shown by the sluggish movements and diminished vitality, while many had clear-cut holes or ulcers, as described above. Others appeared with the eyes entirely gone; in others great patches of skin and underlying muscle tissue had fallen out, leaving large irregular pits in the body walls; others still had lost fins or lower jaws, etc.

Upon working out the life-history of the parasite, it was found that spores accumulate in the lymph spaces of the fish and prevent normal nourishment of the tissues, which die and fall out leaving holes in the body-walls. The spores are taken into the digestive tract of the fish—it is not known from where they came originally; in the intestine they give rise to eight sporozoites or germs each of which develops into an adult amœboid individual not more than .001 inch in length. These adults penetrate the bundles of unstriped muscle cells of the intestine and there become mature. At maturity a spherical spore-forming cyst is formed in the lymph of the fish; here also the spores are liberated, and are then carried to all parts of the body where at different points the accumulations are formed which lead to ulcers.

Two very important points were not determined viz, (1) the origin of the disease which hitherto has probably been unknown, and, (2) the remedy. There was little chance of finding out after October how the disease originated in May, while the extinction of all the diseased fish before the parasite was even discovered effectively headed off experiments with remedial measures.

GARY N. CALKINS.

EMBRYOLOGY OF LEPAS. *

THIS paper was based upon the results of an investigation recently completed, which was undertaken with the view of applying the cell-lineage method in an accurate study of the cleavage and the formation of the germ-layers in *Lepas* and other Cirripedes.

The cleavage of *Lepas* is total, unequal, and regular. Stages of 2, 4, 8, 16, 32, and 62 cells are normally formed. Cells of a given generation may anticipate their companions in division, but no second division of such cells takes place before all other cells have completed corresponding cleavages and become of the same generation.

The first cleavage is nearly parallel to the long axis (polar) of the ellipsoidal egg. The egg is divided into an anterior ectoblastic cell and a posterior yolk-bearing macromere. The second cleavage is at right angles to the first, both cells dividing, and from the yolk-macromere is cut off a second ectoblastic cell. The third cleavage is essentially perpendicular to the first two, dividing all the cells, and a third ectoblastic cell is separated from the yolk-macromere, which is now mesentoblastic. Thus by the first, second and third cleavages three protoplasmic cells are separated from the yolk. These three cells contain all the ectoblast and by repeated division they form and extend the blastoderm. The fourth cleavage separates the mesoblast from the entoblast, which is now represented by the yolk-macromere. The 16-cell stage is composed of fourteen ectoblastic cells, which largely surround the entoblastic yolk-cell. The single mesoblast cell lies in the blastoderm at the posterior edge of the blastopore where the entoblastic yolk-cell is still exposed to the exterior. By the fifth cleavage all these cells are divided, the two mesoblastic cells still remaining on the surface. During the sixth cleavage the two mesoblastic cells before dividing sink beneath the blastoderm as it closes over the blastopore. At the same time four cells of the blastoderm, lying at the anterior and lateral edges of the blastopore, divide perpendicularly to

* Abstract of a paper read before the Biological Section of the New York Academy of Sciences, April 9, 1900.

the surface. Four cells are thus formed beneath the blastoderm, and they are apparently added to the mesoblast, for in the next stage their derivatives can not be distinguished from the rest of the mesoblast. The entire mesoblast then originates from one cell which is separated from the entoblast in the fourth cleavage (16-cell stage), and from four other cells which are derived from the ectoblast in the sixth cleavage forming the 62-cell stage. The lineage of these four 'secondary' mesoblasts has been traced back to the first and second ectomeres.

The course of the cleavage as sketched above has been determined to be quite constant. Cells of definite origin in the early cleavage stages are the ancestors of cells which occupy particular positions in later stages. Following Conklin's terminology ('97), the cleavage may be characterized as 'determinate.' This conclusion is completely opposed to the results of the earlier investigators of Cirripede development.

Gastrulation is of the epibolic type, and is the result of the extension of the ectoblastic blastoderm over the entoblastic yolk-macromere. The blastoderm usually closes over the blastopore during the sixth cleavage (62 cells). The blastopore is identified as marking the ventral and posterior of the future embryo.

In the general features of the late development of the embryo the results of this investigation confirm those of some earlier workers.

A paper with figures in support of all the above conclusions has been prepared, and is now awaiting publication.

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ERNST HARTIG.

Ernst Hartig, 'der Geheime Regierungsrat Professor Dr. Hartig' of the 'kgl. Sächsische Technische Hochschule,' at Dresden, died April 23rd. He was born, Jan. 20, 1836, studied at the Dresden Polytechnikum, finding in the late Geheimrat Professor Dr. A Hulsse an inspiring teacher and a warm friend through whose encouragement and aid he was induced promptly to take up a line of study and work which gave him, ultimately, large opportunities and great reputation. He became, in 1862, the assistant for mechanical technology and was promoted to his professorship in 1865. In 1890 he became the director of the Technical High school. He was active in the organization of the various technical departments and the laboratories of engineering research and made himself an authority relative to the materials of engineering and in all departments of textile work. He published some important papers.

His 'Untersuchen uber die Heizkraft der Steinkohlen Sachsens' came out as early as 1860; from 1864 to 1869 he was engaged in the pursuit of a number of researches and published the results of an experimental investigation of the power required in the operation of spinning and weaving machinery. In 1873 he brought out his work of similar character on the machine-tools and in 1876 that on the machinery of the combed wool manufacture. At the desire of its author, then surrendering his hold upon his long-sustained work in that direction, Hartig undertook the preparation and admirably completed the issue of the fifth edition of Karmarsch's 'Handbuch der mechanischen Technologie' for his old friend and teacher and assumed thenceforth the position of a leading authority in that branch. From 1877 he had much to do with the formulation and systematization of the patent laws and patent systems of the kingdom and of the empire, accomplishing much for the inventor, and for the courts as well. He was an admirer of the United States system and recognized its