importance. Essentially the difference is that Minkowski assumes the same form for Maxwell's equations in moving media as for stationary media, while Chu showed that although his formulation and Minkowski's agreed in predicting electric and magnetic fields in vacuum, there were large nonrelativistic differences in the two force expressions.

The principle of virtual power, which the authors have developed, and which is based on the principle of virtual work, is described in chapter 4 for nonrelativistic cases, and illustrated with two previously considered problems: inviscid fluid with no heat flow and a quasi-static electric-field system. This principle is then applied to new problems for which solutions are not known, and the results worked out. The following chapter treats the relativistic principle of virtual power and some of the same problems as the previous chapter. There is also a good section on four-dimensional notation.

Hamilton's principle is discussed in chapter 6, and several formulations—Minkowski, Chu, Amperian and Boffi—are compared in some detail in chapter 7. As was noted at the outset chapter 8 is a very concise, interesting review and appraisal of electrodynamics literature: This is extremely valuable. Though the book is not a text it may be used as a graduate supplement.

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James B. Kelley, professor of physics at Marquette University, specializes in electromagnetism and electrodynamics.

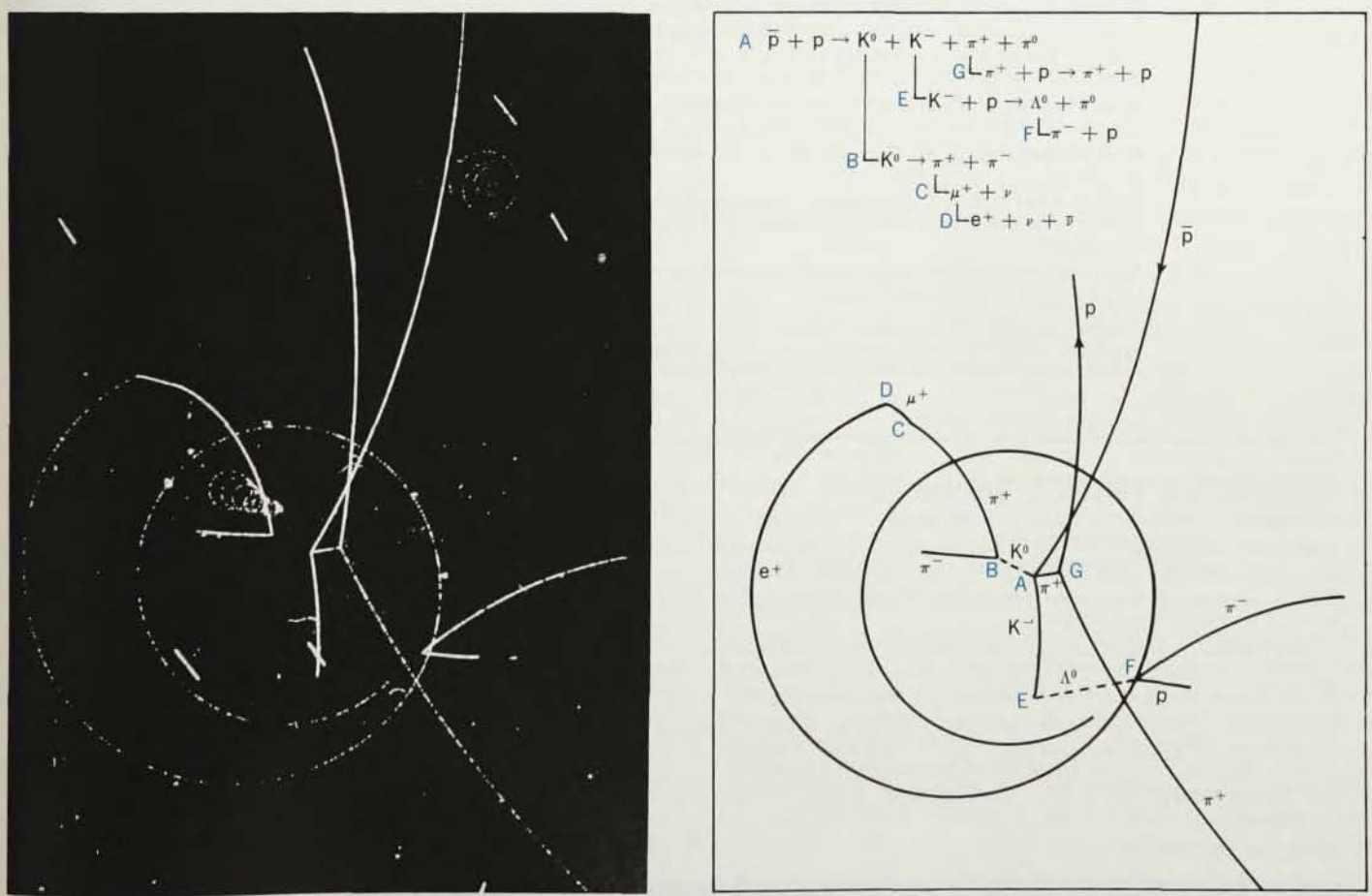
Theory of strong interactions

HIGH ENERGY COLLISIONS OF ELEMENTARY PARTICLES. By R. J. Eden. 298 pp. Cambridge U. Press, London, 1967. $9.50

by Maurice Jacob

The scope of this book is actually not as wide as its title may sound. It is primarily devoted to the present analysis and understanding of two-body, and quasi-two-body, high-energy collisions of hadrons, that is, strongly interacting particles. Nevertheless this domain of particle physics has been an extremely active one during the last few years. There was therefore undoubtedly a need for a book that would, at the same time, assess the progress made and also serve as a guide to the abundant and highly specialized literature for the student engaging himself in this quickly developing field. This book certainly meets this need. The very good introduction to the study of the analyticity properties of collision amplitudes, and then to Regge theory, makes it very useful for any graduate student intending to work in theoretical hadron physics, but also for more senior physicists engaged in other fields and wishing to become acquainted with a good mathematical introduction to their colleagues' vocabulary.

It should be stressed, though, that all through the book a very strong



BUBBLE-CHAMBER TRACKS made with the Nimrod 7-GeV proton synchrotron at the Rutherford High Energy Laboratory. This picture is said to contain "almost the whole of high-energy physics."

emphasis is put on analyticity properties, how they can be obtained from first principles, or postulated, and then thoroughly used. On the other hand, symmetries, which also play a prominent role in particle physics, are only mentioned to the extent that they provide relations among two-body amplitudes. The reader is assumed to be already familiar with them. In other words, collision amplitudes are analyzed and studied as obeying general properties, and only a little attention is paid to the colliding particles themselves in the initial or final states.

This being said, it is a very good thing that this book, which emphasizes the subjects that correspond to the author's highest interest, fully benefits from his thorough knowledge and experience; in a more neutral review, these particular aspects of high-energy physics could not have been so well presented. In particular, the chapters on bounds and more generally on the asymptotic behavior of collision amplitudes will provide the graduate student, or any interested reader, with a valuable introduction to this field.

If the student might not always find all the necessary material or guidance to carry to the very end some by now rather standard calculations, he will easily find useful references to the pertinent literature.

R. J. Eden is among the most well-known workers in the field presented in this book. The book itself has been developed from lectures to graduate students at the University of Maryland, the Scottish Universities Summer School and in the Cavendish Laboratory, Cambridge. After a brief presentation of experimental facts, as well as of a general theoretical background, it gives a detailed discussion of analyticity properties of collision amplitudes. Then follows an introduction to Regge theory, first in potential scattering and then in its relativistic formulation. Regge phenomenology is discussed at the end of the book, where mention is also made of other special models. Before that, the book gives a thorough discussion of asymptotic bounds and general results on the asymptotic behavior of collision amplitudes. Each part of the book is a valuable introduction to more technical literature as well as an up-to-date summary of present knowledge in the field it covers.

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The reviewer is a staff member with the CERN theoretical study division.

A different look at energy

THEORY OF ENERGY TRANSFERS AND CONVERSIONS. By Federico Grabiel. 217 pp. Wiley, New York, 1967. $10.95

by Kurt E. Shuler

The prospective reader of this book is probably best served by the reviewer in having made available to him a number of direct quotations from the author's preface. The author is presently an operational analyst with Hughes Aircraft Company and lecturer in mathematics and theoretical physics at Loyola University, Los Angeles.

"This book presents the main body of my investigations concerning the laws of energy transfers and conversions. A linear theory of energy transfers and conversions is developed that encompasses the second and third laws of classical thermodynamics and their consequences as particular cases." "Constant confrontation, in the book, of the predictions of the theory with data from observation and experimentation has not been deemed necessary in view of the fact that the results of the theory contain those of classical thermodynamics and others that are well known and readily accessible." "The presentation of the theory follows the rigorous form of well distinguished definitions, assumptions, theorems, and interpolated discussions and motivations." "Utility is not the sole criterion for employing the rigorous manner of presentation that has been chosen—the human mind delights in clearness of ideas, and precision of distinctions is indispensable for the attainment of depth of analysis and beauty of synthesis."

The book contains 49 references of which 27 are to papers or monographs in mathematics including such classics as Ulisse Dini, *Lezioni de Analisi Infinitesimale*, Vol. I: *Calcolo differenziale*, Stab. Tipografico Succ. FF. Nistri, Pisa, 1907 and Sophus Lie, *Geometrie der Berührungs transformationen*, dargestellt von Sophus Lie und George Scheffers, Druck und Verlag von B. G. Teubner, Leipzig, 1896, and 12 references to monographs both recent and more ancient on thermodynamics and heat and mass transfer. There are also 3 journal references to the recent literature.

It would appear to the reviewer that this book should be primarily of interest to nonutilitarian thermodynamicists who would like to take a different look at the subject through the eyes of Federico Grabiel.

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Plasma reviews reviewed

COLLECTIVE OSCILLATIONS IN A PLASMA. By A. I. Akhiezer, R. V. Polovin, A. G. Sitenko, K. N. Stepanov. Trans. from Russian. 190 pp. MIT Press, Cambridge, Mass., 1967. 8.50

by Sanborn C. Brown

For physicists looking for a broad view of the effects of oscillations in a plasma, this small volume will be of considerable interest. It is not really a book in any cohesive fashion, but rather four rather independent reviews of the development of the dielectric tensor from the linear Vlasov equation, a discussion of stability theory, calculations of the fluctuation spectrum, and scattering of electromagnetic waves from these fluctuations. The independent parts of the book reflect the multiauthor nature of the volume. The first two chapters are a concise compendium of the results of the theory of waves in collisionless plasmas, which is much more readable than the more detailed treatments of the same subject that have already appeared. The third chapter is an interesting account of the essence of stability theory, the discussion primarily dealing with beam instabilities. The fourth chapter, which deals with fluctuations in a plasma, suffers from the fact that the reader is unprepared by previous sections of the book for the subject matter in this particular chapter, and it reads rather more like a paper than a chapter in a book. It should be pointed out that one of the authors, A. G. Sitenko, has just published a translation of a separate book on this particular subject matter that