A New Species of New Zealand Land-Planarian, *Artioposthia civis.*

NOTES ON ANATOMY, HISTOLOGY AND PHYSIOLOGY WITH ECOLOGICAL DATA.

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Artioposthia civis n.sp. Plates 37, 38.

This species may be identified by the characteristic colouring and by the anatomy of the reproductive organs. The coloration is as follows:—

The dorsal surface has a ground colour of light grey-green with a broad median stripe of dark brown, nearly black, occupying about one-fifth of the total width. Running across the ground colour is a longitudinally stretched network of light brown lines, the most lateral ones fading into a series of dots. The ground colour itself may have irregular brown markings on it, and always shows fluorescent green flecks of microscopic size. The ventral surface is a faded brown-white, covered with brown spots, the latter forming markings similar to those found on the dorsal surface except for definite rings round the pharyngeal opening and genital pore.

Minor modifications may be found in the markings. The colour tends to become lighter with increase in size, and more intense if the animal shrinks, as with starvation. Although the colouring described above is the normal, there is every modification from a light terracotta red to grass-green. This change in coloration is not, however, accompanied by any modification of pattern or in the anatomy of the reproductive organs.

THE ECTODERM.

The ectoderm, pharynx and peripharyngeal space are covered by a thin transparent cuticle. The ectoderm of the body is unusual in that the dorsal ectoderm is composed of thicker cells than those of the ventral ectoderm, and these dorsal cells do not have cilia. They are columnar cells. The tissue also contains rhabdites and globular glands that secrete mucus. The ventral ectoderm is more typical in that it is ciliated. These cells are cubical; and certain of them, arranged in bands converging on the pharyngeal opening, bear longer cilia.

Histologically a typical ectoderm cell has a round central nucleus in which no nucleolus but several chromidia may be distinguished. The cytoplasm is generally clear around the nucleus, but elsewhere it contains small granules and fatty drops. The base of the cell is broad, and connected to it are fibrillae. The basal granules are difficult to distinguish without a special technique. All cells seem to possess considerable powers of expansion, especially laterally.

The rhabdites are short and thick when undischarged, but, when discharged, are long and slender with a rounded distal knob. At the base of each is a coiled secretion apparently of the same composition as the rhabdite itself. The rhabdite is secreted, as is usual with these animals, by a special cell deep in the mesoderm.

Stripe pigment can be seen in section as a heavy deposit of dark brown granules in groups of special parenchyma cells lying about the region of the circular muscles. The ground colour pigment is deposited in a thick band of small parenchyma cells under the storage tissue. There is some indication that the pigment deposits alter in depth in the tissues under different conditions.

The ectoderm of the pharynx is not ciliated, nor is the ectoderm lining of the peripharyngeal space, otherwise this ectoderm is quite similar to that of the ventral ectoderm.

The Endoderm.

The description given by Arnold of the endoderm of triclads can be applied, with only minor modification, to the endoderm of *A. civis*. The columnar cells are very long and much vacuolated; with secretory granules of a bright red colour instead of bright yellow as mentioned by Arnold. The nuclei are proportionately larger, but show the characteristic large nucleolus. The goblet cells open into a space between the columnar cells, and are almost completely vacuolate, the central nucleus being suspended by thin protoplasmic threads. The secretion appears liquid.

The Nervous System.

The nervous system presents a scattered network of ganglion cells all interconnected and thickest on the ventral surface. Nerve cells are aggregated into two ganglia, one at the anterior tip, the other at the base of the pharynx. The nerve net is in communication with tactile cells embedded in the ectoderm and with nervous cells near each of the endodermal diverticula. Nerve cells are quite typical.

Eyes are very similar to those found in polyclads and described by Dahlgren and Kepner. There is a pigmented cup formed of a single cell, communicating with the exterior by means of a secreted cone drawn out distally into a rod which reaches to the surface of the ectoderm. The eyes are scattered in the lateral anterior region.

The Mesoderm.

The majority of the mesoderm, excluding the muscles, consists of a highly vacuolated storage tissue, rather similar in appearance to the fatty tissue of higher animals. The cells are large and their boundaries are indistinct, but the nucleus appears to be placed at one edge. In sections these cells always appear as vacuoles. Running through them is a system of thin-walled canals, which seem to communicate with the enteron, and can be traced by the injection of the gut by a pipette. Only by these means can these canals be distinguished from storage cell vacuoles, but they are quite different in appearance from the excretory canals, which are surrounded by an epithelium of ciliated cells.

The muscles and their non-contractile terminal portions occupy a considerable portion of the space between ectoderm and endoderm. The muscle is made up of several fibres, the terminal ones being non-contractile and drawn out into long thread-like processes which mingle with others from associated muscles. The contractile portions are elongated and twisted on themselves like strands of a rope. The muscles may be classified into the following groups:—

1. *Circular,* lying just below the epidermis. These are oval in cross-section and are finer than other types. The non-contractile portions curve down and interlock with those of the next group, to lie just below the contractile portions.

2. *Longitudinal,* lying just below the circular muscles, their non-contractile portions mingling with those of the latter. There are generally four to six layers, and they are exceedingly thick on the ventral surface.

3. *Oblique* muscles form an open network through the body, running from the region of the circular muscles to that of the muscles surrounding the enteron.

4. *Enteric* group of muscles surround the diverticula of the enteron, and appear to facilitate the circulation of fluids.

These muscle groups can best be distinguished by polarised light, in which the systems show up one by one as an unstained section is examined.

REPRODUCTIVE SYSTEM.

The reproductive system is marked by the great development of the accessory glands, and by a distinction between the male and female portions of the atrium. This latter is in the shape of an H, the anterior portion being the *atrium masculinum* and the posterior the *atrium femininum.*

Seminal products are collected by four *vasa efferentia,* and are passed into the *atrium masculinum* by the median seminal duct, which may be closed by the extension of the anterior adenodactylus. At the dorsal edge of the median seminal duct opening there opens the duct of the prostate gland, which secretes bright red globules to mix with the seminal products.

The oviduct opens, in the corresponding position to the median seminal duct, into the *atrium femininum.* The sequence of events is hard to follow, but the egg and yolk products seem to pass into the dorsal portion of the *atrium femininum,* where fertilisation takes place. The shell is then secreted round the mass and the whole egg is forced out of the genital pore by the action of the muscular processes. It is certain that the male and female gonads are functional at the same time, and self-fertilisation must take place in a percentage of the cases. However, copulation takes place, the head of one worm being applied to the tail of another, so that there can be mutual interchange.

There are three adenodactyli, one between the prostate gland and the *ductus seminalis,* a large median one separating the *atrium masculinum* and the *atrium femininum,* the third above the opening of the oviduct.

The testes are minute and bulb-like, running back from about halfway between the anterior tip and the pharynx to the level of the base of the pharynx. The ovaries lie on each side of the pharynx, and run back to the level of the genital opening. The vitelline glands are ventro-lateral in position and all posterior to the *atrium femininum.*

Degeneration of the reproductive system takes place in the summer and winter, so that the animal seems to lay spring and autumn eggs, as is the case with certain freshwater planaria. No reproductive system is found in the smaller specimens nor in animals that have been starved for upwards of a month. With de-differentiation the system is invaded by phagocytes and long strings of cells grow into it. Finally a loose vacuolated tissue is formed. At the end of winter the only sign of the system is a small mass of this tissue above the genital pore.

Excretion.

This takes place through a series of fine canals, which open into two lateral main canals, which in turn open to the exterior by four pores on each side of the latero-posterior end of the body.

Ecological Notes on *Artioposthia civis.*

Some forty specimens of this form were collected in a fairly restricted area in Kelburn, Wellington. The following is a list of the habitats:—

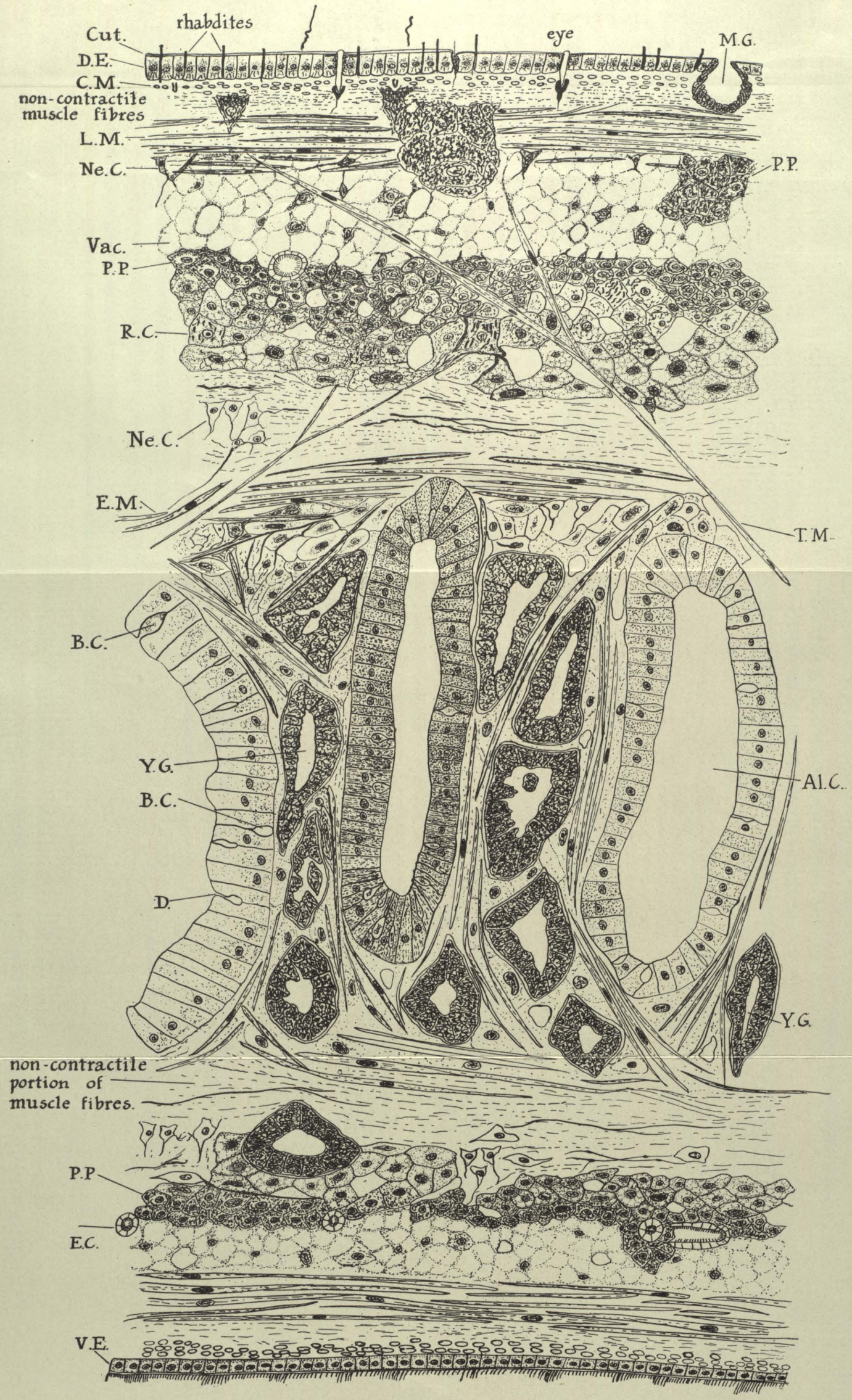
Under bark and logs, damp surroundings, summer	13
Under bark in dry surroundings, summer	7
Under small stones, damp earth, summer	7
Under stones in dry conditions, summer	5
In dry earth, about two inches deep, winter	8

Animals found in the same habitats included spring-tails, centipedes, caterpillars, and spiders. None of these were seen attacking any of the planaria, but the latter were collected while eating earthworms.

The planaria are easily killed by strong sunlight and by a prolonged drought. When found they are generally extended, flattened, and in close contact with the supporting surface. The body is capable of much extension when in motion, which can be extremely rapid over a short distance. Generally the dorsal surface is convex and the ventral slightly concave. The pharyngeal opening is about halfway along the body on the ventral surface, and the genital pore about halfway between this and the posterior end.

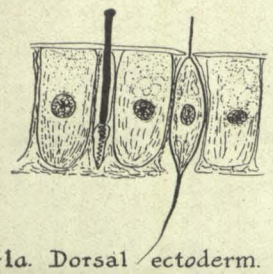
Note on Technique.

The following method of fixing is recommended. A mixture is made up of the following:—20% formalin, 1 part; sat. arsenious acid, 1 part; 96% ethanol, 1 part. Treat for 12 hours. Acid fuchsin stain was always used, followed by either a counter stain of Mallory's "triple stain" or ·5% methylene blue in an aqueous solution of 5% NaCl.

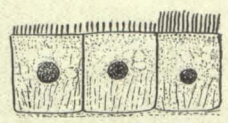


INDEX TO LETTERING OF PLATES.

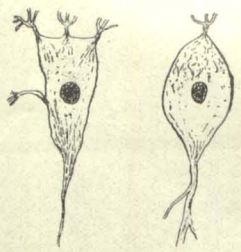
Aden.: Adenodactylus. Al.C.: Alimentary canal. Atr.F.: Atrium femininum. Atr.M.: Atrium masculinum. Cut.: Cuticle. C.M.: Circular muscles. D.E.: Dorsal ectoderm. D.: Duct. E.C.: Excretory canal. E.M.: Enteric muscles. G.B.C.: Goblet cell. L.M.: Longitudinal muscles. M.G.: Mucus gland. M.Pr.: Muscular processes. Ne.C.: Nerve cell. O.D.: Oviduct. P.P.: Pigmented parenchyma. R.C.: Rhabdite secreting cell. R.Ag.: Reservoir of adenodactylus gland. S.G.: Shell gland. T.M.: Tangential (or Oblique) Muscles. Vac.: Vacuolar space. V.D.: Vas defferens. V.E.: Ventral ectoderm. Y.G.: Yolk gland.



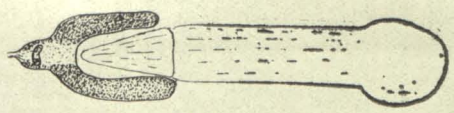
1a. Dorsal ectoderm.



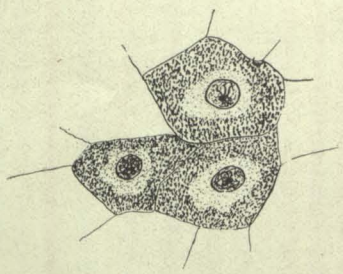
1b. Ventral ectoderm.



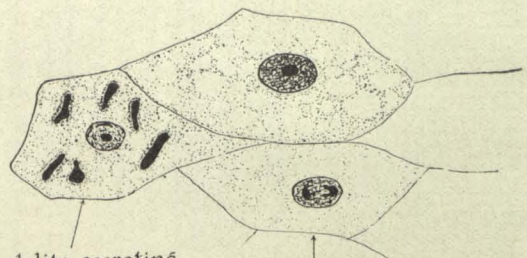
2. Neurons.

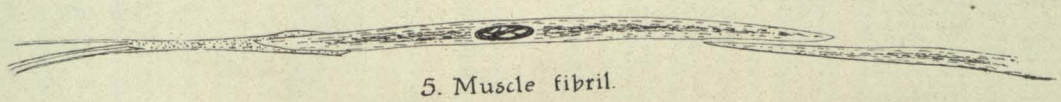


3. Eye



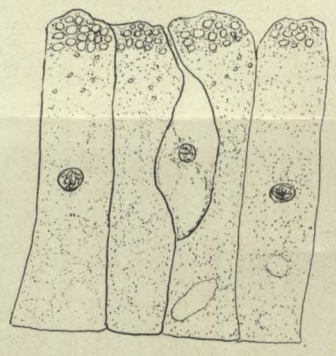
4a. Pigmented parenchyma.





5. Muscle fibril.

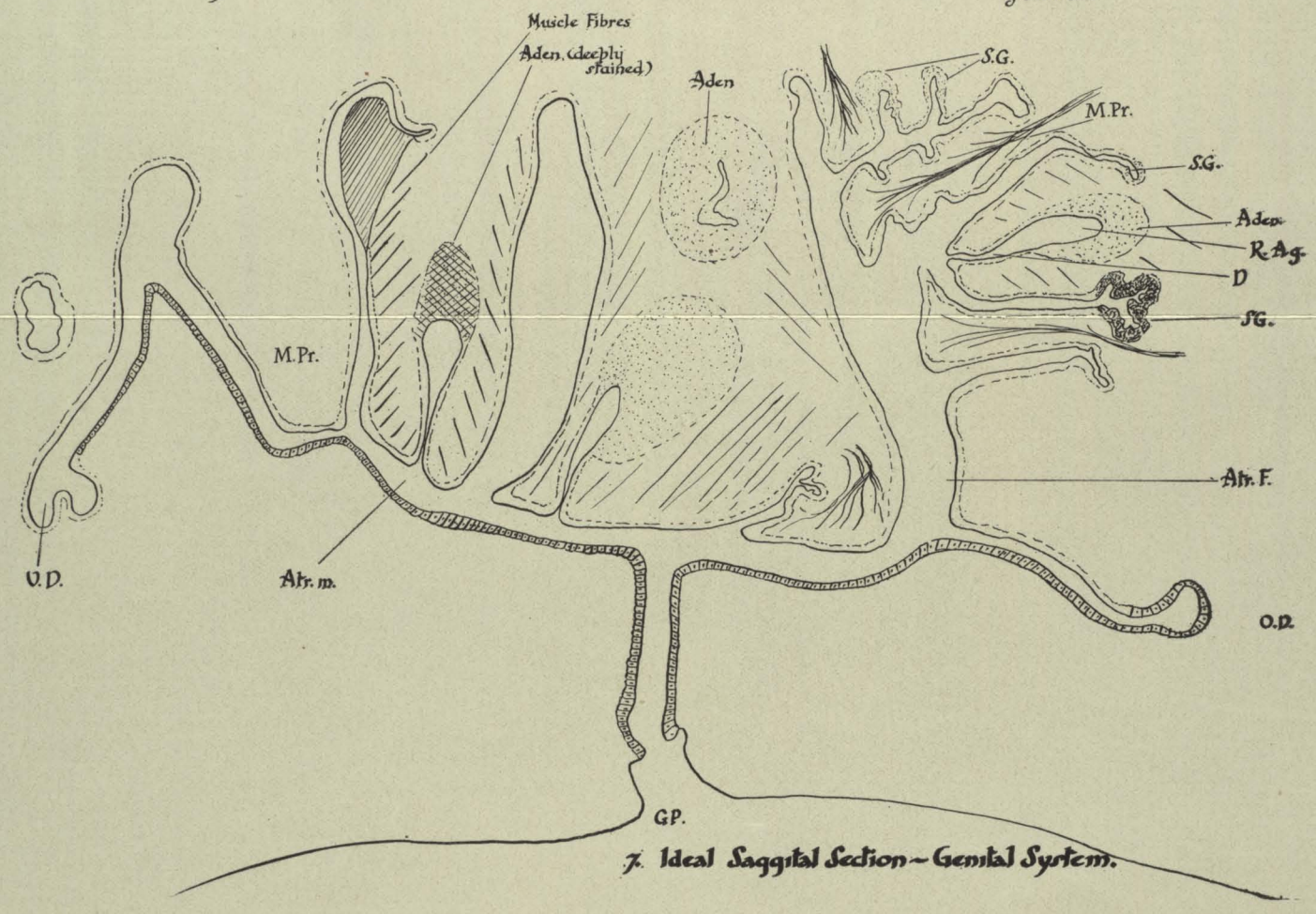
8. Pharynx.



6a. Endoderm tissue.

6b. Goblet cell.

6c. Endoderm cell with secretory grainules.



7. Ideal Saggital Section – Genital System.

PHYSIOLOGY.

The animal is strongly negatively heliotropic. Sudden light and sudden heat causes a quick cessation of movement, which is followed by motion away from the stimulus. Experiments seem to suggest that there is no perception of red, green or blue light, and that the eyes are infra-red sensitive. Strong sunlight is rapidly fatal.

The optimum temperature for movement is about 37°, the most favourable temperature being 18° to 25° according to conditions, such as humidity. At this range of temperature the animal is most active. Temperatures above 45° and below 0° are rapidly fatal. At a temperature of below 11° the animals can be induced to move only with strong stimulation, and then with difficulty. Hibernation takes place by the worm burrowing into the earth when the temperature falls below 15°, and will follow severe cold, even in summer.

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