

in the ureido carbon atom (equivalent to position 2 of orotic acid assuming closure to form a 6 membered ring). After growth in each instance, the washed cells were dried, ground, and treated with 5% trichloroacetic acid at 100° for 30 minutes. The liberated nucleic acids were degraded by hydrolysis in 1 *N* HCl at 100° for one hour.⁶ This procedure in our experience with *Lactobacillus bulgaricus* 09 yields free purines and variable proportions of pyrimidine nucleosides and pyrimidine nucleotides. The nucleic acid hydrolysates were chromatographed on paper against a tertiary butyl alcohol-HCl mixture.⁶ The eluted purine com-

pounds were chromatographed further on Dowex-50⁷ to satisfactory absorption ratios at 262/248 m μ . The eluted pyrimidine components similarly were chromatographed further on Dowex-1⁸ to satisfactory absorption ratios at 278/262 m μ . The purified purines and pyrimidine derivatives isolated, as well as aliquots of the orotic acid and ureidosuccinic acid used to promote growth in the two experiments, were counted with the results summarized in Table I.

Although interpretation of the data in Table I is complicated by a small factor of dilution in the pyrimidine derivatives isolated, it would appear that the following facts have been established: (a) as in the rat,^{9,10} orotic acid serves as a source of the pyrimidine components of ribonucleic acid, and, more significantly, (b) at least in the present system, ureidosuccinic acid is an acyclic biological precursor of the pyrimidine ring.

(7) W. E. Cohn, *Science*, **109**, 377 (1949).

(8) W. E. Cohn, *THIS JOURNAL*, **72**, 1471 (1950).

(9) S. Bergström, H. Arvidson, E. Hammarsten, N. A. Eliasson, P. Reichard, and H. v. Ubisch, *J. Biol. Chem.*, **177**, 495 (1949).

(10) L. L. Weed, M. Edmonds, and D. W. Wilson, *Proc. Soc. Exptl. Biol. & Med.*, **75**, 192 (1950).

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TABLE I
SUMMARY OF RADIOACTIVE ISOTOPE STUDIES

Growth factor	Compound studied	Activity counts/ μ M/min.
Orotic acid	Orotic acid	11,650 (0.143)
	Adenine	14 (0.390)
	Guanine	19 (1.62)
	Uridylic acid	7,500 (0.586)
	Cytidylic acid	7,950 (0.120)
Ureidosuccinic acid	Ureidosuccinic acid	12,060 (1.03)
	Adenine	0 (1.08)
	Guanine	17 (2.00)
	Uridylic acid	7,600 (1.21)
	Cytidine	7,000 (1.08)

All samples were counted on 1.33 sq. cm. plates with a windowless Q-gas counter. Figures in parentheses indicate the amount of compound in μ M counted.

(6) J. D. Smith and R. Markham, *Biochem. J.*, **46**, 509 (1950).

BOOK REVIEWS

Physical Aspects of Organic Chemistry. Fourth Edition. By WILLIAM A. WATERS, Sc.D., M.A., Ph.D. (Cantab.); M.A. (Oxon.); F.R.I.C.; Fellow of Balliol College, Oxford; University Lecturer and Demonstrator in Organic Chemistry, Oxford University. D. Van Nostrand Company, Inc., 250 Fourth Avenue, New York, N. Y., 1950. xii + 539 pp. 15 x 22 cm. Price, \$8.00.

The present edition of this book seems to be quite in keeping with the author's expressed intention of presenting the theories of organic chemistry in the framework of their historical development. Representative portions of the book which clearly adhere to this aim are to be found in Chapter XIV, which gives an excellent treatment of the evolution of the concepts of tautomerism, prototropy, etc., and in the material of Chapter XVII dealing with the beginnings of aromatic substitution theory. This historical approach has been rendered more valuable by the judicious incorporation of direct quotations from many classical papers in the field.

However, the impression was gained by this reviewer that, in certain sections of the volume at least, far more emphasis has been placed on the earlier phases of development of the science than on the more instructive and striking discoveries of the past twenty years. This stress on early papers at the expense of very recent work could lead to a mistaken impression of the present level of advancement of physical organic theory. The lack of updating is particularly apparent in the discussion of ionic reactions in general. Specific examples of this point are to be found in the con-

sideration of the Friedel-Crafts reaction as an addition-elimination process, the complete neglect of a possible ionic formulation (given by Criegee) for the reaction of lead tetraacetate with 1,2-glycols, and the overzealous presentation of the theory of alternating polarity to explain the reactivity of conjugated systems. In contrast to this treatment of ionic reactions, though, the corresponding sections involving free radical reactions have received a fairly thorough and stimulating discussion.

One rather undesirable feature resulting from the process of revision in this new edition is the presentation of a given subject in an incomplete form at an early point in the book (e.g., the section on the addition of halogens to olefins, on pp. 216-218), and the completion of this topic with new and pertinent data in a later chapter (pp. 320-322). Integration of both new and old references at one point would have led to a more forceful exposition.

Some mild criticism might be directed too at the hazy nature of certain portions of the treatment of reaction rate theories given in Chapter V. Hammett's ρ - σ correlation is given a very minimum of attention, and no clear distinction is made between the collision and transition-state theories. Also, a regrettable tendency to discuss solution reactions in terms of the collision theory is evident.

A very fine feature of the book is to be found in the authoritative treatment given to chapters dealing with the evaluation and significance of the physical properties of organic molecules. Here one finds a uniquely valuable discussion of the theoretical and experimental techniques em-

ployed, as well as the usual interpretation of results in terms of molecular structure.

In the matter of physical details concerning the volume, it might be noted that the proof-reading appears to have been somewhat cursory, since a large number of minor errors occur throughout in both the running text and formulas.

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Organic Syntheses. Volume 30. ARTHUR C. COPE, Editor-in-chief. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. 1950. vi + 115 pp. 15.5 × 23.5 cm. Price, \$2.50.

Volume 30 of "Organic Syntheses" contains directions for the preparation of thirty-nine organic compounds. The same high standards found in other volumes of this series are maintained in this volume and the specific preparations are well chosen as to the types of compounds and reactions. The subject index of Volume 29 was cumulative for volumes 20 to 29, and therefore the subject index of Volume 30 comprises material from that volume only.

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Chemical Kinetics. By KEITH J. LAIDLER, Associate Professor of Chemistry, The Catholic University of America. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 18, N.Y. 1950. ix + 408 pp. 16 × 24 cm. Price, \$5.50.

There is a definite need, which this book will fill, for a modern text-book which covers all aspects of chemical kinetics in a unified way. Laidler's book is particularly welcome since it gives a clear, concise, and understanding account of the work of the Eyring school, and such an account has been badly needed at the text-book level. An additional merit of the book is that theory is not too much divorced from experiment as tended to be the case with Glasstone, Eyring and Laidler's "Theory of Rate Processes." The student and the worker in the field will get from the book a very good appreciation of the accomplishments of the theory of absolute reaction rates and, in general, an excellent account of the whole field of chemical kinetics. The picture given of the theory of absolute reaction rates, however, is rather over-enthusiastic, and it seems a pity that the defects of the theory of absolute reaction rates are not pointed out as vigorously as are the defects of the collision theory. Also, for a text-book, it would have been desirable to show clearly the relationship of the two theories as is admirably done in the last edition of Hinshelwood's "Kinetics of Chemical Change" (pp. 235-239). The student should be told that frequently the only difference between the two theories is that they afford alternative methods of expressing our ignorance. In spite of these remarks, however, it should be emphasized that Laidler has admirably accomplished his main purpose of showing how chemical kinetics can be fitted into the framework of the theory of absolute reaction rates, and has produced by far the best modern text-book of chemical kinetics.

As far as the individual chapters are concerned, the author in view of his interests is naturally happiest in the purely theoretical part, and on reactions in the gas phase and in solution. The Introduction, and the chapters on the Mechanism of Elementary Processes, Elementary Gas-Phase Reactions and on Potential-Energy Surfaces are particularly well-done. The three chapters discussing Complex Reactions are well-presented, but are not as critical as they might be in some places. There are also some rather sketchy parts, especially the section on inhibition by nitric oxide. The attempt to cover all phases of Oxidation in twenty-eight pages will leave the reader rather confused.

A smaller coverage in greater detail might have been better, both here and in other parts of the book.

The chapter on Reactions on Surfaces and in the Solid State does not make any very serious attempt to discuss the merits of rival theories, or to appraise critically some long-standing ideas which have recently been coming under fire. It is also rather surprising in a book of this character that statistical methods of deriving adsorption equations have not been used.

The weakest chapter in the book is that on Experimental Methods. This might well have been omitted in a book devoted primarily to principles. As it is, a rather haphazard collection of methods are described, with many trivial details, and at least one of the examples given is an outstanding case of poor technique. Also, the author has neglected an excellent opportunity to emphasize the dangers of using methods of following reactions other than by chemical analysis.

While the book thus possesses some defects, these are thoroughly outweighed by its good points. It represents a very successful attempt to bring together diverse fields, and it gives an admirably lucid description of the application of complex theoretical ideas. The reviewer recommends the book most strongly to all students of chemical kinetics and to all workers in the field.

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BOOKS RECEIVED

February 10, 1951—March 10, 1951

E. R. BLOUT AND H. MARK (edited by). "Monomers, Section II." A collection of data and procedures on the basic materials for the synthesis of fibers, plastics, and rubbers. Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, N. Y. 1951. 257 pp. \$5.00.

HAROLD GOMES CASSIDY. "Adsorption and Chromatography." Technique of Organic Chemistry. Volume V. Arnold Weissberger, Editor. Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, N. Y. 1951. 360 pp. \$7.00.

DAVID M. GREENBERG (compiled and edited by). "Amino Acids and Proteins." Charles C. Thomas, Publisher, 301-327 East Lawrence Avenue, Springfield, Illinois. 1951. 950 pp. \$15.00.

F. RADT (edited by). "Elsevier's Encyclopædia of Organic Chemistry." Series III Carboisocyclic Condensed Compounds, Volume 12 B Naphthalene A. Compounds Containing One Naphthalene Nucleus. Part IV: Naphthalene-Oxo Compounds except Quinones. Elsevier Publishing Company, Inc., 250 Fifth Avenue, New York 1, N. Y. 1950. Pages 2189-2716. For subscribers to the complete work \$37.50, for subscribers to Series III only \$43.75, single volume \$50.00.

JOHN E. RICCI. "The Phase Rule and Heterogeneous Equilibrium." D. Van Nostrand Company, Inc., 250 Fourth Avenue, New York 3, N. Y. 1951. 505 pp. \$12.00.

ARNOLD WEISSBERGER (Editor). "Distillation." Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, N. Y. 1951. 668 pp. \$14.00.

F. E. W. WETMORE AND D. J. LEROY. "Principles of Phase Equilibria." McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 18, N. Y. 1951. 200 pp. \$3.50.

J. G. WILSON. "The Principles of Cloud-Chamber Technique." (Cambridge Monographs on Physics). Cambridge University Press, American Branch, 51 Madison Avenue, New York 10, N. Y. 1951. 131 pp. \$2.75.