

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