Although this volume is the third in a trilogy, it is quite different from its two predecessors, and it stands on its own. It seems much closer than the others to being a true textbook and could work well with any of several excellent quantum field theory texts as its front end. May a new generation of students imbibe its content and spirit, and may it become the user's manual for the Large Hadron Collider!

Cosmological Physics

John A. Peacock
Cambridge U. P., New York, 1999. 682 pp. $85.00 hc ($39.95 pb) ISBN 0-521-41072-X hc (0-521-42270-1 pb)

Even under the best of circumstances, writing a text on modern cosmology is not easy. In the first place, the field is developing at a lightning pace; new observations have daily been revolutionizing our picture of the large-scale structure of the universe. Next, there is the question of what to include and what not to. A proper appreciation of this field requires input from particle physics, astrophysics, and general relativity, at the very least. One must therefore choose whether to assume some knowledge of each of these fields, or whether to provide a pretense of an introduction to each of them. Otherwise, one must provide three textbooks in one, and this has, to date, been largely beyond anyone's ambitions.

John Peacock however, has taken up this latter challenge, and he has very largely succeeded. His *Cosmological Physics* is a remarkable book, both for its scope and for its depth of understanding. I was frankly amazed to see subjects as diverse as observational constraints on the two-point galaxy–galaxy correlation function and a discussion of the beta function in non-abelian gauge theories, all treated with authority and precision. For this reason alone, this book is sure to find a place in the libraries of both graduate students and long-standing researchers in cosmology.

It is probably best to review this book by discussing the problems it doesn't have, many of which can be found in other texts.

First, it is not merely bibliographic. Some books, in an attempt to cover all the necessary material, read more like a good table of contents for a text. On the other hand, it is not intimidating, so one need not scan myriad pages to learn about a single topic. Peacock tends to get to the heart of the matter and develops just enough mathematical background to help one get a handle on new developments.

Next, it is clear, at least from my random checks, that Peacock does not discuss topics that he doesn't really understand. Nor does he merely regurgitate the equations of classic papers on various subjects. While his background is as an astrophysicist and not a particle physicist, one nevertheless gets the sense that each topic he chose to cover is one that he has studied in enough detail to get it right.

Finally, the book is not generally out of date. Because the field is changing so quickly, many well-known texts, such as Edward Kolb and Michael Turner's *The Early Universe* (Addison-Wesley, 1993), are good places to find an introduction to the field—but not the most current findings or the latest results.

This is not to say that the book is completely up to date. Several areas in which I found Peacock's treatment was somewhat behind, for example, include age determinations of globular clusters and big-bang nucleosynthesis constraints on light-element abundances, two areas in which, admittedly, I have worked and so am more familiar with the literature.

Gaps aside, Peacock's presentation is logical and coherent. He begins the book with a short but comprehensive primer on general relativity, both in the abstract and as it is applied in astrophysics. Peacock then proceeds to classic tests of cosmology, from the determination of the isotropy of the universe to gravitational lensing to the classic age and distance tests. Changing directions, he then reviews the basics of quantum field theory in a 100-page introduction that is quite comprehensive—perhaps too comprehensive for some.

Having established the necessary tools, Peacock then proceeds to explore the physics of the early universe, from the standard physics of the hot big bang model to the more exotic physics associated with both topological defects and the zoo of inflationary model building. Once again, even in these exotic areas one feels the book has been shaped by a firm hand in command of the basic principles as well as many of the details.

The latter part of the book is devoted to the empirical meat of cosmology, including observations of galaxy dynamics, the inference of dark matter, active galactic nuclei, and galaxy formation and evolution. The book ends, correctly I believe, with a discussion of cosmic microwave background fluctuations. This area will, over the next decade, carry cosmology fully into the twenty-first century and promises to constrain empirically many of the fundamental parameters of our expanding universe that have to date remained beyond the reach of observers (if not theorists).

One of the successes of this book also presents a problem for the reader or teacher. It is clear that no single graduate course can cover with any fairness all of the topics discussed. Some topics probably require a separate textbook. I have spoken to one or two colleagues who have tried to teach out of this book, and they all indicate that there is simply too much material.

Nevertheless, this book is sufficiently comprehensive so that readers wishing to brush up on a modern topic in cosmology are likely to find their basic questions addressed, a reasonable perspective on modern developments, and sufficient background so that they can move on to more detailed references. This is not faint praise. The fact that Peacock has succeeded in this regard means that this will remain a valuable reference source for some time to come, and one which both active researchers and students will want to keep handy.

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Quantum Generations: A History of Physics in the Twentieth Century

Helge Kragh
Princeton U.P., Princeton, N.J., 1999. 480 pp. $29.95 hc ISBN 0-691-01206-7

Helge Kragh is an excellent historian of modern physics who has several books and many fine articles to his credit. Thus, he was a logical person for *Princeton University Press* to ask to write a book summarizing the development of physics during the past century. However, he confesses in his preface to *Quantum Generations*, "I should have known that it is simply not possible to write a balanced and reasonably comprehensive one-volume account of twentieth century physics." He thus offers as a substitute "a fairly brief and much condensed and selective account."

Quantum Generations contains three sections, of about equal length, dealing respectively with the well-chosen periods 1890–1918, 1918–1945, and 1945–1995, followed by ten-page chapters with such titles as "Nobel Physics" and "A Century of Physics in Retrospection." There are charts and tables but no equations and no photographs. About a fourth of the contents concerns the sociology and politics of physics—such topics as "personnel and resources," "physics in industry and war," "physics and the new dictatorships," and, concerning more recent times, "science under attack."

Many subjects of historical importance are of necessity merely mentioned or treated very briefly. Henry Mosely's work leading to atomic number and the Franck–Hertz experiment showing discrete atomic energy levels are together mentioned in a single paragraph, while Stern–Gerlach space quantization seems to have been omitted altogether. Experiments are not described in any detail. Theoretical comparisons are fair, though too brief, and fail to make clear why, for example, Henri Poincaré's was "a relativity theory indeed, but not the theory of relativity," or why John Nicholson's 1911 atomic theory, with its quantized atomic angular momentum, "was not really a quantum theory of the atom."

While some subjects are hard to take in from the sheer density of discoveries, discoverers, and their dates, others are discussed in a more readable, discursive fashion. Not surprisingly, these usually turn out to be the subjects in which Kragh himself has done original historical research and published. Among the more interesting discussions, I found those on the Thomson atom, low temperature physics (in Leiden), the electromagnetic world view ("A Revolution that Failed"), telegraphy, "Eddington's Dream and Other Heterodoxies," and physics in the Weimar Republic to be particularly engrossing. On the last topic, Kragh says Paul Forman has argued that the Weimar Zeitgeist "craved for a crisis in the existing semimechanical atomic theory" and encouraged acausal quantum mechanics. Kragh concludes, however, that "adaptation to the Weimar Zeitgeist was of no particular importance." (I say: Amen!)

There are a few historical points on which I differ with Kragh. He credits Robert Marshak with producing (with Hans Bethe) a "proper two-meson theory" in 1947 and mentions a "proposal somewhat similar" made independently by Shoichi Sakata and Takesi Inoue. In fact, while Bethe and Marshak proposed that the high-altitude, strongly interacting mesons were fermions (interacting in pairs) and the daughter sea-level "cosmic ray meson" was a boson, the Japanese theorists (correctly) made the opposite assignments—and five years earlier. In discussing quark "color," Kragh mentions Oscar Greenberg and Yoichiro Nambu as independently proposing an additional quantum number for quarks. Actually, what Greenberg proposed is called parastatistics; Nambu did propose a new quantum number in 1966, which he called "charm" (the word was later used differently). Much more important: Nambu made quarks the sources of an SU(3) octet of massless gauge gluons as the carriers of force between quarks, an idea adopted by Murray Gell-Mann and collaborators only in 1972 and named by them "quantum chromodynamics."

An unusual feature of Kragh's book is that there are no references to original scientific papers. Even on the occasions where quotations are used, the reference is always to a secondary source. This is true even where a physicist's collected papers or letters have been published; one must trace down the original through the secondary source. One fortunate consequence of this is that Kragh provides a rich bibliography of secondary sources at the back of the book. There is also an appendix for each of the chapters that gives advice on further reading.

The book can function, therefore, as an excellent guide to the historical literature on almost any subject in the history of twentieth-century physics. It will be enjoyed in smaller doses by many readers of PHYSICS TODAY and can be a useful primary or supplementary text in in history courses for physics students. The book does not contain enough explanation of the physics itself to provide people outside of physics with much enlightenment, except on the sociology of science.

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Introduction to Superconducting Circuits

Alan M. Kadin
Wiley, New York, 1999. 382 pp.
$89.95 hc ISBN 0-471-31432-3

As its title indicates, Alan Kadin's *Introduction to Superconducting Circuits* is not a book on the physics of superconductors or even on superconducting devices, but on circuits. So, why a review in PHYSICS TODAY?

I believe a case can be made that physics undergraduates, who learn a lot about the physics of superconductivity, should be offered an opportunity to learn something about the circuit applications of superconductors. The latter are becoming increasingly important, but their coverage in physics-oriented texts is minimal. Normally, this might be considered an electrical engineering subject. Indeed, Kadin's book was written as a textbook for students with an EE background. But it is unlikely that the EE departments at most universities will offer courses on superconductive circuits. Hence, if the physics faculties want to see such a course offered, they might have to do it themselves. Ergo, this review.

Considering the scarcity of alternatives, Kadin's book would be a viable choice as a text for such a course, even under the auspices of a physics department, especially if supplemented with some material from a standard solid-state physics textbook. The minimal level of quantum mechanics employed in Kadin's book matches the background of the majority of engineering students, but most physics undergraduates will already know far more quantum mechanics than this, and some of them (and many instructors) will bemoan the fact that this knowledge is not drawn upon. While there is something to be said for showing just how elementary the subject can be made, physics instructors should have no problem supplementing Kadin's treatment. One obvious choice as a source of still relatively elementary supplementary material would be Charles Kittel's *Introduction to Solid-State Physics* (Wiley, 1996 and earlier editions), but there are others.

As an alternative to Kadin, some instructors might prefer the more advanced text by Theodore van Duzer and Charles W. Turner, *Principles of Superconductive Devices and Circuits* (Prentice Hall, 1999). But I believe that, for a physics undergraduate course, Kadin's text, supplemented with some physics-based material, would be more suitable.

Apart from a long-winded chapter 1, called *Preview*, which goes into far more detail than a reader not already familiar with the material would find useful, Kadin's book is well organized, with a good selection of topics presented in the right order.

The necessary quantum concepts are introduced purely descriptively: energy gap, Cooper pairs, quasiparticle excitations, density-of-states distribution, tunneling, and coherence