particle correlations from building up. It appears that the authors have mistaken a sufficient condition for irreversibility—recent equilibrium—for a necessary one. I found this surprising in a book that claims to resolve "the paradox of irreversibility ... in a simple, logically clear, and aesthetically pleasing manner."

DAVID LAYZER
Harvard University

Introduction to Gauge Field Theories

Masud Chaichian and Nikolai F. Nelipa
332 pp. Springer-Verlag, New York, 1984. $46.70

There are now a half-dozen or so books available whose main purpose is to present and discuss the standard model of elementary-particle interactions. This is entirely appropriate as there is now a broad consensus that the standard model provides us with an essentially correct description of high-energy physics. The modifications that are seriously considered these days are confined to adding more particles (such as an extra family of quarks and leptons, or supersymmetric partners of known particles), while the basic, underlying ideas of gauge invariance, spontaneous symmetry breaking and renormalization seem secure. Nonetheless anyone setting out to write a book on the standard model is faced with the problem of deciding which aspects to discuss. After all, the standard model is able to account for (or at least does not blatantly contradict) the results of all high-energy experiments. Furthermore, the mathematical basis of the standard model, quantum field theory, is itself a vast subject with many subtleties.

In *Introduction to Gauge Field Theories*, Masud Chaichian and Nikolai F. Nelipa tackle this problem, with mixed results. This text, intended for advanced graduate students and workers in the field, presupposes some familiarity with quantum field theory and the basic properties of elementary particles. Even readers with adequate preparation, though, will find some vexing deficiencies. There is almost no meaningful comparison of theory and experiment and hence no real discussion of how the standard model came to be the standard model. For example, after presenting an alternative model in which quarks have integer charge, Chaichian and Nelipa say that "nowadays one considers mostly models with fractional charges," but they do not say why. In a number of places they make statements that could easily mislead the unwary reader. For example, in one paragraph of the introduction we are told that the strong nuclear interaction is short range (true), that short-range interactions are mediated by massive particles (true) and that gauge particles can be either massive or massless (true). However, the obvious inference—that the strong interaction is mediated by massive gauge particles—is not true. The theory of the strong interaction, quantum chromodynamics, is fully explained later, but a clearer presentation in the introduction would have been welcome. This may partly be the fault of the translation by Juri Estrin, which does not always fall easily on the ear. But the translation cannot be blamed for figure 10.2, which depicts beta functions that do not vanish at zero coupling (as they must), or the discussion of the origin of the up-quark mass in the SU(5) grand unified theory, which is simply wrong.

On the plus side, there are thorough and clear treatments of quantum mechanics for constrained systems (gauge fields are an example), of the renormalization group for a generic quantum field theory and of applications of quantum chromodynamics to strong-interaction phenomena at high energies. This last topic is the book's strongest point; here Chaichian and Nelipa do present and discuss experimental data as well as theoretical calculations.

If this were the only book of its type available, I would recommend it in spite of its flaws. However, it has stiff competition. I particularly like *Gauge Theory of Elementary Particle Physics* by Ta-Pei Cheng and Ling-Fong Li (Oxford U.P., New York, 1984; for a review see PHYSICS TODAY, December, page 78), which is better written and more complete. Anyone planning to read or own just one book on the standard model of elementary particles would do well to investigate the alternatives.

MARK SREDNICKI
University of California, Santa Barbara

Elements of Modern Optical Design

Donald C. O'Shea
402 pp. Wiley, New York, 1985. $39.95

The usual, somewhat limited concept of optical design deals with ray tracing through optical systems. Donald C. O'Shea definitely stresses ray tracing in this text, introducing it gradually—first for thin lenses, then for paraxial rays and finally as the exact ray tracing. He makes it amply clear, however, that one must consider other topics: modulation, scanning, spectrometers, detectors and the shape of the laser beam. Separate chapters are devoted to these topics, and anyone who knows some optics will have an easy time reading them. The book also includes a review of elementary optics and a chapter on radiometry, both of which are easy to follow. The ray-tracing part is another matter: Here one has to make some effort to follow the precepts of the author.

O'Shea shows once more that geometric optics and optical design can be subjected to a reasonably simple analytical treatment. This is probably what he is referring to when he says that "one of the delights of optics is the ease with which most systems can be understood." This does not mean, however, that one has an easy time learning optical design. As in every specialty, one has to follow all the details scrupulously, beginning with the sign convention (which is not very conventional for anyone who learned optics from an undergraduate textbook) and then going through the *y–u*, *y–nu* and *Q–U* traces. O'Shea presents all this systematically and understandably. The reader can test his accumulated knowledge with the two examples given at the end of the book: the design of a laser printer and of a projector.

"No design is ever finished," O'Shea says; "it is stopped." Here he implies that all the detailed prescriptions aptly furnished in his book and those that one would find in more specialized references still do not guarantee an ideally designed product. His book, however, guarantees a good start.

ALFRED ZAJAC
Adelphi University

Differential Geometry for Physicists

Andrzej Trautman
145 pp. Bibliopolis, Naples, Italy, 1984. $19.50

Applied Differential Geometry

William L. Burke
414 pp. Cambridge U.P., New York, 1985. $54.50 hardcover; $19.95 paper

The number of expository books on differential geometry and topology written for physicists is increasing rapidly. Whereas in 1963 there was just one (Harley Flanders's *Differential Forms*, Academic, New York) there have been at least four new publications in this area in 1985. Both books reviewed here require no more mathematics than is known by a first-year physics graduate student; however, they presume quite different degrees of mathematical maturity on the part of the reader.

Andrzej Trautman's book resulted from a series of lectures he gave in the academic year 1976–77 at the State University of New York at Stony Brook. The book is brief and tightly organized. It develops concepts in algebra, differential manifolds, Lie groups, fiber-bundle connections and gauge fields, topological invariants and characteristics classes, all in 135 pages. In spite of its rapid pace it manages to give a large number of very useful examples, exercises and heuristic arguments. Nevertheless it requires very close reading to follow and supply the details of some sketchy arguments. Because it discusses only a very limited number of applications to physics—included, in brief treatments, are applications to magnetic monopoles and instantons—the motivation must come from the outside.

William Burke dedicates his book "to all those who, like me, have wondered how in hell you can change $\dot{q}$ without changing q." *Applied Differential Geometry* discusses some of the same topics as Trautman's book, in a much more informal, picturesque way. It contains many down-to-earth examples. Its discursive, lecture-type format is useful for an introductory text.