To me this is a far more important single concept than any other to explain co-ordination of all kinds, even the continuance of the healthy life of cells in higher animals, unless it be that of the influence of protoplasm on protoplasm, *per se*, and directly. Nevertheless, this doctrine of the influence of one cell on another, through chemical agency, which the theory of the constant effect of the nervous system renders clearer for all higher animals, is one that is also indispensable and which we are now beginning to understand in more detail. The main purpose of this communication is to put forward as broad a basis as possible for conceptions of the nature of living things, for the exact demonstration of which in a way to satisfy a rigid logic we must still wait, it may be long, but which we cannot afford, in the meantime, to ignore without making many errors and unduly restricting the field of view.

WESLEY MILLS.

MCGILL UNIVERSITY,
MONTREAL, May 13, 1897.

## HIGHHOLE COURTSHIP.

SOME mornings since I observed two highholes on the same branch evidently in courtship. The male, as I took it, would give a few clucks, and rapidly bob its head up and down four or five times describing about a quarter of a circle, and the female then responded with the few clucks and corresponding motions. This was repeated at short intervals, and they flew to another tree, and continued this rather comical performance. Mr. Burroughs, in describing this courtship of the highhole, speaks of the female as 'unmoved,' which, however, was plainly not so in this case. As the meaning of the head bobbing I would suggest that the motion, being much the same as when pecking at a tree or in the turf, may signify the offering of food. The male says, "Come with me and I will find you lots of fat grubs," and the female assents by the same acts and signifies mutuality. The whole is in the same line of sentiment and action as that of the young man who offers his best girl ice cream and soda water. I may also mention that I have often noticed this spring what I supposed to be the male blue jay approach his mate with a cluck and transfer to her bill some article of food, the whole affair appearing to be gallantry. It may even be that the kiss is a survival of lip-to-lip feeding.

As to the pugnacity of birds in early spring I may mention that some seasons since I observed a cock robin fight for some hours his own reflection in a cellar window. This season a mirror was placed upon a wren's box which had been usurped by a pair of English sparrows. The female fought her reflection most furiously, but the male showed more intelligence, investigated carefully, and would retire around the tree and peer out to see if the supposed bird would move toward the nest. At nightfall he took his place before the mirror, as if on guard. A carefully conducted series of experiments with mirrors upon birds and other animals would, by providing the new environment, be of great value in testing intelligence.

HIRAM M. STANLEY.

LAKE FOREST, ILL., May 5, 1897.

## A QUESTION OF CLASSIFICATION.

TO THE EDITOR OF SCIENCE: In your issue of December 18, 1896, pp. 918–922, in a communication by myself entitled 'A Question of Classification,' through a typographical error I am made to say that "all other students place the Dakota formation in the middle of our American Upper Cretaceous." The word 'Upper' should have been omitted from this sentence, as it was my intention to say that "all other students place the Dakota formation in the middle of our American Cretaceous and at the base only of the upper of the two great series into which the Cretaceous of this country is divided."

ROBT. T. HILL.

## SCIENTIFIC LITERATURE.

*The Materials of Construction.* A Treatise for Engineers on the Strength of Engineering Materials. By J. B. JOHNSON, Professor of Civil Engineering in Washington University, St. Louis, Mo. New York, John Wiley & Sons. 1897. 8vo. Cloth. Pp. xv+787, with 9 plates. Price $6.00.

This work is divided into four parts, the first treating of the mechanics of the subject, the second of general properties of materials, the third of methods of testing, and the fourth of results of tests. The number of pages in these

several parts is 86, 215, 167 and 254, the remaining 65 pages being devoted to an appendix and index. Although mainly designed for engineers, it will be useful to physicists and to all who have to do with the mechanic arts, for a large part of the information that it gives can be found in no other book. The task of the author in sifting and discussing the vast number of tests on record was a difficult one, but it has been performed with skill and success.

Part I is somewhat disappointing in that it is, in the main, occupied with elementary matter regarding bars and beams which is found in all text-books on the resistance of materials. In an advanced work of this kind the engineer or physicist would naturally expect to find the mathematical theory of elasticity developed to a point in advance of that taught in technical schools, and especially to see the theory of true internal stress in beams set forth. A valuable discussion regarding the elastic limit is here given, and the results of very recent theoretic investigations of combined concrete and iron beams are presented.

Part II, although perhaps giving a fuller account of the manufacture and properties of materials than other general works on construction, has not been prepared with the best care and discrimination. For instance, the blast furnace is not mentioned, although 14 pages on the manufacture of cast iron is quoted from a British book on metallurgy. The chapter on timber, which fills 97 pages, is a reprint from a bulletin of the United States Forestry Bureau, and much of this might have been well omitted altogether, while the remainder should have been properly digested and condensed. Steel, cement and paving brick are discussed, however, in a very clear and concise manner.

Part III presents a more complete account of testing machines and methods of testing than can be found elsewhere in book form. The classification and discussions are here most excellent, and the presentation of conclusions of the European commissions on the question of standard specimens and methods is very complete. Static tests of tension and flexure naturally receive the greatest share of attention. Impact tests, with the exception of the cold-bend and drifting methods, seem inadequately treated in view of their growing use and importance; for instance, the flexural test of steel rails by a falling ram, where deflections and the elongations on the tensile side are measured, has long been used in Europe and during the past five years has been adopted by some of our leading railroads, and hence should have received at least brief notice.

Part IV gives an admirable digest of the results of experiments on materials. A most excellent feature, and one which indeed runs throughout the entire book, is the presentation of results by means of diagrams. These set forth the relations between the different properties of materials far more clearly than columns of figures can do and enable the reader to make comparisons which otherwise would be difficult or impossible for him to undertake. The tests which are discussed are, in the main, those precise and comprehensive ones made on metals during the past twenty years by Bauschinger, Tetmajer, the French commission, and by Howard at the Watertown arsenal, and those by the author on timber. Lack of space forbids a mention of the conclusions and results here recorded, but it should be said that the care exercised in selecting the data and the admirable method of presentation is alone sufficient to render the book an authoritative one.

The proper definition of the term 'elastic limit' has long been a puzzling question. While generally defined as the limit at which Hooke's law of proportionality of stress to deformation fails to hold good, it has also been explained to be characterized by the beginning of the permanent set, while in commercial tests the so-called yield point, where a sudden molecular change occurs, is generally regarded as the elastic limit. The author discusses these definitions at length, and proposes that the term 'apparent elastic limit' be used to indicate that point where the rate of elongation is fifty per cent. greater than the rate at the beginning of the elongation. This definition enables the elastic limit to be readily marked on a stress diagram, and for ductile materials it appears to locate a characteristic point which lies higher than the limit of elastic proportionality and lower than the yield point. The new definition, although defective in not referring

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