books

When physics, politics, and consciousness collide

Faust in Copenhagen

A Struggle for the Soul of Physics

Gino Segrè
Viking, New York, 2007. $25.95 (310 pp.). ISBN 978-0-670-03858-9

The Mental Aftermath

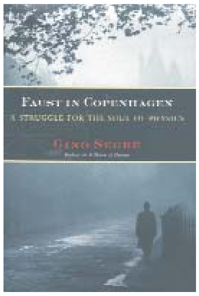
The Mentality of German Physicists, 1945–1949

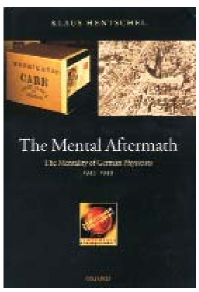
Klaus Hentschel (translated from German by Ann M. Hentschel)
Oxford U. Press, New York, 2007. $49.50 (205 pp.). ISBN 978-0-19-920566-0

Reviewed by Mark Walker

Gino Segrè's *Faust in Copenhagen: A Struggle for the Soul of Physics* and Klaus Hentschel's *The Mental Aftermath: The Mentality of German Physicists, 1945–1949* are both about the development of physics in Europe, particularly in Germany, in the 20th century, and both authors try to capture the mentality of the physicists involved. In other respects, these two works are profoundly different in scope, methodology, and intent.

Segrè, a theoretical physicist and nephew of Nobel Prize laureate Emilio Segrè, uses three vehicles to tell the story of the development of modern physics—quantum mechanics and relativity—in the early 20th century. He weaves into his narrative the 1932 theoretical physics meeting in Copenhagen at Niels Bohr's institute; the satirical version of the play *Faust*, which was scripted and performed by the physicists as entertainment for the meeting; and the careers of seven physicists involved, even if only indirectly, in those events. (The online version of this book review links to the play's dramatis personae and some of George Gamow's caricatures of the cast, courtesy of the Niels Bohr Library and Archives.) Hentschel, a historian of science, especially physics, at the University of Stuttgart, Germany, uses German physics immediately after the country's devastating defeat in World War II as a case study to write a "history of mentalities" of that scientific community. In this respect, the perspectives of the authors are decisively different: Segrè focuses on what is most interesting to a majority of today's practicing physicists; Hentschel tries to illuminate patterns and currents within that physics community that either were not visible to contemporaries or were repressed and avoided by them. Thus Segrè writes that his book is "about the human side of science, describing not only what these physicists did but how they did it and what they were like" (page 2). In contrast, Hentschel tells readers, "I specifically chose the word 'mentality' as part of the title of this study because the focus is less on specific actions than on collectively perceived horizons and expectations, on hopes and fears. . . . If we can better understand how people of that time thought and felt, we can better understand why they acted and wrote the way they did" (pages 1, 2, and 6).





Segrè's main subjects are Niels Bohr, Max Delbrück, Paul Dirac, Paul Ehrenfest, Werner Heisenberg, Lise Meitner, and Wolfgang Pauli. By using the physicists as the focus of a series of interconnected vignettes, the author surveys the most important developments in theoretical physics. For example, he covers Pauli's proposal of the neutrino and his often bitingly sarcastic personality; the diffident Max Planck and his revolutionary suggestion of the quantum of energy; Albert Einstein's transition from a young revolutionary to a conservative old "king," suspicious and resistant to the new quantum mechanics; Heisenberg as a risk taker, in physics and in general; Bohr's patient, if sometimes trying, mentorship of the young Turks who were creating the new physics; and Ehrenfest's eager engagement with quantum physics and his deep and eventually fatal insecurities and depression.

Segrè's analysis has a strong psychological component. He skillfully weaves into his narrative the yearly meetings at Bohr's institute and the satirical plays the younger physicists put on to gently mock their elders and entertain themselves by incorporating as metaphors the very problems they were wrestling with. Delbrück's rewriting of the classic play *Faust* at the 1932 meeting, on the eve of National Socialism's triumph in Germany and the forced exodus of Jewish scientists, appears all the more powerful in retrospect, because within a decade many of those scientists who met in Copenhagen would be working for the National Socialist regime or for Adolf Hitler's nuclear weapons program—or both. Segrè's well-written and engaging book, which presents a heroic account of a collective of physicists at work, is only mildly critical of his subject in a few places, and even then the criticism acts to enhance the stature of the actor as physicist. Pauli's sarcasm facilitated his fearless and perceptive criticism; Dirac's otherworldly personality allowed him to see clearly and penetrate a deep understanding of quantum mechanics.

Hentschel's book is also well written; originally published in German in 2005, its translation is very good. He begins with a perspective on German physics from foreign colleagues, sometimes from scientists who were forced out of Hitler's Germany. German physicists and their fellow émigré colleagues after World War II had a great deal of difficulty understanding each other; in fact, they often talked past one another. The tense and ambivalent

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relationship the Germans had with the occupying Allied Powers was dominated by the Germans' fear of the Russians, by resentment over the US policy of bringing scientists and engineers to the US to work, and by bitterness over the division of Germany. Actually, science control officers of the Allied Powers, especially the British, were often quite supportive, but the Germans appear to have taken such treatment for granted more than they appreciated it.

Tragically, the émigré physicists who were most interested in helping the German scientists were alienated by the lack of remorse they encountered. The physicists who had lived through Hitler's regime appeared unwilling to take much personal responsibility for any part of the excesses, abuses, and crimes of the National Socialist regime. Perhaps most surprising, although Nobel Prize–winning scientists such as physicist Max von Laue, the president of the postwar German Physical Society in the British zone, and chemist Otto Hahn, the first president of the Max Planck Society, were internationally recognized for their morally upright stance under Hitler, they worked hard and successfully after the war for a blanket amnesty for their colleagues, some of whom had significant "Nazi" pasts. The exceptions to the amnesty campaign were the few scientists who had belonged to the "Aryan Physics" movement: Philipp Lenard, Johannes Stark, and their followers. Those scientists were made into scapegoats for the physics under Hitler. But perhaps most disturbing is the shameful way the postwar German physics community dealt with émigrés who wanted compensation, or at least respect, and the few members of their own community who criticized these "politics of the past." The émigrés were rebuffed, and the few German scientists living in Germany who criticized the former Nazis still in positions of authority were ostracized and driven out of the country.

In *Faust in Copenhagen*, Segrè wants to preserve and spread physicist lore. He provides occasionally embellished but mostly factual stories about how scientists did physics and how their personalities and experiences influenced their work. In contrast, Hentschel wants to excavate and illuminate the fact that these physicists and their work were influenced by patterns of thinking and beliefs that not only transcended physics but also profoundly affected it.

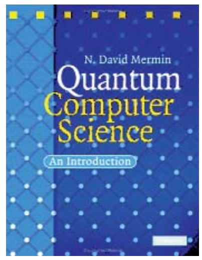
Quantum Computer Science
An Introduction

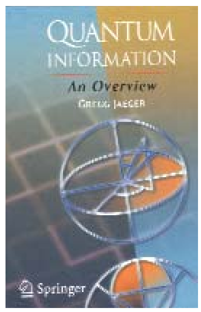
N. David Mermin
Cambridge U. Press, New York, 2007. $45.00 (220 pp.). ISBN 978-0-521-87658-2

Quantum Information
An Overview

Gregg Jaeger
Springer, New York, 2007. $49.95 (284 pp.). ISBN 978-0-387-35725-6

In the past 10 years, more than 30 textbooks have appeared on the subject of quantum information and computation. It seems natural to assume that a void existed for those books to fill—namely, to educate physicists, mathematicians, and computer scientists who have an interest in the emerging field. However, only a few books so far have gone beyond summarizing the results to truly teaching researchers the new subject. But to teach a subject, an author first has to master the material. Such mastery is achieved by rumination, swallowing, and thorough digestion. Yet that is not all. The author has to be able to turn this digestive experience into a tale that is precise and rigorous when necessary, highlights intuitions, points out pitfalls of understanding, and is generally stingy with formalistic treatments.





At least two great digests of comprehension on quantum information and computation have appeared: *Quantum Computation and Quantum Information* (Cambridge University Press, 2000) by Michael Nielsen and Isaac Chuang and the more computer-science-oriented *Classical and Quantum Computation* (American Mathematical Society, 2002) by Alexei Kitaev, Alexander Shen, and Mikhail Vyalyi. Now we can add a third book to that short list: *Quantum Computer Science: An Introduction* by N. David Mermin. Perhaps one of the reasons why writing a book on quantum information and computation is so nontrivial is because the subject is interdisciplinary and diverse. Hence, does one strive for breadth or depth? Mermin's book and Gregg Jaeger's *Quantum Information: An Overview* offer opposite solutions to this dilemma.

Jaeger, an assistant professor of natural sciences at Boston University, has been an active researcher in quantum information. The preface of the book speaks of his intentions: to write a text that provides an overview of the fundamentals of the field. The book has an extensive bibliography—with 477 references—that is also available on Jaeger's website as a PDF with links to the literature (http://math.bu.edu/people/jaeger). In fewer than 300 pages, the author does cover a wide set of topics: the basic quantum formalism, quantum nonlocality, the theory of quantum entanglement, decoherence, error correction, quantum communication, and quantum algorithms. Unfortunately, in attempting to cover so much, often with much mathematical and superfluous detail, Jaeger sacrifices the fundamental ideas underlying the results.

The book's readability is further diminished by the many footnotes and references to the appendices and other sections. As a work of reference, it may have some merit. However, one may question whether there is an audience for such encyclopedic texts, especially given the easy access to online sources of information such as the arXiv e-print server and Wikipedia. The additional value of a textbook can lie in its cohesive presentation of the topics and the unique insights the author brings to the subject. Unfortunately, Jaeger's book does not excel in either of those two categories.

As a physics writer, Mermin, Horace White Professor of Physics Emeritus at Cornell University, hardly needs an introduction. He has been a regular contributor to the Reference Frame columns in PHYSICS TODAY. He wrote the standard textbook *Solid State Physics* (Holt, Rinehart and Winston, 1976) with Neil Ashcroft, and he is the author of two widely praised pedagogical books on relativity theory: *It's About Time: Understanding Einstein's Relativity* (Princeton University Press, 2005; see the review in PHYSICS TODAY, June 2006, page 61) and *Space and Time in Special Relativity* (McGraw-Hill, 1968).

Mermin has a long-standing affair with quantum physics, which, along with relativity theory, was among his childhood curiosities. That interest was renewed and strengthened with the advent of quantum computation, in which he has, in some sense, played the role of godfather, approving and expounding