of blood cell culture. It is not of particular value to those interested in the applications of these techniques in fields other than hematology.—*J. E. Till*

Nuclear Interactions by S. DEBENEDETTI; 636 pages; $16; John Wiley & Sons, 1964.

Present-day graduate students in physics are in an unenviable position compared to their predecessors. A generation ago, it was still possible for graduate students to understand the basic ideas discussed in most of the papers published in *The Physical Review.* Today, however, this is seldom possible. Even in one's own field, one often cannot make much sense of a paper without a considerable expenditure of time and effort. Because of this lamentable state of affairs, today no physicist can truthfully claim to be an expert in all phases of nuclear physics. Accordingly, it is an occasion of great rejoicing when a book appears which will help to bridge the ever-widening gap between graduate physics courses and research work. Professor DeBenedetti's exemplary textbook is such a work.

As this book takes its readers to the very forefront of our knowledge of nuclear physics, it will be necessary for them to have had courses in classical mechanics (Goldstein), electromagnetic theory (Stratton), mathematical physics (Morse and Feshbach), nuclear physics (Leighton), and quantum mechanics (Merzbacher). The outstanding virtue of this book is that it is a labor of love. The author actually explains the subject. Authors often expound—a profound and important difference. No idea is introduced without the accompanying physical motivation and its fruitfulness developed in considerable detail. All mathematical steps are given in most instances, and there are no "It can easily be shown that . . . " and "It is left as an exercise for the reader to show that . . . " to frustrate the reader. Numerous applications of the theory are given, and the bibliographies are excellent, detailed, and modern.

In Chapter 1, the general properties of nuclear forces are discussed. It begins with a discussion of the conservation laws and symmetries of space-time and ends with a discussion of the two-body problem. In Chapter 2, nuclei containing three or more nucleons and the many-body problem are discussed. The various models of the nucleus and the specific features and shortcomings of each model are developed in detail. As our knowledge of the nucleus comes primarily from scattering experiments, Chapter 3 is devoted to scattering phenomena of all kinds—neutron, electron and nucleon scattering and polarization effects. Chapter 4 is devoted to interactions between nucleons and radiation, a fairly well-understood process. Chapter 5 on nuclear reactions is a modern version of the treatment found in Blatt and Weisskopf. It must be admitted that our ignorance in this regime is still considerable. Chapter 6 treats the relativitistic interaction between fermions and radiation. A very clear and concise discussion of Feynman diagrams as propagators is given, which even experimentalists should have no trouble understanding. The treatment is rather incomplete, for there is no mention of Wick's theorem and the subtleties connected with the S-matrix approach. For such matters, the reader must consult Schweber or Bjorken and Drell. Pion physics is the subject of Chapter 7, and considerable experimental data are given along with a fine physically motivated discussion. The book ends with a readable treatment of weak interactions.

This is a remarkable book and deserves the serious attention of physicists. It will undoubtedly be widely adopted and used as a textbook and as a reference. The typography is good, and there are relatively few misprints. Physicists are indebted to Professor DeBenedetti for taking time out to write such an excellent book.—*Howard Chang*

Cosmic Rays by B. ROSSI; 268 pages; $5.95 cloth, $2.95 paper; McGraw-Hill Book Co., 1964.

Studies of the cosmic radiation have been immensely fruitful for twentieth century physics. Prior to development of high-energy particle accelerators, cosmic ray phenomena constituted the sole clue to the realms of subnuclear processes lying beyond those hinted by radioactivity. The history of the use of cosmic rays as a tool for prying into those secrets has now been retold in fascinating form by an investigator who has himself been intimately involved in that history for several decades.

Rossi's book can be enthusiastically recommended to a broad range of readers. Specialists in the field of cosmic radiation should find his narrative exciting. At the other extreme, even undergraduate science students will find this an outstanding (the outstanding?) account of the intriguing area of cosmic radiation. Historians of science must not fail to take notice of Rossi's book, for it gives a deeply discerning treatment of a field rich in implications for modern science history and studded with surprising twists and turns of interplay between theory and observation.

From the heroic age of cosmic ray research, beginning with the 1912 balloon ascent of Victor Hess, and moving on after the war years to the energetic field work of Millikan (who coined the slightly unfortunate name "cosmic rays" because he felt sure for many disputatious years that these were extra-energetic gamma rays) and Compton (whose observations were instrumental in revealing that the "rays" were in fact charged particles), Rossi traces expertly and engagingly the steps by which two generations of diligent physicists sorted out the almost unfairly confusing array of events that comprise the atmospheric interactions of the cosmic radiation. Clarifications ran neck and neck with new confusions through the thirties; but after World War II attacks on many fronts nearly cleared the field within ten years. Today, the great remaining question is: where and how are the cosmic ray primaries formed?

Rossi, in a final epilogue, suggests that future historians of science may "close the chapter on cosmic rays with the fiftieth anniversary of Hess's discovery." That may or may not be what the future holds; but Rossi's retelling of those fifty years of cosmic ray research will probably be the definitive historical treatment for years to come.—*James E. McDonald*

X-Ray Optics & X-Ray Microanalysis, edited by H. H. PATTEE, *et al.;* 622 pages; $22; Academic Press, 1964. Proceedings of the 3rd International Symposium, Stanford University, California, August 1962.

The publication of Symposium proceedings is now a widely accepted procedure in spite of serious objections that can be raised against this practice. Many communications offered to the public through this medium would not survive the reviewer's scrutiny if submitted to a reputable scientific journal. Usually, the tutorial papers contributed by authoritative invited speakers are repetitions of material already published elsewhere, with minor alterations, if any. If important original papers are published in Symposium proceedings, the information presented will probably appear later in a slightly different format in a scientific journal.

The proceedings of the Stanford Symposium on X-Ray Optics and X-Ray Microanalysis demonstrate that shortcomings observed in many publications of this kind can be avoided. Most of the papers in this volume are communications of significant original work. The presentations are clear and readable, and careful editing is apparent. A review of the literature published since the Stanford meeting indicates that most authors did not think it necessary to re-publish their work through other channels.

The Stanford symposium is the third of a series of international meetings organized by V. E. Cosslett, A. Engström, and H. H. Pattee. To the bewilderment of the librarian, these editors have chosen to change the titles of their successive symposia and of the respective proceedings. The first of the series (Cambridge, 1956) was called "X-Ray Microscopy and Microradiography," and the second (Stockholm, 1959) "X-Ray Microscopy and X-Ray Microanalysis." The fourth symposium, to be held in Paris, in September 1965, will be entitled "X-Ray Optics and Microanalysis." This change of emphasis from microradiography to microanalysis (mainly electron probe microanalysis) is reflected in the contents of the successive proceedings, as pointed out by V. E. Cosslett in the first paper of the current volume. Of 52 papers, 12 deal with x-ray physics and general aspects, 12 with diverse x-ray absorption techniques, mostly applied to biological specimens, 25 papers concern microprobe analysis, while 3 deal with microfluorescence techniques. Some areas of applied x-ray physics such as x-ray microradiography are by now well-established techniques, while, in reflection x-ray optics and microscopy, there is little hope for practical advance in the near future. The electron probe, however, has become a powerful tool of wide application; furthermore, the theory of quantitative electron probe microanalysis was, at the time of the Stanford meeting, in a state of evolution.

Under these circumstances, one would expect that obsolescence would quickly affect the significance of publications concerning quantitative probe analysis, particularly in view of the fact that the Proceedings appeared 15 months after the Symposium. Curiously, in spite of further developments in this field, most of the communications in this category, such as those of Duncumb and Shields, of Archard and Mulvey, of Poole and Thomas, of Green, and particularly that of Philibert, have, if anything, gained in perspective. The appearance of these papers has greatly stimulated the analysis of the electron impact and x-ray production in solid targets. It is probable that the procedures for quantitative analysis recommended by the above mentioned authors will be further implemented, modified, and adapted to digital computing routines. The reviewer expects that the papers contained in this book will be of permanent value to the scientist interested in quantitative x-ray spectrography.—*K. F. J. Heinrich*