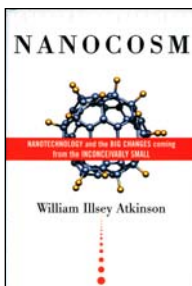


introduction is regrettably followed by what might be the weakest part of the book: a glimpse into the world of 2015. Although chapter 1, "Nanoworld 2015," contains a few interesting concepts, it includes extrapolations that will undoubtedly grate against the temperament of professional scientists.

Chapter 2, "Nanoscience: Trends in World Research," is a lively, entertaining series of interviews with selected scientists that illustrates the complex, multidisciplinary aspect of the field. Though one can argue that the scientists, disciplines, and topics chosen do not best represent the field (the book has a decidedly Canadian focus that reflects the author's origins), such grumbling misses the point: Nanoscience has many faces, all tremendously fascinating to those on the front lines and all linked by a common scientific thread.

It is not by coincidence that Atkinson covers nanoscience and nanotechnology in two separate chapters. Chapter 3, "Nanotechnology: Trends in World Development," explores various fledgling attempts to commercialize nanoscience and the eternal quest for the Killer App. As in chapter 2, such snapshots do not represent an exhaustive survey; instead, they highlight selected topics, such as why Switzerland has embraced nanotechnology as a potential successor industry to high-value luxury watches, which leads to a dialog on the difficulty of launching new technologies.

Chapter 3 naturally leads to chapter 4's "Nanofornia" and the culture, according to Atkinson, of "The Young and The Stupid"—techno whiz kids whose hunger for new technology serves as a virulent petri dish for both the good and the wacky. The author attends a "nano-Woodstock," where he stumbles upon a number of characters (the most colorful being an irreverent compatriot christened Scaramouche) who act as skillful foils for the zany antics arising out of this strange blend of serious science and "thinking out of the brain" nanohyperbolae. This is home turf for the "Church of St. Drex," named after K. Eric Drexler, author of *Engines of Creation* (Anchor Press/Doubleday, 1986) and *Nanosystems: Molecular Machinery, Manufacturing, and Computation* (Wiley, 1992). But rather than resort to indiscriminate Drexler bashing, Atkinson balances appropriate credit for nanoboosters' popularization of the field with a thoughtful exploration, although at times laced with



hilarious lampoonery, of the fanaticism of the church's disciples. Chapter 4 has wonderfully memorable phrases, such as "they . . . give snake oil a bad name," that are sure to enthrall scientists and antagonize devout followers. The reader will find substance in the chapter, both in the specifics of the infeasibility of Drexlerian molecular machinery and in the elucidation of the specious arguments of true nano-believers.

The book wraps up with chapters on characterizing and imaging at the nanoscale—indeed one of the outstanding challenges in the field—and "wet" nanotechnology, that strange blend of nanotechnology and biology. The discrepancy between the scientist's view of the field and that of the author is greatest in these chapters, which have a clear focus on the "fashionable" areas in nanotechnology. That discrepancy is also evident in the concluding chapter on the nanotech effort in Japan and its focus on commercialization, which sometimes confounds exploratory nanoscience with existing technology at the microscale (for example, microelectromechanical systems). But such disparities are minor flaws in a captivating and entertaining tale of the author's coming of age in these worlds.

Nanocosm is a wonderful, informative, and timely read, especially because it appeared on the heels of Michael Crichton's nanotech thriller *Prey* (HarperCollins, 2002). Atkinson's book also contains a brilliant epilogue on the absurdity of a "Drexlerian Apocalypse" and its seductive subliminal message—particularly, the horrifying penalty for St. Drex nonbelievers. Atkinson paints a delightfully fresh picture of the world of nanotechnology; and, like a master painting, its minor cracks and blemishes disappear when one steps back to enjoy the entire illustration.

Mark Reed
Yale University
New Haven, Connecticut

Applied Quantum Mechanics

A. F. J. Levi
Cambridge U. Press, New York,
2003. \$130.00, \$55.00 paper (523
pp.). ISBN 0-521-81765-X, ISBN
0-521-52086-X paper, CD-ROM

Teaching graduate-level quantum mechanics to engineering students is a significant challenge. The barriers do not lie where one might expect in

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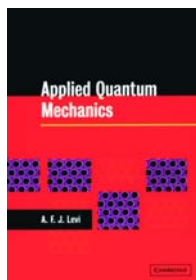
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the conceptual difficulties of indeterminacy and wave-particle duality but rather in the fact that the subject does not lend itself to the large volume of homework problems those students expect. Moreover, the fraction of the engineering curriculum that can be devoted to quantum mechanics is limited by the need to present other levels of abstraction of modern technology, such as circuits and systems. In the typical physics curriculum, mastery of nonrelativistic quantum mechanics requires not only two semesters of the topic itself, but also two semesters of mathematical methods. Engineering curricula, however, cannot commit that many classes to teaching quantum mechanics.

Anthony Levi's *Applied Quantum Mechanics* is a significant contribution to solving the problems mentioned above. The author addresses parts of the subject that are important to terrestrial, low-energy technologies. In contrast to a textbook aimed at physics students, Levi's book devotes minimal attention to problems such as atomic structure and scattering from spherical potentials. The text focuses on electron systems that may be described in one dimension, such as bound and extended states; on the harmonic oscillator as a model for collective modes including photons and phonons; and on perturbation theory, with discussions on Fermi's golden rule for stimulated optical transitions. The author also presents equilibrium statistical mechanics, a necessary element of any engineering application. In a very nice touch, he uses the semiconductor diode laser as the primary example of how quantum mechanics is applied. The device depends upon essentially all of the topics covered in the book. Although Levi only considers a simple model of the diode laser, presenting the device as a target application gives an instructor the opportunity to motivate students into examining the book's topics.

The first chapter is a review of classical mechanics and electromagnetism, but the author chooses examples that have relevance to quantum systems. For example, the linear chain of masses coupled by springs introduces the notion of nonlinear dispersion (frequency versus wavevector) relations. In later parts of the chapter, Levi includes discussions of classical systems, such as photonic crystals, that share a mathematical foundation with the quantum systems that are the focus of the text.

The book comes with a CD-ROM that contains MATLAB code for a



number of examples and exercises; the book also introduces elementary numerical techniques for dealing with quantum problems. The inclusion of numerical techniques significantly increases the number of problems the student can solve with reasonable amounts of effort. It also offers readers a much more realistic appreciation of the way quantum systems must be analyzed in practical technological applications.

One frustrating aspect of the book is that, on some occasions, Levi develops the background for a significant result but then fails to follow through to the result itself. An example is his treatment of the dynamics of electrons in crystals, including the effects of the complicated dispersion relation, or band structure. At various points, the author mentions group velocity and describes band structures, but he never explicitly states the group-velocity and acceleration theorems that determine the electron dynamics.

A novel feature of *Applied Quantum Mechanics* is the inclusion of solutions for all the exercises. I am not quite sure how this will work in the context of a course taken for credit. Because the answers are readily accessible, instructors will need to either supplement the problems given in the text or modify their grading algorithms.

In summary, Levi's book represents a very large step in the right direction for teaching quantum mechanics to engineering students. I have adopted it as the textbook for my next class on the subject. However, I believe we ultimately need an even more radical departure from the traditional physics curriculum textbook.

William R. Frensley
University of Texas
at Dallas

Basic Concepts for Simple and Complex Liquids

Jean-Louis Barrat and
Jean-Pierre Hansen
Cambridge U. Press, New York,
2003. \$110.00, \$55.00 paper
(296 pp.). ISBN 0-521-78344-5,
ISBN 0-521-78953-2 paper

Liquids are strongly interacting but disordered systems whose very existence arises from a delicate balance between energy and entropy. They exist over a much smaller range of temperature and density than do

solids, in which energy usually dominates, or gases, in which entropy dominates. Because liquids are relevant in everyday life and essential in biology and biophysics, physicists need to gain a better understanding of this elusive state of matter and the ideas that researchers in the field have developed in the past 50 years. However, some of those ideas are difficult and involve new concepts and approximations not usually taught in standard physics courses. *Basic Concepts for Simple and Complex Liquids*, a concise, very well-written textbook by two experts in the field, should help fill this gap in the physics curriculum.

The book by Jean-Louis Barrat and Jean-Pierre Hansen describes and connects formal work and simulations of atomic-scale properties of mostly simple fluids to the coarse-grained mesoscopic models and scaling arguments used to explain critical phenomena and to describe complex fluids such as liquid crystals and polymers. Coarse-grained models and scaling ideas are familiar to most physicists, and their integration with standard topics in condensed matter physics was well presented in the textbook *Principles of Condensed Matter Physics* (Cambridge U. Press, 1995) by Paul M. Chaikin and Tom C. Lubensky. Barrat and Hansen's book covers some of the same ground from a different perspective, with more emphasis on polymers and ionic solutions, and relates the mesoscopic-scale physics most physicists know to the less familiar molecular-scale physics of liquids. These connections should help researchers in many different fields get a succinct overview of the conceptual issues in liquid-state science. The authors' inclusive approach is quite different from that taken in most earlier books on liquids: In those books, the emphasis is mainly on simple atomic liquids and on the detailed, formal development of specialized techniques for such systems.

To get an idea of how Barrat and Hansen's approach works, consider their treatment of phase transitions. That part of the book begins with a general discussion of mean-field approaches, which includes a detailed discussion of the Landau theory of phase transitions, followed by specific applications to the van der Waals equation of state, to the Flory-Huggins theory of polymer blends,

