resentation (Spiegelbild) of that of the upper waters.

The last sentence in the body of the work is well worth quoting for the beauty and grandeur of the conception involved:

"Denn alles, was oben im Spiel der Wellen und im Sonnenlicht lebt und vegetiert, muss endlich doch noch in irgend einer Form zur Tiefe gelangen, um in der dunklen, von keiner Welle erregten Riesengrabstätte des Meeresgrundes den Kreislauf des Stoffes zu vollenden."

Following the body of the work are twenty closely printed pages of notes of a more technical character, embodying the actual facts which form the basis for the statements and conclusions of the author. These are of real value to those who study more carefully the fascinating problems of the deep.

The work as a whole will form a welcome addition to the library of the general student, and the specialist will find it well worthy his careful perusal and frequent consultation.

C. C. NUTTING.

Agricultural Bacteriology: A Study of the Relation of Bacteria to Agriculture with special Reference to the Bacteria in the Soil, in Water, in the Dairy, in Miscellaneous Farm Products, and in Plants and Domestic Animals. By H. W. CONN, Ph.D. Philadelphia, P. Blakiston's Son & Co. 1901. Pp. 412. Figs. 40.

This is a new book on a new subject. There have been books treating of separate phases of the subject, as dairy bacteriology, but heretofore no book has been issued in English which has attempted to cover the whole range of bacteriology in its relations and applications to agriculture. As the sub-title explains, it has special reference to the bacteria in the soil, in water, in the dairy, in miscellaneous farm products and in plants and domestic animals.

Professor Conn shows that while in the popular mind bacteria have come to be almost synonymous with disease, they are intimately associated with many normal processes which are going on in the soil, water and elsewhere, and are important and very often essential factors in the operations of farming as well as in every-day life: "From beginning to end the occupations of the agriculturist are concerned in the attempt to obtain the aid of these micro-organisms when they may be of advantage, and in preventing their action in places where they would be a detriment"; and he adds that "farming without the aid of bacteria is an impossibility." As yet only a beginning has been made in studying their application. In the section on bacteria in the soil, the author shows that they have important relations to agricultural processes in at least five different directions, namely, in the decomposition of rocks, the fixation of free atmospheric nitrogen in the soil, the decomposition of all complex organic bodies and compounds in the soil, the formation of nitrates, and, in connection with the legumes, in reclaiming nitrogen from the air. He prophesies that "in the future the problem of the proper treatment of soil for the use of agriculture will be, in a very large degree, a problem of the proper control of bacteria. Agriculturists must learn to stimulate the bacterial actions which are advantageous, and check those which are disadvantageous, if they would insure the continuance of soil fertility." There is perhaps no phase of agriculture where bacteria play such an important part as in the dairy. It is appropriate, therefore, that this subject, to which Professor Conn has himself been an important contributor, should receive quite extended treatment. The advances made in the control of bacteria in milk, as a result of better understanding of their sources and of pasteurization, have contributed to a better milk supply of cities, as well as to superior quality of the butter produced. The author contends that the introduction of pure cultures for ripening the cream in butter-making has resulted in improving the general quality of butter and has led to greater care in the preparation of the 'starter' where pure cultures are not employed. The part played by enzymes, especially galactase and rennet, in the ripening of cheese is pointed out, but the author is inclined to ascribe considerable importance to lactic bacteria in this connection. Elsewhere the importance of enzymes in explaining various phenomena formerly ascribed to the direct action of bacteria is discussed at some length. This opens up an interesting

line of study in a field where comparatively little beyond the result is known at present. The book is written in a clear and entertaining style that should commend it to the general reader as well as the student. It is an important addition to our agricultural literature, and will be welcomed by many who have felt the need of a general treatise on the subject.

E. W. Allen.

The Feeding of Animals. By Whitman H. Jordan. New York, The Macmillan Co. 1901. Pp. 450.

This book by the director of the New York State Experiment Station, is the latest contribution to the excellent Rural Science Series. Several books on feeding have been published by American writers, but in some ways this is the most systematic and comprehensive treatment of the subject, especially as adapted to the needs of the student. While the teachings of European experiments and experience are taken account of, American conditions are kept constantly in mind, and this gives the book a distinct advantage over some which have adhered too closely to the German feeding methods. Dr. Jordan has combined a quite thorough review of the important scientific teachings on the subject, with a plain and clear statement of the application of these facts in practical feeding. He has digested the investigation relating to feeding at home and abroad, and gives the reader the benefit of his judgment and insight into the subject in interpreting and applying them. The applications which he makes of the science of feeding to practical conditions show that he is not bound down by any theoretical ideas or teachings but is thoroughly familiar with the standpoint of the practical feeder. He breaks away, in a measure, from the mathematical doses of nutrients prescribed in feeding standards, but at the same time he admits the value of these formulas as an aid in selecting adequate, uniform and well-proportioned rations. The first part of the book is taken up with the principles of feeding, the relations of plant and animal life, the composition and digestibility of feeding stuffs, the function of nutrients and the laws of nutrition; while the second part considers the practice of feeding, the selection and compounding of rations for maintenance, for milk and meat production, for growing animals and for work, as well as questions of general management. The arrangement of the book is logical and orderly, and it is well suited to the needs of the student and the class room; in fact it may quite possibly prove more popular as a text-book than as a manual for the farmer or practical feeder, and for such a text-book there is perhaps the greater need at present.

E. W. Allen.

A Text-book of the Physics of Agriculture. By F. H. King. Second edition. Madison, Wis., Author. 1901. Pp. xvi + 604. Figs. 276.

In this book, which is by the professor of agricultural physics in the University of Wisconsin and physicist of the experiment station, "the aim has been to present to the student who expects to be a farmer some of the fundamental principles he must understand to become successful." The author states that it is his purpose to present these principles from the physical rather than from the chemical or biological standpoint, and from that of the general student and farmer rather than from that of more technical scientific agriculture. Nevertheless, the book will be found to be a notable contribution to the literature of scientific agriculture in a field which has not heretofore received the attention its importance demands. The introduction deals briefly with certain general physical principles, laws and factors, a knowledge of which is necessary to an understanding of their subsequent practical application. Other chapters deal with the nature, origin and waste of soils; chemical and mineral nature of soils; soluble salts in soils; physical nature of soils; soil moisture; physics of plant breathing and root action; movements of soil moisture; conservation of soil moisture; relation of air to soils; soil temperature; objects, methods and implements of tillage (especially the plow); ground-water, farm wells, and drainage; principles of rural architecture, including strength of materials (posts, barn frames etc.), warmth, light and ventilation, principles of construction, construction of silos; farm mechanics, including principles of draft, construction and maintenance of country roads, farm motors (animal power, steam and gasoline