The Search For an Iron Brain

The Story of the Invention of a New Machine—The Autarith

THE philosophers and mathematicians of Europe have been trying for centuries to build a machine that will really do problems of arithmetic. The abacus of the Greeks and Romans was one of the first crude attempts in this line. The ancient Chinese made a simple device which they called the suanpuan, and which looks much like a kindergarten chart. It is still in use among the yellow race.

Following these ancient forms, we have the first recorded attempt at an arithmetical instrument by Napier in the seventeenth century. His work on logarithms, however, was of more practical value than his calculator.

The first real calculating machine was invented

Alexander Rechnitzer

by Blaise Pascal, the philosopher, about 1642, consisting of a series of wheels connected with one another and engraved with the figures 0 to 9. It was of little use, however, and the carrying of tens was accomplished by hand. Thirty years later, or about 1672, the great philosopher-mathematician, Leibnitz, put together a machine for performing the four fundamental arithmetical operations of addition, subtraction, multiplication and division, and so thoroughly did he apply both his philosophy and his mathematics to this reckoning machine that it is still the basis of all calculators of this sort. Some thirty years ago, Bollee, a Frenchman, built a calculating machine upon a principle somewhat different from that of Leibnitz, but with it the process of division is too cumbrous for practical use.

Charles Babbage, an Englishman, designed and partially constructed from 1822 on, what are probably the most complex calculating machines ever known, devoting nearly all his life, $100,000 of his private fortune, and $80,000 of government grants to this work. His first machine was called a "Difference Engine," but it was never entirely finished, although large sums were expended in experiments. The actual benefit to the mechanical world, in improved and more accurate methods in the manufacture of machines of precision, nevertheless exceeded in value the amount of money spent. After vexatious delays with this Difference Engine, which fully stopped all work upon it, Mr. Babbage conceived a still more complicated automatic mechanism, the equal of which has never been produced, and this he called an "Analytical Engine." It was designed to work out the algebraic development of any formula whose law was known and convert it into numbers. In fact, Mr. Babbage declared that if constructed, it could solve any algebraic problem, the successive steps of which could be conceived by the human mind, do it automatically, and without error.

For practical purposes, however, the Leibnitz calculator in its various modifications is the one with which we are concerned as a commercial factor. Thomas, of Colmar, constructed a machine about 1850, for multiplying and dividing, upon the lines laid down by Leibnitz. From this machine has developed the modern adding machine in present use in many offices, effecting a great labor saving over purely mental calculations, but still requiring a certain amount of mental effort and manual labor to operate it, which becomes wearisome after a time.

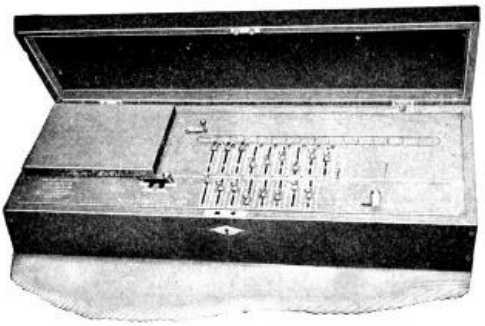
The next and latest step beyond these calculators was to make one entirely automatic; that is, to relieve the operator of any mental strain or manual effort in making a calculation. This may seem to some a comparatively simple step, after the progress already made, but it was really the most difficult task of all. The solution to this problem, however, is presented in the Autarith, a purely automatic calculating machine.

To Alexander Rechnitzer, of Vienna, belongs the credit of having evolved the first automatic calculating machine for performing the operations of multiplication and division, as well as those of addition and subtraction. It is called the Autarith, and is indeed an ingenious machine, fascinating in its operation. While the Autarith, as Mr. Rechnitzer first constructed it, was an operative mechanism, it was not a perfected machine, and the Keuffel & Esser Company, of New York, who had already devoted much time and energy

to calculating machines of various sorts, spent over two years experimenting and improving before they brought it to the state of a practical commercial machine.

In three years only five machines have been built, while $90,000 has been spent in perfecting these pieces of mechanism.

The principle upon which the fundamental arithmetical operations are effected in this machine, as in its predecessors, is borrowed from Leibnitz, but for the greater number of its parts and in many of its devices, the design and mechanical execution are unique with this calculator. All the mechanical assistance which is needed with the Autarith is to indicate, by means of the pointers or numeral wheels, the problem to be performed. A movement of the single controlling lever then sets in motion an electric motor, and all further movements are effected automatically, the carriage advancing step by step through the successive stages of the calculation and returning upon the conclusion to its initial position, leaving the result indicated by



The Autarith

the numeral wheels or pointers, as the case may be, depending upon the operation performed.

Probably the most interesting function of the Autarith is dividing. In this operation, which amounts to a successive subtracting, the machine closely simulates the mental operation in "trying out" the quotient, and appears to deliberate upon the correctness of the successive stages of the operation. Having repeatedly subtracted the divisor until it is no longer contained in the dividend, it continues to do so once more, when, finding this to be incorrect, it automatically corrects itself by adding the divisor once. The machine then proceeds with the next place nearer units, exactly as one would bring down another figure to the remainder in arithmetically performing long division.

The analogy to the mental calculation is in this case so striking that one will not be surprised that the inventor states he was led to the construction of his machine by considerations which were originally of philosophic interest only. It is interesting to note, in this connection, the prominent part philosophy has played in the development of the calculating machine, as evidenced by the work of Pascal, Leibnitz and others. When we consider that figuring is a fundamental basis of all commerce and industry, such a machine as the Autarith becomes of the greatest practical importance, effecting as it does, an enormous saving of mental work, and insuring absolute accuracy in its results, which is not attainable by other than mechanical means.

The operation of the Autarith is simple, a single lever sufficing to control it. The varying problems are indicated by means of the pointers, or on the numeral wheels, and upon throwing the starting lever into position the carriage advances, performs the calculation, and when through, returns to its initial position, disconnecting the motor at the end of its trip and bringing all parts to rest.

As to capacity, the present style of Autarith will automatically multiply any two numbers from one figure each up to eight figures each, yielding a product of sixteen places. In division it will automatically divide any number of sixteen figures by any number of eight places down to one figure by one. Numbers of eight places can be added or subtracted. The numeral wheels on which the results are read are placed close together to enable one to read the numbers rapidly. The pointers are conveniently placed as well, and a single turn of the canceller sets all numeral wheels to zero. The necessary power to run the small electric motor is readily obtained from an electric light socket.

Sixteen hundred separated pieces of metal must be put together to form the intricate mechanism of this iron brain. Four hundred of these pieces are each made differently in structure and each serves a different purpose. Yet all the sets of gears and mechanisms are locked in their turn when another set is in action, thus preventing slips or shifting, while the carriage is held by guides and rollers.

Before a representative of THE BUSINESS WORLD the machine was demonstrated recently. A number of eight figures was multiplied by one of the same number of figures in 23 seconds. The same multiplication was completed by a bookkeeper in 129 seconds, and by an ordinary clerk in 137 seconds.

Some of the records of speed made by the new calculating machine are given below:

$36,425 \times 4,679 = 170,432,575$
Time, 12 seconds.

$97,564,382 \times 76,854 = 7,498,213,014,228$
Time, 14 seconds.

$166,814,765 \div 45,734 = 36,475$
Time, 16 seconds.

$6,347,835,831 \div 74,983 = 84,657$
Time, 18 seconds.

$98,765,432^2 = 9,754,610,558,146,624$
Time, 20 seconds.