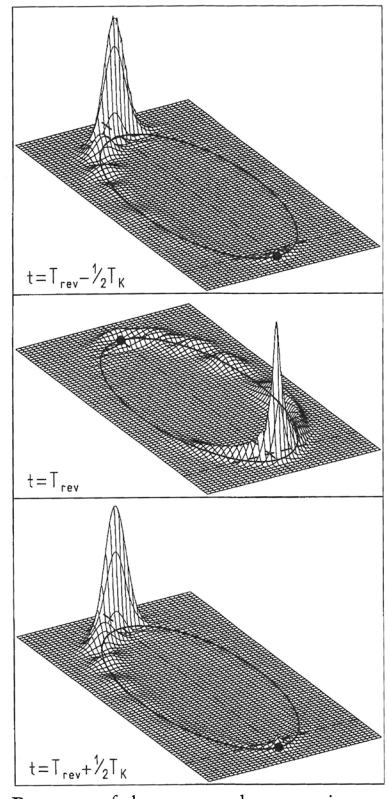
we find the greatest strengths of the book. Examples of the first category are some of the pictures of wave functions and probabilities for stationary states in simple wells; examples of the second include representations of wave packets evolving in time (see figure) and of coherent and squeezed states, which have only begun to find their way into textbooks. Students surely will build strong intuitive senses of what these entities are when they study the pictures here.

The book is unusual not only in its graphics but also in its emphasis on simple, paradigmatic examples and general concepts. The authors relegate most of the connections to laboratory observations to a final chapter. One valuable illustration of how this style can illuminate subtle concepts is the discussion of the evaluations of variances and uncertainties and, in this context particularly, the comparison of quantum and classical treatments of the hydrogen atom and Kepler orbits. Another is the comparison, in the context of nuclear magnetic resonance, of the motion of the centroid of the spin vector as frequency is changed, as magnetic field is changed and as the representation is transformed to a moving frame. Here the graphics clarify the ideas elegantly. This is true too of the discussion of spin echoes and their application to the determination of spin relaxation times; I wish that this discussion had been included in chapter 15 on magnetic resonance rather than chapter 16, the potpourri of experimental physics. But the important thing is that it is there.

What bothers me about this book? Foremost is its deliberate avoidance of derivations of the solutions to solvable problems, such as the Schrödinger equations for the harmonic oscillator and the rigid rotor. I miss discussions of such points as the basis for integral—or half-integral or any—quantization of angular momentum. In the same manner, the authors provide no discussion of the separability of partial differential equations and its intimate connection with physics or of the special character of the only Gaussian form for wave packets. And why do they invariably choose only Gaussian packets for their examples? Such examples leave me feeling that the authors have omitted from the text the kinds of insights that they have so deliberately sought to provide in the illustrations.

Finally, there is a wistful sense of a lost opportunity. The richness of the book is its computer-generated graphics. How much more exciting it would have been if the authors had included a CD-ROM or floppy disk of programs and problems to engage the student actively in generating new images! Let us hope that they will consider producing a supplement to the book to do just that, and to include it in a third edition.



REVIVAL of the wave packet over time. From *The Picture Book of Quantum Mechanics.*

R. STEPHEN BERRY
University of Chicago
Chicago, Illinois

A Short History of the Universe

Joseph Silk
Freeman, New York, 1994.
245 pp. $32.95 hc
ISBN 0-7167-5048-1

When confronted with a new "cosmic history" of the universe, one's first reaction might be to ask, Why? Following the release of Steven Weinberg's ground breaking *The First Three Minutes* (Basic Books, 1977) and Stephen Hawking's colossal bestseller *A Brief History of Time* (Bantam) a decade later, a plethora of popular books on cosmology has hit the market.

Nevertheless Joseph Silk's *A Short History of the Universe*, part of the Scientific American Library of popular science books, does manage to provide a succinct and fresh perspective on

modern cosmology that both the nonprofessional and the practicing physicist might find worthwhile to read.

Silk, an internationally recognized and very active theoretical astrophysicist, stresses in this volume the astronomical basis of cosmology. Many of the current crop of cosmic histories stress instead the first microsecond of the big bang, an epoch in which the exciting world of elementary particle physics plays a major role and where discoveries in microphysics affect our understanding of macrophysics. While there is a great deal of excitement in this emerging field of "particle astrophysics," and Silk himself has played a role in recent developments in this area, the fundamental astronomical basis of observational cosmology often receives too short a shrift. At the other end of the scale there is a crop of what I term *People* magazine versions of modern cosmology: those that focus on personalities, often at the expense of the science.

Silk navigates with a firm hand between these extremes, covering in generally readable prose everything from the nature of the big bang to the origins of cosmic structure. Particularly appreciated are the observational details that form the underpinning of modern cosmology.

Too much theory and not enough data have been a common complaint about cosmology in the past 50 years. However, in *A Short History of the Universe* Silk offers details of standard candles and the cosmic distance scale, stellar evolution, interstellar and intergalactic matter, velocity flows and cosmic microwave background radiation measurements—the grist of the modern cosmologist's mill. These are treated in this thin volume in sufficient detail to give the nonexpert an understanding of why the standard model of cosmology has developed and, what is perhaps more important, which of its features are less well established.

This strength of Silk's volume is also, however, related to one of its weaknesses: Any treatment of something as vast as the history of the whole universe is a daunting task and is inevitably colored by the pedigree of the author. While Silk is a charter member of the emerging cadre of particle astrophysicists, his background is astronomy. When the discussions turn to aspects of particle theory and the early universe, they are often cursory and sometimes slightly misleading. For example, while there is an excellent discussion of the nature of quantum fluctuations and the Casimir effect early in the book, the origin of primordial density fluctuations during the inflationary epoch is attributed to quantum fluctuations in the gravitational field rather than quantum fluctuations in matter fields. Similarly, Silk argues that the W and Z bosons unite the weak and electromagnetic interactions as the photon unifies electricity and magnetism. The analogy is not correct.

The editing of the book is also somewhat uneven. There are sections where mathematical equations are used, while in other places they are strictly avoided. There is also some repetition throughout the text, and one gets the feeling that various chapters were moved around late in the editing process, as certain detailed discussions are presented early on and introduced later. There are also some minor mistakes as, for example, when Silk suggests that the number of atoms in the observable universe (10^{78}) is the largest meaningful number in the observable Universe. In fact there are roughly 10^{88} photons in observable cosmic microwave background today.

These are small quibbles however, and it is a tribute to Silk's skill as a writer and scientist that in this short volume he is able to give a largely accurate and also reasonably comprehensive introduction to modern cosmology. With an abundance of wonderful figures and photographs—one of the strengths of the Scientific American series—this is an informative and useful addition to the current literature and one that many physicists as well as nonphysicists might find worthwhile.

Lawrence Krauss
Case Western Reserve University
Cleveland, Ohio

At the Fringes of Science

Michael W. Friedlander
Westview P., Boulder, Colo., 1995.
196 pp. $24.95 hc
ISBN 0-8133-2200-6

At the Fringes of Science is a smorgasbord of a book. I came away happy to have seen so much good stuff laid out, wondering about the dishes that weren't present, uncertain about the underlying theme of the cuisine yet glad I came.

The book starts with some familiar examples—Immanuel Velikovsky's *Worlds in Collision* (Macmillan, 1950), krebiozen, and the battery additive ADX-2 (which nearly destroyed the National Bureau of Standards). It then balances the scale with some genuine discoveries that were ahead of their time and therefore met resistance.

In between, Michael Friedlander gives us UFOs (phony), the fifth force