augmented at a frightening rate, while some of the very fundamental concepts in this area continue to be found only in the rather sketchy original accounts of the research journals. It appeared to us that the time was ripe to attempt a consolidation of this material."

In general, the book is not difficult to follow, provided the reader has a background in quantum mechanics and introductory nuclear physics.

The first part, Radiation Theory and Nuclear Photoexcitation, is mainly a review. Though a good part of this material is available in other books, part 1 still is a very useful starting point and reference.

The next part, Electroexcitation of Nuclei, is quite comprehensive, covering electron scattering, both elastic and inelastic, Coulomb excitation, muonic atoms. Much of this is not available in book form. Part 3 deals with weak interactions in nuclei, in particular nuclear beta decay and muon capture. This part is less comprehensive than the first two, but it might still be useful as a reference.

The appendices should be of considerable help to readers who want to study the book in detail. This is especially true for appendix A—"The quantum theory of angular momentum." Even though this material is available elsewhere, its inclusion makes the book more self-contained.

Altogether this book should be useful to both graduate students as a textbook and to nuclear physicists as a reference. In this reviewer's opinion, Eisenberg and Greiner have succeeded very well in their stated goal.

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Electronic Phenomenon

Electron Paramagnetic Resonance of Transition Ions. A. ABRAGAM and B. BLEANEY. Clarendon (Oxford University Press), New York, 1970. xvi, 912 pp., illus. $41.50. International Series of Monographs on Physics.

About 25 years ago Zavoisky discovered electron paramagnetic resonance in solids. Today paramagnetic resonance is not only a subject of study in itself but also a tool used in many fields of investigation. It is one of the important tools in the investigation of the electronic properties of the ground state of magnetic centers, and its applications are found in physics, chemistry, biology, metallurgy, and geology.

The authors of *Electron Paramagnetic Resonance of Transition Ions* are among the first pioneers in this field. Abragam, together with Pryce, while working in Oxford, provided the main theoretical framework for the understanding of the properties of transition ions in single crystals. The initial important experimental work was done by Bleaney in the early '50's and was extended by his students and co-workers. The Oxford school consisted of scientists such as Stevens, Elliott, Judd, Ingram, Baker, Hayes, Griffiths, and Owen, each of whom has significantly enlarged the scope and importance of this field.

This monumental book is the outcome of the research of this group and bears the imprint of their knowledge and philosophy. It is a very large book, even within the restriction of dealing only with transition ions. Among the best chapters are the beautiful preliminary survey, a discussion of the implication of the spin Hamiltonian, and (in chapters 5 through 8) a detailed discussion of the ground state of the energy levels of transition ions. The theoretical survey (chapters 11 through 16) deals lucidly with aspects of crystal field theory and group theory. There are many standard textbooks dealing with these subjects, however, and these chapters, which, though clearly written, are not directly related to the main body of the book, are somewhat superfluous. In addition, the transition from the group theoretical calculations to the spin Hamiltonian is not clearly indicated. On the other hand, the theoretical discussion contains probably the finest descriptions available of time reversal and Kramers degeneracy, and of the Jahn-Teller effect in paramagnetic substances.

The book before us is the most authoritative book in this field. It will be used both as a reference book by the expert and as a book of study by the graduate student beginning to work in the field.

The reviewer does not do himself justice without a few words of criticism. There is no discussion of the paramagnetic resonance spectra of transition elements in organic biological materials or in metals; the authors deal nearly exclusively with transition ions in inorganic salts and should have indicated this in the title of the book. (On the other hand, in the discussion of the electron nuclear double resonance, or ENDOR, the authors illustrate the ENDOR effect mainly through spectra of donors in silicon where the paramagnetic center is not a transition ion and the host not an inorganic salt.) Reference should also have been made to paramagnetic resonance of transition elements of optically excited states. This field is probably going to become more important in the future and may provide some additional tests of various fine points of the theory of spin resonance in solids.

This volume is a worthy companion to Abragam's classic *Principles of Nuclear Magnetism.*

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Volcanic Chain

Volcanism and the Upper Mantle. Investigations in the Kurile Island Arc. GEORGII S. GORSHKOV. Translated from the Russian edition (Moscow, 1967) by Charles P. Thornton. Plenum, New York, 1970. xvi, 385 pp., illus. $35. Monographs in Geoscience.

Gorshkov's original Russian text was entitled "Volcanism: Kurile Island Arc." The change of title to emphasize the nature of the upper mantle as understood from studies of the products and roots of Kurile volcanoes was not done entirely to generate wider interest in this important book. This emphasis is the message, and it comes through loud and clear.

Deep seismic soundings by refracted explosion waves clearly show that the relatively simple Kurile island arc is underlain by three distinct types of crust: in the north by a continental crust of 30 kilometers' thickness; in the center by an oceanic crust 10 to 15 kilometers thick; and in the south by a 30-kilometer-thick "suboceanic" crust composed of a "basaltic" lower sequence overlain by up to 7 kilometers of volcanic rocks. In effect, the arc has roots at the northern and southern ends, but with different seismic velocity layers; these are separated by a 200-to-300-kilometer-long central gap with little or no crustal root.

The surprising thing is that the chemistry of the volcanic rocks along the arc shows almost no relationship to this major difference in basement rocks. The north and central Kurile Islands have identical calc-alkaline lavas, and the southern Kurile lavas are similar