

providing a review of recent work. In contrast, Duran's book is didactic in style and provides an excellent starting point for an advanced student to enter the field. In Duran's work, there is considerable discussion of the physical principles involved and of simple models such as the Janssen model for stresses in a silo. There is a greater emphasis on models and mechanisms than in Ristow, but there is probably less of an attempt to be inclusive of all the recent work in this area. As with Ristow, the prose is clear. Both these volumes would be valuable additions for those with interest in the field.

Heavy Quark Physics

▶ Aneesh V. Manohar
and Mark B. Wise
Cambridge U. Press, New York,
2000. \$64.95 (191 pp.).
ISBN 0-521-64241-8

Intense experimental and theoretical studies of heavy quark systems have allowed for precise measurements of fundamental parameters of the Standard Model of electroweak interactions. The inherent difficulty in extracting these parameters is that the strongly interacting particles created in the laboratory, such as the B meson or the Λ_c baryon, are nonperturbative composites of the quark and gluon fields whose dynamics are defined by the Standard Model. The theoretical framework with which heavy quark systems are understood and described has evolved from the phenomenological models of the strong interaction of the early 1980s to that of the rigorous heavy quark effective field theory used today.

The monograph *Heavy Quark Physics*, by Aneesh V. Manohar and Mark B. Wise, is the first text devoted to the theoretical treatment of heavy quark systems. This is a detailed and well-thought-out presentation by two world-renowned experts on the theoretical techniques used to understand high-precision data on systems containing heavy quarks. The symmetries uncovered by Nathan Isgur and Wise (both recipients, along with Mikhail Voloshin, of the 2001 J. J. Sakurai Prize from the American Physical Society) that become manifest in the heavy quark limit form the backbone of this text and enable Manohar and Wise to move seamlessly among different aspects of heavy quark physics. With the introductory chapter providing a concise review of the Standard Model, loops, and effective field theory techniques, it can be considered self-contained. However, a

firm background in field theory and particle phenomenology allows for a much more rewarding experience with this text. It is oriented toward those who wish to learn to calculate various quantities of importance in heavy quark systems and provides all the details necessary to do so. At the end of each chapter, problems are given that either develop a point discussed in the chapter or enable the reader to tackle issues beyond those discussed. References to important published papers relevant to the content of each chapter are also included.

After a thorough discussion of relations between observables that are a direct result of the spin and flavor symmetries existing in the heavy quark limit, such as those between matrix elements for $B^{(*)} \rightarrow D^{(*)} e \bar{\nu}_e$ decay, the text moves on to discuss the implementation of corrections to the heavy quark limit. These corrections allow a connection with the charm and bottom quark sectors. Considerations of the perturbative quantum-chromodynamic (QCD) corrections in $\alpha_s(M_Q)$, including matching for heavy-heavy and heavy-light currents, and of nonperturbative corrections in Λ_{QCD}/M_Q , including discussions of Luke's theorem, culminate in the determination of the weak mixing angle V_{bc} from exclusive B meson decays.

The synthesis of heavy quark and chiral symmetry necessary to describe the low-momentum processes of baryons and mesons containing heavy quarks, such as strong decay widths and the radiative decays of the D^* mesons is detailed. A nice comparison is made here among the implications of the D^* widths for constants in the heavy quark chiral Lagrangian, results from lattice QCD, and predictions of the nonrelativistic quark model. However, the reader is left wanting more on this subject, as the discussion could have been somewhat more detailed and could have included heavy baryons.

The area of inclusive weak semileptonic decays, which developed somewhat after the initial work on the impact of heavy quark symmetries on exclusive decays and on meson spectroscopy, is discussed in great detail. After addressing important issues concerning the endpoint of the electron spectrum in $B \rightarrow X_e \nu$ and $B \rightarrow X_\mu \nu$, a determination of V_{bc} made possible by these tools is presented.

In recent years, much effort has been spent on understanding systems with more than one heavy quark. However, this text is clearly focused on detailing the accomplishments in

systems with only one heavy quark, and discussion of nonrelativistic QCD is confined to only a brief outline.

To summarize, this is a wonderful text for graduate students in particle and nuclear physics who are interested in learning the tools of heavy quark physics from two of the experts in the field. This book is a must for both particle theorists and experimentalists who are currently researching heavy quark systems. In many ways, this text should be considered a sequel to Howard Georgi's *Weak Interactions and Modern Particle Physics* (Addison-Wesley, 1984).

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Iron, Nature's Universal Element: Why People Need Iron & Animals Make Magnets

▶ Eugenie Vorburger Mielczarek
and Sharon Bertsch McGrayne
Rutgers U. Press, New Brunswick,
N.J., 2000. \$30.00 (204 pp.).
ISBN 0-8135-2831-3

Earth's living systems use nearly every element, but iron plays a particularly important role, and it is not clear that it could be replaced by other elements. Eugenie Mielczarek, a physicist, and Sharon McGrayne, a science writer, describe in their very readable *Iron, Nature's Universal Element* the importance of iron for life. The book is entertaining, amusing, and challenging and, despite the elementary level, contains some new information for most readers.

One could expect that a popular book, covering topics from the origin of life to bird migration and the ecosystem, would contain some mistakes. I did not find any; besides being very careful, the authors had the book reviewed for scientific accuracy by many of their friends. A brief description of some of the topics covered and some quotes will give an idea of the wide range covered and of the style of the authors.

In the first chapter, the authors describe the emergence of life, nearly four billion years ago. Life began without oxygen, and relics of this early time most likely survive deep in the oceans, in complete darkness and under immense pressure. The actual origin of life is not known with certainty, but the authors provide a balanced brief review of a conceivable beginning, in which iron is part of the