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THE ANATOMY OF FUHRMANNIA VIRGINIA
(A New Species)

CLARENCE RHODES BENNETT

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A Thesis Presented to the Academic Faculty of the
University of Virginia in Candidacy for the
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by
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(A New Species)

This rhabdocoele was found in a small pond in the vicinity of the University Of Virginia,November 19,1923, and in all liklihood has not here-to-fore been observed. These animals occurred on plants or other submerged objects such as leaves,and especially along near the edge of the pond among the grass growing in the water. They are creatures of the crawling habit and never seem to leave the surface of some object. They are unable to swim and in the laboratory crawl along the bottom or sides of the aquarium, or some submerged surface,and do not leave this unless forced to do so by some mechanical means. In the aquaria they are easily recognizable from the other types of small rhabdocoeles by their characteristic attitude,e.g. that of resting in close spirals. (Fig.No.1) Even when the animal is jarred loose from the sides of the aquarium it retains this spiral shape,slowly sinks to the bottom without making any effort to remain afloat,and can not be made to uncoil by any mechanical stimulus. When resting on the bottom in these close spirals it can very easily raise the anterior half of the body to a vertical position.

The Genus Fuhrmannia,in which genus this new species has been placed,was first discovered in 1902 by von Dr. Otto Zacharais and was classified by him at that time as Stenostoma Lemnae. (Zool. Anzeiger 1903). In 1907 Hallstrom and Luthur reported the same wormlet and called it Lophorhyncus,but in a second article in the same volume

they call it Clyphorhyncus. (Zool. Anzeiger 1903). In 1908 L. von Graff gave the species a new generic name, that of Fuhrmannia, and the only existing species of the genus at that time the name of Fuhrmannia Turgidum. von Graff says in his description of the Genus, that it is easily distinguished by the fact that the sex organs, the ovary, lies under the pharynx. (Die Susswasserfauna Deutschlands). But in his article "Genus Fuhrmannia" in Das Tierreich of 1913, he says that the sex organs are unknown, and that the kidneys and non-sexual propagation have not been observed. From these two articles we find his description of Fuhrmannia turgida to be: Catenulidae, with an indefinite number of protuberances ciliated like the remainder of the body. Length 0.5 mm. colorless, without statocysts, ciliated groves, and eyes. Mouth ventrally situated and triangually tipped. With ciliated oesophagus and an indistinct offsetting intestine that forms the body cavity and appears to be full of great endodermal cells. On the ventral surface of the lobes of the head, directly before the oral opening is located a semi-circular cushiony thickening, that is sectioned by a number of lenghtwise groves. On this cushion is located a mane of fairly long cilia which closely approach the mouth. In the skin abundant rhabdites appear. They are singly distributed and are especially numerous in the last third of the body.

The above is the description that von Graff gives to the Species turgida of the Genus Fuhrmannia. The new type rhabdocoele found here at the University is closely related to Fuhrmannia turgida and has been placed in the Genus

Fuhrmannia as a new species with the name Fuhrmannia Virginia. Its systematic position is given below:

Class---Turbellaria.
Order---Rhabdocoela.
Family---Catenulidae.
Genus---Fuhrmannia.
Species---Fuhrmannia Virginia.

The length of this little flatworm which by refracted light appears greenish-white through-out the posterior part of the body, and gray through-out the anterior part beyond the pharynx, is from 2 to 3 mm, and is usually about 80 microns wide. The body retains the same shape through-out except in the anterior one-twelfth, which is slightly narrower. From a dorsal view this anterior part of the body is seen to be filled with large mesodermal units, which are so arranged as to give a segmented appearance. (Fig. No.4). About one-tenth the length of the animal from the anterior end the mouth opens into the ventral side. Leading back from the mouth is a ciliated pharynx which passes into a long enteron. The portion of the pharynx which leads into the enteron is enlarged, having a large flask-like shape. The enteron fills the entire posterior part of the animal. Perhaps the most striking feature of this species is the peristalic movement which takes place through-out the long enteron. These constrictions can begin at either the anterior or posterior ends and travel toward the middle, or else begin at any part of the enteron and travel towards the ends in very short and rapid intervals, thus showing a beautiful example of peristalsis. The ectoderm in profile, is approximately 6 microns in thickness. Lying dorsal to the pharynx chamber and extending from the anterior end of the enteron to the

Pachomatia as a new species with the name Pachomatia Virginia. Its systematic position is given below:

Class---[illegible].
Order---[illegible].
Family---[illegible].
Genus---[illegible].
Species---[illegible], Virginia.

The length of this little [illegible] found by reflected light appears greenish-white throughout the posterior part of the body, and [illegible] throughout the anterior part beyond the pharynx, is from 2 to 3 mm. and is usually about 10 times its width. The body [illegible] the [illegible] [illegible] [illegible] in the anterior one-half, which is [illegible]. From a dorsal view this anterior part of the body is seen to be filled with large masses which, which are so arranged as to give a segmented appearance. (Pl. V, 1). About one-tenth the length of the animal from the anterior end the mouth opens into the [illegible]. Leading back from the mouth is a ciliated [illegible] which passes into a long enteron. The portion of the pharynx which leads into the enteron is enlarged, having a large flask-like shape. The enteron fills the entire posterior part of the animal. Perhaps the most striking feature of this species is the constrictions which take place throughout the long enteron. These constrictions can begin at either the anterior or posterior ends and travel toward the middle, or else begin at any part of the enteron and travel through the entire length at [illegible] and equal intervals, thus showing a beautiful example of peristalsis. The enteron is [illegible], in [illegible] a [illegible] pigment is [illegible]. [illegible] served to the pharynx [illegible] and extending into the posterior end of the enteron to the middle of the pharynx is a long pear shaped pharyngeal gland. (Fig. 1, F.) The brain can be seen from both the dorsal and lateral sides, but can be more plainly seen from the latter. From a lateral view the brain can be seen lying slightly anterior to, and somewhat above the oral opening or mouth. It appears as a small whitish lobe, somewhat oval in shape but slightly larger on the anterior side.

The animal is ciliated, the cilia near the mouth being much longer than those on any other part of the body. When the animal moves the cilia all over the body stir harmonously. The skin in this type, as in the type described by von Graff, contains rhabdites, which are distributed singly through-out the animal as relatively short spikelets, but which appear more numerous in the posterior part of the body. The long enteron appears to be full of large pear-shaped endodermal cells, which form, for the most part, the walls of the enteron. After macerating the animal and studying these cells they were found to be large pear-shaped endodermal cells, many of which were ciliated. Although these large ciliated cells could be seen in the macerated specimen, the cilia on them could not be seen in the histological study of the fixed specimen.

Specimens used for histological study have been fixed in chrom-aceto-formolin mixture and aceto-sublimate, at various temperatures. For this species I find that hot aceto-sublimate is the best fixative used, because by using a hot fixing fluid many of the specimens can be caught uncurled from their usual spiral attitude, and can be fixed when relatively straight, whereas by using a cold fixing fluid the specimen always has time to resume its closed spiral contour. It was also observed

that in using any fixing fluid at a cold temperature the animal would disintegrate, or at least portions of the ectoderm would slough away. Hot aceto-sublimate prevents this and by its use specimens could be fixed without disintegration. Specimens were fixed in this hot aceto-sublimate from one to three minutes, washed in several changes of tap water, and then carried through to paraffin. I find that it is always best to handle the specimens separately and not to work on several at the same time, because when working with more than one they are easily broken, or more easily lost in transferring from one container to another. Sections 7 microns thick, were stained in iron haemotoxylin with Bordeau red as a counter stain.

Fuhrmannia Virginia is a triploblastic animal possessing the three germ layers ectoderm, mesoderm and endoderm, from which several systems of organs have been derived. There are well developed muscular, digestive and nervous systems. An excretory canal consisting of nephridia, or tubules lying in the mesoderm has been observed in the living specimenffrom a dorsal view, but so far no details as to its extent or termination has been worked out. No reproductive system has been observed.

The power of changing the shape of the body which may be observed when the animal moves from place to place, lies in two sets of muscles made of mesodermal tissue; a longitudinal layer just beneath the ectoderm, and a circular layer of muscle fibers lying at the base of the endodermal cells. The ectoderm is composed of a single layer of columnar cells with relatively large nucleui. This specimen possesses a

well developed nervous system consisting of a bilobed mass of tissue, the brain, just anterior to the pharynx. There are no nerve cords present, but from the brain nerves pass to various parts of the anterior end of the body. So far no sense organs have been observed. The animal is without eyes, and no ciliated pits have been observed, although it is highly probable that ciliated pits constitute the organs of special sense of this species. The digestive system consists of a mouth, a pharynx and a long enteron which fills the posterior two-thirds of the body. In this specimen, as in some of the other lower forms of animals such as Hydra, no anus is present, the faeces being ejected through the mouth.

Transverse sections through the enteron just posterior to the pharynx show endodermal cells of type "A" in (Fig.3), narrow cells, very elongated and containing only a few chyle droplets. Transverse sections somewhat further back toward the posterior part of the enteron show cells of type "B" in (Fig.3), cells shorter and wider than type "A" and largely filled with chyle droplets. It was thought at first histological study of these two cells that they were different type cells; type "A" probably being a secretive cell located just posterior to the pharynx and type "B" a digestive cell, but from a more detailed study the conclusion has been reached that they are the same type digestive cells, their difference in shape and appearance being due to their relative position in the enteron, the type "A" cell being more elongate and narrow because it has digested less food and therefore contains fewer chyle droplets than type "B" cell which lies in the central portion of the enteron. The type nucleus found in these cells is shown well developed nervous system consisting of a bilobed mass of tissue, the brain, just anterior to the pharynx. There are no nerve cords present but from the brain nerves pass to various parts of the anterior end of the body. So far no nerve endings have been observed. The animal is sightless and no ciliated pits have been observed, although it is highly probable that ciliated pits constitute the organs of special sense of this species. The digestive system consists of a mouth, a pharynx and a long enteron which fills the posterior two-thirds of the body. In this species, as in some of the other lower forms of animals such as Hydra, no anus is present, the faeces being ejected through the mouth.

Transverse sections through the enteron just posterior to the pharynx show undeveloped cells of type "A" in (Fig.1), narrow cells, very elongated and containing only a few large droplets. Transverse sections through further back toward the posterior part of the enteron show cells of type "B" in (Fig.2), cells shorter and wider than type "A" and largely filled with small droplets. It was thought at first from a cursory study of these two cells that they were different type cells, type "A" probably being a secretory cell located just posterior to the pharynx and type "B" a digestive cell, but from a more detailed study the conclusion has been reached that they are the same type digestive cells, their difference in shape and appearance being due to their relative position in the enteron, the type "A" cell being more elongated and narrow because it has digested less food and therefore contains fewer small droplets than type "B" cell which lies in the central portion of the enteron. The large vacuoles found in these cells is shown in (Fig.3). It is distinguished by the dark periphery of the nucleolus, and the radiating strands from the nucleolus to the border of the nucleus.

Another type cell, a secretive cell of type "D" in (Fig.3), is found in the endoderm. These cells show more plainly in a longitudinal section. They lie in between the big digestive cells. Their nucleui closely resemble those of the digestive cells. The cytoplasm of these secretion cells presents an alveolar appearance. They are smaller in size and contain no chyle droplets as are found in the larger digestive cells.

Certain transverse sections through the enteron show elongated spaces lying in the mesoderm of the body. These spaces are sinuses filled with plasma, colorless blood, and constitute the circulatory system of the specimen. They are comparable to the coelom of higher forms. At some places they extend nearly around the animal, but at no place in the specimen's body do these sinuses join each other, which would give this little animal a somatic and splanchnic mesoderm and from which a complex circulatory system could be derived. Their circulatory system, though primitive to us, is able to meet the needs of the little form to which it belongs.

End.

EXPLANATION OF FIGURES.

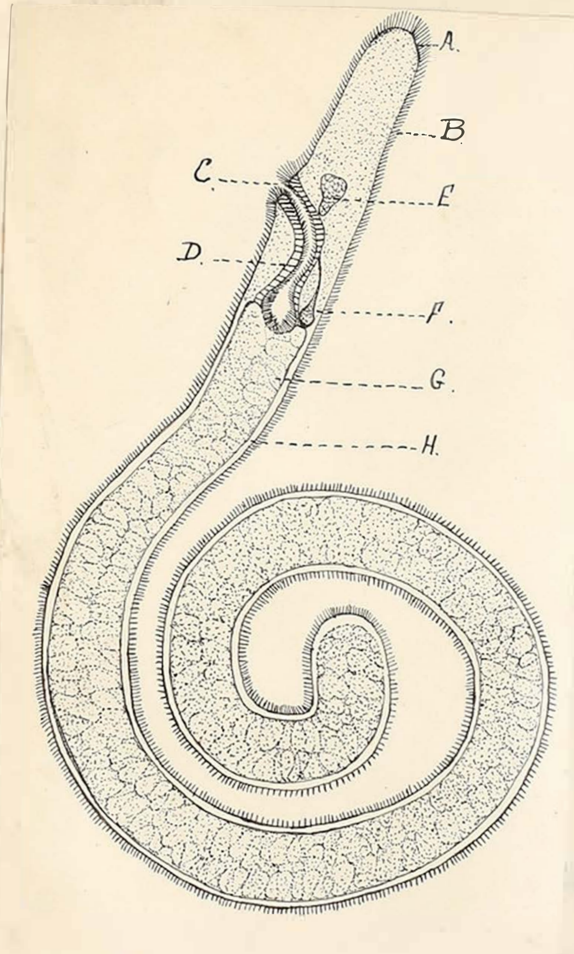

FIGURE NO I.

FIGURE NO.1. Lateral view of Fuhrmannia Virginia showing characteristic contour of animal. X 150.

A. Anterior end.	E. Brain.
B. Cilia.	F. Pharyngeal gland.
C. Mouth.	G. Enteron.
D. Pharynx.	H. Ectoderm.

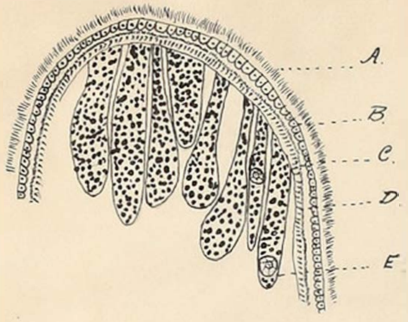

Figure No. 2.

FIGURE NO.2. Transverse section through middle of the body, in the region containing the enteron. X 600.

A. Cilia.
B. Ectoderm.
C. Longitudinal muscles.
D. Circular muscle fibers.
E. Endodermal cells.

Slide reading for section shown in figure above.
Slide C. 37.8|84.8

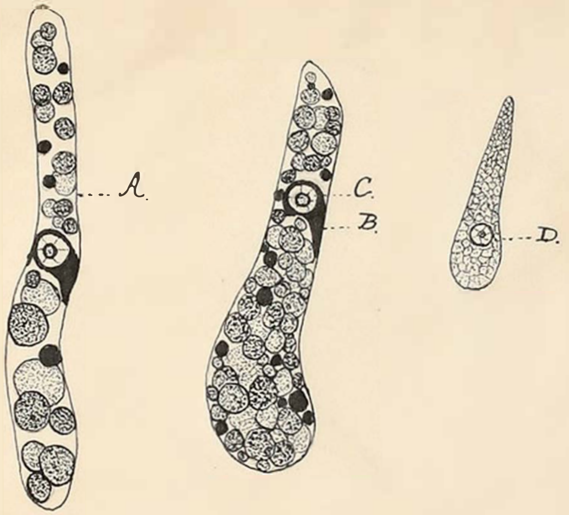

FIGURE No 3.

FIGURE NO.3. Endodermal cells. X 1800.

"A." Type of endodermal cell shown in transverse section from a region just posterior to the opening of the pharynx into the enteron.

"B." Type of endodermal cell shown in transverse section from a region through the middle part of the enteron.
(These cells "A" and "B" are the same type digestive cells. Note the greater number of chyle droplets in cell "B" than in "A").

"C." Type nucleus found in the endodermal cells.

"D." Type secretive cell found in endoderm.
(Note alveolar appearance of cytoplasm).

Slide reading for cells shown in figure above.
Cell "A", Slide C.37|87. Cell "B", Slide C. 37.8|84.8. Nucleus shown in both of these cells, Slide C. 37.8|84.8.
Cell "D", Slide C. 36.7|90.3.

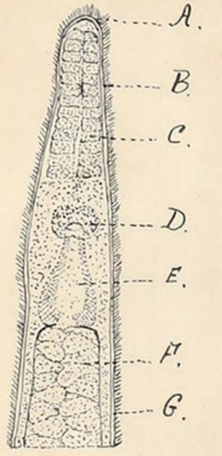

FIGURE NO. 4.

FIGURE NO. 4. Dorsal view of anterior fourth of Fuhrmannia Virginia.

A. Anterior end.
B. Cilia.
C. Mesodermal units, giving animal a segmented appearance.
D. Brain.
E. Pharynx.
F. Enteron.
G. Ectoderm.

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