DISTORTION OF POLARITY IN HYDRA

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The phenomenon of distortion of polarity in regeneration is of considerable interest in connection with the study of the plasticity of the organism.

One of the organisms exhibiting distinctly marked polarity is the hydra. In the literature there are references to the possibility of distortion of polarity in regeneration in hydra [2,3] however, this phenomen has been observed as a result of a more or less complicated influence on a fragment excised from the body of the hydra. To obtain distortion of polarity in one of the injured surfaces in regeneration in hydra is also possible without special influences. Thus, for example, a small isolated section of the body of a hydra can occasionally assume a bipolar shape in which at the oral and at the aboral terminus there is hypostome development. Nevertheless in the literature there is no information on the possibility of development from an isolated fragment of the body, of a morphologically normal, unipolar hydra with complete distortion of polarity (at 180°) except in the case of special interference. But the data on distortion of polarity in conditions of experimental interference led us to the hypothesis that among the isolated fragments of the body of the hydra showing unipolar regeneration, there can be specimens with complete distortion of polarity, i. e., specimens forming a hypostome at the aboral end and a pedicle at the oral one. In order to check this hypothesis the experiment described below was performed.

EXPERIMENTAL METHODS

We used Pelmatohydra oligactis as the test object. From the body of the hydra we excised rings and marked them and then made observations on the regeneration of the marked rings.

The marking was performed in the following manner: the hydra was placed in a drop of water on a slide. After it had completely straightened itself, it was quickly extracted with the aid of a needle on to a dry site. When the hydra was thus not excessively contracted a grain of methylene blue was deposited on its surface. After 30 sec. to a minute, the hydra was transferred to water, the grain of blue was washed off and a fairly clear mark remained in its place. Then the ring was excised from the body of the hydra in such a way that one transverse cut passed through the middle of the mark and the other outside it. The mark usually persisted very well for 3-4 days and this period was quite sufficient to establish the relationship of the polarity of the regenerated fragment to the original polarity.

The rings were excised from three sections (Fig. 1), the hypostome zone 1, the middle zone 2 and the zone of gemmation 3. In order to make sure that the marking itself exerted no influence on distortion of polarity of the fragment, the marks were applied in such a way that the oral and aboral ends of the ring were marked alternately. Altogether 275 cases of regeneration were investigated. In 48 cases the rings were excised from the hypostome zone, 53 from the zone of gemmation and 174 from the middle zone. The greater part of the experiments were conducted in the spring.

TABLE

	Result of regeneration		Rings		
			From hypostome zone	From middle zone	From zone of gemmation
Unipolar forms	Regeneration with maintenance of original polar orientation	Mark on oral end of ring	14	90	30
		Mark on aboral end of ring	14	58	19
	Regeneration with distortion of original polar orientation by 180°	Mark on oral end of ring	–	7	1
		Mark on aboral end of ring	–	5	–
Bipolar forms	Misshapen forms		–	4	–
			20	10	3
		Total	48	174	53

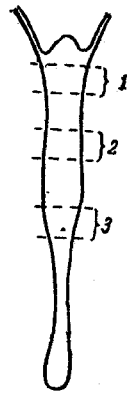

Fig. 1. Sketch of excision of rings from the body of hydra.
1) hypostome zone,
2) middle zone,
3) zone of gemmation.

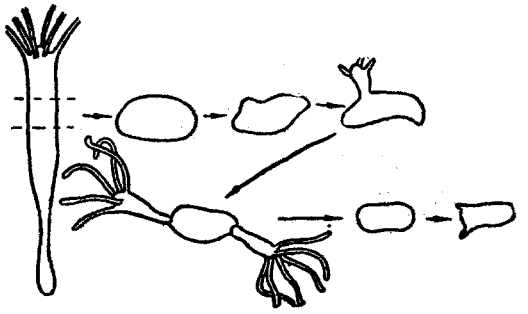

Fig. 2. Regeneration of hydra from rings of middle zone.

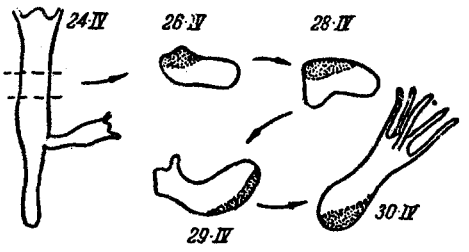

Fig. 3. Distortion of polarity in hydra. Mark applied on oral end of ring.

EXPERIMENTAL RESULTS

The results of the observations are indicated in the table.

It follows from the table that the hypothesis concerning the possibility of complete (180°) distortion of polarity of the fragment was completely borne out in practice. 13 cases of distortion of polarity were obtained. 12 of them were concerned with rings excised from the middle zone. One ring giving distortion of polarity, was taken from the region border of the middle gemmation zone (in the table it is included under zone of gemmation). In the rings from the hypostome zone distortion of polarity was never observed but on the other hand they produced a considerable large percentage of deformed shapes, i. e., those in which polarity was in general not distinctly marked since feelers grew all round, or, with the exception of the normal oral ring, single feelers were growing in places where they are normally absent. In the latter cases, the mark always proved to be situ-

ated in the direction of the original polar orientation, i. e., it indicated absence of distortion of polarity. Although relatively few cases of regeneration with complete distortion of polarity were obtained (12 out of 174 for the middle zone, i. e., about 7%) nevertheless the possibility of obtaining complete distortion of polarity is not open to doubt since the result is of qualitative character.

Should one on the basis of the findings obtained draw the conclusion that change in polarity depends on purely chance circumstances ? Such a conclusion would be premature. While observing regeneration of the nonmarked rings from the middle zone we sometimes noticed that the round lump into which the ring was quickly transformed after the intervention formed one or two buds. These buds either detached themselves or, it would seem, absorbed the material of the ring (Fig. 2). Such a process was usually observed in rings excised from the middle zone. Twice we observed it in rings taken from the gemmation zone but never in the rings from the hypostome zone.

These observations led us to the hypothesis that the laying down of the bud in the usual course of gemmation occurs in the middle zone and then the embryo descends to the zone of gemmation where both its growth and differentiation take place. Such a hypothesis is admissible if it is remembered that the bud appearing in the zone of gemmation is constantly displaced downwards and separates only after descending to the pedicle.

Accepting the hypothesis put forward one can explain the phenomenon of complete distortion of polarity by the development of the embryo of the bud forming on the aboral end with subsequent absorption by it of the material of the ring. Such an interpretation is also supported by one of the experiments in which distortion of polarity (Fig. 3) was found. As can be seen from Fig. 3, the ring excised from the middle zone started to form a bud, a bud which at first was sufficiently distinct individually and later drew in the whole of the material of the ring.

Cases of formation of buds in rings taken from the zone of gemmation are probably connected with the fact that the embryo of the bud descending into the zone of gemmation was still at such an early stage that it could easily have been overlooked. A similar kind of interpretation of corresponding phenomena has been offered by V. M. Isaev [1], who attributed cases of "heteromorphosis" in hydra to activation of the bud embryos.

Our findings show that polarity in regeneration in hydra is not such a stable phenomena as has been usually accepted.

LITERATURE CITED

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* In Russian.