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RELATIVE ABILITY OF ANTERIOR AND POSTERIOR ENDS OF THE BODY TO REGENERATE IN EARTHWORMS

By F. L. FITZPATRICK

The following experiments were begun in July, 1928. They were anticipated to some extent by preliminary experiments performed in conjunction with Mr. E. I. Solomon, a major honors student at Coe College two years ago. Prof. T. H. Morgan¹ carried out somewhat similar experiments on the regenerative powers of short pieces cut from the posterior ends of worms. (presumably *Allolobophora foetida*).

Fifty large specimens of earthworms (Lumbricidae) were the subjects in the first experiment. The posterior twenty segments were cut away from each of these specimens. Only the anterior ends were saved, the object of the experiment being to test their powers of recovery, and incidentally, their powers of regeneration.

The cut posterior ends of the worms began to taper and the wounds showed signs of closing within ten or fifteen minutes after the time of operation. In some cases the next to the last remaining segment constricted and the segment with the cut surface was sloughed-off. Within an hour the cut posterior ends of the worms were well on the way toward healing and establishing new anal openings.

The worms were then placed in a large container filled with dirt and leaf mould. The dirt was moistened and the worms were examined daily. Fifty controls were placed in another container and kept under conditions as nearly identical with those of the first container as possible.

A summary indicating the rate of survival follows:

Day	1	2	3	4	5	6	7	8	9	10
	50	50	50	50	50	50	50	50	50	49
Day	11	12	13	14	15	16	17	18	19	20
	46	44	42	39	39	39	39	38	38	38

The controls suffered a mortality of six individuals during the

¹ T. H. Morgan, Experimental studies on the internal factors of regeneration in the earthworm, *Archiv für Entwicklungsmechanik der Organismen*, Bd. 14, 1902.

period between the tenth and thirteenth days, which was perhaps accountable on the ground that the weather during this interval was extremely hot and humid.

At the twentieth day sixteen of the worms which had undergone the operation had regenerated from one to six new posterior segments. The conclusion seems to be that if only some twenty segments are removed from the posterior end of an earthworm, the remaining anterior end will survive in most cases, and will begin the regeneration of new segments at the posterior end of the body after an interval of about twenty days.

The second experiment was designed to measure the comparative ability of anterior and posterior ends of the earthworm to survive after being separated from each other, and possibly to regenerate new parts. Twenty-five specimens served as subjects. They were bisected behind the clitellum and as nearly in the middle of the body as possible. This left the principal organs (hearts, cerebral ganglion, pharynx, oesophagus, proventriculus, gizzard, and the anterior end of the intestine) in the anterior halves. The anterior halves were placed in one container of dirt and leaf mold, the posterior halves in another. The following summary shows the comparative rate of survival over a period of thirty days:

Day	1	2	3	4	5	6	7	8	9	10
Anterior ends	25	25	25	24	24	24	23	22	22	21
Posterior ends	25	25	24	24	24	24	24	24	22	20
Day	11	12	13	14	15	16	17	18	19	20
Anterior ends	20	18	17	16	15	15	15	15	14	14
Posterior ends	14	12	7	5	3	2	1	0	0	0
Day	21	22	23	24	25	26	27	28	29	30
Anterior ends	14	14	14	14	14	14	14	14	14	14
Posterior ends	0	0	0	0	0	0	0	0	0	0

In these results we find corroboration of the results obtained in the case of the anterior ends of the first experiment described above, and corroboration of T. H. Morgan's results on the survival of groups of segments cut from the posterior ends of worms. The anterior halves survive in the majority of cases; the posterior halves live for some time, but eventually they all die. The failure of the posterior halves to survive, as Morgan has stated, is attributable to their inability to regenerate new heads, and the inevitable starvation which results from this failure.

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