field. For instance, Zangwill offers some fine examples of Anderson's prickliness as a peer reviewer and his short-lived attempt in the mid 1960s to run an alternative journal sans peer review. Although that experiment was not a representative portrait of midcentury journal practices, it nevertheless says a lot about the function and dysfunction of physics journals.

Given that I am a historian of industrial physics, my one disappointment with *A Mind Over Matter* is that the reader doesn't get much of a sense of Bell Labs, the organization where Anderson worked for some 35 years. At that time, Bell Labs was the leading institution in condensed-matter physics and a host of other fields. But Zangwill doesn't really show us what Anderson did as a manager in that organization. Maybe that's because "What do middle managers do?" is an even harder question to answer than "What do theorists do?"

But Bell Labs' curious marginalization in Zangwill's account is a relatively minor blemish on an engaging and insightful biography. For anyone interested in Anderson's contributions, his personal philosophy and style of physics, the fights he picked (for better and worse), and the scientific times in which he lived, *A Mind Over Matter* is an enlightening read.

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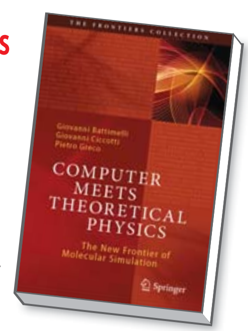
Female computing employees at the Ballistic Research Laboratory, Aberdeen Proving Ground, Maryland, in 1962 holding components from four of the earliest electronic computers. From left, Patsy Simmers holds an ENIAC board; Gail Taylor, an EDVAC board; Milly Beck, an ORDVAC board; and Norma Stec, a BRLESC-I board.

The first 30 years of computer simulation

Computer Meets Theoretical Physics
The New Frontier of Molecular Simulation
Giovanni Battimelli, Giovanni Ciccotti, and Pietro Greco, trans. Giuliana Giobbi
Springer, 2020. $49.99



Today we take it for granted that we can use computers to, for example, discover new materials, develop pharmaceuticals, and predict the weather. But when the first electronic computers became available in the wake of World War II, it required great vision to realize their scientific potential. At that time, several young physicists working at the US national laboratories in Livermore, California, and Los Alamos, New Mexico, set out to use the new computers to solve a long-standing problem: How do the properties of matter arise from the interactions of atoms and molecules?

Investigating systems of elastically colliding hard spheres, the pioneering researchers used the new computers to simulate hundreds of particles, a feat that had been impossible with previous numerical methods. The success of their work demonstrated that computers could be used to predict and understand the macroscopic behavior of condensed-matter systems on a microscopic level.

That achievement can be viewed as the birth of molecular simulation, and it is the starting point of the beautiful book *Computer Meets Theoretical Physics: The New Frontier of Molecular Simulation*. Authored by Giovanni Battimelli, Giovanni Ciccotti, and Pietro Greco, it recounts the early history of computer simulation—

from the first days in the 1950s to the field's coming of age in the 1980s. The authors focus mainly on the development of molecular dynamics, in which the motions of many atoms are simultaneously advanced and tracked in small time steps. They explain the scientific evolution of the field; provide biographies—and numerous photographs—of leading characters such as Berni Alder, Marshall Rosenbluth, and Aneesur Rahman; and offer an epistemological assessment of the simulation approach, which changed the way science is practiced and now pervades all fields of science and technology.

As the authors show, early work on hard spheres was soon followed by efforts to simulate more realistic systems. Scientists in Europe took notice of the exciting developments in the US, and centers of activity in computer simulation arose almost simultaneously in France, the UK, Germany, and Austria. Those early activities led to a succession of conceptual advances and efficient algorithms that eventually enabled a deeper understanding of many condensed-matter systems and processes, including phase transitions, liquid crystals, biopolymers, superfluid helium, and critical phenomena.

One particularly interesting aspect of the book is how it illuminates the human element of the scientific enterprise. Chance encounters between people with different backgrounds often sparked new ideas, which led to unexpected research directions (and sometimes lifelong friendships). Battimelli, Ciccotti, and Greco gathered recollections from many of the scientists who contributed to the development of computer simulation, and their personal memories illustrate how the field's early proponents struggled to gain recognition from traditionally minded scientists who initially looked down on the new method. The successes of the simulation approach, however, eventually paved the way for it to be widely accepted as a powerful research tool.

Although computer simulation was at first driven largely by a few visionary individuals, the field gradually matured. Journals and meetings dedicated to computer simulation were created and provided an institutional basis for the discipline. The authors show that the European Center for Atomic and Molecular Computation, or CECAM, which was founded in 1969 in Paris, was particularly important in that process. Practically all simulation scientists active since the 1970s made repeated trips to CECAM to use its computing facilities or to take part in its extended workshops. Many of the ideas conceived and discussed at CECAM were crucial to the development of computer simulation and continue to influence the field today.

Although the first 30 years of molecular simulation were characterized by the creation of fundamental techniques, those methods have since been efficiently implemented on supercomputers across the globe and are now used in numerous disciplines, including materials science, geophysics, chemistry, molecular biology, and medicine. Currently, ideas from machine learning and artificial intelligence are stimulating new developments in molecular simulation. It will be interesting to see where that trend leads in the years to come.

Computer Meets Theoretical Physics should be on the bookshelf of anyone interested in the history of science. I hope that future books will pick up where it leaves off and document the next chapters of computer simulation's exciting story.

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