

COMPARATIVE BIOCHEMISTRY

A Comprehensive Treatise

Edited by MARCEL FLORKIN
HOWARD S. MASON

Volume III

CONSTITUENTS OF LIFE

Part A

COMPARATIVE BIOCHEMISTRY

A Comprehensive Treatise

Edited by

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Volume III

CONSTITUENTS OF LIFE—PART A

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Preface

In order to provide a systematic comparison of the biochemical phenomena of life throughout the phylogenetic scale, *Comparative Biochemistry* has been organized as follows: Volumes I and II are primarily concerned with the biological transformations of energy, Volumes III and IV with the biological transformations of matter, and Volumes V and VI with the properties of the organized systems occurring in living organisms.

Thus, the present volumes, III and IV, are devoted to the principal classes of constituents of cells and organisms, their distribution, and the comparative enzymology of their biogenesis and metabolism. The comparison of *structure and distribution*, on the one hand, and *metabolism*, on the other, require different types of specialized knowledge; we have asked two different authors, when necessary, to describe these different aspects of the composition of living organisms.

In the main, organisms are made up of fatty acids and lipids, mono- and polysaccharides, amino acids and proteins, nucleotides and nucleic acids, and water. This is an aspect of biochemical unity to which, on earth at least, there appears to be no exception. It is logical to arrange the chapters in these volumes to emphasize this unity. There are also numbers of other structural classes of metabolic components which occur only in portions of the phylogenetic scale; these less usual components illustrate the diversity of life.

The editors, although they have preferred to delay publication of individual volumes rather than have chapters appear out of their organized context, have been confronted with serious difficulties arising from the necessity of translating manuscripts written in languages other than English, and of insuring the publication of texts already received without too long a delay. They have therefore decided not to postpone the printing of chapters already on hand. This somewhat upsets the original plan of organization which, nevertheless, continues to underlie the treatise as a whole.

Among the chapters of Volume III of *Comparative Biochemistry* is printed the last publication of Professor W. Bergmann of Yale University. The chapter he has written is the result of many years of study, and will remain a testimony to his high competence in this field, as well as a

sign of his devotion to comparative biochemistry, of which he was one of the undisputed pioneers.

The publishers have continued to provide us with prompt and reliable technical assistance, and we are grateful to them.

M. FLORKIN
Liège, Belgium

H. S. MASON
Portland, Oregon

December, 1961

COMPARATIVE BIOCHEMISTRY

A Comprehensive Treatise

Volume I: Sources of Free Energy

An Introduction to Comparative Biochemistry

MARCEL FLORKIN AND HOWARD S. MASON

Thermodynamics of Living Systems

HENRY EYRING, RICHARD P. BOYCE, AND JOHN D. SPIKES

Comparative Mechanisms for Fatty Acid Oxidation

P. K. STUMPF AND G. A. BARBER

Phosphoric Acid Anhydrides and Other Energy-Rich Compounds

F. M. HUENNEKENS AND H. R. WHITELEY

Onium Compounds and Their Biological Significance

G. L. CANTONI

Phototropism and Phototaxis

KENNETH V. THIMANN AND GEORGE M. CURRY

The Distribution and Evolution of Visual Systems

GEORGE WALD

Aerobic and Anaerobic Reactions of Inorganic Substances

CLAUDE FROMAGEOT AND JACQUES C. SENEZ

Comparative Biochemistry of Glycolysis

ERNEST BUEDING AND EMMANUEL FARBER

Comparative Biochemistry of Electron Transport and Oxidative Phosphorylation

ERIC E. CONN

Utilization of Thermal Energy by Living Organisms

MARY BELLE ALLEN

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M. R. ATKINSON AND R. K. MORTON

Utilization of Free Energy for the Biosynthesis of Saccharides

LUIS F. LELOIR, CARLOS E. CARDINI, AND ENRICO CABIB

Comparative Biochemistry of Free Energy Utilization for the Biosynthesis of Peptides and Proteins

H. CHANTRENNE

Ammonia Metabolism and Urea Biosynthesis

PHILIP P. COHEN AND GEORGE W. BROWN, JR.

Muscular Contraction

S. V. PERRY

Other Mechanisms Producing Movements

HARTMUT HOFFMANN-BERLING

Active Transport

B. ANDERSEN AND H. H. USSING

Balance of Water, Electrolytes, and Nonelectrolytes

FREDA BROWN AND W. D. STEIN

The Mechanisms of Osmoregulation

J. SHAW

Nerve Conduction and Electrical Discharge

MICHAEL A. GEREBTZOFF AND ERNEST SCHOFFENIELS

Bioluminescence

E. NEWTON HARVEY

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T. L. V. ULBRICHT

Cellulose, Starch, and Glycogen

J. S. BRIMACOMBE AND M. STACEY

The Biogenesis of Lignin

F. F. NORD AND WALTER J. SCHUBERT

Nucleic Acids

GEORGE BRAWERMAN AND HERMAN S. SHAPIRO

Protein Molecules: Intraspecific and Interspecific Variations

ALLEN VEGOTSKY AND S. W. FOX

Metabolism of Aromatic Amino Acids

L. M. HENDERSON, R. K. GHOLSON, AND C. E. DALGLIESH

Structural and Chemical Properties of Keratin-Forming Tissues

A. GEDEON MATOLTSY

Sclerotization

M. G. M. PRYOR

Silk and Other Cocoon Proteins

K. M. RUDALL

Blood Coagulation

CHARLES GRÉGOIRE AND HENRY J. TAGNON

Metamorphosis and Biochemical Adaptation in Amphibia

THOMAS PETER BENNETT AND EARL FRIEDEN

Porphyrins: Structure, Distribution, and Metabolism

C. RIMINGTON AND G. Y. KENNEDY

Pteridines: Structure and Metabolism

HUGH S. FORREST

Carotenoids: Structure, Distribution, and Function

T. W. GOODWIN

Comparative Biochemistry of the Alkali Metals

H. B. STEINBACH

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* Most of the names refer to phyla, except in a few cases where some of the smaller taxonomic groups are shown. Capitalized names written across lines are groups including all forms above the name.

NOTE: Charts I, II, and III were prepared by Helen A. Stafford, Reed College, Portland, Oregon. For further information see "A Guide to the Nomenclature and Classification of Organisms," by Dr. Stafford, in Vol. I of this treatise.

CHART I

HYPOTHETICAL PHYLOGENETIC RELATIONSHIPS

BETWEEN EXTANT MAJOR GROUPS

OF ORGANISMS*

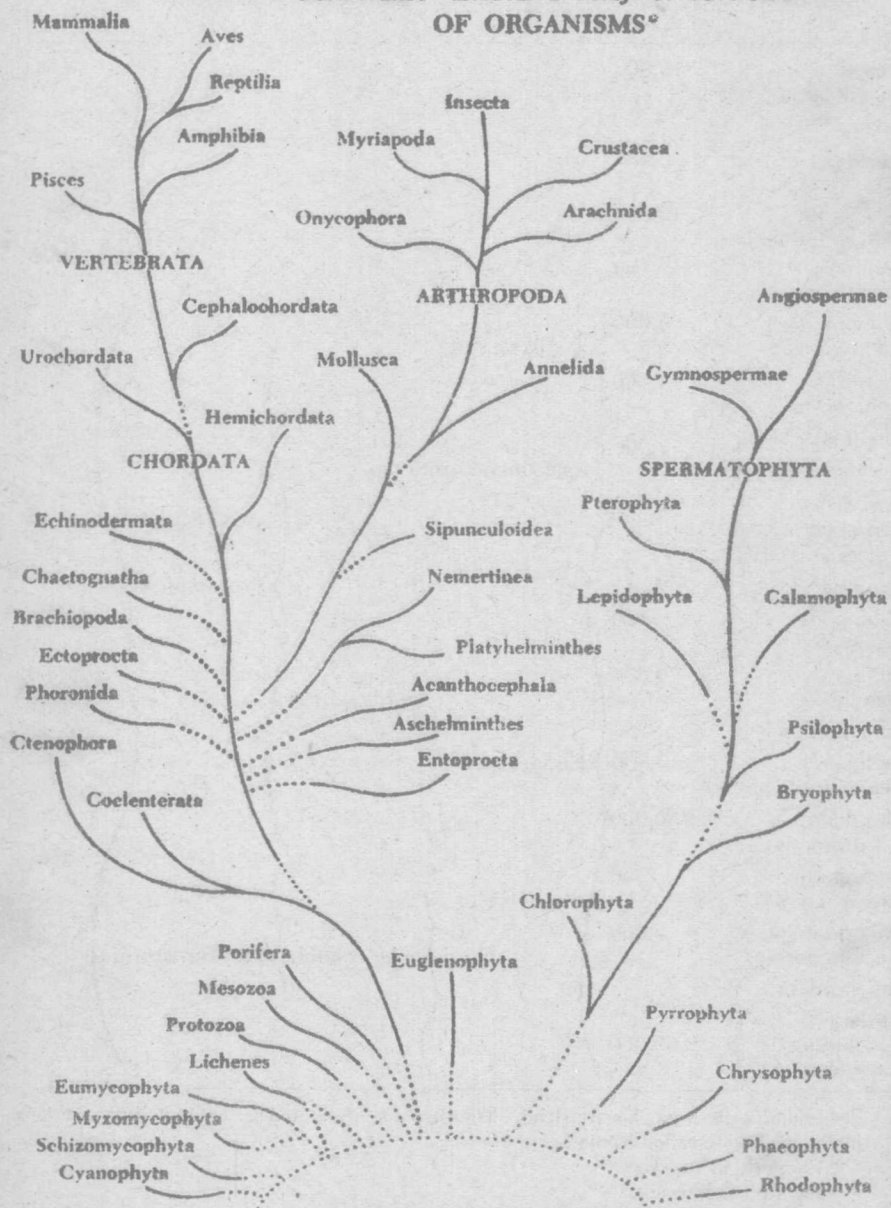


CHART II: ANIMAL KINGDOM

Divisions	Estimated Number of Species ^d	Taxonomic Classifications						
Protozoa (acellular animals)	15,000							
Mesozoa	—							
Porifera (sponges)	5,000							
Coelenterata (coelenterates)	10,000			} Radiata				
Ctenophora (comb jellies)	100							
Platyhelminthes (flat worms)	6,000	} Acoelomates	} Protostomia	} Bilateria				
Nemertinea (nemertine worms)	500							
Aschelminthes ^a	7,000	} Pseudocoelomates						
Acanthocephala ^a								
Entoprocta ^b	3,000	} Schizocoela						
Ectoprocta ^b (moss animals)								
Phoronida	15							
Brachiopoda (lamp shells)	120							
Mollusca (mollusks)	70,000							
Sipunculoidea	—							
Annelida ^c (segmented worms)	6,500							
Arthropoda (arthropods)	750,000							
Chaetognatha (arrow worms)	30	} Enterocoela	} Deuterostomia					
Echinodermata (echinoderms)	5,000							
Hemichordata	60,000							
Chordata (including vertebrates)								

^a Includes Rotifera, Gastrotricha, Kinorhyncha, Nematoda, Nematomorpha, Priapulidea. Formerly called Némathelminthes.

^b Formerly in Bryozoa.

^c Includes Echiuroidea.

^d Taken from "Handbook of Biological Data" (4), p. 533.

CHART III: PLANT KINGDOM

Divisions	Estimated Number of Species ^d	Major Synonymous Terms						
Euglenophyta (euglenoids)	340	Algae	Cryptogamia					
Chlorophyta (green algae)	5,700							
Pyrrophyta (cryptomonads, dinoflagellates)	1,000							
Chrysophyta (yellow green algae, diatoms)	5,700							
Phaeophyta (brown algae)	900							
Rhodophyta (red algae)	2,500	Thallophyta		Cryptogamia				
Cyanophyta ^a (blue-green algae)	1,400							
Schizomycophyta ^a (bacteria)	1,300 ^e	Fungi			Cryptogamia			
Myxomycophyta (slime molds)	430							
Eumycophyta (true fungi)	74,000							
Lichenes (lichens)	15,500	Bryophyta				Cryptogamia		
Bryophyta (mosses and liverworts)	23,800							
Psilophyta ^b (whisk ferns)	3	Psilopsida	Tracheophyta				Phanerogamia	
Calamophyta ^b (horsetails)	30	Sphenopsida						
Lepidophyta ^b (lycopods)	1,300	Lycopsida						
Pterophyta ^{b, c} (ferns)	10,000	Pteropsida	Phanerogamia					Phanerogamia
Spermatophyta (seed plants)	201,000							

^a Sometimes grouped as Schizophyta.

^b Formerly classed as Pteridophyta.

^c Formerly classed as Filicineae in Pteropsida.

^d Taken from "Handbook of Biological Data" (4), p. 533.

^e There is much disagreement concerning designation of species here.

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