in a chair and asked me to tie him in place. So well did I tie him that we had to cut him out afterwards. Then he fell into a trance, and suddenly I became aware of dazzling celestial lights over his head. Then my son's voice cried out: 'Father, father.' The voice was not a yard from my face.

"Yes, my boy," I answered. "Yes, what is it?"

"'Father! Pardon!' he said, and I felt his hand on the top of my head, bowing down my head, and then felt his lips touch my forehead.

"I knew what he meant immediately. Only I could have known. He had never subscribed to my belief while alive, and now he had come back to tell me that it had been as I said.

"'Yes, my son,' I called back to him, 'you had a right to your own belief while here with us.'"

Again the speaker, wrought up to a high pitch, cried:

"If that isn't spiritual communication, what is it?" And the audience, listening intently to every word, broke out in a clatter of applause.

SCIENTIFIC BOOKS

Studies of the Development and Larval Forms of Echinoderms. By TH. MORTENSEN. 266 pages, 33 plates and 102 text-figures. Published at the expense of the Carlsberg Fund. G. E. C. Gad, Copenhagen, 1921.

For some years, the well-known Danish zoologist, Dr. Th. Mortensen, has been gathering material in the embryological field to use in throwing light on the phylogeny of the echinoderms and on the interrelationships of families and genera in the most perplexing groups. A two year's journey around the world including stays of several weeks or more at Zamboanga and Jolo in the Philippines; Misaki, Japan; Sydney, N. S. W.; New Zealand; Hawaii; Nanaimo, British Columbia; La Jolla, California; Taboga Island, Panama; and Tobago, B. W. I., resulted in such an accumulation of material that the present noteworthy report has been prepared and published. Yet the indefatigable Danish investigator is again afield in search of more material and at the same time is hunting out the best place in the East Indies for the establishment of a permanent Scandinavian marine biological station!

As one turns the pages and studies the plates of this great contribution to embryology, it is hard to decide whether one should admire the more the industry, patience and skill of the investigator, or the ability to marshal his facts and set forth clearly his conclusions, revealed in the writing. Descriptions and figures alike leave nothing to be desired and even if one were not to accept all the suggested conclusions one can not question the care or the fairness with which they are expressed.

An introduction of 19 pages gives a brief but clear summary of what has so far been accomplished in acquiring knowledge of the embryology of those echinoderms which have free-living larval forms. Including Mortensen's own results we now have such knowledge, often very fragmentary it must be granted, of some 125 species. There is also much material accumulated concerning the life histories of many species which do not have free-living larvæ, but these are not included within the scope of the present report. The main purpose of Mortensen's research has been, to quote his own words, to throw light on "the interrelation between the larvæ and the adults in regard to a natural classification."

The second section of the report, designated "Special Part," deals with the larvæ of more than sixty identified species and nearly fifty additional larvæ, whose parent forms are unknown. No crinoids are discussed, as Dr. Mortensen has published his studies on crinoid development elsewhere. As experience demonstrated that the eggs of echini are more easily fertilized artificially than are those of other echinoderms, it is not surprising that nearly three fourths of Mortensen's work was done on members of that class, at least so far as results reveal. The early stages of no fewer than 43 species were studied and many species were carried along through weeks and sometimes months of larval life. One of the interesting results of this work was the demonstration of the hardiness of the larvæ of certain species. Thus some larvæ of the common West Indian rock-boring urchin (*Echinometra lucunter*), hatched from eggs fertilized

the last week in March or early in April, were carried from Tobago to Copenhagen via New York, arriving in Denmark, June 1, still living, though not thriving! Besides the larvæ whose parentage was certain, Mortensen describes and discusses the relationships of nine echinoid larval forms taken in tow nets.

Among the sea-stars, artificial fertilization was successful with eleven species, and the larvæ resulting are described in ten of them, to a greater or less extent. Owing to unsatisfactory preservation no asteroid larvæ from tow-net collections are described. With the holothurians and ophiurans, particularly the latter, artificial fertilization is exceedingly difficult to obtain and with only two species of brittle-star (both at Tobago) was Mortensen able to study material derived from eggs fertilized in the laboratory. With holothurians, artificial fertilization was successful in three species, but with two of these the larvæ only lived two or three days. On the other hand, Mortensen describes three forms of a noteworthy Auricularia, one from Tobago, one from Misaki, and the third from New Zealand waters, and no fewer than 35 ophiuran larvæ, whose parentage is unknown. The most extraordinary fact recorded in this section is that certain Ophioplutei do not end their free-swimming existence by complete metamorphosis into miniature brittle-stars, but rather give off the new ophiuran as a sort of bud, and then apparently *regenerate a new larval body in place of the original one.* If this new body is capable of giving rise to a new ophiuran by a second metamorphosis, we have here, as Mortensen says, the only case of metagenesis known in the whole Echinoderm phylum. But the evidence is tantalizingly incomplete.

The last fourth of the volume, entitled "General Part," is divided into three sections, a short one on "Classification," a longer called "Morphology, Phylogeny, Biology," and a few pages on "Geographical Distribution." In the first section, Mortensen raises the question whether there is any correspondence between groups of larvæ arranged according to structure and the natural groups of the adults, and so far as the major groups of echini are concerned, he answers the question in the affirmative with little hesitation. He has further unquestionably demonstrated that no classification of echini can henceforth be accepted which does not give fair consideration to the characters of the larvæ so far as they are known. As for the ophiurans on the other hand, we are on much less sure ground, nor can we make very practical use of the ophioplutei in classification until a far larger number of them have been traced back to their parent forms. Among the Asteroidea, too, we still lack sufficient data, in spite of Mortensen's masterly efforts, but enough facts are known to warrant the hope that the various larval forms will prove of great value in tracing relationships within the class. The Crinoidea and Holothurioidea are still largely *terra incognita,* so far as larval forms are concerned. In the pages dealing with the morphology of the larvæ, a number of debatable points are discussed and one very important one is emphasized, namely, that there is no homology between the sucking-disk of a brachiolarian larva and the Pelmatozoan stalk. The remarkable animal described by Koehler and Vaney as *Stellosphæra mirabilis* is shown to be a larval form of a sea-star, probably *Pedicellaster sexradiatus.* After a detailed discussion of the various larval forms, Mortensen pays his respects to Grave's theory that the primitive echinoderm larval form had transverse rings of cilia, and then passes on to an interesting discussion of the proposals of Boas, Simroth and A. H. Clark regarding the phylogeny of the echinoderms, though the ideas of the last two are dismissed briefly, their refutation being designated "a superfluous task"! There then follow discussions of Giard's theory of *poicilogony,* as applied to echinoderms, of the rate of growth of larvæ, and of the relation of temperature to the production of matured reproductive cells. The pages devoted to geographical distribution deal mainly with the matter of the influence of currents in the distribution of echinoderm larvæ and the probable existence of vertical upward currents, which are important in bringing the larvæ of deep sea forms to the surface.

The volume closes with a brief appendix and a very full explanation of the admirable plates. There is no bibliography and no index,

but the absence of the latter is atoned for by the presence of a table of contents just before the introduction. As in most of Dr. Mortensen's publications the illustrations are all that could be desired and are of the greatest service to the user of the book, while the text is entirely free from ambiguities and shows the customary positiveness of the writer. The whole appearance of text and plates is admirable and the Carlsberg Fund, no less than the author, is to be congratulated on this very important contribution to our knowledge of echinoderms.

HUBERT LYMAN CLARK

SPECIAL ARTICLES

A BACTERIAL WILT OF THE BEAN CAUSED BY BACTERIUM FLACCUMFACIENS NOV. SP.

A NEW bacterial disease of navy beans has appeared in South Dakota. The grower on whose farm the disease was discovered reports that what he believes to be the same disease killed 90 per cent. of his 1920 crop. In 1921 he planted the seed harvested from the remainder and lost about 25 per cent. of his crop. Some of this 1920 Dakota seed planted at Arlington, Virginia, also produced a large proportion of diseased plants, many of which never survived the seedling stage. The disease is characterized by a wilting of the leaves of seedlings sometimes accompanied by a discoloration, and by dwarfing, reduction of yield and the death of some of the shoots, if the plant survives the early stages of growth.

Plants from South Dakota, received in the Laboratory of Plant Pathology, Bureau of Plant Industry, August 6, 1921, were found to contain bacteria in the vessels of the stem often accompanied by a browning of the vascular ring. The writer suspected the presence of *Bacterium solanacearum* Erw. Sm. but when petri dish poured-plates were made from the diseased stems a yellow organism was isolated. This, when pricked into vigorously growing King of the Mountain bean seedlings produced the wilt in every case. From these infected plants the yellow organism has been reisolated and has produced the wilt in Great Northern beans. King of the Garden lima and Ito San soy-beans have also become infected as the result of pure culture inoculations.

The same organism has been isolated from the Arlington, Virginia, plants and with it the writer has reproduced the disease.

The discoloration mentioned above may consist of a dull green or brownish green, greenish brown or reddish brown area sometimes bordered with yellow. The discolored area is flabby at first and later dry and papery. In many cases the whole leaf blade and petiole become flabby and droop without any discoloration at all, whereas in others a portion of the leaf becomes flabby and discolored while the rest of the blade and the petiole is turgid for a time at least. It is presumably a question of the number of vessels plugged by the bacteria. This same phenomenon has occasionally been observed in secondary infections of young leaves by *Bacterium phaseoli*.

The wilt of the seedlings in some respects suggests the "systemic disease" of beans ascribed by Burkholder to *Bacterium phaseoli* but the parasite under consideration is very different from *Bacterium phaseoli*. For example, its very moderate, often scanty growth on potato cylinders, due to its very slight diastasic action, is in marked contrast to the exceedingly copious prolonged growth and marked diastasic action of *Bacterium phaseoli* Erw. Sm. The color on potato is Ridgway's mustard or primuline yellow (Color Standards and Nomenclature, plate XVI, 2nd ed., 1912) and there is usually a marked graying of the potato. The difference in the colonies are less marked but plates of the two organisms when compared are easily distinguishable. The colonies of *Bacterium phaseoli* are much more wet-shining and of a much more syrupy consistency. Both *Bacterium phaseoli* and the South Dakota organism reduce the litmus in litmus milk in 4 to 7 days but the cultures of the latter finally become acid and the behavior of the two organisms is very different in regard to the manner and time of the other changes taking place in the milk. Cultures of *Bacterium phaseoli* begin to clear in 1 to 6 days, and a very soft mobile curd is formed, a partial peptonization