tion manual is available.

The organization of the new book is similar to that of the first edition. Its first part covers thermodynamics. The second part, "Concepts from Probability Theory," discusses elementary probability distributions and limit theorems (such as the central limit theorem), master equations, Fokker–Planck equations, Markov chains, random walks (including Lévy flights) and ergodic theory. The third part covers equilibrium statistical mechanics—the microcanonical, canonical and grand canonical ensembles, critical phenomena and the equilibrium theory of classical fluids. The book's fourth and largest part is on nonequilibrium statistical mechanics, covering hydrodynamic processes near equilibrium, transport theory and nonequilibrium phase transitions. Hydrodynamic equations for normal fluids and superfluids are derived, and important theorems such as the fluctuation–dissipation theorem and the Onsager relations are discussed. The second edition covers topics not included in the first; two examples are Lévy flights and the thermodynamics underlying biological processes.

The level of the book is graduate student and up. Significant background is assumed from the beginning in quantum mechanics (including Dirac bra-ket notation), linear algebra (including eigenvector analysis of non-Hermitian matrices) and partial differential equations. Many of the exercises are rather sophisticated, consistent with the assumption that the reader will have a substantial theoretical background.

As noted in the preface, the sequence of topics is such that subsequent chapters do not necessarily require knowledge of previous chapters for comprehension. The book is, therefore less well suited for independent study—a student could be overwhelmed by the sheer volume of material covered—than as a textbook for a course, during which a professor can cover nonsequential portions of the material and stress the logical connections among topics. Each section includes references to the literature—other textbooks as well as primary references—a feature that students and researchers both will find useful.

The choice of topics reflects the author's research interests. The book is dedicated to Nobel Prize winner Ilya Prigogine, whose influence on Reichl's point of view is particularly apparent in the discussions of ergodic theory and nonequilibrium phase transitions. Despite the breadth of material covered, some important subjects are not treated, such as systems with quenched randomness (for example, random magnets and percolation) and dynamical problems such as interface motion, surface growth and diffusion-limited aggregation. Chaos theory is considered briefly in the discussion of ergodic theory, but there is no mention of universality at transitions to chaos. This omission is particularly regrettable because the close connections to critical phenomena in equilibrium phase transitions can be so illuminating. However, omissions are inevitable, given the extent of modern statistical physics.

Reichl has made a heroic effort to create a textbook that captures the scope of an exciting and important field. Her book should be valuable to students and researchers for years to come.

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Sliding Friction: Physical Principles and Applications

Bo N. J. Persson
Springer-Verlag, New York, 1998. 462 pp. $79.95 hc
ISBN 3-540-63296-4

The past decade has witnessed tremendous advances in our understanding of tribological phenomena in general and friction in particular. This growth has been driven by the new methods available to the experimenter, such as atomic force microscopy and the surface forces apparatus, and by increases in accessible computing power, which has made possible molecular dynamics calculations of tribological systems on ever larger ensembles. Simultaneously, surface analytical approaches have begun to unravel the mysteries of lubricant–surface interactions, driven in part by the need to replace environmentally incorrect additives with more benign alternatives while not sacrificing performance or increasing cost. Paralleling this scientific boom, engineering tribology has continued to prosper, with increasingly refined lubrication models and bearing designs coming on line.

The challenge of the last few years has been to blend our recently enhanced physical understanding with the body of engineering tribological knowledge gathered since the dawn of tool use and codified by the likes of Leonardo da Vinci and Guillaume Amontons. While interdisciplinary conferences and journals have propelled the blending of science and technology at the research level, there has been a need for textbooks to put the last decade's progress in tribological physics into its proper context in a way that can be digested by the entire tribology community. Bo Persson's book goes a long way toward filling this need.

Although several useful textbooks that deal with tribology from a materials science or engineering perspective have appeared in recent years (I. M. Hutchings's *Tribology—Friction and Wear of Engineering Materials*, CRC Press, 1992; J. A. Williams's *Engineering Tribology,* Oxford U. P., 1994; and G. W. Stachowiak and A. W. Batchelor's *Engineering Tribology*, Elsevier, 1993), *Sliding Friction* treats the topic comprehensively from the standpoint of physics. In this sense, it can be thought of as an update of Frank P. Bowden and David Tabor's classic, *The Friction and Lubrication of Solids* (Clarendon, 1985).

Sliding Friction is both readable and comprehensive, and it will serve excellently as a treatise on the subject for advanced undergraduates, graduate students and others carrying out research in tribology. Not only does it cover such fundamentals as real contact, hydrodynamic, elastohydrodynamic and boundary lubrication from an interesting and partially historical standpoint, but it also presents the very latest developments in the field, such as the results of quartz-crystal microbalance and surface forces apparatus measurements on the fundamentals of friction and the author's own theoretical work on time-dependent plastic deformations.

Particularly apparent in this book is Persson's ability to illustrate and discuss phenomena that have been known for many years in light of results obtained by the newer experimental and computational techniques. One example is his coverage of boundary lubrication, where results from both molecular dynamics and the surface forces apparatus are pressed into pedagogical service to illuminate such issues as static/dynamic friction coefficients and stick–slip phenomena. Another example is Persson's illustration of shear thinning (particularly important in animal joint lubrication) by means of projected molecular orientational distributions.

The book closes with a chapter on novel sliding systems, many of which (earthquakes, biotribology and sliding on ice and snow) I found useful and interesting, although some (sliding of flux-line systems and charge-density waves) I found to stretch even the most permissive interpretation of tribology a little far.

Persson is renowned for his contributions to the tribology physics literature. He has now produced a reference work on the physics of friction that is accessible in style and content to engineers and materials scientists. He has done this without sacrificing physical rigor, and for this he is to be heartily congratulated.

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A Complete Introduction to Modern NMR Spectroscopy

Roger S. Macomber
Wiley, New York, 1998. 382 pp. $49.95 pb ISBN 0-471-15736-8

A Complete Introduction to Modern NMR Spectroscopy by Roger Macomber is a largely descriptive textbook that aims to teach advanced undergraduates and graduate students in chemistry the nuts and bolts of modern nuclear magnetic resonance spectroscopy. A fundamental up-to-date textbook in this area is badly needed: In the last 15 years, an alphabet soup of cutely acronymed pulse sequences, two-, three- and four-dimensional Fourier transforms and increasingly complex algorithms for spectral interpretation and data reduction have turned what had been a physically simple spectroscopic methodology into a field unto itself.

The author covers the morass of methods quite comprehensively. He sorts through alternative techniques systematically and critically, and he lays out in a straightforward and pedagogically sound fashion the principles of the Fourier transform in *n* dimensions along with the various schemes for coherence transfer and the interpretation of NMR spectroscopic data. In these respects, the book is among the best on the subject currently in print. Its most serious flaw is, curiously enough, its description of the fundamental principles of NMR, which contains a significant number of severe errors. To take just two examples: Macomber states that the Larmor precession frequency of individual spin states is independent of their m_z quantum number, an assertion that makes the precession of the coherence absurd. And he very nicely shows pictorially how individual spin magnetic dipoles at equilibrium add to give a macroscopic z-magnetization, but then spoils it by depicting a transverse coherence using spin dipoles that add up vectorially to zero.

Fundamental flaws of this sort make the book useless to physicists and physical chemists. More seriously, they will lead the intended, less sophisticated audience into the all-too-common belief that the physical principles of NMR spectroscopy are somehow mysterious and counterintuitive and cannot easily be grasped by those whose primary interest in the spectroscopy is as an analytical tool. It is regrettable that these errors were not caught in the reviewing or editing process, since they mar what is otherwise a fine volume.

Macomber's text will obviously not replace the still-unsurpassed monograph of Charles Slichter—*Principles of Magnetic Resonances*, (Springer, 1990)—as a primary source for physicists interested in NMR. Its very clear strengths might recommend it, however, to a teacher of analytical or organic chemistry, but only if the teacher is willing painstakingly to correct the mistakes in the first few chapters.

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Randomness

Deborah J. Bennett
Harvard U. P., Cambridge, Mass., 1998. 238 pp. $22.95 hc ISBN 0-674-10745-4

Randomness, by mathematician Deborah J. Bennett, was obviously a labor of love. The result is an interesting book that combines a well-researched, anecdotally presented survey of the history of chance, probability and randomness along with some elementary instruction in probability. The cultural, or historical, part of the book is by far the more important, and more successful, part. The author notes that there is evidence that gaming existed in Ur and Egypt five thousand years ago. She describes some of the dice (not all of them cubical) found in excavations in Mesopotamia, the Indus valley and Egypt. Dice were also referred to in the epic poem *Mahabharata* (400 BC–400 AD).

Games of chance played a number of roles throughout history: They were believed to ensure fairness, they were used to obviate discussion, and the random element in games of chance was believed to exclude human intervention but leave room for divine guidance. As such, the drawing of lots played an important role in major events. In the *Iliad*, for example, a lottery was used to designate the Greek soldier who would fight Hector; similarly, the Jewish defenders of Masada against the Roman legions drew lots to determine the sequential actors in their mass suicide. Chance was also used to select personal predictions from the *I Ching* (The Book of Changes).

Bennett also delves into the history of the mathematical understanding of chance events, an understanding that required an appreciation of the concepts of equal likelihood (as in the appearance of any one face on a cubical die) and the independence of sequentially repeated events (as in the tossing of one die after another). The first mathematical work on chance was done in the 16th century by Girolamo Cardano, who correctly computed probabilities for various outcomes of two- and three-die totals and who observed that the larger the number of trials, the closer the actual results to the mathematical expectation. A century later, the serious study of probability began with the work of Blaise Pascal and Pierre de Fermat.

Bennett provides a detailed account of the evolution of sampling and the realization that, to detect patterns in data, whether they are meteorological or social, it would be necessary to generate random samples. This leads to the problem of the generation of tables of random numbers and the question of how one tests whether a sequence of numbers is really random. The discussion of the ways random numbers are generated is fascinating. The author points out that the method with which I was familiar, the taking, say, of a four-digit number, squaring it, taking the middle four digits of that, squaring, and so on, developed by John von Neumann, has its problems (for example, 3792 repeats itself very unrandomly!). In the description of the more modern approaches, the going gets a bit rough. A reader who is not trained in statistics will be snowed under by references to modular arithmetic, lagged Fibonacci sequences and the subtleties of finding criteria for randomness.

Bennett's book devotes some space to showing how simple probabilities can be calculated. This part of the book is less successful. The actual demonstrations are scattered about and embedded in the more historical and scholarly parts of the book; the author does draw our attention to most of the common misconceptions about figuring odds, but the clarification could be better. To learn some simple probability theory, the reader would be better off with other, more specialized introductions to the subject, such as *Lady Luck* by Warren Weaver (1963, now available from Dover) or *Reasoning About Luck* by Vinay Ambegaokar (Cambridge U. P., 1996).

Randomness is at heart a very scholarly book. It includes a wide-ranging and rich bibliography that reflects the passion of the author for the subject. Anybody interested in gaming, random