elution of members of this group is related to the number of sugar hydroxyl groups and the extent of their dissociation. The ability of methanol–water mixtures to readily elute substances only slowly desorbed by water is due to the greater ionization of methanol (in water) as compared to water.[12] The effectiveness of a series of alcohols (aqueous) as eluents for cytidine was found to parallel roughly the published pK_a values,[12] *i.e.*, 2,2,2-trifluoroethanol > glycerol > ethylene glycol > methanol > ethanol > 1-propanol.

Recent progress in synthetic methodology has made available a large number of nucleosides and nucleoside analogs.[13–15] In the absence of those anchimeric effects leading to exclusive formation of the β-anomer, synthetic methods give mixtures of α- and β-anomers the total resolution of which is often difficult. The ease of resolution of such anomeric pairs on Dowex-1 (OH^-) is seen in Figure 1B and expt. 3 of the table. The separation of isomeric nucleosides resulting from the hydrolytic opening of 2′,3′-epoxide, 2,2′-anhydride, and other synthetic intermediates has also been achieved and has simplified the preparation of certain antimetabolites and chemotherapeutic agents. A specific example is the resolution of the mixture of cytidine and cytosine arabinoside obtained on hydrolysis of 2,2′-anhydro-1-β-D-arabinosylcytosine.[16]

Other applications of the method which are currently being investigated include (1) the quantitative isolation of certain O- and N-methylated nucleosides from soluble and ribosomal RNA's and (2) the resolution of alkali-stable derivatives of nucleosides which are employed as intermediates in the synthesis of nucleotides and polynucleotides.

Since the method is based on ion exchange, the amount of material which can be resolved is limited only by the dimensions of the column and the capacity of the resin employed. The use of volatile solvents for elution greatly simplifies product isolation.

(11) (a) R. Kuhn and H. Sobotka, *Z. physik. Chem.*, **109**, 65 (1924); (b) J. J. Fox and D. Shugar, *Biochim. Biophys. Acta*, **9**, 369 (1952).
(12) P. Ballinger and F. A. Long, *J. Am. Chem. Soc.*, **82**, 795 (1960).
(13) See reviews in A. M. Michelson, "The Chemistry of Nucleosides and Nucleotides," Academic Press Inc., New York, N. Y., 1963, Chapter 2; T. L. V. Ulbricht, *Angew. Chem. Intern. Ed. Engl.*, **1**, 476 (1962).
(14) (a) T. Sato, T. Simadate, and Y. Ishido, *Nippon Kagaku Zasshi*, **81**, 1440, 1442 (1960); (b) Y. Ishido and T. Sato, *Bull. Chem. Soc. Japan*, **34**, 347, 1374 (1961).
(15) M. J. Robins, W. A. Bowles, and R. K. Robins, *J. Am. Chem. Soc.*, **86**, 1251 (1964).
(16) See Table I, footnote *l*.

Charles A. Dekker
Department of Biochemistry
University of California, Berkeley, California
Received February 27, 1965

Book Reviews

Die Nucleinsäuren. Eine einführende Darstellung ihrer Chemie. Biochemie und Funktionen. By EBERHARD HARBERS. Institut für Medizinische Physik und Biophysik der Universität Göttingen. Georg Thieme Verlag. Postbach 732, Herdweg 63, 7000 Stuttgart 1, Germany. 1964. xii + 303 pp. 18 × 26 cm. DM 68.

This book offers a good guide to fundamental facts in nucleic acid biochemistry and structure. At the same time, it covers much of what is valuable and interesting in present-day work at the molecular (*i.e.*, macromolecular) biological frontiers. The approach is critical enough to distinguish in general between supported and provisional models, yet the style remains lively and agreeable. Illustrative material is very good, and the bibliography contains over two thousand items, fifty per cent of them from the years 1960–1963 and forty per cent from the preceding decade.

The work achieves considerably more critical evaluation and comprehensiveness than its origin as an expanded lecture series would ordinarily lead one to expect. The emphasis is concisely centered upon accumulated fact (and hypothesis) and only to a very limited extent upon a historical development of the several topics. On the other hand, the approach is naturalistic rather than intellectual; the nucleic acids are of interest because they exist and have significant roles in living cells—not as triumphant theoretical contributions of the human mind. The authors have not detracted from the brilliance of the mental powers focused on a DNA fiber in a darkened room or the beauty of the patterns derived when they clearly point out that an eminently measurable photographic plate and a clear monochromatic X-ray beam had first to operate in that dark chamber.

In fact, the section on physical studies of nucleic acids, contributed by W. Müller, is admirably thorough in presenting the physical, thermodynamic, and hydrodynamic approaches to nucleic acid structure. The principles and strengths generally taken for granted and the weaknesses commonly overlooked in the modern work or omitted from most short compendia are described here. The section on biochemistry of constituents by the same author is brief but includes essential reactions and an introduction to th newer chemical synthetic methods. The section by G. F. Domagk on metabolism of nucleotides is extensive and even includes a brief summary of nucleotide coenzyme functions. Harbers himself has contributed main sections dealing with localization in tissues, metabolism of nucleic acids, biosynthesis, and information transfer. These are remarkably up to date and objective in reporting a field which moves so fast. The level reached is that of the exceedingly well-informed biochemist or molecular biologist of 1963; perspective and critical judgment are only slightly weaker on the latest additions to the story. The newest physical studies on nucleic acids, ribosomes, etc., appear here rather than in the chapter on physical methods.

If this reviewer were to attempt the classical "sampling in depth" for his own specialty, information transfer, he would have mainly to report a satisfactory breadth, with a certain relative lack of emphasis. Whereas 30 pages are devoted to tumor biochemistry, two-thirds of it to drug therapy, only 3 pages are given to the transformations (with 1 for transduction and 10 for virus chemistry) that within the past two decades convinced everyone of the importance of nucleic acids. The genetic coding mechanisms are well-covered elsewhere, so if there is any weak emphasis, it is on the biological side of transfer. One misconception might be noted, although it is a frequently misinterpreted subject: heat inactivation of transforming agents is pictured as it once was, as inactivation of genetic function, whereas it has been shown in papers actually referred to as inactivation of ability of DNA to be incorporated into cells, without loss of linkages or intrinsic activity.

It may be surprising too that in a work that presents nucleic acids as works of nature rather than of man, so little attention is paid to the overwhelming and empirical fact that base compositions of nucleic acids of different species are so different. No tables are given, and the fact itself slips in in two or three lines of text almost unnoticed, as the underlying assumption toward which certain chemical and physical searches for homologies are directed.

A respectful but welcome calmness characterizes the treatment of sequence homologies as tested by complex formation and the inductive analysis of nucleic acid by reasoning retrospectively from protein structure.

Illustrative material—graphs, metabolic schemes, tabulated information—are excellent; nearly one-half appears to be composed by the authors. An appendix describing several tested working methods, somewhat arbitrarily chosen but again objective and up to date, concludes the volume. The methods include analytical, chromatographic, metabolic, preparative, and degradative chemistry, and a few modern physical ones such as low shear viscometry. The enormous bibliography furnishes approach to virtually all aspects of the literature and history.

This book is recommended as an acceptable and agreeable small reference work on nucleic acids which will bring the chemist and biologist up to date in a reasonably objective fashion better than anything except wearying excursions into hypnosis in constant contemplation of the current literature.

Rollin D. Hotchkiss
The Rockefeller Institute
New York, New York 10021

BOOKS RECEIVED, *July 1965*

J. B. BIRKS, General Editor, and J. HART, American Editor. "Progress in Dielectrics." Volume 6. Academic Press Inc., 111 Fifth Ave., New York, N. Y. 1965. 334 pp. $14.50.

HARRIS BUSCH. "Histones and Other Nuclear Proteins." Academic Press Inc., 111 Fifth Ave., New York, N. Y. 1965. 266 pp. $9.50.

PIERRE CRABBÉ. "Optical Rotatory Dispersion and Circular Dichroism in Organic Chemistry." Holden-Day, Inc., 728 Montgomery St., San Francisco, Calif. 1965. 378 pp. $11.75.

A. DAUVILLIER. "The Photochemical Origin of Life." Academic Press Inc., 111 Fifth Ave., New York, N. Y. 1965. 193 pp. $7.50.

WILHELM EITEL. "Silicate Science." Volume II. "Glasses, Enamels, Slags." Academic Press Inc., 111 Fifth Ave., New York, N. Y. 1964. 707 pp. $26.00, list; $23.00, subs.

HARRY L. FRISCH and JOEL L. LEBOWITZ. "The Equilibrium Theory of Classical Fluids. A Lecture Note and Reprint Volume." W. A. Benjamin, Inc., 1 Park Ave., New York, N. Y. 1964. 518 pp. $10.00, cloth edition; $5.95, paperback edition.

R. M. FRISTROM and A. A. WESTENBERG. "Flame Structure." McGraw-Hill Book Co., 330 West 42nd St., New York, N. Y. 1965. 424 pp. $17.50.

N. GLINKA. Translated from the Russian by DAVID SOBOLEV. "General Chemistry." Gordon and Breach Science Publishers, 150 Fifth Ave., New York, 11, N. Y. 1965. 694 pp. $17.50.

BERNARD G. HARVEY. "Nuclear Chemistry." Prentice-Hall, Inc., Englewood Cliffs, N. J. 1965. 120 pp. $1.95, paper; $3.95, cloth.

HERBERT O. HOUSE. "Modern Synthetic Reactions." W. A. Benjamin, Inc., 1 Park Ave., New York, N. Y. 1965. 309 pp. $9.00.

ARNE JENSEN. "Exchange Reactions of Bis-Cyclopentadienyltitanium(IV) Complexes. Equilibrium and Kinetics." Akademisk Forlag, Kobenhavn K, Denmark. 1965. 201 pp. d. kr. 36,00.

JIŘÍ KUCHARSKÝ and LUDĚK SAFAŘÍK. "Titrations in Non-Aqueous Solvents." American Elsevier Publishing Co., Inc., 52 Vanderbilt Ave., New York 17, N. Y. 1965. 286 pp. $12.50.

EDWIN M. LARSEN. "Transitional Elements." W. A. Benjamin, Inc., 1 Park Ave., New York, N. Y. 1965. 183 pp. $2.45, paperback; $4.95, cloth edition.

MICHAEL LEDERER, Editor. "Chromatographic Reviews. Progress in Chromatography, Electrophoresis and Related Methods." Volume 7. American Elsevier Publishing Co., Inc., 52 Vanderbilt Ave., New York, N. Y. 1965. 202 pp. $11.50.

PATRICK MEARES. "Polymers. Structure and Bulk Properties." D. Van Nostrand Co., Inc., 120 Alexander St., Princeton, N. J. 1965. 381 pp. $12.50.

EUGEN MÜLLER, Editor. With O. BAYER, G. MEERWEIN, and K. ZIEGLER. "Methoden der Organischen Chemie (Houben-Weyl). Vierte, Völlig neu Gestaltete Auflage." Band VI/3. "Sauerstoff-Verbindungen I." Teil 3. Georg. Thieme Verlag, Postfach 732, Herdweg 63, 7000 Stuttgart 1, Germany. 1965. 832 pp. Moleskin DM 212; Vorbestellpreis, DM 190,80.

HANS NEURATH, Editor. "The Proteins. Composition, Structure and Function." Volume III. 2nd Edition. Academic Press Inc., 111 Fifth Ave., New York, N. Y. 1965. 585 pp. $21.00, list; $18.50, subs.

ERWIN PARTHÉ. "Crystal Chemistry of Tetrahedral Structures." Gordon and Breach Science Publishers, 150 Fifth Ave., New York 11, N. Y. 1965. 176 pp. $9.50.

PAUL PASCAL, Editor. "Nouveau Traité de Chimie Minérale." Tome XX. Troisième Fascicule. "Alliages Métalliques (Suite)." Masson et Cie., 120, Boulevard Saint-Germain, Paris 6, France. 1964. 3136 pp. Broché, 205 F.; Cartonné toile, 217 F.

SAUL PATAI, Editor. "The Chemistry of Alkenes." Interscience Publishers, John Wiley and Sons, Inc., 605 Third Ave., New York, N. Y. 1964. 1315 pp. $37.00.

B. PAVLOV and A. TERENTYEV. Translated from the Russian by BORIS BELITZKY. "Organic Chemistry." Gordon and Breach Science Publishers, 150 Fifth Ave., New York 11, N. Y. 1965. 568 pp. $16.00.

F. M. PEREL'MAN. Translated by R. G. P. TOWNDROW. English translation edited by R. W. CLARKE. "Rubidium and Caesium." The Macmillan Co., 60 Fifth Ave., New York 11, N. Y. 1965. 146 pp. $9.00.

WILLIAM H. SAUNDERS, JR. "Ionic Aliphatic Reactions." Prentice-Hall, Inc., Englewood Cliffs, N. J. 1965. 113 pp. $1.95, paper; $4.50, cloth.

J. C. P. SCHWARZ, Editor. "Physical Methods in Organic Chemistry." Holden-Day, Inc., 728 Montgomery St., San Francisco, Calif. 1965. 350 pp. $9.75.

RORERT F. STEINER. "The Chemical Foundations of Molecular Biology." D. Van Nostrand Co., Inc., 120 Alexander St., Princeton, N. J. 1965. 468 pp. $12.00.

J. C. SYLVESTER, Editor. "Antimicrobial Agents and Chemotherapy—1964. Proceedings of the Fourth Interscience Conference on Antimicrobial Agents and Chemotherapy, New York, N. Y., 26–28 October 1964." American Society for Microbiology, 115 Huron View Blvd., Ann Arbor, Mich. 1965. 789 pp. $15.00.

B. TREMILLION. "Les Séparations par les Résines Échangeuses D'ions." Gauthier-Villars et Cie., 55, quai des Grands-Augustins, Paris VI, France. 1965. 400 pp. Cartonné toile, 90 F.