

Except for a short "digression" (chapter 4, on the nature of the electron distribution), the book emphasizes mathematical methods rather than physical concepts, and consequently it loses some of its educational value. For the well initiated, however, it does present a current, well-organized summary of the methods and approaches used.

After a brief but basic introduction the problems associated with many-electron wave functions, including configuration interaction and correlation, are outlined. On this foundation molecular orbital and valence bond theories are developed with a distinct emphasis on density matrix formalism. The monograph includes a chapter surveying solutions of Schrödinger's equation in the presence of magnetic and electric fields from a relativistic approach and concludes with an unsatisfactory attempt to compare the advantages and disadvantages of a few of the methods developed in the main body of the book.

In such a condensed treatment it is difficult to be comprehensive, and indeed the authors readily admit the deficiency of the book in this respect. As a survey the book is good and does an excellent job of bridging the chasm that developed historically between valence bond and molecular orbital theory, thereby giving a clear perspective to the importance of configuration interaction. It is not, however, the type of book one reads lightly with the expectation of gaining much insight into the physical implications of quantum mechanics; one gains insight only into the mathematical formalism that forms its basis. In short, the book is written for the theorist, not the experimentalist.

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## Heterogeneous Catalysis

**Catalysis by Nonmetals.** Rules for Catalyst Selection. OLEG V. KRYLOV. Translated from the Russian by Michael F. Delleo, Jr., George Dembinski, John Hoppel, and Alvin H. Weiss. Academic Press, New York, 1970, xii, 284 pp., illus. \$14. Physical Chemistry, vol. 17.

Heterogeneous catalysis is an old and difficult subject but it is of wide application. Thus the publication of a short account of a good half of this huge area should be of interest to the chemist looking for a solid state introduc-

tion to the field, the physicist searching for a reaction to be catalyzed by an interesting solid, and the molecular biologist interested in possible enzymatic analogies. The translation of this book, which was first published in Russian in 1967, is the result of a cooperative effort by four distinguished American catalytic scientists.

In spite of a large number of uncommon usages (duplet instead of doublet, for example) and the usual misspelling of names that have been transliterated twice (Pirson instead of Pearson, for example), the book is a readable introduction to the more theoretical aspects of heterogeneous catalysis by nonmetals. In fact, it is a guided tour of almost 700 references. If this were a guide to restaurants, it would resemble more a listing in the yellow pages of the telephone directory than a red Michelin guide. But maybe this is just a reflection of the author's stark realism: if he had been very critical, maybe he would never have written the book.

And that would have been a real loss because of the wealth of information, intuition, and data on catalysis viewed from the side of the solid. The survey of solid state properties from color to band gap in the first half of the book and the description of reactions from hydrogen-deuterium exchange to Ziegler-Natta polymerization is covering a large body of respectable, if inconclusive, research that cannot be ignored by anyone entering the field with the illusions of a neophyte. In fact, the book should be required reading for any mature scientist who looks at catalysis as a means to solve some of our environmental problems.

But this is not a book for the beginning student, who will be utterly lost by formulas without proof, concepts without proper introductions, and a very difficult logic that is best summarized by this paragraph (p. 63): "Nevertheless, in the overwhelming majority of recent works, the two-spiked diagram for change of catalytic activity of metal oxides of the fourth period in oxidation-reduction reactions is verified. The non-occurrence of this relationship in a given concrete case does not justify consideration of arguments against the expedience of applying crystal field theory in catalysis. In each case, it is necessary to seek a concrete explanation of a specific result."

I have checked this statement in the original version I bought two years ago in Moscow for 1 ruble and 20

kopecks. Maybe some words or expressions could be changed as a matter of taste or grammar, but the flavor of the original has not been lost. Whether a reader likes this flavor or not, he will benefit from Krylov's expert review, the completeness of which—up to 1964—should not be judged by the subject index, which is woefully inadequate.

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## Books Received

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