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OUTLINES

PHYSIOLOGICAL PSYCHOLOGY

A TEXT-BOOK OF MENTAL SCIENCE

FOR

ACADEMIES AND COLLEGES

BY

GEORGE TRUMBULL LADD

PROFESSOR OF PHILOSOPHY IN YALE UNIVERSITY

NEW YORK

CHARLES SCRIBNER'S SONS

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PREFACE.

In the early part of 1887 I published the results of several years of research, in a book entitled "Elements of Physiological Psychology." The very gratifying reception almost immediately given to this work showed an extended and profound interest in the experimental and physiological study of mental phenomena. The signs of this interest have continued unabated until the present time; and the book has been widely adopted, both in this country and abroad, for private reading and for the instruction of classes.

Although the "Elements, etc." did not enter into the detailed history of discoveries and discussion of theories in the field of physiological psychology, it was necessarily somewhat voluminous and technical. For it aimed to give a summary of the entire field; and thus to render accessible the data and conclusions to be found, separated, only in scores or hundreds of larger and smaller monographs.

Almost immediately the demand arose for a smaller and less technical book, which should be adapted to aid the teacher with classes less mature, or able to afford less time to the subject. The present volume has been written for the express purpose of meeting this demand. It is not, however, a mere abridgment or revision of the larger work. While it, like the larger work, surveys the entire field, it omits all details, discussions, and references, which — however valuable for the purposes of more thorough mastery

— are likely to embarrass beginners of more limited patience and ability. The Parts (I. and III.) which treated of the nervous mechanism and of the nature of mind as related to the body, have been in this volume relatively much abbreviated; while the Part (II.) which treated of the phenomenal relations existing between the excited organs and mental phenomena, has been relatively somewhat expanded. Here considerable new material — especially in the chapter on " Consciousness, Memory, and Will " — has been added. I have thus aimed to furnish a complete and yet compact *text-book* for the briefer study of mental phenomena from the experimental and physiological point of view.

In carrying out the general aim of this manual, both pupil and teacher have been kept in view. The material has been arranged so as to adapt it for learning with the least unnecessary expenditure of strength and time. It is my hope also to have succeeded in providing those who give instruction with a book which can be successfully taught.

Some equipment of apparatus is desirable, if not absolutely indispensable, for the most effective instruction in physiological psychology. This equipment need not, however, be large or expensive. A set of models of the brain (I recommend the Bock-Steger), a few charts, a judicious selection of histological preparations, a machine for mixing color-sensations, etc., are of great assistance.

For the use of teachers, of more advanced or mature pupils, and of such readers, generally, as can command the patience and the time, the " Elements of Physiological Psychology " is still to be preferred. For most teachers who adopt the present, smaller treatise as a text-book in the class-room, the larger work will be found indispensable for their private use. The latter is still, in most of the subordinate topics, well abreast of the very latest researches.

And if its material is constantly supplemented by those notices of new discoveries for which one must look to periodical literature (*e.g.* the *American Journal of Psychology*), it will serve to keep even the teacher who is not a specialist in the lines of physiology and psycho-physics, in advance of his classes.

Having been for some years a teacher of this subject, I am well aware what are the difficulties of presenting it. But I have also learned that the rewards which follow the overcoming of those difficulties are correspondingly great. It will be a matter of great interest to me, therefore, to receive suggestions and encouragement from those of my fellow-teachers who may avail themselves of this book.

GEORGE TRUMBULL LADD.

YALE UNIVERSITY, NEW HAVEN,
Nov., 1890.

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INTRODUCTION.

NATURE OF PHYSIOLOGICAL PSYCHOLOGY.

THE satisfactory definition of any science is often one of the latest and most difficult achievements of that science. Our definition of the particular science which we intend to consider must, therefore, be understood as preliminary. It involves positions upon various disputed questions which the beginner is quite unable to comprehend; and it must be allowed, in a measure, to rely upon the course of the following investigation for its explanation and defence. Everything cannot be said at once. Terms must be freely used, the meaning of which will be made clear only by their use; and answers to later inquiries will sometimes be implied in what is said upon inquiries that are earliest raised.

It is plain that a correct conception of *Physiological Psychology* involves some special knowledge of those two sciences whose names are combined in the term itself. These are, of course, Psychology and Physiology. It is also plain that a peculiar relation is assumed to exist between certain of the results obtained by the study of these two sciences; otherwise they could not properly be combined in one term. It is furthermore suggested by this compound name, that the science which furnishes the noun — namely, psychology — defines the end which we desire to reach; while the science which furnishes the

adjective — namely, physiology — prescribes the means which we are to employ. This suggestion we shall find to be confirmed by our subsequent investigations.

Definition of Pyschology. — It was for a long time customary to define psychology as "the science of the human soul." Sometimes the definition went so far as to add that the soul, "as the *real* foundation of the spiritual life," or as "the subjective spirit," is the "subject-matter of psychology." Of late, however, serious objections have been raised against every such definition. It has been complained that the word "soul," although its German equivalent is freely employed in biological and physiological treatises, cannot be sufficiently kept free, for scientific purposes, from theological and other prejudices. The word "mind," which had originally a much narrower significance, has therefore been substituted in the greater number of English works on psychology. Thus Mr. Sully defines psychology as "our general knowledge of mind reduced to an accurate and systematic form."

Other objections to the customary definition of psychology are not met, however, by exchanging the word "soul" for the word "mind." Thus it is said that both words are often used so as to conceal the unproved assumption that mind or soul is an independent entity; whereas it is the business of the science of psychology to prove, if it can, the existence of such an entity. Biology, which aims to extend its researches so as to include mental as well as other vital phenomena, sometimes asserts that it wishes the opportunity to explain what occurs in consciousness without making use of any assumptions. Some writers, then, have gone so far as to advocate "psychology without a soul." Others, on the contrary, have thought they found proof, in the complex phenomena of human life, of both an "animal" and a "rational" soul.

In order to the intelligent pursuit of physiological psy-

chology, it is necessary to notice the foregoing objections only very briefly. Our view of the best preliminary description of the nature of psychology is as follows: It is expedient, as far as possible, to avoid all controversy at the beginning of our scientific investigation. We should therefore be willing, where this can be done, to dispense with controverted words in forming our fundamental conceptions. It is also more satisfactory, from the purely scientific point of view, to have the definition include only a description of that particular group of phenomena which it is the business of the science itself to explore. In this way, then, we define *psychology with reference to its primary problem*, which *is, the description and explanation of the states of human consciousness, as such.*

If the term "sentience" seems preferable to consciousness, it must be understood as equivalent to consciousness in the broader sense of the latter word. We may then say that psychology is the science which describes and explains the phenomena of the sentient life of man.

This definition plainly implies an acquaintance, already gained, with a certain class of phenomena. These are the phenomena of consciousness. What it is "to be conscious," and what is that peculiar character which belongs to all phenomena of consciousness, as such, can never be defined.

It would be inconvenient and unnecessary — not to say impossible — to refuse to speak of the "soul" or "mind" simply through fear of unscientifically making the assumption that some such entity really exists. In all languages, and in the every-day use of them all, men in expressing their states of consciousness, as well as in addressing their fellows, employ such terms as "I" or "me," and "thou" and "he," or "it." But all these words imply some kind of reference to a subject of the phenomena of consciousness; they also imply a contrast between this subject and other subjects to which other phenomena are attributed.

In all the earlier part of our investigation, whenever we use the word "mind" or "soul," we wish to imply no more than all men inevitably mean whenever they say "I" see, or think, or feel, or purpose, this or that. It is the seeing, thinking, feeling, and purposing, etc., as states of consciousness, with this possible reference to a subject of them all (*states of consciousness as subjective*), which constitute the field to be explored by psychology.

Definition of Physiology. — The science which is to be combined with psychology in our investigations is human physiology. This is the science of the functions of the human physical organism. Its modern study implies an acquaintance with several other sciences with which it is closely allied, or upon which it is dependent. These are molecular physics and chemistry, as related to the structure and changes of the tissues of plants and animals; biology, including the allied phenomena of plant life; embryology and the general theory of development; and gross and special microscopic anatomy, or histology. It is only, however, with a small part of this vast domain that physiological psychology has directly to deal. Its chief concern is with the structure and functions of the human nervous system.

Definition of Physiological Psychology. — It has already been implied that our conception of this science is dependent upon the way in which we understand the two sciences to be combined in its pursuit. But the science of psychology furnishes the end or final purpose of our researches. In other words, we aim to describe and explain the states of human consciousness, as such. On the other hand, physiology furnishes the peculiar means to be employed, — the point of view held in our description, and the method and source of our explanation. We study the subject-matter indicated by the noun; but we study it by use of the somewhat peculiar means and ways of approach

indicated by the adjective. We may, then, define physiological psychology as *the science of the phenomena of human consciousness in their relations to the structure and functions of the nervous system.* It is psychology, because it is the science of the human mind, or soul; it is physiological psychology, because it regards the mind as standing in peculiar relations to the bodily mechanism.

Method of Physiological Psychology. — In its method this compound science necessarily partakes of the characteristics of the two sciences which enter into it. But these two sciences differ somewhat widely in respect to their long-established methods. They also differ in their very nature in such a way as to make necessary a difference of method in their pursuit. It has always been held by a great majority of its students that the method of psychology is necessarily what is known as "introspective." But there can be no doubt that the method of physiology is one of external observation and experiment; since physiology is a physical science and has to determine external facts of the structure, development, and functions of a physical mechanism. It is not strange, therefore, that doubts and even disputes have arisen as to the possibility of combining these two methods, and as to the proper way of making the combination, in case it is to be made at all. These doubts and disputes are, however, for the most part, unimportant.

The method to which psychology has, from time almost immemorial, appealed is, as has been said, *introspection*, or self-consciousness. The exhortation given to the student of mental phenomena is, accordingly, made to run as follows: "Would you know what it is to see, to hear, to think, to feel, to desire, to will? Then look within yourself and find the answer there." To answer such questions, inspect *within* (*intro*-spect); to know what is the meaning of consciousness, in any of its varied forms, be

self-conscious, or aware of the states of consciousness as immediately known to be your own. But like the definition of psychology, this conception of its method has of late been much called in question, and its lack of scientific character as well as its general unfruitfulness have been exposed.

What view, then, shall we take of the use of introspection in psychology, and more particularly, in physiological psychology? Now there should be no mystery or arrogant assumption about such words as "science" and "scientific method." Science is knowledge — real, verifiable, systematic. Scientific method is nothing but the way of arriving at such knowledge. In physiological psychology, as a science, any way of arriving at genuine knowledge is justifiable; all ways of arriving at such knowledge should be diligently and skilfully employed. But the phenomena which we must somehow know, in order to describe and explain them, are states of consciousness; and states of consciousness, *as primary facts*, can be ascertained in no other way than in and by consciousness itself. This way of ascertaining these facts is introspection. Introspection is, therefore, not only a legitimate but it is an indispensable method of physiological psychology. To object to it, so far forth, is not only inexpedient and useless, but is even absurd.

Psychology as a *science*, however, requires not only that we should ascertain by introspection what the states of consciousness, as primary facts, actually are, but also that we should explain these facts and their relations to one another in the life of the mind. Such explanation requires at least two things: these are, the analysis of the states into their simplest factors, and the discovery of the laws under which the states are related to each other and to all the conditions on which they depend. Our adult states of consciousness furnish the problems to psychology; they

are its primary facts, the admitted data from which it takes its start. But they are all, as states, exceedingly complex, and involve numerous factors. Self-consciousness can no more discover all the factors which have united to form these states than simple external observation can analyze a portion of water into its constituent oxygen and hydrogen gases. Especially is it true that few of the antecedent and accompanying conditions of these complex states of consciousness can be discovered by introspection. Introspection, therefore, can never serve as the sole method for establishing a science of psychology.

Moreover, those antecedent or accompanying conditions of the states of consciousness, which physiological psychology particularly endeavors to discover, are the structure and functions of the nervous system. About these matters introspection can, as a rule, tell us nothing whatever. The physical science of physiology, with its method of external observation and experiment, must be relied upon to describe such conditions of mental phenomena.

It is obvious, then, how physiological psychology must combine the two methods which belong to the two sciences on which it depends. Introspective psychology must furnish us with the description of those complex states of consciousness, as such, which it is desired to explain. These furnish the problems to be solved. Physiology, on the other hand, must be relied upon for a description of the living and active nervous system, regarded as giving conditions to the origin and character of the states of consciousness. Physiological psychology, therefore, attempts to bring the two orders of phenomena, those called mental and those belonging to the nervous system, face to face. It considers them as mutually related; it endeavors, as far as possible, to unite them in terms of a uniform character, under law. Its method is to explain the phenomena of

man's sentient life as correlated with the life and growth and action, under stimuli, of his nervous system.

Divisions of the Subject. — The different chapters of this book fall under three main divisions. We shall first consider the structure and functions of the nervous system from the modern mechanical point of view. In these earlier chapters we must rely upon the method of external observation and experiment as employed by the modern science of psychology. Our object will be to give a clear picture in outlines of what the nervous system of man is, and of how it acts in response to the different forms of stimuli which excite or irritate it. This work requires little reference to states of consciousness or to the nature of the mind. We shall, in the main, consider the nervous system as a purely physical mechanism. Yet even in these chapters certain important considerations bearing upon the nature of the mind and its relations to its bodily basis will indirectly come into view.

The next eleven chapters (VIII.–XVIII.) may be considered as constituting the second or main division of the book. In these chapters the various relations which the science of physiological psychology has discovered between the states of conscious mind and the conditions of the excited nervous system, are presented in order. Such relations may conveniently be considered under three general groups or classes. The first group comprises the relations which can be established between the condition and activity of the higher nervous centres and the phenomena of conscious sensation and motion. The principal question raised under this head concerns the so-called "localization of function" in the hemispheres of the brain. The second group of relations includes the phenomena with which *psycho-physics* (in the more precise use of the term) attempts to deal. Such are the relations which exist between the quality, quantity, combination, and time-

order of the various stimuli which irritate the nervous system, and the kind, amount, composite result, and time-relations of the mental phenomena. A third class of relations considers mind and body as dependent upon differences of age, sex, race, etc.

At the close of the more strictly scientific discussions of the book, we shall be in position to verify certain conclusions as to the nature of the human mind, and as to its general connection with the bodily organism. Some of the considerations introduced at this point will be of the kind ordinarily known as "metaphysical." We consider it scientific to postpone these questions, as well as all assumptions bearing upon them, until we have candidly and thoroughly discussed the related phenomena and the laws (or uniform ways) of their relation. But we also hold that psychology, even when it employs the physiological method, has the right, and is under obligation, to suggest and defend true conclusions as to the nature of the mind.

Benefits of the Study. — It has been shown that physiological psychology can scarcely claim to be an independent science, or even a separate and definite branch of general psychology. It is, nevertheless, a most interesting, suggestive, and productive way of studying mental phenomena. For a long time the so-called "old psychology," as pursued by the introspective and metaphysical methods, made little or no advance. In a single generation, as pursued by the experimental and physiological methods, the science of psychology has been largely reconstructed.

The modern science of man emphasizes the necessity of studying his nature and development as that of a living unity. Man is known as the head of a series of physical and psychical existences. Only by considering him in this way can we have a trustworthy and adequate picture of his mental life and mental evolution. Such a consideration

the psychology which relies *solely* upon introspection and metaphysical speculation is unable to furnish. The actual achievements of the new science of physiological psychology — though, of course, still including many uncertainties and leaving many gaps to be filled — are a sufficient justification of its demands upon all students of the human mind. Further proof of the benefits of its study we confidently leave to the test of the student's experience.