

own original and penetrating insights. They also bristle with high technical and mathematical detail. For all the clarity of the presentation, the material is no pushover. This is professional business, requiring a good background in quantum field theory and a willingness to pay close attention.

The chapter on unitary symmetry, though splendidly done, is perhaps the least special in the book. The subject has long since been assimilated by particle physicists, there being nicely compact accounts in many other places. This is somewhat the case also with the material on soft pions, though—in my opinion—Coleman's short discussion of how PCAC is to be interpreted beats much of the longer-winded competition. In the later chapters the material becomes more deeply complex and field-theoretical. Coleman's talents are sorely needed and he comes fully into his own. Those tutorials were expository breakthroughs for their time, and still today they provide the best compact and accessible treatments. Though not a textbook, *Aspects of Symmetry* must surely be an invaluable supplement and resource for any advanced course in particle physics. It is also a keepsake for those who have known and learned from Coleman. His writing is elegant, lean, utterly authoritative—and a bit sly and tricky. He is one of the great characters of physics. Through the printed page you can see him grin maliciously—the famous Coleman grin—just as he's about to spring a logical trap on you, to teach humility. This book is a classic.

Perfect Symmetry

Heinz R. Pagels

390 pp. Simon and Schuster, New York, 1985.

ISBN 0-671-46548-1. \$18.95

Few developments in science have been so thoroughly (or so hastily) celebrated in popular form as the wedding of quantum fields with astrophysics: relativistic early-universe cosmology. Steven Weinberg's pioneering effort of a decade ago, *The First Three Minutes*, has by now been embellished so many times, and by so many authors, that any new contribution to the genre had better offer something unique. Heinz Pagels's *Perfect Symmetry* meets this requirement, at least for the more astute segments of the popular audience.

The most commendable feature of this book is a solid introduction, occupying more than a third of the text, to the present state of the universe. Stellar formation, evolution and collapse, the peculiarities of compact objects,

galactic structure, the cosmic distance scale, large-scale inhomogeneity, and the Hubble expansion are all clearly elucidated.

Above all, Pagels conveys a keen sense of just how recent and how hard-won all of this knowledge is. In an experimental science, once an important question is clearly formulated it is usually soon answered. Astronomy is surely the oldest science, but it remains observational. Immanuel Kant suggested in 1755 that the so-called "spiral nebulae" might be galaxies like our own. But it was still possible for an astronomer as influential as Harlow Shapley to doubt it in 1922, and the dynamic origins of galactic spiral arms remain elusive to this day.

The middle section of the book treats the early universe, which requires an introduction to quantum fields. In this branch of theory, there is complete correspondence between symmetry principles, field equations, and the properties of field quanta. Any of the three may be assigned logical primacy. Pagels, like most particle theorists, clearly prefers symmetry.

From a metaphysical standpoint, this is an eminently defensible position, in the grand tradition of Emmy Noether and Eugene Wigner. Pedagogically, however, it may not be the wisest choice.

Few readers when first exposed to physical theory are likely to find much enlightenment in the sentence: "Gluons are therefore a consequence of symmetry." In practical terms, as long as most particle masses remain free parameters, it is more natural to assign a central role to the couplings and intrinsic properties of particles. This approach has more intuitive appeal to the uninitiated.

Partly for this reason, the latter portions of this book are more suitable for undergraduates in physics or astronomy, or for serious amateurs of science, than for the casual lay reader. The interconnections within the assortment of theories that has come to be known as the "Standard Model" are more clearly explained than in other works of this type. The treatment of inflationary cosmologies is another high point, but again demands some sophistication on the part of the reader.

The author's voice is occasionally uneven, suggesting that the text might have profited from one more round of editing. Though Pagels's prose is usually lucid and entertaining, in a few places it reverts to the mustiness of the lecture hall, and in others it takes wing in fancies such as "wild baby stars."

The final chapters give a brief but comprehensive tour of the speculative frontiers, both in cosmology and uni-

fied field theories. Here Pagels is nonjudgmental to a fault: He includes some notions that one suspects are not even taken seriously by their authors.

Any such treatment is bound to be dated before it sees print, and this one is no exception. It outlines early efforts toward Kaluza-Klein compactification of supergravity, but seems to have been completed just before the boldest step on that particular path, the "superstrings" of Michael Green and John Schwarz. As with quantum field theory, Pagels again is strongest on the genealogy and family ties among theories, which can be so hard for outsiders to penetrate.

Speculation on the origins of the universe is too fascinating to be fully subject to normal standards of scientific prudence. This book is a reasonably articulate statement of what theoretical physics had to say on that subject as of 1985.

ROBERT H. MARCH

University of Wisconsin at Madison

Nobel Dreams: Power, Deceit and the Ultimate Experiment

Gary Taubes

261 pp. Random House, New York, 1986. ISBN 0-394-54503-6. \$19.95

In 1928 Albert Einstein refused a request from Heinrich Meng and Stefan Zweig to support the nomination of Sigmund Freud for a Nobel Prize. Even after collaborating with Freud in writing the booklet *Why War?*, Einstein wrote in 1949: "[He]... had a sharp vision; he let himself be lulled by no illusion except for an often exaggerated faith in his own ideas." Sigmund Freud never won a Nobel Prize, but Carlo Rubbia did, and from reading *Nobel Dreams*, one concludes that Gary Taubes probably would apply Einstein's judgment of Freud to Rubbia.

This book purports to tell how Carlo Rubbia of CERN and Harvard and Simon van der Meer of CERN came to share the 1984 Nobel Prize in Physics for "decisive contributions to the large project, which led to the discovery of the field particles W and Z, communicators of the weak interaction." The subtitle of this book, *Power, Deceit and the Ultimate Experiment*, reveals the author's point of view. Accordingly, only about a third of the book is concerned with the building of the CERN pp collider and the UA1 experiment through which the W and Z particles were discovered. The first part is devoted largely to a summary of some previous experiments performed by Rubbia. Taubes notes that measurement of a constant pp total cross