books. Also, legal decisions are often decided by arguments based on a fine-tuned interpretation of the law rather than on scientific merit or common sense. In several cases, for both Townes and Gould, clever and dogged legal representation backed by huge financial resources won the day.

Townes also discusses his role in shaping US science and defense policies. In his account of his interactions as an adviser for the military and for NASA, as a founding member of Jason (a group of academic scientists who meet to consider defense and related technical issues), and as vice president and director of research for the Institute for Defense Analyses, we become privy to formerly classified debates in which Townes and other advisers wrestled with science-policy questions and engineering choices.

How the Laser Happened is more than a chronicle of a stellar career; it is full of glimpses into the forces that guided Townes. The memoir may not satisfy all of those who contributed to the development of the laser, but then it is unlikely that any account, no matter how even-handed, could satisfy everyone. Readers should relax and savor the frequent moments of reflection, where Townes reveals his personal insights. "I am not at all sure," Townes writes, "that the public has a clear idea of how scientists get started and how they work." For young scientists at the beginning of their careers, this book will provide an inspiring case history of how an outstanding physicist got started and went on to do great science.

Advanced LabVIEW® Labs

John Essick
Prentice-Hall (Simon & Schuster), Upper Saddle River, N.J., 1999. 397 pp. $28.00 pb
ISBN 0-13-833949-X

In the world of computer-based data acquisition and control, the graphical interface program LabVIEW, from National Instruments Corp, is so ubiquitous that in many ways it has become the laboratory standard. To date there have been approximately 15 books introducing LabVIEW to the reader. John Essick's *Advanced LabVIEW Labs*, however, takes a completely different approach from all of the previous treatments.

In the more standard treatments of LabVIEW, such as *LabVIEW Graphical Programming: Practical Applications in Instrumentation and Control* by Gary W. Johnson (McGraw-Hill, 1997), the emphasis has been on programming LabVIEW to create a virtual instrument (VI) on the computer for interfacing to a laboratory instrument.

These previous LabVIEW discussions have been concerned mainly with teaching the researcher to use G, the graphical programming language developed by National Instruments and used in LabVIEW. Without going into details here, G incorporates the usual loops, arithmetic expressions, and the like that are found in many programming languages, but in an iconic or graphical environment. The net result is that LabVIEW contains all of the standard methods needed for interfacing to instruments, data acquisition, data analysis, graphics, and the methodology needed to incorporate into LabVIEW programs written in other languages.

Before he became involved with LabVIEW, Essick had developed a series of experiments for an upper-division laboratory course on computer-based instrumentation. His observation was that, while many students had the necessary background in computer programming languages, other students had virtually no idea what was involved in writing a computer program, let alone a computer-based interfacing program. Thus the aim of his book was not only to be a tool to help teach computer-based instrumentation techniques, but also to be a way for the beginner to experience the writing of a computer program. Essick sees LabVIEW as the "perfect environment in which to teach computer-based research skills." With this as his goal, he has succeeded admirably!

Each of the twelve chapters in the book is a laboratory assignment suitable for a ten-week course. The first topic introduces the "while-loop" and waveform chart VIs. After learning how to launch LabVIEW, the student is introduced to such LabVIEW functions as sine, cosine, and the like. The beauty of this and subsequent chapters is that the student is introduced immediately to computer-based instruction and the usefulness of having the results displayed in graph form on the screen. At each point along the way, the student is introduced to another LabVIEW operation or function as well as such subjects as spreadsheets for data storage, numerical integration, Fourier transformations, and curve-fitting algorithms. The last few chapters deal with computer-based instrumentation—the overall purpose of the learning module. Computer-based laboratory projects such as converting analog to digital and digitizing oscilloscopes are also treated in detail. *Advanced LabVIEW Labs* finishes with a discussion of GPIB (general purpose interface bus) interfacing, and the student is then asked to create an operating VI for temperature control.

This is an excellent text. It is both a treatise on LabVIEW and an introduction to computer programming logic. Any programmer who is trying to learn how to interface computers to instruments and to understand top-down programming and other programming language concepts should read this book.

Eric D. Jones
Sandia National Laboratories
Albuquerque, New Mexico

Basic Ideas and Concepts in Nuclear Physics: An Introductory Approach

Kris Heyde
IOP, Philadelphia, 1999. 524 pp. $156.00 hc ($57.00 pb) ISBN 0-7503-0534-7 hc (0-7503-0535-5 pb)

The second edition of Kris Heyde's 1994 textbook on nuclear physics is a worthy successor and a welcome addition to a field with a shortage of undergraduate/graduate textbooks. As did the original, the new edition, presents essentially all the basics of the subject in a thorough, readable manner, with an emphasis (roughly 60% of the book) on the topic of nuclear structure, the author's forte. The mere 22 pages dedicated to nuclear reactions in the current version, however, does not provide a complete survey of this topic. Thus, the book remains limited compared to such all-inclusive nuclear physics textbooks as *Introductory Nuclear Physics* by Kenneth S. Krane (Wiley, 1988) and *Introductory Nuclear Physics* by Samuel S. M. Wong (Prentice Hall, 2nd edition, 1999).

Most of the revised and new material in the second edition deals with recent developments in nuclear structure theory. This includes, for example, a new chapter on nuclei far from stability, as well as additions to existing chapters regarding the shell model Monte Carlo method, new extensions to the interacting boson model, and superdeformed and identical bands. The most significant addition is the introduction of three sets of homework problems following the first three major sections on nuclear constituents and characteristics, nuclear interactions, and nuclear forces, respectively. The fairly high level of these problems, however, may prove difficult for the average undergraduate. Krane's textbook, for example, contains problems of more varied levels of difficulty.

One of my favorite features in both Heyde editions is what the author calls "boxes," short sidebars that expand upon particular subjects in the text or connect the material in a given chapter with recent related advances. The lively and timely information highlighted in the boxes conveys to the reader excitement at what is currently happening in nuclear physics.

Heyde, a highly respected nuclear structure theorist with a worldwide reputation, has written several textbooks, all of which present the relevant course material in a straightforward style. The present book is no exception and will make a suitable text for a one-semester nuclear physics course at the advanced undergraduate or graduate level. It will need to be supplemented, however, with another textbook or additional material to cover nuclear reactions—both theory and experiment—in more detail. I liked the first edition and used it as a supplemental textbook in my graduate course on nuclear physics. I am currently utilizing the second edition in a similar manner.

Bruce R. Barrett
University of Arizona
Tucson, Arizona

Understanding Quantum Mechanics

Roland Omnès
Princeton U. P., Princeton, N.J., 1999. 307 pp. $35.00 hc ISBN 0-691-00435-8

Quantum Philosophy: Understanding and Interpreting Contemporary Science

Roland Omnès
Translated by Arturo Sangalli
Princeton U. P., Princeton, N.J., 1999. 296 pp. $29.95 hc ISBN 0-691-02787-0

Roland Omnès, professor of physics at the University of Paris, is the author of *The Interpretation of Quantum Mechanics* (Princeton U. P., 1994), which is the basic treatise on decoherence and the consistent histories formulation of quantum theory. His new books, *Quantum Philosophy* and *Understanding Quantum Mechanics*, provide substantial modernization and simplification of this earlier work. I believe they will prove to be indispensable adjuncts to standard quantum mechanics and philosophy of science courses. This review focuses on the physical interpretation of quantum theory, which is the common thread underlying both works; it deals with Omnes's exhaustive analysis of related philosophical questions only by implication.

The nature of the problems addressed by Omnès is embodied in the following three questions:
(1) Is there a universal logical language that permits a description of "all" physics?
(2) Are the laws of classical physics a consequence of fundamental quantum theory?
(3) Is the linearity of quantum amplitude superposition compatible with the noninterference and probabilistic uniqueness of macroscopic phenomena?

The consistent histories picture, invented by Robert Griffiths and further developed by James Hartle and Murray Gell-Mann, goes a long way toward providing a satisfactory resolution of the problems implicit in the above questions.

Before indicating how this comes about, let me first comment on Omnès's intent in writing these books. He states that they are "addressed to beginners with some elementary knowledge of quantum mechanics." While such readers will undoubtedly find helpful the first two parts of *Understanding Quantum Mechanics*, difficulties may well be encountered in part III, where proofs of important results are sketchy and sometimes omitted completely. (Note that the discussion of physical problems in *Quantum Philosophy* relies heavily on the fuller mathematical treatment in *Understanding Quantum Mechanics*.)

Let me now try to convey the essence of the new messages in Omnès's works. A history is a temporal sequence of propositions and associated projection operators in the Hilbert space of the closed system under consideration. Histories are to be regarded as elements of a sample space to which probabilities are assigned according to a well-defined rule. Not all families of histories are admissible if the Kolmogorov probability axioms are to be satisfied. Complete families that satisfy these axioms are referred to as consistent. The basic reason for inconsistency is the incompatibility of linear superposition of amplitudes with the required additivity of probabilities for mutually exclusive events.

Griffiths and Omnès obtained necessary and sufficient conditions for consistency, which are algebraically quite complicated. An important advance made by Omnès is his recognition that these algebraic considerations may frequently be replaced by much quicker arguments stemming from decoherence and the demonstrable classical behavior of macroscopic devices.

Omnès makes the further notable observation that, with appropriate definitions of the logical connectives and inference, reasoning may be carried out within a unique consistent family according to the familiar rules of Boolean logic. But it must be emphasized that there exist many families of histories that are internally consistent but that cannot be combined into larger consistent families. This is the formal manifestation of complementarity in the present picture, and several physically interesting examples are analyzed by Omnès. The existence of complementary families of histories motivates the adoption of Omnès's universal rule of interpretation: Valid reasoning may only be carried out within a unique consistent family. The choice of such a universe of discourse depends on the experiment one wishes to analyze or, indeed, on whatever one may wish to discuss, real or fanciful—after all, we are constructing a language. Failure to observe this rule lies at the heart of most misunderstandings of the consistent histories picture.

The universality of the language is still in question: I have been speaking entirely in quantum mechanical terms and have not yet considered how classical physics gets into the act. Omnès demonstrates that we can assign quantum projectors to sufficiently large and regular cells in phase space, thus enabling an up and back translation of classical and quantum propositions for macroscopic systems. More spectacular still is his proof of the equivalence of classical dynamics for closed macroscopic systems with the quantum dynamics generated by the time evolution operator. This proof is based on the replacement of the quantum Hamiltonian by its Weyl symbol and the powerful Egorov theorem of microlocal analysis. Thus, Bohr's correspondence principle, relating classical and quantum physics, becomes a theorem, and it is not necessary to live simultaneously in two worlds with no clear line of demarcation and logical connection between them. We are well on the road to the creation of a universal logical language.

But we have not yet attained our goal, since macroscopic systems are rarely isolated from their environment, with which they are inextrica-