



Handbook of Biochemistry and Molecular Biology

3rd Edition

**Physical and Chemical Data
Volume I**

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CRC PRESS, Inc.
18901 Cranwood Parkway • Cleveland, Ohio 44128

Library of Congress Cataloging in Publication Data (Revised)

Main entry under title:

Handbook of biochemistry and molecular biology.

Previous editions published under title: Handbook of biochemistry.

Includes bibliographies and indexes.

CONTENTS: A. Proteins. 2. v.—B. Nucleic acids. 2. v.—C. Lipids, carbohydrates, steroids.— D. Physical and chemical data, miscellaneous.

1. Biological chemistry — Handbooks, manuals, etc.

2. Molecular biology — Handbooks, manuals, etc.

I. Fasman, Gerald D. II. Sober, Herbert Alexander, 1918— [DNLM: 1. Biochemistry — Tables.

2. Molecular biology — Tables. QU16 H235]

QH345.H347 1975 574.1'92 75-29514
ISBN 0-87819-509-2 (v.1)

This book presents data obtained from authentic and highly regarded sources. Reprinted material is quoted with permission, and sources are indicated. A wide variety of references are listed. Every reasonable effort has been made to give reliable data and information but the editor and the publisher cannot assume responsibility for the validity of all materials or for the consequences of their use.

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International Standard Book Number (ISBN)

Complete Set 0-87819-503-3

Physical and Chemical Data, Miscellaneous 0-87819-509-2

Library of Congress Card No. 75-29514

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PREFACE

The rapid pace at which new data is currently accumulated in science presents one of the significant problems of today — the problem of rapid retrieval of information. The fields of biochemistry and molecular biology are two areas in which the information explosion is manifest. Such data is of interest in the disciplines of medicine, modern biology, genetics, immunology, biophysics, etc., to name but a few related areas. It was this need which first prompted CRC Press, with Dr. Herbert A. Sober as Editor, to publish the first two editions of a modern *Handbook of Biochemistry*, which made available unique, in depth compilations of critically evaluated data to graduate students, post-doctoral fellows, and research workers in selected areas of biochemistry.

This third edition of the *Handbook* demonstrates the wealth of new information which has become available since 1970. The title has been changed to include molecular biology; as the fields of biochemistry and molecular biology exist today, it becomes more difficult to differentiate between them. As a result of this philosophy, this edition has been greatly expanded. Also, previous data has been revised and obsolete material has been eliminated. As before, however, all areas of interest have not been covered in this edition. Elementary data, readily available elsewhere, has not been included. We have attempted to stress the areas of today's principal research frontiers and consequently certain areas of important biochemical interest are relatively neglected, but hopefully not totally ignored.

This third edition is over double the size of the second edition. Tables used from the second edition without change are so marked, but their number is small. Most of the tables from the second edition have been extensively revised, and over half of the data is new material. In addition, a far more extensive index has been compiled to facilitate the use of the Handbook. To make more facile use of the Handbook because of the increased size, it has been divided into four sections. Each section will have one or more volumes. The four sections are titled:

Proteins — Amino Acids, Peptides, Polypeptides, and Proteins

Nucleic Acids — Purines, Pyrimidines, Nucleotides, Oligonucleotides, tRNA, DNA, RNA

Lipids, Carbohydrates, Steroids

Physical and Chemical Data, Miscellaneous — Ion Exchange, Chromatography, Buffers, Miscellaneous, e.g., Vitamins

By means of this division of the data, we can continuously update the *Handbook* by publishing new data as they become available.

The Editor wishes to thank the numerous contributors, Dr. Herbert A. Sober, who assisted the Editor generously, and the Advisory Board for their counsel and cooperation. Without their efforts this edition would not have been possible. Special acknowledgments are due to the editorial staff of CRC Press, Inc., particularly Ms. Susan Cubar Benovich, Ms. Sandy Pearlman, and Mrs. Gayle Tavens, for their perspicacity and invaluable assistance in the editing of the manuscript. The editor alone, however, is responsible for the scope and the organization of the tables.

We invite comments and criticisms regarding format and selection of subject matter, as well as specific suggestions for new data (and their sources) which might be included in subsequent editions. We hope that errors and omissions in the data that appear in the Handbook will be brought to the attention of the Editor and the publisher.

Gerald D. Fasman
Editor
August 1975

PREFACE TO PHYSICAL AND CHEMICAL DATA, MISCELLANEOUS:
ION EXCHANGE, CHROMATOGRAPHY, BUFFERS,
MISCELLANEOUS, E.G., VITAMINS, VOLUME I

This section of the *Handbook of Biochemistry and Molecular Biology* on Physical and Chemical Data is divided into two volumes.

The first volume contains data on amino acids which consists of the coefficients of solubility in water, heat capacities, entropies of formation, and heats of combustion. Oxidation-reduction potentials of compounds of biochemical interest and of hemoproteins and metalloproteins are listed. Heats of proton ionization, pK and related thermodynamic quantities, free energies of hydrolysis and decarboxylation, and calorimetric ΔH values accompanying conformational changes of macromolecules in solution are listed. Information on the measurement of pH, buffer solutions, pH indicators, and the ionization constants of acids and bases are detailed.

Tables of refractive index of water, various solvents, salt solutions, liquids, temperature dependence, and Lorentz corrections are available.

Specific gravity of liquids, sucrose solutions, CsCl solutions, isokinetic glycerol and sucrose gradients for density gradient centrifugation, and the temperature dependence for selected compounds are included.

This collection of data, for which the editor alone is responsible, is highly selective in nature. It is hoped that this volume will be of assistance to those working in the field of biochemistry and molecular biology.

Gerald D. Fasman
Editor
March 1976

THE EDITOR

Gerald D. Fasman, Ph.D., is the Rosenfield Professor of Biochemistry, Graduate Department of Chemistry, Brandeis University, Waltham, Massachusetts.

Dr. Fasman graduated from the University of Alberta in 1948 with a B.S. Honors Degree in Chemistry, and he received his Ph.D. in Organic Chemistry in 1952 from the California Institute of Technology, Pasadena, California. Dr. Fasman did postdoctoral studies at Cambridge University, England, Eidg. Technische Hochschule, Zurich, Switzerland, and the Weizmann Institute of Science, Rehovoth, Israel. Prior to moving to Brandeis University, he spent several years at the Children's Cancer Research Foundation at the Harvard Medical School. He has been an Established Investigator of the American Heart Association, a National Science Foundation Senior Postdoctoral Fellow in Japan, and recently was a John Simon Guggenheim Fellow.

Dr. Fasman is a member of the American Chemical Society, a Fellow of the American Association for the Advancement of Science, Sigma Xi, The Biophysical Society, American Society of Biological Chemists, The Chemical Society (London), the New York Academy of Science, and a Fellow of the American Institute of Chemists. He has published 180 research papers.

The Editor and CRC Press, Inc. would like to dedicate this third edition to the memory of Eva K. and Herbert A. Sober. Their pioneering work on the development of the Handbook is acknowledged with sincere appreciation.

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Nomenclature

BIOCHEMICAL NOMENCLATURE

This synopsis of the recommendations of the IUPAC-IUB Commission on Biochemical Nomenclature (CBN) was prepared by Waldo E. Cohn, Director, NAS-NRC Office of Biochemical Nomenclature (OBN), located at Biology Division, Oak Ridge National Laboratory, Oak Ridge, TN 37830, from whom reprints of the CBN publications listed below and on which the synopsis is based are available.

The synopsis is divided into three sections: Abbreviations, symbols, and trivial names. Each section contains material drawn from the documents (A1 to C1, inclusive) listed below, which deal with the subjects named.

Additions consonant with the CBN Recommendations have been made by OBN throughout the synopsis.

RULES AND RECOMMENDATIONS AFFECTING BIOCHEMICAL NOMENCLATURE AND PLACES OF PUBLICATION (AS OF FEBRUARY 1975)

- I. IUPAC-IUB Commission on Biochemical Nomenclature
 - A1. Abbreviations and Symbols [General; Section 5 replaced by A6]
 - A2. Abbreviated Designation of Amino-acid Derivatives and Peptides (1965) [Revised 1971; Expands Section 2 of A1]
 - A3. Synthetic Modifications of Natural Peptides (1966) [Revised 1972]
 - A4. Synthetic Polypeptides (Polymerized Amino Acids) (1967) [Revised 1971]
 - A5. A One-letter Notation for Amino-acid Sequences (1968)
 - A6. Nucleic Acids, Polynucleotides, and their Constituents (1970)
 - B1. (Nomenclature of Vitamins, Coenzymes, and Related Compounds)
 - a. Miscellaneous [A, B's, C, D's, tocols, niacins; see B2 and B3]
 - b. Quinones with Isoprenoid Side-chains: E, K, Q [Revised 1973]
 - c. Folic Acid and Related Compounds
 - d. Corrinoids: B-12's [Revised 1973]
 - B2. Vitamins B-6 and Related Compounds [Revised 1973]
 - B3. Tocopherols (1973)
 - C1. Nomenclature of Lipids (1967) [Amended 1970; see also II, 2]
 - C2. Nomenclature of α -Amino Acids (1974) [See also II, 5]
 - D1. Conformation of Polypeptide Chains (1970) [See also III, 2]
 - E1. Enzyme Nomenclature (1972)^a [Elsevier (in paperback); Replaces 1965 edition.]
 - E2. Multiple Forms of Enzymes (1971) [Chapter 3 of E1]
 - E3. Nomenclature of Iron-sulfur Proteins (1973) [Chapter 6.5 of E1]
 - E4. Nomenclature of Peptide Hormones (1974)
- II. Documents Jointly Authored by CBN and CNOC [See III]
 1. Nomenclature of Cyclitols (1968) [Revised 1973]
 2. Nomenclature of Steroids (1968) [Amended 1971; Revised 1972]
 3. Nomenclature of Carbohydrates-I (1969)
 4. Nomenclature of Carotenoids (1972) [Revised 1975]
 5. Nomenclature of α -Amino Acids (1974) [Listed under I, C2 in the following table]
- III. IUPAC Commission on the Nomenclature of Organic Chemistry (CNOC)
 1. Section A (Hydrocarbons), Section B (Heterocyclics): *J. Am. Chem. Soc.*, 82, 5545;^a Section C (Groups containing N, Hal, S, Se/Te): *Pure Appl. Chem.*, 11, Nos. 1-2^a [A, B, and C Revised 1969:^a Butterworth's, London (1971)]
 2. Section E (Stereochemistry):^b *J. Org. Chem.*, 35, 2489 (1970); *Biochim. Biophys. Acta*, 208, 1 (1970); *Eur. J. Biochem.*, 18, 151 (1970) [See also I, D1]

^aNo reprints available from OBN; order from publisher.

^bReprints available from OBN (in addition to all in IA to ID and II).