THE MYCOPLASMAS

I

CELL BIOLOGY

VOLUME EDITORS

M.F. Barile and S. Razin

THE MYCOPLASMAS

VOLUME I

Cell Biology

Edited by

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FOREWORD

It must be wondered why mycoplasmology has lagged so far behind other disciplines in microbiology. I think the explanation might be the uncertain relationship to bacteria that existed for so long. When I first took up the study of mycoplasmas, there were doubts among scientists as to whether they even existed, some claiming they were merely forms of bacteria. In fact, the field was regarded as slightly disreputable. There was disagreement about the morphology and the method of replication. Large bodies are characteristic of the pleuropneumonia-like morphology of mycoplasmas and of L-phase organisms, and there was much dispute about the significance of these and whether the large bodies were viable. In the older literature there are many descriptions of life cycles, but the morphology of these organisms was studied to the relative exclusion of all else. Today, there is agreement that mycoplasmas divide by binary fission, so far as the genome is concerned, with filaments being formed when there is delay in cell division. Rodwell and Mitchell discuss replication in Chapter 4.

Classification and nomenclature of the various members of the group lagged behind; we did not know how to refer to the organisms, except to say that they were organisms of the pleuropneumonia group—named after the first organisms isolated from bovine contagious pleuropneumonia. We used to speak of pleuropneumonia-like organisms, abominably abbreviated to P.P.L.O. Classification and nomenclature is discussed in Chapter 1 by Freundt and Edward.

Confusion also arose from the fact that bacteria, under the effect, for instance, of penicillin, appeared the same as a pleuropneumonia-like phase, so-called L forms, as regards morphology and colonial appearances under certain conditions of growth. Klieneberger-Nobel's series of isolates included one L-phase organism, the L1 organism, which actually belongs among the true mycoplasmas. Additional confusion was caused by the claims that mycoplasmas had reverted to bacteria. The reversion theory is postulated in at least one comparatively recent textbook, which does not consider the alternative hypothesis: that mixed cultures were being used, i.e., mycoplasmas being contaminated with bacteria. This is not to say I disbelieve that in the course of evolution mycoplasmas were descended from bacteria; Neimark in Chapter 2 provides evidence that

this is so. My disbelief only extends to this being a contemporary occurrence. I have always regarded mycoplasmas as a distinct class of organisms.

In 1969 a comprehensive textbook, edited by Hayflick, with contributions from a number of experts in the fields of mycoplasmology and L-phase organisms was published. In the ten years that have elapsed since then, so much information has been collected by workers that a three-volume work is needed to present it, even though consideration of the L-phases of bacteria has been omitted. Klieneberger-Nobel wrote a Foreword to the Hayflick book, wherein she traced the early history of the mycoplasmas, dating from the initial isolation of the organism of contagious pleuropneumonia, and emphasized the original contributions she made at a time when there was little interest in the subject. I have no need to repeat this early history.

Since the earlier volume, much information has become available about the T-strains, now renamed ureaplasmas, which have been put into a new genus, *Ureaplasma*. They are reviewed in Chapter 17 by Shepard and Masover; the former is the discoverer of T-strains. The first acholeplasma was isolated in 1936 from sewage by Laidlaw and Elford; it is of interest that non-sterol-requiring mycoplasmas, with varying properties including serological ones, are at present being isolated from a wide variety of sources including plants. Accordingly, a chapter (Chapter 16) is included in this volume, where Tully discusses acholeplasmas and hypothesizes as to whether the effect of viruses can alter antigenicity. Darland and others in 1970 isolated from a coal refuse pile an organism they recognized as a mycoplasma, in spite of its needing for growth an extremely acid pH and a high temperature. A new genus, *Thermoplasma*, has been established for it, and information is given about this new genus by Langworthy in Chapter 18. Mycoplasmas have been isolated from another unlikely habitat, namely, the rumen of cows and sheep. These mycoplasmas are strict anaerobes, and an account of them is given by Robinson in Chapter 19; the problem of classification is dealt with in the chapter of taxonomy.

The most exciting development has been the visualization in the electron microscope of mycoplasma-like bodies in plants suffering from certain diseases, together with their insect vectors. Intensive efforts were made to cultivate the bodies, using established media successful with mycoplasmas from animal sources and many modifications of these media. However, all attempts were unsuccessful until Bové and collaborators succeeded in isolating an organism from citrus plants affected by stubborn disease and established Koch's postulates with the organism. A similar mycoplasma has been isolated from corn stunt. Morphologically these mycoplasmas are characterized by motile spirals, so the myco-

plasma has been named *Spiroplasma*. These mycoplasmas will be dealt with in Volume III, and only classification will be considered in this volume, in the chapter on taxonomy.

Bacteria are coated with a cell wall, but only the membrane separates the mycoplasmas from their environment; it is therefore important to study the composition of the membrane and to know its function. This is dealt with comprehensively in Chapters 8 through 11 by three authors.

As far back as 1946 Andrewes and Welch demonstrated motility in *Mycoplasmel pulmonis*. Bredt (Chapter 5), finding other species to be motile, has reinvestigated the phenomenon of motility.

The study of mycoplasmas has now branched out to include the investigation of the viruses associated with them. Gourlay was the first to isolate a "lytic" virus from *Acholeplasma laidlawii*, and viruses have now been found associated with spiroplasmas. They are discussed in Chapters 14 and 15: Cole deals with the morphological aspects and Maniloff and colleagues with the molecular biology.

So, at last, there is substantial progress in the newest branch of microbiology. One speaks of the "golden age" of bacteriology; it seems that we are now going through a similar "golden age" in mycoplasmology. Recently, a link has been discovered between animal and insect mycoplasmas. Two agents from rabbit ticks have been identified as spiroplasmas; these agents are pathogenic for suckling mice and rats, the so-called suckling mouse cataract agent. They have been cultivated on special media and serologically are similar to other plant spiroplasmas involved in stubborn disease and corn stunt. There is, therefore, an indication to try out the special media to search for other mysterious infections.

These volumes constitute a reference work written by experts in their various fields. Each chapter is furnished with an extensive bibliography to provide further reading matter and to cater to mycoplasmologists with diverse interests. This work should provide an impetus for progress in the future.

D. G. ff. Edward

PREFACE

"The Mycoplasmas," a comprehensive three-volume series, encompasses the various facets of mycoplasmology, emphasizing outstanding developments made in the field during the past decade. The pronounced information explosion in mycoplasmology was prompted primarily by the discovery of insect and plant mycoplasmas and mycoplasma viruses in the early 1970s, which attracted many new workers from different disciplines. During this period significant progress in the field of animal and human mycoplasmas was also made, providing important new insights into the nature of host–parasite relationships and into the mechanisms by which mycoplasmas infect and cause disease in man and animals.

Mycoplasmas are the smallest and simplest self-replicating microorganisms, and their use as models for the study of general biological problems has contributed considerably to our understanding of cell biology, particularly in the field of biological membranes. Volume I deals with the cell biology of the mycoplasmas, largely concentrating on problems regarding their classification, phylogenetics, and relatedness to wall-covered bacteria; their unique molecular biology, energy metabolism, transport mechanisms, antigenic structure, and membrane biochemistry. The characterization, ultrastructure, and molecular biology of the mycoplasma viruses, as well as the special properties of several groups of mycoplasmas, are also included.

Volume II is concerned with host–parasite relationships of mycoplasmas in man and animals. In part, emphasis is placed on recent developments in the study of classical mycoplasmal diseases of animals, such as cattle, sheep, goats, swine, and chickens. On the other hand, new information on the host range of mycoplasmas made it necessary to describe the mycoplasma flora of hosts not previously known to harbor mycoplasmas (for example, equines) or to document the increasing number of new mycoplasmas found in some other animal hosts (as observed in canines, felines, and nonhuman primates). This volume also offered the opportunity to record current knowledge about mycoplasmal diseases of man, including those involving the respiratory and genitourinary tracts. Humoral and cellular immune responses to mycoplasmas, which are assuming an ever-increasing significance in our understanding of the pathogenesis of human and animal mycoplasmal diseases, are

covered in detail. The volume closes with reviews on mycoplasmas as arthritogenic agents and the interaction of mycoplasmas with cell and organ cultures.

Volume III represents the first serious attempt not only to present an extensive and critical review of the rapidly expanding field of plant and insect mycoplasmas but to integrate these important new subdisciplines into the total field of mycoplasmology. Many of the contributions involve current information on an entirely new group of helical mycoplasmas (spiroplasmas), stressing their part in plant and insect diseases. Tick-borne spiroplasmas and their possible role in vertebrate disease are also discussed here. Additional coverage in this volume updates our knowledge of other suspected mycoplasmal plant diseases, as well as vector transmission of mycoplasmas and spiroplasmas, and discusses the chemotherapy of mycoplasmal plant diseases.

Thus, this three-volume series provides a standard reference work for every mycoplasmologist and a current exhaustive treatment of recent advances in mycoplasmology for other interested microbiologists, cellular and molecular biologists, membrane biochemists, clinicians, veterinarians, plant pathologists, and entomologists.

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