

We see that the selection rule for such addition reactions depends on whether an even or odd number of phase changes are made, and thus such *addition reactions are favored where there are an odd number of π bonds in the relevant segments*. This is the same rule obtained by Woodward and Hoffmann⁴ from a completely different type of analysis using correlation diagrams for Hartree-Fock orbitals. An application of this same orbital phase continuity principle (OPCP) to electrocyclic and hydrogen-migration reactions again leads to the rules found by Woodward and Hoffmann for thermal reactions.^{4,5}

In the Woodward-Hoffmann approach one determines the symmetries of the bonding and antibonding molecular orbitals (essentially minimum basis set Hartree-Fock orbitals) and constructs a correlation diagram. In this approach molecular and orbital symmetry are crucial. In the OPCP approach we use just the bonding GI orbitals (for many cases these are very much like valence-bond orbitals). Here molecular and orbital symmetry are irrelevant. Thus the OPCP approach

for C_2F_4 plus butadiene the energy of the diradical intermediate is much lower and 2 + 2 cycloaddition dominates: P. D. Bartlett, *Science*, **159**, 833 (1968).

may be useful even for reactions along low-symmetry reaction paths and involving molecules of low symmetry and may provide a convenient means of predicting and discussing such reactions.

Woodward and Hoffmann⁵ have generalized their rules to cases for which correlation diagrams would be difficult or impossible to construct. For thermal reactions these rules are in general agreement with the predictions from OPCP. Trindle⁸ has proposed a way of using the nodal structure of MO's to analyze low-symmetry reactions. Since OPCP is based upon GI-type wave functions, it is more akin to valence-bond wave functions than to MO's, and there is no direct connection between these MO approaches and OPCP. More significant differences result for excited states, where the GI wave function can lead to descriptions quite different from the MO or Hartree-Fock wave functions.

(8) C. Trindle, *J. Amer. Chem. Soc.*, **92**, 3251, 3255 (1970).

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Book Reviews

Organic Fluorine Chemistry. By WILLIAM A. SHEPPARD, Central Research Department, E. I. du Pont de Nemours and Co., and CLAY M. SHARTS, San Diego State College. W. A. Benjamin, Inc., 2 Park Ave., New York, N. Y. 1969. xvi + 602 pp. 16 × 23.5 cm. \$30.00.

This book is a "must" for any organic chemist who has any interest in the field of fluorine chemistry, and even for the average organic chemist who wants to comprehend the effect of fluorine substitution in organic compounds.

Critical discussion of the theory of the carbon-fluorine bond adds to the importance of the book as a standard desk reference, since it compiles into one volume a thorough compilation of fluorine chemistry reviews. This book is an excellent example of the effectiveness of collaboration between industrial library organizations, which can compile all the available literature, with authors who are active in the field. The bibliography compiled by the library organization is faultless, and this is by itself enough to make this volume worthwhile. There should be more of this type of collaboration in the future.

This book is a welcome addition to the rather broad but specialized field of fluorine chemistry. The authors have done an excellent job, on the whole, in discussing the classical (pre-1960) methods of fluorination. This book should be a welcome complement to Hudlicky's earlier book in giving a critical evaluation of the various synthetic methods for introducing fluorine into the organic molecule.

There are some general criticisms, however. The typography could be better; it is quite difficult to read the printed material for any length of time and the tables are too compact.

The authors have not always given primary references, but in many instances have referred to another general review (e.g., Table 1-6, p 7) without giving proper credit to the people who actually carried out the work.

In referring to bond dissociation energies, the authors at one point refer to them as B(C-X) (see p 3) and later as D(C-X) (see p 16). One or the other should be used, not both.

The reviewer also is quite surprised that the critical character of this book seems to have lapsed in the discussion of the "Freon" process (p 77), which is described as operating at 30-40 atm. This process is as old and outmoded as the Model T. Another shortcoming is found in the section in which the authors describe the perfluorinated epoxides and their polymers. Very little mention is made of the outstanding contribution of Du Pont chemists in this field. Modesty may be a virtue; in this instance it is carried too far.

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Nitrenes. Edited by WALTER LWOWSKI, Research Center, New Mexico State University, Las Cruces, N. M. Interscience Publishers, John Wiley and Sons, Inc., 605 Third Ave., New York, N. Y. 1970. xi + 457 pp. 16 × 23 cm. \$23.50.

The definition of a nitrene is stated in the introductory chapter to the book: "the name nitrene stands for the electron-deficient, electroneutral molecule NH and its derivatives. The derivatives are formally produced by substitution of the hydrogens in NH. . . . The definition is based on the structure of the molecule, and not on any particular chemical property." The latter sentence is quite pertinent in that the chemistry of a particular derivative is markedly influenced by the nature of the group substituted for H in NH. While the name nitrene strongly resembles the name carbene, the chemistry of these two species is only mildly analogous, the strong-

est resemblance being observed for the carbalkoxy and the cyano-nitrene.

From a historical point of view nitrenes are quite old, the first one having been proposed in 1891. However, from a practical point of view, nitrene chemistry can be said to have its origins in the 1950's. Three reviews on this subject have been published, one each in 1959, 1963, and 1964, but the present book is quite timely in that it appears at the end of the mother lode period of nitrene chemistry, when every swing of the chemical pickaxe struck pay dirt. The going will be more difficult from now on, but anyone interested in working in or learning about this field can do so most profitably by studying this very comprehensive book. The book succeeds in accomplishing the desire stated by the Editor in the Preface, that "the authors... were encouraged to put forth their working hypotheses and speculations, so that the reader would be exposed to the ideas that govern the course of present and future nitrene research." Furthermore, the book was intentionally designed so that there would be some overlap between the various chapters, in the belief that this would expose the reader to different interpretations of cer-

tain observations and allow him to obtain comprehensive coverage of any topic by reading just one or two chapters. All the chapters contain more than just a compilation of nitrene chemistry; they present critical discussions of reactions which one might be tempted to interpret in terms of nitrene intermediates but very probably do not involve such a species.

All the chapters are well written but most are presented in the rather formal, dry technical style taught to all budding scientists and found in most journal articles. This tends to make the book somewhat dull and heavy but nevertheless useful as bedtime reading for insomniacs. An outstanding exception is the chapter by D. M. Lemal. He writes in loose, sometimes witty, chatty style more like a spoken presentation, which keeps the reader awake and attentive. It is a pity more of us do not write this way.

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