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FRESH-WATER BIOLOGY

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WITH THE COLLABORATION OF A STAFF
OF SPECIALISTS

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PREFACE

FOR the ordinary student and teacher on this continent fresh-water life has a significance heretofore greatly underestimated. In most parts of the country it lies at one's very door, readily accessible, and is indeed the only type of aquatic existence which can be studied living and at work. This fact gives to fresh-water life, once the student has been introduced into its domain, an appealing interest that fetters his attention and stimulates his desire to know something more of it. Among the most remarkable of early works that followed hard upon the first use of the microscope are some great classics which represent work in this very field.

Various European countries possess elaborate monographs on fresh-water organisms as a whole and on single groups, but no attempt has been made heretofore to deal with North American fresh-water life in its entirety, and few treatises have essayed to cover completely any group of fresh-water organisms. American workers in general have accordingly avoided this field and the few who have attempted to engage in its study have found their problems very difficult to solve.

The preparation of the present work was undertaken many years ago with the purpose of stimulating the study of the material so easily obtainable and of aiding workers of all grades to acquire some definite and precise knowledge of the organisms met in such study. Each chapter has been handled by a specialist on the group and the results achieved by this method have a significance that could not have been attained in any other way. Conditions entirely unavoidable led to the completion of the different parts of the work at somewhat different dates. It is believed that this will not, in fact, impair the value of the work as a whole and will find an excuse in the magnitude of the task. Individual chapters represent a survey of the group treated that is complete

for this continent up to the time at which the chapter was closed.

The first few chapters are devoted to a discussion of general biological factors. Evident space limits prevented extended discussion of many most interesting biological topics, which are at best only outlined here. The exact citation of sources at the close of these chapters will aid the reader to pursue such topics further if desired. Not all discussions on general questions have been confined to the introductory chapters. The chapter on Rotifera, by Jennings, presents an admirable description of life processes, which, altho written specifically for that group, applies with appropriate modifications to all groups of many-celled organisms. In the chapter on Copepoda, Marsh has treated with some detail the general question of distribution as illustrated by this group; yet the very factors which he shows to be operative in it are those that lie at the basis of the distribution of most if not all other groups. The discussion of the aquatic vertebrates by Eigenmann is purely biological and the systematic outline is omitted entirely, since that of itself would demand an entire book for its adequate presentation. The same is true of the chapter on Bacteria, by Jordan, and of that on the higher aquatic plants which are treated by Pond in the physiological (chemico-physical) aspect primarily.

Apart from those just mentioned all chapters conform to the same general plan. Each is devoted to a single group of organisms and opens with a general account of the occurrence and history of the group. The description of the anatomy of the forms treated is very brief and deals chiefly with such features as are of special value in the key. Similarly the life history is given in condensed form. More attention is devoted to the biological relations which at this point are discussed with reference to the entire group, whereas individual features are left for later record under individual species except as they are needed for illustrations of general questions. Care has been exercised to include descriptions of special methods for collecting, preserving, and studying the organisms of each particular group.

Special details both biological and morphological regarding genera

and species are included under a synoptic key which comes at the close of each chapter except as noted above; in some cases it is carried to species but in others only to genera. The form utilized for the keys has been in constant use for many years at the University of Illinois, having been applied to many aquatic types by Professor S. A. Forbes and his associates. The introductory number of each key line is followed by an alternative number printed in parentheses and on reaching a decision that this line is not acceptable, the student proceeds at once to the line introduced by the alternative number; in case a given alternative is accepted the further course of the inquiry is indicated by a number at the close of the line.

In order to achieve maximum ease in use and perspicacity in grasping the facts presented, all the information on a given form, viz., the illustration, the description, and the biological features with the frequency, range, and other special data, are included between the key line which introduces the name and the key line next following. The total information on a single type forms thus a solid panel and appeals promptly and as a whole to the eye and mind of the student. Each chapter closes with a brief list of the most essential references to the topic. No textbooks are cited and only such works are noted as may be considered indispensable for present-day study of North American forms. The student is cautioned not to regard any such list as in any sense a bibliography of the subject.

To encompass such a mass of material within the limits of a single volume, even tho it be generous in size, has necessitated brevity of treatment at every point. Technical terms are defined or discussed only once and no glossary is introduced. The index includes important terms and all of the scientific names used in the keys so that the reader can find every item promptly.

A serious effort was made to attain uniformity in the use of names thruout the entire work but the worker will find that this end was not fully achieved. The most conspicuous failure in this particular obtains in the citation of host names for various parasitic species. In all such cases that name is employed which was used by the authority from which the record is cited. It was felt

that in the absence of monographic revisions of the species of parasites noted any other method would have been indefensible in a brief treatise.

Abundant use has been made of figures to illustrate the forms described. Most of the illustrations are new and many of them drawn by the author of the chapter especially for this work.

In chapter II certain figures and tables are taken with modifications from Shelford's *American Communities in Temperate America* by courtesy of the Geographic Society of Chicago and the University of Chicago Press.

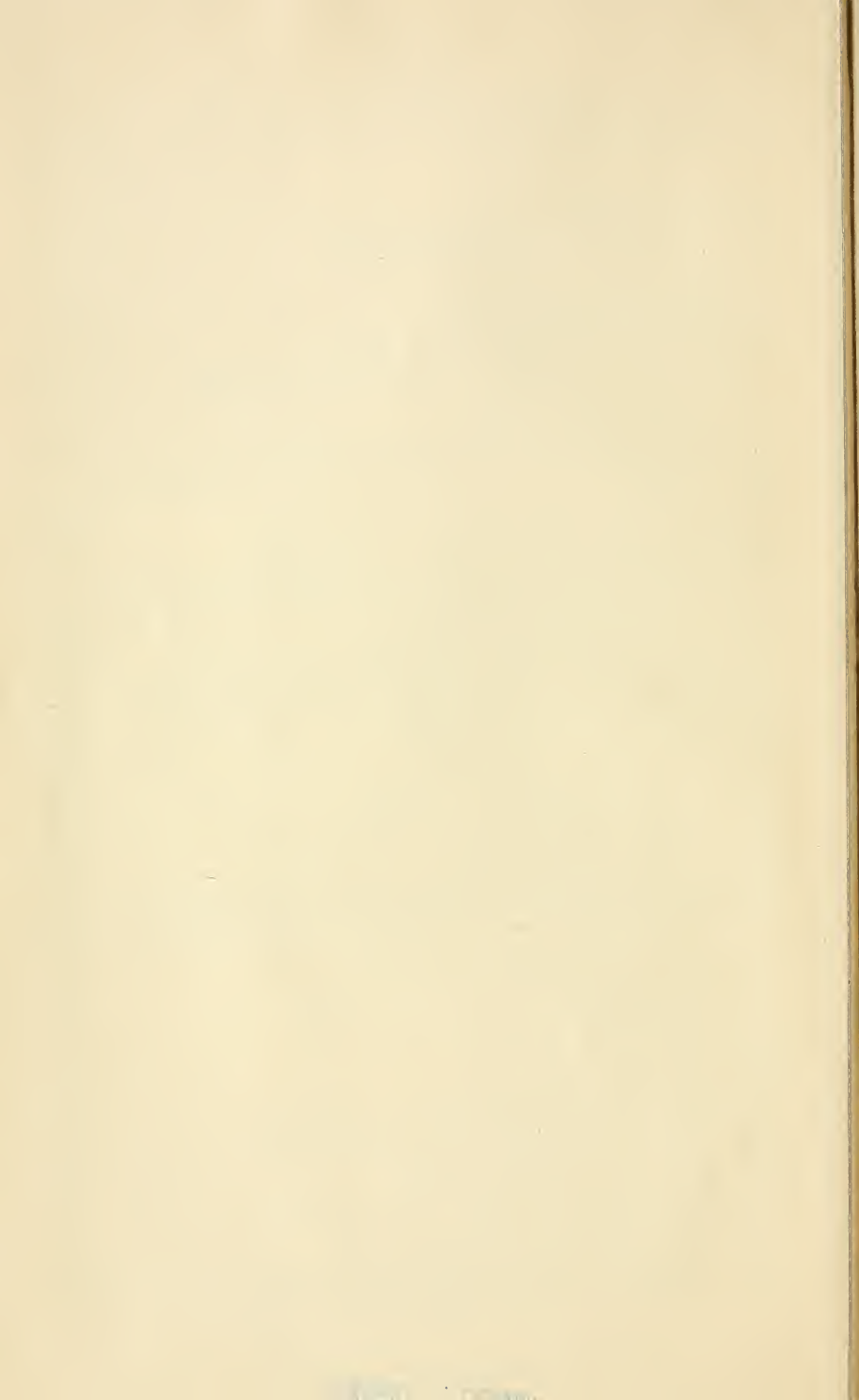
It would be impossible to acknowledge all of the aid which has been extended during the progress of the work. Valuable suggestions from many sources have been freely extended us and as freely utilized.

To all of our colleagues who, in spite of multitudinous difficulties and seemingly interminable delays, have worked so generously to perfect their individual chapters the sincerest thanks of the editors are due. Especial mention should be made of the numerous helpful suggestions and criticisms given outside their own chapters during the preparation of the work by Professors E. A. Birge and Frank Smith. Grateful acknowledgement is also due E. C. Faust and H. G. May for aid in reading and checking proof.

Finally, it is a pleasure as well as a duty to express our appreciation of the work of the publishers. Their forbearance and continued kindly assistance during the long and difficult period of preparation has made possible the completion of the work and its presentation to the scientific worker in attractive form.

CONTENTS

CHAP.	PAGE
I. Introduction, Henry B. Ward.....	1
II. Conditions of Existence, Victor E. Shelford.....	21
III. Methods of Collecting and Photographing, Jacob Reighard.....	61
IV. Bacteria, Edwin O. Jordan.....	90
V. Blue-Green Algae (Cyanophyceae), Edgar W. Olive.....	100
VI. The Fresh-Water Algae (Excluding the Blue-Green Algae), Julia W. Snow.....	115
VII. The Larger Aquatic Vegetation, Raymond H. Pond.....	178
VIII. Amoeboid Protozoa (Sarcodina), C. H. Edmondson.....	210
IX. Flagellate and Ciliate Protozoa (Mastigophora et Infusoria), H. W. Conn and C. H. Edmondson.....	238
X. The Sponges (Porifera), Edward Potts.....	301
XI. Hydra and Other Fresh-Water Hydrozoa, Frank Smith.....	316
XII. The Free-Living Flatworms (Turbellaria), Caroline E. Stringer.....	323
XIII. Parasitic Flatworms, Henry B. Ward.....	365
XIV. The Nemertean, Wesley R. Coe.....	454
XV. Free-Living Nematodes, N. A. Cobb.....	459
XVI. Parasitic Roundworms, Henry B. Ward.....	506
XVII. The Wheel Animalcules (Rotatoria), H. S. Jennings.....	553
XVIII. Gastrotricha, Henry B. Ward.....	621
XIX. Aquatic Earthworms and other Bristle-Bearing Worms (Chaetopoda), Frank Smith.....	632
XX. The Leeches (Hirudinea), J. Percy Moore.....	646
XXI. The Fairy Shrimps (Phyllozoa), A. S. Pearse.....	661
XXII. The Water Fleas (Cladocera), Edward A. Birge.....	676
XXIII. Copepoda, C. Dwight Marsh.....	741
XXIV. The Ostracoda, R. W. Sharpe.....	790
XXV. Higher Crustaceans (Malacostraca), A. E. Ortmann.....	828
XXVI. The Water-Mites (Hydracarina), Robert H. Wolcott.....	851
XXVII. Aquatic Insects, James G. Needham.....	876
XXVIII. Moss Animalcules (Bryozoa), Charles B. Davenport.....	947
XXIX. The Mollusca, Bryant Walker.....	957
XXX. The Aquatic Vertebrates, C. H. Eigenmann.....	1021
XXXI. Technical and Sanitary Problems, George C. Whipple.....	1067



CHAPTER I

INTRODUCTION

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ON the surface of the globe, water and life are intimately associated. As water grows scantier life becomes more restricted until with the total failure of water life also disappears. In regions where water is very scarce the few organisms that exist have learned to store water or to discharge vital functions with a minimum supply and thus to meet the natural defects of the situation.

The hydrosphere, or the total water mass on the globe, forms the subject of study for hydrography which is readily subdivided into (1) oceanography, that deals with the vast continuous mass of salt water in the ocean, and (2) limnology, which treats of the various fresh-water units. The term limnology is sometimes restricted in its application to the more stable bodies such as lakes and ponds, in which case rheology is used to cover various types of flowing waters. All fresh water is distributed over the surface of the land and variably grouped into separate series of systems connected with each other only through the ocean to which each system is joined. The rare desert systems, such as terminate in the Carson Sink or the Dead Sea, are exceptional in having no present connection with the ocean.

Fresh water is deposited on the land in the form chiefly of rain or snow, and tends ultimately to reach the sea, though first and last a considerable part is taken up by evaporation and goes back directly into the atmosphere. Much of the precipitation soaks into the ground to reappear elsewhere in springs or by seepage to feed ponds and streams. Activity or rate of movement distinguishes two classes of water bodies: the flowing water of streams and the temporarily quiet water of lakes. The latter almost always form parts of stream systems and have thereby an intimate connection with the ocean that is of fundamental importance in determining the origin of fresh-water organisms.

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