excellent texts that are tantalizingly introduced in the reference lists of Foderaro's book.

Nuclear structure theories are touched in very brief and mainly quantitative descriptions of the shell model, the collective model, and the statistical model of highly excited nuclear states. In dealing with neutron interactions, proper, there are quite detailed accounts of resonance theory, of the R-matrix theory of nuclear reactions, the optical model for neutron scattering, and Hauser–Feshbach calculations for neutron induced reactions, most of which include step-by-step prescriptions for carrying out numerical calculations. There are also more cursory descriptions of the theories of radiative capture and gamma-ray spectra, and a chapter on the effects on neutron scattering of target structure and atomic motion. The brief treatment of fission theories omits more recent developments on the "double-humped" nature of the fission barrier. Selected exercises close each chapter, and an appendix lists various constants and units.

The material is organized chiefly along historical lines and the tone of the book tends to the didactic rather than the explanatory. Thus, a very nice explanation of the need for the optical model is apologetically tacked to the end of the discussion on that subject, instead of introducing it. If the first-year nuclear-engineering graduate student finds that he needs much additional information on physical phenomena and experimental facts in order to appreciate the theories in this text, he may later value Foderaro's book as a thorough and succinct collection of formulas and derivations from among the long line of theories that stretch from Newton's laws to neutron resonances.

PETER A. MOLDAUER
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## Notes on Elementary Particle Physics

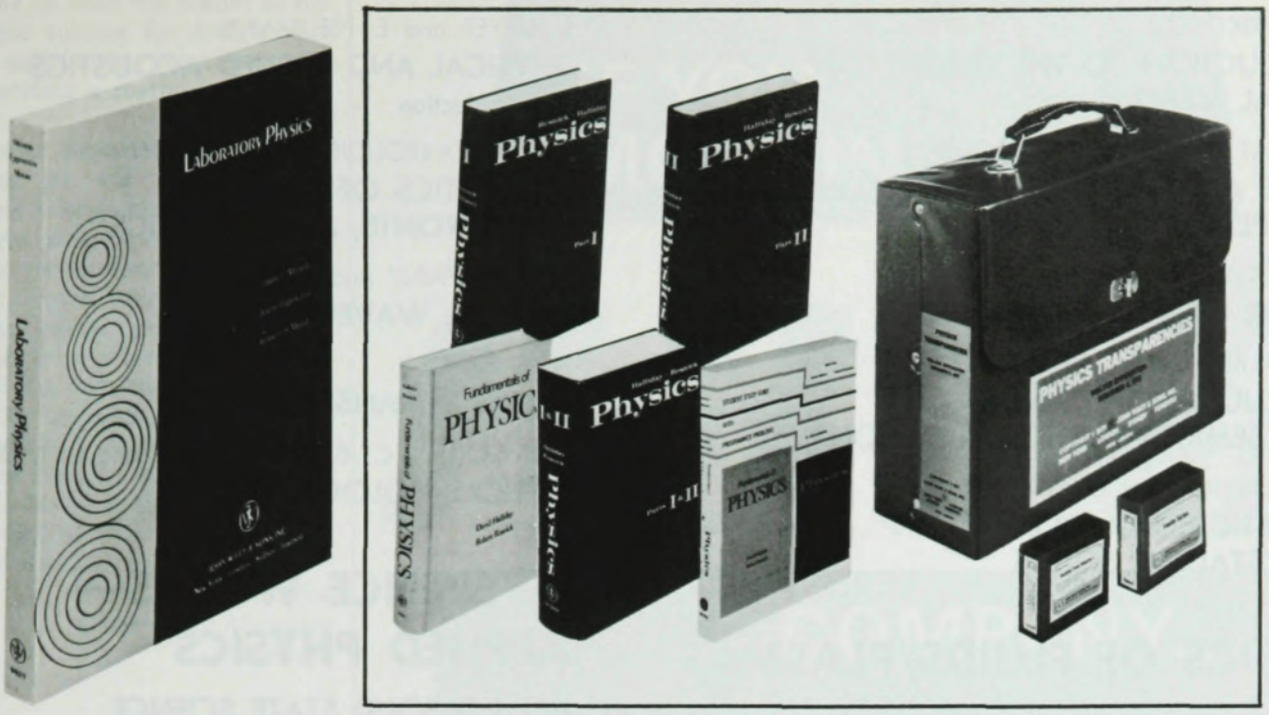
**H. Muirhead**
252 pp. Pergamon, New York, 1971. $13.75

This is a short book derived from thirty lectures given to first-year graduate students at the University of Liverpool. The author is an experimental physicist who earlier wrote a longer text entitled *The Physics of Elementary Particles.* High-energy physics has traditionally been taught at many universities to students in their second or third year as an advanced graduate course. Since most other fields of specialization in physics offer a course at a lower

level, it seems appropriate for high-energy physics to do the same. A graduate student should have the opportunity to sample various fields in some detail before beginning soecialized research. A market for a good text at the first-year graduate level about high-energy physics therefore exists. Such a text is difficult to write, however, for it must satisfy several requirements that appear mutually exclusive: It must be short and readable with clear discussion and simple notation; at the same time it must also be self-contained for a student with a knowledge of quantum mechanics, and it must cover enough material with sufficient depth to give a true impression of the subject.

This book is brief, retains simple notation throughout, and is on the whole quite readable. It begins with the necessary preliminaries in relativistic quantum mechanics for calculating rates and cross sections. It then takes up the three main subdivisions of the field—electromagnetic, weak and strong interactions. The last and longest chapter in the book is devoted to strong interactions, whereas the other two topics are treated rather briefly in two shorter chapters. A remarkably large number of topics is covered, and some of the examples used are well chosen and presented. The $\rho$ meson is used to advantage several places in the text: as an example of an exchanged particle, in the discussion of pion form factors and $e^+e^- \rightarrow \pi^+\pi^-$, and as a Regge trajectory. The problem of $\omega$-$\phi$ mixing is discussed in the section on $SU_3$. The Veneziano model is introduced at the very end of the book as a specific example of a scattering amplitude that exhibits the desirable properties of analyticity, crossing symmetry and duality. A table of particle properties and some topics in quantum mechanics are included as appendices.

The principal flaw of the book is that, in certain parts, it fails the criterion of being self-contained, and the treatment becomes very sketchy and difficult to follow in any detail. One example of this phenomenon is the use of techniques of analyticity and dispersion theory. Although these concepts do not form the backbone of the text, they are used. Dispersion integrals appear in chapter 4 in the discussion of single-particle exchange amplitudes, and again in chapter 7 in the section on finite energy sum rules. Notions of analyticity are also important in the discussion of Regge poles and the Veneziano model. The analytic behavior of scattering amplitudes is a fairly tricky business that is not likely to be very familiar to the first-year graduate student, but which is unfortunately not discussed at all in the book. The instructor must therefore

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either clarify these ideas in class and refer the students to other works, or skip these topics in the course. Muirhead is prone to refer the reader to his more complete volume for details, but this is not a satisfactory solution to the problem of writing a really good lower-level book.

Many physics departments have already started or are considering a course in high-energy physics for first-year graduate students. Muirhead's book can be recommended as a good starting text, which treats some topics very well and which furnishes a fairly broad outline from which the instructor can mold his own course. Perhaps others will be inspired to attempt to solve the problem of writing a first-year graduate text for a field that has only indications of a firm theoretical basis and which is still rapidly changing from year to year.

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*Madison*

## Topics in Applied Quantum Electrodynamics

**Paul Urban**
265 pp. Springer-Verlag,
New York, 1970. $16.70

One area of great importance in high-energy physics that has never been adequately covered in texts is the practical topic of radiative corrections to scattering processes. Paul Urban's book contains a useful pedagogical review of the basic theory and calculations appropriate to elastic and inelastic electron–proton scattering. The only other source that contains comparable material at the introductory level is D. R. Yennie's lectures published in the *1963 Brandeis Lectures in Theoretical Physics*.

Urban deserves a great deal of credit for this comprehensive treatment of a subject that has both great elegance—for example, the beautiful theorems for the summation of infrared effects—and some very unpleasant aspects—for example, the long analytical analysis required for applications to explicit experiements. Fortunately, Urban treats both aspects of the problem in a creditable manner, with sufficient detail given so that the reader can readily follow the deviations. The book includes a comparison of the classical current for treatment of soft photons with the standard evaluation of radiative corrections within the framework of quantum electrodynamics. Although the very complicated radiative corrections to inelastic processes such as electropion production (with the electron and pion