

# Toxic behavior in earthworm.

1992

Purpose: To demonstrate various capability of the sensory perception rendered to the earthworm.  
To demonstrate their repertoire of behavioural response induced by stimulation of these sensory canals.

Materials: earthworm

Procedure:

- (1) ミミズを光で照して反応を見る。
- (2) ミミズの体の各部分をそれぞれ照して反応を見る。
- (3) 酸素欠乏のため水をいれたガラスコップを通して光をあてる。
- (4) 土の中にかくまわれたいミミズは、どう動いていこうとする。
- (5) かくりかえして、むかしもやるようになる。
- (6) 酢酸を近づけて反応を見る。
- (7) habituationを見る (動物世界が短いほど 慣れが速い)
- (8) lateral inhibitionを見る (後述)

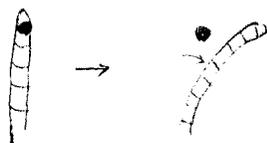
Result:

- (1) ミミズの体にかざると、



ミミズは頭をむいて、したいに腹へ移動していく。

- (2) 部分的に光を当てると、



頭部に spot light をあけると、ミミズは頭部を光から避ける。

尾部では特に反応を示さない。



# Locomotion of the earthworm.

Purpose: To demonstrate the role of peripheral as well as the central nerve system in coordinately movement of the earthworm.

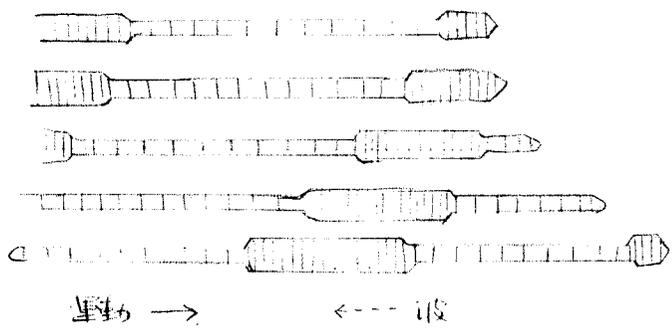
Material: earthworm

Procedure:

- (1) ミミズの normal locomotion の観察
- (2) 前述しているミミズをうしろへおける。
- (3) ミミズを切断し、動かさない locomotion をみる。
- (4) 尾部のみを動かす。その後、動かす。

Result(1) ミミズは 蠕動運動をする。

ミミズは、腹背(腹は上向き、背は下向き)が交互にあり、その間は、前後、前後、前後、と、体は前進する。



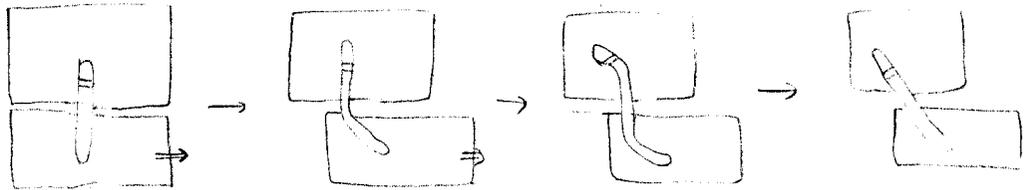
- (2) 腹部に剛毛がはさかいて、後方には進まない。
- (3) ミミズとまいたりの切断し、糸で連結すると。



a. 前半分が前向きに曲げると、収縮の波は、前から後へ、一個体の  
 の時同様に伝わる。  
 が、すぐ後半分は協調しなくなり、ただ前半分にはひきずられて  
 いくだけとなっていった。

b. 空中にのりさげに状態では後半分の協調は、みだれた。

(4)



ミミズは尾の曲げられた方向とは反対の向きに頭を曲げ、体が  
 一直線になるような定位をする。

**Comments** ミミズは、環状筋の収縮波と縦走筋の収縮波を交互に肩の方向へ  
 送り、前進する。各体節は環状筋が収縮すると伸び、つぎに、  
 環状筋が弛緩し、縦走筋が収縮すると短縮する。これを交互に繰り返  
 かし、腹部剛毛がすべり止め役を(かなりの)前進圧力として、  
 前進する。

最近連続した実験から、蠕動運動は、中枢神経系の支配によるもの  
 ではなく、前節が後節を引っ張るという刺激によるものによる。空中に上げ  
 損傷されたことから、神経への刺激(情報)が sensory cells を通して  
 segmental ganglion に入り、そこから出る情報-impulse が、  
 筋肉を収縮させる。

homostrophic reflex は体壁筋内受容器への刺激が、中枢  
 神経系を経て、頭部の体壁筋へ伝わることによるものと考  
 えられる。

Refer.

The central nervous system is essentially the same as that of the insect. A brain (suprapharyngeal ganglion) lying above the pharynx is connected by two nerves with a large ganglion (subpharyngeal ganglion) lying below the pharynx. These two ganglia and nerves to the sensitive anterior segments and are considered to be the "higher centres".

The brain is supposed to direct the movements in response to sensations of light and touch which it receives; but if it is removed, the behaviour of the worm is affected little. After removal of the lower ganglion the worms no longer eat, and they cannot burrow in normal fashion.

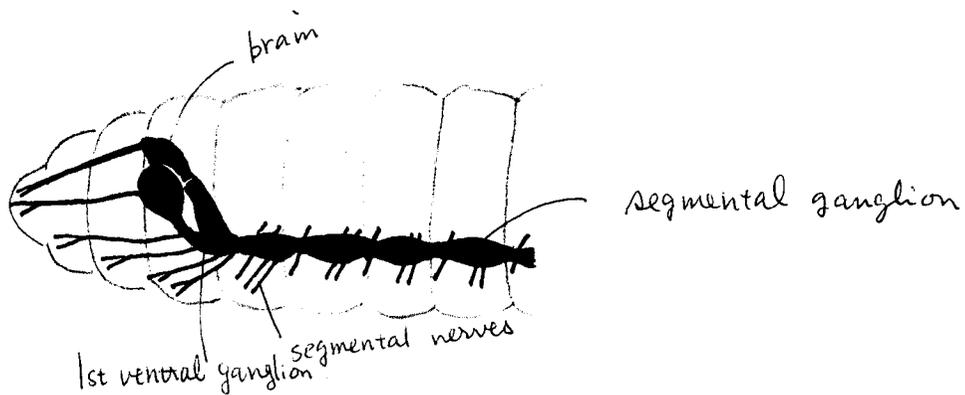
From this first ventral ganglion the double nerve cord runs to the posterior end of the body, enlarging in each segment to a double segmental ganglion from which nerves go to all parts of the segment. Each ganglion serves as a centre which receives impulses coming from sensory cells in the skin and sends impulses that result in contraction of the muscles.

The ganglia co-ordinate the impulses so that the longitudinal muscles relax while the circular muscles contract, on the opposite. Without this arrangement the two sets of muscles might only counteract each other's activities, and no movement would result. The smooth muscular waves which pass down the body in the ordinary creeping movements of the earthworm are not controlled by the large ganglia at the anterior end, for almost any sizable piece of an earthworm will creep along as well as a whole worm. The co-ordination is thought to be achieved through impulses relayed from one segment to another by nerve cells in the cord which run from one ganglion to the next. Since there is a certain amount of delay involved in the transfer from ganglion to ganglion in this chain-like succession of connecting fibres, these impulses travel very slowly.

If measured as the speed of travel of the waves of thinning or thickening in the body of a moving worm, the rate is only about 1 inch per second. Besides the ordinary creeping movements earthworms can suddenly contract the whole body in response to strong stimulation of any region.

If the anterior end is extended from the burrow and receives some unfavourable kind of stimulus, the longitudinal muscles contract as a whole, and the worm disappears into its burrow almost instantly.

Such a response requires very rapid nervous transmission, and we do find certain 'giant fibres' in the ventral nerve cord which pass over long distances or even throughout the length of the cord. The speed of transmission in these giant fibres has been estimated at 1.5 yards per second. The speed is about the same in the giant fibres of the nereis, but may be almost 10 yards per second in some of its relatives. These figures seem very low when compared with the rate of nervous conduction in the motor nerves of man, in which impulses travel at about 100 yards per second.



Anterior end of the earthworm, showing the nervous system.

[ R. BUSCHSBAUM, 1951 ]