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BOOK REVIEWS

Isotope Effects in Chemistry and Biology. Edited by Amnon Kohen (University of Iowa) and Hans-Heinrich Limbach (Freie Universität Berlin). CRC Press/Taylor and Francis Group: Boca Raton, FL. 2006. xiv + 1074 pp. $229.95. ISBN 0-9247-2449-6.

Kohen and Limbach have produced a massive text that broadly covers the subject of isotope effects in 42 chapters written by experts in the field. Collectively, the chapters demonstrate the very close connection between experiment and theory that is the hallmark of research on isotope effects. The book follows a logical progression of subjects beginning with a fitting perspective by Bigeleisen on the foundations of isotope effects, followed by chapters that elaborate further on theoretical considerations, isotope separation, and isotope enrichment. The chapters in the remainder of the book cover advanced computational research, applications of isotope effects, and spectroscopic studies for a wide range of chemical and biochemical systems.

The chapters on applications are appropriately rich in topics that concern hydrogen bonding, related proton transfers, and enzymatic reaction mechanisms and are interspersed with strong sections covering atmospheric isotope effects and spectroscopy. Noteworthy recurring themes in numerous chapters are the importance of anharmonic treatments of vibrational motions and the contributions of nuclear tunneling to isotope effects. These themes, and the focus on hydrogen bonds, may give a false impression that the book overemphasizes deuterium isotope effects; the book is so large, however, that there is ample coverage of heavy-atom isotope effects, including reviews of chlorine and oxygen isotope effects, as well as intriguing accounts of effects on reaction rates from exotic isotopes such as ^{11}C and muonium.

Among the engaging aspects of many chapters are the insights and admonitions freely offered by the authors. Some examples include guidelines on the use of electronic structure calculations for isotope-effect studies (Wolfsberg), the "cautionary notes on mutations at hydrogen-bonding sites in enzymes" (Schowen), advocacy for mass-spectrometric calibration scales based on absolute isotopic abundances (Roth, Létolle, Stevens, and Robert), warnings about the "intrinsically statistical character of the medium" in theoretical treatments of liquid-phase reaction rates (Truhlar), and an advisory on potentially small catalytic contributions from dynamics effects in enzymic reactions (Schwartz). Further examples are cautions against mistaking interpretations of measured isotope effects for experimental findings (Warshel, Olsson, and Villà-Freixa) and advice about using the substrate dependence of isotope effects to augment rather than replace conventional initial rate studies of enzymic kinetic mechanisms (Karsten and Cook).

All of the chapters begin with a helpful table of contents, and most have introductory sections that provide excellent background for the subsequent advanced material. If not for the high price, this book would make a good primary or supplemental text for multiple graduate courses covering subjects such as vibrational spectroscopy, enzyme mechanisms, reaction rate theory, or isotope separation and enrichment. Overall, Kohen and Limbach have produced a worthy and much needed successor to the series of books—Melander (1960), Collins and Bowman (1970), Cleland, O'Leary, and Northrop (1977), Melander and Saunders (1980), Cook (1991)—that have been so important to isotope-effect researchers and their students.

W. Phillip Huskey, *Rutgers University—Newark*

JA069717Y

10.1021/ja069717y CCC: $33.50 © xxxx American Chemical Society