both classical and quantum terms. The review of some of the classic measurements of photoelectron counting distributions forms a nice complement to the theoretical background.

The first section closes with a short survey of pulse propagation in nonlinear media. This includes resonant and nonresonant propagation and a brief mention of solitary pulses—too little to do justice to this growing subfield, but enough to provide the interested student with a launching pad.

The most successful part of the book, and the most interesting one from the point of view of applications, is the second. This is devoted to the development of the semiclassical and quantum mechanical models of the laser, including descriptions of noise, linewidth and fluctuations (chapter 7), to nonlinear propagation phenomena involving one-photon processes, coherent interactions and transient effects (chapter 8), and to a number of atom–field interaction processes that are more easily described in quantum mechanical terms, including resonance fluorescence, photon antibunching and superfluorescence (chapter 9).

Nonlinear optics in its traditional sense is taken up again in chapter 10, which contains a description of multiphoton absorption and emission, and in chapters 11 and 12 with discussions of the generation of harmonic, sum and difference frequencies; parametric amplification and oscillation; and stimulated Raman scattering. Optical bistability and phase conjugation are the subjects of the final two short chapters. An appendix with a compendium of quantum mechanical definitions and equations completes this impressive survey. The emphasis is mainly on the theoretical side, but the book contains in addition a number of useful illustrations of the main experimental facts.

In reviewing a volume of this size and scope it is appropriate to comment on the selection of topics and the unity of the presentation. I grant at the outset that the matter of selection is subjective to some extent: What may please one reader may displease another. I rank the selection of topics as outstanding and quite in line with the stated purpose of creating a useful teaching tool. In fact, many active researchers in modern optics also are likely to find this work a useful reference source. The treatment in the various chapters should also receive high marks, although some sections, understandably, are more successful and complete than others. (For example, I find the discussion of optical bistability and phase conjugation quite sketchy, in spite of the wealth of background material assembled in previous chapters, which could have been used to deepen the presentation of these subjects.)

Numerous references appear at the end of each chapter; some important landmark papers have been left out (for example, the well-known theory of the laser amplifier by F. Tito Arecchi and Rodolfo Bonifacio, which appeared in 1965 in the *Journal of Quantum Electronics*, is not mentioned), but this is unavoidable and even understandable. The book is singularly devoid of misprints and awkward sentences; the authors and the publishers should be commended for their efforts.

A course in modern optics based on this book should be designed as a yearlong sequence for American students with a traditional graduate background. A more advanced audience, however, may benefit also from exposure to selected topics from the second half of the book during a one-semester course, after an accelerated review of some introductory material. In either case this volume should be quite successful as a teaching tool and as a reference source for a number of years to come.

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Fearful Symmetry: The Search for Beauty in Modern Physics

Anthony Zee
Macmillan, New York, 1986. 322 pp. $25.00 hc
ISBN 0-02-633430-5

This is a really lovely book. It is the story of how the idea of symmetry has led physicists in the 20th century to an ever clearer understanding of nature. The book is very well written—a rare feat for a popular science book. Its special feature is the obvious excitement Anthony Zee feels and communicates to the reader about advances in elementary-particle physics. With enthusiasm and much hindsight, he pictures an essentially straight road (though acknowledging some turnoffs) leading from Albert Einstein to Emmy Noether to Chen Ning Yang and Robert Mills to Steven Weinberg and Abdus Salam. The road passes through such territory as Lorentz invariance, parity, group theory, the "eightfold way," gauge theory, the electroweak unification, GUTs and cosmology.

But instead of emphasis on the facts, the common denominator is the search for beauty and the increasingly sophisticated use of symmetry to limit theoretical possibilities. One comes away with the sense that one has wandered around a complicated and confusing country in the hands of a careful, knowledgeable guide who has deftly created, from amid all the jumble, a beautifully organized, conceptual and historical tour through the wilderness.

I doubt that a nonphysicist will follow most of the details, but the spirit and flavor will come through, and even a specialist will find the story interesting and will have his sense of wonder restored. So I recommend the book to everyone.

But like any good book, it tends to start one thinking. My thoughts here, however, are not to be taken as a criticism of the book itself, where the author's exuberance is a definite plus, but as a comment on a growing attitude of many theoretical physicists (including the author). So enthralled is he by the recent victory of the standard model, and the structure of SU(5) GUTs, that he clearly believes that the end of physics is probably not too far away. Even the failure of the proton to decay doesn't really faze him.

Success has seduced him to return to the old Platonic ideal that pure thought can lead to the "true" theory of the universe (which he believes consists of writing down the proper action function, and all else follows). To this end he misreads some of his quotes from Einstein, and consistently downplays the role of experiment and phenomenological analysis. To him the idea is to find the right representation of the right Lie group. Experiment can help, but group theory, as it is applied today, is the key to the Great Truth.

History, of course, teaches an entirely different story: Symmetry goes back way beyond Einstein. Johannes Kepler, an ideal example of its pitfalls, went to his grave believing that his beautiful idea connecting the planets to the five perfect geometric solids was his chief accomplishment, though he was unhappy over the details. Nevertheless his ellipses contain a hidden symmetry not fully understood to this day. (The energy degeneracy of the $1/r$ potential is related to the four-dimensional Euclidean group.) The lesson here is that symmetries you are absolutely sure of may later prove accidental, while "accidental" symmetries may have a deeper cause.

The belief that the experimental

success of a theory has led one closer to the master design of the universe is not merely a historical fallacy that goes back to Ptolemy and beyond, it is a dangerous philosophical and political fallacy. It is dangerous because of the herd instinct of humanity—physicists included. It leads to believing in a "right" approach to problems and to the deliberate blocking of funding (and worse) for "heretics." It encourages a self-righteous priesthood and a self-perpetuating establishment.

And so we come to the end of the 20th century with the same smug overconfidence that characterized the end of the 19th, and we are sure to receive the same comeuppance. Recently, in the journey from the macroscopic domain to the atomic scale, all hell broke loose. It is a much longer journey by far from the subnuclear scale to the Planck length. To assume that nothing new will happen along the way seems to me to be the height of arrogance. (I suspect that with the Hubble Space Telescope going up, after 10 years our present ideas about cosmology will seem hopelessly naive.) It is amazing, considering all the truly wondrous things we have learned about the world from careful experiments, how little we have learned about ourselves from our previous mistakes.

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A Life in Science

Nevill Mott
Taylor and Francis, Philadelphia, 1986. 198 pp. $30.00 hc ISBN 0-85066-333-4

Nevill Mott's *A Life in Science* is the sort of autobiography that provokes nostalgia in those who were reasonably close to his times and experiences, whose "earliest memories are of the Pennine hills, green slopes and stone walls . . . alone with my bicycle," and whose friends, whether a Christian at Cambridge or a Jew at Oxford, were often deeply religious, but strongly divided between religion by prayer and religion as a basis of ethics. Mott himself was born to a life in science, his parents having met as students of J. J. Thomson in the Cavendish Laboratory. Mott did not enjoy his "public" school, though it also produced his own successor in the Cavendish Professorship, Brian Pippard. Theoretical physics in England was concentrated in Cambridge University, and Mott soon made his mark there. At the age of 22 he paid "the penalty of working out one's own bright ideas, instead of doing the dull things [Ralph] Fowler suggests." He showed his results to Fowler. Paul A. M. Dirac was at Cambridge, and when "Fowler called him . . . Dirac said timidly that it was all nonsense." Then in Copenhagen under Niels Bohr, Mott "learned what physics was all about, how it was a social activity and how a teacher should be with students and how beautiful physics could be." He came back to Cambridge to make his first major discovery—why the scattering of alpha particles in helium was different from their scattering in any other gas. Even Ernest Rutherford, who had little use for theory, said, "If you think of anything else like this, come and tell me."

In 1933 Mott moved to Bristol and totally changed his approach to physics. He decided to show how physics could explain the specific properties of real materials: ionic crystals, metals and alloys, amorphous solids. He built up the embryonic solid-state theory group in Bristol to a position of world leadership. In course of time he moved to the Cavendish Professorship in Cambridge, mastership of his college, a knighthood and a Nobel Prize. He has been the champion in England of the view that as much good physics lies in the old unexplained problems (Why is nickel oxide an insulator? Why is glass transparent? Why are alloys strong?) as in the new frontiers. In retirement in his eighties he continues active research, but finds more time for social philosophy and religion.

I have only one regret about this autobiography. Mott is "a man of whom stories were told, whether true or not." I wish he had recorded more of them.

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Reminiscences About a Great Physicist: Paul Adrien Maurice Dirac

Edited by Behram N. Kursunoglu and Eugene P. Wigner
Cambridge U. P., New York, 1987. 297 pp. $49.50 hc ISBN 0-521-34013-6

Tributes to Paul Dirac

Edited by John G. Taylor
Adam Hilger, Bristol, UK (US dist. Taylor and Francis, Philadelphia), 1987. 123 pp. $22.00 hc ISBN 0-85274-480-3

P. A. M. Dirac was born in Bristol, England, on 8 August 1902, and died