ANIMAL MICROLOGY

Practical Exercises in Zoölogical Micro-Technique

By

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With a Chapter on Drawing by

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FIFTH REVISED EDITION

1953

THE UNIVERSITY OF CHICAGO PRESS

THE UNIVERSITY OF CHICAGO PRESS, CHICAGO 37
Cambridge University Press, London, N.W. 1, England
The University of Toronto Press, Toronto 5, Canada

ANIMAL MICROLOGY

PREFACE TO THE FIRST EDITION

For the last ten years it has been a part of the writer's duties to give instruction in microscopic technic, and it has seemed to him that there is need for a series of practical exercises which will serve to guide the beginner through the maze of present-day methods, with the greatest economy of time, by drilling him in a few which are thoroughly fundamental and standard. The book is intended primarily for the beginner and gives more attention to the details of procedure than to discriminations between reagents or the review of special processes. The student is told what to do with his material, step by step, and why he does it; at what stages he is likely to encounter difficulties and how to avoid them; if his preparation is defective, what the probable cause is and the remedy. In short, the book attempts to familiarize the student with the little "tricks" of technic which are commonly left out of books on methods but which mean everything in securing good results.

A very brief, nontechnical account of the principles of the microscope is inserted (Appendix A) with the idea of giving the student just enough of the theoretical side of microscopy to enable him to get satisfactory results from his microscope. The microscope is so ably treated in the excellent works of Gage (*The Microscope*) and Carpenter (*The Microscope and Its Revelations*) that the writer feels himself absolved from any further responsibility in this matter.

The aim of the entire book is to be practical: to omit everything that is not essential; and, above all, to give definite statements about things. Appended to each chapter is a series of Memoranda which serve to supply additional information that is more or less pertinent without obscuring the main features of the method under consideration.

In Appendix B the formulas for a number of the most widely used reagents are given, with comments upon their uses and manipulation. Following this (Appendix C) is a concise table of a large number of tissues and organs with directions for properly preparing them for microscopic study.

Inasmuch as every experienced worker has his own "best" method for the preparation of almost any tissue, it is manifestly impossible to give all "best methods" in such a table. The writer believes, however, that the student will find the methods recommended all good ones which will yield satisfactory results.

In Appendix D some directions are given for collecting and preparing material for an elementary course in zoölogy.

It is hoped that the volume will prove of use: (1) as a class textbook; (2) as a guide to the independent individual worker (teacher, physician, college or medical student, or novice); (3) as a reference book for teachers, in the preparation of material for courses in elementary zoölogy, histology, or embryology.

In the matter of expressing his obligations the writer is at a loss to know just what to do. Many of the methods in microscopic technic have been handed down tradition-wise from one worker to another until their origin is unknown; they are the accumulated experiences of several generations of workers. Furthermore, many points have been absorbed, as it were, by the writer, from fellow-workers in the Universities of Chicago, Nebraska, and Cincinnati, respectively; consequently the obligation cannot be specifically expressed. Where the name of the originator of a method is known, due credit has been given. The books to which the author is most heavily indebted are the volumes of Gage and Carpenter, already mentioned, Lee's *Microtomist's Vade-mecum*, Whitman's *Methods in Microscopical Anatomy and Embryology*, Hardesty's *Neurological Technique*, Foster and Balfour's *Elements of Embryology*, Minot's *Laboratory Text-Book of Embryology*, Huber's translation of the Böhm-Davidoff *Text-Book of Histology*, Stöhr's *Text-Book of Histology*, Mallory and Wright's *Pathological Technique*, Bausch's *Manipulation of the Microscope*, and the *Journal of Applied Microscopy*. Grateful acknowledgment is also made to the various manufacturers of microscopic instruments and appliances for the loan of most of the cuts which have been used in this volume.

M. F. G.

PREFACE TO THE SECOND EDITION

The favorable reception accorded the first edition of *Animal Micrology* has encouraged the author to believe that a second edition, incorporating some of the many new methods which have appeared during the last ten years, would be equally welcome. The general plan of the book has not been altered (see Preface to the First Edition, on a preceding page), although changes have been made on nearly every page, many sections have been entirely rewritten, and two new chapters, one on "Cytological Methods," the other on "Drawing," have been added. The chapter on drawing was prepared by Dr. Elizabeth A. Smith.

In spite of a determined effort to limit the book to its former size, it has expanded by over fifty pages. For every method dropped, there seemed to be a host of good new ones demanding recognition. These in the main, however, have been left to the encyclopedia and the various technical books and journals listed at the end of the volume. As in the first edition, the policy has been, not to attempt to give all "best" methods, but rather to select representative good ones which have proved their worth by satisfactory tests in American laboratories.

Whatever merit the new edition may prove to have over that of the earlier one is due in no small measure to the many helpful suggestions of my colleagues in other colleges and universities. I am particularly indebted in this respect to Professors C. E. McClung, R. R. Bensley, H. McE. Knower, F. L. Landacre, F. C. Waite, B. M. Allen, George R. La Rue, Edward L. Rice, F. D. Barker, R. M. Strong, and H. L. Wieman, and to Doctors Elizabeth A. Smith and C. H. Heuser.

M. F. G.

PREFACE TO THE THIRD EDITION

The continued use of this book in both American and foreign laboratories encourages the author to believe that it still satisfactorily meets the needs of beginners in microscopic technic. That they may have the benefit of the more important advances of recent years, this third edition has been prepared. As in former editions, the effort has been to make it, not an encyclopedia of technic or a catalogue of all possible procedures, but a representative series of reliable standard methods.

For helpful suggestions in connection with the present edition, I am particularly indebted to Harold W. Beams, Joseph B. Goldsmith, Christopher J. Hamre, Frederick L. Hisaw, Steven J. Martin, Harvey M. Smith, Opal M. Wolf, and Chao-Fa Wu.

M. F. G.

PREFACE TO THE FOURTH EDITION

If the author may judge from the continued use of this book in many laboratories for some thirty years, together with comments he has had on it from time to time, it has become a sort of stand-by for beginners in animal microscopy, for many physicians who wish to do microscopic investigation, and for teachers who are their own technicians. He feels obligated, therefore, to pass on to such users any knowledge of outstanding advances in technic that comes his way which may save their time materially or make for greater precision. Because of its time-saving advantages and also its value with tissues which become unduly hard, brittle, or friable under ordinary treatment, the introduction of the dioxan method (chap. vii) would alone warrant a new edition. Minor changes, mainly additions, have been made on many pages, however; and such new special technics as have proved to be exceptionally valuable in the author's own laboratory or in those of his immediate associates have been included.

Grateful acknowledgment is made to Harland W. Mossman, Pearl E. Claus, Nellie M. Bilstad, Ernst J. Dornfeld, Melvin Doner, James O. Foley, and Merlin L. Hayes for helpful suggestions.

M. F. G.

PREFACE TO THE FIFTH EDITION

Although this book was first published over forty-five years ago, its steadily increasing use in various laboratories as a textbook and for reference makes it imperative that it be revised from time to time, with the addition of new technics and the replacement of various older ones. It is left to earlier editions to provide such of the latter as may still occasionally be desired.

While interest is at present probably keener in the chemical constitution of living matter than in its histological makeup, still a knowledge of the structural background of what we are analyzing chemically is indispensable. The fact remains that in plants and animals the chemical constituents are very definitely combined and arranged into characteristic larger units, and it is these that the histologist is viewing and naming.

Inasmuch as Appendix C on the preparation of individual tissues and organs has come to be widely used for reference in many laboratories, the author has had it carefully reviewed by Dr. Pearl E. Claus (Mrs. Eugene Whitehead), who gives both introductory and advanced cytological courses in technic in the zoölogical department of the University of Wisconsin. He also is greatly indebted to various others of his associates for their suggestions and assistance.

M. F. G.

CONTENTS

INTRODUCTORY

APPARATUS AND SUPPLIES REQUIRED

The student should provide himself with the following supplies:

One half-gross box best-grade glass slides, standard size (25 × 75 mm.).

One-half ounce, 18 mm. or ¾ inch, round cover glasses, medium thickness, (0.18 mm.)

Thirty 25 × 50 mm. cover glasses, medium thickness.

Two or three Pillsbury slide boxes (Fig. 1).

One box of labels for slides.

Three to six camel's-hair brushes (Fig. 2).

Six pipettes (Fig. 3).

One package Valet razor blades.

One set of dissecting instruments as follows:

- One large scalpel or cartilage knife (Fig. 4).
- One small scalpel (Fig. 5).
- Two needles (Fig. 6).
- One fine straight scissors (Fig. 7).
- One fine straight dissecting forceps, file-cut points (Fig. 8).
- One blowpipe (Fig. 9).
- One section lifter (Fig. 10).

To which may well be added:

- One heavy scissors (Fig. 11).
- One curved scissors (Fig. 12).
- One heavy forceps (Fig. 13).
- One fine forceps, curved tips (Fig. 14).

One horn spoon.

One desk memorandum calendar.

Blank cards (about 75 × 100 mm.) for keeping records of experiments. The kind of card used for library card catalogue will do.

One section razor (Fig. 15), or one microtome blade.

A piece of moderately heavy copper wire with one end hammered out to a width of 7–10 mm.

A sheet of aluminum foil.

Towels.

A glass-marking pencil (wax) or writing diamond will be found useful.

Coarse carborundum "engraver's pencil points," which may be purchased for 75 cents a dozen, are very satisfactory for marking glass, according to Professor C. E. McClung.

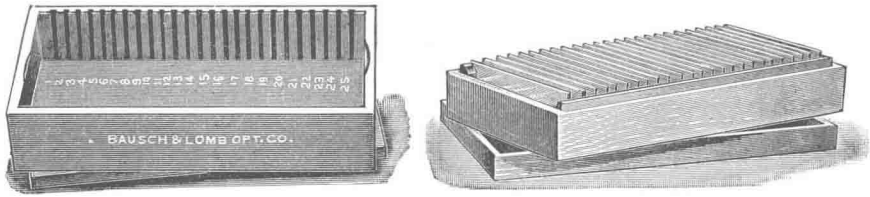

FIG. 1

FIG. 2 FIG. 3

FIG. 4

FIG. 5

FIG. 6

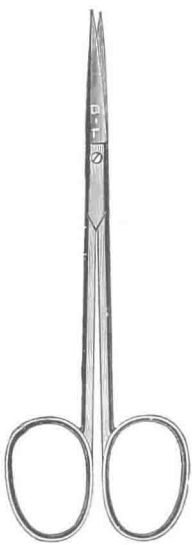

FIG. 7

FIG. 8

FIG. 9

FIG. 10

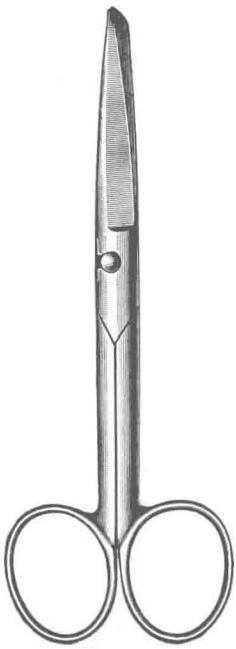

FIG. 11

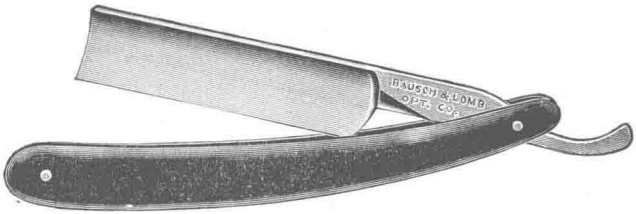

FIG. 15

FIG. 12

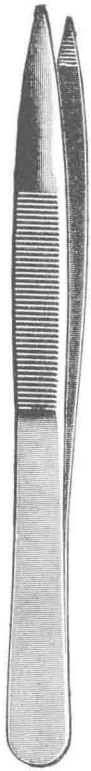

FIG. 13

FIG. 14

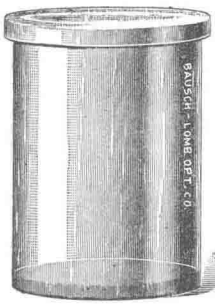

FIG. 16

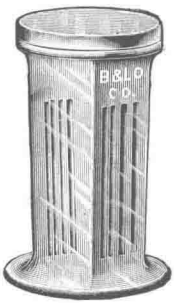

FIG. 17

FIG. 18

FIG. 19

FIG. 20

FIG. 21

FIG. 22

FIG. 23