Chaim L. Pekeris and the Art of Applying Mathematics with WEIZAC, 1955–1963

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1 Introduction: Pekeris, computing and applied mathematics

In the early 1950s, an unlikely project aimed at building an electronic computer in the recently established State of Israel was initiated at the Weizmann Institute of Science (WIS). The project was successfully completed in the years 1954-55 and the WEIZAC, as the computer was called, worked in full capacity for almost a decade. Its designers and builders used cutting-edge technology and achieved the highest benchmarks of computing performance at the time. The computer was modeled after the famous machine of the Institute for Advanced Study (IAS) in Princeton, which operated since 1952. Mathematicians and scientists at WIS and at other research institutions in Israel, as well as members of Israeli government organizations, used the computer to advance science in Israel and to spread the word of this new technology all over the country. The driving force behind the project was the applied mathematician Chaim Leib Pekeris.

In a recent publication, *WEIZAC: An Israeli Pioneering Adventure in Electronic Computing (1945–1963)*, we described in detail the process that led to the project, its planning and early stages, and its immediate contribution to creating a computer-savvy community of users within the scientific and industrial sectors in Israel (Corry & Leviathan, 2019). While stressing the role of Pekeris as the visionary leader who helped the project come true, we located the discussion within the realm of the broader historical issue of the role of science and technology in the process of nation-building in general and in the case of the State of Israel in particular. We also provided a brief, but thoroughly documented analysis of the impact of WEIZAC on actual scientific research in Israel and beyond. This account made clear the astounding extent to which research based on calculations performed with WEIZAC (as well as with the two machines that followed it at WIS, GOLEM 1-2) played an important role in the processes that turned WIS into the world-class leading institution that it soon became. It also made clear the extent to which WEIZAC was at the heart of the creation of a relevant community of scientists, engineers, technicians, and users of all kinds, of computing technologies in Israel, in its research institutions and in its governmental branches.

The present book is devoted to analyzing in greater detail and within its relevant historical context the specific scientific contributions of Pekeris that were based on calculations performed with WEIZAC. Years before the WEIZAC was built, Pekeris started to conceive in very concrete terms the research agendas and the kinds of problems that he wanted to address in various fields of applied mathematics as well as the kind of computing techniques he would apply in order to do so. Like many other scientists involved in similar research, Pekeris had been applying numerical methods of increasing difficulty and efficiency, and performing calculations that required ever more intense resources, much before electronic computers were available. Eventually, this background allowed a smooth transition to the electronic era.[1] He made sure that the electronic computer be built at WIS and, at the same time, he also became the chief consumer of computation time and resources, often working with collaborators who played key roles in his research projects, as we will see below. Among them were researchers who eventually achieved international prominence on their own, such as Zipora Alterman (1925–1974) and Philip (Pinchas) Rabinowitz (1926–2006), as well as some of Pekeris' Ph.D. students, like Hans Jarosch (1928–2013), Yigal Accad (b. 1936) Ivor Martin Longman (1923–1993) Hana Lifson (1920–2016) and Kriss Frankowski (1932–2021). All of them and many others, spent many hours programming the WEIZAC for Pekeris.

The scientific tasks that Pekeris took upon himself and worked out with the help of WEIZAC and his collaborators, and the influence they had in their respective fields of interest are the main issues discussed in this book.

[1] Similar processes affected various scientific communities where computing-intense methods existed prior to the advent of electronic computers, and that made a successful transition to the new era. Two noteworthy cases are those of *pure* mathematics, mainly number theory (Corry, 2010) and quantum chemistry (Park, 2003).