THE M-3 IN BUDAPEST AND SZEGED

By MÁTÉ SZABÓ

I. THE FIRST COMPUTER IN HUNGARY

The M-3 was the first electronic, vacuum tube computer built in Hungary by the Cybernetics Research Group of the Hungarian Academy of Sciences (Magyar Tudományos Akadémia, Kibernetikai Kutatócsoport, MTA KKCs). The group was founded in 1956, its director was Sándor Varga while Rezső Tarján served as the scientific deputy director. The group employed several young engineers and mathematicians; many of them received their degrees during 1956 and 1957. Their original aim was to develop a computer on their own, the B-1,[1] based on Tarján's ideas. However, they were inexperienced and most of them had never seen an electronic computer working.[2] In September 1956, Varga contacted Sergey Alekseevich Lebedev[3] in Moscow, for whom he had worked at the V.I. Lenin All-Union Electrotechnical Institute between 1934 and 1946, for help [7, pp. 140–141]. Varga and Tarján visited Moscow, and most likely it was Lebedev who suggested the M-3 for Varga and the group, a "small machine," the conception of which was suggested by Isaak Semenovich Bruk[4] [11, pp. 159–160] (Fig. 1).

In this article, the author takes a look back at the developments that led to the first electronic vacuum tube computer to be ever built in Hungary.

The Cybernetics Research Group received the documentation, blueprints, and some instructions for the M-3 by mid 1957. They also received the essential components from the Soviet Union, such as the tubes, cuprox diodes, connectors, etc., but used resistors and capacities made by the Hungarian plant REMIX. Around this time Tarján was made to step down and Bálint Dömölki[5] became head of the Computer Development Department. It was Dömölki who "started to study the logical and electronical technical documentation on his own and [...] understood—step by step—the working method of the computer" [8, p. 71]. He prepared new documentation for the M-3, which required a considerable intellectual effort. This was the documentation that the members of the Group used while constructing the computer, as the original documentation was insufficient for that purpose. They also came up with their own solutions for the problems that arose: for example, changing circuits in the arithmetic unit, including new instructions to the original instruction set, or developing a new magnetic drum controller for four drums, and so on [8] (Fig. 2).

One possible explanation for the limited usefulness of the original instructions for the construction of the computer might be that at the time when the documentation arrived to Hungary there was no M-3 in operation yet, not even in Moscow [7, p. 172]. This also explains the incompatibility of the M-3 computers around the world. About the same time Hungary received the documentation; other research groups and factories in Minsk (Belarus), Tallin (Estonia), Yerevan (Azerbaijan), and Beijing (China) received it as well.[6] At each place the engineers came up with different solutions for the problems they faced; the groups had limited or no communication, and, admittedly, cared little about compatibility at this point.

Hungary built one M-3, but M-3s were simultaneously in production in Minsk and Beijing. In Minsk, the Special Design Bureau of the G. K. Ordzhonikidze computer factory invited Georgiy Pavlovich Lopato,[7]

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[1]B stood for Budapest.
[2]They only had experience with the first relay computer in Hungary, the MESz-1, designed by László Kozma [IEEE Computer Pioneer Award recipient, 1996 (posthumously)] at the Budapest Technical University for educational purposes [9, pp. 297–299].
[3]IEEE Computer Pioneer Award recipient, 1996 (posthumously).
[4]"M" in M-3 stands for "Малая электронная счётная машина," meaning "small electronic computing machine."

[5]After whom "Dömölki's algorithm" is named.

[6]Belarus, Estonia, and Azerbaijan were part of the Soviet Union at the time and were called, respectively, the Byelorussian, the Estonian, and the Azerbaijan Soviet Socialist Republic. About the connection between Moscow and Yerevan, and Moscow and Minsk, see [11, p. 160].
[7]IEEE Computer Pioneer Award recipient, 2000.
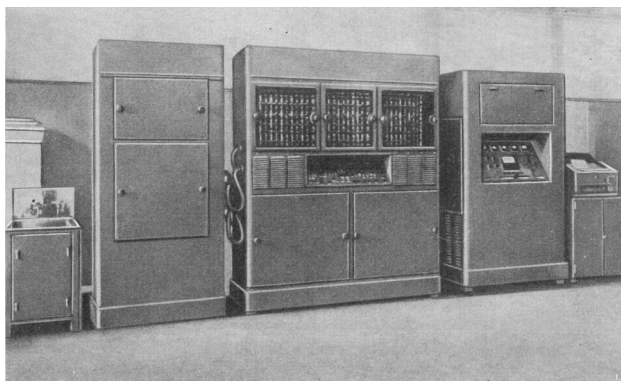
Fig. 1. *An M-3 in the Soviet Union. Photo from the Russian Virtual Computer Museum, http://www.computer-museum.ru/galglory/mergeilyan.htm?sphrase_id=61286.*

Fig. 2. *"The logic units of the M-3 computer. (Left) The new developed drum controller unit, with Hungarian produced long-life tubes. (Right) The old unit; the original Soviet design with Soviet elements" [8, p. 77]. Photo from the CD-ROM supplement of [7].*

one of the developing engineers of the M-3 from Moscow, to serve there as chief engineer. By the end of 1960 the factory produced 26 M-3 computers, ten of them with ferrite memory.[8] Lopato was also sent to Beijing to assist the assembly of the first computer in China [5], [14]. The DJS-1 (or 103) was also based on the M-3. It was in serial production from late 1961; altogether 36 were built[9] [17], [7, pp. 151–157].

[8]Those with ferrite memory are sometimes referred to as M-3 M.

[9]Around the same time they also built a larger computer, called DJS-2 (or 104) based on BESM-2.

II. THE M-3 AT WORK

Once the M-3 started working the question arose how could it be officially declared to be operational—how could it be handed over to the Academy. It would serve several purposes. The departments of the Academy would be notified about the computer which they could use for their research from that point on. At the same time this achievement would serve to gain some respect for the work of the Cybernetics Research Group and would start to change the atmosphere surrounding the computer. Indeed, the leadership of the Academy was not too optimistic about the computer and its

impact, and thought it was a fruitless expense.

But who could conduct the inspection of the M-3 to hand it over? Being the first computer in the country, there were no other computer experts outside the members of the Cybernetics Research Group. Varga invited Lopato, the chief engineer from the computer factory from Minsk, and made the M-3 subject to the same handover and checking procedure as in Minsk. Before the handover, Lopato helped the group to make the computer run more reliably. The M-3 passed the long process and was declared complete, and Lopato signed the documentation which was accepted officially by the Academy a couple of days later. The stand of the Academy was that there would be no need for further development of computers at least for five years, since the M-3 would satisfy every need of its scholars.

The timeline of the handover is incomplete, as the documents are lost. The *Evening Newspaper (Esti Hírlap)* covered the completion of the first Hungarian computer on January 21, 1959 (Figs. 3 and 4).[10] Members of the Cybernetics Research Group speculate in [7] that the handover must have happened a couple of days before, as the media coverage was surely only allowed once the process was successfully passed. Lopato spent a considerable time in Budapest as he arrived at the end of 1958 [7, pp. 184–186 and p. 248], [8, p. 71].

Once the M-3 was running more or less reliably (Fig. 5), the Cybernetics Research Group was reorganized and renamed and in its new function it served as the Computer Centre (Számítóközpont) of the Hungarian Academy of Sciences. The computer still ran 120 hours a week on average, serving both educational and research purposes as well as

[10]Although the journalist found the computer astounding, they felt that "30 operations per second" did not sound impressive enough. The group members suggested to multiply it by 3600, and sure enough the article described the speed of the M-3 as "100.000 operations per hour" [7, p. 188].

Fig. 3. *The cover of the Evening Newspaper (Esti Hírlap), January 21, 1959. Photo from the CD-ROM supplement of [7].*

Fig. 4. *From left to right: Sándor Podhradszky, István Ábrahám, Imre Molnár, László Szanyi, Győző Kovács, Zsolt Várkonyi, Bálint Dömölki, and Kálmán Kardos (in the dark). Photo from the CD-ROM supplement of [7].*

running calculations for industrial applications.[11] The Centre had an Economics Department and a Mathematics Department. The Economics Department helped the Planbureau calculating economic models for the five-year plans and planned economy, and solving optimization and other operational research problems.[12] The

Mathematics Department wrote subroutines and developed mnemonic coding for the computer and helped the economics projects. Their bigger projects included statistical language analysis and automated translation, optical system design, and static calculations for the verification of the plans of the Elisabeth Bridge (Erzsébet-Híd) over the Danube in Budapest. Although the leadership of the Academy was not too excited about the computer, the younger scholars were eager to learn about and to be able to use the M-3 for their projects, such as the linguistic ones [7, pp. 203–207], [8, p. 72].

Kovács tells the story of Dömölki and him visiting the M-3 in Minsk after the handover [7, p. 178]. He

describes the other M-3 at their first encounter as a "familiar yet different" computer. It was in operation and its tubes were glimmering. The room became silent as they recognized that Dömölki was focusing on the blinking lights. After a while he began smiling and asked whether the program running was calculating a solution of a partial differential equation. He earned tremendous respect among the engineers in Minsk as the computer was indeed doing that. (This stunt was only possible on the early M-3 computers, performing 30–50 operations per second. After ferrite memory was added, the speed increased to 1000 operations per second. Calculations that previously took several minutes were now finished in seconds, resulting in a much more quick and even blinking of the lights.)[13]

In Hungary, the M-3 was introduced to the general public at the Budapest Industrial Fair (Budapesti Ipari Vásár) in 1960 (Fig. 8). In order to familiarize the public with the invention, they wrote a program in which the visitors could choose one of the yet unused 1600 memory addresses and store there an 8 bit "secret" number. Then, they could check anytime before the end of the Fair whether the number was still there. It worked; people were excited and surprised that the computer still "remembered" their secret number even on the last day of the exhibit [7, pp. 201–203].

III. THE M-3 AT SZEGED

The Computer Centre in Budapest received an URAL-2 vacuum tube computer in 1964, which was operational from mid 1965. The future of the now outdated M-3 had to be decided. Győző Kovács, who was the head of the Computer Operations

[11]According to [7, p. 206], already in the first six months of 1960, the M-3 was in operation 550 hours monthly, on average, though it was still under significant development in the first months.

[12]One of the first successful projects on the M-3 was a program for inverting 40×40 matrices. They had to use external punch tape memory to store partial results as the only 1.6 kWord drum memory (Figs. 6 and 7) available with 31 bit words was not sufficient. (The original memory was 1 kWord. See the Appendix).

[13]Kovács recalls the first time they run the M-3 with ferrite memory. Although they all expected the computer to be significantly faster, still, when it stopped after a couple of seconds, the "usual mathematician–engineer" debate began: namely, who was to blame for the error this time. The debate was shortly lived as Dömölki pointed out that the program did run and finish correctly [7, p. 200].
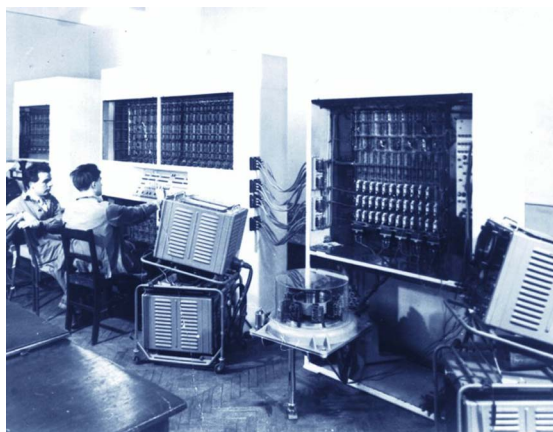
Fig. 5. *Győző Kovács and Bálint Dömölki at the M-3. Photo from the CD-ROM supplement of [7].*

Fig. 6. *The drum memory of the M-3. Photo from the CD-ROM supplement of [7].*

Department at the Computer Centre by this time, suggested that it should be brought to the Cybernetics Laboratory at the University of Szeged.[14]

The Cybernetics Laboratory (Kibernatikai Laboratórium) was founded by Professor László Kalmár[15] at the Bólyai (Mathematics) Institute at the University of Szeged in 1963. Its headcount was half of a person, filled in part-time by Kalmár's assistant, Dániel Muszka [12, p. 74].

Originally Kalmár was a mathematical logician and his interest turned toward the applications of logic, i.e., toward computers and cybernetics, around the mid-1950s. As constructing a computer would have been too expensive, they built a Logical Machine[16] which they finished by

1957 (Fig. 9), and Muszka built a conditioned reflex model, an Electronic ladybird (Elektronikus Katicabogár). (Fig. 10 and 11)[17] They were introduced to the general public at the Budapest Industrial Fair in 1960 at the same time as the M-3. [6, pp. 48–57]; see also [10].

Kalmár spent the winter of 1958–1959 in China at the invitation of Fudan University in Shanghai as part of the Hungarian–Chinese cultural treaty. Besides Shanghai he gave lectures in Beijing, Wuhan, and Hangzhou. The lectures concerned mathematical logic and undecidability, the Logical Machine built in Szeged, general problems of programming computers, and particular arithmetic operators and algorithms for the M-3 computer [3], [4, p. 20].

As early as the 1957/58 academic year Kalmár also started an "applied mathematician" program at the University of Szeged to train the students to work with computers. This was the first such program in the country at the university level; colloquially, it was referred to as the "applied calculator mathematician" program, and the students enrolled as "EDSAC people." As a reminder, at this point the M-3 was not yet even in operation! Students learned to "program" on "fictive computers" in "fictive programming languages" invited by Kalmár himself. Once the M-3 was in operation in Budapest, Kalmár's students visited the computer regularly,[18] ran their programs and wrote their theses on or about it. The possibility of such a program was due to new regulations from 1957. Before that everyone who studied natural sciences had to enroll as a high school teacher with two majors, e.g., mathematics and physics. But now the top 5% of the juniors and seniors

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[14]Between 1962 and 1999 the university adopted the name of the Hungarian poet Attila József and was called József Attila Tudományegyetem, JATE.

[15]IEEE Computer Pioneer Award recipient, 1996 (posthumously).

[16]"The important innovation [in the Logical Machine] is that the boxes [gates realizing basic logical operations of two variables] represent the "true" (T) or "false" (F) value of the logical variables not with voltage levels, but with short circuits—physical connections. Because of those the input [and output] points are realised with three connecting sleeves instead of two, and the middle sleeve is in short circuit with one or another on the side depending on whether the input [or output] has T or F value" [6, p. 55].
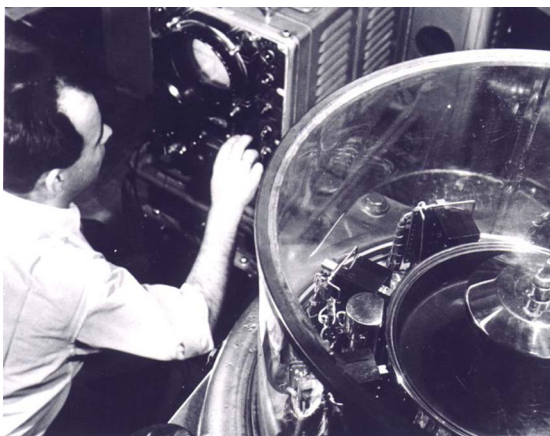
[17]For more information, see http://ajovomultja.hu/ladybird-from-szeged/ and http://cyberneticzoo.com/cyberneticanimals/1956-57-elektronikus-katicabogar-electronic-ladybird-muszka-daniel-hungarian/.

[18]The trip between Szeged and Budapest takes about two hours by train.

Fig. 7. *Győző Kovács and the drum memory of the M-3. Photo from the CD-ROM supplement of [7].*

Fig. 8. *Budapest Industrial Fair (Budapesti Ipari Vásár), 1960. Poster by Nándor Szilvásy.*

The arrival and installation of the computer in Szeged is immortalized by the story of the M-3 "taking a bath." The computer was disassembled and sent in boxes to Szeged to be followed by three members of the Computer Centre, Győző Kovács, József Drasny, and Kálmán Kardos, a couple of days later. When the members of the Cybernetics Laboratory in Szeged led by Muszka opened the boxes, they were caught by surprise by the amount of dirt and soot covering the computer. The M-3 was stationed in downtown Budapest and it did not have a ventilation system. This meant that computer was always running with the windows opened to the street, even during winter at a time when the heating system of most buildings still used coal. A member of the Cybernetics Laboratory discovered the following phenomenon: although they measured 20 kΩ resistance between two joints of a subunit, after blowing on it strongly, the device showed 80 kΩ. This realization lead to the quick decision: the M-3 had to take a "bath" to be cleaned. It required the power in the building where the computer was stationed to be cut, as it was cleaned with around 40 liters of gasoline. The action took about three days to complete. When Kovács, Drasny, and Kardos arrived from Budapest, they became concerned, as they considered the accrued soot part of the machine. Their concern proved to be justified: once the computer was turned on, none of its parts were functioning, and the fuses went off one after another in the power supply. Apparently, it was the soot that kept the loose solder joints and wires together, and its resistance was factored into the operation of the machine. This resulted in a couple of weeks of extra work for the enlarged group. The computer was working again by mid 1965 [12], [1], [7, pp. 208–210].

Once the M-3 was operational again, it was time to ceremonially put it in operation, to which

were allowed to drop one of their majors in order to gain deeper knowledge in their first major and conduct research.[19] [16, Ch. 3].
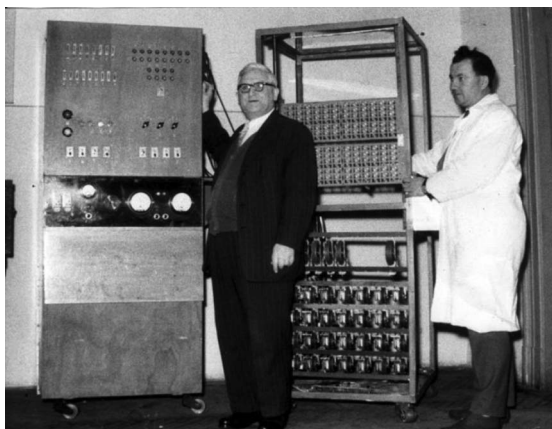
Contrary to several promises from the ministries, the Cybernetics Laboratory at Szeged still did not have a computer in 1964. Kovács suggested to Kalmár and Muszka not

to wait for a new computer but to take the M-3. Kovács expected, and turned out to be right, that were they to have their own computer center in Szeged, it surely would be further developed in the future by the ministry. Thus, in early 1965, the Computer Centre officially "sold" the M-3 to the Cybernetics Laboratory in Szeged for 1 Hungarian Forint, worth two scoops of ice cream at the time [7, pp. 208–210].
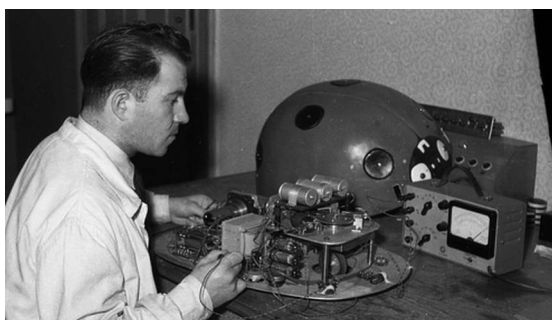
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[19]Three students enrolled in fall 1957, four in fall 1958, and five in fall 1959.

Fig. 9. *László Kalmár and Dániel Muszka with the Logical Machine, late 1950s. Photo from http://cyberneticzoo.com/cyberneticanimals/1956-57-elektronikus-katicabogar-electronic-ladybird-muszka-daniel-hungarian/.*

Fig. 10. *Dániel Muszka with the Electronic ladybird (Elektronikus Katicabogár), late 1950s. Photo from http://ajovomultja.hu.*

ceremony Kalmár invited several leaders of the University. Muszka [12, p. 75] tells the following story about the night before the big event. Kalmár visited the M-3 around 9 P.M. to ask once again whether everything was in order. Muszka and his colleagues gave a reassuring response as the test programs were running for days without any problems. However, half an hour after Kalmár left, an enormous thundershower broke out, and after a huge burst of lightning, a blackout followed. Although it only lasted for 20 min, it caused serious problems in the computer. The crew ended up working until 5 A.M., replacing approximately 40 vacuum tubes. At 6 A.M., the test programs were running, once again, without any problems.

With the M-3 in operation, the Cybernetics Laboratory at the University of Szeged became the first computer center in Hungary outside Budapest, with a headcount of 12.[20] The computer still ran 120 hours a week on average, serving both educational and research purposes as well as running

calculations for industrial applications. Besides educational use,[21] the Laboratory designed an automatic system for the Plate Glass Factory at Salgótarján to control the fire in the furnaces, and most departments of the Faculty of Medicine initiated projects that involved the M-3. Possibly the most visible project done on the M-3 at Szeged was the design of the sound decelerator system for the Szeged Open-Air Festival. It is the biggest open-air theater, musical, and opera festival in Hungary. It is held at the Dóm Square in Szeged downtown, a square next to the cathedral, bordered by buildings, making it not ideally suited for this purpose (hence the use of the computer) [13].

There are a number of reasons for the shift toward the more industrial applications of the M-3 during these later years. The computer culture was changing in Hungary by the second half of the 1960s. The first commercially available journal devoted solely to computers, Information Electronics (Információ Elektronika), was available since 1966 (Fig. 12). The Hungarian Academy of Sciences owned multiple computers and other research institutes were able to purchase their first computers as well, covering most of the area of scientific research. On the other hand, application of computers in the industrial context began rather early. The Ministry of Heavy Industries (Nehézipari Minisztérium) had its own computer center since 1962. At the same time, Kalmár initiated many of these projects while looking for possible applications of computers and logic. He was personally seeking out to the departments of the Faculty of Medicine and visiting factories for possible projects. The projects coming from outside the University were also financially advantageous for the Cybernetics Laboratory; the income from

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[20]According to [2], at the end of 1969, there were 16 computers in operation that were purchased in 1965 or earlier (and 80 altogether). It should give a good estimate of the numbers in 1965, though it does not include the M-3 for example, which was disassembled by the time; see the last paragraph of this section.

[21]From 1960, while the M-3 was still in Budapest, Kalmár and his students in the Applied Mathematician program got involved in metallurgic projects at the Ironworks in Dunaújváros (Dunai Vasmű). An operations research group was founded at the Ironworks, and the students solved problems on the M-3 offered by them [15].
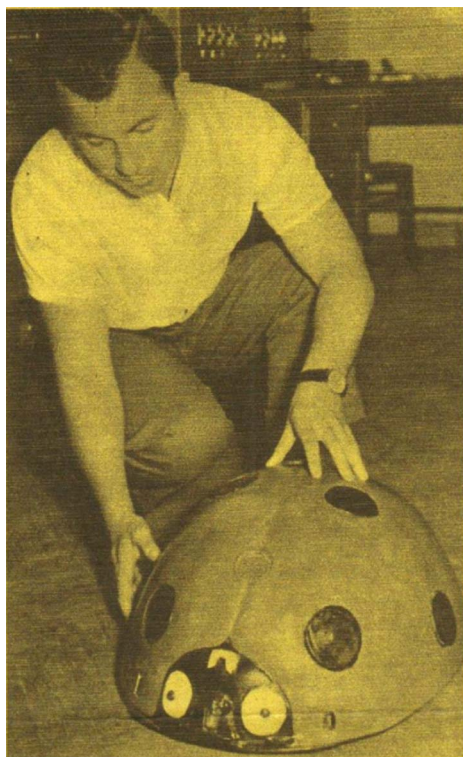
Fig. 11. *Dániel Muszka with the Electronic ladybird (Elektronikus Katicabogár). Photo from http://cyberneticzoo.com/cyberneticanimals/1956-57-elektronikus-katicabogar-electronic-ladybird-muszka-daniel-hungarian/.*
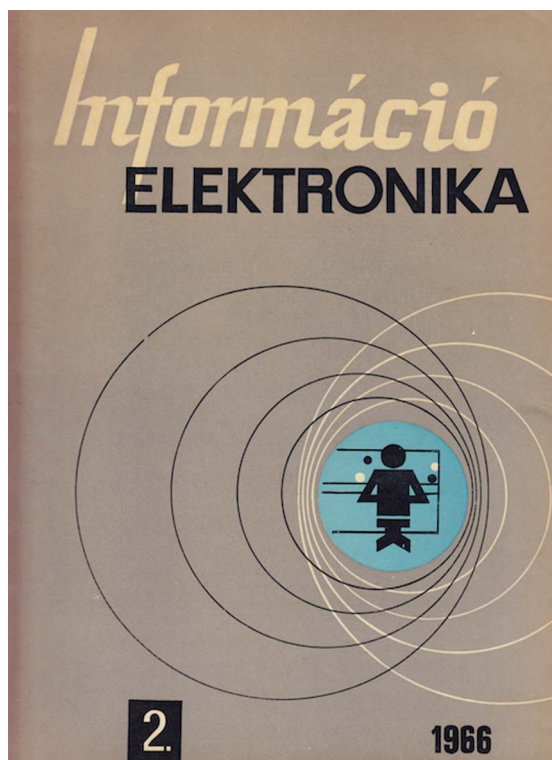
Fig. 12. *No. 2 of Information Electronics (Információ Elektronika), 1966.*

these projects were "outside" their budget and counted as extra income.

To acknowledge their outstanding work, Kalmár and the Cybernetics Laboratory received a MINSK-22 transistor computer as a gift from the National Committee of Technological Development (Országos Műszaki Fejlesztési Bizottság, OMFB) during the first quarter of 1968. By this time, the Laboratory employed about 40 people [1]. The arrival of the new computer rendered the M-3 obsolete. On January 2, 1968, it was turned on for the last time [12, p. 77]. After its disassembly, the different parts were given to various departments at the University[22] [8, p. 74].

APPENDIX
THE TECHNICAL CHARACTERISTICS OF THE M-3

This Appendix is a direct quote of the entire 7th Section of [8, p. 74] with the same title; quotation marks are dropped.

Arithmetic unit: 31 bits/word, parallel computing, four registers, operational speed: addition: 60 microsec, subtraction: 70–120 microsec, multiplication: 1.9 milisec, division: 2.0 milisec.

Input/output device: First: Siemens T-100 teletype, tape reader and puncher, 5 position telex code, input/output speed: 7 chrs/sec. Later the input device was a Ferranti photoelectric tape-reader, 8 position code, speed: 300 chrs/sec, the output device was a Creed puncher, 8 position code, speed: 100 chrs/sec.

Memory: First a magnetic drum, 1 kWord (later 1.6 kWord) capacity. Later as back ground memory... two—simultaneously—running drums were operating together (2 × 1600 Words), then, as operating memory: a ferrite core memory, its capacity was 1 kWord.

[22]The magnetic drum is exhibited at Szeged at *The Past of the Future* exhibition at the Agora, http://ajovomultja.hu. For further details, see the catalog of the exhibition [6].

Control unit: Two address code, 31 bits per instructions, 1 sign bit, 6 bits for operational code, 12 bits first address, 12 bits second address.

Power supply: Total power dissipation: about 10–15 kW.

Parts used (approximate numbers): about 500 logic units, about 1000 vacuum tubes, about 5000 cuprox diodes, about 4000 resistors, about 3000 capacitors. ∎

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