this outstanding Japanese work did not gain the attention of chemists in the Western world until well into the 1950's. Thereupon there was a tremendous proliferation of interest and scientific activity in the chemistry of heterocyclic *N*-oxides. In 1967, Ochiai published a monograph entitled *Aromatic Amine Oxides*, which became the definitive work on the subject, covering the literature through about 1964.

In the present monograph Katritzky and Lagowski survey the literature on heterocyclic *N*-oxides through March 1970. To avoid duplication and in line with their own research interests, the authors place less emphasis on historical development and spectral and biological properties of *N*-oxides than did Ochiai in his monograph. After an introductory chapter, Katritzky and Lagowski present methods of preparation of heterocyclic *N*-oxides and then, in the two succeeding chapters, deal with the reactions of *N*-oxides. The fact that a volume of this magnitude is appropriate so soon after Ochiai's work is testimony to the intense current activity in this field.

The style of the authors is quite terse, with heavy reliance on structural formulas and the use of tables, much in the manner of *Organic Reactions*. The tables are intended to be comprehensive, and my own testing in areas of particular interest shows them indeed to be so. There is a strong emphasis on a theoretical understanding of the physical properties and the role of the *N*-oxide function in the various heterocyclic *N*-oxides. Mechanistic interpretations, often original with the authors, are provided for the reactions exhibited by the *N*-oxides. Although one has to keep in mind that frequently these interpretations are only speculations, they are one of the real attractions of the monograph.

The authors use a novel system for references. Each reference is given a code number conveying the year of publication, the title of the journal, the volume number where necessary, and the page number. The references are cited by these numbers in parentheses in the text. The bibliography, which contains an explanation of the code, then compiles the references in order by code number (in effect, by year of publication), with a complete citation in conventional form. Clearly, this provides a great convenience for the authors, but it also cuts down the likelihood of introducing errors in compiling the bibliography. I did not find that this style of reference citation detracted from readability, and I would think other authors might wish to copy this device.

In conclusion this is a very useful monograph, presented in an imaginative and attractive manner, that brings up to date the published work in the fast growing field of *N*-oxide chemistry. It is an appropriate companion piece to Ochiai's authoritative work on the subject.

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Excited States

Photophysics of Aromatic Molecules. JOHN B. BIRKS. Wiley-Interscience, New York, 1970. xiv, 704 pp., illus. $29. Wiley Monographs in Chemical Physics.

Interactions between physicists, chemists, and biologists studying the physical and chemical properties of nonionic electronically excited states of molecules have been particularly fruitful in the last decade. Photophysics—which Birks defines as the science of measurement of physical (as opposed to chemical) properties of electronically excited states of molecules—has contributed to photochemistry and photobiology not only an essential body of data about excited states but an invaluable language for discussing those processes which occur before or in competition with photochemical transformations. Photochemistry in turn has contributed much to photophysics—for instance, kinetic methods for determining many excited-state parameters for molecules which do not exhibit luminescence often greatly simplify measurement of excited-state parameters for luminescent molecules also. Neither the photophysicist nor the photochemist/photobiologist can today afford not to be conversant with major developments in the other field. Therein lies a problem; despite their shared interests in common phenomena, photophysicists, photochemists, and photobiologists have still very different scientific backgrounds. Interdisciplinary education requires patience and hard work from both instructor and student. When the photophysicist teaches it is important for him to emphasize physical insights using an approach as strong as possible on intuition as opposed to mathematics. Conversely, the teaching chemist or biologist must help the photophysicist through the complexities of large molecules and systems which are from any fundamental point of view poorly understood by theory (and perhaps also experimenter). Recently, the photophysicists have provided several excellent texts describing selected aspects of photophysics of molecules.

Birks's book is known to me because I used it extensively last spring while teaching a course in photochemistry at the Bell Laboratories to physicists and electrical engineers involved in laser science and related fields. I found it to be an invaluable source of information about both photophysical theory and experiment. Explanations of theory seemed to be reasonably rigorous without demanding mathematical sophistication beyond that which should be acquired by the modern photochemist or photobiologist. But the chief value of this text to the practicing photochemist or photobiologist will be the extensive documentation and very clear presentation of the data available in this field. The 100 or so tables in the book range from a very useful presentation in the first chapter of structures of typical photophysical substrates—a task all too often omitted in original papers—to compilations of luminescence data which give results from 100 original sources or more. This book should prove extremely useful to anyone concerned with the properties of electronically excited states of molecules.

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Elementary Human Physiology. Labo-

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(Continued from page 580)

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