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DEPARTMENT: ANECDOTES

Tracing the Origins of the First Soviet Computers, Beyond Legends

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The first Soviet digital computers, the M-1 and the MESM, were built in 1951, a few years after their western counterparts. Anecdotal storytelling narrates that Russian scientists learned of electronic computers from Western radio broadcasts and popular magazines that arrived in the Soviet Union. The article examines the plausibility of the legends and tries to reconstruct the origins of the first Soviet computers and the influence of Western projects on more solid bases of historical research.

The USSR was among the first countries to develop computer technology. Their first machines were completed in 1951: The Automatic Digital Computer Machine One (in Russian АЦВМ-1, here M-1 for short) at the Power Engineering Institute of the USSR Academy of Science in Moscow, and the Small Electronic Calculating Machine (MESM, following the original acronym МЭСМ) at the Institute of Electrical Engineering, Ukrainian Academy of Sciences in Kiev. Both projects started in 1948. The protagonists of the two projects were Isaak Brook and Bashir Rameev for the M-1, and Sergei Lebedev for the MESM.

In 1948, Rameev worked as an engineer at the Institute of Radar in Moscow. He was from a family of wealthy Tatar gold miners. In the 1930s, his father was exiled to the Gulag, and Rameev himself was expelled from university [23]. His outstanding abilities helped him overcome political discrimination, however, and become the designer of the first Soviet computers, Strela and Ural.

Brook was born into a poor Jewish family. After the revolution, he received a higher technical education. Even before the war, he achieved significant success in the development of analog mechanical integrators. In 1948, he was the head of the laboratory at the Energy Institute of the Academy of Sciences.

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Sergei Lebedev in 1948 was the director of the Institute for Electrical Engineering of the Ukrainian Academy of Sciences. Before the war, he worked at the All-Union Electrotechnical Institute in Moscow, where he obtained substantial results in studying problems of stability of power systems. After the war, he moved to Kiev, where he successfully continued to research in the management of power systems and automation devices. His work on solving problems of trouble-free operation of long power lines was awarded the Stalin Prize. After the MESM Project, Lebedev led the construction of the successful series of BESM computers for which he is best known.

How Brook, Rameev, and Lebedev got the idea to start a project for the building of electronic computers is subject of anecdotal storytelling. Here we examine these legends and try to trace the origins of the first Soviet computers and the influence that information about Western projects had on their development. The article is organized as follows. Section "The Legends, Origins, and Plausibility" reviews the legends and discusses their plausibility. Section "Knowledge of Western Results" examines how the knowledge of Western results arrived in the Soviet Bloc and summarizes the most relevant publications, outside and inside USSR. Section "The M-1 and MESM projects" recaps briefly the projects that built the first Soviet computers.

The Legends, Origins, and Plausibility

Boris Malinovsky [23] wrote that Rameev heard about foreign developments while secretly listening to a BBC broadcast. The same source says that Lebedev learned of the Western advances reading an article on digital computing devices in a magazine brought from Switzerland by a familiar radio amateur.

THE RADIO BROADCAST

BBC has made it possible to find all radio and television programs since 1929 through its BBC Genome Project 2 [17]. Apparently, for the 1940s, only one program was devoted to computers. On Saturday, 11 January 1947, the BBC Third Programme aired a half-hour *Science Survey* starting at 11:30 PM—certainly not prime time for a British listener, even less so for Moscow time (2:30 AM). The first half of the program discussed the beneficial properties of penicillin. In the second half, Douglas R. Hartree, professor of mathematical physics at the University of Cambridge, explained the new automatic calculating machines.

Hartree was deeply involved in automated computing. In 1933, he had visited Vannevar Bush's differential analyzer at the Massachusetts Institute of Technology and, back in England, he built one in Manchester. After the war, Hartree played a role in the development of early British computers and visited twice the U.S. laboratories working on electronic computers [9].

According to Malinovsky's book, Bashir Rameev learned about the ENIAC computer while listening to this broadcast. Hartree's radio talk made a strong impression and he decided that he would take part in the construction of the first Soviet electronic computer.

FIGURE 1. Bashir Rameev, a designer of the first Soviet serial computer, "strela." Wikipedia, accessed 13 October 2023.

However, in those years in the Soviet Union, listening to BBC broadcasts was extremely dangerous, with consequences including arrest and imprisonment. Rameev would have faced particular risks. Before the war his father had been prosecuted for political reasons. As son of an "enemy of the people" Bashir was excluded from the list of students of the Moscow Power Engineering Institute; for the same reason he did not have registration to reside in Moscow and was constantly looking for stable housing.

There was a radio broadcast featuring computers, although intended for a general audience, given by a prominent figure. Yet it seems unlikely that Rameev, in his precarious housing situation, would have listened to the BBC in the middle of a weekend night, with all the risks that such behavior entailed. Even odder is the notion that a simple broadcast, overheard by chance, was enough to ignite the idea in Rameev.

THE SWISS MAGAZINE

The supporting actor of the Swiss magazine story is Oleg Bogomolets, a renowned pathophysiologist and son of Alexander Bogolomets, president of the Ukrainian Academy of Sciences. His interests included the treatment of radiation injuries, a topic that became a research field after the atomic destruction of the populations of Hiroshima and Nagasaki. In April 1948, the World Health Organization opened its headquarters in Geneva and Bogomolets, fulfilling government assignments related to his medical research, visited several times.

An avid amateur radio operator, Bogolomets collected during his trips brochures and magazines reporting on advances in electronics, including the ones on digital computing devices. Returning to Kiev, he showed the material to Mikhail Lavrentiev, at that time vice-president of the Ukrainian Academy of Sciences. He in turn showed them to Lebedev, raising in him the determination to build an electronic computer in Kiev [23].

In 1948, there were no electronic calculators in Switzerland, but on 13 October the newspaper *Neue Zürcher Zeitung* published an article entitled "Electronic Counting Machines" [31]. The author was Eduard Stiefel, founder of the Institute of Applied Mathematics at ETH Zurich. Stiefel, convinced that programmable digital computers were necessary for the development of science and technology, in the following years lead the projects that first rented the

Zuse Z4 for the Institute (1950) and then built the ERMETH (1956). Stiefel was also in close contact with the projects of Howard Aiken at Harvard, John von Neumann at Princeton, and Maurice Wilkes at Cambridge [30]. The article in the *Neue Zürcher Zeitung* was probably written as part of the Stiefel's campaign to pique public interest and help raise funds for his projects.

So, again we have a public, widespread, and authoritative source of information, which is also dated from one of the periods that Bogomolets was in Switzerland. However, the fortuitous chain of events raises doubts, as does the claim that an established scientist changed his research direction based only on information read in a newspaper.

Knowledge of Western Results

The first electronic, programmable, digital, general purpose computers were preceded by machines based on electromechanical relays, such as the Harvard Mark 1 [32] or the aforementioned Zuse computers. All of these responded to a growing need for increasingly complex calculations, both in terms of algorithms and the amount of data to be processed. Such need originated from varied and widespread applications, civil and military. War and the subsequent nuclear arms race made the need even more pressing. Leslie Comrie's writings of the 1940s [11], [12], [13], [14] are good examples of the description of needs as well as the review of solutions, written by a scientist engaged in both research and dissemination of general information and results.

FIGURE 2. Academician Sergei Lebedev, an outstanding Soviet scientist and engineer, founder of the leading Soviet computer school.

The use of electronic circuits to perform logic calculations had been published since the beginning of the 1930s. The works of Rossi and Jacobsen [28], [20], although relating to applications of experimental physics, were known through journals such as *Nature*. Through *Nature* were also disclosed in 1946 the Mark I [21]—with an emphatic title–and the ENIAC [19] and, in 1948, the University of Manchester's Small-Scale Experimental Machine [34]. Arthur Burks of the ENIAC project published an extensive article on the computer's circuits in *Proceedings of the Institute of Radio Engineers* (IRE) in 1947 [6]; the Institute also sponsored public sessions on electronic computers at the IRE National Conventions that the U.S. Army Security Agency found valuable [29].

All this information reached the USSR. Even if the articles did not go into details, the basic principles of electronic computers were published and there was evidence of the progress made in the USA and U.K. Moreover, there was much intelligence work: Soviet spies infiltrated important research laboratories and industries and collected many classified documents related to radar, sonar, computers, and other electronic technologies [16], [18].

Besides the information that arrived, one way or another, from the West, the USSR was driven by the same hunger for computing power needed to support scientific and technological developments. In February 1946, Stalin had given Russian scientists precise directives to "not only to overtake but to surpass" the achievements of their Western colleagues [18]. The main topics of research were nuclear physics and rocketry, but other fields were targeted and automatic computing appeared as a valuable aid to practically every one of them.

In October 1947, Mikhail Lavrentiev, director of the Institute of Mathematics of the Ukrainian Academy of Sciences in Kiev, warned the Soviet Academy of Sciences to invest in the field of "machine mathematics," where the USSR ran serious risks of lagging behind the West. Lavrentiev also proposed the foundation of an institute devoted to applied mathematics and computer technology [18].

As a result of political directives and scientific interest, a number of articles appeared in Soviet journals.

In 1947, Mikhail L. Bykhovskii published a short note in *Uspekhi Matematicheskikh Nauk* (*Russian*

Mathematical Surveys). Entitled "New American tabulating machinery" [7], it briefly described the Mark I and ENIAC, with references to articles in *Popular Science* [25], [27] and *Nature* [19].

In 1948, Bykhovskii published two more articles in the same journal. The first was his translation of Howard Aiken and Grace Hopper's "An automatically controlled calculating machine" [1] that was largely coincident with the content of their two-part article in *Electrical Engineering* [2], [3]. The second was his full translation of Hartree's article on the ENIAC [19].

Finally, in 1949 the journal published Bykhovskii's extensive article, "Principles of electronic mathematical machines for discrete calculation" [8]. This described the engineering principles for the electronic implementation of several computer components and included many detailed diagrams and circuits.

Uspekhi Matematicheskikh Nauk was targeted to the mathematical elite from the Academy of Sciences and leading universities in the USSR. It normally published few translations of foreign articles, and was usually devoted to pure mathematics. The presence of four papers related to a very specific topic of applied mathematics indicates the interest in it: both as support for the construction projects that were starting up, and as a way to create consensus among researchers in other fields interested in the new computing machines.

The M-1 and MESM Projects

Building the first Soviet electronic computers was an experimental and pioneering work in many senses. Information was available on the results of Western projects, but limited to general principles. Implementing the electronic solutions also required overcoming the difficulties of obtaining electronic components in the required quantities. Moreover, even the idea of pursuing the development of universal machines was subject to debate.

In July 1949, when the M-1 and MESM projects were in their early stages, a decisive meeting was held at the Department of Technical Sciences Bureau of the Academy of Sciences. It can be considered a pivotal point in the determination of developmental paths of Soviet computer technology.

During the meeting, two points of view clashed on promising directions in the development of automatic computing machines. Defenders of the first party argued that it was impossible to create a reliable electronic computer based on unreliable components such as vacuum tubes. Therefore, the main efforts should be directed to specialized analog and mechanical calculators. The second group believed that building specialized machines for each problem was expensive and would take years of work to complete. Therefore, the future would belong to universal electronic machines. It is noteworthy that both sides called on the experience of ENIAC's construction and operation.

Brook and Lebedev attended this meeting. However, Mstislav Keldysh made the main contribution to the final decision. As the deputy director of the Mathematical Institute of the Academy of Sciences, Keldysh was responsible for calculations of the atomic bomb project. Like no one else, he understood that only universal computers could cope with the enormous and growing number of problems that such projects posed. His energy and perseverance led to the curtailment of work on specialized machines. All efforts were then directed to the development of universal computers [24].

The work [22] described the formation and development of Soviet scientific and technological policy in the field of computer technology.

M-1

Brook and Rameev presented a detailed project to design an automatic digital computing machine in August 1948. In 1948, Rameev was an engineer at the Institute of Radar in Moscow. The institute's director was Aksel Berg, one of the USSR's radar pioneers. Not only a scientist, Berg was also an admiral and the work of the institute was mainly related to defense. Berg recommended that Rameev discuss with Brook the idea of building an automatic computer; at that time Brook worked on specialized computing machines at the Power Engineering Institute of the Academy of Sciences.

In October 1948, a proposal was made to organize a laboratory for the realization of the project and Brook and Rameev submitted to the USSR State Committee for Inventions and Discoveries an application for an "automatic computing machine for universal purpose." On 4 December 1948, the Committee issued a certificate of invention, i.e., a patent [4]. Today, 4 December is celebrated as the Day of Russian Computer Science.

Due to lack of funds and personnel, probably also because of the debate in progress, the ADCM project was halted for a year and a half; actual work began only in the spring of 1950. Among the difficulties was the lack of electronic components, eventually solved by using captured German materiel.

In December 1951, Brook's group issued a report entitled "Automatic Digital Computer M-1" [26]. At that time

FIGURE 3. Corresponding member of the academy of sciences Isaak Brook, an outstanding Soviet scientist, engineer, and author of the first Soviet electronic computer, M-1.

the M-1 had successfully passed its first tests and, shortly thereafter, it became a fully operational, small machine with good computing performance for many practical applications. Among its characteristics was the double main electronic and magnetic memory [10]. The magnetic drum not used as the only main storage (as in the Booth machines [5]) nor as an I/O device (as in the Manchester machines [21]).

MESM

In May 1946, Lebedev became director of the Institute of Energy of the Ukrainian Academy of Sciences, in Kiev. One of his first initiatives there was the organization of seminars to explore alternatives to satisfy the computing needs of the institute. Initially oriented toward analog machines, they moved to more flexible, universal, digital machines. Among the other researchers, Solomon Pogrebinskii presented lectures summarizing Soviet and foreign work on analog and relay calculators.

In May 1947, the Institute was reorganized in two branches and Lebedev was appointed director of the one devoted to electrical engineering. With the support of Mikhail Lavrentiev, Vice-President of the Academy of Sciences of the Ukrainian SSR, a special secret department, Laboratory Number 1, was established. The first period was spent recruiting personnel and gathering information. By way of Lavrentiev, Lebedev's group had access to the articles published in *Uspekhi Matematicheskikh Nauk* and possibly to classified materials. In the spring of 1949, about 20 people worked at the laboratory and began designing the MESM. In one of his speeches of this period, Lebedev said: "I have data on eighteen machines developed by the Americans. This data has the character of advertisements, without any kind of information on how the machines are built. Taking advantage of experience from abroad is difficult since published material is scarce" [23].

The overall computer architecture and schematics of the main logical circuits were ready by the end of 1949. In 1950, computer installation began in a building in Feofaniya, a park south of Kiev, and by the end of the year, the first tests were carried out.

On 25 December 1951, the official government final tests were passed successfully and MESM began regular operations [15].

CONCLUSION

In the cathedral of Pisa, guides show tourists a chandelier and announce that Galileo Galilei, one day while attending Mass, understood the isochrony of the pendulum by observing the oscillations of exactly that chandelier.

The story is based on a line from Galileo's first biography written by one of his disciples, Vincenzo Viviani, over 50 years later [33]. However, no source tells us which chandelier it was. Galileo, as one of the originators of the scientific method, conducted multiple experiments and not only during masses. Yet, a bit of plausibility remains and the story captures the attention of the general public.

The archives show that the first Russian computers were the result of articulated, even debated, projects. They were the effort of the cooperation of many people at different levels of responsibility. Moreover, they were based on the collection of useful information obtained through different means and, again, through the work of many people.

Legends do not emerge from thin air. Indeed, there was a BBC broadcast and an article in the *Neue Zürcher Zeitung*, but they could not have been the deciding factors in starting work on the first Soviet computers. Brook and Lebedev already knew a lot about electronic computers from other sources.

Legends and myths may be dangerous: They often work to reinforce partisan pride. They favor the invention of one individual instead of recognizing the reality of many people who work alone and collaboratively, in search of a solution to a common problem, all while drawing on the research of many others. It is vital to dynamic societies, such as those involved in electrical and electronic innovation, to correct the historical record. However, to maintain the interest of the general public in history, it must be done without completely destroying the romantic halo that characterizes the response to many difficult challenges, including scientific and technological ones.

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