

LIBRI NOVI

The Actinomycetes. Vol. 2. Classification, Identification, and Descriptions of Genera and Species. SELMAN A. WAKSMAN, Institute of Microbiology, Rutgers University. The Williams and Wilkins Co., Baltimore. 1961. pp. 1x, 363. \$ 15.00.

The second volume of this definitive trilogy on the Actinomycetes is a comprehensive systematic treatment of the order Actinomycetales. The author positively states in the preface and elsewhere: "I am now certain of one thing, namely, that the place of the actinomycetes is definitely among the bacteria and not among the fungi."

Following a brief preface, an Introductory presents a key to the 10 genera in three families of this order. The families are: Actinomycetaceae, with vegetative mycelium fragmenting into bacillary or coccoid units and including *Actinomyces* and *Nocardia*; Streptomycetaceae, with nonseptate vegetative mycelium not fragmenting into bacillary and coccoid elements, and including the genera *Streptomyces*, *Thermoactinomyces*, *Waksmania*, *Thermopolyspora*, *Micromonospora* and *Thermomonospora*; and the Actinoplanaceae, with spores occurring in sorangia and including the genera *Actinoplanes* and *Streptosporangium*,

The text is divided into 13 chapters, largely based on the requirements of a text on systematics. The first chapter considers the systematic position of the Actinomycetes and problems of generic and specific limitation. The question "What is a microbial species?" is answered by reviewing the ideas of a number of workers in microbiology. Speciation of *Streptomyces*, and of the other genera in the order, is taken up at length as a review of the ideas expressed in earlier work of the author and others. One is left with the impression that the author will adopt the best characteristics based on morphology and physiology for his species characterizations, and that species based on minor variations will not necessarily be recognized.

Separate chapters are used to characterize the genus, key out and describe the species of the genera *Actinomyces*, *Nocardia*, *Micromonospora* and *Waksmania*. In *Actinomyces* 8 species are keyed out and described. For *Nocardia* several systems are listed, and three major keys are given. For the 59 species described, a modification of the key given in the 7th ed. of Bergey's Manual is presented. Nine species of *Micromonospora* are described, and one of *Waksmania*.

Five chapters are given to the classification of the largest genus in the order, *Streptomyces*, of which 251 species are described. Basic morphological and physiological characteristics are considered

first for all groups in the genus and several species or species complexes are selected for a tabular demonstration of the complexities involved in species characterization. Serology, chemical composition, ecology, sensitivity to antibiotics, actinophage sensitivity, genetics, and type cultures are discussed in detail. The importance of the use of standard media is considered and in Appendix II are presented formulae for preparation of 42 natural, synthetic and semisynthetic media used in the study of this order. Techniques for the description of species in this genus are given in more detail with numerous warnings concerning minor variations, care concerning comparison with types of related species and the fickleness of a published description as a reliable interpretation of another's work.

Five early systems of classification of *Streptomyces* are reviewed as well as 12 recent systems. As time goes on and more and more species are described, the tendency is for systematists to group species of this genus into morphological or physiological groups. There is no need to blame this tendency on "growing economic importance." The climax to this tendency is presented as the author's own system in which two subgenera are recognized. Two series are placed in the subgenus *Streptoverticillium*, and 14 in subgenus *Streptomyces*. The latter is further subdivided into two subgroups with 1 thermophilic series and 13 mesophilic series. In the latter are found two superseries, the first melanin-negative with 9 series, the second melanin-positive with 4 series.

The 16 series of species of *Streptomyces* are described and discussed in detail. Each series is considered separately on the basis of morphology and physiology, and the more important series are discussed at length in regard to antibiotic production, experimental studies of various sorts, and earlier treatments. In efforts to justify lumping or splitting of certain species or species groups extensive tabulations are presented of characteristics considered significant by various workers including the author. The names of a few characteristic species of each series are appended to the discussion of the series. Finally, in chapter 7, a key is given to the 251 species described for the genus *Streptomyces*. To be consistent with the treatment of this genus it would seem to this reviewer that this key should first have brought the reader down from genus to subgenus, then to subgroups, superseries, and finally series before attempting to key out the species. However, this key is essentially a single-character semidichotomous key to 251 species without regard or reference to "series" or higher categories within the genus. Rather than pairs of characters in the key, there may be as many as 18 choices. Where key characters are based solely on color, one must have a good knowledge of how colors are described in this group and in Appendix I the color designations of LINDENBEIN are given.

Chapter 8 includes the descriptions of 251 species of *Streptomyces* listed alphabetically. Critical references are given and one is referred to the 7th edition of Bergey's Manual and the original publi-

cation for additional information concerning synonymy. In addition to morphology, and growth reactions on as many as 13 media, the antagonistic activities are indicated, the habitat is given where known, remarks such as related species and additional information, and type culture numbers in one or more type culture collections are given where the species is so preserved.

Chapter 11, cited as chapter 10, unfortunately, in chapter 6, presents descriptions of the thermophilic species. A key to the 5 genera is presented. Six species of the *Thermophilus* Series of *Streptomyces* are keyed and described. Three species of *Thermomonospora*, 2 of *Thermopolyspora*, 6 of *Thermoactinomyces*, and one of *Pseudonocardia* are keyed and described.

The Actinoplanaceae are considered briefly in Chapter 12. One species in each of the two genera *Actinoplanes* and *Streptosporangium* are described and it is indicated that at least in the latter genus more species are known.

The final chapter in the book presents a list of several hundred names published for Actinomycetes based on cultures not known at present and on descriptions which were incomplete or too brief to give significant information. A table lists 76 species from which different antibiotics have been reported to be produced but which are too poorly described to recognize again. The statement is made that much of this type of work is by persons anxious to obtain priority for a species on the basis of patent rights.

In connection with a group of organisms such as the Actinomycetes, the following statement needs brief comment: "Certainly, the idea expressed by Baldacci *et al.* in 1955 that 'it is not possible to speak of a natural systematization of these microorganisms at the present state of knowledge ... for the time being, one must limit oneself to a classification aiming at diagnosis and nomenclature, "represents a defeatist attitude". This reviewer agrees with the BALDACCI group since essentially this is a group of "imperfect" organisms in which a sexual state is unknown and in which exchange of chromosomal material must be fragmentary or only partially complete. On this basis classification can be only of the card-file type. True relationships will remain unknown until someone discovers a way to unlock the hereditary patterns which may connect species. Until that time the recognition of series, superseries, subgroups and subgenera will be a convenient method of classification without necessarily implying relationship in the sense of genic continuity.

A comment should be made on the use of a term throughout the text. Only an avid splitter "creates" species. Here "create" is used in the sense of the lumper who sees a splitter creating trouble for him. The "species" is "created" by the genic aberration which occurs in the chromosomes during their division in the parent organism. The taxonomist, or the industrial microbiologist, who wishes to name a strain he has found, does so not as an act of "creation" but

as an act of "recognition". This may be a valid recognition of characters differing so radically from those of any other known strain that no other choice is left, or it may be the result of a desire to tighten a legal hold on a culture which produces an antibiotic presumably worthy of recognition, if only temporarily, as a separate entity.

This second volume is set up in the same format as the first, and has the same high quality workmanship as exemplified by other books by the Waverly Press. A comprehensive bibliography is included, the organism and general indices appear to be complete, and the illustrations reproduced well. Unfortunately, however, figures like 63 and 65 conveyed nothing to this reviewer possibly because he is unfamiliar with the organisms portrayed.

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L. R. HESLER, *Mushrooms of the Great Smokies.*

The University of Tennessee Press, Knoxville, Tenn. p. 289.

Price: \$ 5.50.

Popular books on fungi invariably represent a compromise of various points of view and of conflicting purposes. HESLER's book is refreshing from this standpoint because of his approach. By simply writing an account of the more conspicuous fungi of the Great Smoky Mountains National Park, he has produced a good popular book on Mushrooms for the Southeastern States.

It is especially valuable to the beginning student because so many types of fungous fruiting body are illustrated irrespective of their edibility, a feature HESLER has emphasized by the copious use of excellent photographs. There are over 200 half-tones, many of species which were previously poorly illustrated in the literature, or very few illustrations were available; *Lactarius gerardii*, *Entoloma salmoneum*, *Leptonia suberrulata* are examples. Mushroom hunters in the southeastern area will find this the most helpful work published to date.

For those who wish to explore the varied plant life of the Park itself the book is a must; but during a good season many more species will be found than could possibly be treated in a work in this price class. The Great Smoky Mountains National Park is a meeting ground of northern and southern floras, which accounts for much of the diversity in plant life within its borders, and which adds interest for the amateur and professional botanist alike. Dr. HESLER is to be congratulated on a good book attractively published.

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HARLEY, J. L., *The Biology of Mycorrhiza*. Leonard Hill (Books) Limited, London. 1961. Price: 55s

Mycorrhizas comprise an extremely interesting group of fungi that have very important ecological implications. Yet, the biology of these fungi is, as a rule, hardly understood by biologists.

The mycorrhiza condition is found in some members of all higher plant phyla. So some knowledge of the biology of mycorrhiza is not only desirable but essential to the interpretation of the ecological and cultural behavior of many economical and scientifically important plants.

J. L. HARLEY, in developing his book *The Biology of Mycorrhiza*, has created a well organized and easily followed treatise on these organisms. Truly, it is fascinating reading and should encourage biologists to become better acquainted with the mycorrhizas. Dr. HARLEY has divided the book into, what he considers, the two great groups of mycorrhizas, namely the Ectotrophic Mycorrhiza and the Endotrophic Mycorrhiza. He points out that it is unfortunate that these two groups have been spoken of under the single title "Mycorrhiza" for they are so very diverse in structure that a definition of the term is difficult if not impossible.

He has discussed the relationship of the ectotrophic mycorrhiza with forest trees and also the importance of mycorrhiza in forest practice. It is Dr. HARLEY's belief that there is some truth that mycorrhiza roots of forest trees are more drought and frost resistant than uninfected counterparts. This is cited as an indication of the importance of these organisms in forest practice.

Information relating to the physiology of the ectotrophic mycorrhiza is well covered in two chapters.

The third part of the book is concerned with endotrophic mycorrhiza and especially those concerned with the Ericales and Orchidaceae. Consideration is also given to other mycotrophic plants with septate endophytes. Finally, a chapter is devoted to mycorrhizas caused by aseptate mycelia such as found on *Taxus*, some of the Leguminosae, Gramineae, Bryophyta, etc.

The book is very well organized, covers the material thoroughly and reliable, and contains sufficient number of illustrations and tables to add greatly to the ease of reading and understanding. The coverage of literature has been thorough and even though the field is one that is not well known to the average biologist, it is a book that anyone in the broad field of plant biology could understand and would enjoy. The author's objective was to present subject matter concerned with mycorrhizas in such a form as to interest biologists who are experimentally inclined. This he has done very well, indeed. In fact, it is a book that should be recommended for reading by any student interested in botany or agricultural sciences concerned with plants.

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AINSWORTH, G. C., Ainsworth & Bisby's Dictionary of the Fungi. Kew, England, Commonwealth Mycological Institute, 1961, ed. 5, viii and 547 pages, 15 plates. 30s.

Users of earlier editions of the Dictionary of the Fungi are fully aware of the usefulness of this handbook. Dr. BISBY began assembling material for the fifth edition in 1954. After his death in 1958 the task of preparing the new edition fell to Dr. AINSWORTH who has continued the traditions of the Dictionary. He has followed a similar format, but has increased the scope of a book which everywhere is recognized as an authoritative and essential part of the working library of the mycologist.

The fifth edition contains 5000 corrections or alterations of definitions and includes much new material. There are new illustrations, 500 generic names have been added and the numbers of species assigned to genera have been corrected to conform with generally accepted usage or the author's best judgment.

A critical revision of his Key to the Families of Fungi, prepared by Prof. G. W. MARTIN, occupies 21 pages and is followed by an Index to Families. The 14 plates contain line drawings of key features and typical fungal structures.

This edition of the Dictionary is remarkable for its comprehensive coverage. The Medical Mycologist will find summarized technical information and definitions applicable to his specialty and will find the book useful as a reference work in fundamental and applied aspects of mycology with which he is not familiar. It should be especially useful to persons who have approached Medical Mycology through bacteriology or medicine.

It is inevitable that a book of this type contains material which is controversial and that the author's judgments concerning names, synonyms or concepts of classification will not coincide with those of every specialist in every group. This reviewer, after spot-checking and using the Dictionary, feels no inclination to pose as a carping critic. The Dictionary is up-to-date, accurate and authoritative. It presents an enormous amount of useful information in an abbreviated form which is clear and accessible. It is the result of painstaking research and verification. Mycologists, knowing the author, and after only a brief acquaintance with the book, will sympathetically understand the author's advice to the reader: "Users of this Dictionary are again urged to verify, whenever possible, the facts to which clues are given and to draw their own conclusions".

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LINSKENS, H. F. *Papierchromatographie in der Botanik.* (Paper chromatography in Botany), Springer-Verlag Berlin, 407 pp, 123 tables, 120 illustrations, 2 color plates. 1959. Price: DM 58.—

The author of this volume presents a profusely illustrated text to introduce the individual lacking prior knowledge of the field to the technique of paper chromatography. The methods presented in the volume are directed towards plant biochemistry and related fields. The aim of the book is to present a sufficiently detailed explanation of the techniques so that an individual not versed in the field can utilize paper chromatography without consulting the original literature. The literature in the field is extremely diverse and widespread and, consequently, the Bibliography is of necessity extensive.

The volume is divided into two sections: The first, an introductory one, in which the principles of counter current distribution, absorption, etc. are discussed. This section also illustrates the apparatus which are in general use and the general techniques used in the field. The second portion of the book concerns itself with special techniques for paper chromatography. This section is also devoted to the various compounds ranging from alkaloids to virus. Tables of Rf values for compounds in different solvents are given together with special reagents and comments on sources of error. Each specific topic is authored by individuals who have worked in the specific fields.

The book contains a pair of colored plates to illustrate the position and color reactions of various amino acids. These are some of the better illustrations to be found in books on chromatography.

The book is written entirely in German, although there is a collection of technical terms in English and French on the last two pages. Some mistakes are evident in the English and French translations, although these cannot be considered too serious.

The book, although pointed directly to botanists, would be useful to plant biochemists and general biologists who are not already familiar with paper chromatography.

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