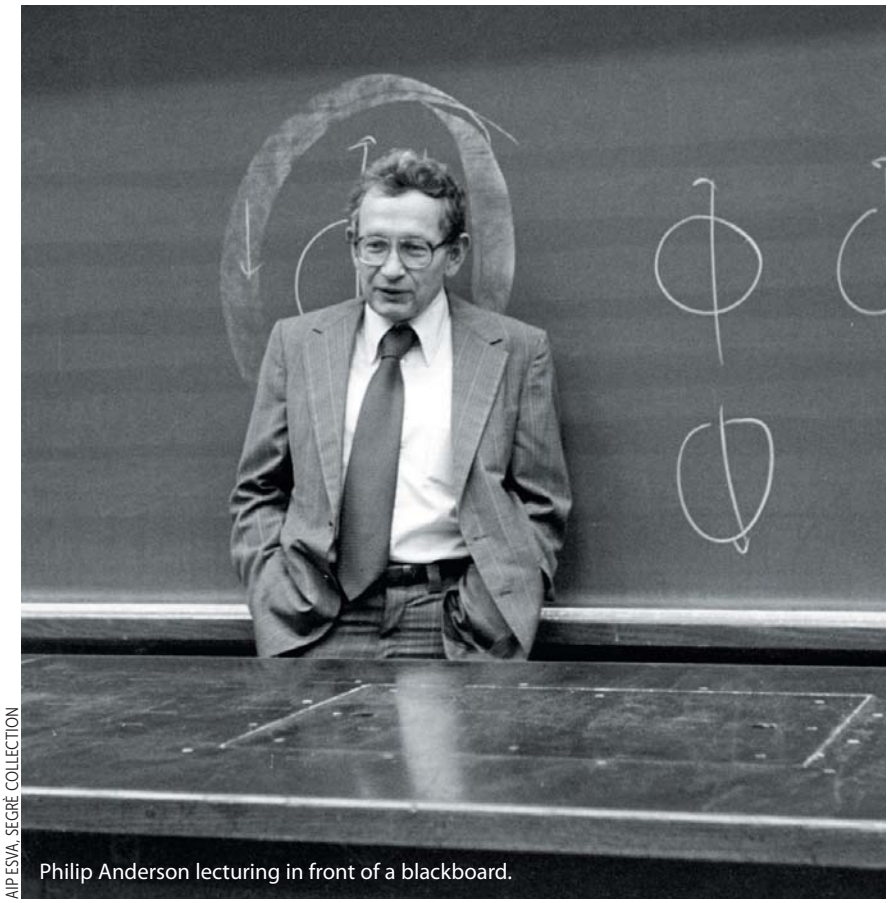
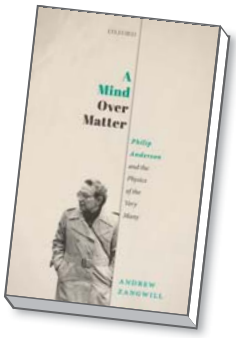


AIP ESVA, SEGRÈ COLLECTION

Philip Anderson lecturing in front of a blackboard.

Condensed-matter titan

A Mind Over Matter
Philip Anderson and the Physics of the Very Many
Andrew Zangwill
Oxford U. Press, 2021. $32.95



What do theoretical physicists actually do? George Gamow once joked that theorizing was outwardly indistinguishable from napping. As the physicist and historian David Kaiser noted in his 2005 article "Physics and Feynman's diagrams," Gamow's joke implies that historians of theoretical physics face a difficult challenge. How do you describe what's happening while a theorist stares at a screen or out the window (or at the backs of their eyelids!) for hours at a time? Gamow was fond of hyperbole, of course, and many elements of theorists' practice are in fact amenable to description, but the joke does point at a real conundrum.

At least with respect to the practice of one influential theorist, the Nobel laureate and primus inter pares of condensed-matter theory, Philip Anderson, Andrew Zangwill attempts to answer Kaiser's question. Zangwill is both a theorist and historian of condensed-matter physics, so his lucid descriptions of Anderson's enormous contributions in *A Mind Over Matter: Philip Anderson and the Physics of the Very Many* are backed by a deep understanding of both the ideas and the community in which those ideas found a home. But he isn't satisfied with just explaining the ideas—he wants to show readers how Anderson arrived at those ideas and give them a sense of his practice and personal style as a theorist.

Zangwill largely succeeds in that aim, although he acknowledges that some aspects of Anderson's creative process—and it was very much a creative process—will always remain a mystery. In fact, they were a mystery to Anderson himself. *A Mind Over Matter* demonstrates that Anderson, more than many of his peers and competitors, enjoyed hanging out with experimentalists and perusing experimental data; that he generally sought out problems where he could make a first, dazzling contribution and then move on to other topics; that he preferred to leave the number crunching to others and intensely disliked theories and theorists that relied on digital methods; and that his best ideas (and the ones he valued most in others) could be exported to other physical fields and scientific disciplines.

Somewhat more speculatively, Zangwill argues that Anderson needed conflict to refine his physical understanding. That characteristic helps to explain both his combative relationship with other theorists and the failure of his late-career theory of high-temperature superconductors: By that point, Anderson was no longer surrounded by people willing to push back against him.

As the high-T_c story indicates, *A Mind Over Matter* is no hagiography. Zangwill treats Anderson with some reverence but isn't afraid to confront his prickly, stubborn, and sometimes egocentric tendencies. Anderson comes across as a complicated, human, but nevertheless admirable character: He could be aggressive, dismissive, and petty toward those he viewed as competitors, but he was also supportive of the underdog both in his private relationships and his public politics. Zangwill also shows that Anderson's contrariness often led him to some of his best decisions, such as opposing McCarthyism, choosing condensed matter as his specialty, and taking a job at Bell Labs instead of at a university.

Because of Anderson's influence and wide network of collaborators and antagonists—who were sometimes one and the same—*A Mind Over Matter* is a biography of both his life and times. Along the way we meet the likes of Brian Josephson, Nevill Mott, William Shockley, Edward Teller, Murray Gell-Mann, and more. We also get an excellent peek at the rituals of postwar physics through the lens of Anderson's critiques of the

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.

Cyrus C. M. Mody
Maastricht University
Maastricht, the Netherlands

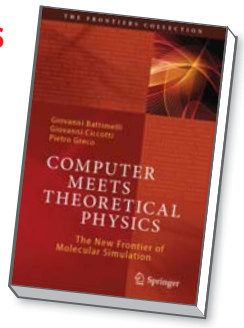
US ARMY PHOTO 163-12-62/HISTORIC COMPUTER IMAGES/WIKIMEDIA COMMONS/PUBLIC DOMAIN

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—