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STEPHEN A. FORBES, PH.D., LL.D.,
DIRECTOR

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ARTICLE XII.

SOME NEW ILLINOIS ENCHYTRÆIDÆ

BY

FRANK SMITH, A.M., AND PAUL S. WELCH, PH.D.

ERRATA AND ADDENDA

- Page 54, lines 3 and 2 from bottom, and elsewhere in Article III. for *Cassia chamaechrista* read *Cassia chamaecrista*.
- Page 62, between lines 4 and 5 from bottom of table insert *Erigeron annuus*.
- Page 101, table, after *Croton glandulosus* read var. *septentrionalis*; and for *Equisetum laevigatum* read *Equisetum hyemale* var. *intermedium*.
- Page 131, line 3, for *coerulea* read *caerulea*.
- Page 138, last line, for *Ziza* read *Zizia*.
- Page 141, line 21 from bottom, dele *Diodia teres*.
- Page 160, between lines 3 and 4, insert as follows:
Erigeron annuus (L.) Pers. An interstitial in the bunch-grass association in the Hanover area.
- Page 177, line 5, for *eastward* read *westward*.
- Page 209, line 3 from bottom, for *copalina* read *copallina*.
- Page 210, line 13 from bottom, for *Diospyrus* read *Diaspyros*.
- Page 211, line 5, for *Foresteria* read *Forestiera*.
- Page 256, line 3 of table, for Dr. H. M. Pepon read H. S. Pepon.
- Page 278, line 16, the fifth word should be in Roman type.
- Page 286, line 6 (second column), page 295, list of secondary species (second column), and page 353, line 8 from bottom, for *hiemalis* or *hiemale* read *hyemale*.
- Page 313, line 4 from bottom (first column), for *pedicularis* read *pedicularia*.
- Page 315, line 10, second column, for *Apoecynum* read *Apocynum*.
- Page 323, line 3 from bottom, for *Cyperus* read *Scirpus*.
- Page 330, line 14, for *virginianum* read *virginicum*.
- Page 336, lines 3 and 2 from bottom, for *virginicum* read *virginianum*.
- Page 337, line 2 from bottom, for *philadelphicum* read *philadelphicus*.
- Page 339, in first list of invading species, for *Rhus hirta* read *Rhus typhina*.
- Page 351, line 4 from bottom, for *xerophitic* read *xerophytic*.
- Page 355, above line 6 from bottom, insert *Scirpus heterochaetus* Chase.
- Page 356, line 14 from bottom, for *Symlocarpus* read *Symplocarpus*.
- Page 360, line 14, for *Pirus* read *Pyrus*.
- Page 362, after line 7, insert *Acer saccharinum* L.
- Page 363, line 2 from bottom, for *quadiflorum* read *quadriflorum*.
- Page 365, line 14, for *thapus* read *thopsus*.
- Page 369, last line, for *Tanacetum* read *Tanacetum*.
- Page 417, line 1, dele *the*.
- Page 497, line 9 from bottom, for *neglible* read *negligible*, and in foot-note, for *Austalt* read *Anstalt*.
- Page 498, line 4 from bottom, for *Lockport* read *Chillicothe*.
- Page 500, line 13 from bottom, after *up* insert *in*.
- Page 501, line 2 from bottom, for *dissolving* read *dissolved*.
- Page 504, line 23, for *gryina* read *gyrina*; line 17, for *dentata* read *knickerbockeri*.
- Page 506, line 11, for *vernata* read *ternata*.
- Page 507, line 3 from bottom, for *Mazon* read *wagon*.
- Page 513, line 19, for *Nepa* read *Zaitha*; line 18, and page 517, line 13 from bottom, page 520, line 12 from bottom, and page 532, line 4, read *naid* or *naids* for *naiid* or *naids*.
- Page 517, line 6 from bottom, for *pondweed* read *pickerel-weed*.

Page 519, for first sentence of last paragraph read as follows:

We have no exactly comparable chemical data for July; but analyses for August give percentages of saturation for Morris and Marseilles as follows: 20.4 per cent. at Morris on the 11th and 11 per cent. at Marseilles on the 12th; 16.35 per cent. at Morris on the 22d and 23d and 7.4 per cent. at Marseilles on the 24th and 25th.

Page 521, line 6 from bottom, and page 529, line 9, for *chrysoleucas* read *crysoleucas*.

Page 525, line 22, and page 536, lines 21 and 24, for *Ekman* read *Ekman*.

Page 532, line 1, for *Ancylus* read *Ancylus*.

Page 551, line 7, for *oo* read *512*.

Page 615, second line above foot-note, for *106* read *94*.

Page 616, line 1, for the second *Bündeln* read *Bündel*; line 2, for *Bündeln* read *Bündels*; line 3, for *aussern* read *ausseren*; line 6, for *zweierlie* read *zweierlei*.

Page 629, line 12, for *kein* read *keinen*.

Page 634, line 9, for *unternommen* read *unternommenen*; and in line 14 from bottom, after *575* insert *13 fig.*

Plate III, Fig. 1, after the word *mixed* in legend insert *consociés of the*.

Plate IX, Fig. 2, dele the legend and read instead: Root-system of *Tephrosia virginiana*, exposed by blowing of the sand.

Plate X, Fig. 2, dele the legend and read instead: A blowout almost stabilized by bunch-grasses, especially *Leptoloma cognatum*.

Plate XXXIX, for *Calamagrostis* read *Calamagrostis*.

Plate LIV, exchange places of cuts, but not the legends.

Plate LXXXV, for *7* read *7c*.

Nothing has been published on the *Enchytraëidæ* of the Mississippi Valley with the exception of a brief description of *Fridericia agilis* by the senior author nearly twenty years ago ('95, p. 288) and the insufficient account of the problematic forms from Lake Superior by S. I. Smith and Verrill ('71).

In this paper we first describe two new species of *Fridericia* from Urbana, Illinois. The major part of these descriptions was contained in a thesis offered by the junior author in 1911 in partial fulfillment of the requirements for the master's degree from the University of Illinois. We next extend the description of *Fridericia agilis* Smith and add a number of rather important characters not previously given. Finally, we describe a new species of *Marionina* from Urbana, Illinois, which is the first member of this genus reported from the United States. Descriptions of seven other new species of *Enchytraëidæ* from the Mississippi Valley will soon appear in a paper by the junior author which is about to go to press.

The drawings for figures 22 to 28 inclusive were made by Mr. S. Fred Prince, illustrator for the Illinois State Laboratory of Natural History. All other drawings were made by the junior author.

FRIDERICIA Michaelsen

About ninety species are assigned to this genus at the present time, making it the largest genus of the family. Of this large assemblage of species only fourteen have been recorded from North America, and only one from Illinois. Four species from the vicinity of Philadelphia, Pennsylvania, one species from Havana, Illinois, and seven species from California constitute the list for the United States. So far as is known the members of this genus are all terrestrial in habit, although they usually occur under somewhat moist conditions.

The genus was established by Michaelsen in 1889, when he discovered that certain species then assigned to *Enchytræus*, *Neoenchytræus*, *Mesenchytræus* and *Archienchytræus* had definite characters in common which were of sufficient importance to justify the establishing of a new genus. He defines ('00, p. 106) the genus as follows:

*Contributions from the Zoological Laboratory, University of Illinois, under the direction of Henry B. Ward, No. 22.

“Borsten in 4 Bündeln, gerade, zu 2 im Bündeln und dann gleich lang oder zu mehreren und dann die inneren des Bündeln mehr oder weniger regelmässig paarweise und Stufenweise als die äussern. Rückenporen mit Verschlusszellen meist vom 7., selten vom 6. Segm. an vorhanden. Kopfporus meist klein, dorsal zwischen Kopflappen und 1. Segm. Lymphkörper von zweierlie Gestalt. Peptonephridien stets vorhanden. Der Oesophagus geht allmählich in den Mitteldarm über. Das Rückengefäss entspringt meist postclitellial. Blut farblos. Nephridien meist mit grossem Anteseptale, in dem der Flimmerkanal schon Windungen beschreibt. Samenleiter lang. Samentaschen meist mit dem Darm kommunizierend, einfach oder mit Divertikeln.”

Eisen ('05, p. 106) extended the definition by adding the following characters: “Penial bulb without interior muscular strands.” . . . “The intestine in the vicinity of the clitellum contains specialized chylus cells.” It remains for future investigation to show whether or not these characters are worthy of generic rank, since in the majority of the species of the genus the penial bulb and the chylus cells have not been studied.

FRIDERICIA FIRMA n. sp.

Definition.—Length, 24–33 mm. Somites, 62–67. Color, whitish yellow. Prostomium blunt. First dorsal pore in VII. Setæ, 4–7 per bundle in anterior part; 4–5 in middle part; 2 in posterior part. Clitellum on XII–XIII. Lymphocytes elliptical, abundant. Brain $\frac{1}{4}$ longer than wide; anterior margin concave; posterior margin convex. Peptonephridia branching dendritically. Anteseptal part of nephridium slightly smaller than postseptal part; efferent duct arises from mid-ventral surface of latter, near septum. Spermiducal funnel 1.3 to 1.5 times longer than diameter; duct long, slender, and much contorted, and confined to XII. Spermathece each with pear-shaped ampulla communicating with digestive tract in V; each ampulla with 3–4 sessile, unequal, lobular diverticula; duct longer than ampulla, slender, and without glands at ectal opening.

The characters of the penial bulb and the chylus cells are not included in the above definition but will be discussed in another part of the paper (pp. 618, 619).

Described from ten sexually mature specimens. Type and paratypes in the collection of the junior author and paratypes in the collection of the senior author.

The specimens which are the basis of this description were found with many others near Urbana, Illinois, in November, 1910, in moist soil under decaying leaves in undisturbed forest land. They were abundant and most of them were sexually mature.

Affinities.—This species is easily distinguished from the other species of the genus. It resembles *F. agilis* Smith ('95, p. 288), *F. longa* Moore ('95, p. 341), and *F. ratzeli* Eisen ('72, p. 123) more closely than it does other members of the genus, but it differs from *F. agilis* in the number of setæ per bundle, the number of diverticula on each spermatheca, and in the characters of the nephridia. It differs from *F. longa* in the characters of the setæ, peptonephridia, and spermathecæ; and from *F. ratzeli* in size, and in the characters of the brain and the spermathecæ.

EXTERNAL CHARACTERS

The body is long, slender, and cylindrical. The average length is about 30 mm., the extremes being 24 and 33 mm. The diameter is greatest at the clitellum (0.6 mm.), gradually decreasing both caudad and cephalad. The intersegmental grooves are rather obscure except in the region just posterior to the prostomium, where a few are quite distinct. No secondary annulations are present. The number of somites varies from 62 to 67. The prostomium (Pl. XCVIII, Fig. 1) is blunt and rounded. The seta bundles in the anterior part of the body each contain 6–7 setæ; those in the posterior part 2–4 each. The proximal ends (Pl. XCVIII, Fig. 2), especially of the more fully developed setæ, are strongly bent.

INTERNAL CHARACTERS

Body Wall.—The cuticula, though comparatively thin, is tough and firm, and offers the chief difficulty in the dissection of alcoholic specimens; but when once broken, it can be easily stripped from the body. It has a luster, in both surface and sectional views, which gives it a glistening appearance. It is of about the same thickness throughout the length of the body. It is reflected into the mouth and lines the digestive tract as far as the openings of the peptonephridia, being continued into the latter for a short distance. It lines the canal of the head pore for most of its length, but is merely perforated at the dorsal pores. The comparative thinness of the cuticula is probably attributable to the fact that this species lives in moist earth. According to Vejdovský ('79, p. 11) such forms as *Anachata*, which live in dry surroundings, have a very thick cuticula, while in those living in water or in very moist earth it is thin and delicate. It was noticed that the mortality in this species was very high when the earth surrounding the specimens approached dryness, or when they were exposed for a short time to the open air.

The clitellum is on XII and XIII and is distinctly developed. The cells (Pl. XCVIII, Fig. 3) are all of the same kind. The first dorsal pore is in VII, and each pore has a mid-dorsal position in the middle of its somite lengthwise.

Brain.—The brain (Pl. XCVIII, Fig. 4) is in the anterior part of II but projects slightly into I. The length is about one and one fourth times the width. The anterior margin is moderately concave, while the posterior margin is strongly convex. The lateral margins are nearly parallel. Two pairs of supporting strands extend from the lateral margins to the body wall.

Peptonephridia (Salivary Glands).—A pair of these organs open into the ventral side of the digestive tract in the anterior part of IV, close to the septum. They extend caudad through IV and V and a short distance into VI. Each gives off a number of branches at irregular intervals throughout its length.

Chylus Cells.—The chylus cell region is that part of the intestine included in XIII— $\frac{1}{3}$ XVIII. Here the intestine is lined with the layer of ental epithelial cells, which are ciliated and approximately rectangular in section, and each of these cells contains a large spherical nucleus. The chylus cells lie deeper in the intestinal wall, and open between the cells of the ental layer into the lumen of the intestine. They are long, rather narrow, and broader at the bases than at the apices. The intracellular canal (Pl. XCVIII, Figs. 6, 7) is ciliated and nearly straight in the apical part, but elsewhere it is non-ciliated and somewhat tortuous, especially in the broad basal part. It is surrounded by a definite layer of cytoplasm of uniform thickness, which is more hyaline and stains more intensely than the finely granular and deeply staining adjacent part. The two kinds of cytoplasm are sharply differentiated. The elliptical nucleus lies in the base of the cell in the angle formed at the chief bend of the canal. The cell walls are indistinct, and it is somewhat difficult to determine the exact line of demarcation between adjacent cells. However, sufficient details of structure can be made out to prove that these cells are definite units and that each canal is confined entirely within the limits of a single cell. There is some variation in the form of the chylus cells, since near septa and sometimes in the lateral walls of the intestine they are rather short, while between septa they may be rather long and slender. However, in all cases the general structure and the arrangement of parts are uniform. Interstitial cells are absent. Certain considerations relating to the chylus cells will be taken up in another part of the paper (p. 626).

Nephridia.—The first pair of nephridia are related to VI/VII. The anteseptal part (Pl. XCVIII, Fig. 5) of each nephridium is

slightly smaller than the postseptal part. The efferent duct arises from the ventral surface of the latter close to the septum. The lumen is more or less contorted in both anteseptal and postseptal parts.

Spermaries.—The spermaries are in the usual position in XI. In most of the preparations the germ cells show various stages of mitotic division. In sexually mature specimens a large mass of developing sperm cells nearly fills the somite, often pushing the septa into contact with septa IX/X and XII/XIII.

Sperm Ducts.—The spermiducal funnel (Pl. XCVIII, Fig. 8) is nearly cylindrical, and the length is approximately one and one half times the diameter. It is situated in the posterior part of XI with the base in close proximity to the ventral part of XI/XII, and the long axis is directed obliquely dorsad. The anterior end has a well-differentiated reflected collar, distinctly set off from the body of the funnel by a constriction. The sperm duct is rather long, contorted, and confined to XII.

Penial Bulb.—The penial bulbs (Pl. XCIX, Figs. 9, 10) are in close relation to the penial pores* and each is involved in a very material modification of the body wall. At each penial pore there is a deep invagination and an interruption of the muscle layers. The character of the hypodermis is abruptly altered, but the cuticula, slightly reduced in thickness, is reflected into the invagination as a lining. The body of the bulb is composed of two kinds of cells: (1) large, glandular cells which occupy all of the dorsal and peripheral parts of the bulb and have large spherical nuclei; and (2) long, narrow, columnar cells which are situated in the interior of the bulb and are arranged radially around the penial lumen* for its entire length. Cells of the second type contain small ovoid nuclei at their inner ends and stain very lightly. They merge gradually into ordinary hypodermal cells at the ventral side of the bulb, which, in turn, give place to the clitellar cells present in the mid-ventral region. The bulb is covered by a well-developed musculature which is a continuation of the circular muscle layer of the body wall.

The bulb is a typical lumbricillid bulb as defined by Eisen ('05, p. 8). He claims that this organ has taxonomic importance and can be used in the characterization of species, genera, and subfamilies. The structure of the bulb agrees also with his diagnosis of the genus

*We shall not undertake a discussion of the homologies of the penial bulb, but for the purposes of this paper shall designate the ectal opening of its lumen as the *penial pore* (Pl. XCIX, Fig. 10, *pen. po.*) instead of the spermiducal pore, and the lumen itself (Fig. 10, *pen. lum.*) as the *penial lumen*. This latter is the same as Eisen's "extension of the sperm duct" and "elongation of the sperm duct" ('05, pp. 108 and 8).

Fridericia and the subfamily *Lumbricillinae*, based on the character of the penial bulb. The discussion of the importance of this organ in classification is taken up in detail in another paper to be published in the near future.

Spermatheca.—Each spermatheca (Pl. XCIX, Fig. 11) consists of three distinct parts; an ampulla, diverticula, and the duct. The ampulla, the largest part of the spermatheca, is a pear-shaped organ, of which the smaller end is united with the digestive tract in the posterior part of V, and the larger end is connected with the body wall by means of the duct. The cavity within conforms somewhat to the external shape of the organ, being rather spacious in the region of the diverticula, and gradually narrowing to the point where it communicates with the lumen of the digestive tract. The communications of the two spermathecae with the digestive tract are separate. Three or four sessile lobular diverticula are present on the ectal end of the ampulla. They are somewhat similar in shape but vary in size. The duct originates at one side of the ectal end of the ampulla from a cone-shaped expansion. It is uniform in diameter, about three times as long as the ampulla, and is lined with cuticula throughout its entire length. The ectal opening is lateral in position and near the intersegmental groove IV/V. No accessory glands are present at the ectal opening. The hypodermis of IV and V, with the exception of the dorsal third, is strongly thickened, the thickening being greatest in the vicinity of the spermathecal pores.

FRIDERICIA TENERA n. sp.

Definition.—Length, 9–17 mm. Somites, 52–59. Color, whitish. Prostomium rounded. First dorsal pore in VII. Setae, 4–6 per bundle in anterior region of body; 2–4, usually 2, in posterior region. Clitellum on XII and XIII. Lymphocytes elliptical. Brain about one fifth longer than wide; anterior margin concave, posterior margin convex, lateral margins converge cephalad. Peptonephridia each with several branches originating from common base, and some secondary branches. Anteseptal and postseptal parts of nephridia about equal in size; efferent duct arises from mid-ventral surface of postseptal part near septum. Spermiducal funnel about twice as long as wide; duct long, much contorted, and confined to XII. Spermathecae each with barrel-shaped ampulla communicating with digestive tract in V, and each bearing about seven globular sessile diverticula; two glands at ectal opening of spermathecal duct.

For discussion of penial bulb and chylus cells see pages 622, 623.

Described from seventeen sexually mature specimens. Type and paratypes in the collection of the junior author; paratypes in the collection of the senior author.

The specimens which form the basis of this description were found in a compost pile in the forest grounds of the University of Illinois and were collected in October and November, 1910.

Affinities.—This species seems to approach several other species, namely, *F. lobifera* Vejdovský ('79, p. 57), *F. udei* Bretscher ('99, p. 411), *F. beddardi* Bretscher ('00, p. 29), *F. macgregori* Eisen ('05, p. 118), and *F. californica* Eisen ('05, p. 119). Because of brevity, use of general terms, and indefinite statements, the descriptions of *F. udei* and *F. beddardi* are somewhat puzzling and comparisons troublesome, but the aggregate of differences is such that it is not difficult to separate *F. tenera* from them. It differs from *F. lobifera* in length, and in the characters of the brain, peptonephridia, and spermathecæ; from *F. udei* in length, and in the characters of the peptonephridia, spermathecæ, and nephridia; from *F. beddardi* in the characters of the peptonephridia, brain, and spermathecæ; from *F. macgregori* in length, number of somites, and in the characters of the brain and spermathecæ; and from *F. californica* in length, number of somites, and the characters of the brain and spermiducal funnel.

In connection with the above comparison a certain discrepancy which appears in Eisen's description of *F. macgregori* should be noted. In his description of the brain, he says, "Brain anteriorly much convex; posteriorly slightly so." His text figure of the brain shows that the anterior margin is less convex than the posterior. It seems probable that the figure is correct.

EXTERNAL CHARACTERS

The worms are relatively slender and delicate, having a length of 9–17 mm., and a maximum diameter of only about 0.4 mm. The number of somites varies from 52 to 59. The living worms are opaque and whitish in appearance. The clitellum is on XII and XIII and is only moderately developed. It is made up of transverse rows (Pl. XCIX, Fig. 13) in which glandular cells alternate with clear ones. The intersegmental grooves are obscure, except the first four or five. The setæ are of the typical *Fridericia* type and are relatively large. The distal ends are sharply pointed, and the proximal ones (Pl. XCIX, Fig. 14) are strongly recurved. In the anterior part of the body the dorsal bundles contain 4–5 setæ, the ventral ones usually 6; in the middle region both sets of bundles contain 4 setæ; while in the posterior part, 2 is the predominating number.

INTERNAL CHARACTERS

Body Wall.—The hypodermis contains unicellular flask-shaped gland cells (Pl. XCIX, Fig. 16) which are numerous and generally distributed. They occur among the ordinary hypodermal cells, and each opens at the surface through the distal narrowed neck region. They are much larger than the hypodermal cells though shorter. They are approximately uniform in shape except in the thickened region of the first somite and the prostomium, where they are more elongate. The contents show a certain degree of polarity. In the ectal part of the cell the contents are of such a nature that they stain only slightly, while the opposite end is filled with material which stains deeply. The latter also contains a conspicuous nucleus.

Brain.—The brain (Pl. XCIX, Fig. 15) lies entirely in II and is about one fifth longer than wide. The anterior margin is concave; the posterior margin is convex; and the lateral margins are gradually convergent anteriorly. Two pairs of supporting strands connect the lateral margins of the brain with the body wall.

Peptonephridia.—A pair of these organs open into the ventral side of the digestive tract in IV. Each is composed of several branches which arise from a common base, and most of which are directed caudad and terminate in VI. Secondary branching exists to some extent.

Chylus Cells.—The chylus cell region is that part of the intestine included in XV–XVII. The chylus cells (Pl. C, Fig. 18) are flask-shaped, and each cell contains the characteristic intracellular canal, which has a somewhat sinuous course, especially in the ectal end of the cell. The canal is ciliated throughout almost its entire length. There seems to be no special modification of the cytoplasmic layer surrounding the canal, such as exists in *F. firma* and some other species. Each cell contains a conspicuous nucleus, which usually lies in the chief bend of the canal. Between the apical ends of the chylus cells are fitted the wedge-shaped ental epithelial cells. The location of the chylus cells in XV–XVII is different from that in any other species in which they have been described and may, in accordance with the general view of Eisen, be a valid specific character.

Nephridia.—The first pair of nephridia are connected with V/VI. The anteseptal and postseptal parts (Pl. C, Fig. 17) are about equal in size. The efferent duct arises from the mid-ventral surface of the postseptal part, near the septum, and opens to the exterior slightly anterior to the corresponding ventral setæ. The lumen is tortuous throughout its whole length.

Penial Bulb.—In many respects the structure of the penial bulb (Pl. C, Fig. 20) in this species is similar to that of *F. firma*, although a number of distinct differences are apparent. Unlike that of the latter species the body of the bulb is composed of cells of but one kind. They are large and glandular, and each contains a large, conspicuous nucleus at the peripheral end. Each cell has a prolongation which extends to the penial lumen. The peripheral part of the cell stains deeply but the prolongation stains only very slightly. The sperm duct enters the bulb at the anterior end and extends obliquely ventrad, opening into the penial lumen. Figure 20 shows the structural detail of this organ as it appears in a transverse section of the worm. This bulb is clearly of the lumbricillid type as defined by Eisen. It differs from that of *F. firma* in lacking the inner bulb cells which surround the penial lumen.

Spermatheca.—Each spermatheca (Pl. C, Fig. 21) is differentiated into ampulla, duct, and several diverticula. The ampulla is somewhat elongated and inflated in the middle. The ectal end bears a circle of globular sessile diverticula, usually seven in number and slightly dissimilar in shape and size. The duct arises from the center of this circle of diverticula and extends, with few curves, to its ectal opening in the lateral wall of the body slightly posterior to IV/V. Two pear-shaped glands are present at the ectal opening. The cuticula is reflected into the lumen of the duct and lines it for its entire length.

FRIDERICIA AGILIS Smith

At the time that this species was described*, certain organs of the *Euchytræida* were not considered of as much systematic importance as at present, and, accordingly, they were ignored, or received scant attention in the description of *F. agilis*. In view of the large number of species of the genus already known and of the large number that are almost sure to be made known in the future, it is important that descriptions should be quite detailed. For this reason an examination of additional material and a further study of old material have been made and a more extended description prepared, no attempt being made to distinguish the old material from the new.

Definition.—Length, 25–30 mm. Diameter, 0.63–0.82 mm. Somites, 57–66, average, 62. Color, whitish. Prostomium blunt and rounded. First dorsal pore in VII. Setæ, 2–4, usually 2, per bundle. Clitellum on XII–XIII. Lymphocytes numerous, broadly elliptical.

*In 1895, in the Bulletin of the Illinois State Laboratory of Natural History, Vol. IV, Art. VIII, pp. 288–289.

Brain one half longer than greatest width; anterior margin slightly concave, posterior margin quite convex. Peptonephridia large, very much branched, opening into digestive tract in posterior part of III. Dorsal vessel arises in XIX. Nephridia with anteseptal part equaling postseptal part in size; efferent duct arises from posterior end of latter. Spermiducal funnel twice as long as its diameter. Spermathecae each with duct, ampulla, and diverticula; duct about three times as long as ampulla, with a few very small unicellular glands at ectal opening; ampulla with about nine similar, globular diverticula.

For discussion of penial bulb and chylus cells see pages 625, 626.

Described from twelve sexually mature specimens. Type in the collection of the Illinois State Laboratory of Natural History. Paratypes in the collections of each of the authors.

The specimens on which the description of this species is based were collected at Havana, Illinois, in April and May of 1895. They were found abundant in the wooded banks and bottom-lands of the Illinois River, under logs and in the damp rich soil, mingled with decaying vegetation.

EXTERNAL CHARACTERS

The body of the worm is smooth, rather robust, cylindrical, tapering very gradually towards the two extremities. The length of mature specimens is 25–30 mm. The diameter is greatest in the region of the clitellum, where, in alcoholic specimens, it is 0.63–0.82 mm. The number of somites varies from 57 to 66. The intersegmental grooves, except the first four or five, are indistinct. The intersegmental groove IV/V differs from the adjacent ones in being broader and more shallow. The prostomium is blunt, rounded, and smooth. The color of the living worm is whitish. The clitellum, which is on XII–XIII, is moderately developed and composed of cells of but one kind. The setae vary from 2 to 4 per bundle, the more usual number being 2. Each seta is rather strong, acute at the distal extremity, and distinctly bent at the proximal end.

INTERNAL CHARACTERS

Lymphocytes.—The lymphocytes are abundant in most parts of the body. They are broadly elliptical in outline, and the long axis of each averages about 0.025 mm.

Brain.—The brain (Pl. C, Fig. 22) is in I and II. The anterior margin is slightly concave, the posterior margin is quite convex, and the lateral margins are almost parallel. In transverse section it is ovoid. A pair of supporting strands extending from the latero-

posterior parts of the brain in a latero-caudal direction attach it to the body wall.

Peptonephridia.—A pair of these organs connect independently with the ventral side of the digestive tract in the posterior part of III. The apparent absence of septum III/IV makes it difficult to determine the exact point of separation between III and IV. These glands open into the digestive tract very close to III/IV, apparently in the posterior part of III. They are directed caudad and do not extend beyond IV/V. Each branches profusely and in an irregular, dendritic fashion.

Chylus Cells.—Chylus cells (Pl. C, Fig. 23) are present in the walls of the intestine in $\frac{2}{3}$ XII–XVI. They are somewhat flask-shaped, the ectal ends being broader than the ental ones. They vary in form considerably, the length of some being nearly three times their diameter, while in others it is but little greater. It is possible that these ratios are subject to change in the same cell, owing to the different states of contraction of the intestinal wall. The ental part of the intracellular canal is straight; the basal part is sinuous and somewhat branched. Cilia are present throughout the greater part of the ental portion of the canal, and are directed toward the lumen of the intestine. The canal is lined by a specialized layer of cytoplasm, which is everywhere uniform in thickness and structure. The perivisceral blood sinus comes into contact with the basal portion of each chylus cell. The cells of the ental epithelial layer are wedge-shaped, and usually occur singly between the apices of the chylus cells. The ental surface of these cells is thickly covered with long cilia. Interstitial cells are absent.

Eisen ('05) made careful studies of these peculiar cells in a number of species which he described from the west coast of North America and was convinced that their location, form, and size furnish good specific characters. Since other students of *Fridericia* have not described these structures in any detail, Eisen's conclusions were necessarily based on an investigation of but a small number of the many known species, and more extended studies must be made before his views can be justly weighed. The characters of the chylus cells in *F. firma*, *F. tenera*, and *F. agilis* do not coincide with those of any other species in which such cells have been described, but appear to present distinct specific differences.

Nephridia.—The anteseptal and postseptal parts (Pl. CI, Fig. 24) of each nephridium are approximately equal in size, and both are well developed. The efferent duct arises from the posterior end of the postseptal part. The true origin (Pl. CI, Fig. 25) of the duct is

occasionally obscured by a peculiar modification of the nephridium in which the posterior half of the postseptal part is bent ventrad and cephalad, and is in such close relation to the ventral side of the anterior half that the origin seems to be near the septum.

Spermiducal Funnel.—The spermiducal funnel (Pl. CI, Fig. 26) is very large, and the two funnels occupy the greater part of the coelom in XI. They are barrel-shaped and about twice as long as their diameter. Each has a distinct reflected collar set off from the body of the funnel by a constriction. The diameter of the collar is less than the maximum diameter of the funnel. The sperm duct is long, slender, and confined to XII.

Penial Bulb.—The structure of the penial bulb (Pl. CI, Fig. 27) so closely resembles that already described for *F. firma* that it seems unnecessary to give a detailed description. The shape, relative size, musculature, and relation to the body wall are all about the same as in that species. Similarly, also, the body of the bulb is composed of two distinct sets of cells, viz., the inner bulb cells, which immediately surround the penial lumen, and the peripheral bulb cells, which comprise the greater part of the mass of the organ. The relation of the bulb to the sperm duct is also similar to that described for *F. firma*.

Spermatheca.—Each spermatheca (Pl. CI, Fig. 28) has a distinctly differentiated duct and ampulla, the latter bearing diverticula. The duct is slender and about three times as long as the ampulla. It unites with the ectal end of the latter at the middle of the ring of diverticula and extends, with few curves, to the ectal opening, which is laterad and near IV/V. A few inconspicuous gland cells are present about the ectal opening. The ampulla is barrel-shaped and thick-walled. It bears a ring of about nine similar lobular diverticula at the ectal end. The walls of the diverticula are comparatively thin, and the lumina are in direct communication with the lumen of the ampulla. The spermathecae communicate independently with the digestive tract on its dorsal side in the posterior part of V. The spermathecae are quite large and occupy a considerable part of the space in V.

The Function of the Chylus Cells in Fridericia

The homologies and functions of these peculiar cells are, indeed, quite problematical. The intimate connection of the cells with the digestive tract and their close contact with the blood vascular system indicate that they have an important rôle in some metabolic process. Michaelsen ('86, p. 296) has maintained that they are organs of absorption. Eisen ('05, p. 107) also favored this interpretation, and at-

tempted to support it by the assumption that the presence of the cilia in the canal indicates that the canal itself is simply an invagination of the ciliated apical surface of the cell, and that a means is thus provided for bringing the nutritive fluid into close relation with the blood sinuses at the base of the cell. He further held that the probable function of the cilia in the apical end of the canal is to facilitate the introduction of the nutritive fluid, and that the canal is the means whereby greater intestinal surface and rapid absorption are insured without consequent diminution or weakening of the intestinal wall.

Vejdovský ('06, p. 65) and Čejka ('10, p. 17) assign a secretory function to these cells, and assume that the cilia aid in the passage of the secretion from the canal into the lumen of the alimentary tract. They also claim that the cells are produced by modifications of the deeper-lying cells of the epithelium and that, in sections, intermediate stages in such a development can be seen.

We have made no observations which enable us to contribute directly to the determination either of the function or of the mode of origin of these cells, but have made some observations on the arrangement of the cilia of the canals and offer some suggestions as to their probable function.

We have numerous sections of specimens from each of the species of *Fridericia* herein described which show clearly that the cilia of the canal are directed towards the opening at the apical end as represented by Vejdovský, and have found no instance in which they extend in the opposite direction as figured by Eisen ('05, Pl. XVII and XX). We believe that the cilia may have a function quite different from the one previously assumed.

Experiments and observations by Cuénot, although not dealing directly with this subject, throw light on the problem in an interesting way. He has shown ('97, p. 105) that the vibratile cilia in the nephrostome of the nephridium of *Oligochata* can not introduce the *cœlomic* fluid into the interior of the nephridium except when inequalities in the fluid pressure in the lumen will permit. Furthermore, he has shown that solid bodies in suspension in the *cœlomic* fluid can not pass through the orifice of the nephrostome because the thickly set cilia play the rôle of a sieve or filter and form an impassable barrier to any solid particles, except possibly those which are excessively minute. In view of these facts it seems probable that the prime function of the cilia of the nephrostome is the prevention of the passage of solid particles into the nephridial lumen rather than the introduction of fluids into the lumen as has been assumed.

It seems, then, reasonable to infer that the cilia in the apical part of each chylus cell canal also function as a filter, preventing the in-

roduction of solid particles from the intestine, and that they do not induce a flow of fluid into the lumen as claimed. No experimental evidence has yet been secured to substantiate this inferential view but it seems plausible. For some reasons there is even a better basis for ascribing this filtering function to the cilia of the chylus cells than to those of the nephridia. In the first place, the canals of the chylus cells end blindly, while the nephridial canals have external openings and in consequence the nephridial lumen may sometimes be almost or entirely empty, when, as claimed by Cuénot, it is possible for the cilia of the nephrostome to aid in the introduction of the fluids. On the other hand, the chylus cells occur in a part of the intestine where, under normal conditions, the nutritive fluid is constantly present. Since the intracellular canal of each cell has but one opening, the canal is presumably at all times filled with fluid, the amount of which is far more dependent on pressure conditions in neighboring parts than on any action of the cilia. The powerful and frequently changing muscular contractions in various parts of the body are accompanied by more or less violent disturbances of pressure and consequent movements in the fluid contents. It seems reasonable to assume that such disturbances would more profoundly affect the extensive digestive tract and its contents than the diminutive nephridium, which is to such a considerable extent freely suspended in fluid. In the second place, the apical ends of the chylus cells are exposed to great quantities of solid particles, since the contents of the digestive tract must pass by them, and yet none of the preparations examined by us have shown any indication of the presence of such material in the canals. Unless there were some provisions for the prevention of the entrance of solid matter these blind canals would be almost sure to contain such material and their functional efficiency be correspondingly reduced.

MARIONINA Michaelsen

During the autumn of 1895 a study of the animal life in the waterworks reservoir of Urbana, Illinois, was made by Miss Bertha V. H. Forbes, a student in the University of Illinois, and in her collections were a moderate number of small enchytræid worms. They were turned over to the senior author of this paper and were partly worked up at that time, but circumstances prevented the completion of the work, and nothing further was done with the worms until the present year, when their further study was undertaken by the junior author. They proved to be an undescribed species of *Marionina*.

This is not only the first record of a species of *Marionina* for Illinois, but it is also the first time a representative of this genus has been reported from the United States, although Eisen ('05) has described two new species from Alaska.

The genus *Marionina* was established by Michaelsen in 1889. Previous to that time forms belonging to this genus were scattered among a number of the older genera, the old genus *Pachydrius* (*Lumbricillus*) receiving the larger part.

Michaelsen ('00, p. 73) defines the genus *Marionina* as follows: "Borsten S-förmig gebogen. Rückenporen fehlen; Kopfporus klein, zwischen Kopfplatten und 1. Segm. Das Rückengefäß entspringt postclitellial und besitzt kein Herzkörper. Peptonephridien fehlen. Hoden massig. Samenleiter lang. Samentaschen ohne Divertikel." Eisen ('05, p. 90) has extended this definition somewhat: "Setæ sigmoid, as in *Lumbricillus*. Head pore small, between the prostomium and somite I. No dorsal pores. Blood red or yellow. Dorsal vessel rises posterior to clitellum. No cardiac gland. No peptonephridia. Sperm-ducts comparatively long and narrow. Penial bulb without interior muscular strands. Testes undivided, each covered with a small sperm-sac. Ventral glands present or absent. Nephridia with entire postseptal and with comparatively large head-like anteseptal."

The close similarity between the definition of *Marionina* and that of *Lumbricillus* is apparent, the chief difference being the presence of multilobed testes in the latter. Eisen ('05, p. 90) thinks that another difference may be derived from the nephridium, "which in *Marionina* seems to be characterized by a long head-like anteseptal, while in *Lumbricillus* the anteseptal consists of merely the nephrostome." There are insufficient grounds for giving such a character generic rank, since the anteseptal part of the nephridium in *Marionina* is quite variable. In *M. werthi* Mchlsn., *M. falclandica* Mchlsn., and in several other species, the anteseptal part consists of the nephrostome only.

Marionina is one of the smaller genera of the family *Enchytraida*. At present twenty-six apparently valid species are assigned to it, of which only two have been recorded for North America. They are *M. alaska* Eisen and *M. americana* Eisen, both from Port Clarence, Alaska.

MARIONINA FORBESÆ n. sp.

Definition.—Length, 5–6 mm. Diameter, 0.221–0.238 mm. Somites, 25–28. Setæ slightly sigmoid; those of a bundle equal in size; 2–4 per bundle. Clitellum on XII–XIII; developed only on

dorsal and lateral surfaces. Prostomium slightly pointed. Head pore on o/I. Cuticula very thick and resistant. Lymphocytes few in number, oblong, nucleated, cytoplasm heavily granular in appearance. Brain about twice as long as wide; anterior margin conical, posterior margin emarginated, lateral margins convergent anteriorly. Peptonephridia lacking. No ventral glands. Septal glands in IV--VI. Dorsal vessel arises in XIII. Blood yellowish. Anteseptal part of nephridium a mere nephrostome; postseptal part large, flattened laterally, efferent duct arising from its ventral side near posterior end. Spermatheca with distinct duct and ampulla; ampulla pear-shaped; not connected with the intestine and with no diverticula; duct narrow, rather short, with no glands at ectal opening. Length of spermiducal funnel about twice its diameter. Testes undivided; sperm sacs lacking.

For a discussion of the penial bulb see page 632.

Described from five sexually mature specimens, although a number of others were examined in connection with the study on the living forms. The type and a paratype are in the collection of the junior author, and paratypes in that of the senior author.

The above specimens which form the basis of the description of this species were found in the mud and settlings in the bottom of the waterworks reservoir of Urbana, Illinois. At the time of collection they occurred only in moderate numbers. The dates of collection range from October 23 to November 26, 1895. The species name is given in recognition of the discoverer, Miss Bertha V. H. Forbes.

EXTERNAL CHARACTERS

The specimens are small, their length being only 5-6 mm. The figures given are for the living specimens and apply to all the sexually mature individuals. As measurements of alcoholic material gave almost exactly the same result, it appears that in this species of the *Enchytraidæ* authentic data regarding length can be secured from the examination of preserved material. This fact may be due to the exceptionally thick and resistant cuticula, which may perhaps also account for the fact that living specimens have but a slight range in contraction and extension. The number of somites varies from 25 to 28. The body is cylindrical, and the diameter is approximately uniform for almost its entire length, only the first somite and the last two or three showing gradual increase in size. The diameter varies from 0.22 to 0.24 mm. The clitellum is on XII-XIII and is slightly developed dorsad and laterad but is interrupted on the ventral surface of the body. The prostomium (Pl. CI, Fig. 29) is rounded, yet

slightly pointed. The head pore is present at o/l. The anterior four or five intersegmental grooves are distinct, but beyond this region they are obscure. Three to eight secondary transverse grooves occur on all of the somites posterior to II or III with the exception of XII and XIII.

A conspicuous feature of living specimens is the presence of definitely arranged spots on the external surface. They are disposed in transverse rows, 2-3 per somite, each row containing 2-4 spots. One row is slightly anterior to the setæ, another slightly posterior to them, and a third caudad to the latter. These markings do not appear in alcoholic specimens.

Setæ.—The setæ are slightly sigmoid, but in an examination of the living material or of specimens mounted *in toto* it is very easy to overlook their slightly sigmoid form and to mistake them for straight setæ. Transverse sections of the worm (Pl. CII, Fig. 31) reveal the curves distinctly. The setæ are arranged in four bundles per somite, two ventral and two lateral. The number of setæ per bundle varies from 2 to 4. In the anterior region the numbers 4 and 3 seem to predominate, while in the posterior region there are usually 3 per bundle, and but 2 in the last one or two somites. The distal extremities of the setæ of each bundle are all curved in the same direction, those of the lateral bundles curving ventrad and those of the ventral bundles curving dorsad. The proximal ends of the setæ also show a slight curvature in a direction opposite to that of the distal portion.

Cuticula.—There is a very thick resistant cuticula of which the thickness is about equal to that of the combined thickness of the hypodermis and the muscular layers of the body wall. This cuticula is so resistant that in some cases it caused considerable trouble in sectioning. It appears to be approximately uniform in thickness throughout the length of the body.

INTERNAL CHARACTERS

Lymphocytes.—The lymphocytes are scattered sparingly throughout the greater part of the cœlom. They are nucleated and the cytoplasm is granular. The shape varies from an oval to a decidedly oblong form, and the length of some lymphocytes is about twice that of others (Pl. CI, Fig. 30).

Brain.—The brain lies in I, II, and III, chiefly in II. Its length (Pl. CII, Fig. 32) is approximately twice the greatest width. The anterior margin is decidedly conical; the posterior margin is conspicuously emarginate; and the lateral margins converge anteriorly.

In transverse section it is ovoid in shape. Studies on the living specimens revealed the fact that the depth of the posterior emargination is subject to some variation, depending upon certain changes in the states of contraction of the animal. Sometimes the emargination is rather shallow, although always distinct; at other times the emargination is deep. Two pairs of strands connect the brain with the body wall, one pair arising from the lateral margins of the brain and the other pair from the posterior lobes.

Blood Vascular System.—Studies of both living and preserved specimens show that the dorsal vessel arises in XIII. A distinct swelling of this vessel occurs in XIII, where the diameter exceeds that of any other region. No cardiac body is present. The perivisceral sinus appears in the region of the clitellum, and in transverse sections of the worm has a distinctly beaded appearance entirely around the intestine. There is reason to believe that this appearance is due to the fact that there are membranous partitions which run lengthwise of the sinus, thus dividing it into a number of longitudinal tubes. These tubes appear to be distended with blood, and when sectioned transversely exhibit a more or less circular outline. This sinus extends posteriorly from the origin of the dorsal vessel, and shows a decided reduction at the septa. The ventral vessel branches at IV/V. The blood is yellowish in the living specimens.

Nephridia.—The first nephridia are connected with VII/VIII. The anteseptal part (Pl. CII, Fig. 33) is very small and consists merely of the nephrostome. The postseptal part is large, elongated posteriorly, and flattened laterally. The efferent duct arises from the ventral side of the postseptal part, slightly anterior to its posterior end.

Spermiducal Funnel.—The spermiducal funnel is about twice as long as its average diameter. In some specimens the funnel is slightly flattened laterally. A set of typical measurements are as follows: length 0.07 mm; average diameter 0.039 mm. The duct is very long, much contorted, and confined to XII.

Penial Bulb.—This organ is well developed, and is rather conspicuous in transverse sections. It is situated on a distinct invagination of the body wall. It is globular in shape (Pl. CII, Fig. 34), particularly in cases where it is extruded. In the retracted condition it is ovoid. The organ as a whole is covered with a thin peritoneal layer, beneath which lies a comparatively thin layer of muscle tissue. The body of the bulb is composed of a large number of similar, more or less spindle-shaped cells, whose long axes extend towards the external surface. Each cell is conspicuously nucleated and usu-

ally the cell walls are distinct. When retracted, the duct enters the bulb well down on the ental side and extends through it to the exterior opening at the edge of the invagination. In the everted condition the lateral part of the bulb is depressed, the invaginated surface becoming superficial, the bulb becoming more globular in shape, the position of the entrance of the duct being shifted to the dorsal side of the bulb, and the duct extending directly to the ectal surface. Apparently the cells of the bulb are all of one kind, and all extend to the surface of the bulb, none having been found emptying into the duct.

Spermatheca.—A pair of these organs is present in V. Each spermatheca (Pl. CII, Fig. 35) consists of a well-defined duct and an ampulla. The ectal opening of the duct is in the intersegmental groove IV/V, and is latero-ventrad in position. No definite glands are present at the ectal opening. The wall of the duct is thick, and shows a number of large nuclei scattered throughout its length. The lumen is very fine. The duct is nearly straight, extending directly to the dorsal side of the digestive tract, where it expands to form the ampulla. The ovoid ampulla forms a closed sac, having no connection with the digestive tract. Its walls are quite thin, and in all of the specimens examined it was partially or entirely filled with sperm cells.

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EXPLANATION OF PLATES

ABBREVIATIONS

<i>bl. s.</i> , blood sinus.	<i>m.</i> , musculature.
<i>chl. c'l.</i> , chloragog cells.	<i>n.</i> , nucleus.
<i>chy. c'l.</i> , chylus cell.	<i>p.</i> , peritoneum.
<i>cl.</i> , cilia.	<i>p. b. s.</i> , perivisceral blood sinus.
<i>cl. c'l.</i> , clitellar cells.	<i>pen. b. i.</i> , penial bulb invagination.
<i>cut.</i> , cuticula.	<i>pen. lum.</i> , penial lumen.
<i>en. ep. c'l.</i> , ental epithelial cell.	<i>pen. po.</i> , penial pore.
<i>hyp.</i> , hypodermis.	<i>per. gl. c'l.</i> , peripheral gland cells.
<i>in. b. c'l.</i> , inner bulb cells.	<i>r. m.</i> , retractor muscle.
<i>in. c'l. c'n.</i> , intracellular canal.	<i>sp. d.</i> , sperm duct.
<i>l. cyt.</i> , lining layer of cytoplasm.	

PLATE XCVIII

Fridericia firma

- FIG. 1. Outline of anterior end, lateral view.
 FIG. 2. Seta.
 FIG. 3. Superficial section of the clitellar cells.
 FIG. 4. Outline of brain, dorsal view.
 FIG. 5. Outline of nephridium.
 FIG. 6. Part of transverse section of intestine in chylus cell region.
 FIG. 7. Chylus cell, greatly enlarged.
 FIG. 8. Outline of spermiducal funnel.
 FIG. 9. Longitudinal section, oblique to sagittal plane, through lower part of bulb

PLATE XCIX

Fridericia firma—cont.

- FIG. 10. Penial bulb in a transverse section of the worm.
 FIG. 11. Outline of spermatheca.

Fridericia tenera

- FIG. 12. Outline of anterior end, lateral view.
 FIG. 13. Superficial section of clitellar cells.
 FIG. 14. Seta.
 FIG. 15. Outline of brain.
 FIG. 16. Glands in the hypodermis.

PLATE C

Fridericia tenera—cont.

- FIG. 17. Outline of nephridium.
 FIG. 18. Longitudinal section of intestine in chylus cell region.
 FIG. 19. Outline of spermiducal funnel.
 FIG. 20. Penial bulb in a transverse section of the worm.
 FIG. 21. Outline of spermatheca.

Fridericia agilis

- FIG. 22. Outline of brain, dorsal view.
 FIG. 23. Longitudinal section of intestine in chylus cell region.

PLATE CI

Fridericia agilis—cont.

- FIG. 24. Outline of nephridium.
 FIG. 25. Outline of nephridium of the type in which the postseptal part is reflected cephalad.
 FIG. 26. Outline of spermiducal funnel.
 FIG. 27. Penial bulb in transverse section of the worm.
 FIG. 28. Outline of spermatheca.

Marionina forbesæ

- FIG. 29. Outline of anterior end, lateral view.
 FIG. 30. Lymphocytes.

PLATE CII

Marionina forbesæ—cont.

- FIG. 31. Seta hundle.
 FIG. 32. Outline of brain, dorsal view.
 FIG. 33. Outline of nephridium.
 FIG. 34. Penial bulb in a transverse section of the worm.
 FIG. 35. Outline of spermatheca.

PLATE XCVIII

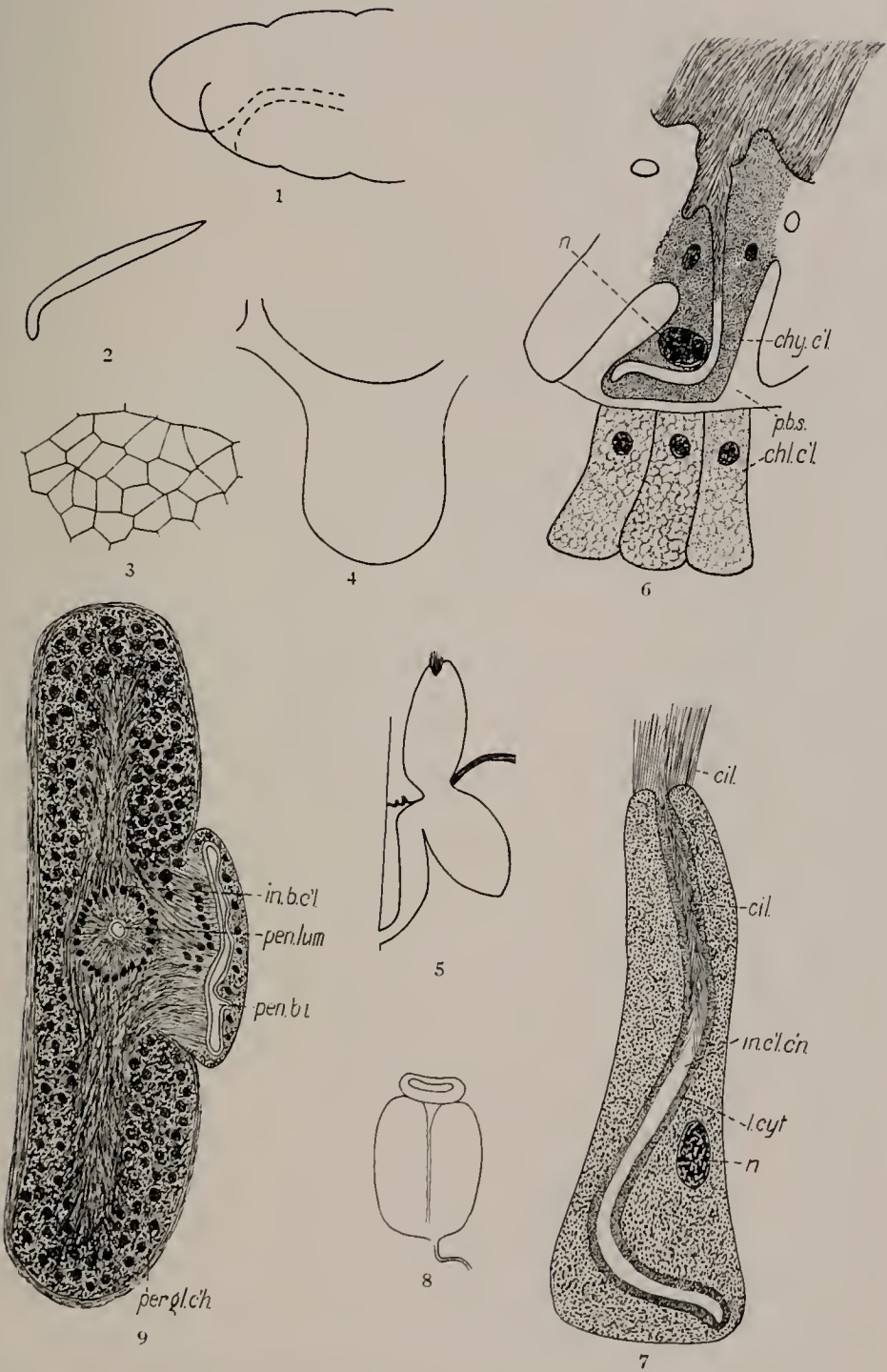
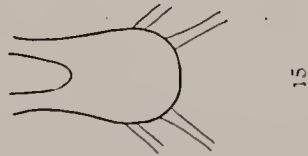
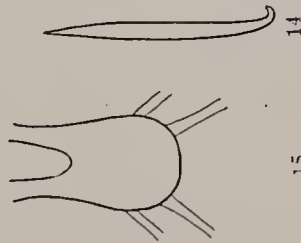
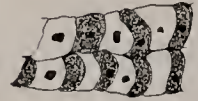
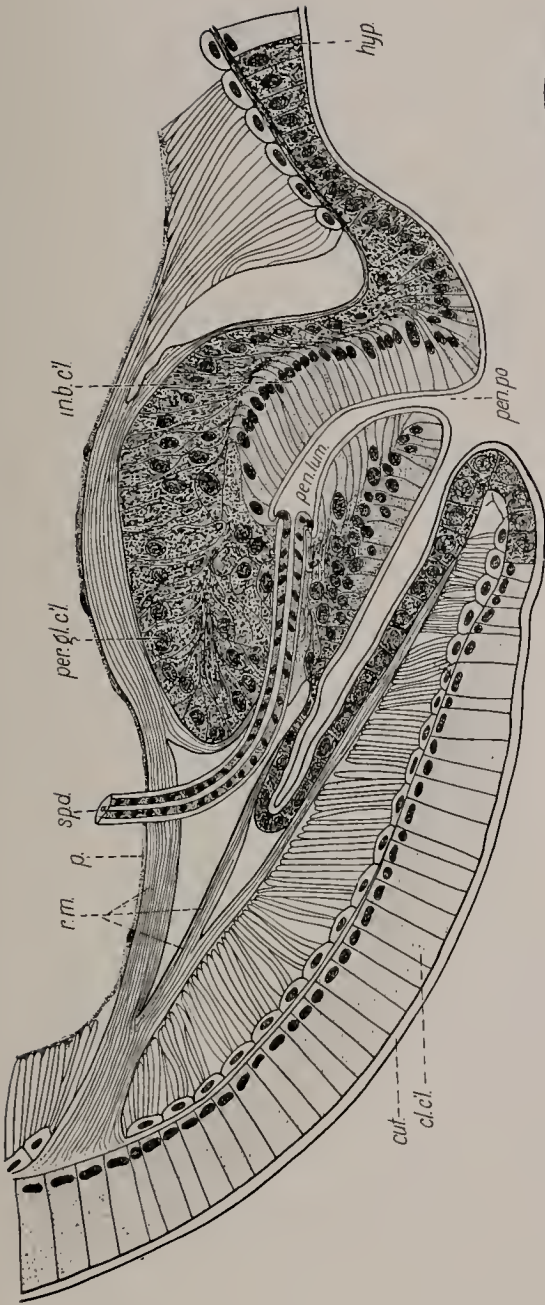


PLATE XCIX



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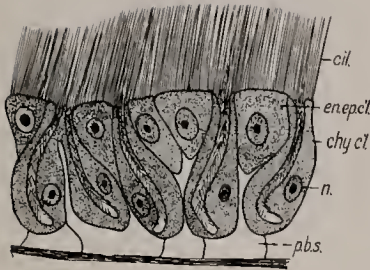
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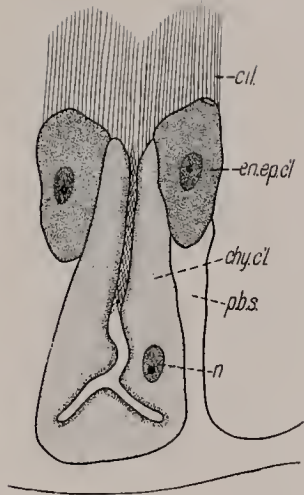
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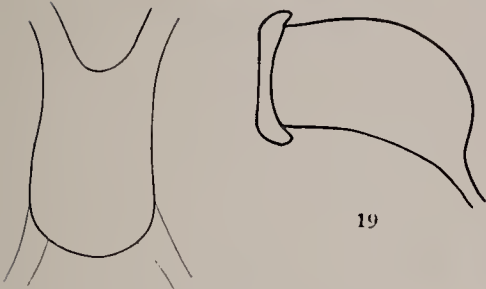
PLATE C



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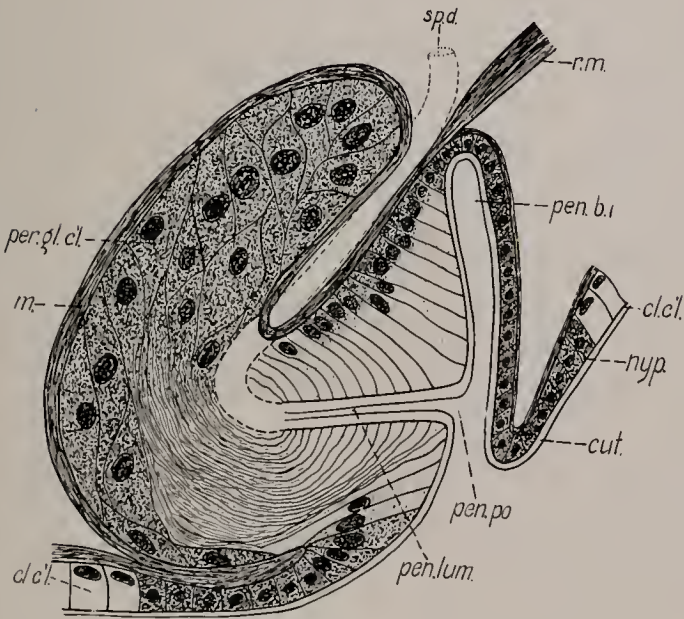


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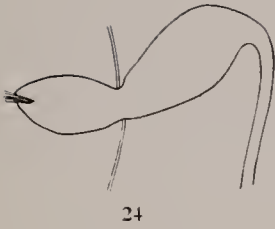


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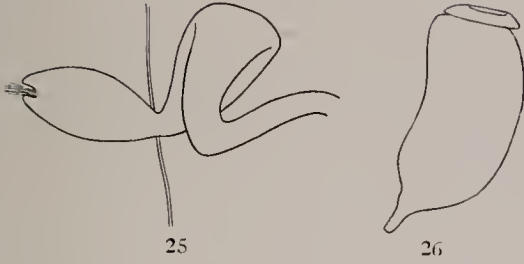
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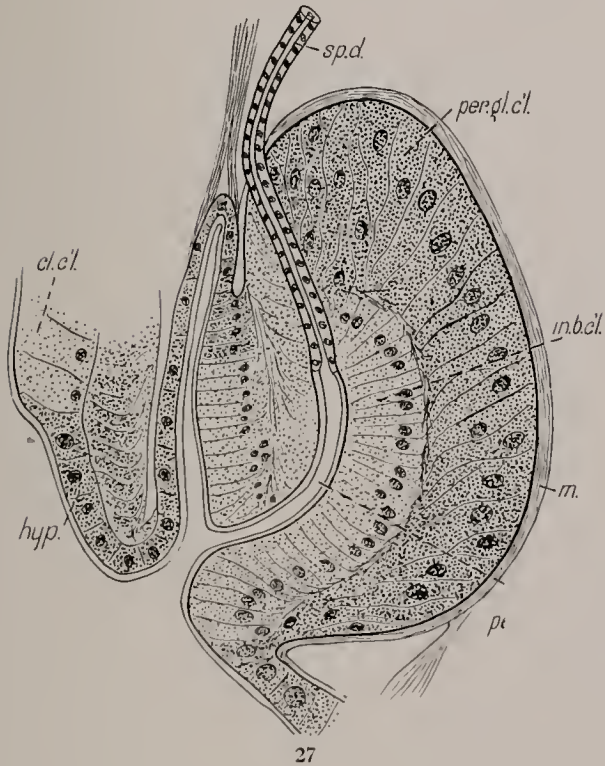


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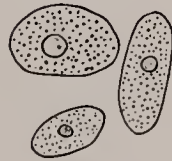
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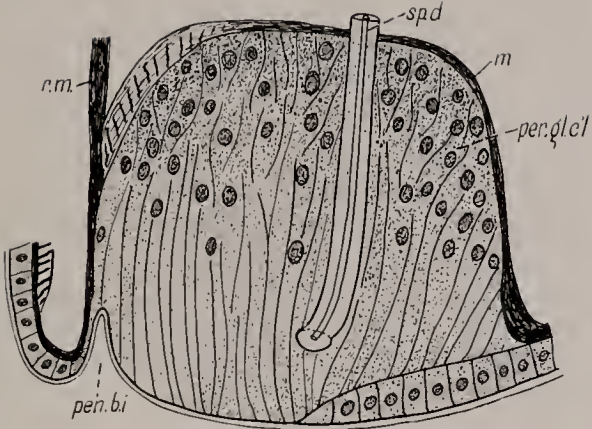


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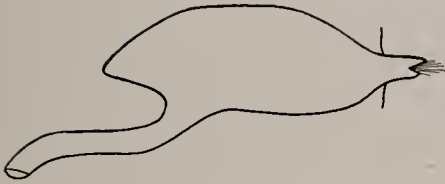


30

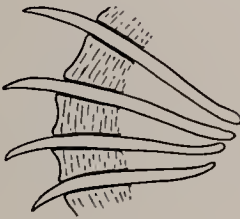
PLATE CII



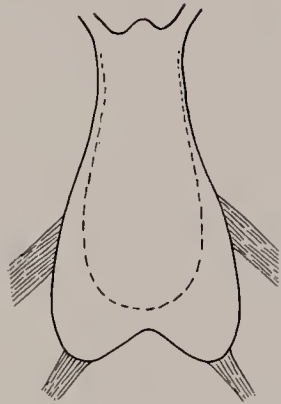
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