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."

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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.

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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