
COMPENSATORY GROWTH IN PODARKE OBSCURA.*

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The idea that when a lost part is being regenerated by an animal, the whole organism of the latter, and not merely the amputated surface is actively engaged in this process of restoration was kept in disrepute. The main objection advanced by the opponents of this idea was that it is at the cut surface only where the histological process of regeneration is to be observed in the appearance of mitotically or amitotically dividing cells. The writer, however, was forced to the opposite view through some studies of the rate of regeneration, but could not produce sufficient evidence in favor of his view from those studies. Since

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that time a number of experiments and observations conducted during last summer, as well as the extremely interesting facts presented before the section of Experimental Zoology of the Seventh International Zoological Congress in Boston by Dr. Prizbram, seem to offer a proof of the idea that the mutilated organism as a whole partakes in the regeneration of a lost organ.

I wish to speak here mainly of my observation on the compensation which takes place in case of posterior regeneration in *Podarke obscura*. This is a small marine polychaet, found abundantly at Woods Hole, in the Eel-pond on sea-weeds. The worms have a chitinous layer over their dorsal surface, the color of which grades from seal-brown to a very light shade of yellow, but in a few exceptional cases it is entirely wanting.

If the posterior half of the worms be removed, a new tail will regenerate in course of some eight days. This regenerated tail will be as a rule devoid of any chitinous covering, and the tissue will therefore be quite translucent. This regenerated tail will soon, however, acquire a chitinous layer over its dorsal surface, which will gradually increase in thickness. As this process of thickening is going on the translucence of the newly regenerated tissue is being lost, and the covering also becomes darker and darker.

The interesting thing to be observed in this connection is, that while this surface layer is formed on the regenerated tail, another phenomenon exactly opposite to the one just described occurs bringing about a gradual thinning out of the chitinous layer over the dorsal surface of the old piece. This gradual thinning out, which results finally in a complete exposing of the underlying tissues beneath, may start either on the part of the old piece nearest to the regenerated tail, or on the part furthest removed from it or even on the left and right sides of all the old segments.

These two processes, the thinning out of the chitinous layer on the old tissue, on one hand, and its thickening on the regenerating tissue on the other hand, will continue until both parts, the old and the new are covered by a continuous layer of uniform thickness. The process, however, may not be brought to an end even at this stage, and go on until the dorsal covering on the new tail would become much thicker and consequently darker, than that on the old part. This shifting of the chitinous material from the old over to the new part will proceed still further, ultimately leading to the formation of a seal brown covering over the new, regenerated tissue and leaving entirely naked so to speak the old tissue. This condition is exactly the reverse of that with which we started when the old part was all coated with a seal brown layer of chitin, and the regenerated part was all naked. First the old tissue was thickly clothed with chitin, and

the regenerated tissue perfectly transparent; now it is the regenerated tissue which is all covered up with chitin and the old tissue became transparent.

We have here thus a case of transmission of materials from all parts of the old tissue to provide for the building up of the new tissue, and, as we mentioned above, the material may come either directly from the region near the cut surface or from the remotest portions.

In those worms where the chitinous covering was absent before the operation, the dorsal surface of the new, regenerated tail also remained free of such a covering. The same thing happened when worms, which bore a layer of chitinous material on their dorsal surface, were subjected to the action of a 0.0001 per cent. solution of strychnin, in which case the chitin disappeared from the old part, and has never been deposited in the regenerated part, indicating that the regenerating organ is dependent on the old tissue for its building material.

This fact here related, as well as others of which I cannot speak now, point to the assumption that it is the organism as a whole and not the exposed, cut surface of the organism that is concerned with the regeneration of the lost tissue.
