THE END.

ELEMENTS

OF

PHYSIOLOGY

PART II.

ANIMAL PHYSIOLOGY.

CHAMBERS' EDUCATIONAL COURSE.

INTRODUCTION

BY

THE AMERICAN EDITOR.

THE value of knowledge in relation to human physiology, and the acquaintance with the laws of health and life which such knowledge confers, have been justly set forth by the author and publishers of this work in their respective prefaces. So also the propriety and facility with which this subject can be introduced among the instructions of the school-room, and rendered attractive to the young, is here fully explained. And these gentlemen may not be in error when they claim that theirs is the first treatise ever prepared in Great Britain, for the use of schools, upon this topic; yet, in the United States, there are several which are entitled to priority, one of which, first published in 1825, was by the present editor of this American republication, and has been extensively adopted, especially in the Sabbath-schools of this country. It did not, however, include animal physiology in general, but only that of the human body.

The present work will, however, be found to condense more extensive knowledge upon human and comparative physiology, within smaller compass, than any of its predecessors. Written by a practical teacher, actually engaged in the impartation of this species of knowledge to children, it has claims to peculiar merit. The illustrative drawings are well adapted to be transferred to canvas, and copied upon transparent media, on a magnified scale, as here recommended. But in this country we are happily furnished with extraordinary facilities of this character, in the splendid engravings on stone of Weber's Anatomical Atlas, by Messrs. Endicott of New York, who

furnish them to schools at a very low rate. These drawings are so large, so accurate, and so beautifully coloured to nature, that they render the actual dissections here recommended in schools wholly unnecessary. Nor, indeed, would the public sentiment tolerate, in this country, the dissection even of inferior animals in schools, and especially in female schools. Nor is it at all called for, with the plates just named; which, indeed, have been brought out by the publishers here with special reference to the common schools of our state and country.

It is true that these plates are anatomical, not physiological; yet neither the teacher nor scholar can pursue the study of the animal functions to any extent, without an understanding of the structure of those organs upon which all the functions are dependent. Hence, anatomy and physiology are inseparable, and should be simultaneously cultivated, especially in schools. And with this book and Weber's plates alone, both sciences may be readily taught by any intelligent teacher, even though he or she may have heretofore neglected this study. It is mainly for the benefit of such that the analytical questions have been prepared, and will be found upon each page.

In using this book in schools, it is recommended that the teacher require the pupils to answer each of the questions in the language of the text, they having the book in the hand on going through it for the first time; but afterwards they should study a given number of pages in each lesson, and be prepared to answer the questions without the book. The ingenuity of the teacher will enable him to vary the questions and call for different examples and illustrations on each topic, and he should especially encourage the moral reflections which the marvellous works of God are calculated to inspire. The drawings, or models of human and animal structure, and of the important organs especially, will be found greatly to increase the attractiveness of the study.

That this book may serve to simplify the subject, and prompt to its more general introduction into the schools, is the hope and aim of

THE AMERICAN EDITOR.

SECTIONS.

EDITORS' PREFACE.

While it has been justly objected to popular medical guides and dictionaries, that, read under the influence of imperfect knowledge, they tend rather to mislead than to instruct, and probably induce more diseases than they cure, a candid mind must regard in a very different light the various works which have been published of late years for the purpose of conveying a popular knowledge of Animal Physiology. The sole and certain result of these must be, by giving a familiar knowledge of the human organization and its laws, to put individuals into the best possible condition for *avoiding* diseases—a very different thing indeed from the attempt to *cure* them. The utility of this knowledge to the non-medical community is now beginning to be generally felt, though still some perhaps require to be convinced of it. To such persons, it might be pointed out that, though almost all, from the communications made to them in childhood, or from their own sensations and experience, are enabled to observe some of the more obvious laws of organization—as, for a familiar instance, those respecting simple overloading of the stomach—there are others of those laws which most persons, for want of knowledge, are constantly breaking, to the great injury of their health. The general prevalence, amongst men of business, of an overtasking of the brain, amongst ladies of a neglect of out-of-doors exercise; the almost universal over-indulgence in stimuli of various kinds; and the tight-lacing of young females; are but a scantling of the errors which we everywhere see around us, as the result of a want of knowledge of the structure and functions of our physical frames. It is only, indeed, where the infraction of any organic law is followed very immediately by its appropriate penalty, as simple over-eating is by indigestion, that ordinary knowledge

observes and records the fact. In the far more numerous, and generally much more important class of cases, where the effect is not to be readily traced to its cause, popular knowledge is completely at fault: nothing can there be of avail but a knowledge to some extent of the human organization and its laws. It may be true that the knowledge itself will not be sufficient to produce, in all, a proper attention to the rules of health; yet it is pretty clear that the knowledge *may* have such an effect, while, without it, nothing of the kind can be hoped for. It might also be expected, that, were a knowledge of our internal organization thoroughly familiarized and made present to every mind, public opinion would become engaged in causing individuals of a negligent disposition to observe the laws of health. It would be thought wrong for a man, having a family depending on himself, to expose his life to hazard by daily-endured mental exhaustion; and a young lady, entering a room with a waist reduced to half its proper circumference, would be shrunk from as a kind of monster. Thus knowledge would operate, not only in a direct way upon individuals, but through one individual upon another.

It is for these reasons, and under these hopes, that the Editors of the present Educational Course have long been deeply impressed with the propriety of introducing Animal Physiology as a branch of study into schools. It is, at the very least, a section of natural science of a most interesting and enlightening kind, in as far as it shows a basis in nature for many of our most familiar impressions, otherwise apt to be themes of wondering ignorance. For this reason alone, it might deserve a prominent place in every liberal course of study. But its most important end is to afford a knowledge of the laws on which *health* depends—that element in life without which no one can be useful or happy, while the want of it often becomes a spreading evil. "It has been objected," says an eminent writer on the science, "that to teach any one to take care of his own health is sure to do harm, by making him constantly think of this and the other precaution, to the utter sacrifice of every noble and generous feeling, and to the certain produc

tion of hypochondriacal peevishness and discontent. The result, however, is exactly the reverse; and it would be a singular anomaly in the constitution of the moral world were it otherwise. He who is instructed in and familiar with grammar and orthography, writes and spells so easily and accurately as scarcely to be conscious of the rules by which he is guided; while he, on the contrary, who is not instructed in either, and knows not how to construct his sentences, toils at the task, and sighs at every line. The same principle holds in regard to health. He who is acquainted with the general constitution of the human body, and with the laws which regulate its action, sees at once his true position when exposed to the causes of disease, decides what ought to be done, and thereafter feels himself at liberty to devote his undivided attention to the calls of higher duties. But it is far otherwise with the person who is destitute of this information. Uncertain of the nature and extent of the danger, he knows not to which hand to turn, and either lives in the fear of mortal disease, or, in his ignorance, resorts to irrational and hurtful precautions, to the certain neglect of those which he ought to use. It is ignorance, therefore, not knowledge, which renders an individual full of fancies and apprehensions, and robs him of his usefulness."* Another not less eminent writer says—"The obvious and peculiar advantages of this kind of knowledge are, that it would enable its possessor to take a more rational care of his health; to perceive why certain circumstances are beneficial or injurious; to understand, in some degree, the nature of disease, and the operation as well of the agents which produce it, as of those which counteract it; to observe the first beginnings of deranged function in his own person; to give to his physician a more intelligible account of his train of morbid sensations as they arise; and, above all, to co-operate with him in removing the morbid state on which they depend, instead of defeating, as is now through gross ignorance constantly done, the best concerted plans for the renovation of health."†

* Preface to Dr. Combe's Physiology.
† Animal Physiology, Library of Useful Knowledge.

As the present little treatise—the first ever prepared in this country for use in schools—is the production of a gentleman not only of respectable acquirements in the science, but who has had much experience in teaching it to popular audiences, the Editors have no doubt that it will be found peculiarly well adapted to its proposed end.

Edinburgh, October 14, 1839.

AUTHOR'S PREFACE.

The method of teaching Physiology in schools, which is recommended in this little treatise, originated from the following circumstances:—Some years ago, while the author was delivering, in Falkirk, a course of popular lectures on the science, he was waited on by the late Mr. Downie, teacher of English in the Falkirk Parochial School, who wished to receive an explanation of some parts of the lectures which he did not quite comprehend. Dr. Hamilton then learning from Mr. Downie that he had attempted to give his pupils some lessons on Digestion and the Circulation, immediately furnished him with his diagrams on these subjects, agreeing, at the same time, to examine, in a few weeks, the progress made by the pupils. This was done, accordingly, and Dr. Hamilton was astonished and delighted to find many of the boys well versed in the subject, and all the children evidently much pleased with explaining and copying the diagrams. After this period, instructions in different parts of Physiology were regularly given by Mr. Downie, with a success which can be appreciated only by those who witnessed the proficiency of his scholars. In giving these instructions, it has been found that the effectual way to interest the children, and to make them comprehend the necessary descriptions, *is to show them the parts to be explained.* When this is done, a thorough comprehension of

very intricate structures becomes quite easy; without it, Physiology never can be taught to children so as to be remembered.

It happens at present, however, almost universally, that before the pupil can be taught, the teacher must himself be instructed; and it is this circumstance that has induced the author to append, to each section of the present work, instructions to the teacher. These, it is hoped, will be found both simple and requiring little pecuniary outlay. Almost the only instruments required to make the preparations directed, are, a scalpel or good penknife, a pair of forceps (both to be had from the surgical instrument makers), and a saw. Let the teacher only "put his hand to," and he will find that a few trials will make him quite an adept.

Numerous wood engravings have been interspersed with the text. The teacher should have copies of the principal of these made, of a large size, without letters of reference, to exercise the pupils. A good and very cheap mode of making large diagrams, is to get a frame of the size wished, and to stretch upon it strong smooth machine-made brown paper.* Give this a strong coat of whitening and size (or glue), and, when dry, draw the figures with water-colours and size, of whatever shades are desired. Then cut them off the stretching frame, and nail them, at the top, between a piece of tape and a slip of wood to hang by, and between tape and a roller below. When smaller drawings are wished, different coloured chalks and cartridge or drawing paper may be used, giving them afterwards a coating of isinglass or skimmed milk. A good size for the larger sheets of diagrams (which are in general preferable) is four feet by six; and a good colour, where particular parts are not required to be distinguished, is burnt umber, to be had from any house-painter.

Additional figures and information may easily be had by referring to Dr. Combe's Physiology, Dr. Roget's Bridgewater

* Furnished by Cowan, paper-maker, Edinburgh, at 4d. per yard, four feet broad, and of any length. In stretching, the sheet should be damped with a sponge, pasted on the frame, and then a hot smoothing-iron passed along the pasted part to dry it first.

Treatise, Dr. Smith's Philosophy of Health, Animal Physiology in the Library of Useful Knowledge, Bell's Anatomy, Edwards's Elemens de Zoologie, Fletcher's Rudiments of Physiology, Caldwell on Physical Education, Prout's Bridgewater Treatise, Bell on the Hand, Brigham on the influence of Mental Excitement on Health, and the various elementary systems of Physiology, &c. To the work of Dr. Edwards the author has to acknowledge himself indebted for many of the illustrations in the following pages.

Both boys and girls received lessons on these subjects from Mr. Downie, and the ages of the children generally ranged from nine to twelve years. The subject seems particularly fitted for interesting boys during the latter years of their classical studies, and it is hoped that the teachers of these branches will find that a few hours weekly may be profitably devoted to such lessons. If possible, the teacher should endeavour to make the lessons of one season include sections that have a close connection with each other; such, for example, as those giving an account of the organic functions or at least those of Digestion, Circulation, and Respiration. Section VII., giving an account of the parts employed in locomotion, and Section IX., of the senses, contain lessons which, with a few explanations, may easily be understood separately.

ANIMAL PHYSIOLOGY.

SECTION I.

ORGANIZATION—LIFE. CLASSIFICATION OF ANIMALS.

[Anatomy is chiefly the subject of the following section, and for the reason that this lies at the foundation of Physiology. The learner should, however, first become familiar with the signification of these and collateral terms.

Anatomy may be defined, the science of organization in the healthy or physiological state. It is called *Human* anatomy, when restricted to the structure of man; *Comparative* anatomy or Zootomy when it includes the inferior animals, and *Vegetable* anatomy when it teaches the structure of plants.

Physiology may be defined strictly as the science of nature, and hence it was originally synonymous with Physics, or Natural Philosophy, and comprehended both animate and inanimate beings. This term is now, however, restricted to signify living organization, or the functions of living bodies; literally, therefore, the science of life, or *living anatomy*. It is hence subdivided into Animal and Vegetable Physiology, the former of which only is the subject of this volume.

Until very lately, "the three kingdoms of nature," *animal*, *vegetable*, and *mineral*, were uniformly considered separately. The two former, however, being endowed with life, and analogous to each other in many respects, both by structure and function, are now classed together as the *organic* kingdom, in contradistinction to the *inorganic* world, which comprises the mineral kingdom.]