

The book is encyclopedic, clearly written from a geographical viewpoint, and profusely illustrated with good drawings and photographs. The authors draw heavily on the recent literature on Iceland, Greenland, and Antarctica. They incorporate observations and principles from over a thousand references, and although many of these involve theoretical physics and mathematics as applied to glaciers, the book has few formulas. It does not just describe glaciers and their effects, however, but attempts to provide an understanding of the processes involved. It is not a complete treatment of the subject because it does not go beyond the limits of present or past glaciers in its treatment of topics. Moreover, because of its focus on landforms and landscapes, it is weak in stratigraphy and correlation or chronology.

An impressive list of colleagues is acknowledged as having read parts of the manuscript. Most are Europeans and members of the International Glaciological Society; none works in the classical glacial stratigraphy of the midwestern or northwestern United States. Perhaps as a result, many major papers from those areas are not cited.

The authors remind us that a third of the land area of the earth has at one or more times been covered with glaciers. Historically, geomorphology started in Europe and was expanded in North America—these being areas that were heavily glaciated. The status and traditions of geomorphology differ from one country to another, as do those of what we call glacial geology. There has been a tendency for geologists in the United States to emphasize glacial stratigraphy and chronology and for geomorphology to be taught in geology departments. In most other countries geomorphology is most often taught in geography departments, and the emphasis is on landforms and landscapes. In recent years there has been a strong surge of interest in the subject on the part of glaciologists—those concerned with the physics of ice—and paleoclimatologists—those investigators from any field who can aid in the reconstruction of former climates. Because of the diversity of the disciplines involved in all these approaches, close cooperation and exchange of information have not always been achieved. The authors hope to unify these different approaches in their book, providing something for everyone, but retaining a focus on glacial geomorphology. Their success will have to be judged by the individual reader, but this reviewer considers their performance creditable indeed. No introductory

textbook can satisfy everyone. Still, even though the glacial geologists of central North America may feel short-changed by the discussion of stratigraphy, I warrant that they can benefit from the synthesis of the many views of others on the characteristics and dynamics of glaciers and on glacial landforms and landscapes.

In dealing with matters of scale, a major theme, the authors use a modified version of a terminology set out by Tricart. For the most part SI units are used. Numerous models are used to simplify and portray graphically the authors' systems approach to the subject. Many students and specialists alike will find them helpful, but, as the authors admit, they are simplistic.

ROBERT F. BLACK

*Department of Geology,
University of Connecticut, Storrs*

Heterogeneous Catalysis

Catalysis by Electron Donor-Acceptor Complexes. Their General Behavior and Biological Roles. KENZI TAMARU and MASARU ICHIKAWA. Kodansha, Tokyo, and Halsted (Wiley), New York, 1976. viii, 208 pp., illus. \$19.

Since the first striking experimental observation of a specific physical consequence of weak donor-acceptor interaction (the Benesi-Hildebrand observation of the benzene-iodine charge-transfer absorption band) and the first careful exposition of the nature of donor-acceptor interactions (by Mulliken in the 1950's), the concept of donor-acceptor interaction has been widely applied in the explanation of physical and chemical properties of interacting molecules. Indeed, since even rather strong interactions, such as the formation of hydrogen bonds, ion pairs, or highly ionic molecules such as lithium fluoride, can be discussed in terms of electron donor-acceptor interactions, the concept is potentially so broad as to be vague—all chemical bonding implies some charge transfer.

The core of Tamaru and Ichikawa's book is the fourth chapter, which provides a detailed summary of recent experimental work, very largely Japanese, on heterogeneous catalysis by donor-acceptor complexes. In this chapter, the term "donor-acceptor complex" is used quite carefully to refer to systems such as sodium-anthracene in which the interaction is specifically and clearly of charge-transfer type. The chapter de-

scribes work on a wide range of processes (ammonia synthesis, hydrogenation, butene isomerization, carbon dioxide reduction) for which catalysis by donor-acceptor complexes has been demonstrated and makes some cogent arguments about possible mechanisms. This work is important and highly specialized, and the present review by leaders in the field is timely and helpful.

In a certain sense, it is obvious that such solid materials as the phthalocyanines and certain aromatics, in which the number of carriers and other electronic properties, such as work function, can be varied within large limits simply by doping the materials with metal, could be employed to make highly selective catalysts. Tamaru and Ichikawa provide examples of cases for which such selectivity has indeed been demonstrated. They fail, however, to provide either an overview of or a general hypothesis regarding the actual means by which this selectivity can be achieved—too often the chapter reads like a compendium of what has been done, and little effort is made to rationalize the separate experimental data within even a phenomenological model of the causes of the processes. This undifferentiated exposition of fact is the major strength of the book, but also its major weakness. One would have hoped that the authors would provide a conceptual framework for their experiments.

The book also has several minor weaknesses. The second chapter, which discusses donor-acceptor complexes in general, is perfunctory and quite inferior to many similar presentations. Much of chapter 3, on homogeneous catalysis, fits rather badly with the subject of donor-acceptor catalysis. There are numerous minor errors (missing electrons in the equation on p. 2, confusion of donor with acceptor on p. 8, confusion over hydrogen bond lengths on p. 26, confusion of sigma bond with sigma complex on p. 138) and many misprints. There are also some confusing sections, such as that on the notion of localization energy on specific atoms, a nonstandard concept that is used but not defined. Also a book published in 1976 should not still claim that alkali and ammonium salts of tetracyanoquinodimethane show the highest conductivities of any organic material. Despite these drawbacks, this book is a useful review of important work and should be read by anyone concerned with heterogeneous catalysis.

MARK RATNER

*Department of Chemistry,
Northwestern University,
Evanston, Illinois*