vestigation, either systematic, structural or physiological, is to destroy originality and keep narrow the ground on which future generalizations must be built. It is accordingly plain that to limit a student's opportunities for biological instruction to a specialized course along some one line has not even the single justification it at first seemed to possess. The present extreme tendency toward 'laboratory work' and away from actual contact with nature on the part of beginners in biology is without doubt a temporary condition. Not every one who sits behind a battery of reagents in a laboratory is an investigator, and not all investigators are thus equipped.

At the cost of an equal amount of labor, which would command the general preference, an acquaintance with the more common plants of one's neighborhood or a mass of facts about plants in general, but applicable as a whole to no plant in particular? Organs, tissues and functions have been named and classified; knowledge in these directions is becoming extensive and complex, and the specialists are zealously trying to keep the beginners up with the times. Recent text-books written from structural and physiological standpoints contain a mass of definitions and an amount of classification equalling or exceeding that of the other extreme in systematic works. This classification is, indeed, not what prominently bears that name, but it is classification none the less, though artificial and based on abstractions instead of affinity or phylogeny. The details of structure and life history are arranged under such heads as 'Growth,' 'Reproduction,' 'Nutrition,' 'Irritability' and 'Symbiosis,' and the emphasis is not upon the facts in nature, but upon the mechanical or chemical considerations which must be invoked to explain the various special problems.

A complaint has been voiced that these so-called modern methods of instruction are atal to the interest and spirit which actuated the naturalists of former days, and this is not difficult to understand. Such work is preparatory only for chemists, physicists and physiologists. Its interest is not in nature, primarily, but in matter and mechanisms. Under the extreme systematic method we had introductions to plants of which we knew nothing; by the avowedly unsystematic method we learn facts about plants which we do not know.

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SCIENTIFIC BOOKS.

Text-Book of General Physics for the Use of Colleges and Scientific Schools. By CHARLES S. HASTINGS, PH.D., and FREDERICK E. BEACH, PH.D., of Yale University. Boston, U. S. A., Ginn & Co.

Apart from the obvious distinction between good and bad, text-books in Physics may be divided into two well-marked classes. In the one the main point of view is to consider the study of Physics as a training of the mind; as a subject which requires the use of logical processes and which ought to develop mental accuracy and habits of thought better than any other science.

The other class of text-books does not lay so much stress upon logical methods, but calls attention rather to the phenomena of Nature which are illustrations of the great fundamental laws, and to the experimental methods by which these laws have been discovered.

The continued success of such text-books as those of Ganot and Deschanel shows that there is a great need in American colleges and schools for the class of text-book which comes under the second head, just mentioned. The most recent text-book, this by Hastings and Beach, is distinctly one of the same order. It treats the subject, however, in a thoroughly modern manner and is free from the inaccuracies of the earlier treatises. One's first impression on opening the book is of great satisfaction. The paper, type, illustrations, arrangement of matter, everything which per-

tains to the printer's art, is more satisfactory than perhaps in any modern text-book of science, and the more one investigates the book itself the more one is convinced that the authors have successfully accomplished their purposes.

The subject-matter is arranged in the following order: Mechanics, Heat, Electricity, Sound and Light. The scope of the book is rather wider than would allow its use in most colleges or schools, including, as it does, such points as radius of gyration, compound pendulums, Carnot's cycle, Thomson and Joule's experiment, entropy, virial, osmotic pressure, thermo-electricity, theory of alternating currents, impedance and so on, electric waves, efficiency of optical instruments, theories of color sensation, and wave surfaces of uniaxal and biaxal crystals. A knowledge of trigonometry and the elements of analytical geometry are presupposed for the study of the book, but no previous knowledge of physics is expected.

Each of the main subjects of Physics is discussed with considerable fulness and is illustrated by many natural phenomena and by many mechanisms and devices in common use. This is particularly true in the subjects of Mechanics and Electricity. One knows before one looks that there will be a most satisfactory explanation and discussion of optical instruments. In fact, all the chapters on Light are of marked excellence.

It should be particularly noted that special attention is paid throughout the book to the description of the various instruments used in physical measurements. The chapters on music, musical instruments and color-sensation are admirable. The book closes with an excellent index.

One may think that occasionally there is want of balance in the amount of space given various subjects and in the arrangement of these subjects. For instance, the space given the 'conservation of momentum' is only about half a page, whereas that given the centrifugal drier and the centrifugal cream separator amounts to nearly four pages. The discussion of measurement of matter and of the concept of force is most briefly stated. It may be said, however, that in a text-book of this character, where the purpose is not to acquaint students with the fundamental principles of Physics and with their logical development, but rather to give them a knowledge extending over wide fields of the phenomena of Nature and to correlate these in groups, such criticism as this is not applicable.

If one speaks of certain questions which do not seem to be treated as well as they might be, it is not from any wish to detract from the high merit of the book, but rather to call the attention of teachers who may use the book to certain points concerning which questions might be raised. In particular, it is doubtful if the chapter on Thermometry or on Calorimetry could be regarded as satisfactory by a class. It is hardly fair in defining a scale of temperature to use, as is done on page 165, the formula for the law of gases, and then to state, as is done on page 179, that "Experiment has shown that in the case of a gas under constant pressure not only is the expansion strictly proportional to the increase of temperature, but that all gases have sensibly the same coefficient." This seems to be using a quantity to define temperature and then to make use of the definition in stating a law.

Again, the words 'definite quantity of heat' are used in what may be considered an indefinite manner. On page 251 the authors use the following words: "The now universally adopted theory that heat is the kinetic energy due to the irregular motion of the molecules of a body"—a statement which is not altogether justifiable. It is possible to speak of the energy of a body and to consider it as partly kinetic and partly potential, using the latter name simply to include all energy that is not, strictly speaking, kinetic from our present knowledge; and it is possible also to say by way of definition that we will call the kinetic energy of the parts of the body by the name 'Heat.' This, however, is quite a different matter from saying that all the heat-effects are manifestations of kinetic energy, or from using the word 'Heat' in the sense of something that is 'applied' to a body, which is the sense most commonly used by the authors.

It is to be regretted that such phrases as 'molecular attractions of the particles of a solid

for those of a liquid are greater than the attractions———' p. 142; 'zinc has a greater affinity for oxygen than copper,' p. 386; 'the bond uniting the hydrogen to the acid radical SO_4 will be ruptured,' p. 388; 'an electrolyte capable of a reaction with one of the conductors,' p. 388, should be retained in a modern text-book. Exception must be taken also to the use of the word 'molecule' on p. 237 without any explanation; to the phrase 'mechanical equivalent at 15° C.,' on p. 264; to the explanation of what is meant by a 'reversible' cycle on p. 269; to the definition of the 'ampere;' to the use of the expression 'stationary waves;' and to the expression 'it is assumed that the current enters.'

Certain explanations are undoubtedly erroneous, such as those of electrolysis, scintillation and the theory of 'angle of contact' in capiliarity; while others are not rigid or not definite, such as those of the simple pendulum, the barometer, Röntgen rays, iridescence.

There are several slight mistakes throughout the book, such as the incomplete statement of Döppler's principle, the use of R instead of R_o in the two formulæ of Van't Hoff on pages 236 and 240, the statement on page 263 that there are discrepancies between the values of the mechanical equivalent as found by the two methods.

As a text-book of the character evidently planned by its authors this treatise must, however, be considered most successful. It is a book to which every student would have occasion to refer from time to time, and which contains within its covers much more matter than any existing book of its class. The style is pleasant, attractive and definite, and every laboratory and library would do well to purchase the book.

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The Principles of Stratigraphical Geology. By J. E. MARR. Cambridge Natural Science Manuals, Geological Series. Cambridge, University Press; New York, The Macmillan Co. 1898. Pp. 304.

Here is a book on a single department of geological science which is the type of many another. Written to give students some idea of the methods and scope of stratigraphical geology, it combines a digest of the contents of larger standard manuals, with an elaboration of some points according to the author's views, and requires for its full understanding a familiarity with structural and dynamical geology, the nomenclature of paleontology, and a minute acquaintance with the local nomenclature of English geography.

The omissions in the earlier chapters imply that the student is preparing for field work after having read Lyell's Principles and Geikie's or some other text-book, while the substance of the chapters reads like lectures given to a class of beginners.

The second half of the book is by far the more valuable, in that it gives a brief, but clear and well-written summary of the stratigraphy of Great Britain, with here and there references to the more conspicuous points of stratigraphical classification in other countries. The stratigraphy of England, Wales and Scotland is described with just enough detail to bring out the differences of sedimentation in separate regions for each period, and shows the growth of the island during geological time.

A fuller treatment of this element of stratigraphy is given in Jukes-Brown's 'Building of the British Isles.'

Some of the author's peculiarities are seen in his classification and use of terms.

Lapworth's term Ordovician is adopted. In his list of systems are included Permo-Carboniferous and Permian, in addition to the Carboniferous.

The grounds of this usage are 'primarily' the recognition of an unconformity between the Carboniferous and Permian in England; and secondly, the correlation of a portion of the Salt Range strata of India as intermediate between these two 'systems' of the English column.

In the Cenozoic six 'systems' are cited, viz: Eocene, Oligocene, Miocene, Pliocene, Pleistocene and Recent; but we are told in the text that these are hardly systems in the sense in which the term is used in the case of the older rocks. Further on, the chapters describing these formations are headed as follows: 'The Eocene Rocks,' 'Oligocene and Miocene