

8.—AN ANNOTATED CATALOGUE OF THE FISHES KNOWN FROM THE STATE OF VERMONT.

BY BARTON W. EVERMANN AND WILLIAM C. KENDALL.

This paper is based chiefly upon observations and collections made in July, 1894, by the senior author and Mr. Barton A. Bean, of the United States National Museum, while engaged in the investigation of the waters along the Canadian border of the United States under the direction of Mr. Richard Rathbun, the representative of the United States on the International Fishery Commission.

The report upon the special purpose of the investigation has been made to Mr. Rathbun. The present paper is a report upon the species of fishes collected or known to occur in the waters of Vermont. We have included not only the species obtained in 1894, but all others which have been recorded from that State by other writers.

The only ichthyologist who has written extensively upon the fishes of Vermont is the Rev. Zaddock Thompson, of Burlington. In 1842 Mr. Thompson published his "History of Vermont, Natural, Civil, and Statistical, in three parts, with a new map of the State and 200 engravings." Twenty-five pages of this interesting and very creditable volume are devoted to the fishes of the State. Not only does he give a catalogue of the species known to him to occur in the State, but much interesting information concerning the habits of many of them. This list and the annotations are particularly valuable, as they are based almost wholly upon the personal observations of Mr. Thompson, who was for many years a careful and conscientious student of the natural history of the region in which he lived.

The total number of species of Vermont fishes listed by Mr. Thompson is 48; these represent 43 species as we now understand them. Among the species, listed the following were described as new: *Pime-
lodus vulgaris* (*Ameiurus vulgaris*), *Lepisosteus lineatus* (the young of *L.
osseus*), *Esox nobilior* (*Lucius masquinongy*), and *Salmoperca pellucida*
(*Percopsis guttatus*).

The following table gives the nominal species listed by Mr. Thompson, together with our identification of each and the water from which each was recorded.

List of the fishes given in Thompson's Natural History of Vermont.

Page.	Nominal species.	Identification.	Locality.
129	<i>Perca serrato-granulata</i>	<i>Perca flavescens</i>	Lake Champlain basin.
130	<i>Lucio-Perca americana</i>	<i>Stizostedion vitreum</i>	Do.
130	<i>Pomotis vulgaris</i>	<i>Lepomis gibbosus</i>	Do.
131	<i>Pomotis megalotis</i>	<i>Lepomis megalotis</i>	Connecticut River at Barnet.
131	<i>Centrarchus venens</i>	<i>Ambloplites rupestris</i>	Lake Champlain basin.
131	<i>Centrarchus fasciatus</i>	<i>Micropterus dolomieu</i>	Vermont.
132	<i>Etheostoma caprodes</i>	<i>Percina caprodes</i>	Lake Champlain basin.
133	<i>Corvina oscula</i>	<i>Aplodinotus grunniens</i>	Lake Champlain.
133	<i>Catostomus cyprinus</i>	<i>Carpilodus thompsoni</i>	Vermont.
134	<i>Catostomus oblongus</i>	<i>Moxostoma aureolum</i>	Lake Champlain basin.
134	<i>Catostomus teres</i>	<i>Catostomus commersonii</i>	Do.
135	<i>Catostomus nigricans</i>	<i>Catostomus nigricans</i>	Walpole, Mass.
135	<i>Catostomus longirostrum</i>	<i>Catostomus catostomus</i>	Vermont.
135	<i>Leuciscus pulchellus</i>	<i>Semotilus corporalis</i>	Lake Champlain basin.
136	<i>Leuciscus crysoleucas</i>	<i>Abramis crysoleucas</i>	Do.
136	<i>Leuciscus atronasus</i>	<i>Rhinichthys atronasus</i>	Do.
137	<i>Hydrargyra fusca</i>	<i>Umbra limi</i>	Do.
137	<i>Esox ester</i>	<i>Lucius lucius</i>	Do.
138	<i>Esox reticulatus</i>	<i>Lucius reticulatus</i>	Connecticut River basin.
138	<i>Pimelodus vulgaris</i>	<i>Ameiurus vulgaris</i>	Lake Champlain.
139	<i>Pimelodus nebulosus</i>	<i>Ameiurus nebulosus</i>	Connecticut River at Barnet.
139	<i>Pimelodus sp. ?</i>	<i>Ameiurus lacustris</i>	Winooski River; Lake Champlain.
140	<i>Salmo salar</i>	<i>Salmo salar</i>	Lake Champlain and Connecticut River.
140	<i>Salmo namaycush</i>	<i>Cristivomer namaycush</i>	Lake Champlain; ponds in western part of State; Orleans County; Bellwater Pond in Barton; several ponds in Glover, Charleston, etc.
141	<i>Salmo fontinalis</i>	<i>Salvelinus fontinalis</i>	Vermont.
142	<i>Osmorus eperlanus</i>	<i>Osmorus mordax</i>	Lake Champlain.
143	<i>Coregonus albus</i>	<i>Coregonus clupeiiformis</i>	Do.
144	<i>Alosa vulgaris</i>	<i>Alosa sapidissima</i>	Connecticut River.
144	<i>Hiodon clodulus</i>	<i>Hiodon tergisus</i>	Lake Champlain.
145	<i>Lepisosteus oxyurus</i>	<i>Lepisosteus osseus</i>	Lake Champlain; Winooski River.
145	<i>Lepisosteus lineatus</i>	<i>Lepisosteus osseus (young)</i>	Winooski River at Burlington.
146	<i>Lota maculosa</i>	<i>Lota lota maculosa</i>	Lake Champlain basin.
147	<i>Lota compressa</i>	do.....	Connecticut River basin.
147	<i>Muraena vulgaris</i>	<i>Anguilla chrysope</i>	Vermont.
148	<i>Muraena bostoniensis</i>	do.....	Connecticut River basin.
148	<i>Muraena argentea</i>	do.....	Vermont.
149	<i>Acipenser rubicundus</i>	<i>Acipenser rubicundus</i>	Lake Champlain.
149	<i>Acipenser oxyrinchus</i>	<i>Acipenser rubicundus (young)</i>	Do.
150	<i>Petromyzon nigricans</i>	<i>Petromyzon marinus</i>	Vermont.
150	<i>Ammocetes concolor</i>	<i>Ichthyomyzon concolor</i>	Winooski River.
30*	<i>Lucio-perca canadensis</i>	<i>Stizostedion canadense</i>	Lake Champlain.
31	<i>Boleosoma tessellatum</i>	<i>Boleosoma nigrum olmstedii</i>	Vermont.
31	<i>Cottus gobioides</i>	<i>Cottus gracilis gobioides</i>	River Lamoyille, Johnson, Vt.
32	<i>Leuciscus atromaculatus</i>	<i>Semotilus atromaculatus</i>	Western part of State.
32	<i>Esox nobilior</i>	<i>Lucius masquinongy</i>	River Lamoyille.
33	<i>Salmoperca pellucida</i>	<i>Percopsis guttatus</i>	Lake Champlain at Burlington and Winooski River.
34	<i>Coregonus clupeiiformis</i>	<i>Argyrosoma arctedi</i>	Lake Champlain.
35	<i>Amia ocellicauda</i>	<i>Amia salva</i>	Lake Champlain at Whitehall and mouth of Otter Creek.

* These references, pp. 30 to 35, indicate pages in the appendix.

A few other writers have mentioned one or more species each from waters of this State. In 1817, in the Journal of the Academy of Natural Sciences of Philadelphia (p. 102), LeSueur described as new *Catostomus longirostrum* (*Catostomus catostomus*) from the State of Vermont. In the same Journal for 1818 (p. 421) Rafinesque described as new *Exoglossum nigrescens* (*Exoglossum maxillingua*) from Lake Champlain.

In 1842, DeKay, in the volume on fishes of his Natural History of New York (p. 209), described as new *Leuciscus nitidus* (*Semotilus corporalis*) from Lake Champlain, and on page 383 of the same volume he describes as new *Ammocetes unicolor* (*Petromyzon marinus unicolor*) from a specimen sent him from Lake Champlain by Zadock Thompson.

In 1850 Girard (Proc. Amer. Assoc. Adv. of Sci., II, 1850, 411, and Proc. Bost. Soc. Nat. Hist., III, 1850, 189; also monograph of Cottoids, in Smithsonian Contributions to Knowledge, 55, December, 1851) described as new *Cottus gobioides* from "a specimen of 4 inches that we have had figured [and for which] we are indebted to the kindness of Rev. Z. Thompson, of Burlington, to whom it was presented by Mr. Ransom Colberth, who caught it in June, 1844, while fishing for the brook trout in a branch of the Lamoille River, in the town of Johnson, Lamoille County."

He also describes as new *Cottus boleoides*, from a series of individuals collected by Ed. Cabot, esq., of Boston, at Windsor, Vt. In 1855 Agassiz gave the original description of *Carpiodes thompsoni* in the American Journal of Science and Arts (p. 76), the type locality being Lake Champlain; and in 1872 Duméril, in his Histoire Naturelle des Poissons (vol. II, p. 419), describes the bowfin (*Amia calva*) as new, giving it the name *Amia thompsoni*. The specimen described came from Lake Champlain, and was sent to the Paris Museum by Zadock Thompson.

The waters of Vermont are chiefly tributary either to the St. Lawrence or the Connecticut River. In the southwestern part of the State a small area has its drainage westward into the Hudson. About two-thirds of the western boundary of the State is formed by Lake Champlain, into which flow the principal rivers of Vermont, among them being the Missisquoi, Lamoille, Winooski, and Otter. The outlet of Lake Champlain is the Richelieu River, which joins the St. Lawrence at the head of Lake St. Peter. The northeastern portion of Lake Champlain is Missisquoi Bay, which is crossed by the international boundary, and lies, therefore, partly in Canada. This bay is important in that it contains extensive spawning beds of the wall-eyed pike and the shadwaiver, and more commercial fishing has been carried on here than elsewhere in the lake in recent years.

Just east of the middle of the northern boundary of the State is Lake Memphremagog, one of the most beautiful bodies of water to be found anywhere in America. It extends for 30 miles in a general north and south direction, the international boundary line crossing it about 8 miles from the southern end. The greatest width of this lake is said to be about 6 miles, but the average probably does not exceed 2 miles. That portion of the lake lying in Vermont is comparatively shallow, the depth rarely exceeding 18 or 20 feet; near the State line it is probably 25 feet or even more. On the Canadian side the depth is much greater; at one place, near the Mountain House, about 8 miles north of the Vermont line, a depth of 700 feet is said to have been found. The south end of the lake has a sandy bottom in most places, with some gravel. At Horseneck Island is a ledge, apparently of limestone, which almost reaches the surface. The bottom on the Canadian side has more gravel and numerous rock ledges.

In most places the shores of the lake rise gently into low mountains, which are covered with forests of birch, maple, fir, pine, beech, cottonwood, and other hardwood trees. At several places on the Canadian side the shores are rocky and rise abruptly.

The outlet of Lake Memphremagog is the St. Francis River, which flows into that expansion of the St. Lawrence River known as Lake St. Peter.

The principal streams flowing into Lake Memphremagog are Black, Barton, and Clyde rivers, all of which enter near the south end of the lake. These are all clear and rather swift streams, but the water is not cold. The temperature in Clyde River in 2 feet of water at noon, July 23, was 79°. This stream was examined at various places in the last 4 miles of its course and was found to be quite rocky and full of snags in places.

Collections were made in the lake at the camp of Hon. L. D. Miles, about 4 miles down the east shore from Newport. A small stream flowing into the lake near here was much colder, and a spring near by had a temperature of 48°.

The Connecticut River forms the entire eastern boundary of Vermont. It receives a number of tributaries from Vermont, but the only ones from which collections have been made are Sleeper and Passumpsic rivers, near St. Johnsbury.

Sleeper River was examined July 25, through more than 2 miles of its course, near the United States fish-hatchery. At that time the stream was 30 to 50 feet wide and $\frac{1}{2}$ to 2 feet deep, with occasional holes of considerable depth. The bed is mostly of rock, apparently a micaceous schist, with a thin coating of gravel, shingle, and sandy mud. The water was clear and apparently pure, but not cold.

The Passumpsic was examined July 26 about 4 or 5 miles above St. Johnsbury, near St. Johnsbury Center. This stream is larger than the Sleeper, but of the same general character. It is 40 to 60 feet wide and, at the time of our visit, 1 to 3 feet deep on the riffles, and deeper in the quiet reaches. The bed is of rock, gravel, or mud. A good many mills along this stream throw their refuse into it; sawdust was abundant in several places in the quiet portions of the stream.

Fishes are very scarce in both of these rivers.

The present list is only approximately complete for the State of Vermont; further investigations will doubtless add some species which are not now known from Vermont, and much remains to be learned regarding the migrations and spawning habits of even the most common and important species.

The specimens obtained by us in 1894 were collected in the following places: Missisquoi Bay at Alburg Springs and on the west shore of Hog Island, July 20; Clyde River near Newport, July 23; Lake Memphremagog at Miles's clubhouse, July 24; Sleeper River, near St. Johnsbury; July 25; Passumpsic River near St. Johnsbury Center, July 26.

For courtesies extended to us we are under especial obligations to the following gentlemen: Hon. L. D. Miles and Mr. Frank Biddell, of Newport; Mr. John W. Titcomb, superintendent United States fish-cultural station at St. Johnsbury; and Mr. Samuel Decker, of Hog Island. Each of these gentlemen did much to assist us in our investigations.

With the growth of population and the consequent cutting away of the forests, cultivation of the land, building of stream-polluting mills and factories, and destructive methods of fishing, a great change has taken place in the fish fauna of the State since the first settling of the country. The changes since Thompson's time have been very great, as may readily be seen by comparing present conditions with his remarks on various species. And Mr. Thompson calls attention to the serious decrease of several important species prior to 1842. He says:

In a country like Vermont, situated so remote from the ocean, and watered only by small fresh-water streams and lakes, a very great variety or abundance of fish is hardly to be expected; and yet it is a notorious fact that when the country was new all our waters swarmed with fishes of various kinds. Salmon and shad were taken in the greatest plenty and perfection in Connecticut River, and the former, together with the salmon trout, were abundant in Lake Champlain and in most of the streams connected with it. In the spring of the year, when these fishes were ascending our streams to their breeding-places, they could be taken at the falls and rapids in scoop nets, or in baskets fastened to poles, in almost any quantities desired. Brook trout, weighing from 1 to 3 pounds, were plentiful in nearly all our streams and ponds, but with the clearing and settling of the country these kinds of fishes have diminished till the three former have become extremely rare, and the latter, though still numerous in many parts, are seldom taken exceeding half a pound in weight. For the production of this state of things several other causes have operated besides their diminution by fishing. The salmon and shad have probably been driven from our waters chiefly by the erection of dams across nearly all our streams, which prevent their ascent to their favorite spawning-places. Freshets, also, which have become more sudden and violent since the country has become cleared, have swept out the logs and other obstructions which formed their places of resort and concealment, and have thus tended not only to diminish the number of our fishes but to prevent their attaining so great magnitude as formerly. Those fishes of our lakes which do not ascend far up our streams to deposit their spawn have not been so much affected by these causes. These, however, though still taken in considerable quantities, are not so abundant as formerly.

LIST OF FISHES FOUND IN VERMONT.

Family PETROMYZONIDÆ. The Lampreys.

1. *Petromyzon marinus* Linnæus. *Great Sea Lamprey*; "*Blue Lamprey*."

Recorded from Vermont by Thompson, who says:

"The fresh-water *lampreys*, or *lamprey-cels*, as they are more commonly called, resemble in their habits the blood-sucker much more than the ordinary fishes. They obtain their subsistence principally by attaching themselves by their mouths to the bodies of larger fishes, and drawing nourishment from them by suction; for this purpose their mouth and tongue are admirably adapted, the latter acting in the throat like the piston of a pump, while the circular lips of the former adhere closely to the side of the fish, and by these means the softer parts of the larger fish are drawn into the mouth and swallowed by the parasite. When a lamprey once fastens himself in this manner upon a large fish he adheres with such force as to baffle all the efforts of the fish to rid himself of his unwelcome incumbrance. Fishes are frequently taken in the seine with lampreys still adhering to them, and others with deep depressed wounds upon their sides, affording indubitable proof of their having been attached. The fresh-water lampreys seldom exceed 6 or 8 inches in length, and no account is made of them as an article of food."

2. *Ichthyomyzon concolor* (Kirtland). *Silver Lamprey*; "*Mud Lamprey*."

Recorded from Winooski River by Thompson:

"During the drought in September, 1841, I found large numbers of these fishes, which had buried themselves in the mud at the bottom of the small coves along the banks of Winooski River, from which the water had evaporated. This fish is known in many places by the name of *mud-eel*, or *blind-eel*."

Family ACIPENSERIDÆ. The Sturgeons.

3. *Acipenser rubicundus* LeSueur. *Lake Sturgeon*; "*Rock Sturgeon*."

Mr. Thompson regarded the round-nosed sturgeon and the rock sturgeon as two different species, but we now know that the latter is simply the young of the former. Concerning the latter he says:

"This fish is occasionally taken in Lake Champlain, and is here known by the name of *rock sturgeon*. It seldom exceeds 3 feet in length or 20 pounds in weight, but is much more generally and highly esteemed as an article of food than the preceding species, some even ranking it as one of our best fishes for the table. This, like the preceding, should be skinned before it is cooked, and for the same reasons."

Sturgeon are still occasionally taken in Lake Champlain, according to Mr. A. S. Hilliker, of Alburg Springs. Fishermen are said to catch them sometimes with grappling hooks fastened to poles; these hooks are said to be most used in the rivers at the foot of the falls.

Mr. Titcomb says sturgeon weighing 75 pounds and over are often taken in Lake Champlain.

Family LEPISOSTEIDÆ. The Gar Pikes.

4. *Lepisosteus osseus* (Linnaeus). *Long-nosed Gar*; "*Billyfish*."

Concerning this species Thompson has the following interesting remarks:

"This singular fish was described by Samuel Champlain as an inhabitant of the lake now bearing his name more than two hundred years ago. He called it *chausarou*, which was probably the Indian name. The Indians assured him they were often seen 8 or 10 feet long, but the largest he saw was only 5 feet long and about the thickness of a man's thigh. It is considered a very voracious fish, and when any of them are taken or seen in the water the fishermen calculate upon little success in taking other kinds."

“Charlevoix tells us that he preys not only upon other fishes, but upon birds also, and that he takes them by the following stratagem: Concealing himself among the reeds growing on the marshy borders of the lake, he thrusts his bill out of the water in an upright position. The bird, wanting the rest, takes this for a broken limb or dry reed, and perches upon it. The fish then opens his mouth and makes such a sudden spring that the bird seldom escapes him. Charlevoix also assures us that the Indians regarded the teeth of this fish as a sovereign remedy for the headache, and that pricking with it where the pain was sharpest took it away instantly. The scales with which this fish is covered are so thick and strong as to form a coat of mail which is not easily pierced with a spear. They are taken only occasionally in the seine at the present day, but are said to be sometimes seen in considerable numbers lying in the marshy coves. Its flesh is rank and tough and is not used for food. The usual length of those now taken is from 2½ to 3 feet, though they are often much longer. The specimen from which the preceding figure and description were made was taken at the mouth of Winooski River May 11, 1841. One of the largest specimens which I have seen was taken at the same place June 16, 1838, and is now in my possession. It is 46 inches long, and when caught weighed 9½ pounds. This species is found in the great western lakes and in the Ohio River, where this and several other species are known by the name of *gar fishes*.”

This *gar* is still common in Lake Champlain. We obtained no specimens on the Vermont side of the lake, but secured some on the New York side near Rouses Point.

Family AMIIDÆ. The Bowfins.

5. *Amia calva* Linnæus. *Mudfish*; *Bowfin*.

Recorded by Thompson from the mouth of Otter Creek and from Lake Champlain at Whitehall. He says:

“This fish abounds upon the muddy bottoms and the marshy coves of the southern part of Lake Champlain. It is very plentiful in the vicinity of Whitehall and also about the mouth of Otter Creek. From its partiality to muddy bottoms, it has acquired in many places the name of *mudfish*. From its resemblance in form to the ling, it is called in some places the *scaled ling*. But its more common appellation in Vermont is that of *bowfin*. It attains to considerable size, frequently exceeding 2 feet in length and weighing 10 or 12 pounds; but its flesh is soft and ill-flavored—very little esteemed as an article of food.”

Family SILURIDÆ. The Catfishes.

6. *Ameiurus lacustris* (Walbaum). *Great Lakes Catfish*.

This catfish, so common in the Great Lakes region, has apparently never been common in Vermont waters. Thompson speaks of it as being occasionally taken in the vicinity of Burlington, but in other parts of the lake it is reputed quite plentiful. He says it is a very good food-fish.

Among a fine lot of fresh specimens received by the Commission April 25, 1896, from Mr. A. L. Collins, Swanton, Vt., at the instance of Mr. John W. Titcomb, is one large example of this species. It, like all the specimens sent by Mr. Collins, came from Missisquoi Bay. It is a female with the ovaries but little developed. The stomach and intestines contained no food that could be identified. Total length of this specimen, 25 inches; weight, 7¼ pounds. Called “catfish” by Mr. Collins.

7. *Ameiurus vulgaris* (Thompson). “*Bullpout*.”

This species was originally described from Lake Champlain. Thompson reported it quite plentiful in Lake Champlain, where it is generally known as bullpout. He says those taken from the lake are usually from 9 to 13 inches in length.

8. *Ameiurus nebulosus* (LeSueur). “*Horned Pout*”; “*Bullpout*”; *Bullhead*.

According to Thompson, common in Connecticut River and in many of its larger tributaries. It is undoubtedly an abundant species throughout the State. In Shelburn Pond it is said to be exceedingly abundant. In Lake Champlain the

bullhead is at present the most important commercial fish, larger amounts of it than of any other species being handled. The local fishermen say that they run from $\frac{1}{2}$ to $1\frac{1}{2}$ pounds dressed, which is probably an overestimate. Mr. Joseph Landrie, of Rouses Point, says that it takes 500 to 600 dressed fish to make a barrel and that they sell for 6 cents a pound. They can be caught on mud bottom. According to Mr. Eli Cameron, of Rouses Point, the bullheads spawn in July. In the fall they "mud up" or bury themselves more or less. According to Mr. J. W. Titcomb the grass along the shores of some of the waters in the State is mown in the spring to allow seines to be hauled for bullheads. In Lake Memphremagog the bullhead is one of the most abundant species. Our collections contain two examples, 4 and $4\frac{1}{2}$ inches long, respectively, from Clyde River at Newport, and one small specimen from Missisquoi Bay. The collection received from Mr. Collins contained two examples of this species, one $10\frac{1}{2}$ inches long and weighing one-half pound, the other $11\frac{1}{2}$ inches long and weighing three-fourths pound. The stomachs contained nothing identifiable.

Family CATOSTOMIDÆ. The Suckers.

9. *Carpiodes thompsoni* Agassiz. *Lake Carp*; "*Buffalo*"; "*Carp Sucker*"; "*Drum*."

Lake Champlain is the type locality of this species. Thompson says it ranges from 1 to 4 pounds in weight, but it is not common. It is still taken by the local fishermen in some numbers. Among the fishes kindly sent us by Mr. Collins is a fine example of this species which he calls "drum." It is a nearly ripe female, 21 inches long and weighing 7 pounds. The roe alone weighed $2\frac{1}{2}$ pounds.

The condition of this fish indicates that the spawning period begins as early as the last of April. The stomach contained nothing.

10. *Catostomus catostomus* (Forster). *Long-nosed Sucker*, "*Sucker*."

This sucker was found by us in abundance in Sleeper River. It is doubtless a common species throughout the State, but Thompson states that he never met with it. On the other hand, LeSueur, in describing *C. longirostrum*, which he took to be different from this species, says: "This fish I discovered in the State of Vermont. I had not seen it in any other State."

11. *Catostomus commersonii* (Lacépède). *Common Sucker*; "*Sucker*"; "*Black Sucker*"; "*Black-fin Sucker*."

Said by Thompson to be quite common in Lake Champlain and in most of the large streams and ponds connected with it. Specimens were obtained by us in Passumpsic River near St. Johnsbury and in Clyde River and Lake Memphremagog near Newport. Two large examples were taken in a gill net at the Miles's clubhouse, Lake Memphremagog, July 21. A nearly ripe female, 18 inches long and weighing 3 pounds, received from Missisquoi Bay April 25. This fish would have spawned early in May. The stomach contained nothing.

In Shelburn Pond, a sucker, probably this species, is said to be very abundant.

12. *Catostomus nigricans* LeSueur. *Black Sucker*.

This species Thompson supposes to be common on the east side of the Green Mountains. It was seen by us only in Sleeper River at St. Johnsbury.

13. *Moxostoma aureolum* (LeSueur). *Redhorse Sucker*; "*Mullet*."

This is the common mullet or large-scaled sucker of Vermont, and seems to be common in Lake Champlain. It is one of the principal species taken in gill nets by the fishermen of Lake Champlain. It is said to be quite abundant in Missisquoi Bay. Our collections contain two large examples taken there in a seine July 20, and two large examples were received April 25 from Missisquoi Bay. One was a nearly ripe male 15 inches long and weighing $1\frac{1}{2}$ pounds, the other a nearly ripe female $25\frac{1}{2}$ inches long and weighing $7\frac{1}{4}$ pounds. They probably would have spawned in two or three weeks. The stomachs were empty. Mr. Collins called the smaller of these a "redfin sucker," the other a "mullet."

Concerning this species Thompson has the following:

"This fish is described by Dr. Mitchill under the name of the *chub of New York*. It is here very generally known by the name of *mullet*, under which name several species of lake suckers are confounded, although it belongs to a family of fishes entirely distinct from the real mullet. This is one of our most common fishes, and in the spring and early part of summer is caught with the seine in large quantities, both in Lake Champlain and in the mouths of its larger tributaries. The flesh of this fish is rather soft, and is considerably filled with the knots of fine bones so common to this family, and yet it is regarded as a very good fish for the table. There are various methods of cooking it, but it is generally most highly esteemed when baked. The fish grows to a larger size, and is taken in Lake Champlain in larger quantities than any other species of this family. Their usual length is from 15 to 20 inches, and their weight from 2 to 5 pounds. But individuals are often taken which are much larger, weighing, in some cases, 9 or 10 pounds. The usual price, when fresh, is from 3 to 4 cents a pound."

Family CYPRINIDÆ. The Minnows.

14. *Pimephales notatus* (Rafinesque). *Blunt-nosed Minnow*.

Apparently not common; two specimens, 2 and 2½ inches long, respectively, obtained by us in Missisquoi Bay.

15. *Semotilus corporalis* (Mitchill). *Fallfish; Silver Chub*.

Obtained by us in Clyde River at Newport and Passumpsic River near St. Johnsbury. It appears to be common in each of these streams, and, according to Mr. Titeomb, throughout the State and in Lake Champlain. According to Thompson "this fish is quite common in Lake Champlain and its tributaries. It is readily caught with the hook, and the flavor of its flesh is agreeable, but it is so soft and filled with small bones that it is not much valued as an article of food. The length of those usually taken varies from 5 to 12 inches, but they sometimes grow to the length of 20 inches."

16. *Semotilus atromaculatus* (Mitchill). *Horned Dace; Creek Chub*.

This chub was taken by us in Clyde River and in Lake Memphremagog near Newport, the specimens being 2½ to 5 inches long. It is probably not uncommon throughout the State. Mr. Thompson says:

"This is one of the most common fishes of this genus in the western part of Vermont. It abounds almost everywhere, both in the rivers and small streams. Its insipidity and small size prevent its being sought as an article of food; but, as it takes the hook with great readiness, it affords the boys an opportunity to indulge in the cruel sport of catching them for mere amusement. They are also caught to be used as bait in taking larger fishes."

Mr. Titeomb says;

"I have caught it quite frequently in a branch of East Creek, Rutland County, and it takes a fly readily and will fight well. Confined with trout of equal or larger size than itself, it will fight them and kill them."

17. *Abramis crysoleucas* (Mitchill). *Shiner; Roach*.

Not obtained by us, but Thompson says: "This fish is quite common, particularly in the small ponds and coves along the shore of Lake Champlain and about the mouths of our large streams, where it is found associated with perch, bullpouts, and mudfishes."

18. *Notropis hudsonius* (Clinton). *Shiner; Spot-tail Minnow*.

Probably common in most waters of the State, but it was taken by us only in Missisquoi Bay.

19. *Notropis cornutus* (Mitchill). *Shiner; Redfin Dace*.

Numerous examples were taken in Clyde River at Newport and Passumpsic River near St. Johnsbury. They vary in length from 1¾ to 3½ inches. Probably the most abundant and most generally distributed minnow in the State.

20. *Rhinichthys cataractæ* (Cuvier & Valenciennes). *Long-nosed Dace.*

Several specimens obtained by us near St. Johnsbury, in Sleeper and Passumpsic rivers; not seen elsewhere in Vermont by us, nor is it recorded by Mr. Thompson.

21. *Rhinichthys atronasmus* (Mitchill). *Black-nosed Dace.*

Sleeper River at St. Johnsbury, 17 specimens $1\frac{1}{2}$ to $2\frac{1}{2}$ inches long; Passumpsic River at St. Johnsbury, 1 specimen $1\frac{1}{4}$ inches long; Clyde River at Newport, 18 specimens 2 to $2\frac{1}{4}$ inches long; Lake Memphremagog, 2 specimens 2 and $2\frac{1}{4}$ inches long. Next to *Notropis cornutus*, this is probably the most common minnow in Vermont. Concerning it Mr. Thompson says:

"This species is quite common in most of the streams in Vermont, and particularly so in those that fall directly into Lake Champlain. It is an active, lively little fish, and on account of the stripes on its sides, the colors of which are changeable, according to the direction of the light falling upon them, it is one of the most beautiful of fishes. When fully grown, this fish is only from $2\frac{1}{2}$ to 3 inches long, and though found in great numbers, its diminutive size renders it of no account as an article of food. It is chiefly sought to be used as bait for pike and other large fishes."

22. *Couesius plumbeus* (Agassiz).

From Clyde River at Newport we obtained 11 specimens of this species, $2\frac{3}{4}$ to $4\frac{1}{2}$ inches long. It was not seen by us elsewhere in the State, but it doubtless occurs in all the clearer, colder streams.

23. *Exoglossum maxillingua* (LeSueur). *Cutlip Minnow; Nigger Chub.*

In 1818 Rafinesque described a specimen of this species from Lake Champlain under the name *Exoglossum nigrescens*. Whether his type came from the Vermont side of the lake we do not know. We have obtained it at Plattsburg, and it doubtless will be found in Vermont waters.

Family ANGUILLIDÆ. The Eels.**24. *Anguilla chrysyra* Rafinesque. *Common Eel.***

Mr. Thompson gives three species of eels (*Murana vulgaris*, *M. bostoniensis*, and *M. argentæ*) as being found in the waters of Vermont. All, however, belong to the one species, which appears to be common in Lake Champlain and the Connecticut. Concerning it Mr. Thompson says:

"The common eel, found in Connecticut River and in the streams and ponds in this State on the east side of the Green Mountains, I suppose to belong to this species. Not having obtained specimens of this and the following species, I can only give Dr. Storer's description of them. In some of the ponds this eel grows to a very large size. They are frequently taken at the outlet of Barnard Pond, weighing 8 or 10 pounds."

Family HIODONTIDÆ. The Moon-eyes.**25. *Hiodon tergisus* LeSueur. *Moon-eye; "Winter Shad."***

Thompson says this is often called the whitefish by the fishermen, and that it is considered a very good fish for the table, but that it is not taken in Lake Champlain very plentifully.

Family CLUPEIDÆ. The Shad.**26. *Alosa sapidissima* (Wilson). *Common Shad.***

Concerning the occurrence of the shad in Vermont, Mr. Thompson remarks:

"This excellent and valuable fish, which is common both to Europe and America, was formerly taken in Connecticut River in large quantities, particularly in the neighborhood of Bellows Falls. It is still taken plentifully in Merrimac River and in many other streams which flow into the Atlantic Ocean from New England. I can not learn that it has ever been taken in Lake Champlain, but on account of some resemblance in form and appearance between this species and the *Coregonus albus*, [*C. clupeiiformis*] or whitefish, the name of shad, or lake shad, is here very generally applied to the latter."

Family SALMONIDÆ. The Trouts and Whitefishes.

27. *Coregonus quadrilateralis* Richardson. *Round Whitefish; Menominee Whitefish; Shadwaiter.*

We obtained no examples of this whitefish in Vermont and have no absolutely certain evidence of its occurrence in the waters of that State. We have seen specimens, however, from small lakes in New Hampshire and in the Adirondacks. In the Adirondacks it is a common species, and we have no doubt of its occurrence in both Lakes Champlain and Memphremagog.

28. *Coregonus clupeiformis* (Mitchill). *Common Whitefish.*

Exact information concerning the presence of this and other species of whitefishes in Lakes Champlain and Memphremagog is very much to be desired. There is in the National Museum a single specimen of the true whitefish, said to have been taken in Missisquoi Bay. Under the name *Coregonus albus* (which he called *whitefish*, or "*lake shad*") Mr. Thompson has the following:

"This fish, though the same as the celebrated *whitefish* of the Western and Northwestern lakes, is generally known in Vermont by the name of *lake shad*. Its Indian name at the Northwest is *attihawmeg*. This fish is quite common in Lake Champlain, and, in some years, is taken in the months of May and June in considerable quantities with the seine. It is also found in many of the small lakes in Lower Canada connected with the St. Lawrence on the south side, notwithstanding the assertion of Dr. Richardson* that it does not exist in the St. Lawrence below the Falls of Niagara. This is universally considered a most excellent fish, and nearly all are disposed to acquiesce in the opinion of Charlevoix that, 'whether fresh or salted, nothing of the fish kind can excel it.' But few, I think, will agree with the Baron La Fontaine, who says that it should be eaten without any kind of seasoning, because 'it has the singular property that all kinds of sauce spoil it.' In warm weather this fish should be either cooked or salted soon after it is taken, as it quickly becomes soft and is spoiled. It is excellent either boiled or fried. The mode of boiling at the Northwest, according to Dr. Richardson, is as follows:

'After the fish is cleansed and the scales scraped off, it is cut into several pieces, which are put into a thin copper kettle, with water enough to cover them, and placed over a slow fire. As soon as the water is on the point of boiling the kettle is taken off, shook by a semi-circular motion of the hand backward and forward, and replaced on the fire for a short time: If the shaking be not attended to exactly at the proper moment, or be unskillfully performed, the fish, coagulating too suddenly, becomes comparatively dry to the taste, and the soup is poor.'

"The stomach of this fish is remarkably thick, and when cleansed and cooked is esteemed a great luxury. The whitefish is very thick and fleshy, and on account of the smallness of the head, fins, and intestines the waste in dressing is less than in any other fish. The greater part of those taken in Lake Champlain are from 15 to 20 inches in length, and weigh from 1 to 3 pounds, though smaller ones are often taken, and occasionally larger ones, weighing from 3 to 6 pounds. They are usually sold fresh as taken from the water, and the price varies from 6 to 10 cents a pound. The whitefish seems to subsist principally upon small molluscous animals. I have sometimes found more than 100 univalve and bivalve shells in the stomach of a single fish."

Mr. Thompson does not give either the round whitefish (*C. quadrilateralis*) or the Musquaw whitefish (*C. labradoricus*) as found in the waters of Vermont, but the second of those species is undoubtedly found there and the other almost certainly occurs in the Vermont lakes. It is evident that Thompson confounded two or three species and that much of what he says of the common whitefish really applies to the Musquaw whitefish. All the specimens of so-called "*whitefish*" or "*shadwaiters*" which we were able to secure belonged to the single species *C. labradoricus* (the Musquaw whitefish). The probabilities are that there are four species of whitefish

* Fauna Boreali Americana, vol. III, page 196

in Lake Champlain, viz, the true whitefish (*C. clupeiformis*), the Musquaw whitefish (*C. labradoricus*), the round whitefish (*C. quadrilateralis*), and the lake herring (*Argyrosomus arctedi*), but further evidence is necessary to settle the exact status of each. The artificial propagation and planting of the various food-fishes greatly complicates questions of distribution of this kind. The true whitefish and perhaps others have been planted in Lake Champlain, and it will now be difficult to determine the natural relations of the species of fishes in this lake.

29. *Coregonus labradoricus* Richardson. "Shadwaiter"; "Shad"; Musquaw Whitefish.

We have examined the following specimens of this species from Vermont waters: Two, Nos. 67 and 68, 15 and 19½ inches long and weighing 1½ and 2½ pounds, respectively, from Missisquoi Bay, obtained by Mr. Richard Rathbun in 1894, and one 18 inches long, weighing a little over 2½ pounds, caught in Lake Memphremagog, received from Hon. L. D. Miles, of Newport, November 23, 1894. The following are descriptions of these specimens:

No. 67. Head 4½; depth, 3½; eye 4½; snout 4½; D. 11; A. 11, not counting rudiments; maxillary 4 in head, just reaching front of pupil, lower jaw included; the distance from snout to occiput 2½ in the distance from occiput to dorsal; scales 10-72-9; gillrakers 9+17 (counting the one in the angle with those on the long arm) short, 2½ in eye.

No. 68. Head 5+; depth 3½; eye 5; D. 12; A. 11; snout 5; maxillary just reaching front of eye, 3½ in head, lower jaw included; distance from snout to occiput 2½ in distance from occiput to dorsal; scales 10-71-8; gillrakers 9+16 (counting the one in the angle as one of the long arm) short, the longest 2 in eye. Color dark on back and sides, but paler than the above; white below; fins all black-tipped as in No. 67.

Description of specimen from Lake Memphremagog, a spent female, 18 inches long: Head 4½; depth 4; eye 5; snout 4½; D. 10; A. 11; maxillary 4 in head, just reaching front of eye; mandible 2½ in head, reaching past middle of pupil, lower jaw included; snout projecting, pig-like; height of dorsal 2 in head, last ray 4 in head; first ray of anal 2, last ray 6, in head; pectorals equal last ray of dorsal or the ventrals in length; caudals deeply forked; scales 10-87-9; gillrakers, 10+15, and 10+16, the longest 2 in eye. Color rather dark olivaceous; sides silvery with greenish reflections, white below; scales on sides of belly with few dusky spots; fins all black-tipped, as in *A. nigripinnis*, all paler at base.

There is a large specimen in the National Museum (No. 102881) from Lake Champlain, collected by Mr. P. S. Phelps.

The two examples from Missisquoi Bay were collected in October, 1894, by Mr. Miles, who called them true whitefish; the one received from Mr. L. D. Miles from Lake Memphremagog, November 23, 1884, is what he called "shadwaiter."

Mr. Eli Cameron, of Rouses Point, says the fishermen often spear bluebacks through the ice in winter. These also are probably *C. labradoricus*.

Mr. A. S. Hilliker, of Alburg Springs, says that "the principal catch by the licensed seines in Missisquoi Bay in the fall is the shad, a kind of whitefish. They bring about 8 cents a pound shipped to New York. They are ripe with spawn in November, when they come from deep water into shallow water, where they spawn."

Mr. Samuel Decker, of West Swanton, says that the "shad" are gotten mostly in the fall, when they come into shallow water for spawning.

Hon. L. D. Miles, of Newport, says the shadwaiters spawn in the fall, when they come near the shores from deep water.

We have received two fine specimens of this fish from Mr. Collins. One was a male, 16½ inches long, and weighed 2 pounds; the other a female, 23 inches long, and weighing 6 pounds. They had apparently spawned last fall. They were called "whitefish or shad" by Mr. Collins.

30. *Argyrosomus artedi* (LeSueur). *Lake Herring; Cisco.*

Recorded by Mr. Thompson from Lake Champlain:

"This fish is only occasionally met with in Lake Champlain, but they sometimes appear here in myriads. In the spring of 1847 they were, for a short time, taken at Burlington in very large numbers, as many as 200 being taken at one haul of the seine. In some years none at all are taken here. The specimen from which the preceding description is made was taken in 1848, and I learned of only two others being taken at that season. It resembles somewhat the lake shad, *C. albus* [*C. c'upeiformis*], but is a rounder fish, having much less depth in proportion to its length. It is much esteemed as an article of food. It is common in Lake Ontario and Lake Erie, and is called in many places the shad salmon."

Mr. Titcomb informs us that this species is quite common in several Vermont lakes, notably Lake Bomoseen, in Rutland County. For the protection of other fish it is not lawful to net them, and they are seldom caught for market except an occasional illegally taken haul. In the fall of the year, October or November, they appear in large schools, close to the rocky shores of the lake, for the purpose of spawning. They are not seen at any other season of the year.

The National Museum contains a specimen (No. 17000) of this species, sent from Vergennes, Vt., by Mr. M. E. Hall. We know of no other definite record of its presence in the waters of that State.

31. *Salmo salar* Linnaeus. *Common Atlantic Salmon.*

We have no record of any recent occurrence of the Atlantic salmon in Vermont. Concerning this fish Mr. Thompson says:

"The salmon, formerly very plentiful in nearly all the large streams in this State, is now so exceedingly rare a visitant that I have not been able to obtain a specimen taken in our waters from which to make a description for this work. They have entirely ceased to ascend our rivers, and only straggling individuals are now met with in Lake Champlain. I have heard of only one being taken here during the past summer, and that I did not see. The causes which have been principally operative in driving these fishes from our waters have already been mentioned. When the country was new, according to Dr. Williams, there was a regular and abundant migration of these fishes to and from our waters in spring and autumn." They came up Connecticut River about the 25th of April and proceeded to the highest branches. Shortly after they appeared in Lake Champlain and the large streams which fall into it. So strong is their instinct for migration that, in ascending the streams, they forced their passage over cataracts of several feet in height and in opposition to the most rapid currents. They were sometimes seen to make six or seven attempts before they succeeded in ascending the falls. When thus going up in the spring they were plump and fat and of an excellent flavor, and from the beginning of May to the middle of June they were taken in great numbers. When they arrived in the upper parts of the streams they deposited their spawn. Toward the end of September they returned to the ocean, but so emaciated and lean as to be of little account as an article of food. In the spring salmon were often taken weighing from 30 to 40 pounds."

32. *Cristivomer namaycush* (Walbaum). *Lake Trout; Longe; Toque.*

The lake trout or longe is said to be uncommon in Lakes Champlain and Memphremagog now. Mr. H. M. Price, of Burlington, says that one is occasionally taken. Mr. Miles, of Newport, says that very large longe are occasionally taken in Lake Memphremagog. One weighing 24 pounds was recently taken near the Mountain House.

Concerning this species Mr. Thompson has the following:

"This species of trout bears considerable resemblance to the *Salmo trutta*, or salmon trout, of Europe, and, being mistaken for that fish by the first European settlers of this country, it has since usually borne the name of *salmon trout*. In the

* History of Vermont, vol. 1, page 147.

northern parts of this State and in the eastern townships in Canada it is at present extensively known by the name of *longe*. In Pennant's Arctic Zoology and by the fur-traders at the Northwest its more common appellation is *namaycush*, or *namaycush salmon*. It is called by Dr. Mitchell the *Great Lake trout*, and he describes it under the scientific name of *Salmo amethystus*.* This magnificent trout equals or surpasses the common salmon in size, and is found in most of the lakes and large ponds in the northern parts of North America. In the Great Lakes at the Northwest it is often taken weighing from 30 to 60 pounds, and, according to Dr. Mitchell, it has been taken at Michilimackinac of the enormous weight of 120 pounds. This fish was formerly common in Lake Champlain and in several ponds in the western part of the State, but, like the salmon, it is now rarely caught in those waters. It is, however, still found in considerable plenty in several ponds in the northern part of Vermont, particularly in Orleans County. Bell-water Pond, in Barton, and several ponds in Glover, Charleston, etc., are much celebrated on account of the fine *longe* which they afford. These usually vary from half a pound to 10 pounds, but are often much larger. Individuals are said to have been taken recently in Glover weighing 25 pounds and in Charleston exceeding 40 pounds.

"This fish passes most of the time in the deepest parts of the lakes and ponds, but, according to Dr. Richardson, resorts to the shallows to spawn in October. It is a very voracious fish, and is sometimes termed the tyrant of the lakes. It is taken with the hook and line, and is also speared by torchlight. Its flesh is of a reddish-yellow color, and is very much esteemed as an article of food. Roasting is said to be the best method of cooking it. 'The Canadian voyageurs are fond of eating it raw, in a frozen state, after scorching it for a second or two over a quick fire, until the scales can be easily detached, but not continuing the application of heat long enough to thaw the interior.' †

According to Mr. Titcomb, "Lake Dunmore, in Addison County, is good fishing for *longe*. Willoughby Lake is the largest and best lake for them in northern Vermont. Maidstone Lake, in Essex County, is inhabited by a *longe* so distinctly individual that many consider it a distinct variety. It is highly prized as a table fish, but does not grow so large as in many other lakes. The average weight of those found in Maidstone Lake is 2 to 3 pounds."

33. *Salvelinus fontinalis* (Mitchill). *Common Eastern Brook Trout*.

One specimen, 4½ inches long, was obtained in Sleeper River at St. Johnsbury. Numerous young trout were seen in a small stream on the east side of Lake Memphremagog. The brook trout is, of course, well distributed over this region. Mr. Thompson has the following interesting paragraphs concerning its former abundance:

"The brook trout is more generally diffused over the State than any other species of fish, there being scarcely a brook or rill of clear water descending from our hills and mountains in which it is not found. When the country was new they also abounded in the larger streams, where they often grew to the weight of 2 or 3 pounds. But they have been diminished by the causes already mentioned and have been sought after with such eagerness as the most delicious article of food of the fish kind that they are now seldom taken in our streams exceeding half a pound in weight, and much the greater number of them weigh less than a quarter of a pound. In many of the ponds they are still taken of a larger size, but their flavor is thought to be less delicious than that of those taken in running water, especially in ponds with muddy bottoms. The rapidity with which this and other species of fishes multiply under favorable circumstances was exemplified in an astonishing manner at an early day, in Tinmouth, in this State. 'A stream which was about 20 feet wide and which, like other streams, contained trout and suckers of the ordinary size and number, had a dam built across it for the purpose of supplying water for a sawmill. This dam formed a pond,

* Jour. Ac. Nat. Science, Philadelphia, vol. 1, page 410.

† Richardson's Fauna Boreali-Americana, vol. III, page 180.

which covered, by estimation, about 1,000 acres, where the trees were thick and the soil had never been cultivated. In two or three years the fish were multiplied in the pond to an incredible number. At the upper end, where the brook fell in, the fish were to be seen in the spring running over one another, so embarrassed by their own numbers as to be unable to escape from any attempt made to take them. They were taken by the hands at pleasure, and swine caught them without difficulty. With a small net the fishermen would take half a bushel at a draft and repeat their labors with the same success. Carts were loaded with them in as short a time as people could gather them up when thrown upon the banks, and it was customary to sell them in the fishing season for a shilling a bushel. While they thus increased in numbers they also became more than double their former size. This great increase of fishes is supposed to have been occasioned by the increased means of subsistence in consequence of carrying the water over a large tract of rich and uncultivated land.*

"The trout is usually taken with the hook, and the bait universally used is the red earthworm, everywhere known by the name of *angle worm*. Fishing for trout is a favorite and common amusement, and parties frequently go 15 or 20 miles for the sake of indulging in it."

Mr. Titcomb is very properly of the belief that the majority of the fish referred to by Williams were suckers rather than trout. He says:

"While it is the trout for which Vermont is famous and it is a fact that they increase rapidly and grow to an astonishing size in a short period, when in a stream or pond which has been raised or flowed over new ground, I doubt very much the story about the pond in Tinmouth, referred to by Thompson. I think the fish he describes were suckers. The same wonderful catch of suckers can be made to-day."

Family ARGENTINIDÆ. The Smelts.

34. *Osmerus mordax* (Mitchill). *Smelt; Ice-fish.*

The smelt is said to be an abundant fish in Lakes Champlain and Memphremagog. At the time of our visit to those lakes these fish were in deep water and would not readily take a hook, so no specimens were obtained then. In the fall they come out into shallow water, when they can be caught. During the winter they bite freely and can be taken through the ice. They can be taken with hook and line, but are also sometimes seined. They are said to make an excellent bait for longe. Through the kindness of Hon. L. D. Miles we received on November 23, 1894, twenty-one fine specimens of smelt taken in Lake Memphremagog. These present the following measurements:

Head 4; depth 6; eye $4\frac{1}{2}$; maxillary reaching posterior margin of eye; D. 10; A. 15; length in inches, $6\frac{1}{4}$; $6\frac{3}{4}$; 7; 7; 7; 7; $7\frac{1}{4}$; $6\frac{1}{2}$; $7\frac{1}{4}$; $7\frac{3}{8}$; $6\frac{1}{2}$; $6\frac{1}{2}$; $6\frac{1}{4}$; $6\frac{3}{8}$; $6\frac{1}{4}$; $7\frac{1}{2}$; $7\frac{3}{8}$; $6\frac{1}{4}$; 7; $7\frac{3}{8}$. Weights in grams (1 ounce equals 28.35 grams): 28, 29, 32, 29, 32, 29, 32, 27, 33, 38, 27, 27, 27, 30, 31, 29, 35, 31, 29, 32, 34. The total weight was 641 grams, or a little less than $2\frac{1}{2}$ pounds.

According to Mr. Titcomb, "Smelt do not come to the surface in our fresh-water lakes until late in winter or early spring. They are then taken through the ice with hook and line. No one appears to know whether they enter our streams to spawn or spawn in the lakes, and I have never been able to settle this question, but presume they enter and leave the streams before the ice is out."

The United States Fish Commission has received a number of unusually large smelt through the kindness of Mr. S. F. Lane, of Port Henry, N. Y. These fish were taken by hook and line in Lake Champlain March 7, in 15 to 70 feet of water, and are locally known as ice-fish. The largest example measured $12\frac{1}{2}$ inches in total length and weighed 214 grams, or nearly one-half pound.

* Williams's History of Vermont, vol. 1, page 149.

In a recent number of *Forest and Stream* Mr. A. N. Cheney has the following very interesting account of this species as an inhabitant of Lake Champlain:

"More than twenty years ago I first heard of the 'ice-fish' of Lake Champlain, and when I saw them I found them to be the common smelt; but from that time to this the identity of the fish has been questioned at recurring intervals. Last year when I saw smelts being taken at Port Henry over 1 foot long and weighing one-half pound each, and was told that even larger ones were caught through the ice at Port Henry and Westport, I was obliged to admit that I had never seen smelts of such great size; nevertheless that is what they were. Last week I was at Port Henry and the identity of the 'ice-fish' was once again discussed, with the added information that the fish were now sent quite regularly to New York City, where they were pronounced to be different from the smelt. I had some packed to bring home with me, and asked to have several of the very large ones put in the box to have the matter of species set at rest. The man who furnished the fish told me that after Mr. Cobb's visit to the lake the United States Fish Commission had sent for specimens to determine just what 'ice-fish' really were, and that specimens had been forwarded to Dr. Hugh M. Smith. I asked Dr. Smith about them and he writes me:

"The specimens of "ice-fish" recently sent to us from Lake Champlain were the salt-water smelt (*Osmerus mordax*). They were fine examples, the largest being more than 1 foot in length and weighing one-half pound. The females were filled with ripe spawn. I have never seen such fine smelts on the New England coast, although they are sometimes taken in Maine and Massachusetts fully as large as those under consideration. As you know, this species is landlocked in some of the Maine lakes, and Professor Evermann took specimens in Lake Memphremagog; the fish in the latter lake, however, are quite small. In your opinion do the Lake Champlain smelts come up the St. Lawrence River each year for the purpose of spawning, or are they permanent residents of the lake?"

"I believe that smelts are not permanent residents of Lake Champlain, as they are caught only through the ice in February and March, and a search for them by the anglers in the summer and fall months has proved fruitless. In New Hampshire, where the smelt is landlocked, I have caught them in June, July, and August, and if they remained in Lake Champlain permanently they would be found by those who have persistently sought them. Another reason for thinking that they come from the St. Lawrence only to spawn, for it will be noticed that they are caught in the lake just before the spawning season, is that they have two runs of smelt in that river, one of small fish and one of large fish, such as are mentioned by Dr. Smith, the large fish of the lake answering to those known to run up the river. The landlocked smelt that I have caught in New Hampshire are much more slender, length for length, than the Champlain fish, showing that the latter are accustomed to rich pasturage probably not found in the lake. In Lake Champlain the large and small smelts are caught together, showing that the schools must mingle after they reach the lake, and they mingle in more than one way, for large smelts have been caught with small smelts inside of them, showing that the big fellows feed on their small brethren. One big smelt has been convicted of eating seven small ones at a single meal. This I learned only a few days ago."

The views expressed by Mr. Cheney do not meet the approval of all the anglers or persons who have observed the fishes of Lake Champlain. In another issue of *Forest and Stream* Mr. Bainbridge Bishop, of New Russia, N. Y., takes issue with Mr. Cheney upon the question as to whether the smelt come up regularly from the sea. We make the following extract from Mr. Bishop's interesting letter:

"As a rule Lake Champlain smelt and herring do not migrate to salt water, but at the approach of summer retire to the deepest part of the lake, where they find 200 to 400 feet of water. Here they stay at the bottom most of the time. When the broad lake freezes over they work up in shoaler water, where the fishermen take them through the ice. They are caught later in the winter at Port Henry, it being farther away from the deeper part of the lake. I have seen smelt in the lake every month in the year, and have caught them in most of the summer and fall months. While trolling off Cedar Beach in very deep water, with a lake-trout rig, I caught a

smelt 14 inches in length. This was in July. I was running a good-sized dace 150 feet below the surface, using $1\frac{1}{2}$ pounds lead. Also in August, while trolling, I caught a one-half-pound smelt in the middle of the lake opposite Westport, where I was running a minnow 200 feet below the surface. When camping in August at Apple Tree Point, a little north of Diamond Island, I used to go out before sunrise to fish for wall-eyed pike in about 100 feet of water. Very often the pike would chase and drive schools of smelt to the surface. They would leap out of the water by hundreds; they were fair-sized smelt.

"In September I was fishing on a reef far out in the lake opposite Westport. This reef has 18 feet of water on it, breaking off suddenly to 200 feet. A strong current was running from the deep water over the reef. Pike were biting finely. Once in a while the water would fairly boil close around the boat, caused by the smelt coming to the surface, driven up by large fish. Some of the pike threw smelt from their mouths after they were in the boat. Game Protector Goper Liberty was with me at the time. Once while anchored on this reef in a still time, with the current running as before, suddenly I noticed great quantities of air bubbles rising to the surface all over the reef. This was a mystery, but it was soon solved by the appearance of thousands of smelt leaping from the water, apparently disabled and in trouble. It seems that the current brought them up from deep water and the diminished pressure expanded their air bladders to such a degree that it brought them to the surface in distress, notwithstanding that they expelled part of the air before they broke water.

"I have taken fair-sized smelt from the mouths and throats of wall-eyed pike all through the summer and fall months—this was when fishing in and near very deep water—and have frequently used smelt so taken for bait with good success. My friend, Samuel P. Avery, jr., tells me that he picked up a dead smelt on the shore of his island at Buttou Bay. He went out on his favorite reef, and with this single smelt caught five fine wall-eyes. Smelt are the natural food of wall-eyes in Champlain and make the best of bait. I have never found smelt in black bass taken in Lake Champlain. Sometimes smelt come to the surface toward night, and in cloudy weather, when the lake is still, observing persons can see them swimming about in large schools, making a wide and curious ripple on the water. This is generally seen at the middle of the lake, where the water is the deepest. Smelt can be caught in Lake Champlain in any of the summer months by going to the right place and using the right means, but I do not think to much advantage, as they lie in deep water and are more scattered than in winter; still, by a little effort enough can be caught to use for bait.

"Here I want to raise a note of warning to those that think of introducing smelt to feed lake trout. They are ferocious little brutes and persistent destroyers of small fish living in all depths of water; they would destroy the young trout. This I think is one reason lake trout are not more plenty in Champlain."

In another issue of *Forest and Stream* Mr. Cheney gives still further information upon this subject. He says:

"In *Forest and Stream* of March 28 I wrote of the smelts, or, as they are called locally, 'ice-fish,' of Lake Champlain, and said that I believed that they were not permanent residents of the lake, 'as they are caught only through the ice in February and March, and a search for them by the anglers in the summer and fall months has proved fruitless.' My friend, Mr. Roland E. Robinson, has written me a letter upon this subject, from which I quote:

'Hon. M. F. Allen, of that place (Ferrisburg, Vt.), told me a few years ago of catching pike-perch off Split Rock, in Lake Champlain, that were gorged with smelt. I do not recall the date, but it could not have been earlier than the middle of June, and may have been in July or August. Mr. Allen is an old angler, well acquainted with the varieties of fish common in our waters, and could not have been mistaken in the identity of the smelt. I well remember seeing an occasional specimen among the great hauls of other fish taken in the old days of unrestricted seining on the then famous fishing-ground at the mouth of Lewis Creek, the Sunghaestock, or Fishing Weir River of the Waubanakes. These facts go to show that the smelt remain in the lake during at least part of the summer.'

"The author of 'Uncle 'Lisha' is the first person to my knowledge residing on or near Lake Champlain to call the smelt of the lake by its proper name, or, in fact, to admit that it is a smelt. That Mr. Robinson has himself observed the smelt among the fish caught in the lake, and that Senator Allen bears like testimony, should settle the question of their presence in the lake in summer. There is a whitefish found in Lake Champlain the young of which might be mistaken for the smelt when found inside other fish, unless the observer was familiar with both species, but this would not apply to either of the gentlemen quoted. A strange thing about the smelt is that they have not been caught by those who have searched for them in the summer months. My information on this subject comes from fishermen at Port Henry only. A year ago, when smelt fishing through the ice was at its height, I visited the fishermen on the ice and questioned them as to their knowledge of the smelt in the summer months. All agreed that, although search had been made for them, they had not been taken. Another strange thing is that no one seems to know anything about where they spawn."

Hon. L. D. Miles, of Newport, says that the smelt is not native to Lake Memphremagog, but was planted there several years from Lake Champlain, and that it has increased quite rapidly. It remains in the lake all the time, coming into shallow water from the first of October to the middle of June. He thinks they spawn on the same beds used by the shadwaiter. They are caught in spring and fall, chiefly in seines, but some are taken with hook and line.

Mr. Bishop's experience with this fish seems to furnish pretty conclusive evidence that it is permanently resident in Lake Champlain, as it doubtless is in Lake Memphremagog.

Knowing what we do of the physical environment of the landlocked smelt in the small lakes of Maine, one would be disposed to believe, in the absence of evidence to the contrary, that those in Lakes Champlain and Memphremagog are also landlocked.

The smelt from Cobessicotic Lake, Kennebec County, Me., was described as a distinct species by Professor Cope in 1870, under the name *Osmerus abbotti*. In the same year Professor Cope described specimens from Wilton Pond, in the same county, as *Osmerus spectrum*. These two supposed new species have usually been regarded as not being specifically distinct from *Osmerus mordax*. The Cobessicotic smelt is said to have the head shorter, the body more slender, and the eye smaller than in the common smelt. The Wilton smelt is said to have the body still more slender, the eye large, and the mouth and maxillary short. We have no specimens of either of these varieties and have had no opportunity to compare them with the true smelt. We have, however, compared examples from Lakes Champlain and Memphremagog with specimens from salt water, and, being unable to discover any tangible differences, are not willing to admit them even to subspecific rank.

Concerning this species Thompson says:

"The smelt is one of those migratory species of fishes which pass a part of the time in salt water and a part in fresh. Though not a constant visitant in our waters, he occasionally makes his appearance, and is sometimes taken in Lake Champlain in very considerable numbers. The form of this fish is long and slender, and its bright silvery hue renders it very beautiful. It is sometimes taken with the hook, but more commonly with the net, and is very highly esteemed as an article of food. In Massachusetts, according to Dr. Storer's report, 750,000 dozen of these fishes are taken annually in Watertown alone and sent to Boston market."

Family UMBRIDÆ. The Mud Minnows.

35. *Umbra limi* (Kirtland). *Mud Minnow*; *Mudfish*.

No specimens were obtained by us, but it is doubtless a common fish in suitable places in Vermont. Concerning it Mr. Thompson has the following:

"These fishes exist in considerable numbers in the marshes and coves along the margin of Lake Champlain, and of the rivers which fall into it. They are very tenacious of life, and live longer than most fishes without water. During droughts,

as the waters subside and recede from the coves, they have the power, by a springing motion, of transporting themselves from one little puddle to another. They also have the power of partially burying themselves and living in the mud and among the moist grass roots, after the other small fishes associated with them are all dead for the want of water. In these situations vast numbers of them are devoured by birds, muskrats, and foxes. In severe droughts, like that of 1841, the quantity of small fishes which die in consequence of the drying up of the coves is exceedingly great. In one small cove, which I visited on the 24th of September, 1841, I found mudfishes and other small fishes dead in piles in the low places which had become dry. One small portion of the cove, still covered with water and leaves to the depth of 4 or 5 inches, was literally filled with fishes struggling together for existence. This portion amounted to about one square rod, and in this space there could not have been much less than a barrel of fishes. They consisted of pickerel, yellow perch, shiners, bullpouts, and mudfishes, but mostly of the two last. My feelings were really pained at the sight, and, moved by compassion for the poor fishes, I heartily wished for rain, which, on the next day, came in abundance, to the joy not only of the fishes and their sympathizers, but of the whole country."

Family LUCIIDÆ. The Pikes.

36. *Lucius reticulatus* (LeSueur). *Pickerel*.

Our collection contains a fine example of this species, weighing 3 pounds, for which we are indebted to the skill and kindness of Mr. J. F. Lincoln, who took it while trolling in Missisquoi Bay, July 20.

Mr. Titcomb writes us that "*Lucius reticulatus* is common on both sides of the Green Mountains. When it gets into our ordinary trout lakes or ponds it means extermination to the trout. If bullheads follow the pickerel in waters where food is not abundant, the pickerel gradually grow less in numbers. One informant says he has found the *reticulatus* dead on the surface of the water with bullheads in them, and that the latter often kill the fish which swallow them."

According to Thompson, this is the common pickerel east of the Green Mountains, as the next species is the more common on the west side:

"This is the common pickerel on the east side of the Green Mountains in Vermont, as the preceding species is on the west side. It is found in Connecticut River and most of its larger tributaries, and it has multiplied exceedingly in several ponds to which it has been transported by the inhabitants in the neighborhood. This is the common pickerel of Massachusetts and the other New England States."

37. *Lucius lucius* (Linnaeus). *Common Pike; Pickerel*.

This is a common fish in Vermont, especially in the western part. It is usually called pickerel, but toward the north end of the State and in Canada it is generally called pike. Two fine examples were obtained by us in Missisquoi Bay. It seems to be common in Lakes Memphremagog and Champlain, and is one of the principal species taken in gill nets when used. They are also caught by trolling and are considered good game fish by many. They spawn in the spring, when they come out into the marshes for that purpose.

Mr. Thompson says:

"This species is very common in Lake Champlain and in all its larger tributaries. It is generally known in Vermont by the name of *pickerel*. About the north end of the lake and in Canada generally it is called the *pike*, on account of its resemblance to the English pike. Indeed, the resemblance is so close that Dr. Richardson regards them as identical, and has described our pike in his Fauna Boreali-Americana, under the name of the foreign species *Esox lucius*, but they are generally regarded by naturalists as distinct species. This fish grows to a large size, frequently exceeding 30 inches in length and weighing 10 or 12 pounds. It is very voracious and devours great numbers of reptiles and small fishes. It is taken both with the hook and seine, and is considered a very good fish for the table. The fishermen say that there

is another fish of this family in Lake Champlain, which they call the *Maskalongè*. If so, it is probably the fish which Richardson (*Fauna Boreali*, p. 127) calls *E. estor*, *maskinongè*. I lately received one which was sent me as a *maskalongè*, but which proved to be only a plump specimen of the common pike."

38. *Lucius masquinongy* (Mitchill). *Maskallonge*; *Muskallonge*; *Mascalonge*.

The maskallonge is said to be taken occasionally in Lake Champlain and the mouths of the larger tributary streams. It is said not to occur in Lake Memphremagog. Thompson records it from the Lamoille River, but we have seen no examples from those waters. It is seldom reported from any tributary to Lake Champlain except the Missisquoi River, in which it furnishes good sport to the few initiated fishermen.

Thompson has the following interesting remarks regarding the "Masquallonge:"

"This fish has, till lately, been confounded with the *Esox estor*, or common pike, or lake pickerel. When my description of the *E. estor* was published, in 1842, I doubted the existence of this species in our lake, but since that time my mind has changed on the subject. In May, 1847, I received from my friend, the Hon. A. G. Whittemore, of Milton, a fish caught near the mouth of the River Lamoille, which the fishermen called masquallonge. It was 26 inches long and weighed about 6 pounds. Upon examining it I was fully satisfied that it was of a species distinct from *E. estor*, and, as I could find no description of it under any other name, I made out a description and gave it the name of *Esox nobilior*.

"In April, 1848, I received another specimen from the same source, which weighed 19 pounds and was 41½ inches long. In May, 1849, two specimens were brought along, both caught near the mouth of the Lamoille, one of which weighed 40 pounds and the other 27 pounds. I purchased the latter, and from it the preceding description is chiefly drawn. Believing this species to attain a larger size and to be a more excellent fish for the table than any other species of the pike family found in the United States, I have given it the specific name of *nobilior*. It is a fish which is eagerly sought and commands the highest price in market, but it is rare in Lake Champlain, compared with *E. estor*, or common pike. Very good figures of both of these species are given in Frank Forester's Fish and Fishing, but both under wrong names; the *E. nobilior* being figured under the name of *E. estor*, and the *E. estor* under that of *E. lucioides*.

"The vulgar name *masquallonge* appears to have been given by the early French settlers of Canada to the pikes and pickerels generally, it being a term or phrase descriptive of the whole family—*Masque*, signifying face or visage, and *allonge*, lengthened, they all having lengthened or elongated heads. In modern times this name, *musquallonge*, has been confined, by the fishermen, to the species here described, while the other species bear the vulgar name of pike or pickerel. The methods of spelling this Canadian-French name have been almost as numerous as the authors who have used it, as may be seen by the following: *Maskallonge*, LeSueur; *masquinongy*, Dr. Mitchell; *maskinonge*, Dr. Richardson; *muskallonge*, Dr. Kirtland; *muskellunge*, Dr. DeKay.

"The oldest forms of this name, it will be seen, approach nearest, both in spelling and pronunciation, to the phrase *Masque allonge*, which we have supposed to be its origin, and, therefore, afford presumptive proof of the correctness of our supposition.

"This fish may usually be distinguished from the common pike by its dark circular markings and its more robust proportions. Its head is proportionally shorter, the face flatter and less grooved, and the width across the eyes and upper jaw greater than in the *estor*. But, perhaps, the mark by which it may be most readily distinguished is on the cheek, the lower half of the cheek in the *E. nobilior*, in front of the preoperculum, being naked, or without scales, while in the *E. estor* the whole cheek is covered with scales. The difference in the general aspect of the two species may be seen by comparing the figure of the *E. estor* below with the *E. nobilior* at the head of this article.

"The specimen here described was a female with her abdomen filled with eggs, contained in two ovaries which extended nearly the whole length of the cavity. This fish abounds much more in the streams and smaller lakes in Canada than in Lake Champlain."

Family **GASTEROSTEIDÆ**. The Sticklebacks.

39. Eucalia inconstans (Kirtland). *Brook Stickleback*.

Through the kindness of Mr. John W. Titcomb the Commission has received a specimen of this species from a small brook in Franklin County, Vt. This brook, which is the outlet of Franklin Pond, empties into Pike River, which flows from Vermont, through Canada, into Missisquoi Bay. Mr. Titcomb says that the stickleback is reported to be common in that particular brook, but he does not think he has seen it elsewhere in the State.

Mr. Thompson appears not to have noticed it.

Family **PERCOPSIDÆ**. The Trout Perch.

40. Percopsis guttatus Agassiz. *Trout Perch*.

Concerning the discovery and naming of this interesting fish Mr. Thompson has the following:

"The first knowledge I had of this fish was in the summer of 1841, when I found a specimen of it, 5 inches long, which was dead, and had been drifted up by the waves on the lake shore in Burlington. On examining it I found it to possess the adipose and abdominal fins of the trout, but in its teeth, gillcovers and particularly in its hard, serrated scales, to bear considerable resemblance to the perch family. After searching all the books within my reach without finding it described I concluded that it might be new, both in genus and species, and accordingly, in allusion to the above-mentioned properties, I described it in my journal under the provisional generic name of *Salmoperca*. A notice of this fish was omitted in my History of Vermont, published in 1842, because I had then only one specimen, and upon that one, with my little experience, I did not think it prudent to found a new genus and species. When Professor Agassiz was at Burlington in 1847 I submitted the above-mentioned specimen to his inspection, having at that time obtained no others. At first sight he thought it might be a young fish of the salmon family, but upon further examination he said it was not a salmon, nor any other fish with which he was acquainted.

"During the summer of 1847 I found three other specimens of this fish, dead, on the lake shore. One of these I took with me to Boston in September to the meeting of the Association of American Geologists and Naturalists, and put it into the hands of my friend, D. H. Storer, M. D., with a request that he would ascertain what it was and let me know.

"In May, 1849, I obtained from Winooski River a number of living specimens, which I kept alive for some time; and, observing the great translucency of the living fish when held up toward the light I gave it the specific name of *pellucida*, having previously called it, in my journal, *coeeta*, from its wing-like pectoral fins.

"About this time I noticed, in the proceedings of the Boston Society of Natural History, that Professor Agassiz had laid before the society an account of a new genus of fishes discovered by him in Lake Superior, which he proposed to call *Percopsis*. Suspecting, from the brief description given of it, that it was identical with my *Salmoperca*, I wrote to Dr. Storer and inquired of him if the specimens from Lake Superior presented to the society by Professor Agassiz were like the one I put into his hands in 1847. He wrote me that he could not say—that the specimen went out of his hands soon after he received it and he had not seen it since.

"In Professor Agassiz's Lake Superior, page 248, I find an account of his genus *Percopsis* and his species *P. guttatus*, and I have no doubt that it is identical with my *Salmoperca pellucida*. Still, I have thought it best to let it remain, in this Appendix, under the name I had given."

Family CENTRARCHIDÆ. The Sunfishes and Baases.

41. *Ambloplites rupestris* (Rafinesque). *Rock Bass*.

According to Thompson, "this fish is here known by no other name than *rock bass*. It is quite a common fish in Lake Champlain and its larger tributaries. It is usually taken with the hook along the precipitous rocky banks of the lake and rivers, and from this circumstance it derives its name. It is considered a very good fish for the table, and its weight is usually about half a pound." A nearly ripe female was received from Missisquoi Bay April 25.

Mr. Titcomb says that the rock bass is quite common in many lakes other than Champlain, particularly in Lake Bomoseen.

42. *Lepomis megalotis* (Rafinesque). *Big-eared Sunfish*.

This sunfish is recorded by Thompson from the Connecticut River at Barnet.

43. *Eupomotis gibbosus* (Linnaeus). "*Sunfish*"; "*Pond Perch*."

Mr. Thompson says:

"This is a very common fish in the coves along the margin of Lake Champlain, and about the mouths of our rivers. Though extensively known by the name of *sunfish* and *pond perch*, it is perhaps more generally known by the name of *pumpkin seed*. It is also sometimes called *breem*. This fish, though said in Jardine's Naturalists' Library to be of unobtrusive colors, is one of the highest colored and most beautiful fishes found in our waters, 'oftentimes vieing in brilliancy with the tropical fishes.' The sunfish, though often taken with other fishes in the seine, is more commonly taken with the hook, at which it bites with avidity. Its flesh is white and palatable, but the fish being small, thin, and bony, is little sought as an article of food."

Two examples, the larger 9 inches long and weighing 10½ ounces, were received April 25 from Missisquoi Bay.

44. *Micropterus dolomieu* Lacépède. *Small-mouthed Black Bass*.

This important game fish is pretty generally distributed throughout the State, and it is probably more abundant now than it was in Thompson's time. He says:

"The black bass, by which name this fish is here generally known, ranks as one of the best fishes taken from our waters; but, as is apt to be the case with good fishes, it is much less abundant than several other species which are greatly its inferior in point of quality. It is usually taken with the seine, and its weight varies from 1 to 5 or 6 pounds."

One small specimen was obtained by us in Missisquoi Bay. Mr. Eli Cameron, of Rouses Point, says there are a good many bass in Lake Champlain, and that they spawn in May and the fore part of June. Samuel Decker says the black bass are abundant and that they spawn in May and June. Others state that the black bass is common in Vermont, and that they spawn in May and June or even as late as July, when they come upon the reefs for that purpose. Mr. Miles claims that the small-mouthed black bass is not indigenous to Lake Memphremagog, but that it was planted there some years ago. An unripe male, 14 inches long and weighing 1½ pounds, was received from Missisquoi Bay. Mr. Collins states that only two examples of the species were taken in his seine during the six weeks of its operation ending April 15.

Mr. Titcomb says:

"Black bass spawn in June and July. Many fishermen insist that they spawn earlier. On June 12, 1896, I took two small-mouthed black bass in Lake Champlain on one of the fishing-grounds where it was claimed they did not spawn, but came there from the spawning-grounds. Upon examination both fish were found to be females and full of spawn. The intestines of the stomach were empty and clean, as if they had been washed and wiped out. They undoubtedly took my hook to get it off from their spawning bed."

Family PERCIDÆ. The Perches and Darters.

45. *Stizostedion vitreum* (Mitchill). *Wall-eyed Pike; Pike.*

Mr. Thompson says:

"The usual length of this fish is from 14 to 20 inches and its weight from 1 to 4 pounds. It is taken very plentifully from the waters of Lake Champlain and its tributaries. It is a firm, bony fish, but as the bones are large and easily separated from the flesh, they are much less troublesome than in the perch and some other species. Its flesh is well flavored, though not so juicy and rich as that of our white-fish and some few others. In the form of its body and the situation of its fins it closely resembles the perches, but its head and teeth are more like the pikes, and hence its name, *Lucio-Perca*, or *Pike-Perch*. This fish is called by Dr. Williams, in his History of Vermont, the *white perch*, but is generally known in Vermont simply by the name of *pike*, while the fish usually called pike in other places is here called *pickarel*. This fish, on the contrary, is called pickarel in Canada. We have another species of this genus, probably the *L. canadensis*, but I am unable to say so positively at present."

The pike is perhaps the most important food and game fish of Lake Champlain, and in the spring of the year it constitutes the principal catch. According to Mr. John W. Titcomb, they go up the east side of Missisquoi Bay when going to their spawning-grounds, but return to the lake by going down the west side. The fishermen on the Hog Island side get them full of roe, while those on the other side get only spent fish. The principal spawning-grounds about Lake Champlain seem to be in Missisquoi Bay and in the lower parts of the larger rivers, particularly the Lamoille and the Missisquoi. The spawning time in Lake Champlain is quite early in the spring, chiefly in April and May. Mr. A. L. Owen, of Burlington, thinks they spawn even before the ice goes out, as he has caught spent fish in April. Mr. A. L. Barrows, of Burlington, thinks they spawn about April 20; says he has caught many full of spawn in April as they were passing Higate on their way to Missisquoi River; many spawn in Lamoille River. Mr. B. R. Seymour, of Burlington, says they spawn early in the spring, even before the ice goes out, and that their principal spawning-grounds are in Missisquoi Bay and Missisquoi, Lamoille, and Winooski rivers. He says that, after spawning, the pike run down the east shore of the lake until stopped by the Sand Bar Bridge. This he regards as a calamity in that it prevents the fish from going on into the southern portion of the lake. This bridge connects Grand Isle with the Vermont shore and has no opening under it through which fish may pass. They might work to the westward and then on south, but Mr. Seymour thinks they are more likely to return north.

The wall-eyed pike is one of the principal game fishes of Lake Champlain. Mr. H. M. Price, of Burlington, says they range in weight from 2 to 5 pounds, the average being, perhaps, 2½ pounds. Mr. Barrows says they average about 2 pounds. According to Mr. Miles, the wall-eyed pike is not found in Lake Memphremagog.

According to Mr. Titcomb, its spawning season in the rivers seems governed by the time the ice leaves the river. They appear immediately after the breaking up of ice in the spring in Missisquoi River, near the dam at Swanton. This is as far as they can ascend the river, and they do not make their appearance until the ice goes out.

Among the fishes sent by Mr. Collins from Missisquoi Bay are two wall-eyed pike. One is an unripe male 25 inches long weighing 5½ pounds, the other an unripe female 18½ inches long and weighing 2½ pounds. The condition of the reproductive organs indicates that the spawning period would not begin until near the middle of May. The stomachs contained nothing that could be identified.

46. *Stizostedion canadense* (Smith). *Sauger; "Ground Pike-Perch."*

Mr. Thompson says there is a second species of *Stizostedion* in Vermont, and thinks it is probably this species. In the Appendix (p. 30) he says:

"When the Natural, Civil, and Statistical History of Vermont was published I was well satisfied that the species here described was distinct from the *L. americana*, but was not so clear whether it was a species already described or not. The difference

between this species and the *L. americana* is so obvious that they are instantly distinguished, even when there is no difference in size; but while the latter species often exceeds 2 feet in length, and weighs 5 or 6 pounds, the *L. canadensis* seldom, if ever, exceeds 14 inches in length, or half a pound in weight. It is much less common in Lake Champlain than the *L. americana*, but is frequently taken in company with it. It usually swims very near the bottom of the water, and hence it has received the name of *ground pike* (pike perch). As an article of food this species is held in the same high esteem as the common pike perch."

Mr. Titecomb writes us that the sauger or rock pike, as it is locally called, is caught in seines while fishing for the pike perch. It does not grow as large as the latter, and is not much valued as a food-fish. It is usually sold as "cull fish" rather in the barrels of clear pike perch.

Two examples of the sauger or saud pike were received from Mr. Collins. One was a nearly ripe female 14½ inches long, weighing three-fourths of a pound, the other an unripe male 15 inches long, weighing three-fourths of a pound. These would indicate an earlier spawning time than that for the wall-eyed pike. The stomach of the male contained a 3-inch minnow, too badly digested for identification, and a number of small insects.

47. *Perca flavescens* (Mitchill). *Yellow Perch; Ringed Perch.*

Mr. Thompson says:

"The yellow perch is one of the most common fishes found in Lake Champlain and in the mouths of the rivers falling into this lake. They are taken both with the seine and hook, but chiefly with the latter. In the winter they are caught by cutting holes in the ice. They vary from 8 to 12 and even 14 inches in length, and are carried around for sale from house to house in the villages along the lake, at all seasons of the year, neatly scaled and dressed ready for cooking. In this condition they are sold at from 10 to 20 cents a dozen, according to the season and their abundance. The flesh of the perch is white, firm, and agreeable to the palate, but is rather dry and bony.

"This fish agrees throughout with Dr. Mitchill's description of his *Bodianus flavescens*, and is undoubtedly the species from which his description was drawn. Cuvier having obtained specimens of this and another species which very closely resembles it, from the waters of the United States, gave to this species the name of *P. serrato-granulata*, on account of its serrated and granulated gill-covering; to the other, distinguished from this by the want of granulations, by its smaller size and greater number of brown bands upon its sides, he gave the name of *P. flavescens*."

The yellow perch is one of the most common fishes of the State and is said to be particularly abundant in Missisquoi Bay. Specimens were obtained by us in Clyde River, near Newport, and from Missisquoi Bay.

Three specimens were received April 25 from Missisquoi Bay. They were 9½ to 10 inches in length and weighed about 7 ounces each. Two were fully ripe females, the other a nearly ripe male.

48. *Percina caprodes* (Rafinesque). *Log Perch; "Hogfish."*

This species, which is one of the largest of the darters, was found in abundance in Missisquoi Bay; the eleven examples saved are all small, measuring from 1¼ to 3½ inches in length. We obtained it at Rouses Point and Plattsburg on the west shore of the lake, but did not find it elsewhere in Vermont, though it doubtless occurs throughout the State. Concerning this species Mr. Thompson has the following:

"This fish, though its vulgar name might be thought to imply the contrary, is certainly one of the most symmetrical and beautiful fishes found in our waters. It received the name of *hogfish* from a resemblance in the form of its snout and lower jaw to those of that quadruped. It is quite common in the mouths of the streams which fall into Lake Champlain, but being a slender fish and never exceeding 4 or 5 inches in length, no account is made of it as an article of food, and very little is known of its habits. It swims low in the water, and when at rest usually lies at the bottom."

49. *Boleosoma nigrum olmstedii* (Storer). *Tessellated Darter.*

This darter is contained in Thompson's list, and it appears to be quite common in Missisquoi Bay. Our collection contains a dozen examples, $1\frac{1}{4}$ to $1\frac{3}{4}$ inches long, from that place. It probably occurs elsewhere in the State, but we have no exact information upon the matter. Thompson says:

"The habits of this fish are quite peculiar. It moves not from place to place by an even, labored motion, like other fishes, but proceeds by sudden leaps or darts, impelling itself forward by its tail and pectoral fins, which it moves as a bird does its wings. It remains suspended in the water no longer than it keeps its pectoral fins in rapid motion. When the motion of its fins ceases the fish sinks at once to the bottom, showing that its specific gravity is greater than water, owing, doubtless, to its want of a swimming bladder. When it reaches the bottom it alights upon its stiff ventral fins, upon which it stands on the bottom, balanced with its head elevated, as a bird stands on its feet. I kept several specimens of this fish alive in a vessel of water for some time for the purpose of watching their motions and learning their habits. They were very uneasy and seemed extremely anxious to escape from their confinement. Aided by their caudal and pectoral fins in giving them an impulse upward, and by their ventrals in climbing and adhering, they would often raise themselves up the perpendicular sides of the vessel, entirely above the surface of the water, excepting only the caudal fin. Another peculiarity of this fish is its power of bending its neck and moving its head without moving the body, in which respect it equals many of the reptiles. This fish is entitled to the name of *darter*, both from its sudden motion and from its having the general form of a dart."

In the stomach of a small ling (14 inches long), caught by Mr. Collins in Missisquoi Bay about April 23, were found at least thirty examples of this darter.

Family SCIÆNIDÆ. The Drums.**50. *Aplodinotus grunniens* Rafinesque. *Fresh-water Drum*; "*Sheepshead*."**

"This fish is quite common in Lake Champlain, and is here generally known by the name of *sheepshead*. It is also found in the western lakes and Ohio River, where it is more commonly called the *white perch*. This fish, taken from the Ohio River, is said to be fat, tender, and well flavored; but ours is lean, tough, and bony, and seldom eaten. It received its vulgar name from its resemblance in appearance to the *Sargus ovis*, which is also called *sheepshead*, on account of its 'arched nose and smutty face'; but the resemblance is in appearance only, for while the latter is considered one of the most delicious fishes for the table, the former is seldom carried to the table."

The fresh-water drum is still a common fish in Lake Champlain, but we know nothing of its occurrence elsewhere in the State. We obtained one large example with Mr. Decker's seine in Missisquoi Bay July 20, and on April 25, 1896, Mr. Collins sent us two examples taken in Missisquoi Bay at Swanton. One of these was an unripe male 28 inches long weighing $12\frac{1}{2}$ pounds, the other a more nearly ripe male 19 inches long and weighing $3\frac{3}{4}$ pounds. Their stomachs were empty.

Family GADIDÆ. The Codfish.**51. *Lota maculosa* (LeSueur). *Ling*; "*Methy*;" *Cusk*.**

Mr. Thompson says:

"This fish, which is quite common in Lake Champlain and its tributaries, I have referred to LeSueur's species the *Gadus maculosus*, as agreeing more nearly with his description than with any other to which I have access. There are, however, several differences between them. In LeSueur's species the jaws are said to be equal; in ours the upper jaw is uniformly longest; in his the lateral line is said to be in the middle of the body; in ours, anterior to the vent, it is much nearer the back than the belly. Our fish bears considerable resemblance to the *Lota brosmiana* described by Dr. Storer in the Boston Journal of Natural History, vol. IV, page 58. But it

differs from his description and figure in having the upper jaw longest, in having the snout more pointed and less obicular, etc. Judging from the descriptions, without specimens for comparison, I should say that our fish differs as much from either of the species referred to as they differ from each other, and that they either constitute three distinct species or are all varieties of the same species.

"The ling is held in very low estimation as an article of food, the flesh being tough and the flavor unpleasant. This fish is one of the greatest gormandizers found in our waters. If he can procure food he will not desist from eating so long as there is room for another particle in his capacious abdomen. He is frequently taken with his abdomen so much distended with food as to give him the appearance of the globe or toad-fish. The smallest of the three before me, when my description was made, being 16 inches long, was so completely filled with the fishes swallowed that their tails were plainly seen in its throat by looking into its mouth. On opening it I found no less than 10 dace, *L. pulchellus* [*Semotilus corporalis*], all about the same size, and none of them less than 4 inches long. Seven of these were entire, and appeared as if just swallowed. Upon the others the digestive process had commenced."

The ling is still found in Lake Champlain, but it is said not to occur in Lake Memphremagog. According to Mr. Titcomb, the cusk, which is common in the Connecticut River, is caught with hook and line, and in the winter by fishing through the ice in the night, setting a number of lines and baiting with live bait. It will take live minnows about sundown and from that time until sunrise. This method of fishing is carried on by local fishermen at Lunenburg, Vt. It is also found in Willoughby Lake. It spawns in March or April, and is regarded as a valuable food-fish.

An unripe male ling was received from Missisquoi Bay through the kindness of Mr. A. L. Collins April 25. It was 14 inches long and weighed 1 pound. In its stomach we found thirty individuals of the common darter of that lake--*Bolcosoma nigrum olmstedii*. Besides this number, which could be identified, there was a large mass of material too badly digested to permit of certain identification, but which probably represented still other darters.

Family COTTIDÆ. The Sculpins.

52. *Cottus gracilis boleoides* (Girard). *Blob*; "*Chucklehead*."

One specimen obtained in Sleeper River near St. Johnsbury, July 25. Mr. Titcomb says it is common in that stream. It was not seen by us elsewhere, though it is doubtless not rare throughout that portion of the State drained by the Connecticut.

Mr. Titcomb says the "*chucklehead*" is found on both sides of the Green Mountains and is often used as bait for large trout by the patient fisherman.

53. *Cottus gracilis gobfoides* (Girard). *Blob*.

This fish was originally described from specimens obtained in Lamoille River near Johnson, Vt. Thompson has the following:

"For the specimen here described I was indebted to the kindness of Mr. R. Colberth. He caught it while fishing for trout in a branch of the river Lamoille, in Johnson. This fish usually lies still at the bottom, or concealed under the stones in the streams, and seldom moves, except when disturbed, and then its motions are sluggish and labored. It is called in some places the 'slow fish.' It probably derived the name of 'star-gazer' from the favorable position of its eyes for looking upward, they being placed very near the top of the head. It seldom exceeds 4 inches in length."