

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.
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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