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LUMINESCENCE IN POLYNOIDS

III. PROPAGATION OF EXCITATION THROUGH THE NERVE CORD

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Luminescent polynoids emit light from their elytra. These structures are arranged in two longitudinal rows covering most or all of the dorsal surface of the worm. Light emission is evoked by stimulation and appears as a single flash or series of flashes (Nicol, 1953, 1957).

When a polynoid is subjected to tactile stimulation, scales anterior and posterior to the stimulated region emit flashes. The response is a reflex, the excitatory pathways of which involve peripheral receptors, nerve cord, and a peripheral ganglion in each elytrum on the efferent side of the arc (Bonhomme, 1942; Nicol, 1954).

It has been observed that when a polynoid is transected, only the part posterior to the cut flashes, the anterior fragment remaining dark (Kutschera, 1909; Nicol, 1953). There is a seeming discrepancy between this restricted response, and the more widespread luminescence which attends tactile stimulation (Harvey, 1952). The observations could be explained if there existed some form of functional polarity in the nerve cord, and I have tested this possibility by means of electrical stimulation.

MATERIAL AND METHODS

Gattyana cirrosa was selected for study because it is large, tough, and sluggish. Specimens were anaesthetized in iso-osmotic $MgCl_2$, and heads and tails were cut off. The majority of elytra were removed, leaving a few at restricted levels, namely at the anterior end, middle of the body, and at the posterior end. The animal was slit longitudinally along the mid-dorsal surface, and the nerve cord was exposed. The preparation was then pinned out so that the residual elytra could be seen from above, and a pair of electrodes could be placed on the nerve cord.

Electrodes were platinum wire, insulated to near the tips. Electrical stimuli were condenser discharges or square wave pulses delivered from electronic apparatus. Stimulus strengths were kept near threshold.

OBSERVATIONS

When severed in two halves with a clean quick cut, *Gattyana* behaves like other polynoids, all elytra in the posterior fragment flashing, while elytra in

the anterior fragment remain dark. Tactile stimulation causes all elytra to flash.

Electrodes were placed on the nerve cord at the following levels: anterior quarter, middle, and posterior quarter.

Electrodes in the anterior region

Results of stimulation were variable. Usually flashing occurred in the elytra at the anterior end, either on the first pulse or after a series of pulses. In these instances continued stimulation led to flashing in middle elytra. In other preparations stimulation caused middle and posterior elytra to flash (first pulse), followed by flashing in anterior elytra when stimulation was continued.

Electrodes in the middle of the body

Stimulation at this level evoked light in contiguous middle elytra and in elytra at the posterior end (first pulse). Protracted stimulation was followed by flashing in anterior elytra.

Electrodes in the posterior region

A single pulse caused posterior elytra to flash. A series of pulses evoked light in anterior elytra.

Protocols of two experiments are as follows:

(1) Preparation with two pairs of elytra, at anterior and posterior ends; electrodes in middle of worm.

1 shock: flash in posterior elytra. 24 shocks at 1/sec: flickering light in posterior elytra. Long bursts at 2, 3, 4 and 5/sec: flickering light in posterior elytra.

(2) Preparation with three pairs of elytra, anterior end, middle and posterior end; electrodes in anterior region.

Burst at 1/sec: flashing in anterior elytra, beginning with eighth shock. Burst at 1/sec: flashing in anterior elytra, beginning with fourth shock. Burst at 1/sec: flashing in anterior elytra, beginning with seventh shock.

Electrodes moved to posterior region.

Burst at 2/sec: flash on first shock in posterior elytra. Burst at 2/sec: flashing in posterior elytra beginning with first shock; flashing in middle elytra beginning with ninth shock.

CONCLUSIONS

In the anterior quarter of the body, excitation for luminescence tends to show preferential conduction anteriorly. Behind this level there is a preferential tendency towards posterior conduction. A single pulse in the posterior half of the body excites elytra behind the electrodes; with continued stimulation light spreads to elytra anterior to that level. Thus, there is evidence for functional polarity in the nerve cord, such that luminescent excitation is conducted with greater facility posteriorly over a large part of its length. The evidence is more equivocal for the anterior end: in the majority of instances conduction

occurred with greater facility anteriorly. It would seem, therefore, that when a polynoid is cut in half, the brief excitation can travel only posteriorly. More protracted tactile stimulation generates longer excitation, overcoming resistance to anterior transmission.

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