

PART IV—ON OIKOPLEURA TORTUGENSIS, A NEW APPENDICULARIAN FROM THE TORTUGAS, FLORIDA, WITH NOTES ON ITS EMBRYOLOGY.

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(Plates 3-8.)

INTRODUCTORY.

A large appendicularian (plate 3, fig. 4) in its house is found in abundance in the vicinity of the Marine Biological Laboratory of the Carnegie Institution of Washington at Tortugas, Florida. It is, no doubt, widely distributed along the coast of Florida, as it has been found by Dr. Mayer and Professor Brooks at Miami, and by Mr. Kellner in the Tortugas. The specimens are from 5 to 8 mm. long, and occur in great swarms at the depth of from 5 to 8 fathoms. They belong to the genus *Oikopleura* and to a species that seems to be new, although its differences from *O. longicauda* and *O. intermedia* of Lohmann are slight. The house (plate 3, figs. 4 and 5) is large, about 20 mm. in diameter, and nearly spherical. In its internal structure it resembles the houses that have been described in other species of the genus.

Most of the houses contain small appendicularians of various sizes, but all are well advanced and in the appendicularia-stage. It is possible that these are the young of the animal in whose house they are found, but it is also possible that they have been drawn into the house by the current of water and that they are not, of necessity, the young of the species which forms the house.

On the tails of some of the specimens (plate 7, fig. 13) are the eggs and early stages in the development of an appendicularian which may be *Oikopleura*, although it is possible that they belong to some other species. The eggs (plate 7, fig. 16) are inclosed in thick capsules of follicle-cells. Some are loosely attached to the tails, while others (plate 7, fig. 19) have, at one end, a process of modified follicle-cells that penetrates the tail like a root and firmly attaches the egg. Two embryos, at two successive stages of early development (plate 7, figs. 20 and 15) were found. They are deeply rooted in the tail by a process that penetrates the blood-sinus of the adult, and the embryos are parasites. On the ventral surface of the older embryo (plate 7, fig. 14) the two spiracles, opening to the exterior at one end and into the respiratory pouches of the pharynx at the other, prove that the embryos are appendicularians, although we have not been

able to make out much of their development from two imperfectly preserved specimens of such minute size. The so-called gland-cells that have been figured and described by Lohmann on the tail of *Oikopleura* are no doubt eggs or embryos.

All of the houses that we examined contained small elongated gregarina-like parasites (plate 3, fig. 6). On the tails of some of the specimens are rhizopods of the genus *Gromia* rooted in the tails by a network of pseudopodia, and with the body covered by a thin transparent shell (plate 4, fig. 12). This rhizopod is described on page 93.

Oikopleura tortugensis sp. nov. (Kellner).

(Plates 3 and 4, figs. 1, 2, 3, 4, 5, 8, 9, 10, 11.)

DIAGNOSIS OF THE SPECIES.

Both slightly elongated. Dorsal outline convex in profile view (fig. 1). Ventral surface between anus, *a*, and mouth, *f*, strongly convex. Mouth nearly dorsal. Whole surface of body, dorsal or anterior to a line that joins the anus to the dorsal end of the reproductive organ, covered with large cells (plates 3 and 4, figs. 1, 2 and 3). In region of oikoplast there are four membranoplasts, *c*, *c*, one on each side of the middle line of the dorsal surface, and one on each side of the body dorsal to the rectum and anterior to the anterior end of stomach.

Endostyle nearly vertical, anterior end near mouth, posterior end much anterior to the spiracles.

Digestive organs (plates 5 and 6, figs. 7, 8, 9, 10).—Stomach large; with two lobes. The œsophagus opens into left lobe at some distance from its posterior end, which terminates in a dorsal conical protuberance. Right lobe is continued into the intestine, which becomes much enlarged near the anus.

Reproductive organs (plate 5, figs. 7, 8) convex posteriorly, anteriorly consisting of two concave lateral portions that partially cover the posterior ends of the lobes of the stomach, and a thicker central portion that lies between these lobes.

Length of body of our largest specimen, 2.5 mm.

Tail (plate 4, fig. 11) broad, with well-developed muscles; end of tail broad, rounded, with no terminal fold.

House (plate 4, figs. 4 and 5) spherical, delicate, transparent, with two openings, *p*, *p*, through which water enters, and an unpaired opening, *q*, through which it is discharged and through which the animal leaves it when it is abandoned.

Distribution.—Abundant near the Dry Tortugas and in Gulf Stream near Cape Florida.

Remarks.—The differences between this species and *O. longicauda* and

O. intermedia, as described by Lohmann (Appendicularien der Plankton-Expedition, von Dr. H. Lohmann. Ergebnisse der Plankton-Expedition der Humboldt-Stiftung. Bd. II. C. c. Edited by Victor Hensen, 1894) are slight. The tail is like that of *O. longicauda*, lacking the fin-like lobe that is described and figured in *O. intermedia* by Lohmann. In other respects it is like *O. intermedia* resembling it, and differing from *O. longicauda*, in the following respects: The digestive organs are less compact than in *O. longicauda* and like those of *O. intermedia*. The œsophagus joins the left lobe of the stomach much anterior to the curved process that forms the posterior end of the left lobe, as in *O. intermedia* (see plate 5, figs. 7 and 8), and not close to it, as in *O. longicauda*. The endostyle is near the mouth and nearly vertical, as in *O. intermedia*, and it is separated from the region of the gills by a wide interval, while it is more nearly horizontal and farther back in *O. longicauda*. The thin membranous veil (Schleier) that Lohmann describes and figures in *O. longicauda*, overhanging the dorsal surface of the posterior end of the body, to which it is attached near the reproductive organ, is not present in any of our specimens, nor does Lohmann mention it in *O. intermedia*.

NOTES ON EMBRYOLOGY.

In plate 7, figure 13, part of the tail of *Oikopleura tortugensis* is shown magnified 43 diameters. Attached to it are three eggs, *r, r, r*, of which one is shown, more magnified in figure 16, and an embryo, *s*, which is shown, more enlarged, in figures 19 and 20. The eggs are attached to the tail by a process that penetrates into the tissues. In figure 16 one of the eggs is shown, magnified 200 diameters. The opaque egg, *r*, is inclosed in a follicle, *z*, of elongated cells with flat outer ends. At the bottom of the figure the fastening process or root, *x*, is shown. It is formed of follicle-cells, and shows indications of an axial cavity. No test-cells can be made out between the yolk and the follicle, the minute, badly preserved specimens not being favorable for observation. All of the specimens were fixed with picro-acetic fixative and carefully preserved with changes of alcohol; but as they were preserved for the identification of the species, with no thought of eggs or embryos, they were not isolated, but were handled wholesale as they were collected. While we found several eggs, we found only two embryos in our collection. While they are much better preserved than the eggs, they are too few to afford much information about the details of the life-history. One of them, shown at *s* in figure 13, is shown, magnified 300 diameters, in plates 7 and 8, figures 17, 18, 19, 20. An older one is shown in ventral view in plate 7, figure 14, in dorsal view in figure 15, and in sections in plate 8, figures 21, 22, 23, 24 and 25. The structure of the older embryo has features of resemblance to an adult appendicularian, and as it is, therefore, more intelligible than the younger one, it will be described first.

It is shown in dorsal view, magnified 300 diameters in plate 7, figure 15, and in ventral view in figure 14. It is deeply rooted in the tail of the adult by a process from the anterior, or oral, end of its body. The process is hollow, as is shown in the sections drawn in figures 24 and 25 of plate 8, but there is no trace of an opening at its tip, and it no doubt absorbs its food in a liquid state. As the sections show, its wall consists of a single layer of large cells, with here and there a cell or a group of cells on its outer surface. These outer cells seem to be blood corpuscles of the adult. In the body-cavity of the embryo there is a row of four big cells in the axis that passes through the root. One of them is shown in section in plate 8, figure 23. They are no doubt concerned with the nutrition of the embryo, making the food that is taken up by the root available.

On the middle line of the dorsal surface, near the attached end of the body, there is an opening, shown at *f* in plate 8, figure 23, which we regard as the mouth. It communicates with a thin-walled, V-shaped chamber, *ad*, which we regard as the oral or stomodæal chamber of the pharynx. At each end it opens into one of the large, thick-walled, ciliated branchial pouches of the pharynx, which are shown at *t, t*, in plate 7, figures 14 and 15, in the entire embryo, and in section at *t, t*, in plate 8, figures 21, 22, and 23. In side view of the adult, figure 1, the gill is shown, at *l*, as a thin-walled tube, opening at its inner end into the pharynx through the internal spiracle, which is shown to be ciliated in plate 4, figure 3, at *k* and *l*; and opening to the exterior through the external spiracle, which is on the ventral surface near the middle line. In all these respects the embryo that is shown in plate 7, figures 14 and 15, is so much like the adult as to show, beyond question, that it is the embryo of an appendicularian. The ciliated pharyngeal pouches are shown in figure 15 in dorsal view and in figure 14 in ventral view, at *t, t*. The gills are shown, *u, u*, in ventral view, communicating with the pharyngeal pouches at the posterior ends, which are above in the figure and opening to the exterior, near the middle line, through openings that are much more elongated than they are in the adult.

In the sections in plate 8, figure 23 is most anterior, and it cuts the mouth, *f*, and the oral region of the pharynx, *ad*, showing its communication with the pharyngeal pouches, *t, t*, which are shown in figure 22, communicating, at *y*, with the gills, *u, u*, through the internal or pharyngeal spiracles; while figure 21 shows the external spiracles at *ac*.

The large, thick-walled chamber shown at *v* in plate 8, figures 22 and 23, may be the stomach, bilobed at its tip. In plate 8, figures 17 and 18, which are optical sections of the younger embryo shown in plate 7, figures 19 and 20, it is shown, at *v*, communicating with the branchial pouches, *t, t*, of the pharynx.

The tissue that occupies the space between the three chambers in figures 21 and 22, and which is badly preserved, may perhaps be the notochord and nervous system.

ON A NEW SPECIES OF GROMIA (G. APPENDICULARIÆ).

On the tails of some of our specimens of *Oikopleura* unicellular parasites were found. One of them is shown in plate 4, figure 12. They are rooted in the substance of the tail by a tuft of pseudopodia that do not anastomose, and the exposed body is covered by a thin, transparent, stiff capsule. The organism is unquestionably a *Gromia*, and we propose for it the specific name, *Gromia appendiculariæ*.

EXPLANATION OF REFERENCE LETTERS ON PLATES.

- a. Anus.
b. Endostyle.
c. Membranoblasts.
d. Oesophagus.
e. Pharynx.
f. Mouth.
g. Stomach.
h. Right lobe of stomach.
i. Left lobe of stomach.
j. The large cells that cover more than half the body.
k. Right gill.
l. Left gill.
m. Reproductive organ.
n. Gelatinous mass.
o. Parasites.
p. Openings through which the currents of water enter the house.
- q. Opening through which the water is discharged, and the animal escapes when it leaves the house.
r. Egg.
s. Embryo.
t. Branchial pouches of pharynx.
u. Spiracles.
v. Stomach (?) of embryo.
w. Chorda (?) of embryo.
x. Root-like process from the body of the embryo, embedded in the tail of the adult.
y. Internal or branchial spiracle, through which the branchial pouch of the pharynx opens.
z. Follicle cells.
ab. Part of tail of adult.
ac. External opening of spiracle.
ad. The median oral division of the pharynx, showing its communication with the two branchial pouches, *t. t.*

EXPLANATION OF PLATES.

PLATE I.

- FIG. 1. *Salpa florida*, solitary form, dorsal view of adult.
FIG. 2. *Salpa florida*, solitary form, ventral view of adult.
FIG. 3. *Salpa florida*, solitary form, digestive organs of adult.
FIG. 4. *Salpa florida*, solitary form, ventral view of young 4.5 mm. long.
FIG. 5. *Salpa floridana*, aggregated form, side view.
FIG. 6. *Salpa floridana*, aggregated form, ventral view.

PLATE 2.

- FIG. 7. *Salpa floridana*, solitary form, side view of very young embryo.
FIG. 8. *Salpa pinnata*, aggregated form.
FIG. 9. *Salpa floridana*, aggregated form, dorsal view of colony.

PLATES 3 TO 8.

All figures on plates 3 to 8 refer to *Oikopleura tortugensis* nov. sp.

PLATE 3.

- FIG. 1. Side view of body of *Oikopleura tortugensis*.
FIGS. 4 and 5. Views of the house.
FIG. 6. Gregarina-like parasites in the house.

PLATE 4.

- FIG. 2. Ventral view of body of adult.
FIG. 3. Dorsal view.
FIG. 11. Side view of entire adult animal.
FIG. 12. Rhizopod *Gromia* rooted to the tail of *Oikopleura*.

PLATES 5 AND 6.

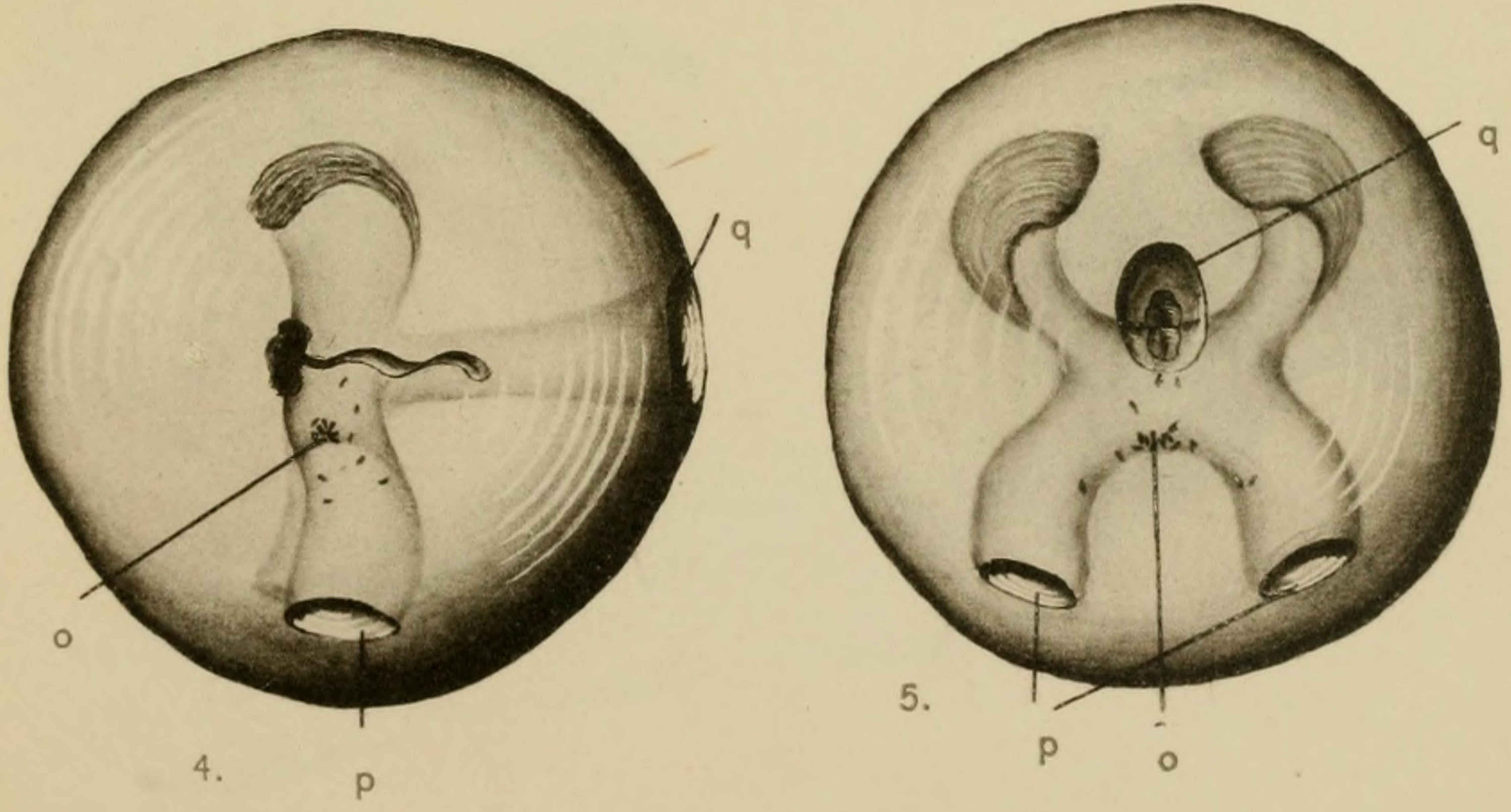
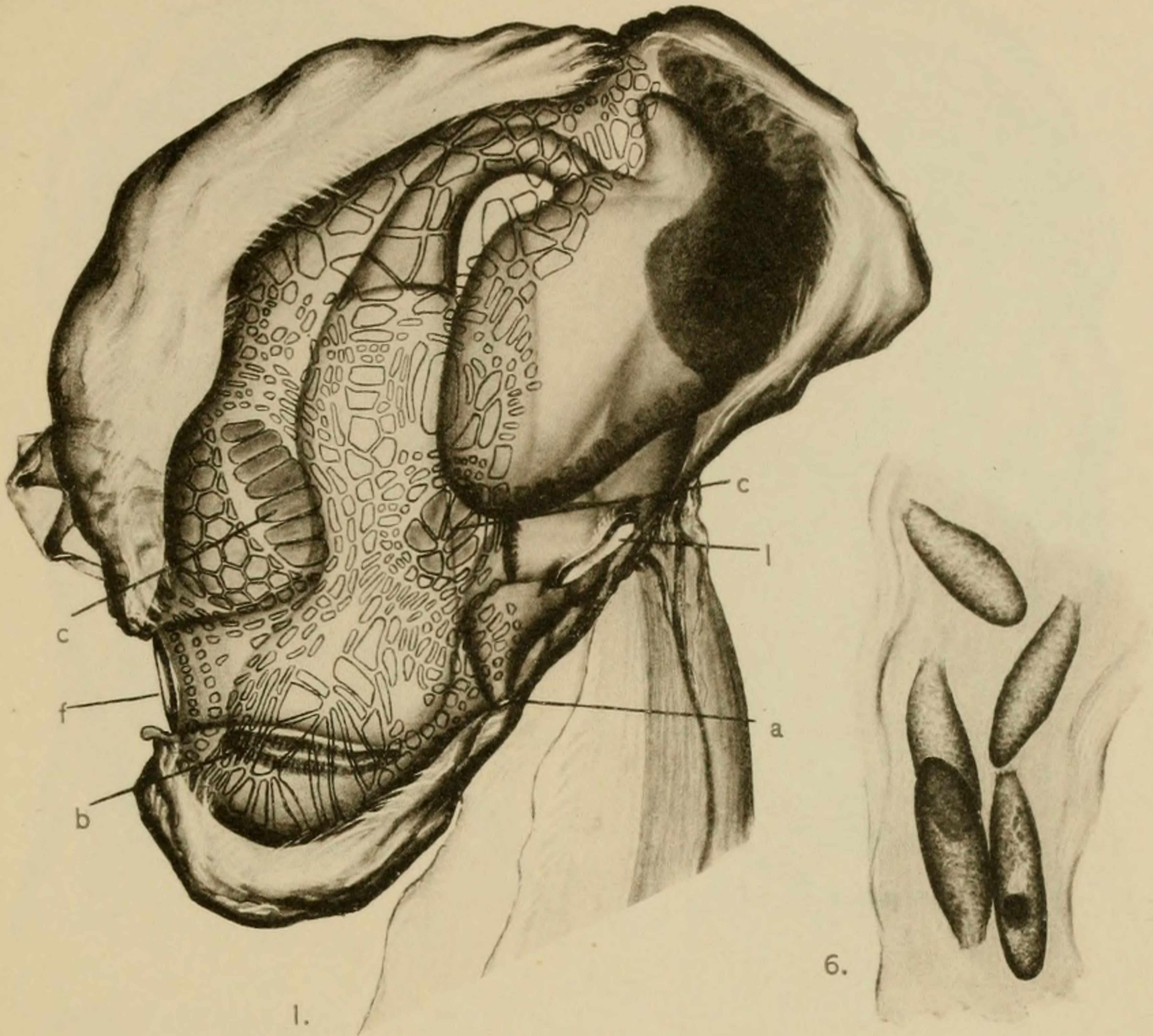
- FIGS. 7, 8, 9, 10. Digestive and reproductive organs of adult.

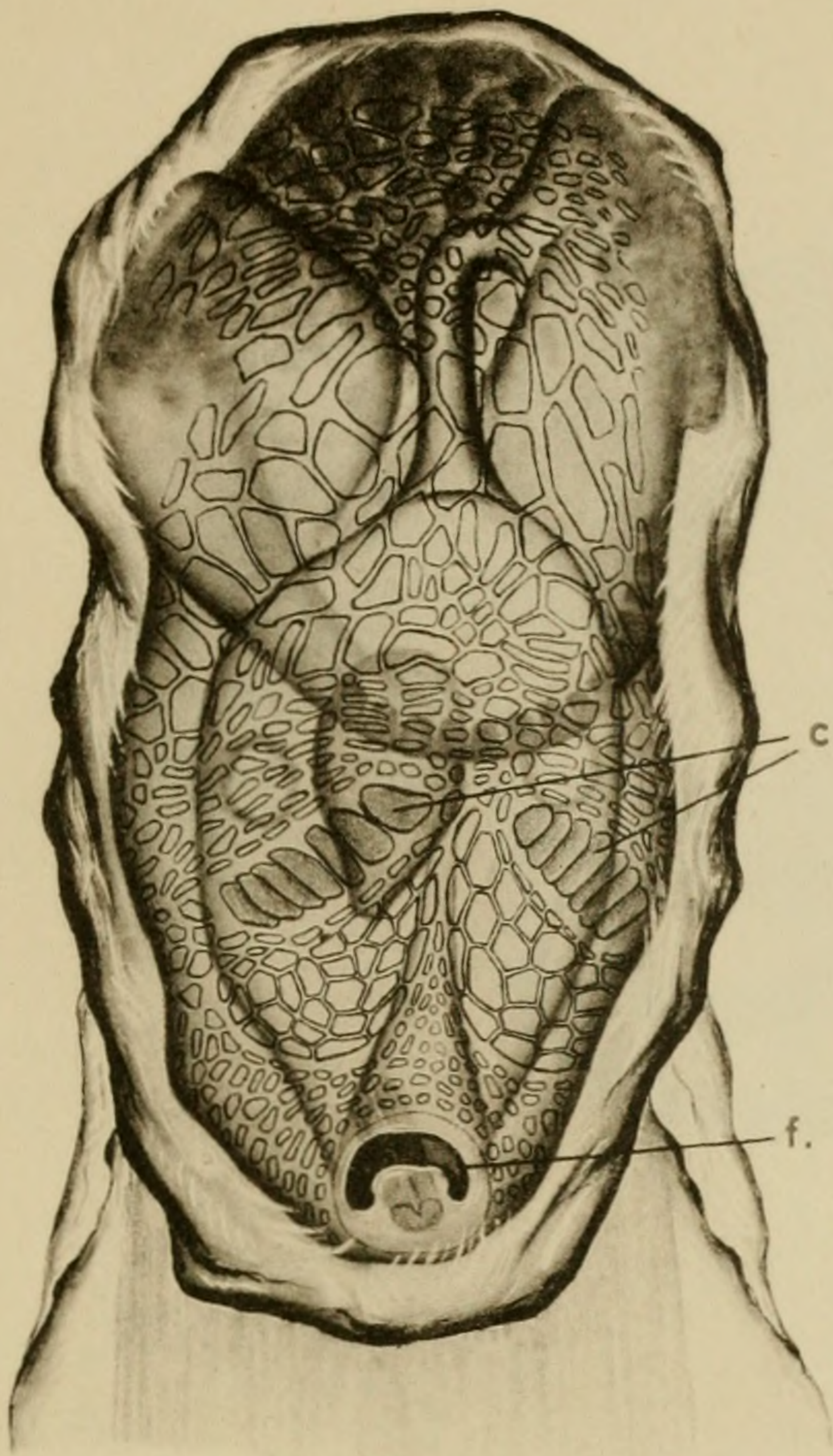
PLATE 7.

- FIG. 13. Part of tail, magnified 13 diameters, showing eggs and embryos rooted as parasites upon it.
FIG. 14. Ventral view of embryo magnified 300 diameters.
FIG. 15. Dorsal view of the embryo shown in figure 14.
FIG. 16. Egg within its follicle, attached to the tail.
FIGS. 19 and 20. Views of an embryo younger than the one shown in figures 14 and 15.

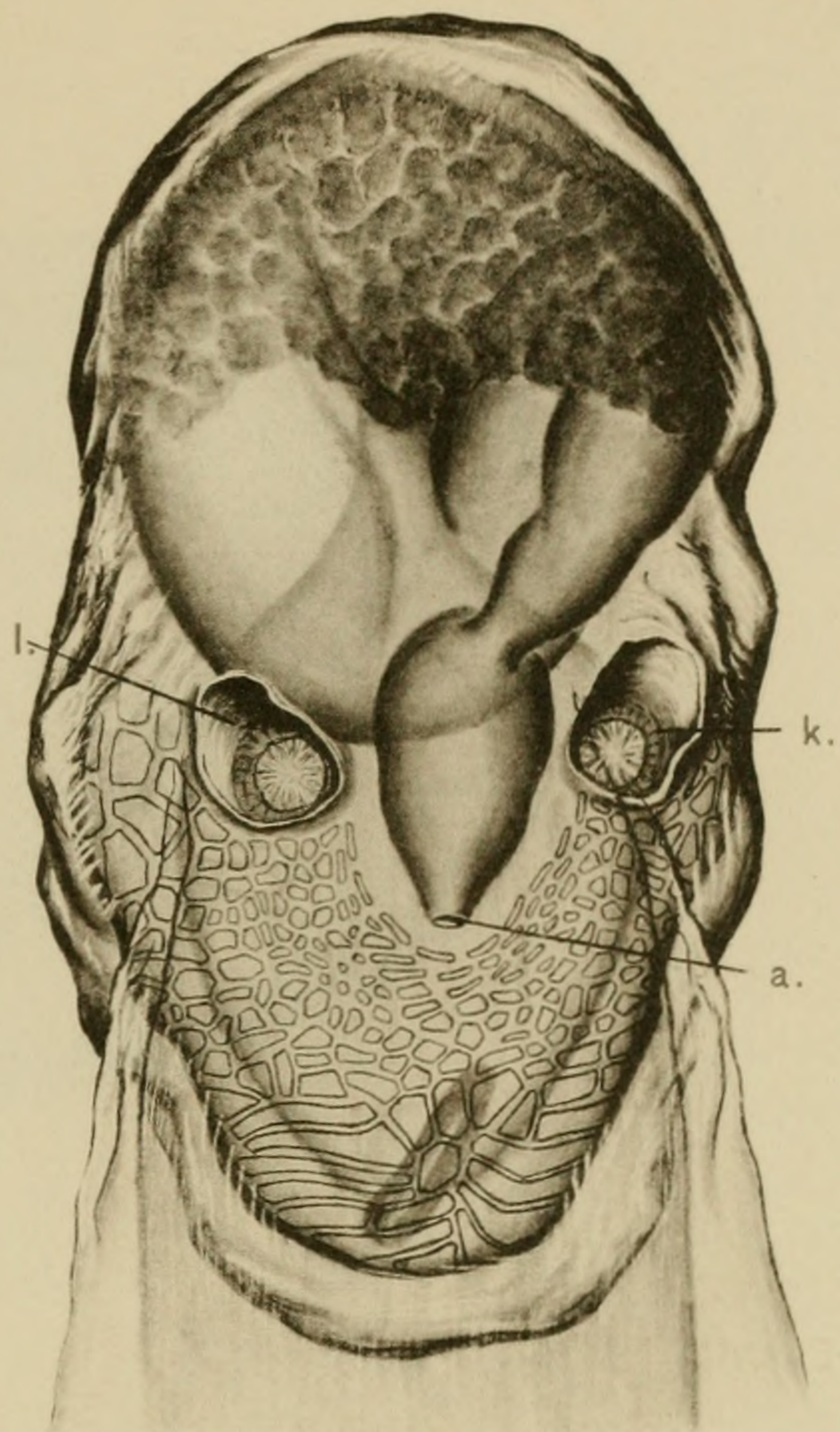
PLATE 8.

- FIGS. 17 and 18. Views of the embryo shown in figures 19 and 20, plate 7.
FIGS. 21 to 25. Sections of the embryo shown in figures 14 and 15, plate 7. Figure 23 most anterior section. Figures 24 and 25, sections of the root of attachment imbedded within the tissues of the tail of *Oikopleura tortugensis*.

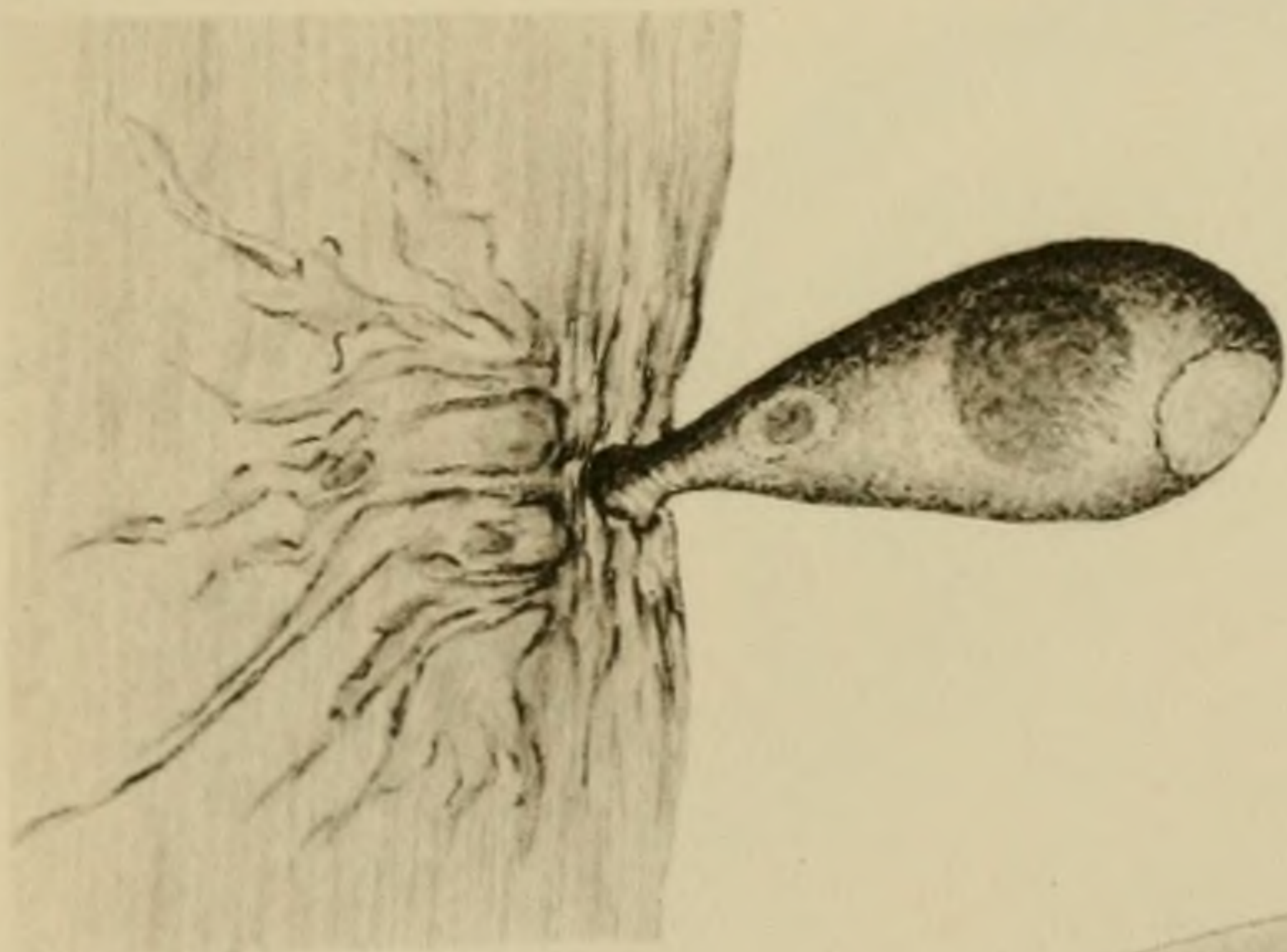




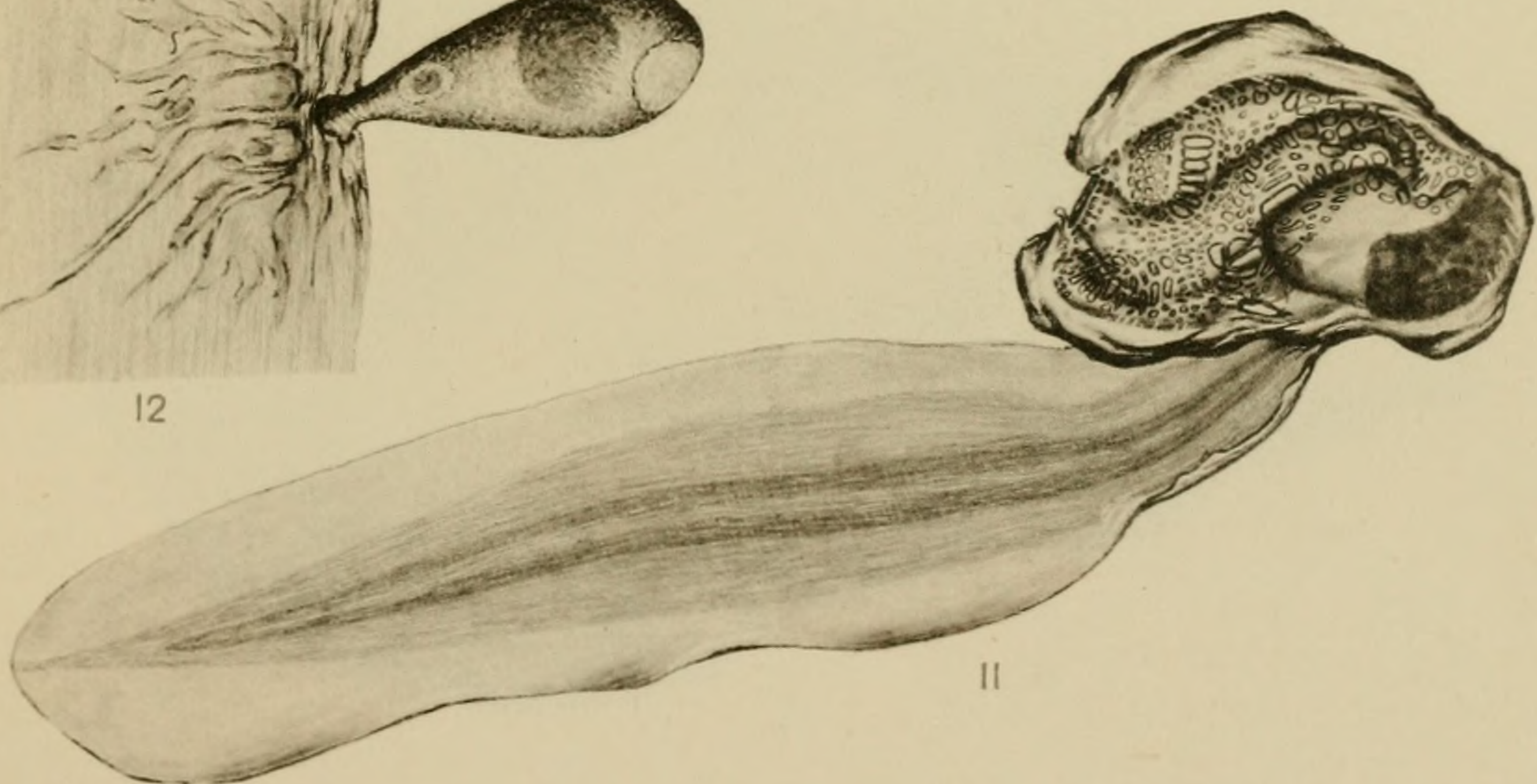
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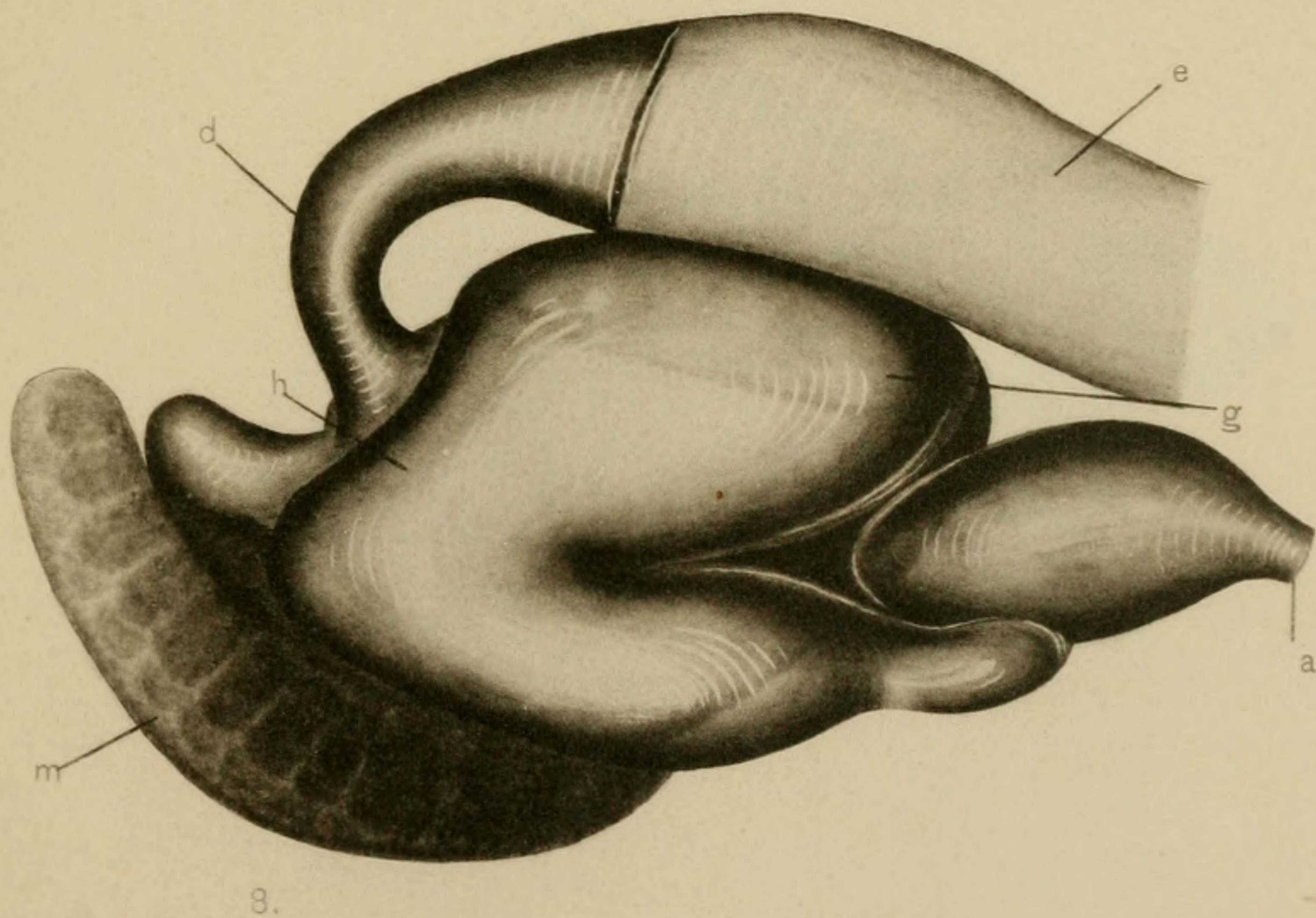
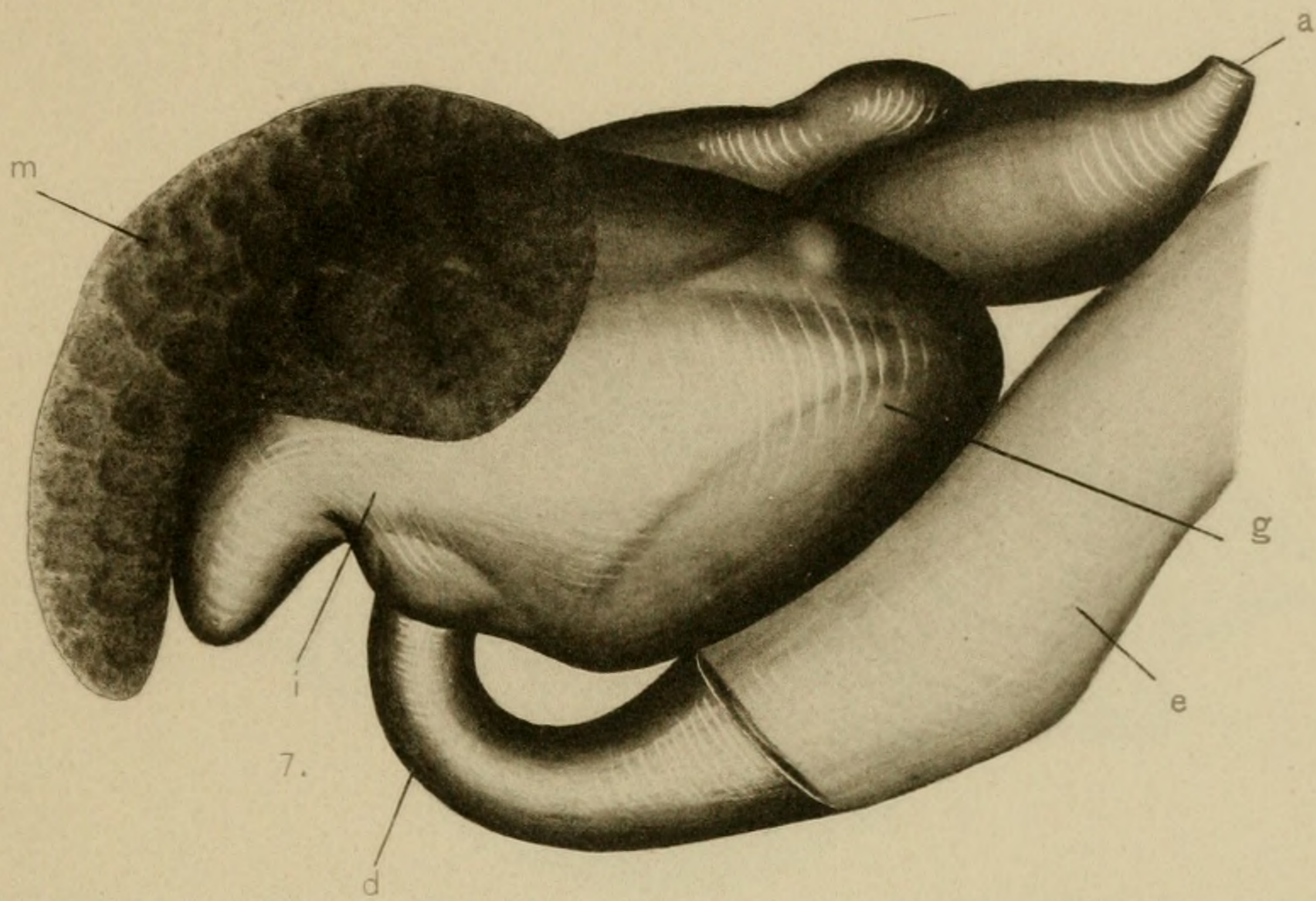
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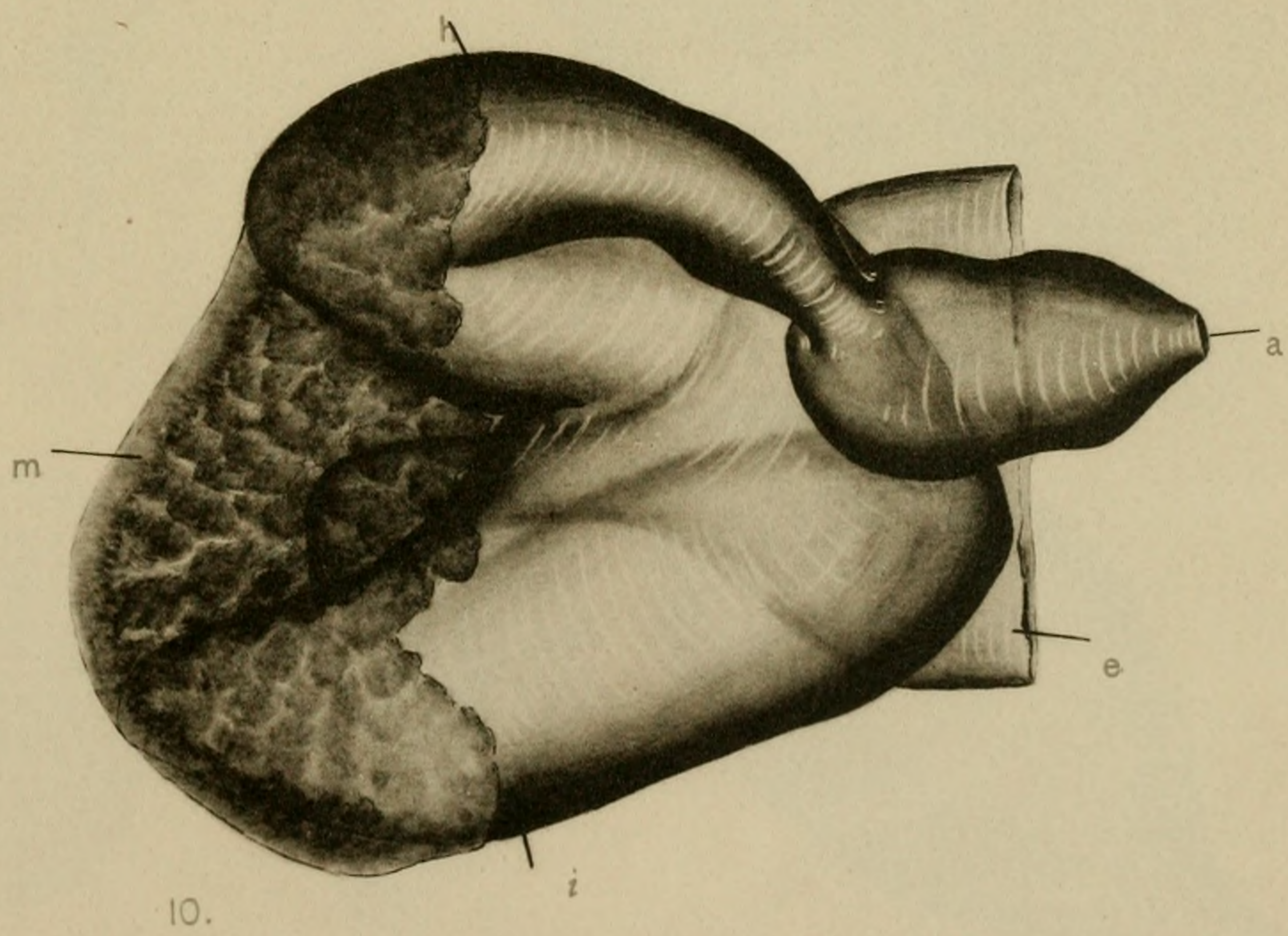
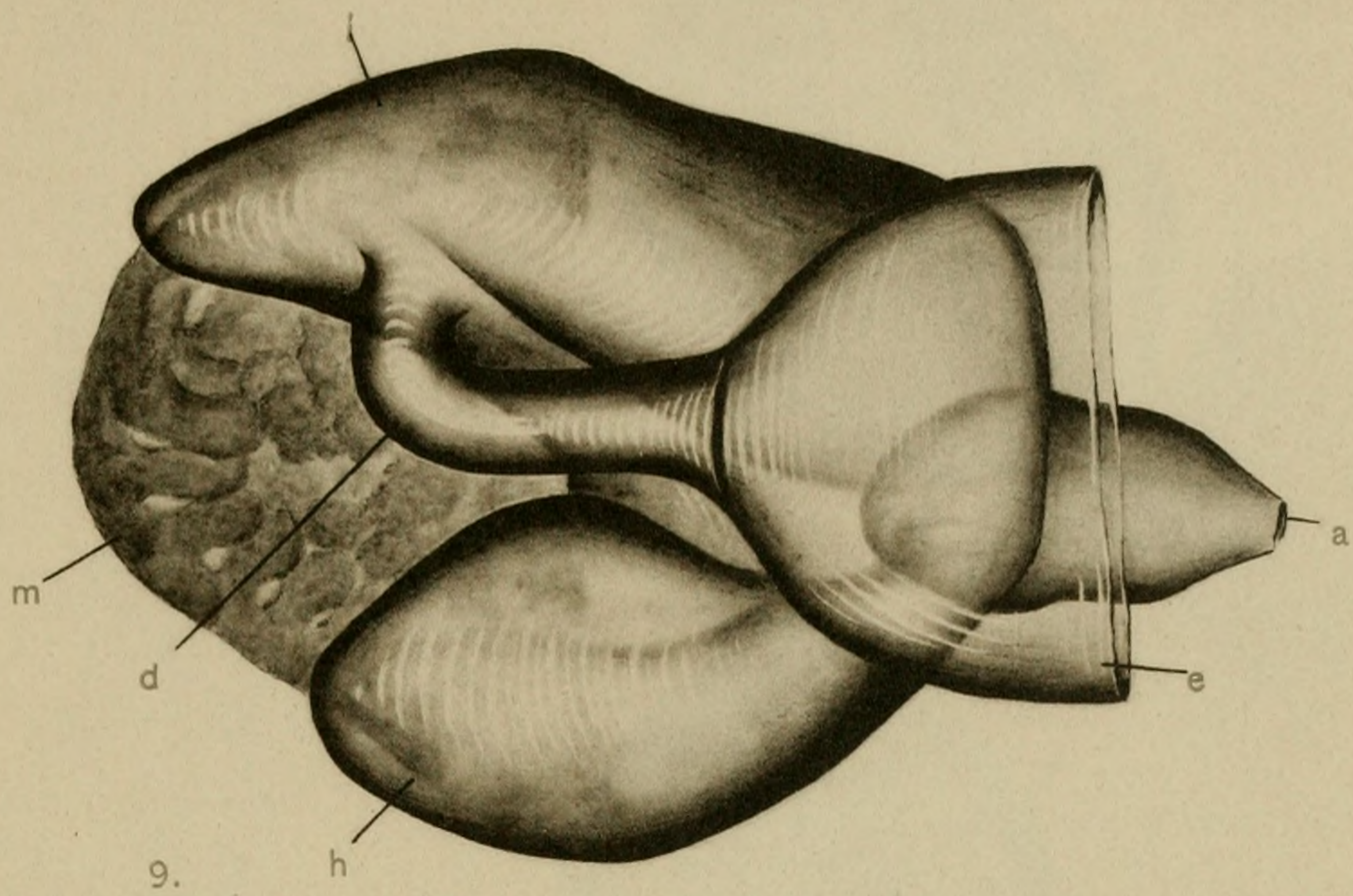


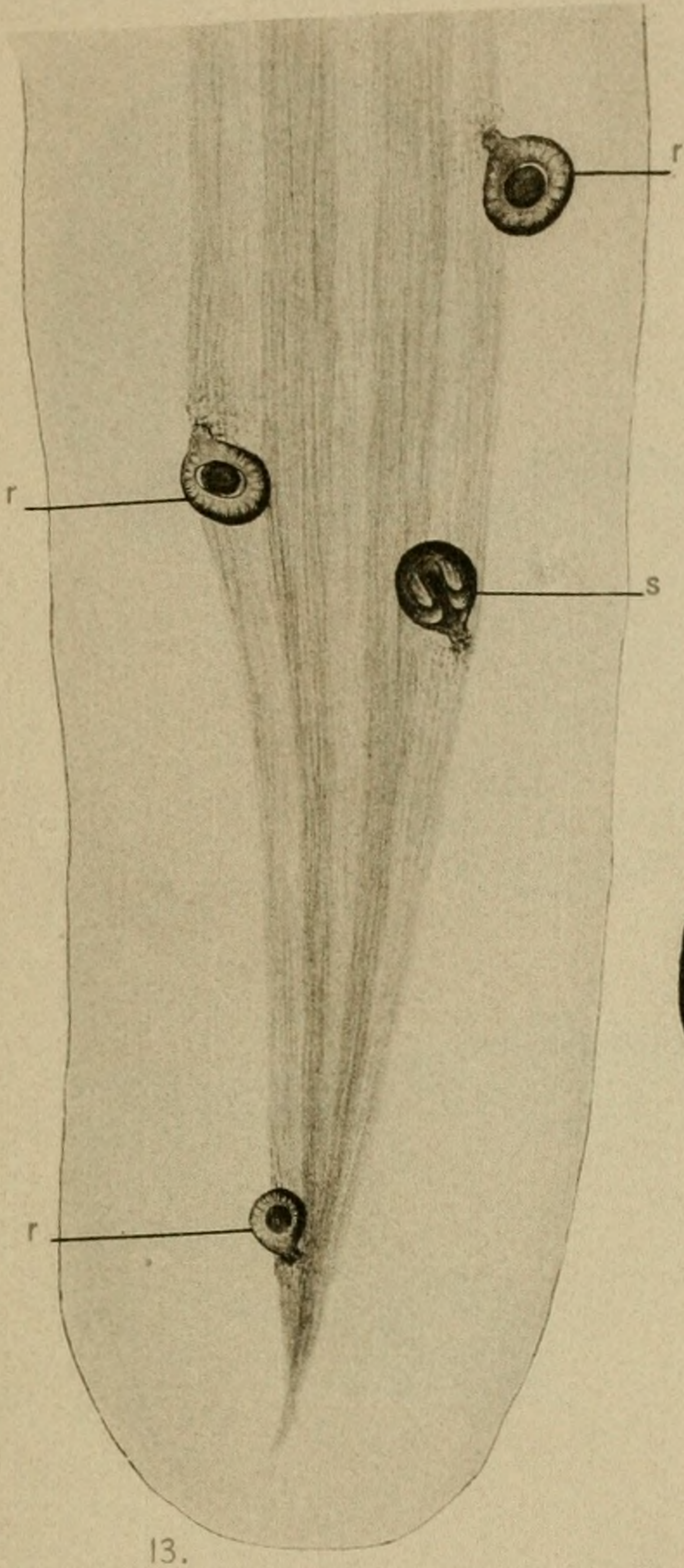
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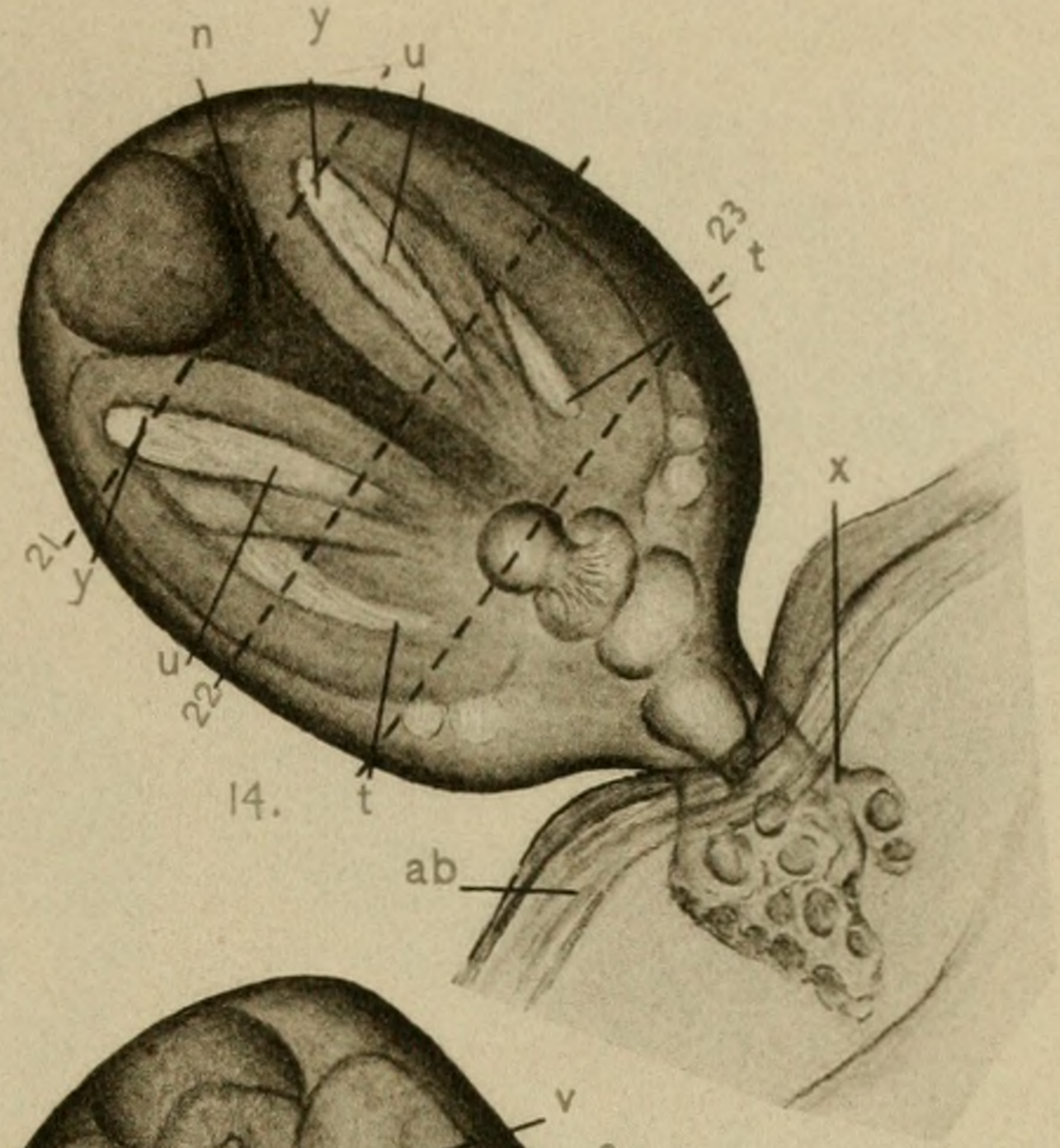
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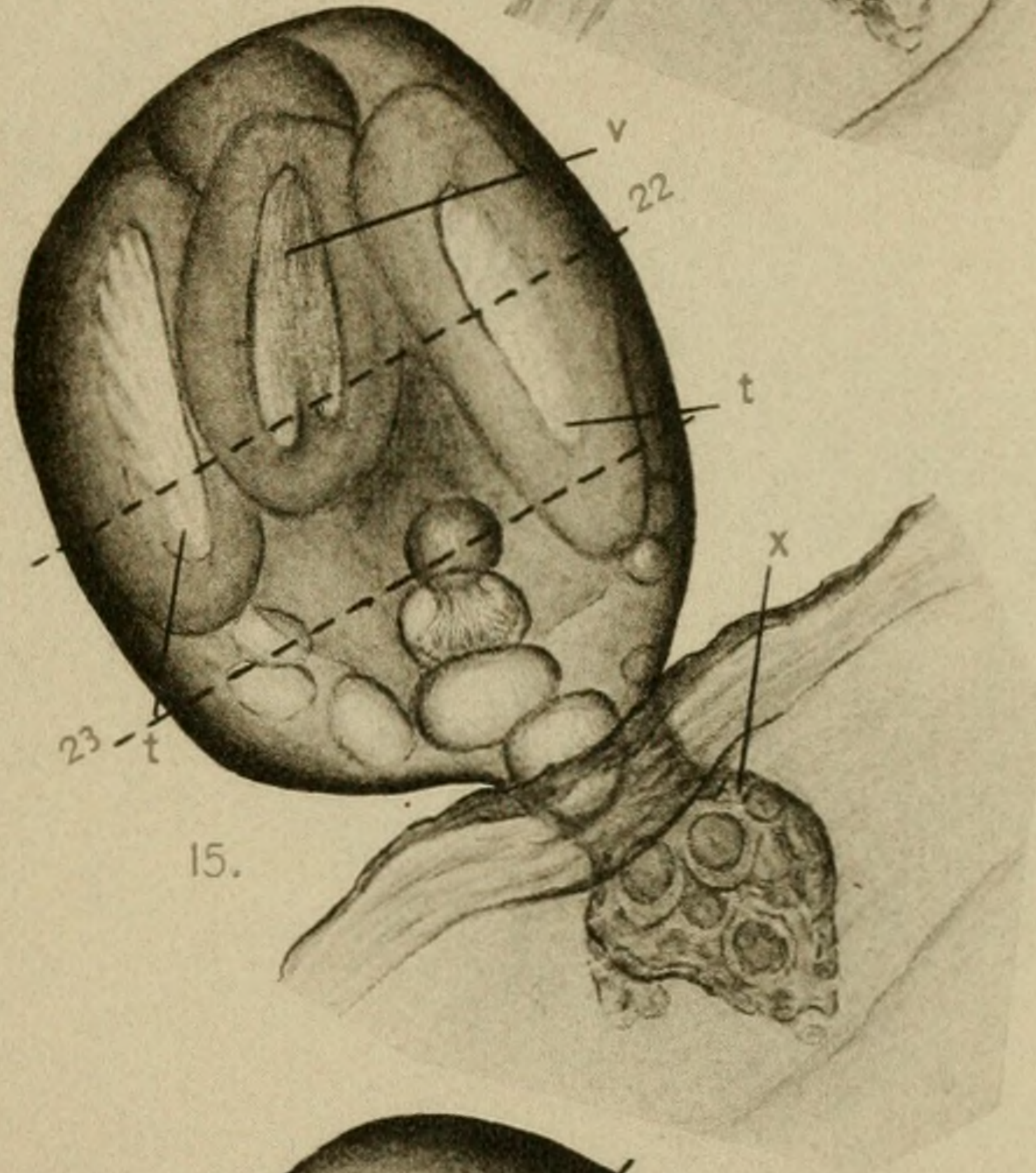




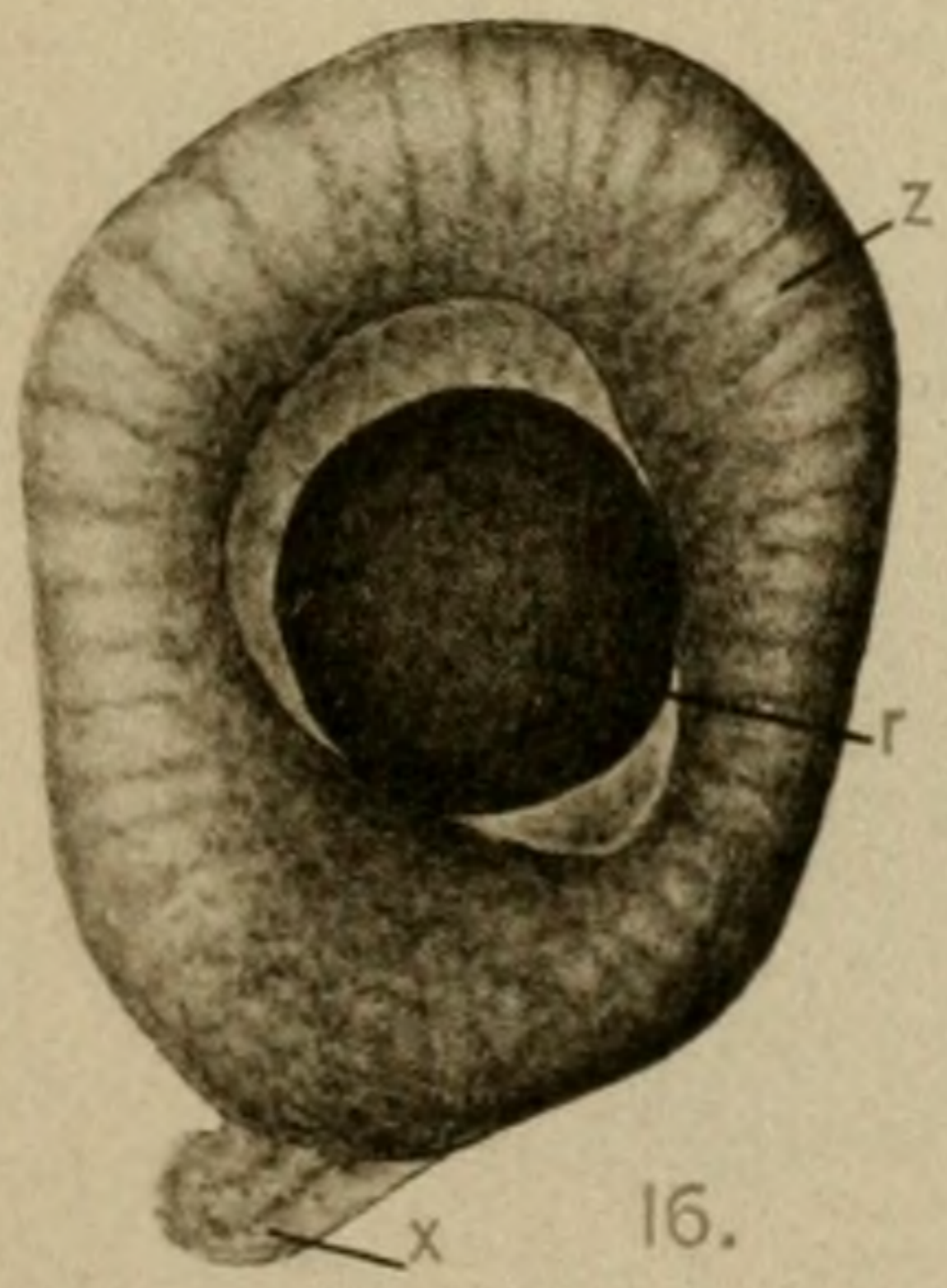
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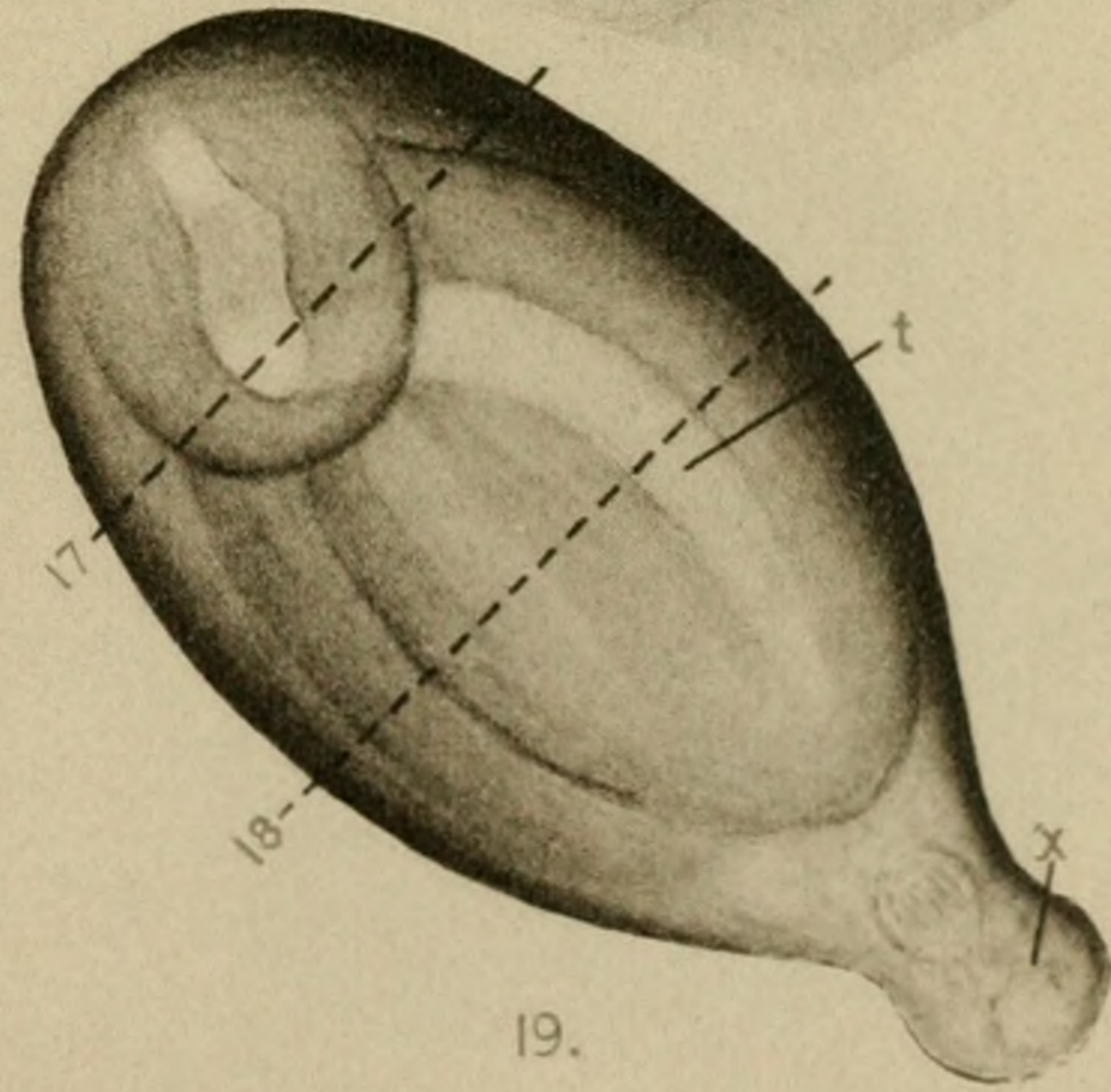
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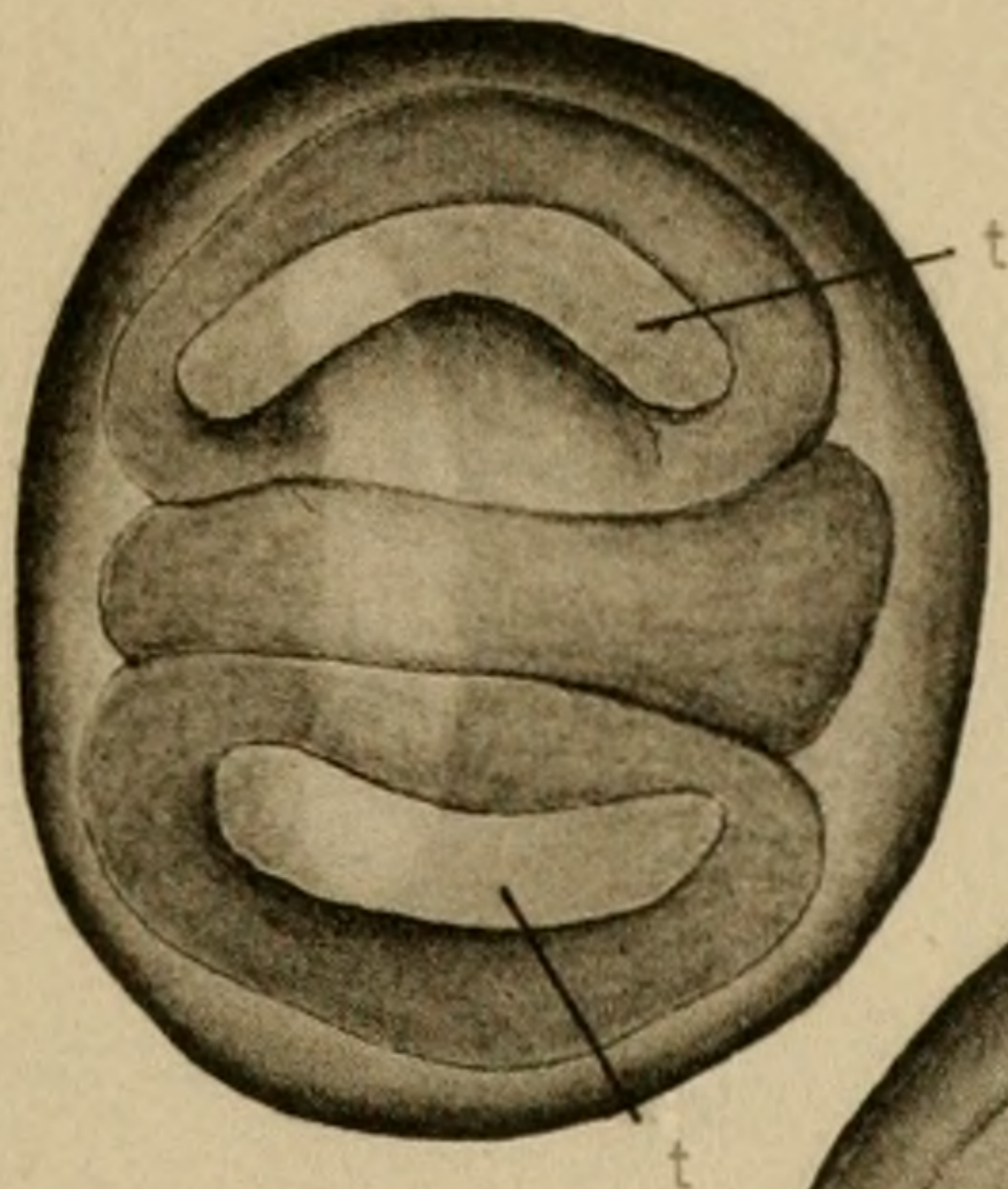
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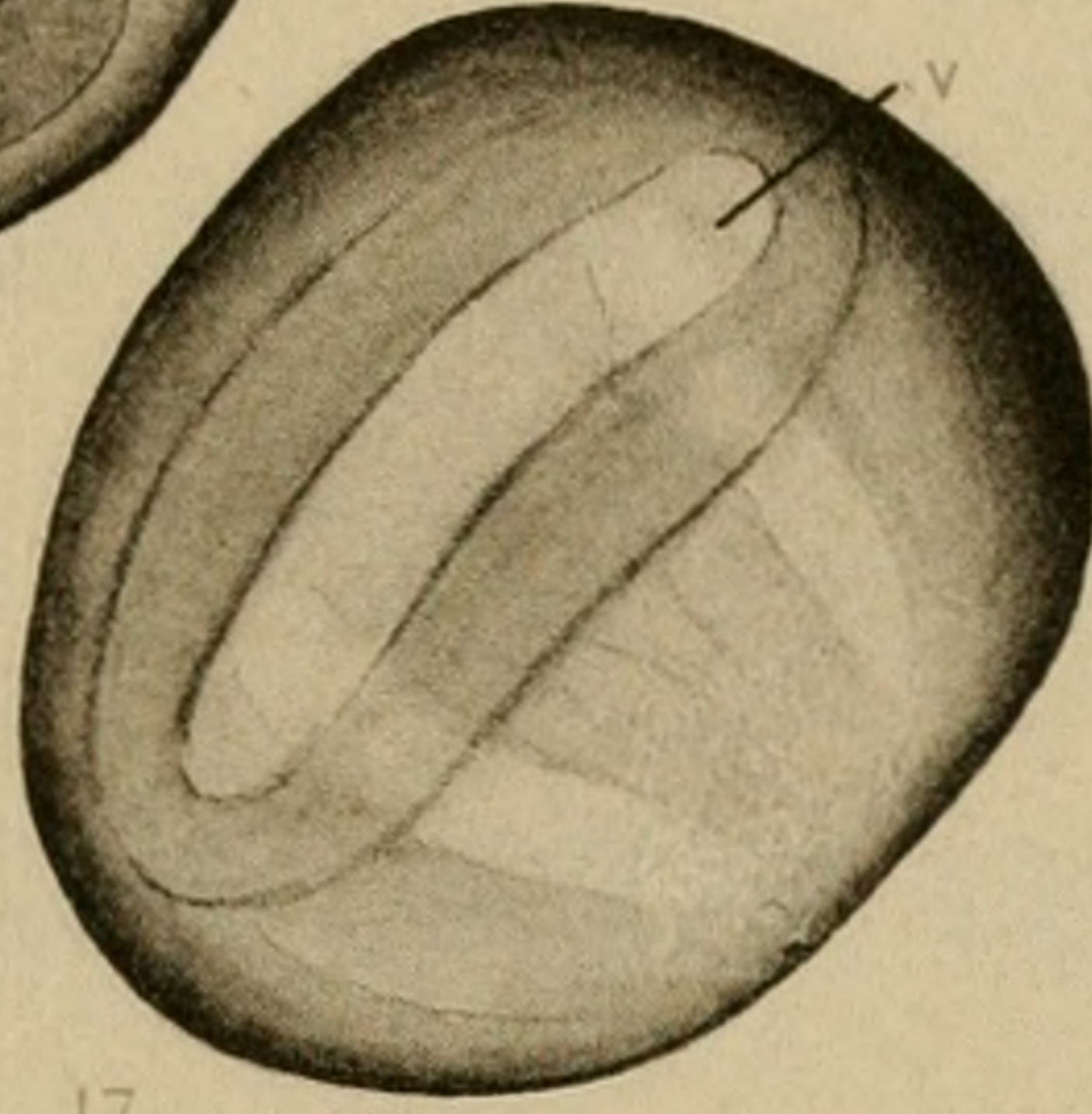
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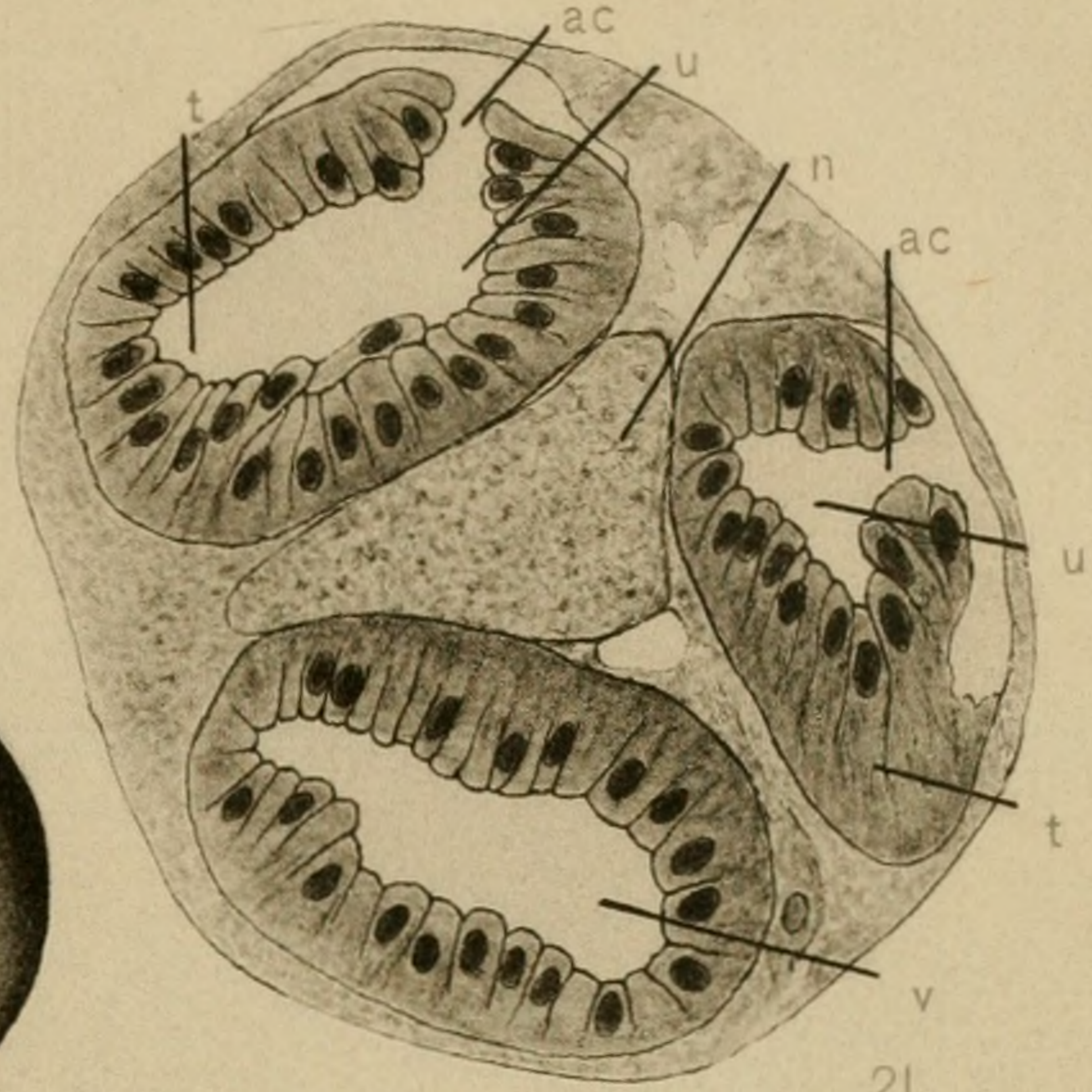
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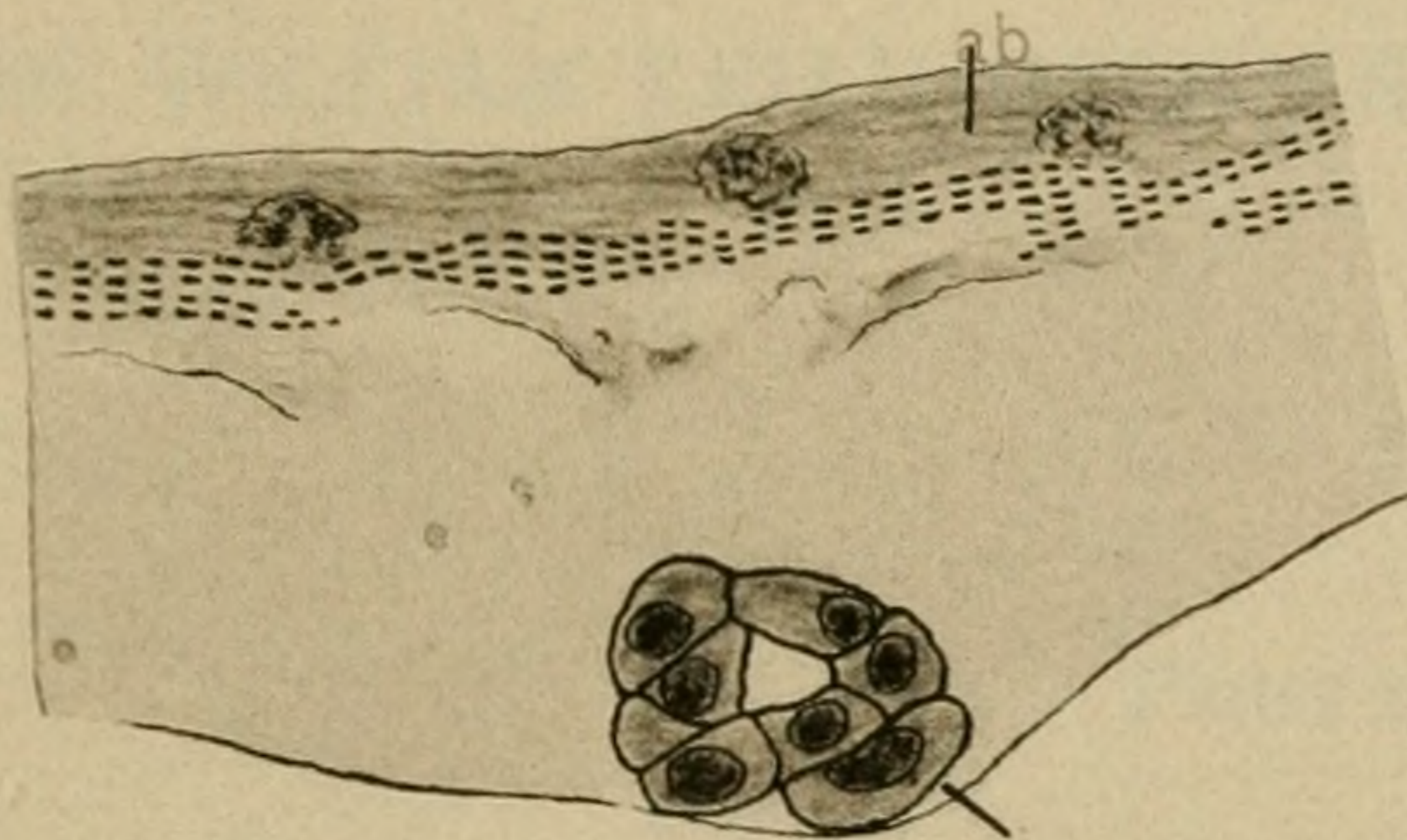
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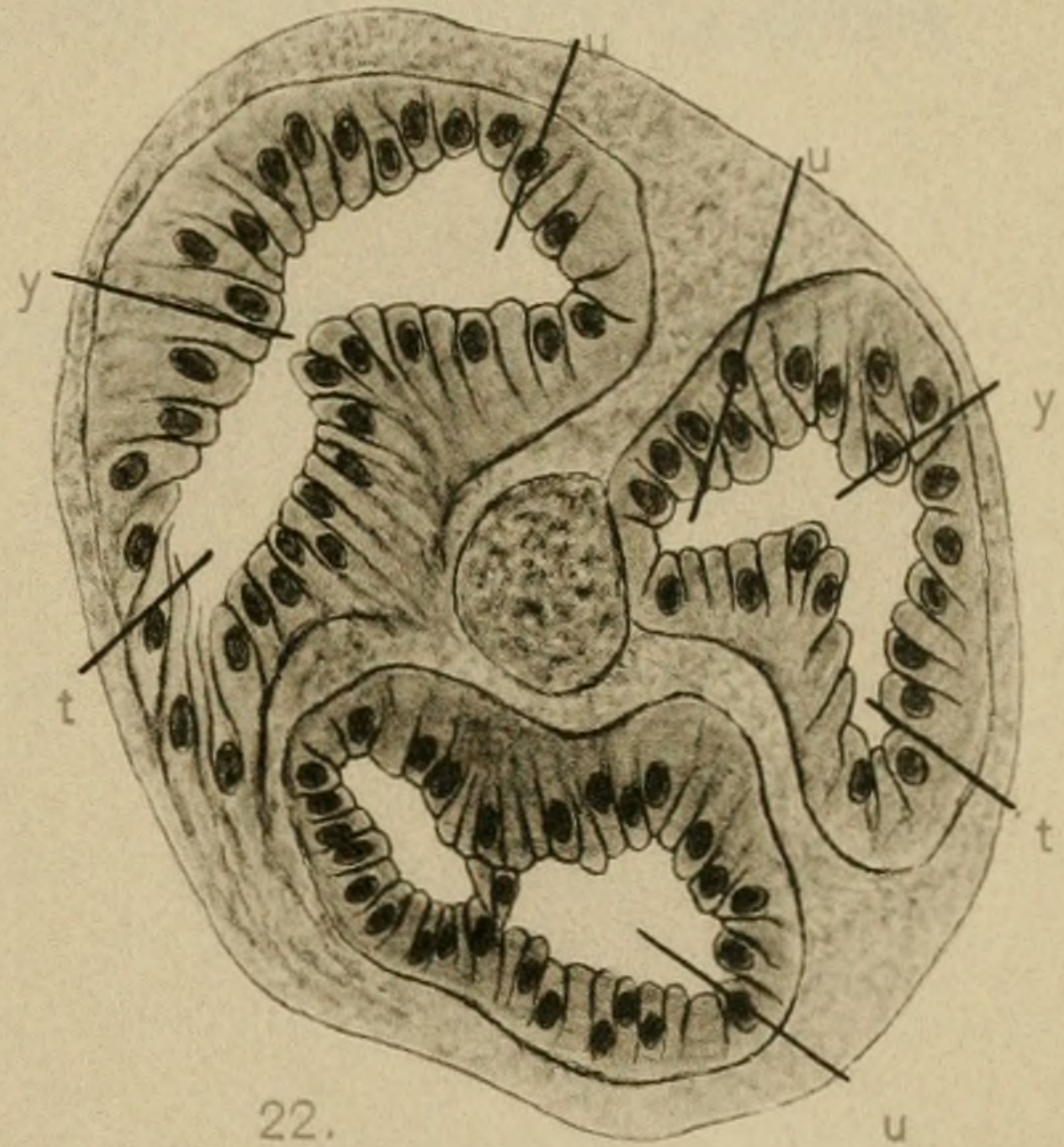
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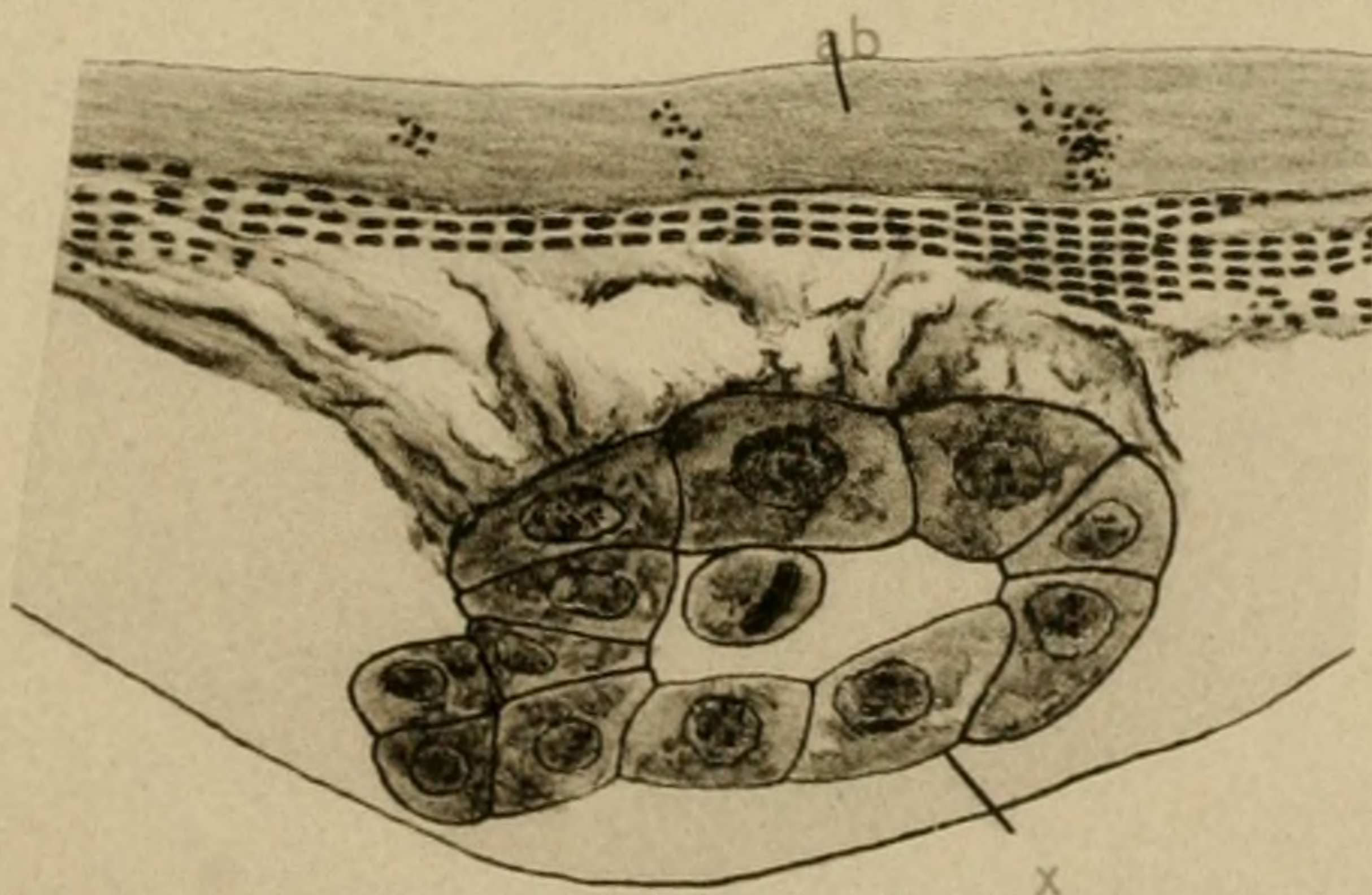
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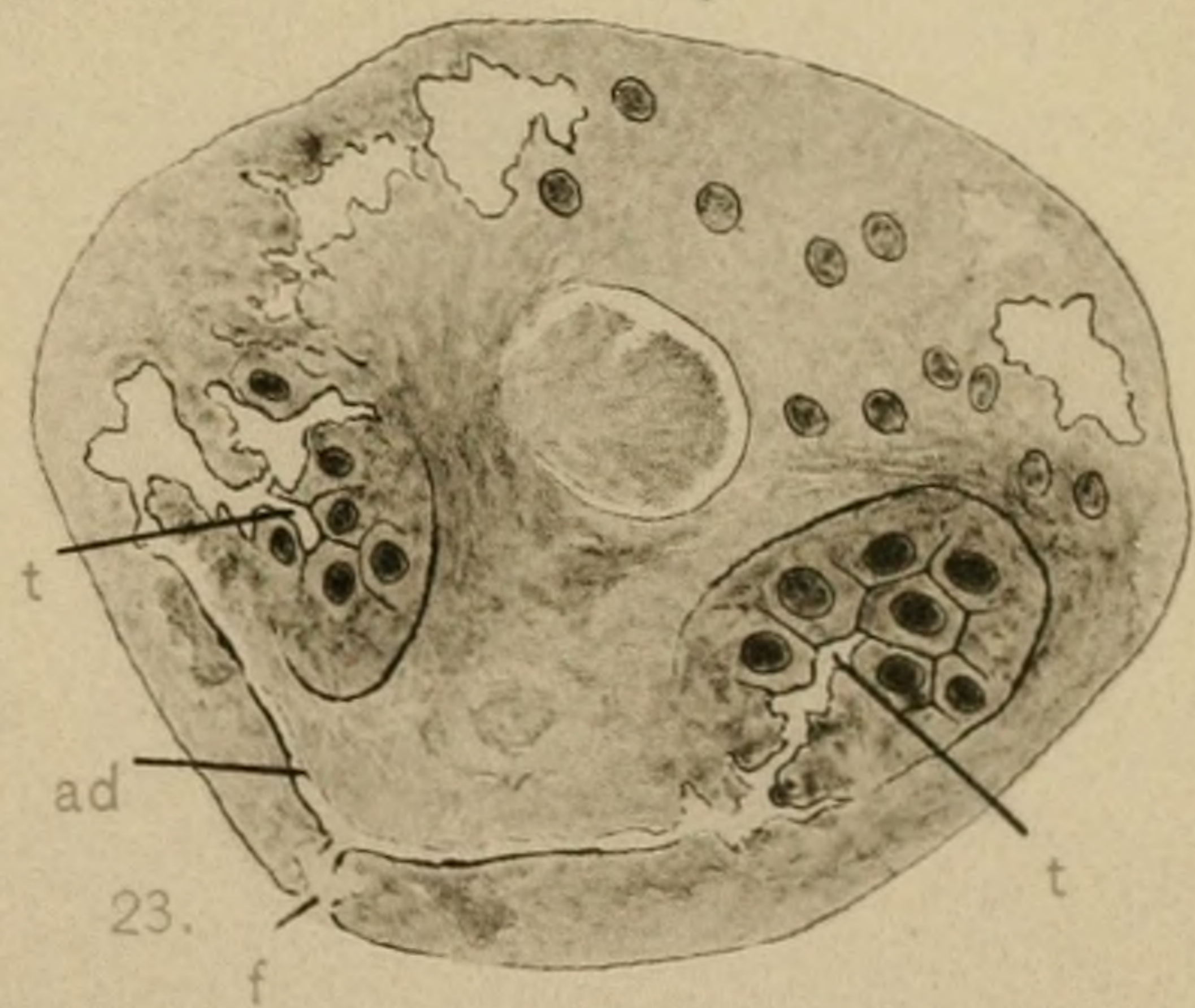
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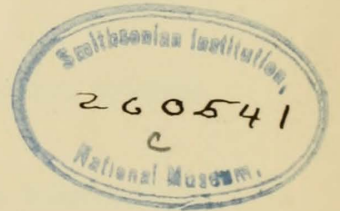
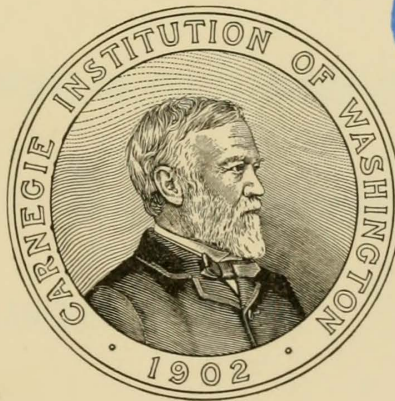
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