constricted at the base, and in preserved material, showing no trace of pigment.

Examination of stained specimens shows that they apparently have the structure of the lateral line organs described by Eisig for the Capitellidæ.* There is the same arrangement of the nuclei, and the same radiations extending from the center toward the periphery (Fig. 2). No trace of cilia could be seen on preserved material, and the organ is apparently not capable of retraction into special sacks in the body wall. The cuticle, also, is relatively more thickened on the outside of the organ than is represented by Eisig's figures.

I am unable to give any details of the finer anatomy of these organs. The material at my disposal is not well enough preserved for histological study, and macerations and sections have thus far yielded no results. My only excuse for presenting this incomplete note is that while it is desirable that the existence of the organ in the group should be noted, there seems no probability of securing more favorable material.

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MARINE BIOLOGICAL LABORATORY,
WOODS HOLL, Aug. 10, 1900.

*'Fauna und Flora Golfes v. Neapel' 16, p. 76, *et seq.*

SCIENTIFIC BOOKS.

An Outline of the Theory of Thermodynamics. By EDGAR BUCKINGHAM, PH.D. (Leipzig), Associate Professor of Physics and Physical Chemistry in Bryn Mawr College. New York, The Macmillan Co.; London, Macmillan and Co., Limited. 1900. 14 x 22 cm. Pp. xi + 205.

In the preface of this newest book on thermodynamic theory, the author states his aim in the following words: "In the course of studying thermodynamics I have found a considerable gap between the text-books available and the modern memoirs. This volume has been written to spare other students some of the time which I have had to spend in bridging over the gap for myself. As the title indicates, it is not a book of applications, but a brief outline of the theory, the applications having been selected solely with a view to their illustrative value." The book is evidently intended for the beginning student.

The treatment begins with the necessary introductory concepts, then takes up successively the first and the second laws of thermodynamics, and concludes with a discussion of the criteria of thermodynamic equilibrium, and of the phase rule.

Under the first of these general heads appears a lucid and brief chapter on thermometry, an elaborate analysis of the idea of a quantity of heat, and the statement that only systems that have equations of equilibrium are to be considered. It is not emphasized, as it might well have been, that a quantity of heat is a purely auxiliary quantity, a convenient but wholly arbitrary mathematical fiction. In connection with the first law of thermodynamics, we find a simple discussion of the law, an exposition of the law of constant heat sums and of the relation between heat of reaction and temperature, and a study of specific heats. A recapitulation at this point completes the first half of the book.

Passing to the second law of thermodynamics, we are introduced to: reversible processes and Carnot's theorem; the ideas of absolute temperature and of entropy, derived from the properties of ideal gases; the combination of the two laws, to yield the differential of the energy of a system; and Gibbs's fundamental equations, which result from changing the independent variables. This part of the book is completed by an admirably clear and consistent account of the theory of the porous-plug experiment, and a number of simple illustrative applications of the general theory. The final three chapters are devoted mainly to the criteria of thermodynamic equilibrium, and to the phase rule as applied to systems in which no chemical combination occurs. It is not made clear here that the criteria of equilibrium are consequences of the inductively reached principle of the spontaneous dissipation of work availability.

In all this, Professor Buckingham has done pretty satisfactorily what he set out to do. The subject-matter is well arranged; the book is

brief, as it should be for the beginner; and the details of the treatment have been carefully thought out and clearly written. The result is probably as satisfactory a student's text as we have.

But a general comment in conclusion seems to be called for. Many people like to have their thermodynamics developed as a sort of sub-topic of the theory of ideal gases. They appear to think it suitable that one of the most beautiful and wide-reaching branches of physical theory should be developed largely from the properties of bodies that exist only in the imagination. In the reviewer's opinion, this procedure is neither necessary nor wise. There are two ways in which an exposition of theoretical thermodynamics can be written. One can reach the absolute temperature and the entropy from the properties of ideal gases, as Professor Buckingham has done; or he can arrive at these functions from fundamental physical postulates. The latter method reaches true results from true premises; while the former jumps to true results from untrue premises. The latter method, properly worked out, is fully as easy of comprehension as the former; and it gives a broader view: for it parallelizes the thermodynamic temperature with other potentials, and the entropy with other quantity-co-ordinates; and it brings out the distinction between forces and potentials, and between spaces and quantity-co-ordinates. As a plain matter of fact, the theory of thermodynamics of the present day is a symmetrical mathematical analysis of the general problem presented by a small number of inductively established postulates; and, in consequence, it cannot be grasped until it is comprehended as a logical system of mathematically developed theory.

J. E. Trevor.

Microörganisms and Fermentation. By Alfred Jorgensen. Third edition. Translated by Alex. K. Miller and A. E. Lennholz. The Macmillan Co. Pp. 318.

A practical knowledge of the phenomena of fermentation has been possessed by man from time immemorable. Until the present century, however, this knowledge has been purely an empirical one, the real cause of the phenomenon not being suspected. The present century has seen the development of the subject from a scientific standpoint, until to-day our knowledge of the process of fermentation is thoroughly systematic and based upon accurate experimentation. The development of our present knowledge upon the subject is properly divided into three periods. The first was that of the indefinite work of the early decades of the century, when Schwann and others were demonstrating that fermentative processes were closely related to the life activity of microörganisms. The second period was dominated by the revolutionary work of Pasteur. Under his influence not only was it demonstrated that fermentations were caused by microörganisms, but various types of fermentation were recognized and found to be produced by different species of microörganisms. Under Pasteur's influence the microscope came to be an aid to the fermentative industries and many a valuable practical method was suggested and applied to the fermentative processes. The third period has been the most fruitful in results and in many respects the most important. This period has been dominated by Hansen, of Copenhagen. So valuable has the work of Hansen been to the brewing industry that a large brewery of Copenhagen has erected for his use one of the best equipped laboratories in Europe, designed both for practical experiments and for pure scientific investigation. This third period of discovery has been dominated by the invention of methods of procuring *absolutely pure cultures* of yeasts.

There is no one better able to write an account of the relation of microörganisms to fermentation than the author of this work, who lives in close relation to Professor Hansen, and if his presentation of the subject is possibly unduly influenced by Hansen's work it is not to be wondered at. The fact is that the whole subject of fermentation has been entirely changed in the last two decades as a result of the study of the strictly pure cultures obtained by Hansen's methods. The earlier theories of fermentation have given place to the theory that fermentations are the results of enzymes produced by microörganisms. The knowledge of the yeast organism has been completely changed as the result of the study of pure cul-