/249527/Edmund-Gunter" \o "Edmund Gunter), the English mathematician who coined the terms cosine and cotangent, built a device for performing navigational calculations: the Gunter scale, or, as navigators simply called it, the “gunter”. About 1632 an English clergyman and mathematician named [William Oughtred](http://www.britannica.com/EBchecked/topic/435352/William-Oughtred" \o "William Oughtred) built the first *[slide rule](http://www.britannica.com/EBchecked/topic/548710/slide-rule" \o "slide rule)*, drawing on Napier’s ideas. That first slide rule was circular, but Oughtred also built the first rectangular one in 1633. The analog devices of Gunter and Oughtred had various advantages and disadvantages compared with digital devices such as the abacus. What is important is that the consequences of these design decisions were being tested in the real world.

1623 the German astronomer and mathematician [Wilhelm Schickard](http://www.britannica.com/EBchecked/topic/725520/Wilhelm-Schickard" \o "Wilhelm Schickard) built the first [calculator](http://www.britannica.com/EBchecked/topic/89155/calculator" \o "calculator). He described it in a letter to his friend the astronomer [Johannes Kepler](http://www.britannica.com/EBchecked/topic/315225/Johannes-Kepler), and in 1624 he wrote again to explain that a machine he had commissioned to be built for Kepler was, apparently along with the prototype, destroyed in a fire. He called it a [Calculating Clock](http://www.britannica.com/EBchecked/topic/725523/Calculating-Clock" \o "Calculating Clock), which modern engineers have been able to reproduce from details in his letters. Even general knowledge of the clock had been temporarily lost when Schickard and his entire family perished during the [Thirty Years’ War](http://www.britannica.com/EBchecked/topic/592619/Thirty-Years-War).

But Schickard may not have been the true inventor of the calculator. A century earlier, [Leonardo da Vinci](http://www.britannica.com/EBchecked/topic/336408/Leonardo-da-Vinci" \o "Leonardo da Vinci) sketched plans for a calculator that were sufficiently complete and correct for modern engineers to build a calculator on their basis.

The first calculator or adding machine to be produced in any quantity and actually used was the Pascaline, or [Arithmetic Machine](http://www.britannica.com/EBchecked/topic/725527/Pascaline" \o "Arithmetic Machine), designed and built by the French mathematician-philosopher [Blaise Pascal](http://www.britannica.com/EBchecked/topic/445406/Blaise-Pascal" \o "Blaise Pascal) between 1642 and 1644. It could only do addition and subtraction, with numbers being entered by manipulating its dials. Pascal invented the machine for his father, a tax collector, so it was the first business machine too (if one does not count the abacus). He built 50 of them over the next 10 years.

In 1671 the German mathematician-philosopher  [von Leibniz](http://www.britannica.com/EBchecked/topic/335266/Gottfried-Wilhelm-Leibniz" \o "Gottfried Wilhelm von Leibniz) designed a calculating machine called the “[Step Reckoner](http://www.britannica.com/EBchecked/topic/725529/Step-Reckoner)”. (It was first built in 1673.) The “Step Reckoner” expanded on Pascal’s ideas and did multiplication by repeated addition and shifting.

Leibniz was a strong *advocate* of the [binary number system](http://www.britannica.com/EBchecked/topic/65540/binary-number-system" \o "binary number system). Binary numbers are ideal for machines because they require only two digits, which can easily be represented by the on and off states of a switch. When computers became electronic, the binary system was particularly appropriate because an electrical circuit is either on or off. This meant that on could represent true, off could represent false, and the flow of current would directly represent the flow of logic.

Leibniz was *prescient* in seeing the appropriateness of the binary system in calculating machines, but his machine did not use it. Instead, the “Step Reckoner” represented numbers in decimal form, as positions on 10-position dials. Even decimal representation was not *a given*: in 1668 Samuel Morland invented an adding machine specialized for British money—a decidedly nondecimal system.

Pascal’s, Leibniz’s, and Morland’s devices were curiosities, but with the [Industrial Revolution](http://www.britannica.com/EBchecked/topic/287086/Industrial-Revolution" \o "Industrial Revolution) of the 18th century came a widespread need to perform repetitive operations efficiently. With other activities being mechanized, why not calculation?

In 1820 [Charles Xavier Thomas de Colmar](http://www.britannica.com/EBchecked/topic/725533/Charles-Xavier-Thomas-de-Colmar" \o "Charles Xavier Thomas de Colmar) of France effectively met this challenge when he built his “[Arithmometer](http://www.britannica.com/EBchecked/topic/726021/Arithmometer" \o "Arithmometer)”, the first commercial mass-produced calculating device. It could perform addition, subtraction, multiplication, and, with some more elaborate user involvement, division. Based on Leibniz’s technology, it was extremely popular and sold for 90 years. In contrast to the modern calculator’s credit-card size, the “[Arithmometer](http://www.britannica.com/EBchecked/topic/726021/Arithmometer" \o "Arithmometer)” was large enough to cover a desktop.

*Beads perline*

*Rods barre*

*bookkeeping Contabilità*

[*slide rule*](http://www.britannica.com/EBchecked/topic/548710/slide-rule) *Regolo calcolatore*

*advocate sostenitore*

*prescient profetico*

*a given un dato fisso*

1 What was the earliest calculating device?

2 How old is it?

3 How does it work?

4 What is the advantage?

5 What did Napier discover?

6 What two mechanical devices were based on Napier’s tables?

7 Who built the calculating clock? What happened to it?

8 Who built the first commercial calculator?

9 Why was the” [Step Reckoner](http://www.britannica.com/EBchecked/topic/725529/Step-Reckoner)” more advantageous than the Pascaline?

10.What was the [Arithmometer](http://www.britannica.com/EBchecked/topic/726021/Arithmometer)”?

11 How long was it in production?