and thus does not feature any of its results, but the content remains current nonetheless.) Phillips consistently avoids explicit citation of research material except in figure captions, although he does include a valuable glossary and a general bibliography.

The book is well written, and despite the breadth of coverage the reader doesn't get the impression that Phillips is cramming in too much information, thanks to his facility for linking different topics smoothly. For example, the chapter on the Sun's place among the stars covers a lot of basic astronomy without ever becoming just a recitation of facts. The chapter on solar energy, which might have seemed out of place, starts with a discussion of the solar irradiance (which once was called the solar constant but no longer is because it isn't) and its measurement, and, as it proceeds to the exploitation of different forms of energy, Phillips makes clear that nearly all of the sources of energy we have stem, directly or indirectly, from the Sun and stars. The various means for directly exploiting solar energy are discussed, again at a very accessible level.

It is difficult for me to judge the potential success of the book in conveying ideas to its target audience, but I found it easy to read for the most part, and it contains so much material that even professionals may find it a valuable summary of the general state of knowledge in fields outside of their own specialties. I can therefore recommend it highly to both the interested outsider and the professional.

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The Quantum Dot: A Journey into the Future of Microelectronics

Richard Turton
Oxford U. P., New York, 1995. 211 pp. $25.00 hc ISBN 0-19-5211-57-X

Microelectronics has evolved at a pace unprecedented in the history of technology. In *The Quantum Dot* Richard Turton explains the physics that allowed this to happen, reports on many interesting recent experiments on electronic motion in small structures and explores a wide range of adventurous proposals for further progress, with an emphasis on computer logic. Along the way the author explains a good deal of physics. Unfortunately, this laudable and ambitious project is not a complete success.

The book is intended for both first-year undergraduates in electrical engineering and physics and an audience with little physics background. As a concession to its intended general audience, the book avoids equations completely and circuit diagrams appear only in a disguised, symbolic form. In a book that is heavily quantum mechanical, Planck's constant turns up only in the second half, and there it makes but brief and incidental appearances. As a result of such concessions, too many explanations are inadequate or hard to follow. In the first two chapters, which explain quantum mechanics and band structure, we find a particularly high density of flawed explanations.

We are told that "if we use a golf ball to represent a proton, then an electron is just a tiny bead a few millimeters in diameter." The Pauli exclusion principle is presented without reference to spin, in a statement that "just two electrons are allowed in any given level." Why two instead of five? Band structure is explained by way of a questionable analogy: In trailers parked in a lattice arrangement in a campground, four children in each trailer attempt to find suitable noninterfering frequencies for talking on walkie-talkies to their favorite neighbors. This is simple only if simplicity is identified with a minimum of algebra and physics. It leaves the reader with no insight into the behavior of band structure.

For a book intended for a broad audience there is surprisingly little history, and some of that is misleading. We are told that the ENIAC computer, whose fiftieth anniversary will be celebrated this year, was replaced by transistorized computers, ignoring over a decade of highly successful and widely distributed electron-tube computers and calculators. Turton dates the first working semiconductor field effect transistors from 1962, but they were actually reported in 1960. In connection with single-electron tunneling and the Coulomb blockade, observed in tunnel junctions with very small capacitances at low temperature, we learn that "until 1985 no one really gave this any thought." John Lambe and Robert Jaklevic published their pioneering experiment on this in 1969.

Turton takes up a remarkably wide assortment of innovative proposals for the future. Most of these come from scientists with a basic research orientation who pay little attention to the need to control device behavior in large systems. (The author of this book, indeed, is far more reasonable than most of the enthusiastic advocates who organize the conferences and the special issues of journals.) Turton does point to some of the problems with these proposals, particularly in his concluding chapter. Nevertheless, there are some lapses, and the attention given to these schemes will mislead the novice who is unaware of the great number of such proposals that have failed.

The author is also optimistic about unguided optical interconnections, which I consider a recipe for disaster, putting light where it is not intended to go. The author perceptively points to the fact that decimal machines required devices with ten accurately defined positions, which led to their replacement by binary machines. But later on Turton celebrates tunneling devices that have many possible states. His discussion of tunneling devices does not tell us that tunneling depends exponentially on device parameters and is therefore hard to control.

The "quantum dot" of the book's title refers to small conducting volumes, small enough to let quantization control the behavior of the electrons in the structure. The interaction between such dots has often been suggested as a basis for computer logic, but such suggestions have typically contained too few details to permit an evaluation. One proposal from a group at the University of Notre Dame does provide a complete description and is discussed in the book. Unfortunately, Turton does not mention that the forward flow of information in this scheme can become trapped in nonpropagating metastable states.

This is not a bad book; almost everyone can learn from it. It is, unfortunately, just not good enough.

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Fundamentals of Optical Fibers

John A. Buck
Wiley, New York, 1995. 264 pp. $59.95 hc ISBN 0-471-30818-8

For the past 15 years optical fibers have been the transmission medium of choice for most high-capacity communications applications. Introductory books on fiber optics usually cover the fiber, sources and detectors, and communications receivers and applications, because these subjects are so interdependent. Although there are advantages to this overview approach, there is interest in more specialized texts that concentrate on a narrower range of topics but are still suitable for an undergraduate course. John Buck's *Fundamentals of Optical Fibers* partly meets this need in the electromagnetic aspects of fiber optics. This slim volume contains much more depth on propagation in fiber than do most introductory texts, and yet its level of detail and sophistication is more appropriate for a first course than are those of more advanced texts.

In general, this is a readable and useful book. Buck provides good physical descriptions, relates simple and more exact models (ray and mode theories, for example) and provides both representative numerical values and helpful approximation formulas for many quantities of physical interest. There are ample and generally very clear figures. Most of the end-of-chapter problems are non-numeric and call for derivations designed to expand on the material presented.

A unique feature for a book at this level is the inclusion of two chapters on nonlinear optics. Although more advanced books are required to do justice to this subject, there is some merit in introducing the subject in an introductory course. The topic that is covered most thoroughly is dispersion. Unlike authors of most introductory texts, Buck treats the case of the propagation of transform-limited pulses where the spectral width is determined by the pulse width as well as the inherent spectral width of the source, but the effects on the maximum bit-rate transmission-distance product are not explicitly covered. Buck also discusses the approximate nature of fiber bandwidth, based on the assumption that, under some circumstances, the fiber may be considered as a linear low-pass system operating on optical intensity.

The optimization of the index-of-refraction profile in multimode fibers to minimize intermodal dispersion is covered theoretically from both a ray optics and modal view. Although the sensitivity of intermodal dispersion to wavelength and to index-of-refraction profile are noted, the quantitative consequences are not considered. Other significant omissions are polarization (polarization-maintaining fiber and polarization dispersion) and passive fiber devices such as filters and couplers. Many of these topics are included in A. Bruce Buckman's *Guided Wave Photonics* (Saunders College, 1992); Buckman's book, however, is much less complete in its treatment of the modal properties of fibers.

For the most part, what Buck treats he treats well, but not all instructors will find the topic selection appropriate for their needs. The book is useful for an electrical engineering or physics curriculum in which there is a separate course on fibers that emphasizes fundamentals over applications and also a separate course on optoelectronics. It should also be useful as a supplementary text in introductory and advanced courses, because it provides more information on specialized topics and it contains clear and generally accurate explanations.

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Theoretical Nuclear and Subnuclear Physics

J. Dirk Walecka
Oxford U. P., New York, 1995.
610 pp. $65.00 hc
ISBN 0-19-507214-6

As a result of recent discoveries, the practicing nuclear physicist must be knowledgeable in many-body theory, scattering theory and relativistic field theory. Those, plus the standard model of electroweak interactions, quantum chromodynamics and effective chiral Lagrangians, are all relevant for today's nuclear physicists. The problem of learning all the different kinds of relevant physics quickly is especially pressing for graduate students in nuclear physics. As a university researcher in nuclear theory who is concerned with educating graduate students, I deal with this issue daily. So must the instructor charged with designing a graduate course in nuclear physics and choosing a book.

J. Dirk Walecka's new text, *Theoretical Nuclear and Subnuclear Physics*, fills a long-standing need for a graduate-level text in nuclear physics. It begins—at the beginning—with a brief but usable description of the nucleon–nucleon interaction and proceeds deftly through conventional many-body theory to arrive at the many-body relativistic theory, which Walecka and his colleagues have pioneered. Chiral symmetry, which controls pionic interactions with nucleons and provides a connection between QCD and hadronic Lagrangians, is described in detail. QCD and its path integral and lattice gauge techniques are prominent in the text, which ends with a detailed discussion of the standard model.

Walecka is well known for writing clear articles and presenting excellent talks. His strong pedagogic style shines through the entire book. The discussions are clear, precise and concise and stress basic principles rather than the latest calculations, which can become obsolete quickly in so rapidly moving a field. The text is not a historical treatment of the field, and some central discoveries are mentioned only in passing. However, adequate references to relevant reviews are presented. There are few misprints or misleading statements. The figures, though not sophisticated, mainly are very good.

This book has some very useful pedagogical features: Many calculations are presented in far greater detail than in the original literature. Furthermore, Walecka has provided an excellent set of problems summarizing many useful results. These are clearly intended to provide students with the techniques necessary to perform useful research.

The interactions of leptons with nuclei at high momentum transfer, including the influence of the weak neutral current, are expected to play a key role in providing data to unravel the mysteries of the nucleus. The use of such tools, provided by the Continuous Beam Electron Accelerator Facility in Newport News, Virginia (where Walecka is a senior fellow), is a central aspect of this book.

The treatment of CEBAF physics is exhaustive. In a book of finite size, this means that other important topics of current nuclear research, such as the physics of the quark–gluon plasma, nuclear astrophysics and new aspects of nuclear structure, are not covered. However, the book does provide the necessary background in many-body theory and lattice QCD.

Much of nuclear reaction theory is covered only in the problem sets; the recent technique of using effective Lagrangians, such as embodied in chiral perturbation theory, is absent. These are the only significant lacunae. Other books on nuclear physics theory might be better for certain specific topics, but this book stands alone for its utility in graduate courses. I would certainly choose it if I were teaching a course in theoretical nuclear physics.

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Understanding Nonlinear Dynamics

Daniel Kaplan and Leon Glass
Springer-Verlag, New York, 1995.
419 pp. $29.95 pb
ISBN 0-387-94440-0

The authors of *Understanding Nonlinear Dynamics*, both professors in the department of physiology at McGill University, have written a readily accessible introduction to nonlinear dynamics based on a one-semester undergraduate course at McGill. Since the audience consists of students studying biological sciences who have completed only a year of calculus, the book presents the main concepts and applications of nonlinear dynamics at an elementary level.

It begins with a consideration of simple finite-difference equations to initiate the reader into three important mathematical themes: local stability analysis, global multistability and problem solving using both an algebraic and a geometric approach. At this point the reader is also introduced to chaos and quasiperiodicity. The next two chapters continue the study of discrete time systems, beginning with networks and cellular automata and continuing with self-similarity and fractals, including the notion of fractal dimension.

Continuous time systems are the focus of much of the second half of the book, beginning with separate chapters on one-dimensional and two-dimensional differential equations, the latter being particularly relevant to the study of compartmental models, used in fields as diverse as pharmacokinetics and ecological systems; included is a discussion of the use of the phase plane to analyze local stability, and the occurrence of limit cycles. Finally, in chapter 6, on time-series analysis, the authors discuss classical and modern methods of data analysis, the latter derived from nonlinear dynamics, to serve as a bridge between theory and applications.

Interspersed in the text are delightful short essays of a page or two each, ranging widely from the random drift of molecules to the patterns underlying global climate changes. These are intended to illustrate the practical applications of the theoretical concepts presented.

Courses on nonlinear dynamics rarely present these topics at the level used in the book. On the other hand, the topics discussed are increasingly affecting much of the physical and biological sciences. Thus, as the authors suggest, their book might profitably be used as a supplement for a wide variety of undergraduate courses in mathematics and the sciences. It is written in a "user-friendly" colloquial style and is a delight to read. While it would be particularly useful for a student in the biological sciences, no reader is likely to encounter a more accessible elementary introduction to nonlinear dynamics.

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