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XLII.—*Preliminary Report on Dredgings in Lake Ontario.*

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IN consequence of the interesting discoveries made in the dredgings carried on in Lake Superior in the summer of 1871 in the U.S. steamer 'Search' (Reports of the Sec. of War, U.S. vol. ii.), I was induced to apply to the government of the Province of Ontario for a grant to be expended in prosecuting a similar series of dredgings in Lake Ontario, a lake which had hitherto never been explored by the dredge. With a praiseworthy appreciation of the value of such scientific researches, the necessary assistance was generously granted to me by the Provincial Government; and the results obtained are of a very satisfactory character. The short time, however, which has elapsed since the dredging was completed has not permitted more than the most hasty examination of the materials collected. In the following preliminary report, therefore, I shall merely state the general results which were obtained, reserving for a future occasion a detailed account of the animals which were collected.

The dredgings were all carried on in the later part of June and the early part of July, and were made partly from the yacht 'Ina' and partly from the steamer 'Bouquet.' They were entirely carried on by hand; and the dredges employed were such as are ordinarily used in sea-dredging. In dredging in deep water, however, a bag of embroidery canvas was attached outside the ordinary net—an addition rendered necessary by the extremely fine nature of the mud at great depths. Even with this precaution the dredge not unfrequently came up nearly or quite empty from great depths, its contents having been completely washed out. In deep water, also, a fifty-six-pound weight was attached to the rope, at a distance of about 12 feet above the dredge; and the same was necessary in shallow water where the weeds were very thick, in order to secure that the dredge should reach the actual bottom.

The dredgings were all carried on within a radius of ten miles from Toronto; and the following will show the general nature of the bottom at different depths, and the chief localities at which the dredgings were prosecuted.

In Toronto Bay itself numerous hauls were made, both from the yacht and the steamer, and the bottom proved very varied, though the depth is almost constantly from 2 to 3 fathoms. The greater portion of the bay, comprising the central part of its area, has a bottom which appears to consist uniformly of a tenacious, exceedingly fine, clayey mud, the temperature

of which is comparatively low. All the shells in this clay are dead, but it contains numerous small Annelides of the genus *Sænuvis*, along with many larvæ of a Dipterous insect allied to *Chironomus* or *Corethra*, the latter being very conspicuous from their brilliant red colour. The muddy bottom seems to be wholly destitute of weeds, and does not appear to encroach upon depths of less than 2 fathoms.

Towards the edges of the bay, where the depth diminishes to one and a half fathom or less, the bottom consists of sand, covered over considerable areas by a dense growth of weeds of different kinds. The chief varieties of bottom in this shallow zone are these:—1. Pure siliceous sand with dead shells, almost destitute of life. 2. Sandy mud with a dense growth of Charas, containing numerous *Gammari*, small leeches, larvæ of *Chironomus* and Ephemerids, with shells of *Unio*, *Cyclas*, *Paludina*, *Planorbis*, *Valvata*, *Melania*, *Pisidium*, and *Physa*. 3. Sandy mud, sometimes with peaty layers, supporting a dense vegetation of *Anacharis canadensis* and Charas. The life in these portions of the bay consisted of much the same animals as in the preceding, except that the *Gammari* were absent, unless in the occasional patches of Charas brought up by the dredge. In some places, in from one to one and a half fathom of water, the sand was crowded with *Uniones*, the dredge coming up completely packed with living and dead shells. This was especially the case at several points under the lee of the "island," a long, flat, insulated strip of land which forms the southern boundary of the bay, running parallel with the shore on which Toronto is built, at a distance of about a mile and three quarters from it.

Another series of dredgings was carried on from a point in the open lake, about eight miles to the south of Toronto, on a line extending to the Toronto rolling-mills, the depth varying from 40 fathoms at the southern end of the line to 3 fathoms at its northern extremity. The deep dredgings along this line were only partially successful, the dredge bringing up nothing but good-sized pebbles, all the finer materials having been washed out before it reached the surface. In about 15 fathoms the bottom was found to consist of a tenacious blue clay, distinctly laminated, and containing numerous broken-up stems of plants, along with small pebbles. No traces of life could be detected beyond a few minute Annelides belonging to the genus *Sænuvis*. Another haul in 10 fathoms brought up the dredge full of sand and pebbles with no traces of life; and another in 8 fathoms showed a bottom of clear sand with dead shells of *Cyclas* and *Pisidium*, but devoid of all vestiges of animal or vegetable life.

Another series of dredgings was taken along a line extending in a south-west direction, from Toronto Point to a point about five miles out in the lake, the depths varying from 8 to 15 fathoms. In this case the bottom was found uniformly to consist of an exceedingly fine, bluish-grey, clayey mud, with numerous patches of a small bushy Alga (a species of *Cladophora*). The mud contained very numerous minute Annelides of the genus *Scenuris*, along with dead shells of *Cyclas*, *Pisidium*, and *Planorbis*; and the bunches of *Cladophora* yielded a large number of little Ostracode Crustaceans, and a few beautiful little Amphipods which are as yet undetermined.

Another series of dredgings was carried on still further to the south-west of the ground examined, in the series just mentioned, at a distance of about eight miles from the shore. The depth here varies from 30 to 45 or 50 fathoms; and the bottom was found to consist uniformly of a fine greyish mud, sometimes highly argillaceous, sometimes more or less arenaceous, with many small pebbles disseminated through it, and containing a few dead shells of *Planorbis* and *Pisidium*, and much broken-down vegetable débris. Every haul also brought up numerous specimens of a beautiful flesh-coloured Amphipod and a few minute Annelides; but no other traces of life were obtained. The Amphipods are referable to *Pontoporeia*, being apparently undistinguishable from *P. affinis* of the Swedish lakes; and I shall speak of them at greater length immediately.

Another series of dredgings were taken in Humber Bay, about four miles to the west of Toronto. Here the bottom, except close to the shore, consisted of a tenacious bluish-grey clay, sometimes with reddish patches in it. Vegetable life was very scanty; and animal life consisted entirely of many minute Annelides.

Lastly, an examination was made, partly with the dredge and partly by means of a hand-net, of the shallow water in the immediate neighbourhood of the "island" and of the extensive ponds which communicate with the lake. The bottom here consisted, for the most part, of a black mud composed almost entirely of decayed vegetable matter, and supporting a dense growth of Charas, *Vallisneria*, *Anacharis*, *Pontederia*, *Nymphaea*, and *Nuphar*. Animal life was naturally extremely abundant, comprising numerous examples of *Limnæa*, *Physa*, *Planorbis*, *Paludina*, *Cyclas*, *Pisidium*, and *Anodon*, along with two species of *Gammarus* and many small Ostracode Crustaceans, a few leeches (*Clepsine*), very many large scarlet water-mites, numerous aquatic insects (*Nepa*, *Gyrinus*, *Dy-*

ticus, and larvæ of *Chironomus*, *Libellula*, &c.), and a large number of young fishes (*Pimelodus*, *Perca*, &c.). Numerous Terrapins were also observed, and a single specimen of *Menobanchus*; but the latter unfortunately was not secured.

In the following list are indicated the chief forms of animal life which were obtained in these dredgings. As before remarked, time has in most cases not permitted of any specific determinations being made, and the species will be described at length in a subsequent notice. The microscopic species also have, in the meanwhile, been completely neglected.

ANNELIDA.

1. *Nephelis*, sp.

A small leech, nearly an inch in length when at rest, with an oblique posterior sucker, and of a liver-brown colour in life. Nearly allied to, if not identical with, *N. lateralis*, Say.

Rare in 3 fathoms, Toronto Bay.

2. *Nephelis*, sp.

An exceedingly remarkable form, apparently undescribed. The body is much flattened, and the width is nearly as great as the length when the animal is at rest. Length $\frac{1}{2}$ inch in extension, $\frac{1}{4}$ inch or less in contraction. Colour sometimes dark greenish brown or nearly black, sometimes light brown, with innumerable black points and numerous yellow spots, which are especially abundant at the margins. A double black dorsal line. The habits of this little leech are very remarkable. The adult leech usually places itself with its entire ventral surface closely appressed to some foreign body, such as a stone or dead shell, to which it adheres like a limpet or small *Chiton*. When forcibly detached or irritated it rolls up like a hedgehog or like the Myriopods of the genus *Glomeris*. The objects served by these peculiar habits become obvious when it is seen that almost every individual carries attached to the ventral surface of the body a large number (generally from twenty to thirty) of young leeches. The young are attached to the ventral surface of the parent posteriorly in a close cluster, which is surrounded on all sides by a vacant space; they adhere to the adult by their posterior suckers, which are separated from the body by a very distinct constriction. The young leeches are about $\frac{1}{32}$ of an inch in length, in colour light yellow or reddish, and semitransparent. The stomach is very conspicuous, and fills the greater part of the body; but no other internal organs could be detected. This extraordinary habit of carrying the young has been noticed by Verrill in a species of

Clepsine; but, so far as I am aware, attention has not been otherwise drawn to it (American Journ. Science and Arts, vol. iii. Feb. 1872). I have also observed it in a species of *Clepsine* from Lake Ontario, and shall describe it more fully upon a future occasion.

Common in from 1 to 3 fathoms.

3. *Clepsine*, sp.

A small leech, about $\frac{1}{4}$ inch in length in extension. The body flattened, with broad, transparent margins exhibiting numerous lateral papillæ. Back and belly, with exception of the transparent borders above alluded to, of a dirty greenish brown. The anterior end of the body is attenuated; the posterior extremity wide and flattened out; and when irritated, it has the habit of rolling up into a ball. This species, also, carries its young attached to the posterior portion of its ventral surface, in a small rounded bunch.

Common in from 1 to 3 fathoms.

4. *Clepsine* (?).

A small undetermined leech, of a worm-like shape and a red colour. Length when contracted about $\frac{1}{2}$ inch, in extension about 1 inch. Instead of remaining quietly attached to some foreign body, like the preceding species, this leech swims actively through the water by a serpentine bending of the body.

Rare in 3 fathoms.

5. *Sænuris*, sp.

A large Oligochætous Annelide, about 2 inches in length, of a red colour, with an iridescent blue intestinal streak.

A single individual was obtained in 3 fathoms, on a sandy bottom.

6. *Sænuris* or *Chirodrillus*, sp.

A small and very slender form, varying in length from $\frac{1}{4}$ inch up to 1 inch, and of a red colour. These minute Annelides occurred in extraordinary numbers at all depths of the lake from 3 up to 45 fathoms; but they were much more abundant at the smaller than at the greater depths. They were uniformly found wherever the bottom consisted of a fine tenacious clayey mud.

CRUSTACEA.

7. *Gammarus*, sp.

A small freshwater shrimp, varying in length from $\frac{1}{5}$ to $\frac{1}{4}$ inch, and of a greenish-brown colour during life, with a dark

green intestinal tract. The antennæ and antennules are about half the length of the body, and nearly equal. Numerous examples of this pretty little species occurred amongst Charas and other water-weeds, in from 1 to 3 fathoms.

8. *Gammarus*, sp.

A minute form, not uncommon in shallow water in the ponds at the "island."

9. *Crangonyx* (?), sp.

A small Amphipod, as yet unexamined, which may perhaps belong to this genus.

Common in from 10 to 15 fathoms, amongst branches of *Cladophora*, upon a muddy bottom.

10. *Cypris* (?), sp.

A small Ostracode Crustacean, as yet undetermined, which occurred plentifully, along with the preceding, amongst *Cladophora* at depths of from 10 to 15 fathoms.

11. *Pontoporeia affinis* (Lindström).

Small Amphipods, varying in length from $\frac{1}{10}$ up to $\frac{1}{4}$ inch, of nearly uniform flesh-colour. They are referable to the genus *Pontoporeia*; and though they have not yet been satisfactorily examined, I have little doubt as to their being identical with the *Pontoporeia affinis* of the Swedish lakes and of Lake Superior.

They occur in great plenty in from 30 to 45 fathoms; but none were found in depths less than this, though they are found in Lake Superior in all dredgings, from the shallowest to the deepest. They were uniformly found inhabiting a muddy bottom; and they died very shortly after they were brought to the surface.

ARACHNIDA.

12. *Limnochares*, sp.

A fine species of this genus was extremely abundant in shallow water and in the ponds at the "island."

13. *Hydrachna*, sp.

A small water-mite of this genus occurred abundantly in Toronto Bay in from 1 to 2 fathoms.

INSECTA.

14. *Chironomus* or *Corethra*, sp.

The larvæ of a species of Dipteron belonging to one of the *Ann. & Mag. N. Hist.* Ser. 4. Vol. x.

above genera occurred in great abundance in all the dredgings in which a muddy bottom was found in depths of from 2 to 20 fathoms, but more abundantly in the smaller depths. The colour varied in different examples from deep blood-red to pink or greenish; and their semitransparency rendered them very beautiful under the microscope.

15. *Ephemeridæ*.

Larvæ of Ephemerids were found rarely in shallow water to a depth of 2 fathoms.

MOLLUSCA.

16. *Planorbis trivolvis*, Say.

Very common in shallow water, but not extending beyond a depth of 3 fathoms.

17. *Planorbis parvus*, Say.

Very common in shallow water, but not extending beyond a depth of 1 fathom.

18. *Valvata tricarinata* (?).

A small species of *Valvata*, apparently referable to the above, occurred abundantly in from 2 to 3 fathoms, ranging, though in much diminished numbers, into depths of from 5 to 8 fathoms.

19. *Paludina*, sp.

A large form, nearly allied to *P. decisa*, Say (perhaps *P. impura*). This species occurred in a living state and in all stages of growth in from 2 to 3 fathoms on a sandy bottom.

20. *Paludina (Amnicola)*, sp.

This is a very minute form which occurred in great plenty, crawling over the stems of *Chara* or *Anacharis* in from 1 to 3 fathoms.

21. *Limnæa jugularis*, Say (= *L. stagnalis*?).

A large species, occurring in great plenty in shallow water at Toronto Island. It is very nearly allied to *L. stagnalis*, but it may perhaps be distinct.

22. *Limnæa*, sp.

A smaller and more elongated form, nearly allied to *L. columella*, Say.

Rare in from 1 to 2 fathoms.

23. *Physa heterostropha*, Say.

Very common in shallow water at the "island."

24. *Physa*, sp.

A smaller form, rare in from 1 to 3 fathoms.

25. *Melania*, sp.

A form nearly allied to, if not identical with, the *M. depygis* of Say (= *M. niagarensis*, Lea?).

Common in from 2 to 3 fathoms in Toronto Bay.

26. *Cyclas similis*, Say.

Common in from 1 to 3 fathoms.

27. *Pisidium abditum*, Haldeman.

Common in from 2 to 5 fathoms.

28. *Unio crassidens*, Lam.

Common, both in the living and dead state, in from 1 to 3 fathoms in Toronto Bay.

29. *Unio*, sp.

A large ventricose form, common at the same depths and in the same locality as the preceding.

VERTEBRATA.

30. *Pimelodus catus* (= *P. atrarius*).

The young of this species, not more than 1 inch to 1½ inch in length, occurred abundantly in the pools in the vicinity of the "island."

31. *Pomotis vulgaris*.

The young of the sunfish or northern *Pomotis* of Richardson occurred not uncommonly in shallow water at the "island."

32. *Perca flavescens*, Cuv.

The American yellow perch.

Common throughout Toronto Bay.

33. *Leuciscus*.

Two individuals of a small species of this genus were brought up by the dredge in Toronto Bay from a depth of about 2 fathoms.

GENERAL OBSERVATIONS.

In a mere preliminary report there are but a few general considerations which require notice. Upon the whole the

results obtained in these dredgings in Lake Ontario agree very fairly with those obtained in Lake Superior; and there is a general conformity in the phenomena observed. The fauna of Lake Superior, however, so far as deep water is concerned, is decidedly richer than that of Lake Ontario; whilst some of the more remarkable forms discovered in the former appear to be altogether absent in the latter. This is especially noticeable as regards the singular Stomapod, Crustacean *Mysis relicta*, which was found in great plenty in Lake Superior at all depths up to 148 fathoms, but which was not detected at all in Lake Ontario.

As might have been expected upon *à priori* grounds, the fauna of Lake Ontario is not extensive, though some forms occur in great profusion. The shallow-water fauna is very rich in individuals, and the number of species is quite considerable for fresh water. No doubt, also, the list might be much increased by a careful examination and by a more extended investigation than it was in my power to carry out. Beyond 8 or 10 fathoms the fauna becomes very scanty; and when we reach depths of 20 fathoms and upwards, the list becomes reduced to some small Annelides and Amphipod Crustaceans. The nature of the bottom, also, at great depths is exceedingly unfavourable to animal life, consisting almost everywhere of a fine clayey mud, the temperature of which is very low.

The most interesting forms of life discovered were the Annelides and Crustaceans. The Annelides are very abundant and varied, the two orders of the *Hirudinea* and *Oligochaeta* being both represented, and the former presenting some species of peculiar interest. Of the Crustacea the most interesting is the little Amphipod which occurs in such numbers in depths of from 30 to 45 fathoms, and which appears to be identical with the *Pontoporeia affinis* of the Swedish lakes. This species and the Stomapod *Mysis relicta*, Lovén, are found in Lakes Wetter and Wener in Sweden; and it is well known that their occurrence in this locality, along with other species of marine genera, led to the belief that these lakes had been formerly part of the sea, from which they had been cut off by geological changes. On this theory these Crustaceans are the survivors of the original marine fauna of the area, which had been able to bear up under the gradual changes by which the formerly existing sea was converted into fresh water. The occurrence, therefore, of these same forms of *Pontoporeia* and *Mysis* in Lake Superior and of the former of them in Lake Ontario is an extremely interesting fact, whether Lovén's theory is to be accepted or not. It may be mentioned also that there are no insuperable geological difficulties which

would prevent the application of this theory to the great lakes of North America. It is a singular fact, however, that whilst both these Crustaceans have been discovered in Lake Superior and also in Lake Michigan, only one of them has been found in Lake Ontario, the *Mysis* seeming to be wholly wanting.

XLIII.—On the Structure of the Echinoidea. By S. LOVÉN*.

[Plate XIV.]

BESIDES the well-known external organs, ocelli, spines, pedicellariæ, the clavulæ of the fasciole, tentacles, and branchiæ, the recent Echinoidea possess another kind of organs which have hitherto been overlooked, although they occur so generally that we seek them in vain only in *Cidaris*. These are very small, button-like bodies, spheroidal, ellipsoidal, or somewhat irregular balls, 0·11–0·375 millim. in their greatest diameter, furnished with a short stalk, which is movably attached to a small, slightly projecting tubercle. They may not unsuitably be named *sphæridia*. They are hyaline, shining, hard, solid, and clothed with connective tissue rich in pigment, with epithelium and a ciliated cuticle. Their pedicel has the reticulated texture typical of the Echinoidea, which spreads more or less distinctly and continuously around its starting-point. In the direction of the axis of the ball we not unfrequently see a tube which opens in its upper pole, and is either simple or branched in a more or less regular manner. A great many of the balls have on their surface small elevations, tubercles, or spines—and many also depressions, which are sometimes shallow, but sometimes sink deeply in, towards the axis, in a conical form. But the greater part of the mass of the ball is formed of very numerous and very thin concentric layers; and there are some which do not present any thing but these. Their solid contents are dissolved by a weak acid, so that only the epithelium remains.

The sphæridia belong exclusively to the ambulacra (radii); and in all the genera which possess them they are never wanting on the peristomial plates, but differ in number and distribution in a direction from the mouth. They always occupy a definite position. In the Spatangidæ they stand, generally uncovered, one, two, or more in a little group, by the base of the tentacular cirri of the buccal area, near the

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