

silyl)-1-butyne is obtained. The nature of the intermediate lithium compounds formed from 1-alkynes and their utility for the synthesis of other organometallic and organic derivatives are now under investigation.

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## Book Reviews

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**Comparative Biochemistry. A Comprehensive Treatise. Volume VII.** Edited by MARCEL FLORKIN, Department of Biochemistry, University of Liege, Liege, Belgium, and HOWARD S. MASON, University of Oregon Medical School, Portland, Ore. Academic Press Inc., 111 Fifth Ave., New York, N. Y. 1964. xix + 476 pp. 16 × 23.5 cm. \$15.00, registered; \$13.00, subscription.

Volume VII is the last volume in the series on "Comparative Biochemistry" edited by Professors M. Florkin and H. S. Mason. The pattern of this volume is similar to that of the earlier ones. The book, titled "Supplementary Volume," contains xix plus 476 pages. It contains an author index and a subject index, plus a topical subject index covering Volumes I through VII. The reviews in this volume number five.

The first chapter, titled "Expressions of the Pentose Phosphate Cycle," is by N. G. Pon. The comparisons drawn emphasize mainly the detailed knowledge of the cycle as it is manifest in various organisms and in various tissues of mammals, which represent roughly one-half of the species which have been studied. The treatment in higher plants concerns the reductive pentose phosphate cycle and the oxidative pentose phosphate cycle. In the Closing Remarks, Pon focuses on the difficult question of assigning degree of primitiveness to these metabolic pathways.

In Chapter 2, P. W. Kent reviews "Chitin and Mucosubstances." Much of this chapter is devoted to an elucidation of the chemical structure of chitin. Distribution and biosynthetic pathways are also reviewed, as are the relationships to mucosubstances.

In Chapter 3, Ernest Schoffeniels discusses "Cellular Aspects of Active Transport." This subject benefits particularly from the comparative, *i.e.*, evolutionary scrutiny, and our understanding of bioevolution may conversely be aided by more penetrating comprehension of the mechanisms of action at the cell boundary. Also valuable is the presentation of data and interpretation of amino acid transport by a representative of the Belgian school which has studied these phenomena extensively. The treatment in this chapter leaves unsolved the many questions resting upon the decision of whether transport is a function of enzymic activities in the membrane or is explainable on a simpler basis. For some the choice is no longer a matter of interpretation but one of a firm premise; Schoffeniels' chapter provides some moderating influence.

In Chapter 4, W. C. Young reviews "The Hormones and Behavior." This, the shortest of the chapters, presents a treatment which is somewhat general in nature. No tables or figures are included.

Chapter 5 on "The Comparative Biochemistry of Antibiosis and Antibiotics" is by Maurice Welsch. The presence of the words Antibiosis and Antibiotics in the same title calls to mind that, while Pasteur seems to have discovered antibiosis, his known bias for vitalistic concepts would have interfered with a search for antibiotics, the chemical principles of the phenomenon of antibiosis. One wonders if so many decades would have intervened between the discovery of antibiosis and the discovery of antibiotics if a mechanist had been responsible for the former. In the 20 years of the era of antibiotics much knowledge has been accumulated on

these typically atypical substances. Welsch treats them in a comparative mode, and as derivatives of salient classes of metabolites. The author has thought deeply about the definition of antibiotic and chooses finally to regard them as structurally diverse substances having selective toxicity. Many chemists will be interested to learn of the extent to which mechanisms of action of the most used antibiotics have been identified.

Many of the reviews in this series are of high quality. The editors are, now that this treatise is complete, to be congratulated for their monumental accomplishment. The thousands of biochemists who contributed to the areas of knowledge which are reviewed should be congratulated for their labors of detail. When one peruses or reads this treatise, he will be led to conclude that biochemistry, as a body of scientific knowledge, has attained a large measure of maturity. Also, this court record supporting Kluyver's principle of "the unity of biochemistry" is an overwhelming document which itemizes Baldwin's concept of a "common, fundamental chemical ground plan" and extends Darwin's comment on "... all living things have much in common, in their chemical composition ..."

In a phrase, the biochemistry of various organisms is a comparison much more than it is a contrast, and this appraisal of the facts strengthens the faith that our fullest understanding of life will ultimately rest basically on knowledge such as that first published in chemical journals.

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**Polycyclic Hydrocarbons. Volumes 1 and 2.** By E. CLAR, University of Glasgow, Scotland. Academic Press Inc., Ltd., Berkeley Square House, Berkeley Square, London W1, England. 1964. 16 × 24 cm. Vol. 1: xxvii + 487 pp. \$18.00. Vol. 2: lvii + 487 pp. \$21.50.

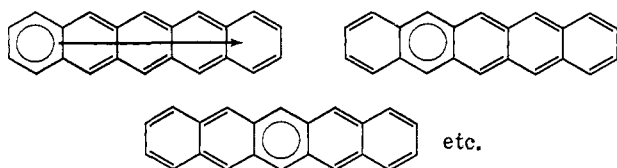
The second edition of Eric Clar's "Aromatische Kohlenwasserstoffe" was published in 1952, ten years after the appearance of his first edition. In 1952 it still appeared possible that the magnificent Elsevier's "Encyclopedia of Organic Chemistry" would continue to be published and would cover systematically and continuously the chemistry of the polycyclic hydrocarbons. Unfortunately, Elsevier's Encyclopedia was discontinued and it was necessary to rely on Beilstein with its limitations or hope that some knowledgeable and energetic author would continue Clar's admirable earlier work. How fortunate then, especially for readers of English, to have Clar himself, twelve years after the publication of the second edition of his German book, write these valuable treatises on polycyclic hydrocarbons.

Volume 1 is divided into two parts: Part I is devoted to what Clar calls "Kata-Annellated Hydrocarbons." Volume 2 is a

direct continuation of Volume 1; the only apparent reason for dividing the treatise into two parts is the desire to avoid an oversized single book. However, the principal advantage appears to be the perhaps inadvertent one, that individuals interested in understanding Clar's rather novel approach to polycyclic hydrocarbon chemistry need only purchase Volume 1 and rely on library copies for reference to compounds treated in Volume 2. Perhaps this possibility did not escape the publishers because each volume has a separate author index. Volume 2 starts with Part III and continues through Part XI; Parts III to IX inclusive treat what Clar calls "Peri-Condensed Hydrocarbons" and Parts X and XI treat some exotic hydrocarbons.

The theory discussed in the early chapters is rather weak, besides being occasionally wrong, and frequently ambiguous; much of it could have been omitted altogether. Chapters 6 through 9 are fascinating. These contain the heart of Clar's approach. They demonstrate how a master of the field can wield his material into powerful empirical generalizations that bring order and understanding out of the chaos of the multitudinous possible arrangements of fused hexagons. Here are elaborated the remarkable correlations Clar has been able to develop between absorption spectra, reactivity, and his annellation principles. His semi-empirical analysis of the spectra of the polycyclic hydrocarbons in terms of the  $p$ -,  $\alpha$ -, and  $\beta$ -band systems is now classic and is an extremely powerful tool.

According to the basic Clar classification, the polycyclic hydrocarbons may be divided into two main classes: Kata-annellated (frequently anglicized by other authors to cata-condensed), and peri-condensed. The cata-condensed hydrocarbons are those in which ring fusion is achieved by the sharing of only two carbon atoms between adjacent rings and thus all the carbon atoms in the system are on the periphery. The cata-condensed hydrocarbons are then further divided on the basis of the maximum number of linearly fused (or annellated) rings: one for benzene; two for naphthalene, phenanthrene, triphenylene, chrysene, 3,4-benzophenanthrene, picene, hexihelicene, etc.; three for anthracene, 1,2,5,6-dibenzanthracene, etc. When the bond distribution in the ring systems is drawn strictly in accord with the notation introduced (1925) by Sir Robert Robinson, to whom incidentally these volumes are dedicated, much is revealed about their properties. In this notation, the aromatic sextet only is indicated by a circle inside a hexagon. Thus, *e.g.*, the five equivalent resonance structures of pentacene are written



The five structures written as shown imply that two  $\pi$ -electrons migrate through the entire five rings of the acene and four  $\pi$ -electrons remain localized in each ring. (The arrow is intended to convey the concept of the mobility of the two  $\pi$ -electrons.) One sextet is thus shared among five rings and hence the benzenoid character is highly diluted. As a matter of fact, the linear seven-ring acene, heptacene, is so reactive it has yet to be prepared in a pure state. The higher acenes finally lose all aromatic character and become chemically similar to cyclic polyenes. The use of the circle to symbolize only the aromatic sextet not only emphasizes relative stability, but indicates the site of reactivity. Thus phenanthrene, the first member of the phene (systems with angular rings) series; is written with circles in each of the terminal rings and a double bond in the 9,10-position suggesting that this angular system is more stable than its linear isomer anthracene and that its reactivity is centered in the 9,10-bond.

Chapters 10 through 17 average about three pages each! Chapter 18 contains an authentic, if limited, account of the work that has been done on the carcinogenic properties of polycyclic hydrocarbons and is written by a guest author, Regina Schoental, who has herself made substantial contributions to this field. However, since there is no essential integration of this material with other portions of the book it seems somewhat out of place.

Volume 2 is devoted principally to the peri-condensed hydrocarbons. Most of these hydrocarbon systems have some carbon atoms which are common to more than two rings and hence there are usually carbon atoms present that are internal and are not on

the perimeter of the system. The admirable practice of including the absorption spectrum of each ring system under discussion is continued in this volume. Although there does not appear to be any drastic revision from the earlier German version, a substantial number of references to papers which have appeared since 1951 are given.

These books are made less valuable than they otherwise might have been by the lack of a subject index even though there is a generous table of contents. It is also regrettable that no serious effort was made to relate the absorption spectra analysis to the free electron model for cata-condensed hydrocarbons so brilliantly developed by Platt. However, these are on the whole minor drawbacks to a valuable contribution. Anyone interested in polycyclic hydrocarbons must have access to these books, and workers in the field will be rewarded by at least owning Volume 1.

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**Alkylation with Olefins.** By A. V. TOPCHIEV, S. V. ZAVGORODNIJ, and V. G. KRYUCHKOVA, Petroleum Institute, U.S.S.R. Academy of Sciences, Moscow. American Elsevier Publishing Co., Inc., 52 Vanderbilt Ave., New York, N. Y. 1964. ix + 306 pp. 15 × 23 cm. \$16.00.

The reviewer was unable to see a copy of the original Russian edition of the book and therefore he is uncertain whether the title was properly translated into English. If so, it is a most unfortunate selection of title, which seems to implement the treatment of alkylation with olefins as the general topic.

Perhaps the title should have read: "Some Preparative Aspects of Boron Trifluoride Catalyzed Alkylation with Olefins." The book in fact consists of selected specialized reviews of fields in which the authors themselves were active. The late Topchiev and his co-workers have done outstanding work in alkylation of carboxylic acids, aromatic hydrocarbons, phenols, and their derivatives, using alkenes as alkylating agents. Their studies predominantly involved the use of catalysts based on boron trifluoride. These studies are well summarized in the four chapters the book is composed of: "Alkylation of Organic Acids with Olefins," "The Alkylation of Aromatic Hydrocarbons with Olefins," "Alkylation of Phenols and Alkyl Aryl Ethers with Olefins in the Presence of  $BF_3$  Catalysts," and "Alkylation of Halophenols and Haloanisoles with Olefins in the Presence of  $BF_3$  Catalysts." There is an additional fifth chapter on "Autoxidation of Alkylaromatic Hydrocarbons" which does not fit too well into the scope of this collection although in their forward the authors stress their reasons for inclusion of this chapter. There is much merit in publishing summary reviews of the work of large research groups in its own field of specialization. It is, however, obvious that claiming that a collection of review papers of this type represents a comprehensive and fundamental coverage of a large field, such as alkylation with olefins, is misleading. The publisher of the translation claims on the dust jacket that the book is a recognized general standard text in its field. In my view this statement is not in accordance with the facts. The authors own introduction clearly states that only the results of Russian chemistry and in particularly those of the research group of the late Topchiev were reviewed.

The coverage of Russian literature pertaining to these catalysts appeared satisfactory and complete even to the extent of reproducing many detailed tables of operating conditions, yields, and physical properties of the products. But the coverage of non-Russian references is extremely sketchy. Therefore no attempt is made for comparison with recent comprehensive reviews.<sup>1,2</sup> Little or no account is given of the many interesting and significant side reactions which often accompany alkylation which other workers have described in considerable detail. For example, the work of Malchik and Hannan is dismissed with the mere statement that they studied the effect of  $BF_3$  catalyst concentrations. Papers by Schmerling and West (skeletal isomerization), Ipatieff, Pines, and Olberg (hydride transfer), and Friedman and Morritz

(1) S. H. Patinkin and B. S. Friedman in "Friedel-Crafts and Related Reactions," Vol. II, G. A. Olah, Ed., Interscience Div., John Wiley and Sons, Inc., New York, N. Y., 1964, Chapter XIV.

(2) "The Chemistry of Alkenes," S. Patai, Ed., Interscience Div., John Wiley and Sons, Inc., New York, N. Y., 1964.