The BACTERIAL CELL

HARVARD UNIVERSITY MONOGRAPH IN MEDICINE AND PUBLIC HEALTH
NUMBER 6

in its relation to problems of Virulence, Immunity, and Chemotherapy.

By RENÉ J. DUBOS

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CAMBRIDGE, MASSACHUSETTS
HARVARD UNIVERSITY PRESS
1955

Fifth Printing

PRINTED IN THE UNITED STATES OF AMERICA

HARVARD UNIVERSITY MONOGRAPHS
IN MEDICINE AND PUBLIC HEALTH

LONDON: GEOFFREY CUMBERLEGE
OXFORD UNIVERSITY PRESS

A ma mère
A Marie-Louise

En souvenir de nos rèves

IN APOLOGIA

L'HOMME DE RECHERCHE *entraîné à la poursuite d'un problème particulier n'a pas à se préoccuper, autant que dure son effort, du problème général de la science. Ses investigations se concentrent sur un point limité; et pendant qu'il s'occupe à sa tâche dans un coin de l'édifice que la science contemporaine élève avec tant de rapidité, il n'est pas nécessaire qu'il embrasse le plan de cet édifice auquel collaborent tant d'autres études que les siennes. Cependant c'est à réaliser ce plan qu'il travaille d'une manière consciente ou inconsciente, comme maçon ou comme architecte.*

Il n'y a donc rien de plus profitable pour un esprit philosophique et généralisateur que de chercher à pénétrer ce dessein qui se réalise par suite de l'évolution naturelle et fatale de la science. C'est ce que nous essayerons de faire ici même. De telles tentatives offrent le double avantage de satisfaire à un besoin de l'intelligence et de contribuer à l'avancement de la science.

CLAUDE BERNARD

PREFACE

J'aime mieux être homme à paradoxes qu'homme à préjugés.
JEAN JACQUES ROUSSEAU

THE microorganisms classified as bacteria probably contain representatives of several unrelated biological groups. In addition to physicochemical properties shared by all living forms, each bacterial type possesses a structural and biochemical individuality which could serve as a basis for an orderly statement of the problems of cellular organization, and for a rational system of classification based on phylogeny. Unfortunately, known facts concerning these distinctive characteristics of each bacterial type are too few and too unevenly scattered among the different microbial groups to lend themselves to convincing integration and generalizations. This situation is due to the fact that, in general, most microorganisms have been studied only from the point of view of their importance in practical problems, and usually without much regard to the other aspects of their biology and chemistry, or to the homologous characteristics of related strains.

For example, the bacteria utilized in the fermentation processes and those which are of importance in the economy of organic matter, or capable of performing interesting and unusual chemical reactions, are studied very largely from the point of view of biochemistry. It is possible to describe their behavior as catalysts of metabolic systems without so much as mentioning their structure as cellular organisms. This approach has given rise to a school of chemical bacteriology which utilizes the methods and points of view of intermediary metabolism and which, in reality, is a part of classical biochemistry.

The study of pathogenic bacteria has proceeded along entirely different lines. In order to analyze the host-parasite relationship,

the student of infection concerns himself primarily with those structures and products of bacteria—the cellular antigens and toxins—which affect the course of the infectious process and against which are directed the reactions of immunity. Many constituents of the bacterial cell have been recognized first by their biological activity. Analysis of the phenomena of infection, immunity, and chemotherapy has thus provided important information concerning bacterial cytology.

A considerable body of knowledge concerning the biological and chemical architecture of bacteria is slowly emerging from these indirect methods. It will be the purpose of the present book to integrate this information with the data obtained by the classical techniques of cytology, and to interpret some of the phenomena of the infectious process in terms of the bio-chemical architecture of the bacterial cell.

No attempt will be made to present a survey of all groups of bacteria, or an exhaustive study of any one particular group. Examples will be selected not on the basis of the importance of the organism concerned, but only with regard to the extent and interest of information available, relevant to the problem under discussion. It has been judged inadvisable in most cases to develop the subject along historical, chronological lines, and, consequently, many investigations have not been quoted, even when their results are obviously incorporated in the text. Whenever possible, reference has been made to recent reviews presenting extensive bibliographies of the subject.

The present volume is the outgrowth of a course of eight lectures delivered during February, 1944 under the auspices of the Lowell Institute in Boston. I wish to express to the trustees of this Institute my gratitude for giving me the opportunity to put into execution a project first outlined in 1938 in the course of conversations with Dr. R. H. S. Thompson, now of the Biochemical Laboratory at the University of Oxford, England. It would be impossible to mention and to thank all those who, directly or indirectly, have helped in the preparation of the manuscript, and who have given permission to reproduce the data and illustrations incor-

porated in the text. I owe much also to Miss Catherine M. Casassa, Miss Jean Porter, and Mrs. Elizabeth Fuller of the Department of Comparative Pathology and Tropical Medicine, Harvard Medical School and School of Public Health. Miss Casassa managed to establish and to maintain order in the shapeless mass of manuscript and references which I submitted to her. Miss Porter read the whole manuscript in an attempt to conceal the foreign flavor of my English style. In addition to sheltering me from many administrative problems by her efficient and good-natured management of the Department, Mrs. Fuller valiantly helped us during many demoralizing June days.

Those who have been at some time connected with the Hospital of the Rockefeller Institute will undoubtedly hear through the following pages the echoes of many a conversation and discussion held at the Monday Night Journal Club and especially in the laboratories of the Division of Respiratory Diseases. I shall be rewarded for my efforts if this book brings back to their memory—even though in a blurred and distorted manner—the smiling wisdom of one known to all for his great scientific achievements, and whom so many call with admiration, gratitude, and love "The Professor"—Dr. Oswald T. Avery.

Boston, Massachusetts
June, 1944

RENÉ J. DUBOS

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