ELEMENTARY MORPHOLOGY AND PHYSIOLOGY

FOR MEDICAL STUDENTS

A Guide for the First Year
and
A Stepping-stone to the Second

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'Had anatomists only been as conversant with the dissection of the lower animals as they are with that of the human body, the matters that have hitherto kept them in a perplexity of doubt would, in my opinion, have met them freed from every kind of difficulty.'

WILLIAM HARVEY: *On the Motion of the Heart and Blood in Animals.*

'Medicine and surgery are therefore based on biology, and biology represents the institutes of medicine.'

'The more we understand of the biological relations of both function and structure, the more easy does it become to detect and understand deviations from the normal, and to suggest methods of meeting the deviations and promoting recovery. Without this understanding we are simply groping in the dark, unable, except by rule of thumb, to diagnose the condition of a patient, or to see how he can be helped.'

DR. J. S. HALDANE: *The Institutes of Medicine and Surgery.* Address to the Middlesex Hospital Medical Society, March 6, 1923.

PREFACE TO THIRD EDITION

THE chief feature of this edition is the introduction of a new chapter on insects based on *Periplaneta americana*. For help in preparing this chapter I am much indebted to Drs. A. D. Imms and V. B. Wigglesworth. I am also indebted to Messrs. Methuen & Co., Ltd., for permission to use one figure from Dr. Wigglesworth's *Insect Physiology* and three from Dr. Imms's *Outlines of Entomology*.

The rest of the text has been thoroughly revised and improvements have been made in some of the illustrations. Two new illustrations have been added in addition to those for the new chapter.

MIDDLESEX HOSPITAL, MEDICAL SCHOOL
March 1943.

FOREWORD TO THE STUDENT

ON

PRACTICAL WORK AND METHOD OF STUDY

THE first step in the pursuit of any science is the observation of facts: in biological science, of facts about animals and plants. The second step consists in constructing hypotheses which will explain these facts and lead to the discovery of new ones.

Perhaps the chief difficulty that confronts the beginner learning a new science is the difficulty of 'seeing the wood for the trees'. This book is intended as a guide to the student in taking the second step; it attempts to present a vision of the wood, but it must be remembered that this picture will be clear or blurred according to the care the reader has taken to become personally acquainted with the trees. The theoretical book must assume that the student has already taken the first step, and has learnt something of the elementary facts of animal biology in the laboratory with the aid of such books as Marshall's *Frog*, and Marshall and Hurst's *Practical Zoology*. No book can take the place of careful personal observation, and observations must be recorded in simple but accurate and original drawings, for the beginner will soon learn that only by drawing will he be compelled to observe accurately. The use of a laboratory guide-book is necessary in view of the limited time available in a course of study intended as a preparation for examination, but the student should acquire the habit from the beginning of seeing whether the statements of the book agree with what he finds in nature, not of making his observations 'square' with the book. Every time the beginner slurs over the difficulty when he finds that his specimen does not conform to type, every time he looks only for what he is 'supposed to see', he shuts his mind more and more to the possibility of fresh discovery and weakens his ability to form an independent judgement. It must be remembered that in these early studies *the method of learning is quite as important as the matter learnt*, for it is at this time that the beginner will either form a true scientific method of approach to biological problems, or will merely acquire the habit of relying on authority. Which path he follows will determine his success or failure when, after examinations are over, he meets with problems not dealt with in the books and is called upon to make a decision for himself.

Just as the observation upon which interpretation rests must be personal, and acquired by the active use of the senses, so must the interpretation itself be made by an active effort of the reader's mind. The student should strive to connect his observations into an orderly whole, so that no fact is merely retained in his mind by an arbitrary effort of memory, but is connected by reasoned links to something else he has learnt in the subject. In this book he is invited to think about the facts he has learnt in the laboratory, and to consider how they may be connected with one another by reducing them to common terms, and by the attempt to discover the general laws which appear to underlie them.

Another stumbling-block to the beginner, especially in an anatomical science, is the difficulty of retaining the hosts of strange terms employed. Technical terms are unavoidable, because we have to deal with objects for which no everyday names exist, or to which common names are given in a loose uncritical way unsuitable for the accurate usage of science. These terms must be learnt before we can discuss the problems of biology; they form the vocabulary of a new language, which must be acquired before we can enjoy its literature. This difficulty can be overcome to some extent by avoiding all terms that are not absolutely necessary, by introducing them gradually, and by knowing something of their derivation, for many of them contain common Greek or Latin roots.[1]

Note on Anatomical Illustrations.

The reader as he works through this book should notice carefully the difference between a *drawing* and a *diagram*. The former attempts to depict accurately the structure of an animal or part as it appears directly to the eye. Its truth or falsity can be verified by any one with normal vision who cares to take the trouble to do so. A diagram, on the other hand, is an *interpretation*, an attempt to simplify the complexity of nature. All science consists in seeking to diagrammatize nature, to express diverse and particular facts in the most general and most comprehensive way, and so to enable the mind to deal with them in a way that would be impossible if it were compelled only to treat of particulars separately. A diagram is therefore the expression of a generalization, and its 'truth' will depend on the truth of the generalization it expresses. This is frequently very difficult to determine and is often a matter for discussion. The beginner is warned therefore not to confuse a diagram with a drawing, but to regard it as an aid to understanding.

[1] In this connexion the student should also refer to the glossary at the end of the book.

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LIST OF ILLUSTRATIONS