interacting electrons in solids, treating the band model, magnetic properties associated with collective electrons, and ligand field effects on localized electrons. He then thoroughly covers the theoretical models and physical properties of magnetically ordered phases, dealing with ferromagnetism, antiferromagnetism, ferrimagnetism, and parasitic ferromagnetism.

In the last half of the book Goodenough describes the interactions of atomic moments in general in the various types of crystal structures commonly encountered in inorganic crystals and minutely examines specific experimental examples from the point of view of the models. Listing a few of the topics that are considered—band structure, magnetic coupling, Jahn-Teller distortion, conductivity, and second order transitions—may give some idea of the theme that runs through the discussion of the different crystal structures.

Although this book is certainly not a textbook, I feel that it could be used as the basis for a very worthwhile course at the second-year graduate level in physical chemistry.

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Geological Oceanography

Submarine Geology. Francis P. Shepard, with chapters by D. L. Inman and E. D. Goldberg. Harper and Row, New York, ed. 2, 1963. xviii + 557 pp. Illus. $11.50.

This revised and enlarged edition of Shepard's *Submarine Geology* records the great progress made during the last 15 years. In material and organization the volume parallels the first edition. It will remain valuable as a textbook for introductory courses in geological oceanography and for single courses in other areas and as a reference source. Shepard has synthesized a vast amount of material excellently; there are 46 pages of references.

Two introductory chapters cover history, methods, and instrumentation. Three chapters cover waves, currents, the physical properties of sediments, and the mechanics of sedimentation.

The two new chapters by D. L. Inman, on sediments and the mechanics treated in 12 pages and the complex applications of modern fluid mechanics of sedimentation, were a necessary addition. Unfortunately, in these chapters Inman attempts too much. Textural properties of sediments, including the statistics of size distributions, are to sediment transport problems in only 32 pages. A student with an adequate background for understanding the remainder of this book will find Inman's presentation so difficult that he will skip this important material. It would have been better to cover fewer concepts in greater detail.

Logically the two chapters on shoreline classification and beaches and related processes should follow the introductory chapters. The material on nearshore processes and the mechanics of sedimentation, which was presented in the introductory chapters, could have been used to greater advantage in discussing shore and beach development.

Five chapters are devoted to the following topics: the description, origin, and sediment distribution of the continental shelves and slopes; submarine canyons and valleys; and coral and other organic reefs. Shepard's descriptions of the features and sediment distributions are more complete than those in any other single source. Discussion of the origin and history of such features must be highly speculative; the author can be complimented for his objective consideration of many hypotheses.

Three chapters cover deep ocean topography, deposits and stratigraphy (a particularly praiseworthy treatment), suboceanic layers, and the origin of basins. Shepard has completely recast, into a more usable form, the classification of marine sediments, and he lucidly presents the distribution of deep-sea sediments and deep-sea stratigraphy within this new classification.

E. D. Goldberg's chapter on the mineralogy and chemistry of marine sedimentation is a worthwhile addition. Goldberg maintains an excellent balance between discussion of the entire field and details. The problems of using our knowledge of present marine environments as a means of interpreting the origin of sedimentary rocks are discussed in another new chapter.

I recommend this book to anyone who is interested in submarine geology at any level. The second edition has a greater diversity of material presented at a higher technical level, but always in very readable style.

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Nuclear Reactions

Direct Interactions and Nuclear Reaction Mechanisms. Proceedings of a conference held at the University of Padua, 3–8 September 1962. E. Clementel and C. Villi, Eds. Gordon and Breach, New York, 1963. xlix + 1187 pp. Illus. $39.50.

Rapid technological advances in precision high voltage accelerators and solid state detectors have brought about a revolution in the field of nuclear reactions. The proceedings of the conference on direct interactions and nuclear reaction mechanisms, held at the University of Padua in September 1962, provides considerable evidence of the rapid progress in this field. More than 400 physicists, representing 28 countries, attended and 177 papers which were read at the conference are published in this volume.

No sensational breakthroughs are apparent. The meeting was characterized by a steady stream of interesting and competent research, which, in its entirety, results in a considerable advance in our knowledge about reaction processes and nuclear structure. The following are a few of the contributions that I find particularly interesting.

The (p, 2p) and (p, pd) experiments being performed at Orsay promise to provide us with a good deal of information about some rather complex problems such as the structure of the deeper shells in nuclei. Riou reported on the results of (p, pd) experiments on H^2 and Li^6. Comparison of the yield curves indicate that the probability of having quasi-free scattering of protons on deutrons in Li^6 is greater than 30 percent. Thus there is finally some direct experimental evidence on the old theoretical problem of the applicability of the cluster model to the structure of this lithium isotope.

A considerable amount of discussion is concerned with the use of electrons in probing nuclear level structure. This work combined with the usual large number of investigations with heavy particles provides a sizeable amount of new information about nuclear levels. Garvey's detection of collective states in C^{12} is perhaps one of the more interesting.

Theoretical contributions are by no means lacking. The dominant development here seems to be the distorted-wave Born approximation, and there are fine review papers by Macfarlane and Satchler. Other reviews on theories of