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Nature of Paralysis Produced in Amblystoma by Triturus Transplants.*

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As previously described,¹ embryonic tissue of the salamander, *Triturus torosus*, when transplanted to Amblystoma embryos, has the peculiar effect of paralyzing the hosts over a prolonged period of time, rendering them entirely insensitive without impeding in any way their normal development, or their growth subsequent to recovery. Aqueous extracts of ground Triturus embryos produce a similar paralysis, of shorter duration, when injected into larvae or adults of Amblystoma. The paralyzing agent was also found present in many cases in adult Triturus female blood, and the suggestion was made that its presence there might be correlated with periods during which it was being deposited in the developing ova. A variety of other experiments performed in the analysis of this phenomenon are summarized in the article cited above. (See also Twitty and Elliott, *J. Exp. Zool.*, Vol. 68.)

Until recently there was little information as to the nature of the effect exerted by the substance in question, but the transplantation experiments outlined below offer strong evidence that its action is specific for the nervous system. Briefly, the method of demonstration consisted of bringing nervous and muscular tissue of *Triturus torosus* and *Amblystoma punctatum* into conjunction with one another in crucial combinations designed to reveal which of these 2 major components of the reaction system was affected by the paralyzing agent.

Experiment No. 1 (control). An inclusive piece from the back of the embryo, consisting of skin and the subjacent neural tube and muscle segments of both sides, was grafted as a unit from the tailbud stage of Triturus to a position well ventral on the flank of an Amblystoma embryo. The graft developed independently *in situ*, and upon the subsequent differentiation of its segmental nerves and muscles contracted readily and vigorously when stimulated. During this period, however, the Amblystoma host was completely paralyzed.

Experiment 2 (control). In this experiment, the reciprocal of

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¹ Twitty and Johnson, *Science*, **80**, 2064.

1, the same type of transplant was made in the opposite direction, from Amblystoma to Triturus. Here, as was to be expected, the Triturus host was active while the graft was paralyzed, even after its muscles were well differentiated.

Experiment 3. This experiment is a modification of 2 and the transplantation was performed in 2 steps: (a) A section of neural tube about 4 somites long was removed from Amblystoma and replaced by a corresponding length of tube from Triturus. After the graft had healed, the second step (b) was performed. A piece was removed from the back of the host, but now included not only the original graft of Triturus cord, but also the adjacent somites of the Amblystoma host. This graft was then placed as in (1) and (2) on the side of a Triturus embryo.

This experiment is to be compared with that in (2). As in the latter, muscles of Amblystoma are now developing on Triturus. There is the difference, however, that these Amblystoma muscles are supplied with Triturus nerves. Knowing that the muscles are exposed to a large dosage of the paralyzing agent from the host, one is in position to determine whether they are immobilized as in (2), where the innervation was from Amblystoma cord, *i. e.*, from cord of their own species.

The results were very clear. When stimulated, the Amblystoma muscles responded by strong contractions. It would seem that the conclusion to be drawn from this result is that the paralyzing agent of Triturus, in exerting its effect on Amblystoma, operates specifically on the nervous system, thereby affecting the muscles only indirectly. The power of the latter to contract is not impaired.

Experiment 4. This experiment is the reciprocal of 3. By an operation in 2 steps, as before, Triturus muscles were transferred to Amblystoma, where they developed in conjunction with a segment of Amblystoma nerve tube. The Amblystoma host was paralyzed by the Triturus tissue, as in (1). In contrast to (1), however, the grafted Triturus muscles did not contract. They are rendered immobile by their own action on the Amblystoma nerves supplying them.