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Experimental Studies on the Developing Perch (Perca flavescens Mitchill).

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The records of experimental analyses of the embryogenic processes in the Teleost are comparatively meagre. The results of defect-experiments performed on Fundulus eggs by Morgan,[1] Lewis,[2, 3] and Hoadley[4] indicate that the ultimate limitation of cellular potencies occurs during gastrulation, but they supply no conclusive evidence concerning the nature of the mechanisms whereby the limitation is accomplished. The time is now ripe for experimental investigation and analysis of Teleost development in the light of the modern concepts of experimental embryology.

The eggs of the yellow perch were used for experimental material in the present research. Transplantation of the tissue corresponding to the dorsal lip of the amphibian blastopore induces the formation of a secondary embryo; the experiment and results are comparable to those of Spemann[5] on the egg of Triton.

The cytoplasm of the perch egg is large in amount in comparison with the yolk. The germ-ring forms and gastrulation commences when almost one-half the yolk is covered by the blastoderm. Early in gastrulation the lip of the blastoderm at which invagination is principally localized induces the formation of a secondary embryo when transplanted to an extra-embryonic region near the germ-ring of an egg the same age as the donor. The induced embryos are only slightly smaller than the normal, and have been obtained complete as far anterior as mesencephalon and myelencephalon. The parts formed are perfect. Active motility and vigorous heart-beat developed in the oldest induced embryo. The primary embryos are normal.

Inductions have also been attained by transplanting dorsal lip from later stages of gastrulation to eggs the same age as the donors. Embryos induced in this fashion are smaller and less complete than those induced by younger dorsal lip. This result may be due partly

1 Morgan, *J. Morph.*, 1895, **10**, 419.

2 Lewis, *Anat. Rec.*, 1912, **6**, 1.

3 Lewis, *Anat. Rec.*, 1912, **6**, 325.

4 Hoadley, *J. Exp. Zool.*, 1928, **52**, 7.

5 Spemann, *Arch. f. Entw.-mech. d. Org.*, 1918, **43**, 448.

to the less ready incorporation of the graft into the thin membrane forming the later blastoderm than into the thicker tissue constituting the earlier. It may also indicate a change in the activity of the transplant or in the reactivity of the host.

In several experiments, cells from very young blastulae—well before gastrulation—were transplanted to blastulae of the same age, generally without visible effect. In one case, however, embryo-formation was apparently regular, but at the tailbud stage an extra row of 6 unpaired somites together with other tissue not diagnostically distinguishable by gross examination extended between the tailbud of the embryo and the yolk. As the tail of the embryo lengthened, the extra tissue was protracted also, and a third fin formed along the side of the tail, which was supplied in the normal manner with dorsal and ventral fin. More experiments are necessary to ascertain what materials other than dorsal lip can cause induction.

Occasionally the dorsal lip transplants fail to induce embryo-formation but preserve their integrity either within the normal embryo or on the yolk-sac. Some of those within the embryo produce or induce appropriate local structures; those on the yolk-sac undergo considerable self-differentiation. One graft of early dorsal lip, marooned on the yolk-sac epithelium, differentiated to form auditory vesicle and either self-differentiated or induced heart. The dorsal lip material giving rise to this graft was removed from a donor the same age as the donors of the dorsal lip transplants which induced embryos complete only as far anterior as the ear level.

The parts played by inductive processes and by self-differentiation in Teleost morphogenesis can now be studied. The dorsal lip of the Teleost gastrula as well as the corresponding region of the chick[6] and amphibian egg induces embryo-formation. The factors controlling development are similar in members of these 3 vertebrate groups.

[6] Waddington, *Arch. f. Entw.-mech. d. Org.*, 1933, **128**, 502.