

sits in a flying machine which makes its way through the air 'fly'? If so, the swift and the merlin and eagle have an action for which we should find another name. One thing such acts have in common—progress. They have little else."

Mr. Dewar says truly that though no date in a calendar can end or begin winter, yet there are some natural events—small touches, but sure—that end one season and begin another. One of them is the nest—with the eggs—of the earliest song-thrush. "The nest may be set in a winter hedge, and a return of iron days and nights kill the work and prevent other thrushes starting on their nests for weeks to come. It does not signify. The first thrush nest found in March in the thorn or ivy, the clay dried, the eggs laid, ended winter." But he does not do the fly-catcher justice when he says it can squeak, and has besides a fretful monosyllable or so, and there is his music. It is true that the fly-catcher very rarely sings, and that many people have apparently never heard the song; but it does really sing occasionally for all that. How one wrong letter will alter the look of a sentence, and even puzzle the reader for a moment! We notice "swallow" written for "sallow" in one place, and "root" for "rook" in another.

TEXT-BOOKS OF PHYSICS.

(1) *Mechanics and Heat: a Text-book for Colleges and Technical Schools.* By W. S. Franklin and Barry Macnutt. Pp. x+409. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1910.) Price 7s. 6d.

(2) *A Text-book of Physics.* By H. E. Hurst and R. T. Lattey. Pp. x+638. (London: Constable and Co., Ltd., 1910.) Price 8s. 6d. net.

(1) WITHIN the last half-century much experience has been gained as to the methods which can be used most profitably in the teaching of science; nevertheless, there is still much diversity of opinion as to the best method to be used. Followers of the heuristic school maintain that a student should build up his knowledge of science by his own unaided exertions, the function of a teacher being to guide the student's mind insidiously toward the correct path. Has any teacher ever attempted to proceed severely on these lines? It may be doubted. So far as the teaching of physics is concerned, such an attempt would be so ridiculously futile that no one could have made it seriously. Ideas such as those connoted by the words "energy," "potential," "entropy," and a host of similar expressions could scarcely be derived by any student, even if he were of the type that might develop subsequently into a Kelvin or a Rayleigh. Quite apart, however, from the question of possibility, it may be argued that no student has received a satisfactory training unless he has learned to profit by the knowledge which has been accumulated by others. Dismissing, then, the claims of the heuristic system as enunciated by its most rigid adherents, the question arises, To what extent is a student necessarily dependent on personal observation, and to what extent is it profitable for him to imbibe ideas directly from his teacher? No general answer

can be given to this question, since so much must depend on the personalities of both the student and the teacher; but if it be accepted that science is the study of real phenomena, it must follow that the practical work done by the student must be sufficiently extensive to give him a clear idea of the phenomena which he investigates. Not only the nature of the experiments, but the order in which they are performed, is of importance. Most of the difficulty experienced by students in becoming acquainted with the dynamical properties of solids and fluids is due to the practice of studying the laws of statics exhaustively before the laws of motion have been mastered; much of the time now spent in the experimental study of statics might be devoted with advantage to the performance of simple experiments designed to illustrate the laws of dynamics. In a systematic course of study an accurate and comprehensive knowledge of mechanical principles should be gained as early as possible, for most of the exact sciences cannot be mastered without such a knowledge.

Messrs. Franklin and Macnutt have advisedly devoted the first 269 pages of their text-book to the study of the mechanical properties of solids and fluids; such subjects as virtual work, the properties of rotating bodies (including the gyrostat), the analysis of the stresses called into play by straining an elastic substance, and the fundamental laws of hydrodynamics are dealt with in a simple but illuminating manner. A few errors may be noticed. The action of the Pitot tube cannot be deduced from the force exerted by a jet of liquid impinging normally on a plane. The velocity of stream, as measured by a Pitot tube, should be equal to $\sqrt{2gh}$, where h is the height at which the liquid stands in the tube, instead of \sqrt{gh} , as given on p. 260. The depression of the surface of the water escaping from the central outlet of a laboratory basin is not essentially due to rotation of the water; even when the water approaches the outlet radially its velocity must increase and its pressure must diminish. In general, however, the treatment of the subject is excellent, and the student is afforded an opportunity of becoming acquainted with many interesting phenomena connected with engineering practice, which are not generally mentioned in books devoted to the theory of mechanics.

The second part of the book is devoted to the study of heat. The first and second laws of thermodynamics are discussed fully, and the most interesting properties of solid liquids and gases are dealt with in passing. The graph given on p. 401 exhibits the rate of cooling of a teapot as compared with that of a Dewar's vacuum flask, and is interesting as showing that the rate at which the teapot loses heat is scarcely affected by radiation, being due almost entirely to convection and, to a small extent, to conduction. How many teachers, it may be wondered, have explained that a silver teapot loses heat more slowly than a porcelain one, on account of the high reflecting and consequent low radiating qualities of polished silver?

(2) Messrs. Hurst and Lattey have written this book for students preparing for the Preliminary examina-

tion in physics in the Oxford Natural Science School; the general standard adopted is somewhat lower than that required for the examinations in physics for the Intermediate B.Sc. of the University of London. The book has been carefully written, and the diagrams are well drawn and reproduced. A large assortment of questions (without answers) is given at the end of each chapter. For the rest, there is not much to distinguish this book from many others on the market. The ordinary ground is covered in a trustworthy but somewhat uninspiring manner, and very little attention has been devoted to display. One or two errors may be mentioned. Ohm's law cannot be proved by the aid of experiments conducted with the potentiometer, as stated on p. 520; the use of the potentiometer is based on the truth of Ohm's law. One of the diagrams on p. 466 indicates that when a charged body is suspended inside an insulated metal can, the distribution of the lines of force radiating externally from the can depends on the position of the body inside the can. This conclusion is well known to be inaccurate. A very bad example is set to students on p. 16, where it is stated that—

"A velocity of 20 miles per hour was gained in 15 minutes; if the acceleration had been uniform, $\frac{20}{15} = 1\frac{1}{3}$ miles per hour had been added in each minute, or $\frac{1\frac{1}{3}}{60} = 0.0218\bar{3}$ miles per hour in each second."

One of the first things that should be impressed on a student of physics is that recurring decimals have absolutely no meaning with regard to physical measurements.

E. EDSEK.

EXPERIMENTAL PSYCHOLOGY.

Lectures on the Experimental Psychology of the Thought-Processes. By Prof. E. B. Titchener. Pp. ix+318. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1909.) Price 5s. 6d. net.

A Text-book of Psychology. By Prof. E. B. Titchener. Part II. Pp. ix+303-558. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1910.) Price 6s. net.

IN these books Prof. Titchener has made two valuable additions to the list of excellent psychological text-books that already stands to his name. The first takes its place by the side of his "Lectures on Feeling and Attention" as another detailed and advanced discussion going to the very heart of general psychological theory; the second is the completion of a new "Text-book of Psychology," intended to take the place of his well-known "Outline."

The lectures on thought-processes are five in number, in which are discussed the general function of mental imagery and its relation to thought, "objective reference" as the universal characteristic of consciousness, the modern methods employed in the experimental investigation of the thought-processes (by Marbe, Binet, Watt, Ach, Messer, Bühler, &c.), and the general conclusion as to the existence of a distinct "thought-element" to which most of these investigators find themselves driven. Titchener finds this

conclusion unjustified by the facts, and to be explained, partly at least, by a confusion of the psychological with the logical point of view. "Cortical set," i.e. a purely physiological factor, together with a residuum of mental imagery, a residuum so inappreciable that it escapes introspection, are to be looked upon as the more probable factors in the make-up of so-called "imageless thought" than any ultimate thought-element.

The first lecture contains an excellent account of the difference between modern psychological sensationalism and the older sensationalism of the associationist school. Whether the difference is so fundamental as Prof. Titchener imagines it to be is perhaps doubtful. When, e.g. he writes: "The experimentalists, on the other hand, aim to describe the contents of consciousness not as they mean but as they are," one may perhaps be allowed to demur. Would not such a complete abstraction of mental process from meaning make a theory of knowledge impossible? A distinction so rigorously drawn between psychology and epistemology or metaphysics really implies a denial of the existence of the latter sciences. In Lecture II. an analogy for the reference to an object implied in all thought is taken from physical organisation.

"Every constituent part of an organism points to and implies all the other parts. In the same way the ideational process which is the vehicle of conceptual meaning is involved in a network of reproductive tendencies; it points to and implies all the special ideas that fall under the concept in question."

Is it not more accurate to say that the "reference" and implication in the former case is explicable on the analogy of that in the latter, and not *vice versa*? The complete identification of "meaning" and "context" may solve many difficulties, but does it not raise still greater difficulties in doing so? Such doubts as these may arise in perusing the lecture, but Titchener does really come to close quarters and grapples with the central difficulty in a way that does much to justify his unshakable faith in psychology and its competency to include the whole field of mental life.

The later lectures are an excellent description and criticism of experimental work on thought. The conceptions of *Bewusstseinslage* and *Aufgabe* are fully explained and the exact position of the problem up-to-date made clear. In the "Notes," which fill more than 200 pages, the original authorities are extensively quoted, and many points are discussed in much greater detail. The entire book will be found of the utmost value to the advanced student.

The "Text-book of Psychology," Part II., deals with Perception Association, Memory and Imagination, Action, Emotion, and Thought, all in a clear and straightforward way. The descriptions are based upon experimentally-determined data, and give an excellent idea of the extent to which Experimental Psychology has widened and deepened the more general science. Very full references for further reading are given at the ends of the chapters. By the device of type of two different sizes the book has been made suitable both for the beginner and also for the more advanced student.

W. B.