tions of the difference between diffraction and interference ever written, a nicely written explanation of the difference between phase and group velocity and a wonderful discussion of many aspects of ferromagnetism. One factual gem I enjoyed is that a car's two headlights can be resolved at distances as far as 17 km!

There are some unfortunate lapses. Occasionally, there are mysterious statements such as "the frequency is 9." We are left to wonder, 9 what? Other proofing errors are not uncommon. Swartz and I have disagreed at times about the significance and use of units, and I can find more to disagree with here than I would have wished. In a "sourcebook," it would have been best to get all units correct and to eschew non-SI units for the most part. This has not been done: We find, among others, the gal, the poise and the gauss. The British thermal unit is sometimes printed correctly (Btu), other times as BTU. Worse, the calorie is emphasized at the expense of the joule.

An even more unfortunate failing for a sourcebook is a muddiness about the distinction between weight and mass and the failure to denote vectors as vectors uniformly, which can, in places, lead to awkward presentation. Velocity is often incorrectly used to mean speed. Most physicists speak of atomic mass, not atomic weight.

A few other things would have made this work more valuable. Some figures could have been bigger to help the reader. One figure (figure 4.11) was so tiny I would have had a hard time reading it if I hadn't remembered the original! More annotated references in the later chapters similar to those in the first few would have been a very welcome addition.

Overall, the first two wonderful chapters and the very nice treatments of various topics in the rest of the book overwhelm any reservations about recommending the book. This will indeed be a valuable addition to a teacher's bookshelf. I hope the next edition will be even more valuable.

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Radio-Frequency Electronics: Circuits and Applications

Jon B. Hagen
Cambridge U. P., New York, 1996.
358 pp. $49.95 hc
ISBN 0-521-55356-3

In the first figure of *Radio-Frequency Electronics*, Jon Hagen delineates the eight decades of the electromagnetic spectrum occupied by radio frequencies: from above 10 kHz to 1000 GHz, the latter corresponding to a wavelength of 0.3 mm. Within that range, we can identify several approximate lines of demarcation, where changes in circuit behavior occur. For example, above several megahertz, the inductance of relatively short lengths of wire can become significant. Above about 300 MHz, lumped constant elements (resistors, capacitors and inductors, which are each effectively concentrated at a single point) give way to distributed constant circuits typified by coaxial and waveguide transmission lines. This is the frequency regime generally referred to as microwaves.

Back in the late 1940s, several volumes in the MIT Radiation Laboratory Series (McGraw-Hill) dealt with rf circuits, devices and design philosophy. The driving force at that time was wartime-spawned radar. Hagen has recognized the need for a fresh look at rf systems and their applications. In addition to radar, his book includes communications (increasingly wireless), radio astronomy and, in the medical field, magnetic resonance imaging.

Hagen developed his text for a one-semester course in electrical engineering for students unfamiliar with rf circuits, devices and systems; for that purpose, I believe the book will be successful. There are 34 chapters covering transmission lines and matching networks, radio receivers and the associated problem of amplifier noise, modulation and detection schemes, oscillators, phaselocked loops and elements such as mixers, filters, transformers and couplers.

That coverage is indeed broad, but I believe that two other topics should have been included. The first concerns broadband—that is, untuned—rf amplifiers of both the small-signal and power variety. It is not the circuit design details that are needed so much as an idea of the many commercially available models. Modern nuclear magnetic resonance spectrometers and imagers depend heavily on those instruments, as well as on the pulse technology associated with pulsed NMR. Although Hagen does treat the transmission line modulators that are useful in radar, it is the more general types—originally referred to as hard-tube modulators—that deserve some discussion.

The book contains problem exercises for each chapter. They appear well designed to test a student's comprehension. The illustrations are well chosen and nicely complement the author's writing, which I found to be both informative and enjoyable to read. Hagen introduces the subject of waveguides in this manner: "The ability of a hollow metal pipe to transmit electromagnetic waves can be demonstrated by holding it in front of your eye (you can see through it)."

I wonder how old-timers other than myself will react to Hagen's first reference to vacuum tubes. An asterisk leads the reader to a definition that begins, "A triode vacuum tube is analogous to an npn transistor)." *Sic transit gloria mundi*! Incidentally, I would have chosen an *n*-channel field-effect transistor as a better analog.

Hagen believes that his book could be a reference for working engineers. That poses a problem. Most of the chapters are only about ten pages long; there is simply not enough in-depth material provided for each topic to satisfy that audience. An experienced rf engineer doesn't usually need an overview so much as detailed answers for solving some knotty problems. But that still leaves a potential readership of rf neophytes, who are enrolled in a formal course or are interested in self-study or who have some knowledge of the field and wish to browse to find out what's new. To that audience, I can and do recommend Hagen's book.

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Anomalies in Quantum Field Theory

Reinhold A. Bertlmann
Oxford U. P., New York, 1996.
566 pp. $115.00 hc
ISBN 0-19-852047-6

In quantum field theory, the word "anomaly" has come to stand for a situation in which a conservation law that follows from naive manipulation of the Lagrangian is not present in the full-fledged quantum theory. It follows that any deductions based on such a conservation law could run counter to experiment. Indeed, this is what happened when David Sutherland and Martinus Veltman showed independently in 1967 that, according to current algebra, the neutral pion could not decay into two photons, when, in fact, it does. The resolution was provided in 1969 by John Bell and Roman Jackiw and, independently, by Stephen Adler. Through a careful analysis of the divergences of certain Feynman diagrams, they found a violation of the naive conservation law of axial charge that gave a decay rate in accordance with experiment.

The following years showed that

anomalies were not mathematical curiosities tied to divergences but entities that lie at the core of many interesting field theories. They appear in gauge theories and quantum gravity. While certain anomalies are welcome, in that they reconcile theory and experiment, others are bad, in that they ruin the consistency of the theory and must therefore be made to vanish by cancellation between different sectors in the theory. Michael Green and John Schwartz's discovery in 1984 of anomaly cancellation in ten-dimensional supersymmetric theories totally energized the string community and could not have escaped the attention of any practicing physicist. Over the years, many mathematical techniques involving differential geometry, topology and cohomology have been invoked to further understanding of these anomalies.

In *Anomalies in Quantum Field Theory*, Reinhold Bertlmann, a collaborator of Bell's and a contributor to the field, has written a book that covers the topic in great detail. It is a leisurely and scholarly treatment of the entire subject from the ground up. You have to know some basic field theory to follow it; he teaches you the rest of the mathematics and field theory techniques. My impression of the book, from the vantage point of someone who was an active particle theorist until a decade ago, is as follows: The material I knew, such as instantons, simple index theory, homotopy and differential forms, are covered very clearly and in a self-contained manner. More recent developments, which required a lot of new mathematics, are accessible given the investment in time required to master the background material that is provided.

The book begins with a long mathematical introduction to topology, homotopy, differential forms, homology and cohomology, and fiber bundles. This is followed by a review of path integrals, anomalies in Feynman diagrams and path integrals, Wess–Zumino consistency conditions, Stora–Zumino descent equations, various index theorems and gravitational anomalies.

This book is suitable for particle theorists (advanced graduate student and above) and for mathematicians who want to know how physicists get interesting ideas that bear on mathematics. Besides being comprehensive, the book manages to convey the depth and breadth of this profound subject as well as its links to mathematics. It is bound to become a standard reference on this fascinating topic.

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Understanding Molecular Simulation: From Algorithms to Applications

Daan Frenkel and Berend Smit
Academic Press, San Diego, Calif., 1996. 443 pp. $65.00 hc
ISBN 0-12-267370-0

Computer simulation is one of the most active and productive areas of research in molecular and condensed matter physics and materials science. The literature has ballooned in the past several years and great progress in both methodology and important applications has been reported. In *Understanding Molecular Simulation*, Daan Frenkel and Berend Smit, senior Dutch investigators in the area of molecular simulation, have provided a treasure. The book is a marvelous mix of just enough formalism with an informal and readable style, sufficient detail to understand methodological advances, appropriate mathematics without *rigor mortis* and penetrating discussions into some of the most important (and, for the nonspecialist, nonobvious) advances in the field.

In their preface, Frenkel and Smit state that "we intend to give unified presentation of those computational tools that are currently used to study the equilibrium properties and, in particular, the phase behavior of molecular and supra-molecular substances." This limitation does hurt a bit: Some of the most important and active areas, such as *ab initio* molecular dynamics simulations, quantum dynamics simulations and hopping models, are absent (although there is a brief but successful and illustrative discussion of a classical limit of the Car–Parrinello *ab initio* molecular dynamics).

The book's indexing, layout and readability are good. There are a few disturbing typographical errors, but they will not really deter even a casual reader.

Understanding Molecular Simulation succeeds admirably in its intentions. It focuses on the two standard methodologies of molecular dynamics and Monte Carlo, and, through comparison and contrast, the strengths and shortcomings of each are made clear. This is a useful text: It has what the working scientist needs to know, and it provides extensive illustration, including simple computer algorithms, data, test case analyses, appropriate references and methodological comparisons. It is a unified text in a field in which most of the published work consists of collective conference reports. In everything from notation to use of such important concepts as generalized Lagrangians in the development of new ensemble sampling methods, the unification is of great help.

There are previous books in this area, and this text does not supplant them. The title is "Understanding Molecular Simulation," and that is where the emphasis really is placed. Details of particular algorithmic approaches and extensive comparison of simulation results to experiment are found in many other useful books, including those by W. G. Hoover (*Computational Physics*, Elsevier, 1991), K. Binder, (*The Monte-Carlo Method in Condensed Matter Physics*, Springer, 1992), M. H. Kales and P. Whitlock, (*Monte-Carlo Methods*, Wiley, 1986), and M. D. Allen and D. J. Tildesley (*Computer Simulation of Liquids*, Clarendon, Oxford, 1987). Still, this book is more recent than those, and it brings in important recent advances—from variable time-step methods to the Gibbs ensemble approach to phase equilibria. It is intended to be useful, and I think that it is. Much of the complex but necessary technical material is relegated to nine appendices, on such topics as statistical errors, long-range interactions and the Gibbs ensemble.

Frenkel and Smit's book should be useful for scientists, ranging from those beginning graduate school to working professionals. Much is presented, and presented with clarity and perspective. In sum, this book is a good one.

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Particle Detectors

Claus Grupen
Cambridge U. P., New York, 1996. 455 pp. $100.00 hc
ISBN 0-521-55216-8

The goal of *Particle Detectors* by Claus Grupen is to describe most of the detector technologies used in high-energy physics, nuclear physics, biology and cosmic-ray physics. The text aims particularly at explaining the basic physical principles underlying both the function and the limitations of the various detectors. For the most part, that goal is achieved, and the book would be an excellent text for a course on detector technology. In this respect, it is similar to the texts by Konrad Kleinknecht (*Detectors for Particle Radiation*, Cambridge U. P., 1986) and Richard Fernow (*Introduction to Experimental Particle Physics*, Cambridge U. P., 1986/1989). In addition to these works, the second edition of *Experimental Techniques in High Energy and*