Chemical content. As far as can be judged from experimental work by Shelford* and other investigators, the combination of high oxygen, low free carbon dioxide, and high bicarbonate contents, with a hydrogen ion concentration in the neighbourhood of 8.0 is a favourable condition for many species of fish and for the fertilization and development of whitefish eggs at least. It is possible, on the other hand, that this combination is one factor accounting for the absence of some species of fish from the lake.

Geophysical features. In conformation, Lake Nipigon is a natural fish cultural body of water. The main portion has ranges of depth down to 134 yards. Large extents of shallow areas, in addition to those along the main shore, are provided because of the many islands. Numerous expansive, fairly shallow bays with more or less narrow openings into the main body of the lake provide protected feeding areas for young fish. The numerous tributary streams bring into the lake large supplies of dissolved materials as well as considerable plant stuffs and provide adequate spawning areas for fish. Several features, on the other hand, are decidedly limiting factors in regard to the productivity of the lake. The large size makes possible the development of severe storms which keep the exposed shores almost barren, and the rocky basin results in the shore line being largely rocky or sandy. Even in the bays the amount of muddy shore line, where aquatic plants can grow, is relatively small. Large amounts of sand are brought down by some of the streams from the surrounding rocky drainage basin and create large, practically desert areas in the lake. Finally, the development of insurmountable falls in the Nipigon river has prevented the movement of fish from Lake Superior.

In spite of the limiting factors mentioned above, Lake Nipigon can be said to be a very productive body of water, and under the operation of proper conservational measures should remain so for all time to come.

*Shelford, Victor C. *The Determination of Hydrogen Ion Concentration in connection with Fresh-Water Biological Studies.* Bulletin, Article IX, Vol. XIV, Div. Nat. Hist. Survey, Dept. Reg. and Educ. Illinois, 1923.

UNIVERSITY OF TORONTO STUDIES

PUBLICATIONS OF THE

ONTARIO FISHERIES RESEARCH LABORATORY

No. 23

THE LEECHES (*HIRUDINEA*) OF LAKE NIPIGON

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TORONTO

THE UNIVERSITY LIBRARY

1924

THE LEECHES (*HIRUDINEA*) OF LAKE NIPIGON

This paper is based upon the collection of leeches made by Dr. F. B. Adamstone, together with the data furnished by him in response to my inquiries.

While the commercial and pharmaceutical importance of the blood-sucking leeches in the days when leech-craft was largely practised have long since passed, these animals retain a limited value as affecting human interests even in temperate regions. To a slight extent they are still employed in blood-letting. In the United States among the older members of the foreign population, (Poles, Italians and French) they are sometimes applied for the relief of boils, contusions, and abscessed teeth ("gum boils"), and in the absence of the European medical leech our native *Macrobdella decora* serves. This species appears to be rare about Lake Nipigon, and there is no evidence of its local employment for this purpose. So far as I have been able to learn from correspondents, there is in Canada no demand for medicinal leeches except, as I am informed by Mr. Frits Johansen, a very limited one among the Poles and Italians at Ottawa, to satisfy which a few leeches are imported from Austria.* This same species (*M. decora*) and to a less extent several others sometimes attack human bathers, but Dr. Adamstone states that because of the coldness of the water and the scarcity of beaches, bathing in Lake Nipigon is not indulged in. In the warmer ponds and small lakes of the northern United States, with their numerous summer camps and resorts at which bathing is a popular pastime, these leeches sometimes

*I have since learned from Dr. George Hilton that a similar situation exists in Quebec and Alberta and Dr. N. A. Powell writes that in hospital practice in Toronto leeches are of great service in relieving inflammation of the iris after operations for glaucoma.

become somewhat of a pest. An effective method of reducing their numbers, devised for bodies of water controlled by dams with flood gates is as follows: In the late autumn, immediately after the leeches have become dormant on the muddy shallows that serve as their winter quarters and before heavy ice has formed the water level is lowered from four to six feet. This exposes the mud in which the leeches are hibernating, and when zero weather comes many are killed (Moore, 1923).

Leeches do some damage to the lower animals also, especially to fishes and frogs which serve as human food. *Macrobdella decora* is quite destructive to frogs' eggs, which it extracts from the jelly in large numbers, and to the adult frogs whose blood it drains. It also occasionally attacks fishes, killing the smaller ones outright and worrying the larger ones. The true fish-leeches of the genus *Piscicola* and related forms attack many species of freshwater fishes under both pond-culture and natural conditions and sometimes cause considerable damage. In the Lake Nipigon collections they are recorded as having been taken on the sauger and whitefish only, but undoubtedly attack other species. On the whitefish grounds of Lake Erie these leeches occur in such enormous numbers that they can hardly be otherwise than seriously injurious. That this is the case in Lake Nipigon also is indicated by Dr. Adamstone, who writes that "this leech (*Piscicola*) is found by hundreds on whitefish and the decks of the tugs are strewn with them when the nets are lifted." In a few cases leeches have been demonstrated to be the intermediate hosts of certain parasites of fishes, turtles, and even mammals, but are not known to transmit normally any human parasite or disease, though septic infection sometimes follows their bites, especially in the Tropics.

When plentiful, leeches are eaten by many species of fishes and water birds. Such fishes as yellow perch, the larger sunfishes, and black bass especially devour them eagerly and for these they are largely used as bait by country boys. For this purpose their toughness and vitality in the water makes them superior to earthworms. Dr. Adamstone has

not known them to be used as bait on Lake Nipigon; nor do they appear to have served frequently as fish food. The collection yields one *Hæmopis grandis* from the stomach of a bass and one *Nephelopsis obscura* from a sturgeon, and Dr. Adamstone reports another from the stomach of a whitefish.

With the exception of the *Ichthyobdellidæ*, most of which are semi-permanent fish parasites, leeches generally prefer swamp and shallow water habitats which afford a longer season of activity and conditions of temperature more nearly optimum than do the deeper, colder waters. They commonly abound in warm, protected areas where they are sheltered from wind and wave action, where plants and loose stones furnish concealment and where the small animals upon which the predaceous forms feed and the larger animals from which the sanguivorous ones draw blood occur in sufficient numbers. The facultative scavengers congregate chiefly on lee shores where debris and the dead bodies of fishes and other animals accumulate.

To judge from the material yielded by the collections made during the summers of 1921, 1922, and 1923, leeches are not abundant in Lake Nipigon. The deep, cold, plant-poor waters and bold, rocky shores offer relatively fewer suitable habitats than many of the smaller and shallower lakes of southern Canada and the United States. It appears, therefore, that the leech fauna occurs chiefly in the protected bays and passages and on the shore lines at the southern end of the lake. This agrees with the observations of Dr. Adamstone, who suggests as an additional factor determining this distribution that the bottom of the northern part of the lake is largely of a hard clay on which life of all kinds is sparse. Factors operating to concentrate the leech population still farther at the south-eastern corner of the lake are the prevailing north-west summer winds, the general set of the current toward the outlet at the Nipigon River and the fish refuse emptied into Orient Bay. Except for the fish parasites, the bathymetrical range of all species is limited and their numbers generally diminish below a depth of three or four

feet. The greatest depth at which a leech was taken is forty-five feet, this being a *Hæmopis marmoratis*, the presence of which at that depth was probably accidental. Except that the abundance of food and the presence of objects for concealment may be sometimes determined thereby, the character of the bottom has little influence upon the distribution of leeches.

Most generally distributed are species, like *Glossiphonia complanata* and *Helobdella stagnalis*, that suck the juices of snails, with which they are nearly always associated. This is well shown in the tables of dredge contents published in the reports of the Lake Nipigon investigations of 1921. Scavenger species, especially *Nephelopsis obscura*, are chiefly confined to the vicinity of Orient Bay, to which they are obviously attracted by the waste from the fish-packing station at Macdiarmid and the offal dump on the opposite side of the bay. This species, together with the large, predaceous *Hæmopis marmoratis* is plentiful also in the small ponds and lakes of this neighbourhood. Fish-leeches are widely distributed throughout the lake.

In all fourteen species are represented in the collections. With only one exception all have been recorded previously from Canadian localities and their distribution is indicated especially in Miss Ryerson's paper on the *Hirudinea* of Georgian Bay (1915) and the author's account in the *Canadian Field Naturalist* of the fresh-water leeches of Southern Canada (1922), in which will be found a key for their determination. Together these two papers enumerate twenty species, several recorded from other parts of Canada not being included. It is probable that some of these would be added to the Lake Nipigon list by more thorough shore collecting and especially by exploration of the small accessory lakes and ponds. The absence of such species as *Placobdella parasitica* and *P. phalera* is correlated with the absence of the snapping turtle and the extreme rarity of the smaller water turtles, while the scarcity of frogs may explain the rarity of *Macrobdella decora* and some other species. *Protoclepsis occidentalis* might be expected to occur, as it is

distributed by ducks and other aquatic birds to which it clings. The novelty of the collection is *Actinobdella triannulata*, a new species of a genus that, so far is as now known, is confined to the Great Lakes region, where it is represented by three species. With the single exception of *Glossiphonia complanata* and the two species of *Piscicola* the examples of every species average of small size, although our present information does not warrant the assertion that they are dwarfed forms.

Following is the list of species with records of their occurrence. Unless otherwise noted, there is but one specimen from each station. The numbers are too small to give any significance to distribution curves.

GLOSSIPHONIDÆ

GLOSSIPHONIA COMPLANATA (Linnæus)

This is the most frequent and widely distributed leech appearing in the collection and was taken generally in well protected places at almost every locality at the southern end of the Lake where collections were made. They occur indifferently on bottoms of mud, sand, gravel, or rock, and at any depth from 0 to 27 feet, but chiefly at less than six feet. They occur consistently in association with the snails and annelids upon which they subsist. The only egg-bearing example was taken in six inches of water at Orient Bay on June 23, 1922.

Stations: (1921), XVII, 7, first bay west of Nipigon R.; XXI, 1, second bay west of Nipigon R., a young one 3 mm. long, taken on August 1; XXII, 1, 8, bay at north end of Shakespeare Island, three specimens; XXIII, 6, channels about Shakespeare Island; XXV, 1, Macdiarmid Harbour; XXVIII, 5, east side of Grand Bay; (1922), 10, Orient Bay, with eggs; 10D, Naonan Island, (1923), XIX, 2, South Bay, with *Helobdella nepheloidea*; 23, McL. Bay, two specimens, associated with *H. stagnalis*, *H. marmoratis* and *N. obscura*.

HELOBDELLA STAGNALIS (Linnæus)

Of all leeches this species is the most nearly cosmopolitan. It occurs practically throughout the entire northern hemisphere and in America has been reported from Newfoundland and Alaska to Chile. Like other widely distributed species, it is carried by migrating ducks and herons.

In Lake Nipigon it is doubtless much more plentiful than the small numbers taken at each station would indicate. Its small size, inconspicuous colours, and habits of concealment cause it to be overlooked. It was collected at points along the shore and dredged in shallow bays and in channels among islands from the shallowest water to a depth of eighteen feet in Nipigon River and twenty-one feet at Shakespeare Island and on bottoms of mud, sand, gravel and rock. During June and July several bearing eggs or young were taken and on August 8th a free young. Most of the specimens are of small size.

Stations: (1921), XX, I, second bay west of Nipigon River; XXIII, 3 and 4, channels (islands north of Shakespeare Island), three specimens; XXVII, 1 and No. 23, among the Virgin Islands, five specimens; (1922), D1, 6 and 9, McL. Bay, six egg-bearing specimens, June 17 to July 7; D3 and 10, Naonan Island, four specimens; V, 10, Chief's Bay, two bearing young, July 20; (1923), XIX, 3, South Bay, one young; VIII, 2, east of Cooke Point, with eggs, July 6; 23, McL. Bay, two specimens with *G. complanata*, *N. obscura* and *H. marmoratis*.

HELOBDELLA FUSCA (Castle)

This form, so abundant and variable in Lake Erie and elsewhere in the Great Lakes region, is represented by a single example taken on a mud bottom in two and one-half feet in McL. Bay, on August 19, 1922.

HELOBDELLA NEPHELOIDEA (Graf)

Also found but once; three small examples at dredging station XIX, 2, South Bay, August 8, 1922, six feet, muddy bottom.

PLACOBDELLA MONTIFERA Moore

A strongly-marked species which attacks fresh-water mussels, frogs, ovipositing toads and fishes. Not taken in Lake Nipigon itself, but two examples bearing young from Black Sturgeon Lake on muddy bottom in shallow water, July 21, 1922.

ACTINOBDELLA TRIANNULATA sp. nov.

Size small to very small, most of the specimens in the ordinary state of contraction measuring from 1.5 mm. long by .6 mm. wide to 4.5 mm. long by 1.8 mm. wide. Of the two largest specimens one, greatly contracted and gorged with blood, measures 5.5 mm. long and 3 mm. wide, the other, extended, is 11 mm. long and slightly less than 2 mm. in maximum width. The latter has the following additional measurements: length from anterior end to male pore—2.2 mm., width of cephalic sucker—.8 mm., width at male pore—1.5 mm., width of caudal sucker—1.3 mm. The type is 4.5 mm. long and 1.8 mm. in maximum width.

Form as usual in small glossiphonids. Partly contracted individuals, like the type (Fig. 1), which have the digestive tract nearly or quite empty are rather broad and flat. Those with the cæca filled with blood are short, thick, strongly convex dorsally and grub-like. The single moderately extended specimen is clavate, rather slender anteriorly, more robust caudally and slightly depressed except at the terete cephalic end.

In the contracted state of the preserved specimens the oral sucker is small and flat with the lip short and inrolled to fill it. Mouth a small pore far forward on the sucker rim in somite I or II as in *Placobdella*. Eyes a single pair situated on somite III, rather large, hemispherical cups looking forward, close together but usually quite distinct, though sometimes the pigment is united medially. Both male and female genital orifices are inconspicuous openings situated in the furrows XI/XII and XII *a2/a3* respectively, the two annuli separating them being often united and contracted on the venter. In some specimens the genital region is enlarged,

apparently due to the presence of clitellar glands. Nephridiopores cannot be detected in surface views, probably because of contraction, but in sections they may be seen on many of the post-clitellial segments opening well back on the neural annuli (*a2*) in the ventral intermediate field. Anus a minute opening at XXVI/XXVII followed by two small annuli.

Caudal sucker very large, widely expanded beyond the narrow pedicle. On all of these specimens it is much contracted, the margin being drawn in to greatly narrow the opening, resulting in a flattened spheroidal form and deep cavity, thus resembling the form of sucker characterizing the fish-leeches. In the type, for example, the extreme diameter of the sucker is .8 mm., of the orifice only .3 mm. If the suckers were fully expanded they would equal the width of the contracted body or, if the latter were extended, exceed it. Dorsal surface of sucker marked by faint radiating ridges which indicate the position of the marginal papillæ and their appended glands. Marginal ventral papillæ (Fig. 2) thirty (29 in one case, 31 in another and 30 or apparently 30 in all others), situated about their own length back from the margin, conical and much shorter than those of *A. inequiannulata*, though this may be due to contraction. They have the same structure as in that species, being provided with an axis of gland ducts enclosed in a sheath of muscle fibres and covered by the hypodermis. Owing to inadequate preservation for this purpose the histological structure cannot be determined beyond what is shown in Fig. 3. The terminal portion appears to be telescopic within a broader base. The glands are much less obvious in this than in other species.

The division into somites and the annulation is very clear and all of the specimens agree closely (Fig. 1). Somites I to IV are all uniannulate, the latter sometimes exhibiting a faint subdivision. V is biannulate dorsally, uniannulate ventrally and VI triannulate dorsally, with the first two annuli (*a1* and *a2*) united ventrally. VII to XXIII are typical triannulate somites. On all of these the middle or neural annulus is rather larger and fuller so that it projects somewhat beyond the others, especially at the margins. On the ventral surface especially the intersegmental are deeper than the intrasegmental furrows and the annuli are often obviously grouped in threes in agreement with the metameric limits. The furrow *a1/a2* between the first and second annuli is usually shallower than *a2/a3*, so that the first two annuli appear to be more closely associated. This is more evident on some specimens than on others. Reduction at the caudal end begins with XXIV on which the furrow *a2/a3* becomes more or less incomplete; XXV and XXVI are both biannulate, each with a larger anterior annulus formed of the combined *a1* and *a2*; XXVII is uniannulate.

Metameric sensillæ are indistinguishable on most of the specimens but on one with the integuments stretched by blood-filled cæca and in sections they may be seen clearly on middle segments. They are disposed in eight dorsal and six ventral series exactly as in *A. inequiannulata* and *A. annectens*. Cutaneous papillæ bearing sense organs are much more prominent in this than the other species (Fig. 1). Usually there are five (median, dorso-marginal and supramarginal) on the neural annulus (*a2*) and five (median, dorso-median or paramedian and dorso-marginal, often with additional smaller ones) on the post-neural annulus (*a3*). The first annulus (*a1*) bears none. The median series begins usually on VI and continues to XXVI. They are large and conical, especially those on the neural annulus, sometimes double and form an irregular series. Supramarginals are very large, usually beginning on VII and continuing to XXIII or XXIV. Dorso-marginals on the neural annuli are also fairly large and occur from about VIII to XXVII. The others are small and may be absent from particular annuli.

The living colour is unknown, but the preserved specimens are olive or brown without definite markings.

A few points of internal anatomy were determined from sections. Proboscis in retraction reaches from V to the end of XI; gastric cæca, seven pairs in XIV to XX inclusive, large but only very slightly lobed or branched; intestinal cæca four pairs in XXI to XXIV. Reproductive organs as

usual in the family; testes five pairs, intersegmental in position behind somites XIII to XVII.

All specimens were taken singly in the dredge in a restricted area in the south-eastern part of the lake at depths from two and one-half to thirty-six feet and on bottoms most frequently of mud but sometimes of sand or gravel. For a leech it is probably a fairly deep water species, most of those collected coming from the zone between six and twelve feet. The presence of vertebrate blood in some of the specimens indicates that it is parasitic, though all were taken free.

Stations: (1921), XVII, 2, 3 and 6, three to eighteen feet, three specimens; XVIII, 3, west side of South Bay, six feet (type); XXIV, 1, Orient Bay at Macdiarmid, six feet; XXXII, 4, Alexander Island Harbour, nine feet; (1922), D7, McL. Bay, two and one-half feet; II, D4, Orient Bay, thirty-six feet; VI, D3, Virgin Islands, nine feet.

The genus *Actinobdella* as now known comprehends three species of small glossiphonids which are especially characterized by the development of a circle of papillæ with attached glands round the inner margin of the caudal sucker. An approach to this condition is found in the finely ribbed and denticulated condition of the ventral margin of the sucker in several species of *Placobdella*, to which in other respects this genus shows its closest affinities. These papillæ are doubtless an adaptation for maintaining a secure attachment to a slippery host. Nothing is known definitely of the habits of these leeches. The presence of blood in the alimentary canal, together with the large size and structure of the sucker leads to the assumption that they are parasitic. With a single exception all specimens have been found free. This exception is the type of *A. annectens* which was taken from a snapping turtle with *Placobdella parasitica*. It is doubtful, however, if this is the usual host as the elongation of the body as a result of increase in the number of annuli points to fishes as the most probable hosts. Concerning their distribution the type species, *A. inequiannulata*, was taken once in the Illinois River at Havana in Illinois and once in Lake Pepin in Minnesota, *A. annectens* once only in Lake Erie at Long Point, Canada and *A. triannulata* from Lake Nipigon only.

The two species previously described, namely, *A. annectens* and *A. inequiannulata* depart from the Glossiphonidæ generally in the tendency of the somites to become elaborated by an increase in the number of annuli to six in typical complete somites. The present species retains the typical triannulate somite. The three species may be readily discriminated by use of the following key:

A. Complete somite sexannulate
1. Marginal sucker papillæ about 30, annuli markedly unequal. *A. inequiannulata.*
2. Marginal sucker papillæ about 60, annuli subequal. *A. annectens.*

B. Complete somite triannulate
3. Sucker papillæ about 30. *A. triannulata.*

ICHTHYOBDELLIDÆ

PISCICOLA MILNERI (Verrill)

The American species of *Piscicola* have never received sufficiently critical study, and their proper discrimination is not yet fully accomplished. As here understood, this species possesses two pairs of cephalic eyes and a circle of eye-like pigment spots on the caudal sucker, often absent in young ones, whereas the next usually has but one pair of cephalic eyes and no caudal eye-like spots.

The habits of both are similar. They attach themselves to the exterior surfaces and gills of various fresh-water fishes and often infest the whitefish in great numbers. They are also found among plants, to which their egg-cases are usually attached.

Stations: (1921), XIX, 4, South Bay; XX, 5, second bay west of Nipigon River; 29, Pustagone River on whitefish seven specimens; (1922), XVIII, 3, Bay north of Sand Point; (1923), 18, on whitefish, Lake Nipigon.

PISCICOLA PUNCTATA (Verrill)

Stations: (1922), 3D, Naonan Island; 12, Ombabika Bay, taken from a sauger, three specimens; (1923), 22, Windigo Bay, sandy bottom near shore, twenty-four specimens.

HIRUDIDÆ

MACROBDELLA DECORA (Say)

This, the widely distributed, conspicuous, and well-known American medicinal leech, so generally abundant in the lakes and ponds of the northern United States and southern Canadian provinces, is curiously scarce in these collections, being represented by two specimens only.

No. 3, (1922), Hill Lake, August 8, shallow water, mud bottom and No. 6, (1922), attached to a sturgeon, July 7, Lake Nipigon.

HÆMOPIS MARMORATIS (Say)

Of the large "jawed" or "ten-eyed" leeches this is by far the most abundant and widely distributed in Canada and it is probable that it reaches farther north than any other species. While it is sometimes known as the "horse leech" and often lives in the pools at which stock are watered there appears to be no evidence that it ever actually enters the nares of drinking animals, as it is reputed to do and as does the *Limnatis* of the Mediterranean countries. It will, however, attach itself to bleeding cuts or sores on animals or human beings wading in the water. It is really amphibious in habit and is often found in great numbers in the mud at the water's edge, where it feeds upon earthworms, small leeches, insect larvæ, small molluscs and dead or dying fishes. Its occurrence in one dredge haul at a depth of forty-five feet in Lake Nipigon is unusual. With few exceptions all of the individuals in this collection are very heavily blotched and dark-coloured, and of small or medium size.

Stations: (1921), 22, Virgin Islands; 23, 26, 27, Macdiarmid, seven specimens; (1922), Tower Lake, two specimens; 7, Hill Lake, D4, Naonan Island; (1923), 1, Orient Bay, two specimens; 4, small lake east of Macdiarmid; 21, Wabinosh Lake; 23, McL. Bay, eight specimens, along with *Nephelopsis obscura*, *G. complanata* and *H. stagnalis*; DV, 5, east of Shakespeare Island, forty-five feet, mud bottom.

With the exception of the last, all were taken in very shallow water from the shore line to two and one-half feet, mostly on mud, but occasionally on sand or rock bottoms.

HÆMOPIS GRANDIS (Verrill)

This sometimes huge leech, the largest found in North America, abounds in the lakes of Minnesota and neighbouring states, where it reaches its maximum size. Its habits are generally similar to the last, but it is much less of a blood-sucker if, indeed, it attacks living vertebrates at all. The three specimens are all small for the species, but one of them, from Black Sturgeon Lake, is nearly six inches long in the partly contracted state and the largest leech in the collection. None were taken in Lake Nipigon proper.

Stations: (1922), 2, Black Sturgeon Lake, shallow water, mud; 5, Gull Bay, three feet, rocks; 11, Black Sturgeon Lake, shallow water, mud, from the stomach of a bass.

ERPOBDELLIDÆ

ERPOBDELLA PUNCTATA (Leidy)

All examples of this species were taken in the immediate region of Orient Bay and the source of the Nipigon River in shallow water to a depth of six feet and on muddy bottoms, except in the dredge haul at the Virgin Islands, where the bottom in six feet was sand and gravel. *E. punctata* feeds on small worms, insect larvæ, etc., but is also a scavenger.

Stations: (1921), XIV, D1, McL. Bay; XXVII, D9, Virgin Islands; (1922), 4, Hill Lake, three specimens; D1, McL. Bay; D2, 3, 5 and 8, Naonan Island.

NEPHELOPSIS OBSCURA Verrill

This and *Hæmopis marmoratis* are the two most largely represented species in the collection, but, like *E. punctata*,

N. obscura was taken in the south-eastern corner of the lake only, though one was collected a little farther westward at South Bay, and it appears to be more abundant in the smaller lakes and ponds. Like the last this species is not only predaceous, but is also a scavenger and feeds largely upon the dead bodies of fishes and other animals. No doubt this explains the abundance of both in this part of the lake, inasmuch as floating debris, fish wastes, and the bodies of dead animals would be likely to accumulate here as explained above. As in the case of *H. marmoratis* most examples of this species are dark-coloured and heavily blotched, and smaller than the maximum size of the species. Found chiefly on muddy or sandy bottoms, but in one case (No. 23, 1923) plentiful on a rocky bottom. Depths from 0 to 14 feet.

Stations: (1921), 21, 24, 25, Macdiarmid, six specimens; (1922), 8, Macdiarmid, 4 specimens; (1923), 2, Lake Nipigon, from stomach of a sturgeon; 3, 7, 8, 9, Macdiarmid, six specimens; 10, Tower Lake; XIX, D1, South Bay, three specimens; XX, D2, second bay west of Nipigon River; 15, Orient Bay; 16, Lake Nipigon, on whitefish; 17, lake at Fairlock, two specimens; 23, McL. Bay, thirteen specimens on rocky bottom.

DINA PARVA Moore

A small inconspicuous species having habits similar to the above.

Stations: (1921), XXVII, D1, Virgin Islands, 6 ft. sand and gravel; 28, Pustagone River; (1922), 6, Macdiarmid.

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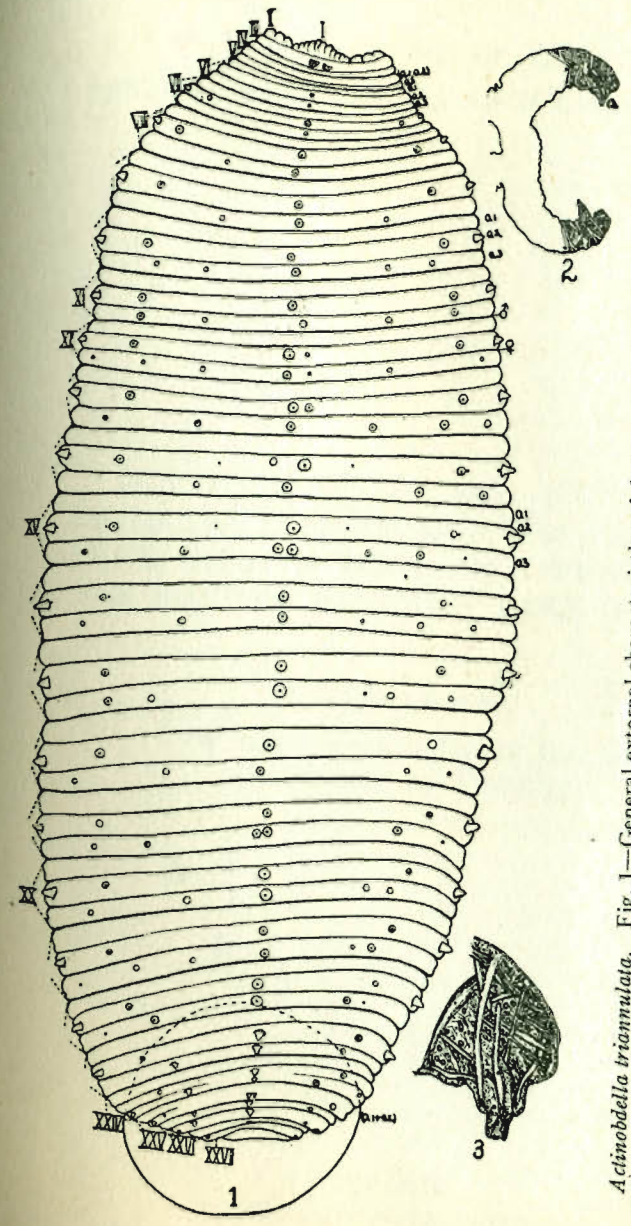

Actinobdella triannulata. Fig. 1—General external characteristics of dorsum, from type with verifications and a few additions of papillæ and sensillæ from other specimens. Roman numerals on left are somite numbers and dotted lines indicate somite limits. Italic letters and numbers designate order and number of annuli. Cutaneous papillæ are represented in proper relative size by circles with central rings or dots or by cones and sensillæ (on somites XIV to XVI only) by solid dots. X37. Fig. 2—Outline of sagittal section of sucker of cotype showing two papillæ. X58. Fig. 3—Detail of the partly retracted papilla at *a* of Fig. 2 showing particularly the arrangement of muscle fibres, gland ducts and connective tissues. X280.