

REACTIONS TO LIGHT AND PHOTO-RECEPTORS OF ANNELIDA.

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As one surveys the more important groups of Annelida, he at once discovers that these groups differ considerably from one another in their possession of eyes or other cells which function as photo-receptors. Although this paper will refer briefly to *Nereis virens* as representative of the Polychaeta, and to *Glossiphonia parasitica*, one of the Hirudinea, it will be chiefly confined to a discussion of our common member of the Oligochaeta, *Lumbricus terrestris*.

Nereis virens, as is well known, possesses two pairs of eyes on its prostomium. If the worms of this species are exposed to lateral illumination, from either the right or left side, they react negatively and orientate readily in a negative direction. If the eyes of a normal specimen are removed from one side with a sharp scalpel it no longer reacts as before, but produces "circus movements" in that it turns chiefly away from the side possessing the functional eyes. With all four eyes removed no reactions to light are apparent. From these experiments we feel warranted in stating that the cells which function in photo-reception in *Nereis virens* are definitely localized, and are probably found nowhere else except in its four eyes.

Our common leeches, such as *Glossiphonia parasitica*, possess several paired segmental eyes which function as photo-receptors in a similar manner as the eyes of *Nereis*. Here the eyes are more numerous and are more widely distributed, however, than in *Nereis*.

Our common earthworm, *Lumbricus terrestris*, possesses no perceptible eyes, yet it responds readily to the effects of light stimulation. Normal worms of this species, when exposed to light of ordinary intensities readily move away from the source of illumination, and orientate very definitely in a negative direction. These same worms, which are negative to light of ordinary intensities, become positive, in keeping with their nocturnal habits, when the light is greatly diminished. If the brain of a normal earthworm is removed by a dorsal incision, or by the removal of the first three anterior segments, the worm no longer reacts negatively to ordinary illumination, but it becomes strongly positive, and if six, or even more of the anterior segments are removed, they are still positive. There is a brief period, however, of only a few seconds' duration when first exposed to light that these worms give negative reactions. In each case they quickly adapt themselves to the light and become positive. Similar results were obtained with *Allolobophora foetida* with as many as forty anterior segments removed. These results show that the brain of the earthworm is not necessary for reaction to light and orientation. They, however, indicate that earthworms are more sensitive to light when the brain and the photo-receptors at the anterior end are functional, than they are when these are not functional. This accounts for the fact that, while normal

worms are photo positive only in very weak light, specimens with the brain removed are positive in strong light.

The experiments referred to above also prove conclusively that the earthworm possesses cells which react to light, and that these cells are not limited in their distribution to the anterior end. In fact, experiments show that the worm is sensitive to light over its entire body, the anterior end being most sensitive, the posterior end next in sensitivity and the middle region of the body least sensitive of all.

These, and other experiments which were performed, seem to indicate that the Annelids as a group are negative in their reactions and orientations to ordinary light; that those forms which possess definite eyes seem to have the cells which function as photo-receptors localized in these eyes, while those worms that do not have perceptible eyes possess cells which function as photo-receptors that may be distributed more or less over the entire body. Some of the annelids, at least, which are negative to ordinary illumination are positive to very weak light, and if the brain and the anterior photo-receptors are destroyed these worms also become positive to strong light.

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