Gottfried Leibniz

1646
Born on July 1 in Leipzig

1661
Enrols at University of Leipzig and awarded degree at 17

1660's
Works as lawyer and diplomat. Publishes paper on 'The Art of Combination'

1672
In Paris, he develops the principle of Sufficient Reason

1673
Calculating machine presented to Royal Society in England

1675
Invents calculus independently of Newton

1676
Considers dynamics through the concept of kinetic energy

1678
Appointed librarian and adviser to the Duke of Hanover

1679
Develops binary mathematics

1683
Publishes pamphlet, 'The Most Christian War God', an attack on Louis XIV

1690's
His genealogy of the House of Hanover expands into a History of the World. Develops an interest in linguistics and the origin of languages

1700
Organises Berlin Academy of Sciences

1714
Responsible for establishing the right of succession of George I to the vacant English throne after the death of Queen Anne

1716
Dies in Hanover November 14

COURTESY OF THE SCIENCE MUSEUM

Scientists involved in the fifth generation computers are taking an interest in the work of this 17th century thinker

Gottfried Wilhelm Leibniz was the leading scientific light of his time — the period known as The Age of Reason. He was born in the central European city of Leipzig in 1646 and died in Hanover in 1716. During his life of three score years and ten (the sort of exact figure you might expect from a mathematician), he invented calculus, worked on dynamics, and made contributions to geology, theology, history, linguistics and philosophy. Most important of all, he developed ideas that would be fundamental to the creation of the computer.

He began his travels at the age of 20, after the University at Leipzig refused to confer a doctorate of law on him because of his youth. Throughout his life, without any private means to support him, Leibniz was forced to take up work that hampered his scientific research. In his early twenties he worked as a lawyer and diplomat; later in life he was a librarian and adviser to royalty.

His interests were wide-ranging, and his cosmopolitan nature led to extensive travel in Europe talking with all the great thinkers of his time. Leibniz was a prolific letter writer, as well — engaging in correspondence with over 600 people.

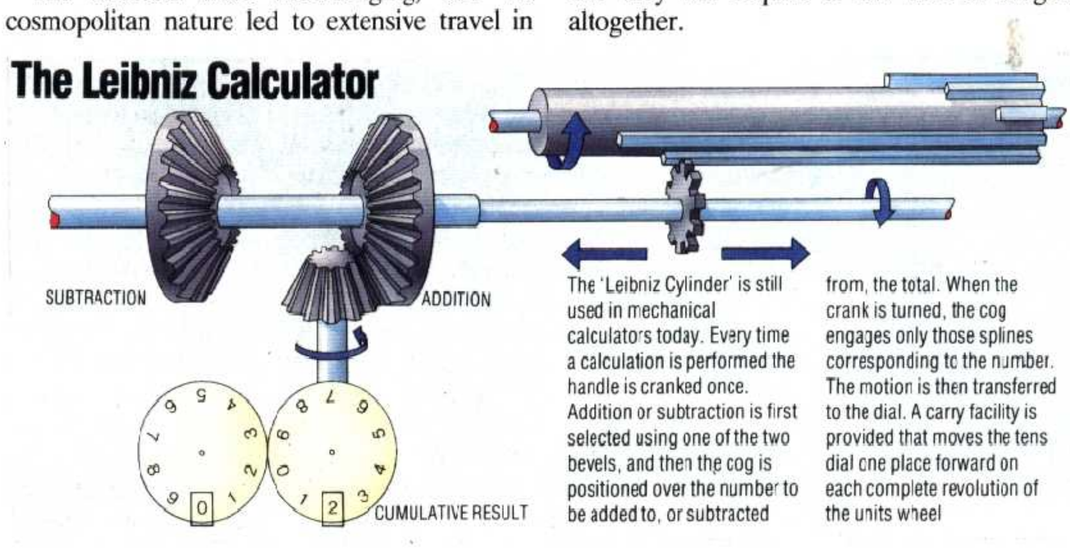
His first important contribution to philosophy came in 1672 when he formulated the principle of Sufficient Reason. This held, simply, that there must be a reason for everything, and 'everything is for the best in the best of all possible worlds'.

Turning his attention to mathematics, he then set to work to perfect the Pascaline adding machine invented by Blaise Pascal in 1642 (see page 86). Leibniz sought to upgrade it so that it would be capable of both multiplication and division. He did so by designing a mechanical device called the Leibniz Cylinder (see below). Leibniz's device was a major breakthrough for its time. Previously, because of the complexity of manipulating Roman numerals, multiplication had been taught only in the higher institutes of learning. A machine that could multiply mechanically made arithmetic more accessible. Once Leibniz had perfected this device, he moved on from base ten arithmetic to consider and formalise binary mathematics.

Leibniz's greatest ambition was to devise a universal language that could use the clarity and precision of mathematics to solve any problem that mankind faced. His language was to use abstract symbols to represent the fundamental 'atoms' of understanding, with a set of rules to manipulate these symbols. His attempt failed; but his ideas were taken up in a more modest way in the early 20th century by Bertrand Russell, who tried to explain mathematics in terms of a formal logical 'language'.

In the last few years, interest has been rekindled in the work of Leibniz by the scientists involved in the long-term project to create the fifth generation of computers. These machines, it is hoped, will be able to solve any problems of human endeavour with the same speed and certainty that computers of today execute mathematical calculations. To do this they will require a new sort of language altogether.

The Leibniz Calculator



The 'Leibniz Cylinder' is still used in mechanical calculators today. Every time a calculation is performed the handle is cranked once. Addition or subtraction is first selected using one of the two bevels, and then the cog is positioned over the number to be added to, or subtracted from, the total. When the crank is turned, the cog engages only those splines corresponding to the number. The motion is then transferred to the dial. A carry facility is provided that moves the tens dial one place forward on each complete revolution of the units wheel

KEVIN JONES