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Book review: Relativistic Particle Physics, by Hartmut M. Pilkuhn

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During the past dozen years, a revolution has occurred in the prevailing view of particle physics. It is now generally believed that a fundamental description of subnuclear physics must be based upon the idea that strongly-interacting particles (hadrons) are composed of quarks. Together with leptons, such as the electron and neutrino, and a variety of force particles including the mediator of electromagnetism called the photon, quarks seem to be the elementary particles—at least at the present limits of resolution.

The support for this new point of view is multifarious and impressive. It derives from the familial patterns of hadrons, the experimental evidence for pointlike constituents within hadrons, the discovery of the atomic-like spectra of heavy mesons J/ψ and Υ, the successful prediction of charm, and the triumph of the Weinberg-Salam model with its implication of weak neutral currents. According to optimists, a grand synthesis of the strong, weak, and electromagnetic interactions is already at hand. A number of experiments are being mounted to search for the proton instability implied by specific grand unified theories. Some physicists with an appreciation for history, troubled by the proliferation of "fundamental" constituents, now are investigating the possibility that the quarks and leptons may themselves be composite.

In view of this paradigm, the appearance of a textbook which mentions quarks only in passing is somewhat surprising. While I regard Pilkuhn's selection of topics as excessively reactionary, it is not without merit. It is important for students to become familiar with a broad range of phenomena that are the concern of high-energy physics. Many aspects of these cannot be described economically on the constituent level, although systematics frequently can be interpreted neatly in terms of quarks. Beyond this, the author seems to have in mind a wider audience than incipient particle physicists, including students of intermediate energy and classical nuclear physics. The reader of Relativistic Particle Physics will indeed gain an awareness of the general phenomenology of particle physics, but will have a somewhat dated impression of what constitutes current theoretical and experimental research.

The strong point of this book is its treatment of nonstandard textbook topics in applied relativistic quantum mechanics. The classical applications are to problems in atomic structure, but these have served as prototypes for recent descriptions of hadron masses. Generally speaking, techniques are thoroughly explained but specific experimental facts are described only briefly. The discussion of the Weinberg-Salam model is quite condensed. The subtleties of spontaneous symmetry breaking are not adequately explained, and no comparison is made with data. In contrast, the chapters on hadron-hadron scattering contain good introductions to a number of useful methods.

As a textbook, Relativistic Particle Physics would be improved by the addition of sets of problems, and by the inclusion in the bibliography of more review articles or summer school lectures that contain excellent pedagogical discussions of specific topics. Several criticisms must be directed to the publisher, Springer-Verlag. To conserve space, equations have been set in a most annoying format: $\frac{3}{8}\pi^{-1}2^{-1/2}$ is a typical infelicity. Many of the figures are sloppily executed, the proofreading is less than meticulous, and the style of the bibliography is inconsistent.

Relativistic Particle Physics is devoted to techniques of lasting interest. Although its viewpoint is not thoroughly modern, it provides a serviceable introduction to high-energy physics on the graduate levels, and individual sections may be read profitably by researchers.