A notable change has taken place in the character of the meetings of the Association of Official Agricultural Chemists, which at first was organized chiefly for the unification of methods of the analysis of commercial fertilizers. This branch of the work has now reached such perfection as to require little or no attention. The great work of the Association is now directed to other subjects, especially to investigations, researches and studies of foods and food adulterants.

The two most important events of this meeting were the reports of the committee on uniform methods of food investigation, of which Dr. W. D. Bigelow, of the Bureau of Chemistry, of the U. S. Department of Agriculture, is chairman, and of the committee on food standards, of which Dr. Wm. Frear, of the State College of Pennsylvania, is chairman. Since nearly all the States have pure food laws, it is of the utmost importance, from both a scientific and a legal standpoint, that uniform methods of investigation be followed and that some definite standards may be fixed whereby the court and jury may follow a uniform method in determining variations from the normal.

The officers elected for the ensuing year are Dr. H. J. Wheeler, Chemist of the Rhode Island Experiment Station, Kingston, R. I., president; Professor R. J. Davidson, Chemist of the Virginia Agricultural Experiment Station, Blacksburg, Va., vice-president; Dr. H. W. Wiley, Chief of the Bureau of Chemistry, U. S. Department of Agriculture, Washington, D. C., secretary; Dr. C. G. Hopkins, Chemist of the Illinois Agricultural Experiment Station, Urbana, and Mr. Fred. D. Fuller, Assistant Chemist at the Agricultural Experiment Station of New York, at Geneva, additional members of the executive committee.

The next meeting of the Association will be held in Washington, at the call of the executive committee, probably in November, 1902. H. W. Wiley.

SCIENTIFIC BOOKS.

Tierleben der Tiefsee. Von Oswald Seeliger, Professor der Zoologie an der Universität Rostock. Leipzig, Verlag von Wilhelm Engelmann. 1901. Pp. 44.

While it can hardly be claimed that this work is a distinct addition to our knowledge of deep-sea life, it nevertheless serves an important purpose in presenting a compact resumé of the more notable facts relating to the animals of the deep and the conditions under which they exist. The author has been fortunate in his method of treatment, which is popular rather than technical, and covers the field as well as could reasonably be expected in the space occupied. There is hardly any 'padding,' and the more technical parts of the work are wisely segregated under the heading 'Anmerkungen' at the end.

An introductory sketch of the development of deep-sea investigation, from the ancient pearl fisheries of the Indian Ocean to the recent German deep-sea expedition, includes notices of the work of John Ross, Edward Forbes, Michael Sars, Lovén, the cable surveys and the resultant discoveries of animal life in abyssal regions, and the expedition under the direction of the naturalist Chun. It is, to say the least, unexpected to find no mention whatever of such notable expeditions as those of the *Porcupine*, *Challenger*, *Travailleur*, *Blake* and *Albatross*. A similar surprise awaits the reader who peruses the pages devoted to a description of methods and instruments of deep-sea research without finding the slightest mention of the many instruments of precision invented by British and American investigators, such as Sir William Thomson, Alexander Agassiz, Professor Brooke, and Captains Sigsbee and Tanner of the U. S. navy.

The discussion of the physical conditions of the deep sea includes a presentation of the more important facts regarding temperature, but presents to greater length the matter of pressure. The author estimates that the total pressure exerted on a human body, if sunk to a depth of 4,000 m., would equal the weight of ten loaded freight trains, each consisting of an engine, tender and 32 cars. The American reader should remember, however, that these are con-

tinental, and not American trains. As a matter of fact, this pressure has little effect on the organisms inhabiting the depths on account of their being themselves so largely composed of and permeated by sea water. But the release of pressure experienced by individuals suddenly transferred from deep to shallow water is most disastrous in its effects, as illustrated by the fate of deep-water fishes when brought to the surface.

In discussing the chemical composition of sea water the author states that the oxygen is derived from the atmosphere, and that the carbonic acid increases with the depth, and that this latter fact explains the lighter calcareous skeletons of deep-sea forms as compared with their shallow-water relatives. On the other hand, silicious skeletons from great depths are proportionately heavier than those from shallow water, although actually smaller. In this connection the point might well be raised that the heavier calcareous skeletons are not needed in the depths for weight or protection against waves or currents, and that their comparative fragility could be accounted for on other grounds than the solvent action of carbonic acid.

The problem of the penetration of sunlight is treated at considerable length. This subject has been made a matter of investigation by means of experiments with sunken photographic plates, the greatest depth at which even the most sensitive are in any degree affected being 500 to 550 m., according to Fol and Sarasin. Red rays, however, might still be present without affecting the photographic plates, and the reddish yellow twilight of Agassiz and Haeckel might result.

Professor Seeliger denies the red-light theory, and maintains that the blue or blue-green rays penetrate most deeply. He substantiates his argument by an ingenious reference to the well-known and beautiful illumination of the famous 'Blue Grotto' of Capri, where the light penetrates a considerable depth of sea water and is reflected upward into the cave. Spectroscopic investigation confirms this blue-light theory, which appears to be now well established by the arguments here recorded. The author believes that no light from the sun reaches the greater depths, and says that no conditions of existence in the deep sea have so strongly influenced the organization and manner of life of animals as the absence of sunlight and heat.

The coloration of deep-water forms is regarded as protective in the main. In explanation of the red color so often found, the claim is made that this color would be protective, on account of its being inconspicuous in a blue light. This point is debatable, in the opinion of the reviewer, as any neutral tint would be just as inconspicuous as red, and thus the utterly useless production of such quantities of bright pigment be avoided. After noting the frequency of dark-colored or black hues among the abyssal fishes, and the contrast between this rich pigmentation, on the one hand, and the bleached, often colorless condition of cave animals on the other, the author fails to grasp the significance of the contrast. He doubts the effective presence of attractive coloration as an aid to sexual selection in the deep 'wo die tiere gar nicht oder nur unvollkommen sehen' (*sic!*). Indeed the discussion of the coloration of deep-sea forms is the most unsatisfactory part of the work.

The loss of sight in abyssal animals is frequently compensated for by the special development of other organs, usually tactile, such as the extremely elongated spines of certain fishes, the immensely lengthened antennæ of crustaceans such as *Nematocarcinus gracilipes* and *Sergestes magnificus*. Such structures are often coordinated with degenerate eyes. Sense hairs are sometimes greatly developed in deep-sea annelids and on the lengthened legs of certain crabs.

The author claims that a light, aside from that of the sun, is found in the depths in the form of phosphorescence, and this he discusses in a very interesting manner. The fisherman at night draws up his net filled with 'tausenden glühender Fünckchen.' The light-emitting forms increase in the deeper waters, "Hier finden sich zeitlebens festgeheftet am Meeresgrund lebhaft phosphorescierende Rindenkorallen, stark bläulich leuchtende Seefedern. Hier leben zahlreiche leuchtende Würmer und Protozoen, prächtig glühende Seesterne (*Brisinga*) und Cephalopoden."

Light-producing organs may be found, often in great numbers, in various parts of the body. Often such organs are coordinated with eyes, and in some cases—*e. g.*, *Ipnops**—the eye itself has become degenerate and replaced by a phosphorescent organ. Among the crabs, as well as fishes, the light-emitting organs serve as dark-lanterns to illuminate the immediate surroundings, and also as lures to attract the prey. The author claims that there is, in general, a decreasing degeneration of the eye with increasing depth. In *Ethusa granulata*, a crab, specimens from shallow water have good visual organs, while those from 900 to 1,300 m. are usually blind. It appears to be a fact that the eyes of deep-sea forms tend either to a great increase in size, on the one hand, or degeneration on the other, as ordinary eyes are of little use in the depths.

The possession of light-emitting organs in blind animals is explained on the ground of utility in terrifying hostile animals or alluring the prey.† There are also instances in which very similar light-producing organs have been developed by widely differing animals by a process of approximation.

In discussing the systematic relationships of deep-sea animals the author states that they do not differ among themselves more than do shallow-water forms. It was at first thought that the abyssal region would yield many ancient types, and, indeed, this is in a measure true. It appears that the older forms were often driven to the depths to escape competition with newer and more specialized rivals. Many deep-sea sponges and echinoderms resemble cretaceous and jurassic types. It can be stated as a generalization, however, that deep-water animals are no nearer mesozoic forms than are those from lesser depths. In sustaining this latter claim the author cites the many cases of so-called 'living fossils' among shallow water mollusks, and also the old-fashioned mammals still existing, such as the proboscidians. On the other hand, deep-sea animals can often, indeed usually, be referred to existing genera of shallow-water forms, and the author claims that the former were originally derived from the shallow-water inhabitants of the past. The conditions of life in the abyssal regions are not conducive to developmental changes, neither are they such as to favor the evolution of the organic from the inorganic.

Professor Seeliger, like most other writers on this subject, cannot refrain from having his fling at the '*Bathybius* theory' of Huxley, which was exploded through the chemical researches of Buchanan, who demonstrated that the apparently vital movements of '*Bathybius*' were purely physical.

Our author believes that animal life becomes less abundant in the greater depth, but that there is no zone that is entirely uninhabited, a conclusion directly opposed to the one so thoroughly demonstrated by Alexander Agassiz, who maintains that there is an intermediate zone which is practically lifeless. The argument against the existence of an uninhabited zone is based on considerations affecting the food supply. In shallow water the food basis is largely vegetable, but plant life becomes sparse below 200 m. and practically vanishes below 400 m. But the inhabitants of the underlying zone ascend to what may be called the plant zone for their nourishment, and then retire satisfied to the deep. The bottom-inhabiting species, whether free-moving or fixed, are nourished by the organic substances sinking, in changed form, to the bottom.

The bottom deposits are briefly described as diatom ooze, radiolarian ooze, globigerina ooze and red clay.

The author concludes by emphasizing the intimate connection between the animal inhabitants of the upper and deeper zones, and the dependence of the abyssal forms upon the upper regions for their food supply. The animal world of the deep is in general a reflected rep-

* It should be noted, however, that the eyes of *Ipnops* still appear to be functional, although exceedingly modified to form the immense phosphorescent lantern that occupies about half of the dorsal surface of the head.

† In the discussion of phosphorescence in the deep sea, the conclusions of Professor Seeliger are so nearly identical with those presented by the present writer in the number of SCIENCE issued May 31, 1901, that attention should be called to the note at the bottom of page 852, referring to a previous article on 'The Utility of Phosphorescence in Deep-sea Animals,' published in the *American Naturalist*, Oct., 1899.

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