An Invention that Might Have Accelerated the Development of Mathematical Machines

Jiří Klír, *Research Institute of Mathematical Machines, Prague*

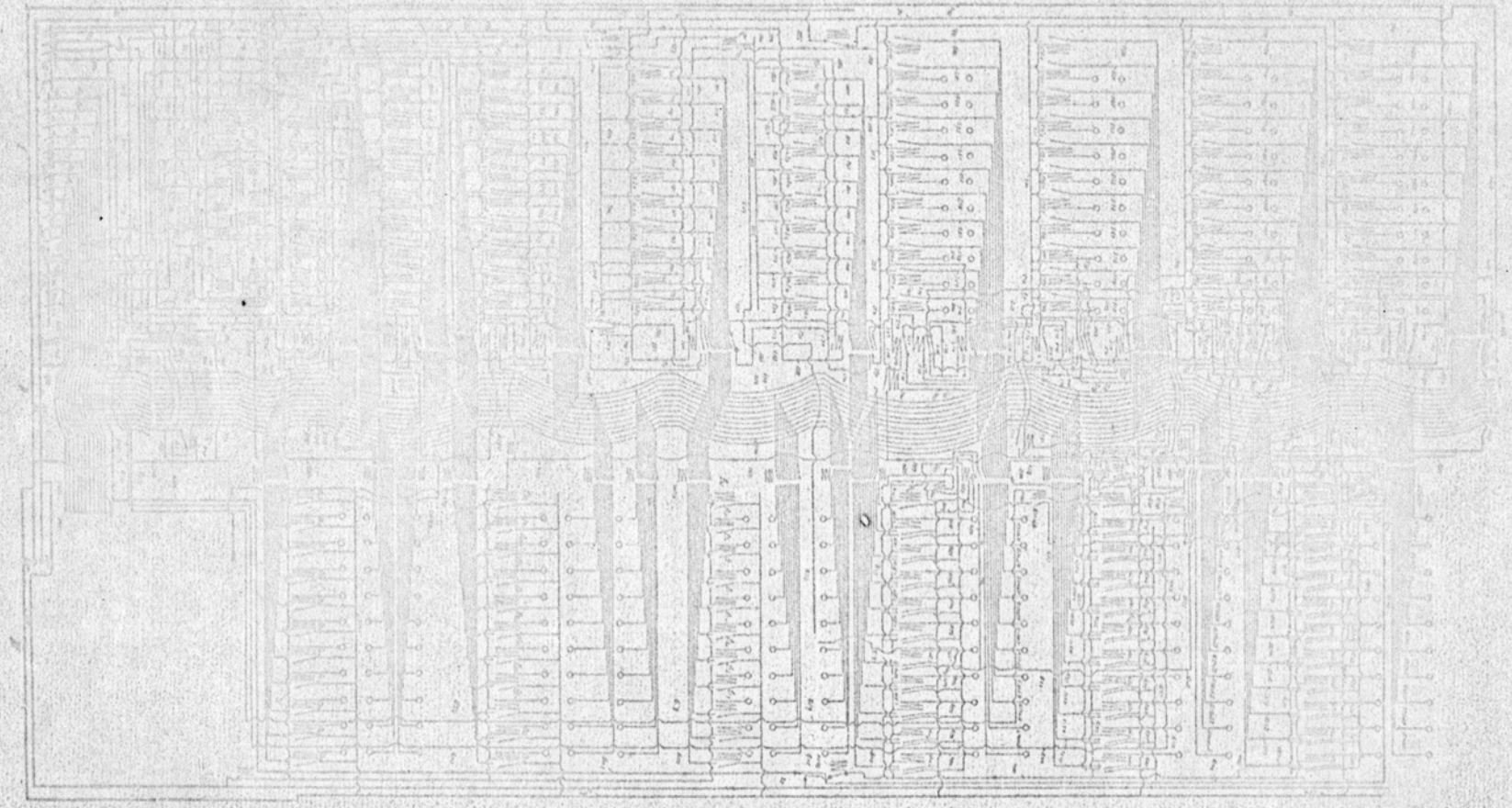
Science and technology are rightly considered callings that require a vision of the future for creative work. However, an occasional glance into the past supplements rather than contradicts this mental attitude. This is why the editor feels justified in presenting the following article to the reader.

In the last two decades, mathematical machines have experienced a most impetuous development based on the successful construction of several automatic computers during the Second World War.

It is well known that the idea of a universal automatic computer was first conceived by the English mathematician Charles Babbage, more than hundred years ago (about 1834—1835). Until the end of his life, Babbage spared no effort to make his computer materialize; however, some constituent parts were all he succeeded in constructing. Though his failure was partially due to lack of funds, decisive was the fact that Babbage actually wanted to construct the computer on a purely mechanical principle, which is absolutely insufficient for the purpose. It is rather interesting that electromagnetic relays, which would have been a much more appropriate structural element, already existed at the time when Babbage designed his computer. Though originally, relays were merely used as telegraph amplifiers, their ability to carry out logical functions was discovered only much later, when the development of automatic telephone exchanges had set in.

Babbage's unsuitable concept for the realization of his computer and his consequent failure were the reason why after his death the ingenious idea of a universal automatic computer was forgotten for a long time. Only when the mechanical notion had been abandoned and the relay concept introduced were the first universal automatic computers constructed. The priority is generally attributed on the one hand to Howard Aiken's large computer MARK 1, constructed at Harvard University, and on the other hand to the smaller computer constructed by Konrad Zuse in Germany. Both were constructed during World War II, but only one of them, MARK 1, survived the war, while Zuse's computer was destroyed during an air raid on Germany.

From this point we do not propose to follow the further development of automatic computers, but on the contrary, we wish to turn back to the work of another early pioneer in this field; his name was Bernard Weiner, and he was a Czech engineer. Though his work has gained very little publicity, it deserves an important place in the development of mathematical machines.



The idea of an automatic relay computer occurred to Weiner as early as during the First World War. Soon after the war he began—privately and on his own resources —to work on the design of his computer, and then to realize it. The final design of the computer forms part of a patent application filed under the heading „Electric computer and typewriter" in 1923. Unfortunately, the model has not survived, but the design is still available since it is contained in the Czechoslovak patent issued under No. 30571.

From the present point of view, Weiner's invention, as described in the patent specification, represents a semi-automatic relay computer of high standard, which could easily be turned into an automatic machine if the storage capacity were increased. The informations are entered by a keyboard. Part of the keyboard serves for the entering of digits, the remainder are operational keys for setting the desired operations.

The automatic performance of Weiner's computer includes the basic arithmetical operations, i. e. adding, subtracting, multiplying, dividing and shifting, as well as complex operations like calculating the values of arbitrary algebraic expressions of some transcendental functions, etc. A programme for each of these operations is firmly built into the computer and set off by pressing the corresponding operational key. The patent specification describes the programmes of the basic arithmetic operations and of calculating the values of $\sin x$, a^x, $\sqrt[n]{a}$, and $\lg x$.

The final results of the calculations are printed by an automatic typewriter, based on a principle similar to those of teleprinters. The initial numbers and various intermediate results are stored in relay registers representing the memory of the computer.

The computer uses decimal notation with a fixed decimal point. Individual decimal figures are represented by the code „one of ten".

In conclusion, a few words about the author of this outstanding invention. Bernard Weiner, born on January 21st, 1891, at Mirovice in Bohemia, turned his interest to mathematical machines as soon as he had finished his studies at the Institutes of Technology in Vienna and Prague. He started work on his computer as soon as he was demobilized at the end of the First World War. Since he had to depend on his own financial resources, he worked under very difficult conditions. He also designed a relay suitable for his computer, the principle of which is preserved in patent specifications (e.g. German patent No. 536096). Later on, several large industrial firms showed interest in his invention, among them U.S.National Cash Register and Vitkovice Iron Works. Finally the latter set up a special research department where Weiner worked in developing his idea and designing a fully automatic computer. This activity was stopped for good by the German occupation: Weiner, who was of Jewish origin, was sent to a concentration camp together with his family; there he perished in 1942.