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## ASKING NATURE QUESTIONS.

### Interesting Work Going on at Woods Holl.

**What the Marine Biological Laboratory Is Doing for Science in the Study of Embryology in Its Relation to Heredity—An Institution That National in Its Aim.**

(FROM OUR REGULAR CORRESPONDENT.)

WOODS HOLL, Aug. 22, 1893. The little village of Woods Holl is, no doubt, familiar to many of the readers of the HERALD as the location of the extensive laboratories of the United States fish commission. But probably few are aware that it is also the location of a laboratory which holds a high rank among our educational institutions, and has played a most important part in the advancement of biological education in the country. This is the marine biological laboratory, established six years ago, principally as the result of the efforts of the Woman's Educational Association of Boston, and now governed by a board of trustees on which the leading universities and colleges of the country are represented.

It is a truly national institution, though entirely free from government control, and drawing students and instructors from all parts of the country, having had in attendance during the session just drawing to a close 111 students and investigators, representing over 50 of our higher institutions of learning and no less than 17 states.

The laboratory fulfils, strictly speaking, two functions, which are, however, intimately related. It supplements the work of the biological laboratories of the colleges by ~~supplying~~ <sup>providing</sup> students facilities for the study of the wonderful variety of animal and plant life to be found only in the ocean and accessible to inland students only as more or less distorted caricatures preserved in alcohol; and, secondly, it gives opportunity for the investigation of problems which can be solved only by continued and earnest study of marine organisms. Instruction and investigation, the two legitimate functions of a scientific institution, go hand in hand.

The department of instruction has had an attendance of 49 students taking laboratory courses in marine zoology and botany, under the direction of competent instructors, and listening to lectures on the various groups of animals and plants, given by specialists, a privilege which cannot be offered even by the largest colleges.

Ample opportunities are afforded the students for seeing the forms they study in their natural surroundings, collecting parties going out in the laboratory steam launch, the Sagitta, two or three times a week, while

#### **Skilful Collectors**

keep the numerous aquaria abundantly supplied.

The department of investigation has equal standing with that of instruction, and is even of greater scientific value. The biological problems of the day are touching the inmost recesses of nature's shrine, and numbers of earnest investigators are striving to penetrate within. The mysterious phenomena which are termed heredity, the proper understanding of which will have untold influence on all questions which concern human life, whether they be agricultural, medical or sociological, are at present the main point of attack, and the most promising ground from which to carry on the attack is to be found in marine zoology. To solve a complex problem it must be reduced to its simplest form, and the problem of heredity is to be solved by the study of the simplest forms of life in their most primitive surroundings. The ocean, with its myriad inhabitants offers these conditions, and marine organisms hold out the greatest promises for valuable results to the investigator. Land and fresh water animals have ultimately descended from marine ancestors, having undergone, in the process of development, innumerable changes in adaptation to the new conditions under which they live, and do not, therefore, represent the simplest and most unmodified conditions which the student of heredity requires; while, on the other hand,

sufficient aeration and other similar conditions on adult animals and developing ova have also been carried on with exceedingly suggestive results, of which want of space prevents a full account, as is also the case with the investigations carried on in the botanical department.

Sufficient has been said, however, to show that the laboratory has amply justified its existence and to warrant its further extension. It is doing incalculable service to science in this country, and has done much to place American biology in the position it now occupies. The work accomplished is certainly equal to that being from the richly supported laboratories of Europe, with the single exception of the magnificent station at Naples, the envy of all zoologists. What is needed to place American biology in the lead is the appointment of a permanent station at Woods Holl, with ample funds for its equipment and maintenance, and no better investment in the cause of science could be made.

and in the single cell, the ovum, by which every animal at one stage of its existence is represented, the simplest conditions represented by that animal are to be found. To study the ovum, to watch its development and the gradual formation from this simple mass of protoplasm of the adult tissues, the endeavor to comprehend the conditions which determine that this constituent of the embryo shall give rise to one adult structure and that to another—these are the tasks of the embryologist.

The facilities for such studies the marine biological laboratory attempts to give, and the results so far obtained amply

#### **Demonstrate Its Usefulness.**

To give in a few words an account of these results would be difficult, but a few of the more important ones may be referred to if but to show what the laboratory has accomplished and how deserving it is of further extension and equipment.

One of the most important results is the discovery of Dr. Watase of the significance of a peculiar structure found in all developing and actively growing cells, and which seems to possess controlling influence over the reproduction of these ultimate elements of living tissues, and, therefore, fulfils important functions in connection with growth. The origin and significance of this structure known as the "centrosome," Dr. Watase has succeeded in determining, and has thus made one of the most important discoveries in connection with the structure of the cell which has been brought to light in many years, a discovery, too, which opens up promises for the correct understanding of the vexed questions of the structure of muscle and nerve tissue, which have up to the present been but inadequately understood. A correct and thorough knowledge of the structure of any organ is necessary to the correct understanding of its mode of action, and the elucidation of the structure of muscle fibres opens up the way for an explanation of the peculiar changes long known to occur in them during contraction.

Another set of results extremely interesting from the standpoint of heredity has been obtained by Dr. Morgan of Bryn Mawr College, by means of experiments upon the developing ova of the sea bass. In most fish the mode of development is very different from what it is, for example, in the frog, and the cause of the difference is found to be due to the tension exerted upon the protoplasmic portion of the egg by the peculiar manner in which the yolk, of which the egg contains a considerable quantity, is arranged. In other words, by the removal of a certain amount of the yolk the early development more nearly approaches what may be considered the more usual method, tension and pressure having evidently an important influence in modifying the manner of development, a fact amply confirmed by the observation of the development of the practically yolkless ova of sea-urchins subjected to artificial pressure. Still more interesting results were, however, obtained by the destruction of one-half the protoplasm of the egg, an operation which resulted in the formation of an embryo one-half the normal size, demonstrating that one-half the ovum possesses all the hereditary powers found in the uninjured mass.

Other observers have carried on extensive investigations in the

#### **Development of Various Animals.**

one having succeeded in tracing step by step the differentiation of the tissues from the simple ovum in several species of crustacea; another has studied the same processes in certain marine worms, while the development of the molluscs has been thoroughly investigated by others. The remarkable phenomena concerned in the fertilization of the ova of the molluscs, pregnant with suggestions bearing on heredity, has been studied in its minutest details by Dr. Conklin, with most fruitful results. In fact, all of these investigations have as their ultimate object the collection of data which may assist in elucidating the forces and conditions concerned in heredity.

Anatomical and physiological problems have not, however, been neglected. A comparative study of the simple sense organs of the fishes has been carried on by several investigators and much light has thereby been thrown on the evolution of such complex structures of the ear, whose minute structure has had considerable light thrown upon it by the researches of Dr. Ayers, who has given strong reasons for supposing it to have been gradually elaborated from the system of sense organs which are to be found upon the head and sides of the body of various fishes and amphibia, and which are known to anatomists as the sense organs of the lateral line.

On the physiological side the functions of the peculiar structures associated with the ear and known as the semi-circular canals have been studied by Dr. Lee, his experiments indicating that the ear is concerned not only in the perception of sound waves, but also is a sense organ, by which we are given information concerning equilibrium, this second function residing in the semi-circular canals. Injury to these structures in sharks, forms in which they have a high grade of development in which they may readily be studied, has been shown to be followed by decided disturbances of equilibrium, the character of