

cal for classic and alternative for alternate, that betray the book's lecture-note origin. These and many other slips, as well as the coinage of interesting new words such as *certaintude*, are a clear comment on the haste with which the book was planned and executed.

Finally, after everything is said the fact remains that the book is the first to be published in its field. Especially for that reason it is too bad that the title is so poorly representative of the contents. Some unwary instructor might even mistake it for a textbook. Nevertheless, it will have its considerable uses, particularly as a compact reference for the reader who is already acquainted with the fundamentals of the subject.

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Einstein's Theory

The Riddle of Gravitation. PETER G. BERGMANN. Scribner, New York, 1968. xvi + 270 pp., illus. \$7.95.

The concept of force, though by no means necessary for the development of physical theories, has nevertheless been very helpful in the understanding of natural phenomena. Of all the forces invented by physicists to explain the macroscopic behavior of bodies, that of gravitation has long been the most mysterious. Numerous theories have been proposed to account for it. Newton's theory simply assumed the validity of his famous "law" of gravitation with its well-known statement that the force of attraction between any two mass particles in the universe varies inversely as the square of the distance between them. Though dissatisfied with this "action at a distance" idea, which was distasteful to many scientists of his time, Newton made no decisive attempt to probe more deeply into the significance of his postulate. Later theorists such as LeSage, Osborne Reynolds, and Bjerknes attempted to provide theoretical bases for the Newtonian principle, but without conspicuous success. The great 20th-century contribution to the problem has been Einstein's relativity theory of gravitation.

The purpose of the author of the book under review is to present an essentially nonmathematical elucidation of Einstein's theory for the nonexpert. This has involved a review of the special theory of relativity, which is admirably

presented, particularly with reference to Minkowski's four-dimensional world. This review is followed by an account of the general theory of relativity, with particular emphasis on its relation to gravitation as a property of the space-time continuum. The significance of the principle of equivalence is stressed, as well as the closely associated fact that a freely falling reference system, by which a gravitational field can be canceled out, cannot be extended arbitrarily through space-time. The difference between flat and curved space-time manifolds is clearly explained, and much emphasis is laid on the Schwarzschild solution of Einstein's field equations as a means of drawing cosmological conclusions from the general theory.

The last third of the book is devoted to modern developments of the Einstein theory of gravitation, including such topics as gravitational collapse, the attempts to detect gravitational radiation, and the relation between gravitation and the quantum theory. Although the reader cognizant of recent developments will note the omission of several important advances such as Wheeler's geometrodynamics and gravitons, the book as a whole constitutes an admirable review for the general reader of a difficult but important segment of modern science.

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Coordination Compounds

Ligand Reactivity and Catalysis. MARK M. JONES. Academic Press, New York, 1968. viii + 272 pp., illus. \$14.

More than a century and a half ago, Berzelius pointed out that when a nonmetallic group attaches itself to a metallic ion the reactivity of both is greatly changed. Other early investigators confirmed this observation through a great variety of experiments. Alfred Werner reported several ligand reactions, one of the most interesting being the "oxidation" of $\text{trans}[\text{Coen}_2(\text{NCS})_2]^+$ to $\text{trans}[\text{Coen}_2(\text{NH}_3)_2]^{3+}$ by chlorine. However, neither Werner nor other early workers spent much time on the study of such reactions. They were, instead, engrossed in establishing the nature of the bond between the metal ion and the nonmetallic atom attached immediately to it. Extensive study of ligand behavior was not undertaken until many years after Werner's co-

ordination theory was well established. This is surprising, for many important reactions depend upon the change in properties of a nonmetallic group when it coordinates to a metal ion. One might cite, for example, the Friedel-Crafts and several other important synthetic reactions and the functioning of biological systems in the presence of traces of metal ions.

Within recent years, however, ligand reactivity has become a very popular and fertile field for investigation. Many aspects of the subject have been discussed in research papers and in several symposia, but until the appearance of this book there has not been an extensive general review of the subject. This volume is therefore very timely.

Jones has done a real service in collecting and classifying the literature on ligand reactivity and catalysis. It is not possible, in a small book, to discuss each reaction in detail, but he has given a brief description of each type of reaction, and in many cases has outlined the reaction mechanisms. The extensive lists of references (about one thousand in all) will lead the reader to more detailed reviews and to the original research papers.

As Jones suggests in his preface, it is an author's prerogative to decide which topics shall be covered extensively and which shall be given only a little space. In this case, the author has relied too heavily on what interests him, and has slighted some topics that are of greater importance to coordination chemistry as a whole, for example, hydrogenation and reactions of biological significance. However, this criticism may reflect only the reviewer's prejudices.

In a reference book such as this, the index is of paramount importance. Can one quickly find any topic that is discussed in the book? The subject index in this book covers only eight pages, but it passes the test with a good grade. The author index (13 pages) is also well arranged, even including references to articles mentioned in the book for which the authors' names are not mentioned. Among books about coordination compounds, this one must be almost unique in that it mentions Alfred Werner only once, and then only briefly.

This is a very useful book, and it will be widely read.

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