to a definite physical phenomenon, has some practical advantages, and it will doubtless receive extended notice and discussion by engineers. An authoritative definition of elastic limit will probably be established in time by the international association recently established for the study and unification of methods of testing.

The author lays much stress upon the method of judging the quality of a material by means of the work required to rupture it, or by its resilience, as Thomas Young called it in 1803. The diagram of a tensile test enables this work to be computed, and undoubtedly too great attention has heretofore been paid to the ultimate elongation and too little to the ultimate resilience. The elongation depends upon the form and length of the specimen and is far from being an absolute measure of the ductility; moreover that part of it which occurs after the maximum strength is reached is of doubtful value in estimating the work of rupture. It is for these reasons that percentage of reduction of area is extensively used in commercial tests, it being found to be nearly independent of the length of the specimen and hence a better index of ductility. In this direction of investigation great advances are to be expected, and the development of impact tests now in progress really results from the desire for a better determination of the ultimate resilience than the static stress diagrams can give. If all tests of metals except one were to be abandoned, the simple test of bending a cold bar by blows of a hammer would, by an overwhelming majority of votes, be the one to be retained; further, if this cold-bend test be made by a single blow, and if the changes of length on the tensile and compressive order be measured, a determination of both resilience and ductility is obtained, which, though not an absolute one, is probably as valuable as that given by the common static tension test. For these reasons it is thought that the author has somewhat overestimated the value of the ultimate elongation as determined on testing machines, and that reliance upon it as an absolute measure of ductility is generally too high.

The space devoted to the different materials is about as follows: 124 pages on timber, 43 on brick and stone, 77 on cement and mortar, 43 on cast iron, 24 on wrought iron, 87 on steel, and 18 on alloys. A timely chapter on the magnetic testing of iron and steel, by W. A. Layman, concludes the book. There are over 600 illustrations, of which about one-half are the valuable graphic representations and comparisons. From the extended experience of the author in laboratory work, and from his record as a writer and investigator, it was to have been expected that this book would be an excellent one. It has, however, more than realized the expectations in its Parts III and IV, for here are presented such careful and comprehensive analyses of modern methods and results that the book must at once take high rank as one of the standard authorities on the materials of engineering.

MANSFIELD MERRIMAN.
LEHIGH UNIVERSITY, June 1, 1897.

Experimental Morphology. Part I. By. Dr. C. B. DAVENPORT. The Macmillan Company. 1897.

The broadening of the biological horizon in recent years has necessitated an ever-increasing specialization on the part of investigators in that department of science. The territory now open to study is so extensive that it is beyond the powers of any individual to examine all parts of it in detail, and, consequently, each must choose for himself a portion of greater or less extent with which he may expect to become tolerably familiar. And yet it is impossible to reap the full benefits of results so obtained unless they can be correlated with what is being accomplished in adjacent fields, and, that his work may approach the ideal condition of being *totus teres atque rotundus*, the investigator of to-day must look to his neighbors to supply him from time to time with statements of what they have accomplished. Dr. Davenport's work on Experimental Morphology aims to be a statement of this kind, its object being to review what has been accomplished in the study of the extrinsic forces which determine the course of the development of organisms. The work, as projected, is to consist of four parts, of which the first, now before us, treats of the action of external forces, chemical and physical, on living protoplasm in general, while

the other three will consider their influence on growth, cell-division and differentiation.

If the first part is to be regarded as an earnest of what is to come, all biologists will look forward with interest to the completion of the work. The present part gives in successive chapters admirable and thorough accounts of the various observations and experiments on the action on living protoplasm of chemical agents, moisture, density, molar agents, gravity, electricity, light and heat, and concludes with an all too brief chapter discussing the light thrown by these observations on the structure of protoplasm, the conditions which limit metabolism, the dependence of protoplasmic movement on external stimuli and on metabolism and on the determination of the direction of locomotion. The action of each force is considered under several headings; light, for example, being considered as to its chemical action, its effect on the general functions of the organism and its action in controlling the locomotion (phototaxis); and the text is illustrated by numerous well-chosen figures as well as by several tables of which there may be especially mentioned No. XVIII., which gives the nature of the response to light of the various forms which have been experimented upon in this connection; No. XIX., which gives the ultramaximum temperature for numerous organisms; No. XX., which similarly gives the ultraminimal temperatures, and No. XXI., which is a list of species found in Hot Springs with the conditions under which they occur. The author's judgment in the treatment of his subject is excellent, as he has confined himself for the most part to a judicious statement of facts and phenomena, with here and there a suggestive inference or an indication of lines for further observation, wisely refraining from what would have been more or less profitless discussions, the times not yet being ripe for broad generalizations on the subjects of which he treats. The material which is discussed has been well digested and is well arranged, and the style, though retaining here and there somewhat of the flavor of the note-book, is on the whole clear and concise. The book is a readable one, and the descriptions and criticisms of methods employed in experimentation, and the bibliographical lists at the conclusion of each chapter, contribute materially to the value the book possesses for both the morphologist and the physiologist.

It is a question, however, if the title chosen for the work is applicable so far as the first part is concerned. The action of poisons, heat, light and electricity on protoplasm, chemotaxis, rheotaxis, geotaxis and similar phenomena, as well as those of acclimatization to various chemical and physical forces, can hardly be considered as falling within the domain of morphology. They are undoubtedly physiological questions. Indeed, the ground which Dr. Davenport here covers is discussed by Verworn, in a somewhat more general manner, in the fifth chapter of his *Allgemeine Physiologie*. Nevertheless, the questions discussed are of the highest interest to morphologists, and Dr. Davenport has placed his *confrères* under great obligations by placing in their hands so lucid an exposition of that side of physiology which especially appeals to them.

Owing to the careful thoroughness with which Dr. Davenport has labored, the work is comparatively free from oversights. It is to be regretted, however, that the author has seen fit to confine his attention almost exclusively to organisms as a whole, to the neglect of considerable valuable information to be derived from observations on vertebrate tissues. The action of poisons, for example, on the peculiarly unstable protoplasm of the vertebrate nervous system is hardly treated with the fullness which its interest and importance demand, and insufficient attention is given to the numerous results of general significance which have been obtained by the study of electrical stimulation of muscle and nerve protoplasm. We miss, too, a discussion of the effects of surface tension in producing movements of protoplasm, a question which has been considered by Ryder in several publications. A few typographical errors are noticeable, though none are serious, but a great defect consists in the absence of an index, a defect which may be remedied in the concluding volume. A separate index for each part would, however, be a great convenience.

J. P. McMurrich.

University of Michigan, May 23, 1897.