demic; it was the production of the first commercial atomic clocks. This was a time when he and many other physicists were discovering the dollar value of their special expertise, as Goldstein describes in a tantalizingly short chapter entitled "Entrepreneurship." In parallel with this, Zacharias's interests were turning to education. He was blunt in expressing his belief that this was too important to leave to professional educators. In 1956, acting on this conviction, he led the development of the famous Physical Science Study Committee physics course for high schools. He then went on to elementary science education in Africa and the US, and later even delved into social studies. (It was in connection with the African projects that Goldstein became closely associated with Zacharias.)

The mid-1960s found Zacharias, a vigorous 60-year-old, looking for fresh fields to conquer. He concerned himself with medical education, mathematics education for minorities, and the Vietnam War. He also found time to push through, against some strong opposition, a major reorganization of the core undergraduate programs at MIT. Not all of his projects were successful; but as Goldstein makes clear, everything he did was dominated by his conviction that education was the key to having an informed and thoughtful public and a successful democracy.

Reading this book, one realizes how much things can change within one human lifetime. Scientifically, politically and socially, the US has become a very different place since Jerrold Zacharias began his career in the middle of the Great Depression, and Goldstein's book provides many reminders of this fact. The author has produced a very well written and interesting story about a fascinating and provocative man, and he has done it with flair and a meticulous attention to detail and accuracy.

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A Tour of the Subatomic Zoo: A Guide to Particle Physics

Cindy Schwarz
AIP, New York, 1992. 112 pp.
$25 pb ISBN 0-88318-954-2

A Tour of the Subatomic Zoo is a brief textbook that introduces the concepts, terminology and techniques of elementary particle physics. There is certainly a need for such a book. Now more than ever, we high energy physicists must be able to explain our field to taxpayers, to politicians, to fellow scientists and perhaps most of all to students, who will become the next generation of taxpayers, politicians and fellow scientists.

Cindy Schwarz of Vassar College, New York, is clearly a good teacher. She has made a considerable effort to cover an enormous amount of material in a way that is easy to understand. She is especially to be commended for her ability to explain the most esoteric of concepts without mathematics. Each chapter is introduced with a section outlining the topics to be covered and concludes with a section reminding the students what they have just learned. (As the average chapter is only about seven pages long, this amounts to overkill.) In addition, each chapter contains a self-test with straightforward multiple-choice questions that students can use to measure their progress in assimilating the material. Answers to all of the problems are given.

In a short introduction, Nobel laureate Sheldon Glashow expresses his pleasure that this book "fills a vast gap in the literature that few of us physicists ever noticed." It is fortunate that the gap is neither that vast nor completely unnoticed, because this book is far too brief to justify such lofty praise. Not counting the introductions, summaries, and self-tests mentioned above, I count only about 60 pages of relatively large-type text—about the size of this copy of PHYSICS TODAY without the advertisements. This brevity means that the book has to skimp on several significant aspects of early and modern elementary particle physics. It reads like a worksheet or outline and fails to capture the excitement, beauty and occasional serendipity of the field. To paraphrase Dylan Thomas, one learns everything about particles, except why.

In the discussions of modern high energy physics, there seems to be an emphasis on a particular type of experimentation (interactions involving strange particles) at the expense of e^+e^-, electron–proton and hadron colliders, and other fixed-target experiments. As a result the book concentrates on exclusive reactions and balancing quantum numbers, with little or no mention of structure functions, jets, neutral currents, missing transverse energy, the Weinberg angle, the search for the top quark, the Higgs mechanism and many other concepts that are important in modern particle physics and that one should be able to explain to the intelligent layperson. The only example given of a calorimeter is that of a lead glass detector, which gets two pages, while drift chambers merit only a single sentence.

There are a number of minor typos and inaccuracies in the text. For example, the pion was discovered in nuclear emulsions, not in a cloud chamber, and we must all soon learn to spell Waxahachie correctly! There are no photographs, and the drawings, which are done by hand, are particularly rough and occasionally ambiguous or confusing. The glossary of useful terms and definitions is a good idea but with only 47 entries in 3 pages could be considerably expanded. The suggestions for further reading (3 books and 3 articles) are also woefully inadequate. There are many recent articles at the *Scientific American* level that, although challenging, could surely be considered for further reading.

Schwarz states in the preface that her goal was to keep things brief so as not to overwhelm or intimidate the reader. Unfortunately this leaves teachers who wish to use the book in a course no choice other than to assign further reading from books such as Frank Close, Michael Marten and Christine Sutton's *The Particle Explosion* (Oxford U. P., 1987) or James Trefil's *From Atoms to Quarks* (Scribner, New York, 1980). This raises the question: Why not then use either of these books (or several others) in the first place? I think that with Schwarz's gift for clear explanations of complex subjects, this book could serve as an outline for a more complete and satisfying revision.

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Doing Physics: How Physicists Take Hold of the World

Martin H. Krieger
Indiana U. P., Bloomington, 1992. 168 pp. $9.95 pb
ISBN 0-253-20701-0

Martin Krieger's general goal in this book is to imbed the practice of physics in a larger cultural background. He argues for his various analogies by focusing on specific examples from the history of physics, especially current physics. His basic theme is that the modes of description and styles of argument that physicists typically employ have obvious precedents in the "explanatory" stories (such as the Bible's Book of Genesis) and modes of expression that man-

kind has traditionally used throughout history. Krieger's analysis suggests that our modern scientific theories and representations of the physical world say at least as much about us and our culture as about any objective, independent existence the theories purport to reflect. Krieger claims that this similarity is not surprising because physical science is merely a subculture, not an autonomous enterprise in its own right. Thus, the author sees scientists sketching an overall picture about the world and then identifying certain "handles"—perhaps "variables" would be a more familiar label—that allow them to probe and manipulate this external reality. However, rather than taking such a structure as merely one possible way the world *might* be, scientists take the actual world to *be* the (successful) model.

This recognition of a conventional element in scientific theories is of course not new, having long ago been emphasized by Henri Poincaré and, perhaps less explicitly and more recently, having been incorporated into Albert Einstein's own description of theoretical physics. For Einstein, the way we parse physical reality (that is, the language we employ) is *our* choice, dictated by conceptual and practical convenience. We then use this vocabulary to formulate laws that hold among defined terms. It is these laws that issue empirical predictions about the real world. Ultimately, Einstein said, this entire theoretical structure stands or falls on the adequacy of these predictions.

The case this book makes is based on a model of science that is reductionist and that subscribes to the principle that whatever is not forbidden will necessarily happen. Science tells a story set on a "stage" concocted by standard analogies common to our culture, and it conceives of knowlege as the ability to handle or manipulate nature (as opposed to the "spectator" concept of knowedge that Krieger associates with philosophy). Thus, in describing the vacuum of modern theoretical physics as a stage (that is, a background) against which the story (that is, fluctuations) of the physical universe unfolds, "physicists in effect reenact Genesis and the creation." In Kreiger's mind the earlier traditions (here, Genesis and the creation) effectively *cause* the form of modern physical theories. They are part of the larger cultural tool kit available to all actors.

While many readers of PHYSICS TODAY may feel a chill come over them when such ideas are put afloat, the argument that sociological factors have an essential influence on the form and content of science is not new—nor is it quite so readily dismissed as some might wish. This is a topic about which emotions run high, and arguments typically leave people with precisely those convictions that they had brought in with them. Krieger's style and level of presentation make the issue accessible to a lay audience. However, as he himself intimates at the end of his text, his arguments are likely to strike practicing physicists as trite or obvious when true (by the standards of those scientists) and as unconvincing or patently false when they question the nature of the scientific enterprise. This may be more a judgment about the profession than about Krieger's arguments.

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Inverse Acoustic and Electromagnetic Scattering Theory. *Applied Mathematical Sciences 93.* D. Colton, R. Kress. Springer-Verlag, New York, 1992. 305 pp. $59.00 *hc* ISBN 0-387-55518-8. *Monograph*

Biophysics and Medical Physics

Acoustic Systems in Biology. N. H. Fletcher. Oxford U. P., New York, 1992. 333 pp. $65.00 *hc* ISBN 0-19-506940-4

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Chaos and Nonlinear Systems

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Chaos and Fractals: New Frontiers of Science. H.-O. Peiten, H. Jürgens, D. Saupe. Springer-Verlag, New York, 1992. 984 pp. $49.00 *hc* ISBN 0-387-97903-4

Chaos, Order, and Patterns. *NATO ASI Series B 280.* Proc. Conf., Lake Como, Italy, June 1990. R. Artuso, P. Cvitanović, G. Casati, eds. Plenum, New York, 1991. 280 pp. $95.00 *hc* ISBN 0-306-44080-6

Fractal Growth Phenomena. Second edition. T. Vicsek. World Scientific, River Edge, N. J., 1992. 461 pp. $68.00 *hc* ISBN 981-02-0668-2

Introduction to Chaos and Coherence. J. Frøyland. IOP, Bristol, UK (US dist., AIP, New York), 1992. 130 pp. $59.00 *hc* ISBN 0-7503-0194-5

Numerical Simulation of Unsteady Flows and Transition to Turbulence. O. Pironneau, W. Rodi, I. L. Ryhming, A. M. Savill, T. V. Truong, eds. Proc. Wksp., Lausanne, Switzerland, March 1990. Cambridge U. P., New York, 1992. 516 pp. $59.95 *hc* ISBN 0-521-41618-3

Proceedings of the 1st Experimental Chaos Conference. Proc. Conf., Arlington, Va., October 1991. S. Vohra, M. Spano, M. Shlesinger, L. Pecora, W. Ditto, eds. World Scientific, River Edge, N. J., 1992. 416 pp. $68.00 *hc* ISBN 981-02-0898-7

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Nonlinear Systems. *Cambridge Texts in Applied Mathematics.* P. G. Drazin. Cambridge U. P., New York, 1992. 317 pp. $74.95 *hc* ISBN 0-521-40489-4

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Chemical Physics

Advances in Photochemistry, Vol. 17. D. H. Volman, G. S. Hammond, D. C. Neckers. Wiley, New York, 1992. 365 pp. $95.00 *hc* ISBN 0-471-55884-2. *Compilation*