ing among psychologists; and, also, if I ascribed to physicists generally some knowledge of the Hering hypothesis. It would, perhaps, have been a more nearly accurate statement to say that most, if not all, of the physicists who are acquainted with Hering's hypothesis reject it. My own acquaintance with the outlines of this hypothesis began sixteen years ago; but Professor Titchener is entirely correct in the conclusion that I have not 'followed up the Hering theory in its meanderings through a large number of scattered journals, some of which are now not at all easy to procure.' I do not consider this remark at all 'blunt,' nor is there anything in Professor Titchener's paper that calls for excuse. I may, however, regretfully remark that, in common with others of my profession, I shall hardly have the opportunity to look up these journals. When a psychologist of recognized authority informs me that 'there are now only two discussable theories of color vision, those of Helmholtz and of Hering,' I am willing and glad to accept his judgment, and to let the rest go with but little attention.

The conflict between these two hypotheses will, therefore, be watched in future years with the calm interest of an outsider, rather than that of a partisan. In teaching that portion of optics which relates to color I shall carefully limit myself to the physical facts; and if Hering's hypothesis should win its spurs, and thus be changed into Hering's theory, the physicists will doubtless forget their ancient hardness of heart and will welcome the settlement of a long vexed question.

Apart from Professor Titchener's discussion, several private communications have brought the assurance that my criticism of the color hypothesis which has for many years held a place in my regular course of instruction has had more than one sympathetic reader. The good spirit which has characterized the reception of my paper is a source of gratification.

W. Le Conte Stevens.

THE GEOLOGICAL AND BIOLOGICAL SURVEYS OF ALABAMA.

To the Editor of Science: In his Presidential address, published in Science, April 29th, Professor V. M. Spalding credits the Biological Survey of Alabama with the botanical work of Dr. Charles Mohr, of Mobile. That Survey is doing most excellent work, but Dr. Mohr has for many years been engaged, under the auspices of the *State Geological Survey*, in the investigation of the Botany of Alabama. As one of the results of this work we have now going through the press a complete flora of the State, and this will be followed by a companion volume in which the useful and noxious plants will be treated in a very thorough manner, as all who know the character of the work of Dr. Mohr will be ready to believe.

The Geological Survey began this work many years before the Biological Survey was inaugurated.

Eugene A. Smith.

University of Alabama, May 6, 1898.

SCIENTIFIC LITERATURE.

An Elementary Course of Infinitesimal Calculus. By Horace Lamb, M.A., F.R.S., Professor of Mathematics in the Owens College, Victoria University, Manchester; formerly Fellow of Trinity College, Cambridge. Cambridge, University Press. 1897. Crown 8vo. Pp. xx + 616.

The English text-books on the Infinitesimal Calculus in common use afford a formal treatment of the calculus that is all that can be desired. A student who has worked all the examples under important topics in one of these books has been through a course of shop-work that prepares him adequately for the manipulation of calculus formulas—and for the tripos examination. But he has done only shop-work. He has learned to differentiate explicit functions and to integrate (some) explicit functions, and to prove all sorts of things by Taylor's Series. He has *not* been trained to examine carefully the reasoning he employs or to consider even the broadest limitations in the statement of theorems. Teachers of elementary calculus are only too prone to leave the consideration of all such matters to the indefinite future; but a wise system of instruction will strive not to hide from the student, but to point out to him those difficulties that are inherent in the fundamental

conceptions and methods of the science, and to provide him with the simplest means known at the present time for dealing with them.

Professor Lamb has produced a text-book the distinctive feature of which, to our mind, is that a serious and successful attempt has been made to meet these latter demands. The author says: "Considerable attention has been paid to the logic of the subject. Writers of text-books, however elementary, cannot remain permanently indifferent to the investigations of the modern Theory of Functions (of a real variable), although opinions may differ widely as to the character and extent of the influence which these should exert. It is not claimed that the proofs of fundamental propositions which are here offered have the formal precision of statement which is *de rigueur* in the theory referred to; but it is hoped that in substance they will be found to be correct. Occasionally, where a rigorous proof of a theorem in its full generality would be too long or intricate, it has been found possible by introducing some additional condition into the statement, to simplify the argument, without really impairing the practical value of the theorem." In this important respect the book is the first of its kind on the subject of Calculus to appear in the English language. May future writers on Calculus emulate the example of Mr. Lamb in trying to make their presentation rigorous according to the highest standards of their day, and at the same time not beyond the comprehension of the students whom they would instruct!

The choice of material is varied and comprehensive. Both the indefinite and the definite integral are introduced at an early stage. There is a chapter of 44 pp. on Physical Applications and one of 62 pp. on Special Curves, besides an earlier chapter of 47 pp. on Geometrical Applications and a later one of 62 pp. entitled Curvature and containing, among other things, a treatment of the instantaneous center and of the space and body centrodes, including an application to teeth of wheels. Then follow chapters on Differential Equations of the first and second orders (34 + 51 pp.). In order, however, to deal with some of the most important differential equations that arise in practice, some knowledge of the properties of power series is indispensable; and so a chapter on Infinite Series (25 pp.) is introduced. This is one of the first elementary treatments in English of the continuity of infinite series and of the conditions under which they can be integrated and differentiated term by term. It is decidedly well done, and the collection of examples at the end is a valuable contribution to the presentation of this important subject. The book ends with a chapter on Taylor's Theorem.

This is not the place for detailed criticism. We cannot refrain, however, from deploring, especially in a book characterized in the main by rigor, the utter inadequacy of the treatment of the important subject of infinitesimals. As one of the consequences of this neglect, a satisfactory definition of the differential is impossible. Again, some of the applications of the calculus to geometry might have been dispensed with to make place for a somewhat fuller treatment of multiple integration. An unfortunate lapse occurs in the foot-note on p. 544. The power series has not been proved 'uniformly convergent for values of x ranging up to a, exclusively.' The text to which this note is appended is, however, clear and accurate.

The author tells us that "this book attempts to teach those portions of the Calculus which are of primary importance in the application to such subjects as Physics and Engineering." For the vast majority of the students of the calculus their interest is quickened and their insight into the nature of the calculus is deepened if they are shown the applications of analysis to the problems of every-day life. We could wish that the author had laid more stress on such problems, had not a most excellent book representing this side of the calculus recently appeared from the pen of Professor John Perry.* Mr. Lamb's plan, however, is a different one. He says himself: "It is to be clearly understood, indeed, that the object aimed at in this book is not to teach Dynamics or Physics or Engineering, but to exercise the reader in the *kind* of Mathematics which he will find most useful for the study of those subjects."

* *The Calculus for Engineers*, Edward Arnold, London, 1897.

We recommend the book as valuable to the student of physics and engineering, but as especially valuable to the student of pure mathematics, and as a book that will be useful to all teachers of the infinitesimal calculus.

W. F. Osgood.

Harvard University, 26 April 1898.

A Text-Book of Botany. By Dr. E. Strasburger, Dr. Fritz Noll, Dr. H. Schenck and Dr. A. F. W. Schimper; translated by H. C. Porter, Ph.D. London and New York, Macmillan & Co. With 594 illustrations, in part colored. 8vo. Pp. x + 632. $4.50.

In 1894 the 'Bonn Text-Book' appeared from the hand of the brilliant German botanist Strasburger, with the assistance of three of his collaborators. In this volume Strasburger prepared the chapter on external and internal morphology (132 pp.), Noll the chapter on physiology (125 pp.), Schenck that relating to cryptogams (104 pp.) and Schimper that on phanerogams (264 pp.). The success of this volume was so great that in but little more than a year a second edition was brought out, with some new matter and additional illustrations. About a year ago the welcome announcement was made that Dr. Porter, of the University of Pennsylvania, was bringing out a translation of this second edition, but its appearance has been much delayed, and the volume was not issued until early in April of the present year. The length of this delay is indicated by the date of the translator's preface, February, 1896, and accounts for the fact that some important additions to botanical science are not noticed in this otherwise very modern book. There is no reference to Harper's proof of the fecundation in the Erysipheæ, nor to the discovery of antherozoids in lower gymnosperms.

The volume in its German dress is so well known to botanists that it is quite needless to speak of its merits. Perhaps no man living is better prepared than Dr. Strasburger to undertake the presentation of the portion of the work which deals with the internal morphology of plants. Certainly no man has a better knowledge of the structure of the cell, and the many changes which it undergoes in constitution and form. This book, unlike many other text-books, is, in this chapter at least, authoritative.

The translation is good, and the publishers have spared no pains to make the type and printing all that could be desired, these being far more pleasant to the eye in the translation than in the original. The colored figures, also, are somewhat improved by a softening of the rather bright colors of the German editions.

The publishers announce an early issue of this work in two volumes, of about 300 pages each, to be sold separately, volume I. containing Strasburger's chapter on Morphology, and Noll's on Physiology, and volume II., Schenck's Cryptogams and Schimper's Phanerogams. This will be a great improvement, since it will enable the student of morphology and physiology to supply himself with the part relating to these subjects at much less expense.

Charles E. Bessey.

SCIENTIFIC JOURNALS.

Journal of Physical Chemistry, April. 'Study of a three-component System:' by Hector R. Carveth. A study of the freezing-points of lithium, sodium and potassium nitrate mixtures and their classification and interpretation according to the Phase Rule. The suggestion is made of the possibility of applying the freezing-point method to the analysis of mixtures of inorganic salts. 'Note on Thermal Equilibrium in Electrolysis:' by D. Tommasi. The effect of the simultaneous action of an oxidizing and a reducing agent upon a substance capable of being oxidized or reduced. A mixture of electrolytic hydrogen and oxygen was allowed to act on various substances, as nitric acid, potassium chlorate, etc. The laws are deduced that when a substance is submitted to two equal and contrary chemical actions the reaction which evolves the most heat will take place in preference, provided always it can begin; and of two chemical reactions that one which requires less heat to start it will always take place in preference, even though it evolves less heat than the other reaction. 'Benzene, Acetic Acid and Water:' by John Waddell. An investigation of the distribution ratio of acetic acid in benzene and water as solvents.