

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.

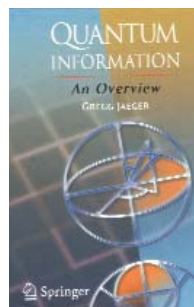
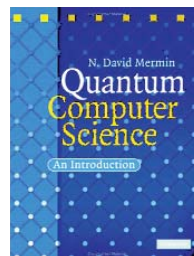
At least two great digests of comprehension on quantum information and computation have appeared: *Quantum Computation and Quantum Information* (Cambridge University Press, 2000) by Michael Nielsen and Isaac Chuang and the more computer-science-oriented *Classical and Quantum Computation* (American Mathematical Society, 2002) by Alexei Kitaev, Alexander Shen, and Mikhail Vyalii. 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



the works of the quantum-computation clan. He has also been teaching the subject to an interdisciplinary crowd of students and faculty at Cornell University. The book is the outgrowth of those courses and has been evidently battle tested by six years of lectures.

Quantum Computer Science covers a subset of the topics that are treated in the classic Nielsen and Chuang book or in the recent *An Introduction to Quantum Computing* (Oxford University Press, 2007) by Phillip Kaye, Raymond Laflamme, and Michele Mosca (see the review in *PHYSICS TODAY*, February 2008, page 61). But what it treats, it treats extremely well, with rigor and attention to detail that reveals a deep understanding of the subject. In that sense, Mermin's book adheres to a "less is more" adage; it's light on formalism and clearly opts for clarity and precision over completeness. That characteristic makes the book quite pleasant to read, even for experts who are already familiar with the subject. Mermin has chosen to provide little background on classical computer science. His approach makes the book an ideal, self-contained introduction to quantum computation for a curious student studying the natural sciences. A computer-science student, however, may miss a connection to the theory of computation at large.

The main emphasis of the book is on how and why the essential quantum algorithms, some quantum error-correction codes, and some simple, few-qubit quantum protocols work the way they do. Mermin exposes those inner workings by extensive, sometimes overabundant, analysis of quantum circuits. Particularly outstanding are the self-contained treatments of Shor's factoring algorithm and its number-theoretic background and the discussion of the Greenberger-Horne-Zeilinger puzzle illustrating the nonintuitive, nonlocal aspects of quantum mechanics. The division between the main text and the 16 appendices feels seamless and natural.

In his book, Mermin introduces the heretical term "Qbits" to denote qubits. Even if Mermin's motivation is right and Qbits is superior nomenclature to qubits, its introduction appears to run counter to the theme in Leo Tolstoy's *War and Peace*: No individual can single-handedly change the course of history. An immediate corollary is that no individual, not even David Mermin, can make us say Qbits when we mean qubits.

Yet what if his book becomes a standard in the undergraduate physics cur-

riculum? Its chapters—I recommend 1, 2, and 6, and appendices A through G—would be used as a first introduction to quantum mechanics, used *before* the floodgates are opened to application of the quantum in physics. We'd have generations of scientists, an army of undergraduates, raised on and ready to defend their first love—Qbits.

I don't know who will win the Qbit versus qubit wars, but I truly hope that Mermin's book will nurture the next generations of scientists in their understanding of things quantum computational—or even just plain quantum.

Barbara Terhal

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Experiments and Demonstrations in Physics

Bar-Ilan Physics Laboratory

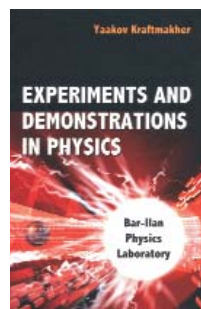
Yaakov Kraftmakher

World Scientific, Hackensack, NJ,
2007. \$128.00, \$68.00 paper
(533 pp.). ISBN 978-981-256-602-7,
ISBN 978-981-270-538-9 paper

Physics education research has amply demonstrated the importance of hands-on activities for students. Most high-school and introductory college physics courses include a laboratory component and lecture demonstrations. A modern innovation is to eliminate the lecture altogether, or at least integrate it with student experimentation. At the upper-undergraduate level, courses tend to be more theoretical and divorced from their experimental counterpart, probably to the detriment of learning.

Resources for physics teachers who want to include more or better experiments and demonstrations in their courses are relatively sparse. Classic references include Richard Sutton's *Demonstration Experiments in Physics* (McGraw-Hill, 1938), *Physics Demonstration Experiments* (Ronald Press, 1970) edited by Harry Meiners, and George Freir and Frances Anderson's

Demonstration Handbook for Physics (American Association of Physics Teachers, 1972). But those books tend not to exploit recent advances in instrumentation, especially computers. My own *Physics Demonstrations: A*



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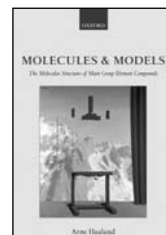
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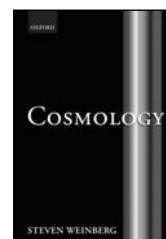
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