PRACTICAL BACTERIOLOGY

AN INTRODUCTION TO

BACTERIOLOGICAL TECHNIC

BY

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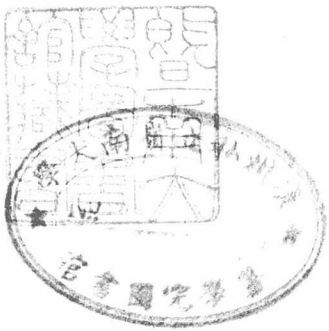

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PRACTICAL BACTERIOLOGY

BOOKS BY FRED WILBUR TANNER, Ph.D.

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Bacteriology: A Textbook of Microorganisms.

A book planned for those who are studying microbiology for the first time, that makes the study one of the most interesting of the biological sciences. Cloth; 6 by 9; 548 pages; 138 figures and one plate.

Practical Bacteriology: An Introduction to Bacteriological Technic.

A Laboratory guide for students. Cloth; 6 by 9; 235 pages; 67 figures and 8 plates.

Bacteriology and Mycology of Foods.

A course for those who wish to fit themselves for food control work, for food chemists, and for household science work. (New Edition in preparation.)

TRANSLATION

The Yeasts.

By ALEXANDER GUILLERMOND, D.Sc., Professor of Botany, University of Lyon, France. Translated and thoroughly revised in collaboration with the author by FRED W. TANNER. Cloth; 6 by 9; 424 pages; 166 figures.

PREFACE

THIS laboratory guide for students who are beginning the study of bacteriology has been prepared to accompany the author's "Bacteriology." It may, however, be used with other texts. Direct references to text-books have not been given since it is assumed that a student who has reached the stage in his development where he is studying bacteriology should know how to use such books. Furthermore, no one author has a monopoly on the best methods for presenting information, and a student should be encouraged to consult as many of the sources of information as possible.

This laboratory guide is somewhat different from a number of recent ones which have been published. It may be no better. The author has avoided the presentation of the various procedures in the study of bacteria in exercise form. They will be found distributed through the book but easily accessible to students. In Chapter VII is given one arrangement by which the book may be adapted to a course meeting three times a week on alternate days. Other outlines may be very easily prepared for classes having other schedules. It has been the author's experience that practically no printed manual exactly fits the requirements of all laboratories. It is hoped, however, that this book may be easily adapted to various conditions.

No attempt has been made to include a mass of extraneous experimental work which should be, and usually is, covered in more advanced courses. The author, after twelve years' contact with students who are beginning their study of bacteriology, believes that an introductory laboratory guide should contain work which will make students proficient in ordinary technic.

An attempt has been made to avoid the use of pathogenic bacteria. There are very few places in an introductory course in bacteriology where a non-pathogenic microorganism cannot be found which will be just as useful as a pathogenic species. Some may believe that this will detract from the interest of the student

since he might be stimulated by the use of pathogens. Such an argument might justify the use of dynamite or trinitrotoluol in beginning courses in chemistry. Furthermore, the continued study of pathogens tends to give a new student a warped idea of the science. There are plenty of organisms and material with which to study the subject of bacteriology as a pure science and thus lay a firm foundation for the various structures of applied bacteriology which may be built later upon such a foundation.

F. W. TANNER

May, 1928

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PRACTICAL BACTERIOLOGY

CHAPTER I

GENERAL BACTERIOLOGICAL APPARATUS

THE apparatus used in a bacteriological laboratory may not necessarily differ from that used in a chemical or biological laboratory. The rigorous technic required to secure and maintain sterility of such apparatus and contents has made it necessary to introduce new procedures into the bacteriological laboratory, which are not used by students of other living organisms. Consequently, in certain cases, special devices have had to be introduced by the microbiologist. It is not the author's intention to discuss completely all the different types of apparatus which may be used. He believes that even those students who are beginning the study of bacteriology should know the more common pieces of apparatus with which they, as bacteriologists, will have to work. One of the best times to begin to become familiar with apparatus is at the beginning of instruction.

Quality of Glass.—This is a factor in the selection of apparatus to which more and more attention is being given. It is probably not within the scope of a book on introductory practical bacteriology to present a detailed review of the data which have been reported in this connection; however, reference may be briefly made to the fact that a number of grades of glass are being used in apparatus. The improved methods of Clark and Lubs for determining the reaction of culture media and similar materials have made it easier to follow changes in reaction due to substances dissolved from the glass. Esty and Cathcart showed that the heating of unbuffered solutions in soft-glass tubes greatly affected the hydrogen-ion concentration. The data presented in their paper leave little doubt that this question has

received too little attention. In general, hard-glass tubes were more satisfactory than soft-glass tubes.

Fabian and Stull also reported data from a similar investigation. "Glassware taken from stock, filled with a non-buffered solution as conductivity water, and autoclaved for thirty minutes at 15 pounds pressure, yielded enough alkali to change the reaction of the conductivity water from *p*H 7.0 to *p*H 9.8. The amount of alkali yielded by this same glassware was not sufficient to change the reaction of a buffered solution as nutrient broth. In fact, the nutrient broth with a reaction of *p*H 7.0 before autoclaving had a reaction in some cases of *p*H 6.8 after autoclaving in this glassware. Soft glass yielded more alkali upon autoclaving than did hard glassware." The data published in these two papers should convince one that for special bacteriological work, at least, the quality of glass may be important. For very careful work, apparatus made of resistant glass should be used.

The following general groups of glass may be recognized:

Hard Glass.—This is a resistant type of glass. Before the World War practically all of the world's supply of hard glass came from Jena, Germany, and consequently Jena glass was regarded as the perfection of quality in glassware. When the War cut off the supply of this glass, researches were carried out in America to find a substitute. We now have resistant glasses, such as Pyrex, made by the Corning Glass Works of Corning, N. Y., which are probably superior to any other glass made, either in America or in Europe, if stability, heat shock and mechanical shock are to be taken as indices of quality. Pyrex is a low-expansion borosilicate glass of simple chemical composition containing no metals of the magnesium-lime-zinc group and no heavy metals. Apparatus from this glass is becoming more common in the bacteriological laboratory.

Soft Glass.—In this group fall a number of types of glass which lack the qualities given above for hard glass. Apparatus made from this glass may cause changes in the hydrogen-ion concentration of the medium by allowing the solution of certain ingredients in the glass. Such glass, if used for the manufacture of apparatus which will be repeatedly sterilized, may etch and make observations on cultures more difficult. The fact that the glass in such apparatus is slowly dissolved is borne out by the white or etched appearance which is often seen below the meniscus line. However, culture tubes of soda-lime glass, which will stand repeated sterilization without appreciable decomposition, are available.

Cleaning Glassware.—The successful bacteriologist needs absolutely clean apparatus. There is no science in which success depends more on clean apparatus than in bacteriology. No special procedure needs to be outlined for cleaning apparatus.