THE THINGS THAT DRAW ONE PHYSICIST TO HIS SCIENCE

And Yet It Moves: Strange Systems and Subtle Questions in Physics

Mark P. Silverman
Cambridge U. P., New York, 1993. 266 pp. $49.95 hc
ISBN 0-521-39173-3

Reviewed by Sidney Perkowitz

Some books are written to convey physics, as in a text or research monograph. Some tell us how a physicist is made and lives a life in science, as in a biography or personal essay. A few show how a questing mind circles a difficult physical problem, seeking the door that opens onto the solution. In *And Yet It Moves*, Mark Silverman, a physics professor at Trinity College in Hartford, Connecticut, does some of each. He draws from his wide interests as a theorist a highly personal list of questions in physics, questions that both engage his sense of wonder and require serious thinking if they are to be resolved, or even stated clearly. Along the way, we learn a good deal of physics and see again the motivations that create scientists.

Each essay in the book discusses a different set of physical questions, liberally intermingled with where and how the author was living and thinking when he contemplated them: To present the "unimaginably strange behavior" of free electrons, Silverman takes us to Japan, where he saw quantum interference effects in a Hitachi electron microscope. He describes fireworks, called in Japanese *hanabi* (fire flowers), whose bright emerging particles remind him of electrons shooting out in all directions; that image leads into his study of interference among multiple electrons. Another essay begins with his father-in-law, whom he identifies only as Fred, a master machinist who had once built a *Wirbelrohr*, a hollow, T-shaped tube with a marvelous property: When a stream of compressed air was sent into the stem, it emerged hot from one end of the cross bar and cold from the other. Silverman tests another *Wirbelrohr* that Fred constructed, finds that it indeed works, and he tracks this apparent Maxwell's demon in the most complete explanation of the effect I have ever seen.

Other essays present the unexpected mysteries of reflected polarized light, the effects of the Earth's rotation and gravity on elementary particles, atomic "pulsers" and more. Index entries range from "birefringence" to "Gödel, K." to "Zeeman effect," an indication of how much interesting ground this slim book covers. Each essay is backed up with citations to Silverman's publications, ranging from research papers in the likes of *Optics Communications* and *General Relativity and Gravitation*, to teaching-oriented pieces in the *American Journal of Physics*. At the end of the book he reminds us that we must teach science in new ways if we are to motivate new scientists.

I have only one caveat: Although the personal story is nicely accessible, as is much of the science, I do not accept the publisher's blurb that touts the book as being suitable for "anyone with a basic physics background." A book that refers to gauge invariance as early as page 16 will be hard going for many students. For some advanced undergraduates or graduate students, however, any essay in the book could be the core of a learning project that links different areas of physics, something not often achieved as we teach. For yourself, read the book and enjoy the intriguing mind of a colleague you might like to meet some day.

Sidney Perkowitz, Charles Howard Candler Professor of Physics at Emory University, writes about physics for popular and specialist audiences. He is at work on the book *Empire of Light* (Holt), on the physics and perception of light.

Introduction to Nuclear and Particle Physics

Ashok Das and Thomas Ferbel
Wiley, New York, 1994. 327 pp. $64.95 hc
ISBN 0-471-57132-6

A short, semiquantitative discussion of the basic concepts of nuclear and particle physics, two stimulating fields that have considerable overlap in subject matter and experimental methods, could be a useful addition to the literature for undergraduate courses. Particularly at this time, when the focus of much of nuclear physics lies outside its traditional interests in nuclear structure—when new accelerators are under construction that will permit nuclear physicists to explore the quark–gluon structure of the nucleon as well as the experimental signatures of a quark–gluon plasma—it would be interesting even to the mature physicist to have a readable treatment of ideas basic to the two areas. In addition, advances over the past two decades have been enormous. Physicists young and old want to understand the buzzwords they've heard in greater depth than the usual last-chapter-of-the-book level.

Introduction to Nuclear and Particle Physics has a number of virtues, but it does not fill the niche just described. Ashok Das and Thomas Ferbel, high-energy theorist and experimenter, respectively, have written a text for a one-semester, upper-division course that includes mostly standard topics in the two areas. For example, they discuss nuclear binding energies, the shell model, radioactivity and fission in some detail, in gen-

(Prentice Hall, 1991); in addition, *The Ideas of Particle Physics* by Guy D. Coughlan and James E. Dodd (Cambridge U. P., 1991) provides a thorough qualitative discussion of contemporary topics in particle physics. None is perfect for a one-semester course for seniors, but this text by Das and Ferbel would not be my first choice among them.

CHARLES GLASHAUSSER
Rutgers University
New Brunswick, New Jersey

Bénard Cells and Taylor Vortices

E. L. Koschmieder
Cambridge U. P., New York, 1993. 337 pp. $64.95 hc
ISBN 0-521-40204-2

Recently, there has been a remarkable revival of interest in fluid dynamics within the physics community. Interest is particularly strong in the formation of sometimes-intricate ordered and disordered patterns. Of course, it is always possible to find complicated patterns in complicated systems; the physicist's goal is to find interesting and complex behavior in systems that are simple enough to understand. Consequently, much of the work on pattern formation has centered on the two systems discussed in Lothar Koschmieder's volume: Rayleigh–Bénard convection, in which a layer of fluid is subjected to a vertical temperature gradient, and Taylor–Couette flow, in which a fluid fills the gap between two rotating cylinders. It has been the hope that insights gained in one system will illuminate problems in the other and increase our understanding of more general flows.

Koschmieder has been an important contributor to experimental research on both Taylor–Couette and Rayleigh–Bénard flows for many years. He entered the field long before the current interest arose within the physics community, and his perspectives are welcome. His book is a good review of these problems, giving us a thorough and accessible account of linear and nonlinear stability problems and of turbulent flows. The author consistently discusses what he feels are the open questions and controversial issues. He also provides historical insights not often found in current research papers. The book does succeed in many respects. It is not, however, immune to criticism. For one, Koschmieder clearly expresses a dislike for letters journals, leading him to overlook some important contributions. For example, the seminal paper on chaos in Taylor–Couette flow by Jerry P. Gollub and Harry L. Swinney in *Physical Review Letters* **35**, 927 (1975) is not mentioned. He also claims there has been no attempt to understand spiral turbulence since initial studies in the 1960s, but this neglects new results reported by John J. Hegseth and coauthors in *Physical Review Letters* **62**, 257 (1989).

Other omissions occur by deliberate choice: Koschmieder does not cover binary fluid convection, in spite of the many novel patterns found over the last several years in water–alcohol mixtures; he argues that it does not meet his criteria for verified results. However, there are instances in the study of this problem in which theory and experiment have converged and comparable experiments have been performed in several different laboratories; this work should be included in a second edition. Some omissions occur because the book includes results only through 1991. Thus Koschmieder does not cover recent work on spiral defect chaos, rotating convection or the phase dynamics of Taylor–Couette structures.

Bénard Cells and Taylor Vortices, in spite of its shortcomings, should be read and considered by those interested in pattern formation in fluids. Koschmieder's critical views of both experiment and theory, such as the use of model equations, are not widely held among workers in the field; thus they may challenge our thinking. However, for a balanced perspective, this book must be supplemented by those with other viewpoints, such as Tom Mullin's *The Nature of Chaos* (Oxford U. P., New York, 1993), and by the overview of pattern formation by Michael C. Cross and Pierre C. Hohenberg in *Reviews of Modern Physics* **65**, 851 (1993).

C. DAVID ANDERECK
Ohio State University
Columbus, Ohio

NEW BOOKS

Society and Government

Science Advice to the President. Second edition. W. T. Golden, ed. AAAS, Washington, D. C., 1993. 329 pp. $29.95 *pb* ISBN 0-87168-509-4

Science and Technology Advice to the President, Congress, and Judiciary. W. T. Golden, ed. AAAS, Washington, D. C., 1993. 529 pp. $29.95 *pb* ISBN 0-87168-510-8

Science Education Partnerships: Manual for Scientists and K-12 Teachers. A. Sussman, ed. U. California P.,