

# Early Israeli Computers<sup>1</sup>

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**Abstract - Israel was the first country in the Middle East that built and installed a Digital Computer. The impetus to build the first Digital Computer in Israel came from a Professor at the Weizmann Institute of Science in Rehovot and was supported by the first President of the State of Israel. Two additional computers were designed and built at the Weizmann Institute and these machines were operational from 1955 to 1983. Elbit Systems developed a minicomputer and presented it in 1968, but had marketing problems.**

**Keywords— WEIZAC, GOLEM, ELBIT, minicomputer**

## I. INTRODUCTION

The State of Israel was officially founded on May 15, 1948, but the Zionist Organization had already prepared earlier its scientific bases: The Technion – Israel Institute of Technology – established in 1912, The Hebrew University in Jerusalem (established in 1918), and the Weizmann Institute of Science (established in 1934). High-level scientists graduated in Germany, the United States and the United Kingdom joined these Institutes and brought with them modern technology, which became the basis for the Israeli High-Tech Industry.

## II. THE WEIZMANN INSTITUTE OF SCIENCE

The Weizmann Institute of Science in Rehovot, Israel, was established in 1934, 14 years before the State of Israel. It differs from other Israeli universities in that it offers only graduate and postgraduate degrees in the natural and exact sciences. It is a multidisciplinary research center, with around 3,800 scientists, postdoctoral fellows, Ph.D. and M.Sc. students, and scientific, technical, and administrative staff working at the Institute. As of 2019, 6 Nobel laureates and 3 Turing Award winners have been associated with the Weizmann Institute of Science.

Chaim Weizmann (1874-1952), was the first president of the State of Israel and founder of the institute in 1934 with a team including Benjamin M. Bloch, as the Daniel Sieff Research Institute. Weizmann had offered the post of director to Nobel Prize laureate Fritz Haber, but took over the directorship himself after Haber's death en route to Palestine. Before he became President of the State of Israel in February 1949, Weizmann pursued his research in organic chemistry at its laboratories. The institute was renamed the Weizmann Institute of Science in his honor on November 2, 1949, in agreement with the Sieff family.

In 1949 Professor Chaim L. Pekeris joined the Weizmann Institute as Head of its Department of Applied Mathematics. Pekeris entered Massachusetts Institute of Technology in 1925, graduated with a B.Sc. in meteorology in 1929 and graduated with his doctoral thesis in 1933. He remained at M.I.T. as an instructor in geophysics in 1941. In 1946 he

joined the Institute for Advanced Study in Princeton, New Jersey' best known as the academic home of Albert Einstein and John Von Neumann after their immigration to the United States. Pekeris made a condition of accepting the Weizmann Institute job – to build a computer in Israel.

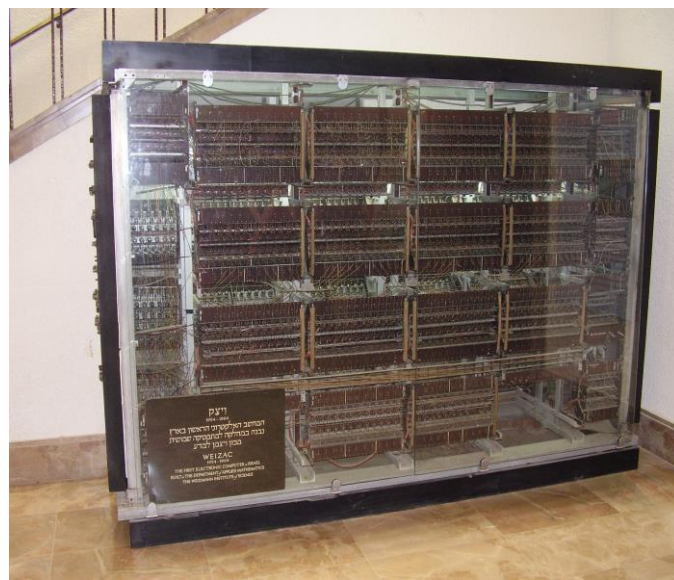
An illustrious committee, including Robert Oppenheimer (who led the Manhattan Project) was set up to consider this request: Albert Einstein was skeptical but was convinced by John Von Neumann and the project got the go-ahead.

## III. THE WEIZAC COMPUTER

WEIZAC (acronym for Weizmann Automatic Computer) was an asynchronous computer, operating on 40-bit words. Instructions consisted of twenty bits. Punched paper tape was used for I/O and later (1958) magnetic tape. The memory was initially a magnetic drum containing 1.024 words and was later replaced by a faster 4.096 word memory.

Construction of the WEIZAC got underway in 1953 under the leadership of Professor Pekeris and Jerry Estrin, a protégé of Von Neumann who arrived in Israel with design drawings based on the computer of the IAS in Princeton. One of the recruited technicians was Aviezri Fraenkel – who later received his Ph.D. in 1961 from the University of California and was recipient of the Euler Medal in 2005 .

WEIZAC, one of the world's first electronic computers was locally built by the institute in 1954–1955 and was recognized by the IEEE in 2006 as a milestone achievement in the history of electrical and electronic engineering. It became operational in 1955 and was operational until December 29, 1963



#### IV. GOLEM COMPUTERS

In 1960 a team of the Department of Applied Mathematics at the Weizmann Institute, headed by Shmuel Rochman, assisted by Zvi Riezel and Miron Melman designed and built the GOLEM. A computer, based on the ILIAC 2 computer of the University of Illinois.

GOLEM A operated on 75-bit words, using the "floating point" system. The memory contained 4,000 words and its calculating speed was 100 times faster than the WEIZAC.

GOLEM A became operational on 29 December 1963. The three designers were awarded the Rotschild price.



In 1967 begun the design of GOLEM B, with 64-bit words, but with a memory of 128K words. It was a fast machine, using emitter-coupled logic and multi-layer circuits. This computer became operational in 1974 and was active until 1983.

#### V. ELBIT COMPUTERS

Elbit Systems was founded in 1966 by Elron Electronic Industries, which combined the existing expertise within the Israel Ministry of Defense-Research Institute ("Rafael"). Both companies were managed by Uzia Galil, founder of the IEEE Israel Section and generally known as "the father of Israel Hi-Tech".

As Uzia Galil recalls: "In Rafael they already started the work for a mini computer and we decided to invest in developing the first minicomputer. In parallel there was in the world only one major company working on a minicomputer – the PDP8, by Digital Equipment Corporation (DEC). In 1968 we were presenting at an exhibition in the United States the Elbit 100, while DEC was presenting the PDP8. People were coming to both our booths, and DEC was selling while we were talking about our technology. There I learned a big lesson!"

#### VI. ELBIT 100 – A SYSTEM COMPUTER

The Elbit 100 was a low cost special purpose computer, designed to be readily integrated into the user's system

instrument or control loop. A 12 bit, single address, fixed word length computer with typical add time of 7.2 microsecond, the Elbit 100 was capable of operating with up to 256 channels of input output equipment via its I/O bus and used DTL monolithic integrated circuits for high reliability and noise immunity. It featured a unique two-level memory system, with one memory being a standard read-write core store with 2 microsecond cycle time and the other being a fixed micro-programmable Read Only Store with 400 nanosecond cycle time. The Elbit 100 was offered with either 1024, 2048 or 4096 words of core memory.

As mentioned, the Elbit 100 failed on lack of marketing despite work with France to sell all kind of applications.

In 1983 Elbit developed a Mainframe computer named "ANAT" and it was sold to the German company Nixdorf. ANAT was further developed by EMC in Boston, Mass.

#### VII. ADDITIONAL COMPUTER ACTIVITIES IN ISRAEL

Despite the fact that Israeli companies discontinued designing computers, the Computing activities continued during the years:

- Intel R&D shop in Israel developed the 8088 processor and Centrino chip in 1974.
- Adi Shamir, working with two American colleagues developed in 1977 the RSA encryption method.
- The LZ data compression algorithms were published by Lempel and Ziv in 1977. The algorithms became the primary basis of early computer information sharing.
- In 1993 Gil Shved and two partners established the computer security firm Check Point. In 1996 Check Point became the leading provider of firewall and security services to business of all sizes around the world.
- In 1995 the Disk-on-Key was invented by Dov Moran and colleagues.

#### VIII. CONCLUSIONS

Israel Scientific community was a pioneer in building and using Digital Computers. As computers became commercially available, the focus of Israel Scientists turned into methods and algorithms. Due to international and local problems, the subject of encryption and security received special attention and a large part of the Start-Up Nation activities are directed towards these subjects.

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