Early Italian computers: Mario Tchou's ELEA 9003

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In the late 1950s the advent of computers was evolving into a technological revolution, and, within it, the era of transistorized computer, the so called second generation, was beginning, Although much of that progress took place in the US and UK, nevertheless, enthusiastic pioneers were giving important contributions also in other nations [1], [2]. Recently, I have been fortunate enough to come in contact with two of them, two Italians who are still in good health to tell me a story that deserves to be reported in these pages. A story that is a tribute to all those scientists, engineers and technicians, who working in several countries, pioneered the era of computers over half a century ago.

Fig. 1 – Mario Tchou (second from left in the foreground) presenting an ELEA computer (courtesy of Archivio Storico Olivetti)

During the 1950s, the Olivetti Company of Ivrea, Italy, was a world top manufacturer of office devices, including the typewriters that were used by famous writers worldwide and are still exhibited in several museums, including the New York Museum of Modern Art (MoMA). From 1938, the company's president was Adriano Olivetti (1901–1960), a visionary leader with a strong philanthropic ethos who aimed to integrate factories with society and the arts. He was also very attentive to new technological developments [3]. In 1949, he met Enrico Fermi (1901–1954) on a journey to Italy made by the latter, a Nobel Laureate physicist then living in the US. At this time, early vacuum-tube stored-program computers were being developed in the US and the UK, and Fermi recommended giving this technology due consideration. Following his advice, Olivetti opened a laboratory in 1952 in New Canaan, Connecticut, as an observation point for developments in the US. Two years later, the very first two electronic computers arrived in Italy, both based on vacuum tubes. The first one of them was a British Ferranti Mark I* bought by the Institute for Calculus Applications of CNR (Consiglio Nazionale delle Ricerche, or the National Research Council) in Rome at a cost of 300 million Lira (€4.98 million in 2020 terms); this machine had been the first marketized electronic computer in 1951, a commercial version of Ferranti Mark I, that was built in only two units. The second was an American National Cash Register (NCR) CRC 102A supplied to Milan Polytechnic for US$120,000 (€1.36 million in 2000 terms), on the advice of prof. Luigi Dadda (1923–2012), a pioneer of electronic computers in Italy [4].

In the same year, 1954, Adriano Olivetti met Mario Tchou (1924–1961) in New York. Tchou was a young and brilliant engineer, the Italian-educated son of a Chinese diplomat, who had received his MS degree from the Polytechnic School of Brooklyn in 1949 and had been hired as an associate in Electrical Engineering at Columbia University in 1952. He was the man Adriano Olivetti had been looking for, and was soon offered a position as a research leader. The following year, in 1955, Adriano Olivetti founded the Laboratorio di Ricerche Elettroniche (LRE, or Electronic Research Laboratory) and placed it under the leadership of Tchou (Fig. 1). Initially, LRE was hosted within the Physics Department of the

Fig. 2 – The LRE research group led by Mario Tchou, fourth from the left in first line, with Giorgio Sacerdoti at his right and Ettore Sottsass at his left; Martin Friedmann is the second from the left in the fourth line (courtesy of Brog)

University of Pisa for a few months, and cooperated with its Centro Studi Calcolatrici Elettroniche (Center for the Study of Electronic Computers, started in early 1955) in building the Calcolatrice Elettronica Pisana (CEP, or Pisan Electronic Computer), providing funding and staff. This machine had been also promoted by Enrico Fermi in 1954. Its "Reduced Version" ("Macchina Ridotta" in Italian), based on vacuum tubes, was ready in 1957, and was the first all-Italian electronic computer [5]. The full version of CEP used both vacuum tubes (3500) and germanium transistors (2000). It started operating in 1961 and was a cutting-edge design at the time, hailed as "the most advanced and most powerful university-made computer in West-Europe Continent" [6]. The three aforementioned electronic computers marked the very beginning of computer science and technology in Italy. LRE moved to Barbaricina, a suburb of Pisa, in Spring 1956 and Tchou applied the experience he had gained from CEP in developing Olivetti's commercial computers. These were actually the first Italian commercial computers, named ELEA (from Elaboratore Elettronico Automatico, or Automatic Electronic Computer; Elea was also an ancient Greek city in Southern Italy famous for its school of knowledge, or what was then dubbed philosophy). Tchou's team consisted initially of 12 Italian physicists and engineers and the Canadian Martin Friedmann, who had previously worked on the magnetic memory for the Ferranti Mark I in Manchester under Frederick C. Williams (1911–1977) and Tom Kilburn (1921–2001) (Fig. 2) [7]. The first two models, ELEA 9001 and ELEA 9002, were based on vacuum tubes (with transistors only in the magnetic tape drivers). In the third model, Tchou chose to use only solid-state devices, and a prototype was ready in 1958. ELEA 9003 was presented in November 1959. It was fully transistorized with germanium semiconductors (both transistors and diodes) [8]. The ELEA 9003 featured a magnetic-core memory with a capacity of between 20,000 and 160,000 words, seven-bit data, eight-character instructions and very advanced multitasking capabilities (three tasks at a time) with a clock time of 10

Fig. 3 – The console and keyboard of the ELEA 9003, were designed by Ettore Sottsass with Andries van Onck. Presented in 1959, the ELEA 9003 was the first fully transistorized all-Italian computer. It was also one of the very first transistorized computers to be marketed (courtesy of Museo della Scienza e della Tecnologia, Milan, Italy).

µs. It had a magnetic tape secondary memory and consumed 4.5 kW. The system architecture was largely designed by Giorgio Sacerdoti (1925–2005), who had previously worked at CNR in Rome on the Ferranti Mark I*, while Ettore Sottsass (1917–2007) designed the machine's aesthetics, assisted by Dutch Andries van Onck (1928–2018), providing it with an original layout that allowed easy access for fast maintenance and easy expansion, and a console with an attractive appearance (Fig. 3). Presented at the 1959 Fiera Campionaria (Trade Fair) in Milan, it was the first fully transistorized computer made in Italy and one of the first in the world of this type designed for commercial exploitation.

Before ELEA 9003, the fully transistorized British Metropolitan-Vickers 950 was completed in 1956, was used in-house by the producer and also sold in a few units, so that it is reported as the first fully transistorized commercial computer. In 1957, Ferranti, UK, offered Mercury, a commercial version of Tom Kilburn's prototype, and, in December that year, IBM released model 608, sometimes reported as the world's first all-transistorized calculator to be manufactured for the commercial market. More

fully-transistorized commercial models were introduced in 1958: American Philco released the S-1000 as a scientific computer and the S-2000 for research and business; IBM released the model 7070, its first transistorized stored-program computer, although quite unsuccessful; RCA offered the model 501; and the Electrologica X1 was marketed in the Netherlands. In 1959, NCR introduced the model 304, in cooperation with GE, and IBM announced the model 1401, later mass-produced in 12,000 units, and the cheaper scientific model 1620; later that year the company released the large mainframe 7090. In addition, Digital Equipment Corporation (DEC), an MIT spin-off, announced the PDP-1, its first computer, delivering the first units the next year, in 1960.

Olivetti delivered the first ELEA 9003 unit to the Marzotto Textile Company in August 1960, fulfilling an order that had been placed the year before. At that time, programming mainframes was a difficult task, and the ELEA 9003 needed a long training period before becoming fully operative. Some 40 ELEA 9003 machines (and 170 ELEAs, including successive models such as the ELEA 6001 of 1961 and the ELEA 4001 of 1962) had been sold by 1964, a good rate of success for these early computers. The ELEAs were built in the new factory started in 1958 in Borgolombardo, near Milan. A 19-year-old Federico Faggin (b. 1941) was recruited by the laboratory in 1960 and led the design of a small transistor computer with a magnetic memory of 4 K × 12 bit. After a few months, he left to study physics at the University of Padua, from where he graduated in 1965. After being hired by SGS-Fairchild, Faggin moved to California, and years later, in 1971, was one of the fathers of the first microprocessor, the INTEL 4004.

After model 9003, subsequent ELEA machines used silicon devices, which had been recently marketed by Fairchild Semiconductor. In fact, aware of the importance of a national transistor industry for future computers and on the advice of Tchou, Olivetti and the Italian firm Telettra had founded Società Generale Semiconduttori (SGS, i.e. General Semiconductor Company) in 1957, which started cooperating with Fairchild Semiconductor, that had been founded in California in the same year. SGS eventually became STMicroelectronics, one of the current leaders in microelectronics.

Unfortunately, Adriano Olivetti died from a cerebral thrombosis in February 1960 and Tchou was killed in a car accident in November 1961. Olivetti's mainframe program was badly compromised by those two unexpected deaths. Bereft of its two leaders, the program remained resource-intensive, with sale profits absorbed by heavy R&D costs, despite its reorganization to form the Olivetti Electronic Division (DEO) in Spring 1962. Moreover, Adriano Olivetti had launched an acquisition of the American typewriter maker Underwood in 1959, which resulted in major financial stresses [9] and the Italian government was not supporting Olivetti, unaware of the strategic importance of the new technology. In order to cope with these issues, Olivetti's share capital was expanded, opening the company to new shareholders, including some major Italian companies and banks, in May 1964. Lacking a farsighted vision or perhaps under external pressure, the new management imposed by this rescue syndicate deemed the DEO a foreign body inside a company that had always operated with profit in the mechanical sector. Concerned about the uncertainties of the emerging solid-state electronics sector and in search of financial resources, the company disbanded the DEO, which was incorporated into a new company, the Olivetti General Electric (OGE) in August 1964. Seventy-five percent of the capital was sold to General Electric (GE), which aimed to penetrate the foreign computer market in which it operated with a small 2% share. GE bought the remaining 25% of OGE from Olivetti in 1968, but business did not thrive, so that eventually GE left the mainframe market and sold its Italian assets to Honeywell in 1970.

Thus, in the late 1960s, the dream of an Italian mainframe company, that had been nurtured by two visionary leaders, Adriano Olivetti and Mario Tchou, was fading away.

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