

**BIOLOGY AND SYSTEMATICS OF  
THE  
SAPROLEGNIACEAE**

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Every generation enjoys the use of a  
vast hoard bequeathed to it by  
antiquity, and transmits that hoard,  
augmented by fresh acquisitions, to  
future ages. -Macaulay

In Recognition

in the generation before us,  
of the contributions and influence of

WILLIAM CHAMBERS COKER

JOHN NATHANIEL COUCH

FREDERICK KROEBER SPARROW, JR.

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## PREFACE

It is unlikely that among the zoosporic fungi there is one group more widely known than the Saprolegniaceae. They are faithful subjects of countless exercises in introductory laboratories of mycology where they perform almost on demand. But, they are as well the tools of a variety of investigations the results of which appear in many sources in several languages. Indeed, the whole broad spectrum of the practice of biology from observational taxonomy, ecology, and cytology to the experimental levels of biochemistry and physiology can be found in the research on members of this family.

As the Saprolegniaceae came into prominence in the late 1800's and early 1900's it was customary to refer to them as water molds, as an indication of their usual habitat. This name did not change even though these organisms were found to occur in soil as well. With time, however, the common name was applied also to other aquatic fungi, including the filamentous chytridiaceous species and the zoosporic members of the Peronosporales. We are using the term in its classical sense to refer only to recognized members of the Saprolegniaceae. This is a limitation of convenience, although it is one without universal acceptance.

The water molds were largely the domain of Old World mycologists until the appearance of William Chambers Coker's account of the family in 1923. The focus of attention soon settled on his publications and those of his students, and the water molds quickly gained recognition in mycology in the New World as well. Coker's treatment -- still the classical foundation of the systematics of the Saprolegniaceae -- is only a taxonomic monograph in the strictest sense. To be sure, he recorded observations on the culture and distribution of these fungi but the thrust was clearly taxonomic. Since the time of Coker and his students, a rich and diverse body of knowledge surrounding the water molds has accumulated. There exists also a wealth of information originating from the laboratories of the very early mycologists -- research that provides the framework on which later studies were founded. There is need, then, only for some incentive to draw these two vast sources together.

We have sought out on a worldwide basis the results of research on water molds, assembled the products -- meritorious as well as errant -- and placed them in the framework of a historical foundation. In terms of time span this account covers the period from *ca.* 1750 through the mid-1980's, with an excursion into the year 2000 in the systematics section. In the biological chapters, our aim has been to inform rather than to offer a critique that would be sure to reflect biases. The treatment pretends to do no more than to record in reasonable detail the events of discovery between those who first faced the problem of whether the water molds were fungi or algae, and those who examine these organisms with the revealing eye of the electron microscope or extract their contents with the biochemist's reagents. Perhaps the account will tempt others to probe into areas where additional knowledge of these organisms resides but has not been discovered; if so, it will have accomplished a purpose.

Our first task was to solve the problem of scope. An abbreviated treatment would draw criticism for omitting favorite subjects; a survey of extreme detail would almost certainly overwhelm and discourage. We are therefore not dealing exhaustively with all that has been written on the Saprolegniaceae, and have made no specific attempts to record all aspects of all publications we have reviewed. Exercising both our prejudices and preferences, we omit references to published abstracts, most popular articles and mimeographed reports, and a cluster of papers of a strictly applied nature (in the chapters on pathology). Where it has been possible to obtain unpublished theses and dissertations with reasonable ease, we have abstracted them, believing that the information therein deserves recognition.

The treatise falls into two parts: an account of the biology of the Saprolegniaceae, followed by a taxonomic treatment. The former is divided arbitrarily into certain major units: general morphology and development, cytology and genetics, physiology and biochemistry, ecology, and pathology. We recognize that the structural and functional aspects of the organisms themselves are not so compartmentalized, and where necessary we have cross-referenced particular articles. The account of the physiology of the Saprolegniaceae, for instance, is not divorced fully from knowledge of their cytology, genetics, or developmental morphology. In the portion on the biological aspects, we treat methods for collecting and isolating, and a review of papers dealing with theories about their phylogeny and evolution.

Terminology, particularly in the fields of physiology, biochemistry, and ultrastructure, has changed as these disciplines evolved over the years. Accordingly, some discrepancies exist among reports in the older literature and those in contemporary papers in use and meaning of terms. Where such changes have occurred -- for example, the designation "Dalton" being employed for the traditional term "molecular weight" we have annotated the account to alert the reader to those differences.

The taxonomic treatment is neither unique nor startlingly new. It has the advantage, however, of being based on the study of hundreds of living specimens collected over more than a decade of effort from a variety of geographical and geophysical areas: tropical, subtropical, temperate, arctic, New and Old World, insular, continental, desert, montane, and others. There is extreme poverty in preserved material of the water molds; from the little that exists we have salvaged whatever observational information could be extracted. All taxa associated with the family are treated in some fashion: as valid or incompletely known representatives, as synonyms, or simply as excluded names. We have attempted to record the known distribution of each species, to cite references to other descriptive or illustrative matter, and to discuss as fully as is consistent with understanding the systematics of each taxon. We are not including all segments of the data base on which our taxonomic decisions were made;

that record is prohibitively long. Naturally, we are proposing taxonomic revisions, and have modified the circumscriptive limits of the family and its genera. Where the evidence is direct and convincing, we have been ruthless in striking down taxa. Years of experience with the watermolds direct us to no other course.

It is of course in the taxonomic portion of the monograph that our prejudices stand out most clearly. We make no apology for our expression of judgment, and no pretense that our account establishes with finality the systematics of the Saprolegniaceae.

Two issues that emerge from our survey of the literature on the watermolds prove to be particularly troublesome. In the first place, species concepts -- and names, therefore -- have changed over the decades. Where such differences between old names and new concepts arise, we have attempted at the first time of occurrence (in each chapter) to call attention to the discrepancies and to clarify the nomenclature. The reader will suffer a noticeable annoyance in dealing with this problem. Secondly, we recognize that there are inconsistencies extant in the nomenclature of host species. We make no attempt to sort out and solve these problems, but use the name applied by the author of the paper cited. We rely on those familiar with the particular biological groups in question to know what names are currently valid.

Many colleagues have aided us unselfishly in numerous ways; though they go unnamed, they will recognize their contributions in the text and know that we are grateful. Through the cooperative efforts of the following persons, we obtained copies of publications unavailable through usual library sources: Madame Maja Sjöström Abrahamsson, Blentarps, Sweden; Librarian, Bundesforschungsanstalt für Fischerei, Hamburg; Bernadette G. Callery, Hunt Institute for Botanical Documentation; Ram Dayal, Banaras Hindu University; Irena A. Dudka, Academy of Science, Ukraine; Syuzo Egusa, University of Tokyo; Robert G. Embree, University of Iowa; Madame Bibi Ericsson, Institute for Freshwater Research, Sweden; David W. French, University of Minnesota; Alwin Gaertner, Institut für Meeresforschung; Pietro Ghittino, Centro Studio Mallattia de Pesci; Boris V. Gromov, Leningrad University; Kishio Hatai, Sankyo Co., Tokyo; Glenn L. Hoffman, U. S. Fish and Wildlife Service; Lennart Holm, University of Uppsala; Peter James, British Museum (Natural History); H. A. Kahn and Shri B. N. Saigal, Central Inland Fisheries Research Institute, India; W. Koch, Biologische Bundesanstalt für Land und Forstwirtschaft; Kazuko, Kazuko Konno, KDG Institute, Japan; E. A. Kuznestov, Moscow; Dah-Jiang Liu, Taiwan Agricultural Research Institute; Lu Shih-I, Academia Sinica, The People's Republic of China; H. Merxmüller, Botanische Staatssammlung, München; A. I. Milanez, Instituto de Botânica, Brazil; David Park, The Queen's University, Belfast; Bosiljka Ristanović, Kragujevac, Yugoslavia; Clark T. Rogerson, New York Botanical Garden; J. A. Slater, University of Connecticut; Kenneth Söderhäll, University of Uppsala; C. Winner, Institut für Zuckerrübenforschung, Göttingen; R. Yokosawa, Higashi Nippon Gakuen University.

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