HIRUDINEA AND OLIGOCHÆTA COLLECTED IN THE GREAT LAKES REGION.

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I. HIRUDINEA.

The operations of the field parties directed by Prof. Jacob Reighard in connection with the biological survey of the Great Lakes yielded a large number of carefully preserved and labeled leeches, the detailed study and identification of which have required considerable time and furnished interesting data on variation that can be more profitably utilized elsewhere than in this report. The bulk of the collection comes from the western end of the lake, where a few specimens were collected in the vicinity of Put-in Bay during the summer of 1898, and a great many at the same place, at other points about the Bass Islands, at Sandusky, and along the Canadian and Ohio shores during the following summer; in the latter season also smaller collections were taken at Erie, Pa., and other places in eastern Lake Erie. As no systematic collecting seems to have been done in the small lakes, ponds, and creeks in which the large, jawed leeches abound, no representatives of the family Hirudinidæ are included; nor was any attempt made to gather the fish leeches, and the single vial containing Ichthyobdellidæ unfortunately met with an accident that prevents the determination of its contents.[a] On the other hand, the shore collecting was very thorough, and the families Glossiphonidæ and Herpobdellidæ are probably represented by every species found in such situations in Lake Erie, and in most cases by many beautifully preserved specimens. Several carefully executed water-color sketches from life, prepared by Mrs. H. S. Jennings, which are herewith published, and some notes on the living colors accompany the collection and furnish valuable data. The determination of some of the species of Glossiphonidæ is especially difficult and requires the most minute study of both internal and external features of their organization in all stages of growth and development, at different seasons, and under different nutritive conditions.

While this and other large collections studied in recent years have materially advanced the writer's knowledge in this direction, much yet remains to be done before the limits of variation and the correlations of characters can be finally defined

[a] A later systematic examination of the food fishes of Lake Erie shows that they are remarkably free from leeches.

for some of our species. Owing to the considerable attention that leeches of this family from the eastern and northern states have recently received, it is not surprising that but a single species has been added to those previously known, and it has not been thought necessary to include detailed descriptions of any others, though a key is added which will serve for typical examples, at least. Complete descriptions with figures, some of them colored, will be found in a report on the leeches of Minnesota prepared by the writer and soon to be published by the Natural History Survey of Minnesota. Some additional information will be found in Castle, North American Fresh-water Rhynchobdellidæ (Bulletin Museum Comparative Zoology, 1900), and Moore, Hirudinea of Illinois (Bulletin Illinois State Laboratory of Natural History, 1901), and in the papers therein cited. A full catalogue of the localities at which each species was taken is given, the station number being included in parentheses and followed by such data as the labels afford.

Key to the species of leeches contained in this collection.

I. Mouth a small pore in the disk of the anterior sucker from which a muscular pharyngeal proboscis may be protruded; eyes all situated close to the middle line.

a. Complete somites of 3 annuli, with the secondary furrows altogether wanting or only very slightly developed.

b. Genital pores separated by a single annulus; eyes simple, 1 pair, widely separated.

c. A brown chitinoid plate and underlying gland situated on the dorsum of somite VIII.

d. Body capable of great extension; no distinct cutaneous papillæ; color pale, pink, gray, or brownish; gastric cæca small and variable in number, never more than 6 pairs. *Glossiphonia stagnalis* (p. 157).

cc. No nuchal gland nor plate.

e. Body greatly elongated, slender and nearly terete, without cutaneous papillæ and very transparent, owing to the nearly complete absence of pigment; gastric cæca only 1 pair. *Glossiphonia nepheloidea* (p. 158).

ee. Body relatively broad and flat; cutaneous papillæ absent or in 1 to 5 rows, which may be very small or very large and often double; deeply pigmented, usually longitudinally striped or with metameric white spots on the neural annuli; gastric cæca always 6 pairs, of moderate size and simple form..... *Glossiphonia fusca* (p. 158).

bb. Genital pores separated by 1 annulus; 3 pairs of simple eyes grouped in twos in a more or less triangular figure.

f. Body very thin, broad, and flat; no distinct cutaneous papillæ; integument transparent and pigment nearly absent; gastric cæca 6 pairs, of moderate size and nearly or quite unbranched ..... *Glossiphonia heteroclita* (p. 159).

bbb. Genital pores separated by 2 annuli; 3 pairs of simple eyes in 2 nearly parallel rows.

g. Body relatively broad and short; cutaneous papillæ low and rounded, no median series; usually deeply pigmented and having a pair of narrow dark longitudinal lines reaching from the eyes to the posterior end; gastric cæca 7 pairs, of moderate size and slightly branched ..... *Glossiphonia complanata* (p. 159).

bbbb. Genital pores separated by 2 annuli; a single pair of compound eyes more or less completely united in a single pigment mass; gastric cæca 7 pairs, of large size and much branched; salivary glands compact.

h. Somites I to V distinctly widened to form a discoid "head."

i. Somites I and II biannulate; dorsum marked by 3 strong papillated keels. *Placobdella montifera* (p. 160).

hh. Anterior somites (I to V) not especially widened.

j. Body very much depressed; the cutaneous papillæ low and smooth; integuments opaque, and the color a conspicuous pattern of some shade of olive

green and yellow, below longitudinally striped; *a*2 more closely united to *a*1 than to *a*3 on all anterior somites; *a*3 without trace of a secondary furrow; size large.....*Placobdella parasitica* (p. 159).

jj. Much depressed, with very inconspicuous, low and smooth papillæ; integuments translucent and not deeply pigmented, usually striped longitudinally below; the union of *a*1 and *a*2 not especially conspicuous; the annulus *a*3 with a distinct incomplete cross furrow on all complete somites; size medium.....*Placobdella picta* (p. 159).

jjj. Much depressed, the back with very numerous papillæ, the largest of which are very prominent and rough; integuments translucent; colors a mixture of browns, greens, and yellows founded on a much broken longitudinal pattern, often longitudinally striped below; *a*3 not subdivided and the dorsal and ventral furrows not accurately meeting; size large. *Placobdella rugosa* (p. 160).

jjjj. Moderately depressed, with more or less numerous and roughened papillæ; integuments translucent; colors variable, much as in the last, but brighter and with more dark pigment on the neural annulus and a more constant median dorsal dark stripe, interrupted by 5 or 6 pale spots; differs from all other species of this key in the several pairs of accessory eyes which follow the compound ones; size medium.....*Placobdella hollensis* (p. 160).

jjjjj. Not greatly depressed, rather slender anteriorly; cutaneous papillæ usually in a median and one paired series, small, acute, and pale yellow or brown; color pattern chiefly longitudinal brown and green stripes, interrupted by light areas; a very conspicuous and constant pale band across the entire width of somite VI; differing from all similar foregoing species in the circle of small papillæ on the margin of the caudal sucker; size small.....*Placobdella phalera* (p. 160).

aa. Complete somites of 6 unequal annuli formed by the subdivision of the 3 primary rings.

k. Three series of prominent dorsal papillæ; caudal sucker large and mobile, with a circle of about 60 marginal papillæ and glands ...*Actinobdella annectens* (p. 160).

II. Mouth relatively large, occupying the entire cavity of the anterior sucker; the pharynx not forming a protrusible proboscis; eyes partly situated on the sides of the head; somites of 5 annuli.

l. Annulus *b*6 not obviously enlarged and subdivided.

m. Eyes 3 pairs; male pore at XII *b*2/*a*2; female pore at XII *b*5/*b*6; the vas deferens forming a loop reaching forward of the atrium to ganglion XI.....*Erpobdella punctata* (p. 163).

ll. Annulus *b*6 distinctly longer than the others and subdivided into two.

n. Eyes 3 pairs; male pore at XII *b*2/*a*2; female pore at XII/XIII; the atrial cornua inconspicuous and passing abruptly into the vas deferens which lacks the anterior loop ...*Dina microstoma* (p. 163).

nn. Eyes 3 or 4 pairs; genital orifices as in *m*; the atrial cornua prominent and the vasa deferentia without anterior loops.

Dina fervida (p. 163).

GLOSSIPHONIDÆ.

Glossiphonia stagnalis (Linnæus).

Abundant everywhere in shallow waters, but especially so at Erie, Pa. Examples from Sandusky, Ohio, bearing young to the middle of August. (Pl. XXXII, fig. 2.)

(90*a*) Lemna Pond, South Bass Island, Ohio, July 5, 1899.

(95*a* and 96*a*) North Bass, Swamp, Put-in Bay, Ohio, July 21, 1899. The commensal ciliate that lives attached to the nuchal gland of this species occurs in particularly luxuriant colonies on these specimens.

(111) Pond near Hatchery, South Bass Island, Ohio, August 18, 1898.

(111*a*) Middle Bass, Ohio, North Swamp, July 24, 1899.

(115) South Bass Island, Ohio, swamp near East Point, August 24, 1899.

(125*a*) East Harbor, Sandusky, Ohio, July 28, 1899; a single unusually large example.
(127) Shore of South Bass Island, Ohio, September 10, 1898.
(179*a*) East Harbor, Ohio, near Lakeside, August 4, 1899; from flag leaves.
(192*a*) East Harbor, Sandusky, Ohio, August 7, 1899; from wild rice.
(209*a*) East Harbor, Sandusky, Ohio, August 9, 1899.
(268*a*) Erie, Pa., north shore, on logs, August 14, 1899.
(313*a*) Long Pond, Erie, Pa., August 15, 1899.
(365*a*) Long Point, Canada, August 21, 1899.
(380*a*) Long Point, Canada, August 21, 1899; 1 specimen taken from a rock bass.
(459*a*) Rondeau Harbor, Ontario, from East Swamp, August 28, 1899.

Glossiphonia nepheloidea (Graf).

This species, which is fully described by Castle under the name of *G. elongata*, is represented by but 3 specimens from (67) Put-in Bay, Ohio, August 12, 1898 (under rocks); (266*a*) Erie, Pa., Graveyard Swamp, August 14, 1899 (from stones and rocks). Two examples from the latter locality are very greatly elongated.

Glossiphonia fusca Castle.

The earliest name given to any of the varieties included under this species is *Clepsine papillifera lineata* Verrill, but as the prior *Hirudo lineata* Müller is almost certainly *Glossiphonia complanata*, and R. Blanchard has shown that the closely related *G. triserialis* E. Blanchard differs in the position of the male genital pore, Castle's name becomes the earliest available. *G. fusca* is the most variable of our *Glossiphoniæ*, and the extremes are so unlike that were they alone in hand no hesitation would be felt in arranging them in two or three distinct species, and it is possible that further study may lead to the recognition of two. The large number of specimens, amounting to between 200 and 300, belonging to the present and other collections that have been carefully studied show that the extremes in color pattern, papillation, size of salivary glands and gastric cæca, length of the stalks of the nephridial funnels, and the degree of development of the cœlomic sinuses are connected by a more or less complete series of gradations. It has not yet been found possible to fully correlate the occurrence of these and other characters, but three well-marked types or varieties may be distinguished: One, having the nearly uniform ground color and metameric white spots of the typical *fusca* as described by Castle, includes most of the smaller nonpapillated individuals; another has a sharply defined longitudinally striated pattern (pl. XXXII, fig. 5) with 1 or 3 rows of small, usually deeply pigmented papillæ like the form figured by Graf under the designation of *Clepsine b;* some of the smaller and most of the medium sized specimens are of this variety; in the largest examples the body tends to become more elongated, flatter, and thinner, and most of the brown pigment becomes concentrated in five or seven rows of exceedingly large papillæ, many of which are double. The eyes are relatively farthest apart, the first pair of gastric cæca small or absent, and the cœlomic spaces best developed in the small, typical *fusca*, while the opposite extremes in these features are likely to occur in the largest and most strongly papillated forms. In all of the three or four examples of each variety sectioned the stalks of the nephridial funnels are longer in the *lineata* than in the *fusca* type, but not noticeably different from those of the strongly papillated variety. All three forms are well represented in the collection and are separated, though sometimes perhaps arbitrarily, in the following list:

TYPICAL FUSCA TYPE.

(103) Sandusky Bay, Ohio, August 18, 1898.
(268*a*) Erie, Pa., north shore, August, 1899; from logs near shore.
(269*a*) Erie Bay, Pennsylvania, August 14, 1899.
(314*a*) Boat Harbor, Erie, Pa., August 16, 1899; from *Ceratophyllum*.
(343*a*) Long Point, Canada, August 18, 1899.
(457*a*) Rondeau Harbor, Ontario, August 28, 1899.

LINEATA TYPE.

(180*a*) East Harbor, Sandusky, Ohio, near Lakeside, August 4, 1899; from flags.
(209*a*) East Harbor, Sandusky, Ohio, August 9, 1899.
—— Huron, Ohio, August 10, 1899.
(269*a*) Erie, Pa., north shore of Erie Bay, August 14, 1899.
(307*a*) Erie, Pa., boat landing, August 16, 1899; from *Sagittaria*.
(314*a*) Boat Harbor, Erie, Pa., August 16, 1899; from *Ceratophyllum*.
(327*a*) Long Point, Canada, August 18, 1899.
(365*a*) Long Point, Canada, August 21, 1899.
(456*a*, 459*a*, 460*a*) Rondeau Harbor, Ontario, East Swamp, August 28, 1899. One specimen only 4 mm. long has the longitudinally striated pattern very strongly developed.

STRONGLY PAPILLATED TYPE.

(200*a*) East Harbor, Sandusky, Ohio, August 8, 1899.
(325*a*, 343*a*) Long Point, Canada, August 18, 1899.
(457*a*, 460*a*) Rondeau Harbor, Ontario, East Swamp, August 28, 1899.

Glossiphonia complanata (Linnæus) Johnston.

A common species. (Pl. XXXII, fig. 4.)
(40*a*, 109*a*) Middle Bass Island, Ohio, North Swamp, July 24, 1899.
(92*a*) North Bass Swamp, Put-in Bay, Ohio, July 21, 1899.
(125*a*) East Harbor, Sandusky, Ohio, July 28, 1899.
(178*a*) East Harbor, Sandusky, Ohio, near Lakeside, August 4, 1899; from flag leaves.
(326*a*) Long Point, Canada, August 18, 1899.
(365*a*) Long Point, Canada, August 21, 1899.
(380*a*) Long Point, Canada, August 23, 1899; from rock bass.
(439*a*) Rondeau Harbor, Ontario, August 28, 1899; East Swamp.

Glossiphonia heteroclita (Linnæus).

This species is either rare in Lake Erie or, on account of its small size and pale color, was overlooked. It was collected in small numbers at but three localities.
(268*a*) Erie, Pa., August, 1899; from logs on north shore.
(327*a*) Long Point, Canada, August 18, 1899.
(459*a*) Rondeau Harbor, Ontario, August 28, 1899; from East Swamp.

Placobdella picta (Verrill).

Taken only in the western end of the lake. The length and distinctness of the median light stripe vary greatly. (Pl. XXXII, fig. 3.)
(33*a*) South Bass Island, East Swamp, July 10, 1899.
(91*a*, 92*a*) Put-in Bay, Ohio, North Bass Swamp, July 21, 1899.
(110*a*) Middle Bass Island, Ohio, Middle Swamp, July 24, 1899.
(109*a*) Middle Bass Island, Ohio, North Swamp, July 24, 1899.
—— East Haven, Sandusky, Ohio.

Placobdella parasitica (Say).

Nearly all of the examples of this species were taken from snapping turtles; one very large one in the bottom tow (39*a*).
(9*a*) South Bass Island, Ohio, Lemna Pond, July 5, 1899.
(39*a*) Put-in Bay, Ohio, July 15, 1899; bottom tow.
(77*a*) Put-in Bay, Ohio, July 17, 1899.
(97*a*) North Bass Island, July 20, 1899; from carapace of turtle.
(135) Put-in Bay, Ohio, Squaw Bay, September 13, 1898.

(137*a*) Sandusky, Ohio, East Harbor, July 28, 1899.
(345*a*, 346*a*) Long Point, Canada, August 19, 1899.
(440*a*) Rondeau Harbor, Ontario, East Swamp, August 28, 1899.

Placobdella rugosa (Verrill).

This common and variable species is widely distributed and occurs either free or parasitic on fishes and turtles.

(8*a*) South Bass Island, Ohio, Lemna Pond, July 6, 1899.
(10*a*) South Bass Island, Ohio, Lemna Pond.
(44) South Bass Island, Ohio, August 16, 1898; on sticks near hatchery.
(92*a*) Put-in Bay, Ohio, North Bass Swamp, July 21, 1899.
(210*a*) West Harbor, Ottawa County, Ohio, August 8, 1899; on *Planorbis*.
(267*a*) Erie, Pa., Graveyard Swamp, August 14, 1899.
(343*a*) Long Point, Canada, August 18, 1899.
(380*a*) Long Point, Canada, August 23, 1899; from rock bass.
(403*a*) Long Point, Canada, September 24, 1899.
—— Huron, Ohio, August 10, 1899.

Placobdella hollensis (Whitman).

A single specimen colored exactly on the pattern of Graf's figure and with typical annulation and eyes was taken at East Swamp, Rondeau, Ontario, August 28, 1899.

Many examples of this species are provided with cutaneous papillæ almost as large and rough as those of *P. rugosa*, and it is often difficult to assign examples to one or the other species. Generally the eyelike character of the anterior dorso-median sensillæ is sufficient and this species is seldom so broad and flat, nor is the lack of agreement of the dorsal and ventral furrows so evident as in *P. rugosa*.

Placobdella montifera nom. nov.

This is the species known in my paper on the Hirudinea of Illinois as *Hemiclepsis carinata* (Verrill). The resemblance to one species of *Hemiclepsis* is entirely superficial and the name *carinata* has been already used by Grube for a species of this genus, requiring that a new one be coined. In the character of its papillation, the incipient subdivision of its annuli, and the papillæ of the posterior sucker, which are very small and number 110 or more, this species approaches *Actinobdella*. The form of the broadly expanded head is, however, distinctive of it among the known species of leeches of North America.

(379*a*) Long Point, Canada, August 28, 1899; from rice grass.
(403*a*) Long Point, Canada, September 24, 1899.

Placobdella phalera (Graf).

Several specimens of a small leech which is rather doubtfully referred here conform closely with Graf's account of the arrangement of pigment, reserve cells, and other features of *P. phalera*. Two of the most striking characters of the species are the strongly developed band of reserve cells, appearing on the surface as a white or pale-yellow stripe, which extends entirely across the neck at somite VI, and the serrated margin of the posterior sucker, which has a circle of small papillæ as in *Actinobdella annectens*, but lacks the definite aggregated glands.

(178*a*) East Harbor, near Lakeside, Ohio, August 4, 1899; from flag leaves.
(196*a*) East Harbor, Sandusky, Ohio, August 7, 1899.
(324*a*) Long Point, Canada, August 16, 1897.

Actinobdella annectens sp. nov. (text figs. 1 and 2).

Most interesting of the leech collections is a specimen, fortunately well preserved, of a new species of *Actinobdella* which, together with an example of *A. inequiannulata* described in the Report on the Leech Fauna of Minnesota, clearly shows that this genus belongs to the Glossiphonidæ and not to the Ichthyobdellidæ as I was erroneously led to suppose from a knowledge of the superficial characters alone

of the type. Much is yet lacking in our knowledge of the organization of these interesting leeches, but it is hoped that a complete account of their anatomy can soon be published. At the present time it seems evident that *Actinobdella* approaches *Placobdella* most closely, especially in the character of the reproductive organs, gastric cæca, and sense organs, while it differs from that genus and resembles *Glossiphonia* in the possession of diffuse instead of compact salivary glands. The fact that certain species of *Placobdella*, notably *P. phalera* and *P. montifera*, possess small marginal papillæ on the caudal sucker is a further indication of relationship which may eventually necessitate a generic grouping somewhat different from that here adopted.

A. annectens, like *A. inequiannulata*, is a small blood-sucking glossiphonid, the type of which is 9 mm. long, 2 mm. wide, and about 1 mm. high. The general form is much like that of *Glossiphonia fusca* but considerably more slender; the body is strongly convex above, flat below, the region of the gastric cæca about half round; the head end, with the sucker and mouth, have the typical glossiphonid form; and the thick, prominent, hemispherical caudal sucker measures 1.2 mm. in diameter

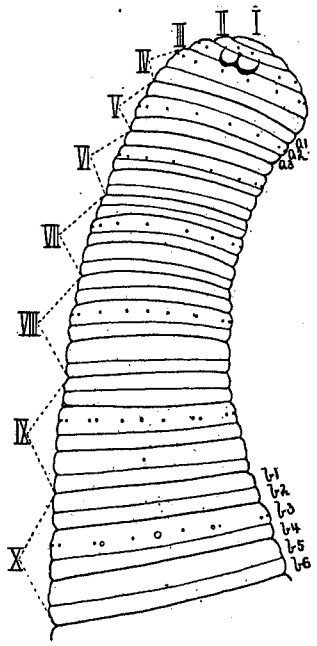

FIG. 1.—*Actinobdella annectens.* Annulation and sensillæ of anterior end. × 30.

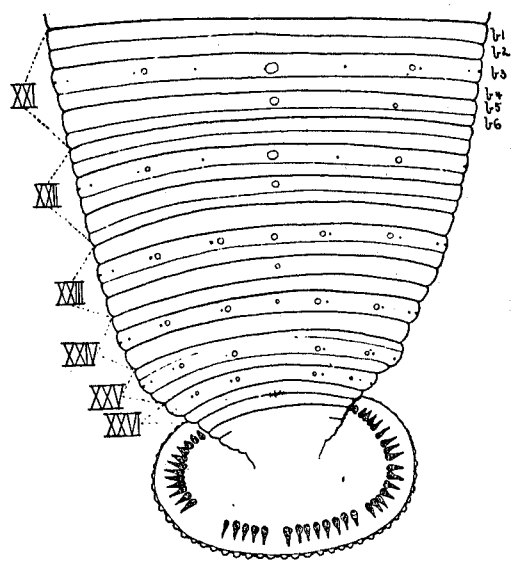

FIG. 2.—*Actinobdella annectens.* Posterior end showing annulation, sensillæ, posterior sucker, etc. × 30.

and its pedicle is contracted and centrally attached, indicating great mobility in this region. The marginal papillæ of the caudal sucker form a ready means of distinction between this species and *A. inequiannulata*, for whereas the latter possesses about thirty very prominent papillæ, *A. annectens* has about sixty much smaller ones. They are unfortunately much contracted, but are clearly continuations of radiating ridges on the ventral surface of the sucker and have the same structure and relation to compact aggregated glands as in the type species. These glands form a conspicuous ring a short distance from the margin of the sucker, the dorsal surface of which they elevate into a circular ridge. In correspondence with the smaller and more numerous papillæ these glands differ from those of *A. inequiannulata*, and at places the continuity of the ring is interrupted by the absence of several together.

A single pair of very large and conspicuous eyes are situated on somite III, with their pigment cups in contact and united in the middle line and reaching into IV. Immediately behind the eyes is a large aggregation of reserve cells extending over the middle portion of somites IV and V and margined by pigment cells. A similar patch occurs on annuli VI *a*3 and VII *a*1, and others are

distributed much as in *Placobdella phalera*. The position of the genital pores is quite as in *Placobdella*, the male orifice being situated between somites XI and XII and the female between the second and third primary annuli of XII. The anus is behind XXVI.

The metameric sensillæ are very obscure on the ventral but easily distinguished on the dorsal surface; they present quite the arrangement typical of the family. Dorsal cutaneous papillæ are also well developed from somites XIII to XXVI inclusive, and the larger ones may be traced faintly anterior of the genital somites as far forward as VI As in *A. inequiannulata* the strictly median series is by far the most conspicuous and dominant one and is represented on the complete and typical somites by a large papilla on the annulus *b*3 and a somewhat smaller one on *b*5. On XXIII these papillæ suddenly become reduced greatly in size and by XXV have disappeared, while rather prominent dorso-median papillæ are coincidently developed on each side and continue to XXVI. Dorso-lateral papillæ on *b*3 are nearly as constant but much smaller as far back as somite XXVI, and on many of the typical somites a corresponding but still smaller papilla occurs in a more median position on *b*5. It will be noticed that in the arrangement of the papillæ, as in so many other characters, this species stands between *A. inequiannulata* and *Placobdella montifera* and *P. phalera*.

In the manner of subdivision of typical somites into annuli this species closely follows the type of the genus. The first primary annulus (*a*1) is always much smaller than *a*2 or *a*3, and is completely subdivided into two short equal or nearly equal rings (*b*1 and *b*2); the primary neural annulus (*a*2) is divided into a larger anterior ring (*b*3), which bears the papillæ and metameric sensillæ and a much smaller posterior ring (*b*4); the third primary annulus (*a*3) is similar in size and mode of subdivision to the second, and its larger anterior annulus (*b*5) bears the papillæ, while the small *b*6 is naked. Somites VII to XXII are complete, although *a*3 is already much smaller than *a*2 even on XXI, and on XXII the furrow *b*5/*b*6 is not quite complete. On XXIII all secondary furrows are nearly absent and *a*3 is a small simple ring. On XXIV *a*1 is barely separated from *a*2; XXV and XXVI are typically biannulate, and several obscure annuli in the caudal pedicle represent postanal somites. The annulation of the anterior incomplete somites is very clear, and shows that elaboration has progressed farther in this species than in *A. inequiannulata*. Somite VI has *a*1 undivided, V is triannulate with *a*2 somewhat enlarged, IV is biannulate with the furrow *a*1/*a*2 indicated, III is a broad, practically undivided annulus, and II and I are simple and undivided. (See figs. 1 and 2.)

A few features of the internal anatomy may be noted. The probocis is slender and, as retracted in this specimen, reaches from XI to VIII. The salivary glands are of the diffuse type and open into the œsophagus in X or XI; they are greatly developed and densely packed by the sides of the alimentary canal as far forward as the anterior part of somite VIII. Exactly similar glands are developed in large numbers along the sides of the body to somite XXIV, but it is impossible to determine definitely in the entire leech to what extent these are salivary or clitellar and cutaneous glands. There are seven pairs of well-developed branched gastric cæca arising in somites XIII to XIX, inclusive, arranged as in *Placobdella*, though not so large and completely branched as in the broad flat species of that genus. The first pair have slender anterior lobes which reach forward by the sides of the reproductive organs to the anterior end of XII; the seventh pair reach backward beside the intestine to XXIII, with five lateral lobes in somites XIX to XXIII. The narrow and posteriorly somewhat tortuous intestine bears the usual four pairs of cæca crowded into three somites (XX to XXII). Although conforming to the general type of the reproductive organs of *Placobdella*, the male afferent ducts are more elongated and slender than in most species and reach to a sperm sac situated on the boundary between XII and XIII, being thus less compact and more open in arrangement than in most species of *Placobdella*. The greater part of the sinus system was worked out and found to conform in most respects to what is found in the Glossiphonidæ generally, one important characteristic being that the submarginal circular sinus of the posterior sucker is connected with the axial sinus behind the anus by 15 or 16 radiating canals. The type specimen (no. 5228, U. S. National Museum) is from station 346*a*, Long Point, Canada, August 18, 1899, and was taken with *P. parasitica* from a snapping turtle. The colors are lost in alcohol.

HERPOBDELLIDÆ.

Erpobdella punctata (Leidy).

Abundant throughout the lake region. (Pl. XXXII, fig. 1.)
(5*a*) South Bass Island, Ohio, pond near hatchery, July 6, 1899.
(7*a*, 8*a*, 9*a*) South Bass Island, Ohio, Lemna Pond, July 6, 1899.
(33*a*) South Bass Island, Ohio, East Swamp, July 10, 1899.
(43) South Bass Island, Ohio, August 17, 1898; shore.
(45) Put-in Bay Island, Ohio, Squaw Bay, August 15, 1898.
(67) Put-in Bay, Ohio, August 12, 1898; under rocks.
(89*a*, 90*a*) North Bass Island, Ohio, swamp, August 22, 1898.
(111*a*) Middle Bass Island, Ohio, North Swamp, July 24, 1899.
(115) South Bass Island, Ohio, swamp near East Point, August 24, 1899.
(118) South Bass Island, Ohio, August 22, 1898.
(127) South Bass Island, Ohio, September 10, 1898; shore.
(135) Put-in Bay, Ohio, September 13, 1898.
(136*a*) North Bass Island, Ohio, swamp, July 21, 1899.
(195*a*) North Bass Swamp, Ohio, July 21, 1899.
(266*a*) Erie, Pa., Graveyard Swamp, August 14, 1899; on stones and flags.
(365*a*) Long Point, Canada, August 21, 1899.
(403*a*) Long Point, Canada, August 24, 1899.
(438*a*) Rondeau Harbor, Ontario, East Swamp, August 28, 1899.

Dina fervida (Verrill).

Quite as plentiful as *E. punctata*, but apparently most abundant at the eastern end of the lake. (Pl. XXXII, fig. 6.)
(6*a*) South Bass Island, Ohio, Lemna Pond, July 6, 1899.
(44) South Bass Island, Ohio, pond near hatchery, August 16, 1898.
(124*a*) Sandusky, Ohio, East Harbor, July 28, 1899.
(191*a*) Sandusky, Ohio, East Harbor, August 7, 1899.
(219*a*, 220*a*) East Harbor, Ottawa County, Ohio, near Lakeside, August 4, 1899; on flags.
(266*a*) Erie, Pa., Graveyard Swamp, August 14, 1899; from stones and flags.
(271*a*) Erie, Pa., north shore, August 17, 1899.
(312*a*) Erie, Pa., Long Pond, August 15, 1899.
(317*a*) Erie, Pa., August 16, 1899.
(333*a*) Long Point, Canada, near boat landing, August 18, 1899.
(342*a*) Long Point, Canada, August 16, 1899.
(365*a*) Long Point, Canada, August 21, 1899.
(437*a*, 438*a*) Rondeau Harbor, Ontario, East Swamp, August 28, 1899.

Dina microstoma Moore.

In striking contrast to the abundant *Dina fervida* this species was found singly at but two stations.
East Harbor, Ottawa County, Ohio, August 5, 1898; on *Chara*.
(266*a*) Erie, Pa., Graveyard Swamp, August 14, 1899; on stones with *D. fervida*.

II. OLIGOCHÆTA.

This report is based upon collections made on Lake St. Clair in 1893, and on the upper end of Lake Michigan and the small lakes south of the Strait of Mackinaw in 1894 by a party sent out by the Michigan fish commission, and by the biological survey of Lake Erie under the auspices of the United States Fish Commission in 1899. Both parties were under the direction of Prof. Jacob Reighard, by whom the

material was sent to me for determination. Most of the work in 1893 was done in the immediate vicinity of New Baltimore, at the northern extremity of Lake St. Clair, and so far as relates to the group of animals under consideration by Prof. H. B. Ward, who furnishes some careful notes and drawings of several species. A preliminary report on the field operations has been published as Bulletin No. 4 of the Michigan fish commission (Lansing, 1894), in which will be found some account of the physical and biological conditions of the region. The Oligochæta were originally sent to Dr. Eisen, who made a preliminary examination and brief report, but has been prevented from completing his studies. Dr. Eisen's list, published in the above-mentioned bulletin, is as follows, the name included in parenthesis following each of Eisen's determinations being, so far as can be determined, the corresponding name in the present report: Genus related to *Thamnodrilus* (*Sparganophilus eiseni*); new genus of Lumbriculidæ (*Thinodrilus inconstans*); two species of *Stylaria* (*S. lacustris* and *S. fossularis*); *Bohemilla* sp. (not found); *Pristina* (*P. leidyi*); *Naidium* (not found), and *Chætogaster* (*C. diaphanus* and *C. limæi*). The collections in Lake Erie were made chiefly in the vicinity of the Bass Islands, Sandusky, and other points at the western end of the lake, though a few Oligochæta were taken at Erie, Pa., and at points on the Canadian shore.

As most of the 15 species included in the two collections are well known either in this country or Europe, no descriptions of them are given in this paper, but after the name of each there is inserted a reference to one of the best easily accessible published descriptions, in nearly every case well illustrated. A key has been added, however, for the discrimination of the species, and the characters given are sufficient in most cases to separate them with considerable certainty from related species inhabiting the same waters. A full list of the localities at which each species was taken is given, the parenthesized number referring in each case to the station, and the data that follow being transcripts of the labels. Of the 15 species enumerated, 10 belong to the strictly aquatic family Naididæ and probably represent the majority of those likely to occur in this fauna. Several additional species of the Æolosomatidæ and Lumbriculidæ and many of the Tubificidæ are likely to be met with in the waters of the Great Lakes, while many Lumbricidæ and other earthworms have already been recorded from the bordering states.

Key to species of Oligochæta reported upon.

a. Size small; reproduction chiefly by means of serial asexual buds; sexually mature individuals rarely found; digestive tract simple; always strictly aquatic.

b. Central nervous system imperfectly developed, intimately connected with epidermis throughout; internal metamerism incomplete owing to the absence of some or all of the dissepiments. (Æolosomatidæ.)

c. In addition to capillary setæ the posterior bundles at least contain alternating shorter, straight, curved, or bifid setæ; prostomium broader than peristomium; integumental oil drops usually with a yellow or green tint..... *Æolosoma tenebrarum* (p. 166).

bb. Central nervous system complete, the brain, at least, quite distinct from the epidermis; dissepiments completely developed; forked setæ exclusively present in ventral bundles. (Naididæ.)

d. Prostomium distinct and more or less prominently developed; somite III not enlarged and the pharynx small and much shorter than the œsophagus; number of somites not greatly reduced; ventral setæ normally present on all somites behind the peristomium.

e. Prostomium produced into a papilliform or tentacular process.

f. Dorsal setæ beginning on somite III, partly capillary, partly acicular in each bundle; prostomial process a short papilla.....*Naidium sp.* (p. 166).

ff. Dorsal setæ beginning on somite II, all capillary and those on III greatly elongated; except in the first two bundles the dorsal setæ are roughened with minute spines; prostomial process a long, slender tentacle.....*Pristina leidyi* (p. 166).

fff. Dorsal setæ beginning on VI, exclusively capillary and smooth, and those on III not materially longer than the others; prostomium without lateral lobes and tapering regularly into the slender elongated tentacle.....*Stylaria fossularis* (p. 167).

ffff. Like *S. fossularis*, except that the prostomium is provided with a pair of lobes, from the cleft between which the tentacular proboscis arises....*Stylaria lacustris* (p. 167).

ee. Prostomium rounded, without any produced process.

g. Dorsal setæ bundles present on all somites except the first five.

h. Dorsal setæ exclusively capillary, those on VI much longer than the others; integumental sense papillæ of large size and metameric; no expanded caudal plate.....*Slavina gracilis* (p. 167).

hh. In addition to the capillary setæ dorsal bundles contain some that are curved and bifid or simply acicular, those on VI not longer than the others; no expanded caudal plate.....*Nais elinguis* (p. 166).

hhh. Dorsal bundles composed of both acicular and capillary setæ not especially elongated on VI; the caudal somite broadly expanded into a plate bearing marginal ciliated branchial processes.....*Dero limosa* (p. 167).

gg. Dorsal setæ totally absent from all segments.

i. Form elongated as in *Nais*, the prostomium well developed; only 2 or 3 setæ in the ventral bundles.....*Schmardaella filiformis* (p. 168).

dd. Prostomium rudimentary and not distinct from peristomium; somite III much enlarged for the accommodation of the large pharynx, which equals or exceeds the œsophagus in length; number of somites small, about 15 for the single zooid; ventral setæ totally wanting from somites III to V and dorsal setæ absent from all somites.

j. Length of living animal 10 to 15 mm.; the œsophagus short but distinct; habit free living.....*Chætogaster diaphanus* (p. 168).

jj. Length of living animal 2 to 4 mm.; the œsophagus very short and indistinct; usually parasitic on water snails.....*Chætogaster limnæi* (p. 169).

aa. Size moderate or large; reproduction normally by the sexual method alone; alimentary canal often complicated by the development of a crop, gizzard or other organs; aquatic, semiaquatic or terrestrial. (Lumbriculidæ, Tubificidæ, Glossoscolecidæ, and Lumbricidæ.)

k. All setæ hooked and bifid distally, more than 2 per bundle in the preclitellar segments at least; a single pair of spermiducal funnels in X, 1 pair of spermathecæ in X; prostate glands elongated.....*Limnodridus gracilis* (p. 169).

kk. All setæ hooked and slightly bifid distally and arranged on all somites in 2 dorsal and 2 ventral pairs; 2 pairs of sperm funnels in somites IX and X; 5 pairs of spermathecæ in XI to XV or XII to XVI..*Thinodrilus inconstans* (p. 169).

kkk. Setæ simple-pointed but slightly ornamented, arranged in pairs as in *kk;* prostomium continuous with peristomium; clitellum extending from XIV to XXVI; male pores on XIX; 3 pairs of spermathecæ in VI, VII, and VIII; a pair of large glands in III; no muscular gizzard.
Sparganophilus eiseni (p. 170).

kkkk. Setæ as in *kkk*, but entirely without ornamentation; prostomium dovetailed into peristomium from which it is separated at the sides by grooves; clitellum beginning on XXV, XXVI, XXVII, or XXVIII, and ending on XXXIII, XXXIV, or XXXV; male pores on XV; 2 pairs spermathecæ in IX and X; gizzard well developed.....*Helodrilus caliginosus* (p. 171).

ÆOLOSOMATIDÆ.

Æolosoma tenebrarum Vejdovsky.

Æolosoma tenebrarum Vejdovsky, System u. Morphologie der Oligochaeten, p. 21. 1884.

Three specimens in the Lake St. Clair collection agree closely with this European species which has been recorded from Illinois by Professor Smith. They are, however, very small, varying from 1 to 3 mm. in length. According to a note furnished by Professor Ward they were, when alive, semi-transparent grayish, with sparse greenish yellow oil drops. They were taken from the surface of a log at New Baltimore, Mich., on August 2, 1893.

NAIDIDÆ.

? **Naidium**, sp. Ward.

Professor Ward's notes mention a species of *Naidium* collected in the bottom tow at various times between August 8 and 25, 1893, at New Baltimore, Mich., but the specimens can not be found in the material furnished to me. The description is as follows:

"Length, 1.785 mm. to 2.95 mm.; diameter, 0.25 to 0.35 mm.; metameres, 14 to 26. Setae in 4 rows; the dorsal beginning on the third, the ventral on the second metamere; the dorsal hair like, 1 long, up to 0.546 mm., and 3 or 4 short, 1 or rarely 2 of which may equal half the length of the long one; ventral setæ, 5 to 7, hooked and very unequally bifid at the end and doubly bent internally. Head abruptly rounded in the smaller, furnished with a small papilliform proboscis in the larger examples, with numerous sensory hairs but no eyes. Œsophagus short; intestine beginning at second metamere, grayish on account of the presence of numerous light yellowish oil drops 2 μ in diameter, a dark band across the anterior end of each intestinal sacculation. No sexual organs nor traces of gemmation."

Sketches of 2 ventral setæ and of an entire worm with small proboscis accompany the note.

Pristina leidyi Smith.

Pristina leidyi Smith, Bulletin Illinois State Laboratory of Natural History, vol. IV, 1896, p. 397.

This species is represented in both collections by about 25 specimens which agree closely with Smith's description, though in all of them the setæ of the first 2 dorsal fascicles lack the spines present on all others, a distinction not mentioned in the original description. In the second bundle some of them often have a length of 5 or 6 times the diameter of the body. The budding zone occurs at XIII or XIV.

Besides those taken at New Baltimore, Mich., on several occasions during August, 1893, a few specimens occur with other naids in the material from each of the following Lake Erie stations: Lemna Pond, South Bass Island, Ohio (18*a*), July 7, 1899; swamp near East Point, South Bass Island, Ohio, August 2, 1899; Sandusky, Ohio, West Harbor (207*a*), August 8, 1899.

Nais elinguis Müller.

Nais elinguis, Vejdovsky, System u. Morphologie der Oligochaeten, p. 28, 1844.

All of the examples of *Nais* in the collection are tentatively and with much doubt referred to this species. Although taken at a number of stations, but 1 or 2 usually much broken and distorted examples occur in each lot, and these differ considerably in appearance. Some, for example, have conspicuously pigmented eyes and others possess little or no pigment. Ward has labeled some of the New Baltimore specimens *N. elinguis* and Smith has recorded this species as abundant in Illinois. Their identification has been permitted to outweigh my doubts. The dorsal setæ of every specimen examined carefully differ in form from those figured by Vejdovsky and others. The few budding specimens have the growth zone at XVII to XIX and the fully formed bud has about 21 segments. No sexual individuals were detected.

Specimens were taken among algæ in association with *Stylaria lacustris* at New Baltimore in July, 1893, at Round Lake July 16, 1894, and at the following stations in Lake Erie: East Harbor, August 5, 1898, in *Chara;* (36*a*) Squaw Bay, July 12, 1899, among bryozoans; (38*a*) Put-in Bay, Ohio, July 10, 1899, bottom tow; (207*a*) Sandusky, Ohio, West Harbor, August 8, 1899; (212*a*) Sandusky, Ohio, August 8, 1899, from *Utricularia* in East Harbor.

Slavina gracilis (Leidy) Vejdovsky.

Nais gracilis Leidy, Journal Academy of Natural Sciences of Phila., ser. 2, vol. II, 1850, p. 43.

The few examples by which this species is represented in the collection are in very poor condition and much distorted and obscured by the mucous tubes in which they are enveloped, and which have been hardened and much shrunken by the alcohol. There can be no doubt that they belong to Leidy's species, but the distinction of this from *S. appendiculata* (Udeken) Vejdovsky is not so clear. Sensory papillæ are well developed and on each somite are arranged in a circle of large ones in the setæ zone, and another of alternating smaller ones, both provided with sensory hairs; the anus is surrounded by 4 or 6 papillæ.

Birgeboro, August 19, 1893, 1 specimen; Lake St. Clair, unlabeled vial, 1 specimen; and Round Lake, July 16, 1894, 2 specimens, with *Nais*.

Dero limosa Leidy.

Dero limosa Leidy, American Naturalist, vol. XIV, 1880, p. 422.

This well-known naid appears to be abundant throughout the entire region covered by these collections. The position of the budding zone is very variable, being found as far forward as XX in small, and as far back as XXXVIII in large individuals, while the total number of segments varies from 36 to 76 in gemmating examples.

New Baltimore, Mich., August 19, 1893, abundant among algæ; Lake St. Clair, unlabeled bottle, numerous; Lemna Pond, South Bass Island, Ohio (18*a* and 78*a*), July 7–15, 1899, plentiful; swamp near East Point, Bass Island (117), August 27, 1898, numerous; Sandusky, Ohio, West Harbor (207*a*), 2 specimens; Squaw Bay, Put-in Bay Island, Ohio (36*a*), 1 specimen among bryozoans, July 12, 1899.

Stylaria lacustris (Linnæus) Lamarck.

Stylaria lacustris, Vejdovsky, System u. Morphologie der Oligochæten, p. 30, 1884.

This also is an abundant species, particularly in the Lake St. Clair region, but in Lake Erie appears to be less plentiful than the next. Among the material from station 17 in Carp Lake is one sexually mature example with well-marked clitellum and genital setæ. Most of the specimens, however, bear buds in various stages of development. Although the resemblance of our specimens to descriptions based on European examples is remarkably close, the ventral setæ are constantly more strongly hooked than Vejdovsky's figures indicate, and there are other slight differences.

Stylaria lacustris was taken at the following stations in and about Lake St. Clair. Birgeboro, August 19, 1893, about 15 specimens with *Chætogaster diaphanus;* New Baltimore, August 24, 1893, with other naids common among algæ in bottom tow (Professor Ward furnishes some excellent drawings of specimens from this lot); Fox Lake, a large number; also taken in the Birge bottom tow net at Crooked Lake (stations 3 and 5), Burt Lake (9), Mullet Lake (11 and 13), Carp Lake (17 and 18), and Bear Lake (20). Lake Erie localities are Put-in Bay (37*a* and 38*a*), July 10, 1899, bottom tow, plentiful; East Harbor, Sandusky (182*a*), August 4, 1899, several with *S. fossularis;* Sandusky, Ohio (212*a*), August 8, 1899, two specimens; Erie, Pa., boat landing, August 16, 1899, numerous; same date and locality (315*a* and 316*a*), several, with a large number of *S. fossularis*.

Stylaria fossularis Leidy.

Stylaria fossularis Leidy, Proceedings Academy of Natural Sciences of Philadelphia, vol. V, 1852. p. 287.

Although students of the Oligochæta have generally failed to discriminate between this species and *S. lacustris*, the two are in reality perfectly distinct and are easily separated, as was done by Leidy, by the form of the prostomium (fig. 3), which in this species is prolonged medially into the base of the proboscis and lacks altogether the lateral lobes which are so conspicuous in *S. lacustris*. The Lake Erie material is beautifully preserved and permits a detailed study of the specimens, which correspond exactly with those occurring in the neighborhood of Philadelphia. In the preserved state the brain is 2½ times as wide as long, with a nearly straight anterior margin and a pair of prominent posterior lobes separated by a deep median emargination. Almost all of the specimens are in process of

stolonization, and the budding zone is situated with remarkable constancy at XXXIV. No sexually mature examples were found, but the large buds of some from Lake St. Clair appear to be nearing that condition, and at least one has genital setæ distinctly developed on V.

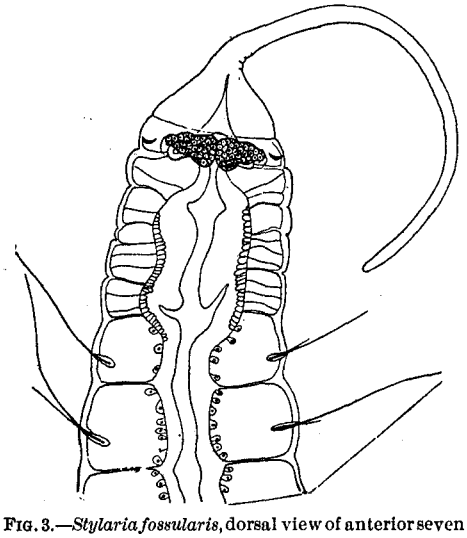

FIG. 3.—*Stylaria fossularis*, dorsal view of anterior seven somites, showing form of prostomium, brain, etc. × 60.

This species was taken at New Baltimore on August 8, 1893, among weeds, at Round Lake July 16, 1894, on the bottom, Burt Lake (9), Mullet Lake (13), and at an unknown station in Lake St. Clair. It occurred at Sandusky on August 4, 1899, and very abundantly at the boat landing at Erie, Pa., with *S. lacustris* on August 16, 1899.

Schmardaella filiformis (Schmarda) Michaelsen ?.

Schmardaella filiformis, Beddard, Ergebnisse der Hamburger Magelhaensischen Sammelreise, Naididæ, p. 5, 1896.

The most important result yielded by this collection of Oligochæta is the addition of *Schmardaella* to the North American fauna. Whether or not the few imperfect specimens represent a new species is uncertain, and though it seems probable that this will eventually prove to be the case our knowledge of both the type and this species is so very incomplete that a definite opinion can not be ventured, and it seems best for the present to record the specimens with this explanation under the above name. *S. filiformis*, the type and only known species, has been found only in Ecuador and Chile, and was described by Schmarda and later by Beddard.

The 3 specimens in this collection, which have neither buds nor sexual organs, were all taken among Chara stems dredged at New Baltimore on August 20, 1893. They vary from 5.3 mm. to 6.5 mm. in length and have from 46 to 52 segments. The prostomium is prominent and rounded; the anterior 2 or 3 somites somewhat enlarged. Dorsal setæ are totally absent, the ventral on all somites considerably enlarged, their length equaling two-thirds or more of the body diameter (fig. 4). In the largest specimen many of the fascicles of the middle region contain 3 setæ, the majority having but 2, while in the smaller ones very few have 3. All are strongly *f*-shaped, with a small but distinct nodulus a little beyond the middle, the tip strongly hooked and bifid, with the 2 prongs strongly divergent, of equal length, and the terminal one half as thick as the accessory. On the first 3 or 4 somites the setæ are more slender, though, owing to the variability of the latter, this may have little significance. The ventral lip of the anus is slightly longer than the dorsal, and bears a pair of small papillæ. Notwithstanding the absence of the dorsal setæ *Schmardaella* is clearly not closely related to *Chætogaster*. So far as it can be made out the alimentary canal is much like that of *Nais*. The brain seems to approach the form of *Dero limosa*, but is narrower. Schmarda figures a worm of 15 segments, and shows 3 setæ per fascicle, while Beddard states that there are but 2. Nothing whatever is known of the genital organs.

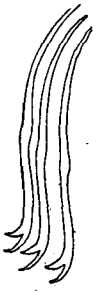

FIG. 4.—*Schmardaella filiformis*, a fascicle of three setæ from middle of body. × 270.

Chætogaster diaphanus (Gruithuisen) Oersted.

Chætogaster diaphanus, Vejdovsky, System u. Morphologie der Oligochaeten, p. 37, 1884.

Many specimens of this beautiful annelid in a state of active bud formation are found in both the Lake St. Clair and Lake Erie collections. Lake St. Clair, August 19 and 22, 1893, bottom, among algæ, several; Round Lake, July 16, 1894, several; Lake Erie (38*a*) July 7, 1899, many; East Harbor, Sundusky, Ohio (182*a*), August 4, 1899, 2 specimens; Sandusky, Ohio, August 4, 1899 (212*a*), 1 specimen.

Chætogaster limnæi v. Bær.

Chætogaster limnæi, Wilcox, American Naturalist, vol. xxxv, 1901, p. 905.

The American examples of this species differ from the European in a number of minor points which will probably require their eventual separation. Some of these differences have been alluded to in Miss Wilcox's excellent description of the species. It is common about Philadelphia and was well known to Dr. Leidy, by whom some excellent manuscript drawings were left, and has been recorded by Professor Smith from Illinois.

Many, both of parasitic and free-living individuals, are included in this collection from the following stations: New Baltimore, Mich., August 14, 1893, several from *Amnicola limosa;* Charlevoix, Mich., August 6, 1894, from *Limnæa stagnalis*, many; Middle Bass Island, Ohio, North Swamp, July 21, 1899, (105*a*), a large number.

LUMBRICULIDÆ.

Thinodrilus inconstans Smith.

Thinodrilus inconstans Smith, Bulletin Illinois State Laboratory of Natural History, vol. iv, 1895, p. 292.

In most respects these specimens agree exactly with Smith's description, but one example sectioned has both anterior and posterior sperm sacs, the former beginning at the septum VIII/IX and reaching to VII, the latter beginning at X/XI and extending to XIV. The paired male orifices are in X and there appears to be a small eversible penis, though it is retracted in all specimens. Five pairs of very small spermathecæ occur in XII to XVI. None of the examples is mature.

About a dozen of the largest examples are contained in an unlabeled vial belonging to the Lake St. Clair collection, and a few fragments each occur in vials labeled (126) South Bass Island, Ohio, near East Point, September 10, 1898, and (32*a*) East Swamp, South Bass Island, Ohio, July 10, 1899.

TUBIFICIDÆ.

Limnodrilus gracilis sp. nov.

Form very slender and elongated, the length reaching 75 mm.; clitellum on XI and XII, but only very slightly developed and none of the examples with enlarged genital region; number of somites, 140 to 175; prostomium flattened, moderately long.

Setæ anterior to X, 4 or 5, sometimes 3 or 6 per bundle; posterior to clitellum usually 2, occasionally 3, and in the posterior fourth of the body only 1, in each bundle. On X the dorsal bundle usually contains 3, the ventral 2 setæ, and the glands which are associated with the setæ bundles of all anterior somites are on this one better developed than elsewhere. On XI ventral setæ are usually absent altogether, their place being occupied by the male genital orifices, while the dorsal bundle is composed of 2 or 3 setæ. All setæ are hooked and bifid and have the form shown in figure 5. Those on the genital and posterior somites have the same shape as the others, but the latter are somewhat smaller.

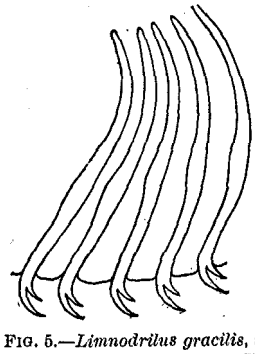

FIG. 5.—*Limnodrilus gracilis*, a ventral seta bundle from V. × 270.

None of the specimens is nearly mature, but the reproductive organs are sufficiently well developed to indicate their characteristic features (fig. 6). Spermathecæ, 1 pair in X, of fairly large size, reaching vertically nearly to the dorsal wall of the body. They are of simple clavate form and, although the upper end is considerably inflated and has much thinner walls than the lower half, there is no clear distinction between duct and pouch. The external opening is in line with the ventral setæ, is simple and without glands or other special features. The spermathecæ are filled with elongated spermatophores having clear centers. Testes, 1 pair, attached on each side near the posterior base of the septum IX/X, long, slender, rising freely into the dorsal part of the body cavity and reaching backward to the spermathecæ. Male efferent organs are not fully developed. Their deeply funnel-form cœlomic ends are in X, with the mouth opening directly dorsad. The vas deferens perforates the septum X/XI in line with the ventral setæ

close to the body floor, forms in XI a sinuous loop or two leading dorsad by the side of the intestine and expands into a fusiform receptaculum, the anterior end of which bears a prominent prostate gland usually drawn out into two slender lobes. A short ductus leads to the atrium which is cylindrical and about three times as long as thick. From the ventral body wall the atrium rises to the side of the intestine. Penis sheath simple, smooth, and chitinous; the penis in retracted condition apparently about 5 or 6 times its diameter and of uniform thickness. Paired external pores in line with spermathecal pores and smaller than they.

The septum X/XI is produced caudal through XI as a single median (or perhaps a pair of closely approximated), sperm sac having the form of a narrow tube, into which the lateral vascular arches of X enter. The septum XI/XII is similarly pushed back into a certainly unpaired tubular ovisac, into which both the sperm sac and the vascular arches enter, the latter much looped and folded. In the specimens sectioned the combined sperm and ova sacs reach only to the posterior end of XII, and while the former is crowded with spermatozoa the latter contains no ova. Similarly to the testes, the ovaries are attached to the posterior face of septum X/XI just laterad of the point of passage of the vas deferens. They are much longer than the testes and loop across the upper part of the body cavity several times. The interior of the egg strings is a granular mass with little or no trace of cell boundaries or nuclei and appears to be formed of disintegrated ova. Whether or not these egg strings are entirely free from the ovaries is uncertain.

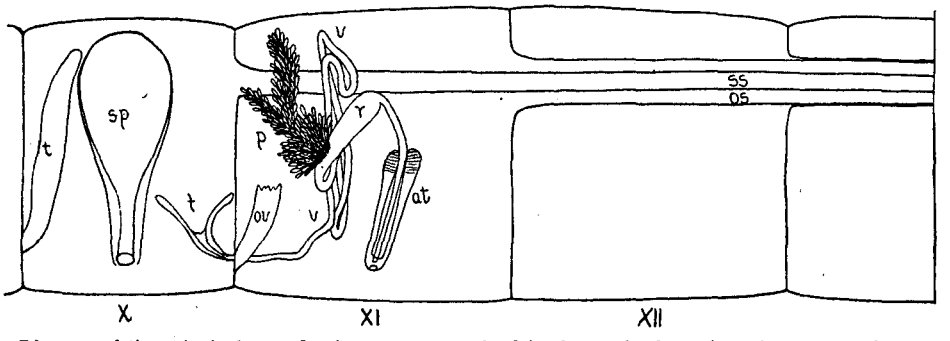

FIG. 6.—Diagram of the principal reproductive organs contained in the tenth, eleventh, and twelfth somites of *Limnodrilus gracilis*, as seen from the side; *t*, testes; *sp*, spermatheca; *f*, sperm funnel; *v*, *v*, vas deferens; *p*, prostate gland; *r*, receptaculum seminies; *at*, atrium containing penis and penis sheath and opening externally at ♂; *ov*, ovary, largely cut away, only the base remaining; *ss*, sperm sac; and *os*, ovisac, both represented as continued beyond somite XII.

Brain about as broad as long, with thick masses of ganglion cells and very shallow anterior and posterior emarginations. Vascular arches of the first seven somites very long, branched, and complexly folded, forming a conspicuous system of integumental vessels. Large hearts in VIII and IX. Chlarogogue cells begin in VIII.

This species was found at several stations (431*a*, 432*a*, 477*a*) among reeds about the shore of Rondeau Harbor, Ontario, during the latter part of August, 1899, and at Norwood, Mich., was dredged in 13 fathoms on August 8, 1894. The former is the type locality, and the type specimen is no. 5227, U. S. National Museum.

GLOSSOSCOLECIDÆ.

Sparganophilus eiseni Smith.

Sparganophilus eiseni Smith, Bulletin Illinois State Laboratory of Natural History, vol. IV, 1895, p. 142.

This species was found at Lake St. Clair August, 1894, 2 small specimens taken on the bottom with the Birge net; bank of Round Lake, Charlevoix, Mich., July 20, 1894, two immature specimens; High Island Harbor, Beaver Islands, Michigan, trawled in Chara, 1 large example; Squaw Bay, Put in

Bay, Ohio, August 12, 1898 (67), under a rock, 1 small specimen; Long Point, Lake Erie, Canada, August 23, 1899 (382), two very small specimens referred doubtfully to this species upon the basis of setæ characters; Rondeau Harbor, Ontario (418*a*), August 30, 1899, 1 specimen.

LUMBRICIDÆ.

Helodrilus caliginosus (Savigny) Michaelsen.

Helodrilus caliginosus, Michaelsen, Das Tierreich, Oligochaeta, p. 482, 1900.

Nine specimens of this species were taken near Port Clinton, Ohio, on the bank of the Portage River on August 12, 1895. The clitellum begins on XXVI; on one specimen on XXV. In all other respects they are normal.

EXPLANATION OF PLATE.

The figures on this plate were drawn and colored from living examples taken at Put-in Bay during the survey of Lake Erie. The figures are numbered from left to right: 1 to 3 above, 4 to 6 below.

Fig. 1. *Erpobdella punctata* (Leidy) Moore. A young example. The pink color on the margin is due to a wave of blood passing through the lateral vessel. × 4.

Fig. 2. *Glossiphonia stagnalis* (Linnæus) Blanchard. A nearly full-grown example. The nuchal gland is scarcely evident in the figure, and the stomach and intestine (containing little or no blood) are pale yellow. × 8.

Fig. 3. *Placobdella picta* (Verrill) Moore. A small and pale specimen, with the branched gastric cæca very distinct. × 4.

Fig. 4. *Glossiphonia complanata* (Linnæus) Johnston. A small and lightly pigmented example, with the dark paramedian lines very little developed. × 10.

Fig. 5. *Glossiphonia fusca* Castle. A full-grown example of the lined variety, with the stomach and intestine partially filled with blood. × 15.

Fig. 6. *Dina fervida* (Verrill) Moore. A nearly full-grown pale specimen, with three pairs of eyes and an additional one on the right side. The red color is due to the blood, seen through the transparent tissues. Fully extended. × 3.