XXVII.—SKETCH OF THE INVERTEBRATE FAUNA OF LAKE SUPERIOR.

By Sidney I. Smith.

In the following paper, I have attempted to bring together all the species of invertebrate animals, excepting many aquatic insects and some groups of minute forms, known to inhabit the waters of Lake Superior. I had at first intended to make it a sketch of the invertebrate fauna of the entire chain of the great lakes, but found it impossible to bring together material enough for that purpose, and so have limited myself to the immediate region of Lake Superior. One of the principal objects of the article is to furnish a means of comparing the food of the fishes with the fauna of the waters which they inhabit. For this purpose, the fauna of Lake Superior is of more importance than that of the other lakes, since most of the material which I have examined from the stomachs of the lake-fishes was obtained in that lake by Mr. J. W. Milner. This account is undoubtedly very imperfect in all the groups; and some species which have been recorded as inhabiting the lake are very likely omitted, although I have intended to include all such. Of the insects I have attempted to mention only a very few species which are important as food for the white-fish, or interesting on account of the bathymetrical distribution. Most of the copepod and ostracoid *Crustacea* of the region are omitted, since they have not as yet been sufficiently studied by any one.

The account of the fauna of the depths of the lake is based almost entirely on a series of dredgings made during August and the early part of September, 1871, under the direction of General C. B. Comstock, superintendent of the survey of the northern and northwestern lakes and rivers. A preliminary report of these dredgings was made to General Comstock in October, 1871, and published as Appendix K in the Report of the Chief of Engineers, forming the second volume of the Report of the Secretary of War for 1871. Comparatively few of the shore-species were collected on this excursion, and consequently some parts of this paper have been largely compiled from other sources, especially from Professor Agassiz's work on Lake Superior. In all cases where the facts were not obtained by myself, however, I have given the authority on which they are inserted.

In order that the references to localities and depths may be better understood, I give a short account of the dredgings conducted by the lake-survey. The dredgings were all made by hand from the steamer Search, while employed in off-shore sounding, or in transporting shore-parties. The dredges used were like those commonly employed in marine dredg-

ing, with the addition of an inner bag of embroidery canvas, which was found necessary to retain the exceedingly fine clayey mud encountered at nearly every haul.

The following list will show the localities at which dredgings were made, the depth, and the composition of the bottom:

Simmons' Harbor, on the north shore of the lake, about twelve and a half miles north-northwest of Otter Island, August 9, 13 to 15 fathoms, bottom of fine sand, with scattered tufts of a small alga of the genus *Cladophora*.

Five miles off Simmons' Harbor, August 11, 60 fathoms, soft bluish clay.

Among the Slate Islands, August 14, while at anchor, two hauls: first, 12 to 14 fathoms, sand, with a little fine mud; second, from the other end of the steamer, 6 to 8 fathoms, sand, gravel, and small stones, with some mud.

On a line from the Slate Islands toward Stannard Rock, August 15, four hauls were made as follows: First, about eighteen miles south of the western end of the islands, 105 fathoms, soft clay; second, about thirty-five miles from the islands, 169 fathoms, the deepest point yet found in the lake, very soft light-drab clay, with small pieces of rotten wood; third, about forty miles from the islands, 116 fathoms, bottom same as in the last haul; fourth, about fifty-seven miles from the islands, 159 fathoms, very soft clay.

On a line southeast from Passage Island, off the east end of Ile Royale, August 18, hauls were made at five points: First, about six miles out, 47 fathoms, soft, reddish-clay and sand; second, about fifteen miles from Passage Island, 129 fathoms, soft clay; third, about twenty-nine miles from the island, 127 fathoms, bottom same as last haul; fourth, about forty-three miles from the island, 134 fathoms, bottom as in the last two hauls; fifth, about fourteen miles north of Keweenaw Point, 82 fathoms, two hauls, reddish clayey mud and sand.

North of Copper Harbor, August 22, dredgings were made at three different points: First, seventeen miles off, 148 fathoms, soft clay; second, nearer the shore, 62 fathoms, soft, reddish mud and sand; third, within a quarter of a mile of the shore, 17 fathoms, sand.

Off fifty miles, on a course northeast by east one-half north of Copper Harbor, August 24, 116 fathoms, soft clay.

In Neepigon Bay, due north of Saint Ignace station and half a mile from the shore of Saint Ignace Island, August 28, 32 fathoms, very soft clayey mud.

In the cove at the eastern end of Saint Ignace Island, near Saint Ignace station, August 29, 4 to 6 fathoms, sand, with some mud, bits of wood, &c.

About three miles south of the same cove, August 29, 73 fathoms, soft clayey mud.

In a small harbor on the south side of Saint Ignace Island, between

the main island and a smaller one, and due south of Saint Ignace station, September 4, two hauls, 8 and 10 to 13 fathoms, a little sand and mud brought up with great quantities of the same species of alga found at Simmon's Harbor, and which, according to Prof. D. C. Eaton, who kindly examined it for me, is a small, densely-tufted species of *Cladophora*, possibly *C. glomerata* Linn., a most variable species, but the specimens do not well correspond with authentic ones from Germany. This alga was brought up in immense quantities, the dredge being full at each haul.

On a line between Michipicoton Island and Copper Harbor, and about thirty-seven miles from the island, September 7, 147 fathoms, soft clay.

From this list it is readily seen that, in all the deeper parts of the lake, the bottom is covered with a uniform deposit of clay or clayey mud. All the soundings made by the lake-survey show the same thing, the specimens of the bottom brought up from deep water by the lead being everywhere of the same character, varying only in color and somewhat in the amount of sand mixed with the clay. The color was not uniform even in the same dredgeful; drab and bluish masses of the clay being frequently mixed with brown or reddish lumps. In deep water, drab and bluish were the prevailing tints, however. Water was taken from the bottom at many points, and was everywhere perfectly fresh. That from 169 fathoms gave no precipitate with nitrate of silver.

The temperature, everywhere below 30 or 40 fathoms, was very uniform, varying only slightly from 39°, while at surface, during the season at which the dredging was carried on, it varied from 50° to 55°.

The fauna of the lake-bottom corresponds with these physical conditions. In the shallow waters along the shores, the fauna varies with the varying character of the bottom, while below 30 to 40 fathoms, where the deep-water fauna properly begins, the same species seem to be everywhere nearly uniformly distributed down to the deepest points. The soft clayey bottom is, however, very unfavorable to most forms of animal life, and, as we might expect, the fauna of this region is very meager. Except among the worms, it seems to have scarcely any species peculiar to it, and is characterized rather by the absence of many of the shallow-water species than by forms peculiar to itself.

Besides the dredgings made by the lake-survey, Mr. J. W. Milner dredged, in 1872, in 60 fathoms off Outer Island, and obtained several of the species which had been found the year before.

It is proper that I should make a special acknowledgment to Professor Verrill for the assistance he has given me in the preparation of this paper. The account of the worms in the preliminary report referred to was prepared wholly by him, and in the following pages the enumeration and description of the species of that class, with which I am unacquainted, has been made up wholly from his published papers and manuscript notes. Special acknowledgments to Messrs. Temple Prime and Charles M. Wheatley for assistance in determining some of the species of *Mollusca* will be found under that group.

ARTICULATA.

INSECTS.

DIPTERA.

Many different species of two-winged flies in the larva stage inhabit the waters of Lake Superior. The great majority of the species, however, inhabit only the shallower waters, and are never found below the depth of a few feet; and such species are very much more abundant in pools, marshes, &c., in the vicinity, than in the pure and cold waters of the lake itself, where, it seemed to me, there were much fewer of all kinds of insect larvæ than in the lower lakes. The slender worm-like larvæ of the numerous species of *Chironomus* were not uncommon in dredgings even from great depths, and some of the species apparently live in abundance over the entire bottom of the lake. The species of the genus seem to be very generally diffused; the larvæ of some of the species even inhabiting salt-water. The winged insects themselves are delicate, mosquito-like flies, with plumose antennæ, and often swarm in vast numbers about ponds and marshy ground. I mention a few of the different forms of these larvæ found in the lake. These forms of larvæ may each, very likely, represent several species in the adult state, but for the present purpose it is convenient to speak of forms which can be distinguished while larvæ.

CHIRONOMUS, species, *a*. (Plate III, figs. 20, 21.)

A large opaque-white larva and its pupa were common in all the shallower dredgings and down to 32 fathoms. Larvæ and pupæ of apparently the same form were found in the stomachs of white-fish taken at Sand Island and at Sault Sainte Marie.

CHIRONOMUS, species, *b*.

A semi-translucent larva, much more slender than the last, was found in many of the shallow dredgings, and was often common, even down to 147 fathoms. The same form was found in abundance in the stomachs of white-fish taken at Outer Island.

CHIRONOMUS, species, *c*. (Plate III, fig. 22.)

A small entirely blood-red larva occurred in 6 to 8 fathoms among the Slate Islands, and in 8 to 13 fathoms among *Cladophora*, &c., on the south side of Saint Ignace Island.

NEUROPTERA.

Many species of *Neuroptera*, especially of *Ephemeridæ* and *Phryganeidæ*, are found about the lake, but, as in the case of the *Diptera*, most

of the species are confined to the shallow pools and other small bodies of water about the lake, and do not occur, or only very sparingly, in the lake itself.

EPHEMERIDÆ, species.

The larva of one species was dredged in 32 fathoms in Neepigon Bay.

The species of this family did not seem to be abundant in the lake itself, and the cast skins of the pupæ were nowhere, as far as my observations went, in such great abundance as they are on the lower lakes.

HYDROPSYCHE, species.

The larva of a species, belonging apparently to this genus, was dredged in 13 to 15 fathoms at Simmons' Harbor. The larvæ, pupæ, and sub-imago of the same or a closely-allied species were found in great abundance in stomachs of white-fish taken at Sault Sainte Marie.

PHRYGANEIDÆ, species. (Plate III, figs. 18, 19.)

The larvæ of another Phryganeid, inhabiting a cylindrical, tapering tube, composed of bits of the stem of the *Cladophora*, among which it lives, were abundant in 8 to 13 fathoms on the south side of Saint Ignace Island, and in 15 to 18 fathoms at Simmons' Harbor. The larvæ and pupæ of the same or an allied genus were found in the stomachs of white-fish taken at Sault Sainte Marie.

ACARINA.

HYDRACHNA, species.

A small, dark-colored species was dredged in 4 to 6 fathoms in the cove at the eastern end of Saint Ignace Island. A species, apparently the same, occurred in the stomachs of the white-fish taken at Ecorse, Mich.

CRUSTACEA.

PODOPHTHALMIA.

CAMBARUS VIRILIS Hagen. (p. 638.)
CAMBARUS PROPINQUUS Girard. (p. 638.)
CAMBARUS RUSTICUS Girard. (p. 639.)
CAMBARUS BARTONII Erickson. (p. 639.)
MYSIS RELICTA Lovén. (p. 642.)

TETRADECAPODA.

AMPHIPODA.

HYALELLA DENTATA Smith. (p. 645.)
PONTOPOREIA HOYI Smith. (p. 647.)
GAMMARUS LIMNÆUS Smith. (p. 651.)
CRANGONYX GRACILIS Smith. (p. 654.)

ISOPODA.

ASELLOPSIS TENAX Harger, (p. 659.)

ENTOMOSTRACA.

CLADOCERA.

DAPHNIA GALEATA G. O. Sars. (Plate II, fig. 11.)

Om en i Sommeren 1862, foretagen zoologisk Reise i Christianias og Trondhjems Stiftor, p. 21, 1863, (*teste* Müller;) E. P. Müller, Denmarks Cladocera, Naturhistorisk Tidsskrift, III, vol. v, p. 117, pl. 1, fig. 6, 1868.

A species of *Daphnia*, which I cannot discover to differ in the least from Müller's description and beautiful figures above referred to, was taken quite abundantly near the surface of the water a few miles south of Saint Ignace Island August 29, 1871, and was found in the dredge from 72 fathoms at the same locality. It was also found in the deeper dredgings in many parts of the lake, but was very likely taken each time near the surface in the dredge on its way up. A few specimens occurred in the stomachs of the white-fish taken at Outer Island and at Sault Sainte Marie.

This and the next species are transparent, and seem to be free-swimming animals, inhabiting the waters of the lakes away from the weedy shores or bottom, where most of the other species of the genus are found. In Europe, this species is found in the lakes of Scandinavia and Denmark, where it appears to have precisely the same habits as in Lake Superior.

It is possible that a minute comparison of specimens from Europe and America may reveal some differences similar to those which I have noticed in the species of *Pontoporeia* from the two countries, but with the figures and description referred to I can find absolutely no differences. The American specimens exhibit the same varieties of form in the head and teste as are described by Müller in European specimens

DAPHNIA PELLUCIDA Müller.

Op. cit., p. 116, pl. 1, fig. 5.

The remarks in regard to the identity of the last species apply equally to this. This species differs from the last in having the rostrum somewhat acute and curved backward instead of truncate, and in having the caudal stylets armed near the base with a series of slender teeth or spines and the rest of the way with very slender setæ, while in *D. galeata* they are without teeth or spines, and are furnished with setæ through their whole length. The front of the head is also more evenly rounded and less crested than it ever is in *D. galeata*, although that species varies much in this respect.

This species was taken at the same times and places as the last, and was also found among the contents of white-fish stomachs from Outer Island.

DAPHNIA PULEX (?).

Baird, Nat. Hist. British Entomostraca, p. 89, pl. 6, figs. 1–3, 1850 ; Lilljeborg, Cladocera, Ostracoda et Copepoda in Scania, p. 30, pl. 2, figs. 2, 3, pl. 16, figs. 10–12, 1853; Leydig, Naturgeschichte der Daphniden, p. 117, pl. 1, figs. 1–7, 1860; Müller, op. cit., p. 110, pl. 1, fig. 4.

A species which it is not easy to distinguish, by the figures and descriptions referred to, from the common *Daphnia* of Europe was found in great abundance in a small pond at Sault Sainte Marie by Mr. J. W. Milner. A more careful examination than I have been able as yet to make may, however, show it to be a distinct but very closely allied species.

BOSMINA, species undetermined.

Taken at the surface a few miles south of Saint Ignace Island.

EURYCERCUS LAMELLATUS Baird(?).

Op. cit., p. 124, pl. 15, fig. 1.

Lynceus lamellatus Lilljeborg, op. cit., p. 71, pl. 5. figs. 7–12 ; pl. 6, figs. 1–7 ; pl. 7, fig. 1, 1853 ; Leydig, op. cit., p. 209, pl. 7, figs. 52–56, pl. 10, fig. 72.

A species of *Eurycercus*, identical with or closely allied to the typical species of Europe, was dredged, among *Cladophora*, in 8 to 13 fathoms, on the south side of Saint Ignace Island, and is, doubtless, common in other similar situations.

LEPTODORA HYALINA Lilljeborg.

Öfversigt af Vetenskaps Akademiens Förhandlingar, 1860, p. 265, pl. 7, figs. 1–22; Müller, op. cit., p. 226, pl. 6, figs. 14–21; G. O. Sars, Om en dimorph Udvikling samt Generationsvexel hos Leptodora, Forhandlinger i Vidensk. Selsk. i Christiania, for 1873, pl. 1; Weismann, Ueber Bau und Lebenserscheinungen von Leptodora hyalina, Zeitschrift für wissenschaftl. Zoologie, vol. xxiv, p. 349, pls. 33–38, 1874.

A single somewhat mutilated specimen, which agrees well with the descriptions and figures above referred to, came up in the dredge a few miles south of Saint Ignace Island, in company with *Daphnia galeata*, *D. pellucida*, &c., and, like them, was undoubtedly taken in the dredge on its way up. It is one of the largest and most remarkable forms of *Cladocera* known. It is wholly transparent, and grows to fully half an inch in length. The shell is very small, and incloses no part of the body; the head with the large eye at its extremity is produced far forward; the basal portion of the natatory appendages is long and very stout, while the rami are comparatively short and four-jointed; the six pairs of legs are crowded together below the natatory appendages; and the abdomen is very long, and the last segment terminates in two stout stylets.

OSTRACODA.

Quite a number of species belonging to several different genera were dredged at different points in the lake, one or two species occurring

even down to 159 fathoms. They were more abundant, however, in shallow water, and were especially numerous in 8 to 13 fathoms, among *Cladophora*, on the south side of Saint Ignace Island.

COPEPODA.

Several species of *Copepoda* were often very abundant at the surface of the water, while I was on the lake, and large numbers were collected. Species were also brought up in the dredge at almost every haul, most of them the same species as those obtained near the surface, but some were different and undoubtedly from near the bottom. They were almost always abundant in the dredgings in which *Mysis* occurred, apparently furnishing most of its food.

SIPHONOSTOMA.

LERNÆOPODA SISCOWET Smith. (p. 664.)

LERNÆOPODA (?) COREGONI Smith. (p. 664.)

WORMS.

OLIGOCHÆTA.

LUMBRICUS LACUSTRIS Verrill.

American Journal of Science, 3d series, vol. ii, p. 449, 1871; and Preliminary Report on Dredging in Lake Superior, p. 1023, 1871.

About 42^{mm} long, 1^{mm} in diameter. Body round, distinctly annulated. Head short, conical, obtusely pointed. Setæ spine-like, strongly curved, acute, arranged two by two, those of each pair close together. Color reddish brown.

Abundant, in 8 to 13 fathoms, among *Cladophora*, on the south side of Saint Ignace Island; also from the stomachs of white-fish taken at Outer Island.

SÆNURIS ABYSSICOLA Verrill.

American Journal of Science, 3d series, vol. ii, p. 449, 1871; and Preliminary Report on Dredging in lake Superior, p. 1024, 1871.

Worm slender, attenuated posteriorly, about 7^{mm}.5 long, 0^{mm}.75 in diameter anteriorly. Body composed of about twenty-eight segments; those of the posterior half elongated; those of the anterior half shorter, separated by slight constrictions. Cephalic lobe short, subconical, rounded in front. Mouth large, semicircular. Intestine slender, moniliform, containing sand. Anus terminal, with three or four slight lobes. Setæ in four fan-shaped fascicles on each segment, commencing at the second segment behind the mouth. The two ventral fascicles are separated by a space equal to about twice the length of the setæ, of which there are five or six in each fascicle; the setæ are simple, acute, slightly curved, equal to about one-sixth the diameter of the body. The lateral

fascicles contain three to five somewhat shorter and straighter simple setæ. One specimen appeared to have four minute ocelli upon the upper side of the head.

Dredged off Copper Harbor, 17 fathoms, sand; off Simmons' Harbor, 60 fathoms; and on the line from the Slate Islands toward Stannard Rock, fourth haul, 159 fathoms.

SÆNURIS LIMICOLA Verrill.

American Journal of Science, 3d series, vol. ii, p. 450, 1871; and Preliminary Report on Dredging in Lake Superior, p. 1024, 1871.

Worm more slender than the preceding, attenuated posteriorly, composed of about 44 segments. Length about 8mm, diameter 0mm.4. Cephalic lobe blunt, conical. Setæ in four fascicles upon each segment, six to eight in each fascicle anteriorly, four or five posteriorly. The setæ in all the fascicles are relatively long, slender, curved, and acute. Two tortuous red blood-vessels pass along the intestine, forming a loop at each segment. Intestine moniliform.

Dredged on the line between the Slate Islands and Stannard Rock, fourth haul, 159 fathoms.

CHIRODRILLUS Verrill.

Allied to *Sænuris*, but with six fan-shaped fascicles of setæ upon each segment, two of which are ventral, two lateral, and two subdorsal; setæ in the ventral and lateral fascicles four to nine, simple, acute, slender, curved like an italic *f*; those of the dorsal fascicles stouter and less curved, three to six in each fascicle. Intestine wide, somewhat moniliform. Anus terminal, large.

CHIRODRILLUS LARVIFORMIS Verrill.

American Journal of Science, 3d series, vol. ii, p. 450, 1871; and Preliminary Report on Dredging in Lake Superior, p. 1024, 1871.

Body rather short and not very slender, cylindrical, obtuse at both ends, distinctly annulated, composed of about 38 rings. Length about 7mm.5; diameter, 1mm.25. Cephalic lobe short, conical, obtuse; mouth large, semicircular beneath. Ventral fascicles of setæ near together, with about five setæ, which are rather short, simple, acute, little curved; lateral fascicles with five or six setæ of similar form and size; subdorsal ones similar. When preserved in alcohol, the body is usually curved ventrally, or in a simple coil. Color, when living, translucent whitish; intestine slightly greenish. A thickened smooth zone commences behind the tenth setigerous ring, occupying the space of about four segments.

Off Copper Harbor, 17 fathoms, sand; off Simmons' Harbor, 59 fathoms, clayey mud.

CHIRODRILLUS ABYSSORUM Verrill.

American Journal of Science, 3d series, vol. ii, p. 450, 1871; and Preliminary Report on Dredging in Lake Superior, p. 1024, 1871.

Subcylindrical, thicker anteriorly, distinctly annulated, composed of about 42 segments. Length, 6mm; diameter, about 0mm.5. Cephalic lobe short, conical, obtuse; mouth large, semicircular. Ventral fascicles with eight or nine setæ anteriorly; five or six posteriorly. The setæ are long, slender, acute, strongly curved; those on the inferior side of the fascicles nearly twice as long as those of the upper side; setæ of the lateral fascicles five or six, slender, nearly as long as those of the ventral ones, and similar in form; dorsal fascicles with four or five shorter, stouter, and straighter, acute setæ.

Six miles southeast of Passage Island, 47 fathoms; on line from the Slate Islands toward Stannard Rock, fourth haul, 159 fathoms.

TUBIFEX PROFUNDICOLA Verrill.

American Journal of Science, 3d series, vol. ii, p. 450, 1871; and Preliminary Report on Dredging in Lake Superior, p. 1024, 1871.

A rather stout species for the genus, about 25mm to 35mm long, 1mm.25 in diameter anteriorly, more slender posteriorly, (0mm.5 in diameter.) Cephalic lobe short, conical; one specimen apparently had two minute ocelli. Mouth large, semicircular. Intestine moniliform, with two simple red blood-vessels running along its whole length and uniting at the constrictions. In the first five or six segments, there are slender vessels of nearly uniform size, which form lateral loops in each segment. Anus terminal, wide, with about ten small lobes. Setæ in four fascicles upon each segment. Those of the lateral fascicles three anteriorly, often but two, short, slightly curved, mostly with minute forked and hooked tips; those of the ventral series in fascicles of four to six, three or four times longer than the upper ones, considerably bent, the ends minutely hooked and forked.

Neepigon Bay, 32 fathoms.

BDELLODEA.

MACROBDELLA DECORA Verrill. (p. 668.)

Collected at Madeline Island by Mr. J. W. Milner.

AULASTOMUM LACUSTRE Leidy. (p. 670.)

Lake Superior, (Leidy.)

SEMISCOLEX GRANDIS Verrill, *var. maculosa.* (p. 672.)

Collected at Madeline Island by Mr. J. W. Milner.

NEPHELIS LATERALIS Verrill. (p. 675.)

Collected with the last species at Madeline Island by Mr. Milner, and a young specimen was also dredged in 6 to 8 fathoms among the Slate Islands.

NEPHELIS FERVIDA Verrill. (p. 676.)

Dredged in 1871, in 8 to 13 fathoms, on the south side of Saint Ignace Island; also from stomach of *Coregonus quadrilateralis* taken at Madeline Island.

CLEPSINE PARASITICA Diesing. (p. 678.)

Judging from the extreme northern and western range of this species, it must occur in Lake Superior.

CLEPSINE PAPILLIFERA Verrill. (p. 683.)

Collected at Bad River by Mr. J. W. Milner.

ICHTHYOBDELLA PUNCTATA Verrill. (p. 687.)

Dredged in 6 to 8 fathoms among the Slate Islands.

TURBELLARIA.

PROCOTYLA FLUVIATILIS Leidy.

Dendrocœlum superbum Leidy, Proceedings Academy Nat. Sci. Philadelphia, vol. v, 1851, p. 288, (*non* Girard.)

Procotyla fluviatilis Leidy, MSS.; Stimpson, Proceedings Academy Nat. Sci. Philadelphia, vol. ix, 1857, p. 23; Diesing, Revision der Turbellarien, Sitzungsberichte der mathem.-naturwissensch. Classe der kais. Acad. der Wissensch. zu Wien, 1861, p. 517; Smith and Verrill, American Journal of Science, 3d series, vol. ii, p. 452, 1871; and Preliminary Report on Dredging in Lake Superior, p. 1025, 1871.

Numerous specimens of this species were dredged in 8 to 13 fathoms among *Cladophora* on the south side of Saint Ignace Island. When living, they were dirty-white, mottled with brown.

It is not uncommon near New Haven, Conn., and in other parts of New England.

MOLLUSCA.

The following list of the mollusks of Lake Superior is largely a compilation from the publications of Say, Haldeman, Gould, Lea, Prime, and Binney, and no sort of revision of the species has been attempted. I have, however, in all cases given the authority for the insertion of the species when I have not observed them myself.

GASTROPODA.

For the identification of several of the following species collected by myself I am indebted to Charles M. Wheatley, esq., of Phœnixville, Pa. For convenience of identification I have added, under most of the species, a reference to Parts II and III of Mr. Binney's Land and Fresh-Water Shells of North America, published in 1865 in the Smithsonian Miscellaneous Collections.

VALVATA TRICARINATA Say.

Binney, op. cit., part iii, p. 9.

From the stomach of white-fish taken at Sault Sainte Marie and the stomach of sturgeon taken at Sand Island.

VALVATA SINCERA Say.

Binney, op. cit., part iii, p. 12.

Dredged in great abundance in 8 to 13 fathoms, among *Cladophora*, on the south side of Saint Ignace; in 4 to 6 fathoms in the cove at the eastern end of the same island; in 6 to 8 fathoms among the Slate Islands; and in 13 to 15 fathoms at Simmon's Harbor; also with the last species from stomachs of white-fish and sturgeon.

MELANTHO PONDEROSA (Say, sp.)

Binney, op. cit., part iii, p. 36.

Lake Superior, (Binney.)

AMNICOLA PALLIDA Haldeman (?).

Binney, op. cit., part iii, p. 83.

An *Amnicola*, found in great abundance in the stomach of white-fish taken at Sault Sainte Marie, is doubtfully identified with this species by Mr. Wheatley.

Amnicola limosa Say, (Binney, op. cit., part iii, p. 84,) probably occurs in Lake Superior, although I do not find it recorded from the lake.

AMNICOLA GRANUM Say.

Binney, op. cit., part iii, p. 86.

North shore, (Gould.) From stomach of white-fish taken at Sault Sainte Marie.

GONIOBASIS LIVESCENS.

Tryon, American Journal of Conchology, vol. ii, p. 33; figs. 205–207, 1866.

From stomach of white-fish taken at Sault Sainte Marie.

PLEUROCERA SUBULARE (Lea, sp.)

Tryon, loc. cit., vol. i, fig. 67, p. 307, 1865.

LIMNÆA STAGNALIS Linnæus.

Binney, op. cit., part ii, p. 25.

Described first from Lake Superior by Say, (under the name *L. jugularis*.) Northern shore, (Gould.)

LIMNÆA COLUMELLA Say.

Binney, op. cit., part ii, p. 32.

Lake Superior, (Binney and others.)

LIMNÆA MEGASOMA Say.

Binney, op. cit., part ii, p. 37.

Lake Superior, (Binney.)

Limnæa palustris Müller, (Binney, op. cit., part ii, p. 44,) doubtless occurs in Lake Superior, since it ranges north to Lake Winnipeg and Great Slave Lake.

LIMNÆA DESIDIOSA Say.

Binney, op. cit., part ii, p. 48.

Northern shore, (Gould.

LIMNÆA EMARGINATA Say.

Binney, op. cit., part ii, p. 51.

Lake Superior, (Binney.)

LIMNÆA CATASCOPIUM Say.

Binney, op. cit., part ii, p. 53.

Northern shore and Fort William, (Gould;) also from the stomach of sturgeon taken at Sand Island.

LIMNÆA CAPERATA Say.

Binney, op. cit., part ii, p. 56.

I found this species in abundance upon the rocky shores of Saint Ignace Island and at Michipicoton Island; also from the stomach of a white-fish taken at Sault Sainte Marie.

LIMNÆA HUMILIS Say.

Binney, op. cit., part ii, p. 63.

Michipicoton, (Gould.)

LIMNÆA LANCEATA Gould.

Binney, op. cit., part ii, p. 68.

North shore, (Gould.) A species which Mr. Wheatley identifies with this was dredged in abundance in 8 to 13 fathoms, among *Cladophora*, on the south side of Saint Ignace Island. These specimens are, however, much less elongated than the figures of *L. lanceata;* approaching, it seems to me, much more nearly to *L. desidiosa.*

PHYSA VINOSA Gould.

Binney, op. cit., part ii, p. 80.

Dredged in 6 to 8 fathoms among the Slate Islands; also, from the stomach of white-fish taken at Sault Sainte Marie.

PHYSA ANCILLARIA Say.

Binney, op. cit., part ii, p. 81.

Dredged in 8 to 13 fathoms, among *Cladophora*, on the south side of Saint Ignace Island; also, common upon the shores of Saint Ignace, Michipicoton Island, and other places on the shores of the lake.

PHYSA HETEROSTROPHA Say.

Binney, op. cit., part ii, p. 84.

Dredged in 4 to 6 and 8 to 13 fathoms at Saint Ignace Island; Black River, Pie Island, Fort William, (Gould.)

Butinus hypnorum Linnæus, (Binney, op. cit., part ii, p. 99,) probably occurs in the neighborhood of Lake Superior, as it extends far to the north and west of it.

PLANORBIS BICARINATUS Say.

Binney, op. cit., part ii, p. 123.

Sault Sainte Marie, Black River, (Gould;) also, from stomach of sturgeon taken at Sand Island.

PLANORBIS TRIVOLVIS Say.

Binney, op. cit., part ii, p. 115.

Occurs at Marquette and doubtless at other points on the lake.

PLANORBIS CAMPANULATUS Say.

Binney, op. cit., part ii, p. 109.

I found this species at Marquette and at Traverse Island, Keweenaw Bay.

GYRAULUS PARVUS (Say sp.)

Binney, op. cit., part ii, p. 133.

Common in 8 to 13 fathoms on the south side of Saint Ignace Island, and in 6 to 8 fathoms among the Slate Islands; also, from stomach of white-fish taken at Sault Sainte Marie.

Gyraulus deflectus (Binney, op. cit., part ii, p. 129) probably occurs in the vicinity of the lake.

Segmentina armigera H. and A. Adams, (Binney, op. cit., part ii, p. 137,) extends from New York State to Great Slave Lake, and probably occurs with the last species.

LAMELLIBRANCHIATA.

For the identification of most of the species of *Sphærium* and *Pisidium* collected by myself I am greatly indebted to Temple Prime, esq., of New York. References to Mr. Prime's "Monograph of American Corbiculadæ," published in 1865, in the Smithsonion Miscellaneous Collections, are added under the species of that family.

SPHÆRIUM SULCATUM Prime.

Op. cit., p. 33.

Sault Sainte Marie, (Gould.)

SPHÆRIUM AURIUM Prime.

Op. cit., p. 35.

Lake Superior ?, (Prime.)

SPHÆRIUM STRIATINUM Prime.

Op. cit., p. 37.

A very small specimen was dredged in 8 to 13 fathoms, among *Clado-*

phora, on the south side of Saint Ignace Island. It was also found in the stomachs of white-fish taken at Sault Sainte Marie, and in the stomach of a sturgeon taken at Sand Island.

Small specimens of the variety *acuminatum* Prime were dredged in 6 to 8 fathoms, among the Slate Islands.

SPHÆRIUM FABALIS Prime.

Op. cit., p. 40.

Lake Superior, (Prime.)

SPHÆRIUM EMARGINATUM Prime.

Op. cit., p. 43.

Region of Lake Superior, (Prime.)

SPHÆRIUM FLAVUM Prime.

Op. cit., p. 43.

Sault Sainte Marie, (Prime.)

SPHÆRIUM JAYANUM Prime.

Op. cit., p. 46.

Lake Superior, (Prime.)

Sphærium partumeium Prime (op. cit., p. 45) undoubtedly occurs in the region of Lake Superior, and probably many other species will be found there.

PISIDIUM VIRGINICUM Bourguignat.

Prime, op. cit., p. 61.

Dredged in abundance among *Cladophora* in 8 to 13 fathoms on the south side of Saint Ignace Island. Mr. Prime remarks that the specimens are unusually light and fragile.

PISIDIUM COMPRESSUM Prime.

Op. cit., p. 64.

Dredged in 4 to 6 fathoms at the eastern end of Saint Ignace Island.

PISIDIUM ABDITUM Haldeman.

Prime, op. cit., p. 68.

Varieties of this species were dredged among *Cladophora*, in 8 to 13 fathoms, on the south side of Saint Ignace Island; in 6 to 8 fathoms at the eastern end of the same island; and in 15 to 18 fathoms, sandy bottom, at Simmons' Harbor.

PISIDIUM ABDITUM, var. ABYSSORUM Stimpson, MSS.

This is a very small translucent form, dredged by Dr. Stimpson, in Lake Michigan, and by him named in manuscript. Mr. Prime, however, regards it as a stunted form of *P. abditum*. Dr. Stimpson's specimens

were dredged in 40 to 50 fathoms off Racine. In Lake Superior, it was common in the cove at the eastern end of Saint Ignace, on a sandy and muddy bottom, in 4 to 6 fathoms, and abundant among *Cladophora*, in 8 to 13 fathoms, on the south side of that island; among the Slate Islands, in 6 to 8 and 12 to 14 fathoms; at 13 to 15 fathoms on a sandy bottom in Simmons' Harbor; near Copper Harbor, in 17 fathoms, clear sand; in 32 fathoms, very soft clayey mud, in Neepigon Bay; off Copper Harbor, in 62 fathoms; and north of Keweenaw Point, in 82 fathoms, soft reddish clayey mud and sand; and in all the deep dredgings down to 159 fathoms. Below 100 fathoms, however, it was never abundant, and all the specimens from deep water were much smaller and more fragile than the majority of those from shallow water. Apparently, great depths are not favorable to its growth, and it never reaches its full development in such places. It was found in great abundance in the stomachs of white-fish taken at Outer Island.

"*Pisidium abysomus* Stimpson," mentioned, without description, by Hoy, (Transactions Wisconsin Academy, vol. i, p. 100, 1872,) is undoubtedly this variety.

PISIDIUM ROTUNDATUM Prime.

Op. cit., p. 72.

Region of Lake Superior, (Prime.)

UNIO RADIATUS Lamarck.

North shore, (Gould.)

ANODONTA PEPINIANA Lea.

Transactions Amer. Philosophical Society, vol. vi, pl. 16, fig. 51.

North shore, (Gould.)

RADIATA.

HYDRA CARNEA Agassiz.

Proceedings Boston Society Nat. Hist., vol. iii, 354, 1850; Ayres, Proceedings Boston Society Nat. Hist., vol. v, p. 104, 1855; A. Agassiz, Illustrated Catalogue Mus. Comparative Zoöl., North American Acalephæ, p. 197, 1865.

A beautiful *Hydra*, agreeing with Ayres' description of this species, was very abundant at the eastern end of Saint Ignace, upon rocks along the shore and near the surface, frequently completely covering quite large surfaces where they were protected from the direct sunlight, and was also brought up in many of the dredgings from 8 to 148 fathoms. In 32 fathoms, Neepigon Bay, and in 59 fathoms, off Simmons' Harbor, it was brought up in abundance from a soft clayey bottom. In the deep dredgings it frequently came up near the bottom of the clay in the dredge, and was evidently not caught while the dredge was near the surface.

Bathymetrical distribution of species.

I have already alluded to the meagerness of the deep-water fauna of the lake, and to the uniform character of the bottom everywhere below 30 to 40 fathoms. Although our knowledge of the fauna of the lake is still very imperfect, enough facts have been presented to show that very few, if any, of the species which inhabit the lake are confined to the deep waters, and that the change from the shallow to the deep water fauna takes place at a depth of about 30 fathoms, at which depth the character of the bottom and the annual temperature both become nearly uniform. The following table will present more clearly the distribution of the species in depth. Under the first column I have checked those species which are really free-swimming animals, most frequently found at the surface; and under the second, those which live in very shallow waters along the shores, &c. The table is of course very imperfect, even for those species which are included. Most of the species of *Mollusca*, which now appear only in the second column, undoubtedly occur in 4 to 8 fathoms or deeper; but I have only checked the species as far as they have actually been observed at the depths indicated.

	Surface.	Shore.	Depth in fathoms.				
			4–8.	10–20.	30–50.	60–100.	100–169.
INSECTS.							
Chironomus, sp., *a*		×	×	×	×		
Chironomus, sp., *b*				×	×	×	×
Chironomus, sp., *c*			×	×			
Ephemeridæ		×	×	×	×		
Phryganeidæ		×	×	×			
Hydrachna, sp			×				
CRUSTACEA.							
Cambarus, several species		×					
Mysis relicta			×	×	×	×	×
Hyalella dentata		×					
Pontoporeia Hoyi			×	×	×	×	×
Gammarus limnæus			×	×			
Crangonyx gracilis			×	×			
Asellopsis tenax			×	×			
Daphnia galeata	×		×	×	× (?)	× (?)	
Daphnia pellucida	×			×	× (?)	× (?)	
Daphnia pulex ?		×					
Bosmina, sp	×				× (?)	× (?)	
Eurycercus lamellatus?			×	×			
Leptodora hyalina	×		× (?)	× (?)	× (?)	× (?)	
Ostracoda		×	×	×	×	×	×
Copepoda	×	×	×	×	×	×	×
Lernæopoda siscowet	×						
Lernæopoda ? Coregoni	×						
WORMS.							
Lumbricus lacustris			×	×			
Sænuris abyssicola				×		×	×
Sænuris limicola							×
Chirodrillus larviformis				×		×	
Chirodrillus abyssorum					×		×
Tubifex profundicola					×		
Macrobdella decora		×					
Anlastomum lacustre		×					
Semiscolex grandis		×					
Nephelis lateralis		×	×				
Nephelis fervida		×	×	×			
Clepsine papillifera		×					
Ichthyobdella punctata	×	×	×				
Procotyla fluviatilis		×	×				

	Surface.	Shore.	Depth in fathoms.				
			4–8.	10–20.	30–50.	60–100.	100–169.
MOLLUSCA.							
Valvata tricarinata		×					
Valvata sincera		×	×	×			
Melantho ponderosa		×					
Amnicola granum		×					
Amnicola pallida?		×					
Goniobasis livescens		×					
Pleurocera subulare		×					
Limnæa stagnalis		×					
Limnæa columbella		×					
Limnæa megasoma		×					
Limnæa desidiosa		×					
Limnæa emarginata		×					
Limnæa catascopium		×					
Limnæa caperata		×					
Limnæa humilis		×					
Limnæa lanceata*		×	×	×			
Physa vinosa		×	×				
Physa ancillaria		×	×	×			
Physa heterostropha		×	×	×			
Planorbis bicarinatus		×					
Planorbis campanulatus		×					
Gyraulus parvus		×	×	×			
Sphærium sulcatum		×					
Sphærium striatinum		×	×	×			
Sphærium fabalis		×					
Sphærium flavum		×					
Sphærium Jayanum		×					
Pisidium Virginicum		×	×	×			
Pisidium compressum		×	×				
Pisidium abditum		×	×	×			
Pisidium abditum, var. abyssorum		×	×	×	×	×	×
Unio, species		×					
Anodonta, species		×					
RADIATA.							
Hydra carnea	×	×	×	×	×	×	×

* See p. 702 in reference to the identification of this species.

CORRECTION.—The statement, on page 649, that none of the females of *Pontoporeia Hoyi*, taken in Lake Superior during August and September, were carrying eggs, is incorrect. Three or four among several hundreds of specimens taken August 22 were carrying eggs, and there may be a few in the same condition in other lots; but, among many thousands collected, certainly not one female in a hundred was carrying eggs.