SEVENTH BIENNIAL REPORT

OF THE

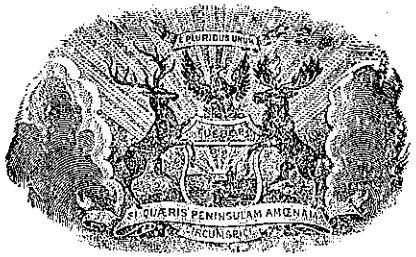
STATE BOARD

OF

Michigan

FISH COMMISSIONERS

FROM DEC. 1, 1884, TO DEC. 1, 1886.



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1887.

STATE BOARD OF FISH COMMISSIONERS.

1886.

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OFFICE OF THE BOARD.

NO. 33 MOFFAT BLOCK, DETROIT, MICH.

REPORT OF BOARD OF FISH COMMISSIONERS.

To the Honorable CYRUS G. LUCE,
Governor of the State of Michigan:

The State Board of Fish Commissioners respectfully submits its seventh biennial report, in obedience to the statute under which the board was organized and exists.

This seventh biennial report covers all operations of the commission from the close of the last report, December 1, 1884, to the 1st day of December, 1886. During the past two years the results of our work have been, in the main, quite satisfactory, and fully abreast, in some particulars in advance, of the promises made in the last report.

Good progress has been made in planting the streams with brook trout; a large number of citizens have been supplied with German carp for private ponds, besides supplying by free distribution the most approved instruction for the care and culture of carp; the product of whitefish hatcheries has steadily increased, and the planting of this product has begun to make an impression on the great lakes; the four stations of the commission are in excellent order and steadily gaining in efficiency; the important work of exhaustive examination of our inland waters has been well begun, its methods having been thoroughly revised and systematized; the office work and finances of the board are most capably managed by an experienced secretary, whose entire time is devoted to the business, and a treasurer, who, without compensation, has given valuable time to our general interests, besides giving the board the advantage of doing its business with an established bank; finally, the general operations of the commission have grown in favor with the people of the State, during these two years, and we believe we are warranted in saying have gained the confidence and co-operation of the great majority of fishermen and fish dealers.

We should be pleased to have the various State officers make personal examination of the hatching stations and business office, in the belief that such investigation would satisfy them that the expenditures made by us on behalf of the State for permanent improvements, as well as for current operations, have been and are being judiciously made, and as economically as is consistent with thoroughness and efficiency.

In proof of the fact that a reasonable amount of success has attended our operations, we refer to the statements made in the treatment of the various topics of this report, as well as to the schedules annexed hereto.

For convenience of the reader, the report is divided into topics covering the various branches of work prosecuted, as follows:

I. The industrial fisheries, their extent and value, including reported catches for seasons of 1884 and 1885.
II. Regulation and inspection of fisheries.
  A. Industrial.
  B. Inland.
III. Artificial propagation and distribution of food fishes.
  A. Operations in food fishes.
    1. Whitefish.
    2. Brook trout.
    3. Schoodic or land-locked salmon.
    4. Lockleven trout.
    5. Pickerel.
    6. Salmon trout.
    7. California trout.
    8. Grayling.
    9. Eels.
    10. Carp.
  B. Other native fish that should be cultivated.
  C. Present stations and equipments.
    1. Detroit station.
    2. Petoskey "
    3. Paris "
    4. Glenwood "
  D. Needed and proposed extension of stations and equipment.
  E. Examination of inland waters.
  F. General organization with work of commission.

I. THE INDUSTRIAL FISHERIES.

Year by year as the population increases, the question of cheap and wholesome food supply is growing in importance, and more urgently calls attention to the necessity of intelligent cultivation of our great public domain of waters. The waters of our State are essentially public because they can never be the subject of any but the most limited private ownership and beneficial use, and their cultivation by private owners for fishery purposes is interdicted by natural laws. If these waters are cultivated at all it must be done by the State. That the continued productiveness of our waters can assist materially in furnishing cheap and wholesome food to our people, must be conceded by every man who knows anything of the economic history of Michigan and its people.

For years past our industrial fisheries have contributed a considerable portion of food to our people, it has furnished a fairly incrative business to many of our citizens, it has given employment and support to many families, in some instances to whole communities, and supplied an article of commerce which has brought back into this State money that has contributed its fair share to the development and prosperity of the commonwealth. Our inland fisheries of lake and stream have been, in proportion to their extent, not less valuable in the same direction. While they have not furnished an article of extended traffic for export, they have, however, attracted many visitors from other States, whose expenditures here have been of great value, particularly in the newer and sparsley settled portions of the State.

Thus, in either branch our fisheries have been, and are still, respectable fa tors in the growth and prosperity of the State; and for that reason a worthy of attention by the public authorities; and every consideration whic affects them, whether it be of their preservation by suitable laws, or of thei gradual extension to increase their productiveness by artificial means, call for patient investigation and intelligent action on the part of those charge by their official trusts with the care of the State's public interests.

The duties of this board require it to present to the Executive and Legi lative departments of the State, a report of their operations in fish culture including such facts and suggestions respecting the well-being of the fisheries as come of experience in the discharge of its duties.

The commissioners have taken a broad view of their duties respecting th industrial fisheries, and have sought by every means in their power, to lear the exact condition, the extent, the value and needs of the same. We hav been seriously hampered hertofore in the performance of this duty by th vagueness of our information and data, and so unsatisfactory has been ou presentation of these matters to the Executive and Legislature on tha account, and so little impression did our representations seem to make upo the Legislature, that it was deemed an imperative duty to provide reliabl statistics and information with this report, as the foundation of our recom mendations respecting the regulation and good government of the industria fisheries. Special attention is asked to this department of the commission' work.

In presenting this branch of our subject, the industrial fisheries of Michi gan, we ask all readers to bear in mind this brief summary of the whol matter.

The industrial fisheries are of great value.

They are being speedily ruined.

They can be saved by (a) proper legal regulation, and (b) artificial propa gation.

They can not only be saved but they can be vastly increased by the sam remedies. The product of 13,000 tons (1885) may be made 30,000 tons.

These same remedies may, within a reasonable period, become self-sup porting by a properly adjusted license system.

The facts are contained in the following pages, and the remedies suggeste by the facts, which this board recommends, have the substantial approval an support of all intelligent men who have considered the subject, as well a that of the entire body of representatives of the fishing interests of th State.

Failing in our request to the Legislature at the last session to secure a law for the appointment and means to employ an inspector and wardens of th fisheries, for the double purpose of enforcing the laws, and gathering statis tics and other indispensable information of the condition and needs of the fisheries, the commissioners were presented with the alternative of going another two years without the facts, upon which alone this subject could be properly presented to the State authorities and the people; or of economizing in some other branches of their work, and expending enough of their appropriation to secure at least one full and intelligent statistical report. The latter course was adopted without hesitation, and they were fortunate enough to secure Mr. Lyman A. Brant, of Detroit, a member of the last House of Representatives, to act as statistical agent of the board for the season of

1885. The commissioners are thus able to present a complete and perfectly reliable report of the extent, value and condition of the industrial fisheries of Michigan, as they existed at the end of 1885. Mr. Brant's work speaks for itself through his admirable report which is given in full below. We wish to make this public acknowledgement of our appreciation of his work, as having been systematically, economically and thoroughly done; and to say that we regard it as the most valuable service that has yet been rendered to the State in connection with the industrial fisheries. Mr. Brant was employed upon this work from September 1, 1885, to April, 1886. It was with sincere regret that his resignation was accepted, because the condition of our funds did not warrant a longer continuance of his services. This was particularly regretted, as an equally accurate summary of the product and general condition of the fisheries for the season of 1886 would, without doubt, have enabled the commissioners to present with this report, a reasonably just and comprehensive scheme for licensing fishing; one that could be urged with confidence, and the assurance that it would be cordially accepted by all fishermen and fish dealers. This matter of license will be further considered under the next general topic, with which it more naturally belongs.

The summary of the fisheries reports for 1884, which are given just below, furnish a striking contrast to the reports of 1883. No agent was employed to visit the coast, as we had no means to employ one, and our only recourse was to send to the fishermen who had reported in 1883 the blanks for reports and urge upon them the advantage of compliance with the law. The result was that 50 fishermen and dealers reported, against 83 in the previous season. We think the only occasion for surprise is that so many reported in the absence of the personal visit of an agent. It, however, also furnishes a very marked evidence of the importance of having the matter brought to the attention of the fishermen when contrasted with the reports of 1885. In that year the number reporting was 432. In examining the summary of the reports of 1884, it must be remembered it is only a partial showing of the product for that year. The number of men reporting was less than one-eighth of the number reporting in 1885. A comparison of the reports of the same firms for these three seasons shows conclusively, what every fisherman has stated in general terms over and over again, that the relative product of each one has steadily fallen off—by relative, we mean the total product as compared to the extent of twine, boats and men.

The smmmary of the reports for 1884 is as follows:

STATISTICS OF FISHERIES FOR 1884.

No. of lbs. of whitefish	1,247,697
" " trout	812,682
" " herring	1,585,742
" " bass	26,627
" " all other kinds	498,642
Total number of pounds	4,171 390
The total value	$125,351.94

No. of gill nets, (288,257 fathoms)	2,479
" pound nets	121
" seines	14
" tugs	11
" sail boats	38
" pound boats	37
" skiffs	29
" men employed	290

There were but 50 fishermen who reported.

The summary of statistics for 1885 will be found in the report of Mr. Lyman A. Brant, statistical agent of the board for that year, which is here given in full:

REPORT OF STATISTICAL AGENT.

To the State Board of Fish Commissioners:

GENTLEMEN:—Receiving from your board, in August last, an appointment as statistical agent, and having entered upon my duties as such officer, I have at this time to present the following report of my doings:

I entered upon, with some misgivings as to my ability to perform in a satisfactory manner, the duties assigned to me by your instructions of September 5, 1885, covering as they did an extensive field of inquiry, and one to which I was almost a total stranger. Whether or not those duties have been discharged in a reasonably satisfactory manner, taking into consideration all the circumstances connected with the task, the facts submitted and the opinions expressed must bear testimony.

I first began the active canvass of the lake coast at Marquette, Lake Superior, where I arrived September 9, 1885. The reason for commencing my work so far away from headquarters was, as you will recollect, that it was deemed advisable to make the Lake Superior coast before the heavy fall gales which prevail there had set in. From Marquette the coast was canvassed up the shore to Big Bay, from thence to Keweenaw Bay and Houghton. Arriving at the latter place I learned that to reach Isle Royale it would be necessary to go to Duluth, and that the trip would consume from 10 to 14 days. As the only Michigan firm fishing there at that time had its headquarters at Houghton, I concluded to abandon my contemplated visit to Isle Royale, being impelled to that conclusion by the fear that the time devoted to it would prevent my making the circuit of other and more important portions of the lake coast before the close of navigation. Other points westward from Houghton and eastward between Grand Island and Whitefish Point were also not visited, partially for the reason stated above, with the additional one that but very few fishermen were at that season of the year engaged there. Those who were on the ground at that time I secured the names and postoffice addresses of, and they have since sent in the returns required by the law. As indicated above, I feel that my canvass of the Lake Superior coast was not as thorough as it should have been. In fact, the work, to be complete, should be done on those shores between October 1 and November 1, as that is the time when the fishing operations there are in full blast. As the country is sparsely settled, much of the

coast very difficult of access, and many of the fishermen non-residents, it is a difficult matter to obtain personal interviews with them at other times.

From Houghton I went to Menominee, on the shore of Green Bay, from that point to Escanaba, from those places working the shores of Big and Little Bay de Noquet thoroughly. The fisheries in these bays of Lake Michigan are very important, and vary from those of Lake Superior in the fact that few trout are taken there, the catch consisting mainly of whitefish and herring. Here also are found a variety of whitefish called "Menominees." They are caught in abundance in these waters, and but rarely in other parts of Lake Michigan. They appear to inhabit about the same depth of water as the whitefish, and are taken largely in the winter season in gill nets of about 3½ inch mesh. They rate in the market but little better than herring, and dealers generally pronounce them inferior as an article of food.

There are perhaps but few localities along the entire lake coast where fishing has been conducted in a more wasteful manner than around the shores of Green Bay and the logical result has followed, viz., the catch of whitefish has exhibited a constant and very marked decline in the number of pounds and average size, but the number of fish taken has not perhaps fallen off in a marked degree. The almost universal testimony of fisherman there, is that steps should at once be taken to stop the further destruction of young whitefish. When I was in that locality almost every fisherman's shanty bore evidence of the extent to which the slaughter had been carried, in the hundreds of packages of Nos. 2 and 3 salt whitefish which they contained, some of the packages of 100 lbs. containing from 300 to 350 fish. Most of the fishing in these waters is done with pound nets, the depth of the water and the bays and inlets protected from storms being favorable to their use. During the past three or four years many of the whitefish caught here bear the peculiar "ear-marks" of the Lake Erie fish, and many of the old fishermen were positive in expression of the opinion that they were the result of plants made by the State and United States Commissions. At Fairport I saw about 1,700 lbs., of whitefish taken from one pound net, and Capt. Nat. Saunders pronounced them to be Detroit River fish, which had been planted. Most of them were No. 1 fish, and they averaged more than 1½ pounds each,

From Green Bay to Detour the character of the fishing is about the same as that of the former place, save that the "Menominees" almost entirely disappear and the lake trout becomes an important part of the catch. At Thompson, Manistique, Seul Choix, Naubinway, Epoufette, St. Ignace, Mackinac Island, St. Martin's Bay and Detour large interests are located. At Gros Cap, near St. Ignace, an important herring fishery is located, about the only one on that shore.

The north shore of Lake Michigan is subject to heavy gales of wind and much of it is unsheltered, which renders the use of the pound net rather difficult, still in every place along the coast where it is possible to make them "stick" they are located, and it is probable that they have made the best catches of this year. Gill netting is also extensively carried on, there being about 100 small rigs in operation between Manistique and St. Ignace and several large outfits, or about one rig to each mile. There are also fully 70 pound nets in the same distance. Near Naubinway there are 13 pound nets in a string, reaching out a distance of three miles or more. As an evidence of the enormous decrease in catch in the neighborhood of the

"Straits" Mr. Wm. Sullivan, of Mackinac Island, says his former partner Capt. Bennett, brought two pound nets there in 1862, and cleared $15,000 with them the first year. In 1882 with eight nets, they did not catch enough fish to pay expenses, and quit the business. There were a few pound nets in those waters before theirs.

From Detour to Sault Ste. Marie not much fishing is done, and that principally by pound nets. The catch is whitefish, wall-eyed pike, sturgeon and muskallonge, ranking in importance in the order named. Probably greater numbers of the latter fish are caught in the widenings of the Sault Ste. Marie than in any other waters of the great lakes. John Buschow ("Indian John," as he is known to tourists) who is the oldest canoe fisherman now at Sault Ste. Marie, reports that the falling off of the whitefish catch at the rapids has been very marked in the past few years. As an instance, he says that on the 12th of April, 1878, with canoe and dip net he caught 1,800 whitefish; on the 13th over 1,300, the 14th about 1,000 and, for six weeks following an average of 250 fish per day. They averaged four pounds each. This year, during May and the first half of June his catch averaged 200 pounds per day—and averaged about 3 lbs. per fish. Eight Indian canoes fished at the "rapids" this year.

Whitefish Point and Grand Marais are the only important fishing points on Lake Superior which have not been heretofore mentioned. The twine principally in use is in the form of pound nets. The coast between these two places is of so bold a character as to afford no harbors, and as there are no railroad connections, the opportunities of getting fish to market, even if nets could be maintained in the water, are very poor.

The east shore of Lake Michigan, from Michigan City as far north as Cat Head Point, presents in general similar characteristics. The whitefish catch has shown a steady and rapid decline for the past four years, and I think the assertion a safe one that the falling off during those years has been 25 per cent. each year from the preceding one. The fisherman attribute this decline to three causes: 1st. The destruction of small whitefish by the use of small-mesh pound nets. 2d. The fouling of the water with mill refuse and fish offal. 3d. The catching of spawning fish as they are traveling to or on the spawning beds. While each of these causes has its adherents, the vast majority of the fishermen declare the first to be the principal evil. Laflin & Co., of Chicago, who have been large buyers of Michigan fish for a number of years, say: "The fish are literally caught out in Lake Michigan, and where there ought to be a large source of food supply to a rapidly filling country, it is being foolishly wasted by a few men to make a living for the time being, who do not intend to stay in the business permanently."

The catch in these waters for pound nets since the whitefish yield began to show such a marked decline has been sturgeon, whitefish, herring and "black-fins," in the order named, the former representing almost 50 per cent. of the catch. For gill nets the catch is trout, "black-fins," "long-jaws" and whitefish in the order named, probably about 40 per cent. each of the first two varieties. Almost the only good catches of whitefish on this shore of the lake this year were made in Grand Traverse Bay a short time in November.

Of the "black-fins" as a variety almost peculiar to these waters, it is proper to say, that, while they have been caught here for many years, persons

whose opinions would be valuable as to their history and habits have not as yet given them much attention. Consequently but little more is known of them than what has been gathered from the observations of practical fishermen of non-scientific education. From these sources it appears that they inhabit the deeper waters, with the lake trout, and, save now and then a stray one, are not taken in pound nets. Even during their spawning season they do not come into shoal water, as do most other kinds of fish. Another peculiarity of their habits is that they begin to spawn about the same time as do the trout, and continue until long after the whitefish have ceased. It has been no unusual thing to take them in mid-winter in a condition that would indicate the eggs just ready to flow. As a food fish they are inferior in quality, being too soft to handle well fresh, and too oily to salt. A mass of fatty tissue ranges along the dorsal fin. A fisherman of long experience writes me: "I would like to haul on the net that would take the last one out of Lake Michigan." The prices they bring in the market are a little better than herring. Of the "long-jaws" still less is known. They are taken in large numbers in the neighborhood of Charlevoix, and fishermen incline to the opinion that they are a hybrid between the whitefish and the herring. They are rarely seen of more than 1½ lbs. weight.

As stated above, the sturgeon catch represents about 50 per cent of the total catch of this shore, and prices are as good as for whitefish. The meat is both smoked and frozen, and at various places the spawn is manufactured into caviar. It was impossible for me to ascertain the number of pounds of this article prepared, owing to the fact that much of it was sold for cash, and no account made of it either by buyer or fisherman. One manufacturer had a record of 14,000 lbs. made by him during the year, and there were others more extensively engaged in the business than was he. As an example of the astonishing yield of eggs per fish, I saw 70 lbs. taken from two fish, and it was not considered anything remarkable either. A comparatively new industry is winter fishing for sturgeon with hooks. These hooks, with snoods about 16 inches in length, are strung on set lines, being placed from six to eight feet apart. The hooks are baited with minnows or larger fish cut in pieces, and are sunk to the bottom. It has these advantages over other forms of winter fishing—the rig costs but little, and it lies at the bottom, where ice and sea has but little effect on it, while the fish do not die and decay if they are left sometime in the water after being caught. No less than 300,000 hooks have been or are been fished this season between St. Joseph and Ludington. Sturgeon gill nets, from nine to fifteen inch mesh, are also largely used.

From the mouth of Grand Traverse Bay north through the Straits of Mackinac, thence southwest as far as Thunder Bay, the fishing presents much the same characteristics, trout, whitefish and herring in the order named constituting the catch. In the vicinity of Thunder Bay, however, the trout begin to grow scarcer, and the wall-eyed pike (commonly called pickerel by Michigan fishermen) appear to take their place, while in Thunder Bay probably 50 per cent of this year's catch for pound nets has been pickerel. They have been fished down to a very small size, as have also the whitefish. Around the immediate vicinity of the Straits and as far south as Cheboygan gill nets appear to be most extensively used, but from Cheboygan southward to and including Saginaw Bay, nearly all the fishing is done with pound nets. Trout and whitefish are the kinds caught by the gill twine; probably 60 per cent the former; and pickerel, whitefish and herring by the pound nets. About 50 per cent of this catch is pickerel, while in Saginaw Bay the percentage is even greater. All the pound net twine in use on this last named coast is small—two and two and a half inches—and as a result the pickerel and whitefish are more than half of them No. 2, or less than 1½ lbs. in weight. Not less than 250 of these nets are in use on the shores of Saginaw Bay alone, and unless something is speedily done to change the conditions under which they are at present operated, ere long profitable fishing in these waters will be a thing of the past. It is a crying shame that this body of water, perhaps the finest on the whole line of the lakes as a resort for this most valuable food fish, should be destroyed to satisfy the greed of a few fishermen, who appear to be too short-sighted to realize the fact that they are "killing the goose that lays the golden egg."

From Port Austin to the St. Clair River but little fishing is done, and that principally by gill nets. The general sentiment among the few engaged in the industry within that range of coast is that the fishing has been destroyed by the same methods which are so rapidly depleting the waters of Saginaw Bay and other parts of the lakes. The catch for these gill nets has been very light during 1885, and fully 75 per cent trout.

The Saginaw and Shiawassee Rivers are also literally "fished to death." All kinds of nets are used, but the principal ones are pound and fyke nets, with meshes of two inches. I recently saw in Detroit two barrels of pickerel (wall-eyed pike) which came from these rivers, and the dealer who had them said the apple barrels containing them held about 1,000 fish. They would not average more than four ounces each. Another year in the water and they would have weighed more than 1½ lbs each, and instead of being worth 1½ cents per lb. as they were, would readily have brought four cents per lb. More than one hundred fyke nets and seventy-five pound nets are fishing in Saginaw River between Banks and Saginaw alone—a distance of about 12 miles.

Fishing in the St. Clair River is practically a thing of the past. A few seines are in use there, but the catch is light. The twine used is 2½ inch mesh or smaller and as a result fully ⅓ of the pickerel caught are under 1½ lbs. weight. A few sturgeon are also taken, but the whitefish, of which there used to be large quantities caught have entirely disappeared. The most extensive fisherman on the river, who has fished there for 25 years, reports that his catch decreased 50 per cent. last year and 25 per cent. for the three years preceding. With one 36 fathom seine 15 years ago he used to catch three times as many pounds of fish as he can take now with seven 60 fathom seines. Then he used to catch large numbers of whitefish, but there are none in the river now.

In Lake St. Clair fishing has been carried on since September 20 last, despite the law prohibiting the use of nets in most of the lake, which went into effect on that date. The nets used are pounds, seines and fykes, and are all of small mesh 2½ inch or less. The catch of the pound nets, which are mostly used in the lake south of Milk River, is sturgeon, pickerel, herring and whitefish in the order named, and that of the seines and fyke nets, pickerel, perch and other kinds of rough and soft fish. As in the Saginaw and St. Clair Rivers, many of the pickerel taken are very small.

But very few fishing grounds are operated in the Detroit River, and the great bulk of the catch is herring. A few whitefish have been taken, but the

number is insignificant when compared with the enormous yield of former years. The vast number of pound nets, set in long strings in the head of Lake Erie, makes it only a matter of surprise that any fish are able to get in the river from the lake below. Seines only are used in this river.

From the mouth of Detroit River to the State line, and, in fact, in the entire end of Lake Erie west of Sandusky extensive fishing is done. Pound nets are used almost exclusively, the waters being adapted to their use by reason of being sheltered from heavy seas. No less than 108 of these nets were in use last year between the Ohio line and the mouth of Detroit River, a distance of less than 25 miles. The catch consists of herring, pickerel, whitefish and sturgeon, ranking in importance in the order named. The herring catch of the fall of 1885 has been perhaps heavier than ever before known, both in the head of Lake Erie and Detroit River, while the whitefish catch dwindled down to insignificant proportions. In the spring the sauger catch is quite an important item. These fish are a small variety of pickerel, and are not taken in any large quantities save in Lake Erie and Thunder Bay, Lake Huron.

From the foregoing it will be seen that an attempt has been made to visit the entire lake coast of the State where fishing is carried on, save Isle Royale. While some portions of the territory, perhaps, have not received the careful attention they deserved, the vast extent of coast to be covered within a comparatively short space of time prevented a more detailed canvass. In this connection I may mention that the United States Fish Commission maintained in the field this fall no less than six men for the performance of about the same work which this commission was compelled, on account of its limited funds, to place upon the shoulders of one. The work is important, as tending to demonstrate the extent and value of an industry peculiar to the State, of which few people, save those actually engaged in the business, have any conception.

A gratifying result of my labors, however, has been the largely increased number of reports received this year from fishermen. In 1883 eighty reports were made; in 1884 but fifty reports were received by mail; while this year the number received foots up 427. This large increase would go to indicate that the interest of fishermen in the work of the commission is beginning to awaken, and that their assistance and coöperation may be more universally looked for in the future. Still, quite a number of fishermen have failed to respond to my request to make returns, but of this class I have pretty generally succeeded in securing their names and postoffices, with a statement of the number and kind of nets used. From this knowledge I have been enabled to make a tolerably close computation of what they have done, based on the average catch of other fishermen in the same localities. In making this computation care has been taken to avoid any tendency to exaggeration, and the approximation is probably some less than the actual yield. Most of the failures to make these reports have been with those fishermen situated remote from mail facilities, or those engaged on a small scale of river fishing.

The almost universal testimony of fishermen from all localities is that the catch of 1885 has shown a decided falling off as compared with that of 1884, which was distinguished as perhaps the worst season ever known. Opinions vary somewhat as to the causes of this decline in yield, which has been steadily going on for the past four or five years, but the theories which generally prevail can be comprised in three.

1. DESTRUCTION OF SMALL FISH BY THE USE OF FINE-MESHED TWINE.

Fishermen in all localities agree that this has been a very potent factor in the rapidly decreasing yield of whitefish and pickerel, our two most valuable species. They are equally agreed that some steps should be taken at once to prevent this wanton destruction, which has been going on for years. They know from the testimony of others of their class, and from actual observation, that on the Canadian fishing grounds, where stringent regulations to preserve the infants of these species are enforced, each year witnesses a good average catch, on the increase, if anything, instead of the steady dwindling away of the yield of the "free-for-all" grounds of Michigan. They have reasoned from effects back to causes. Of course the fisherman who has on hand a quantity of this small meshed twine can hardly be expected to yield his assent to a system of regulation which will make his property valueless, although many of them have had the honesty to do so, as I shall show further on, but none of them have been able to invent any practical scheme for saving these little fish from destruction other than by the enlargement of the meshes.

2. FOULING OF THE WATERS WITH SAW-DUST AND FISH OFFAL.

This cause of complaint, unlike the first, is largely local, and is much less a grievance now than in years past. There are some places, nevertheless, where the practice of running sawdust and edgings into the water has become not only an intolerable nuisance from a sanitary point of view, but a great annoyance to navigators of steam craft, and utterly destructive of fishing grounds which were before the natural resort of the whitefish. Particularly is this state of facts true at Baraga and Pequaming, on Keeweenaw Bay; Manistique on the north shore of Lake Mchigan; and Muskegon and other places on the east shore of the same lake. The surface of the water for miles around each of the places named is covered with this stuff, and both vessel-men and fishermen report that the natural formation of the bottom has been completely covered by the rotten sawdust deposited there. This unnecessary destruction of the feeding and spawning grounds of the fish should have been prevented years ago, but even at this late day there is no good reason why early legislative action should not intervene to prevent the few mill men who still persist in this practice from so using the waters of the great lakes and the streams emptying therein as to subvert the rights of every other class.

3. UNFAVORABLE AND VIOLENT WINDS DURING MUCH OF THE YEAR.

At first blush it might appear that the wind and weather would have but little effect on the total catch of a fishing coast so situated as is that of Michigan; that what would be a good condition for one coast would be a bad one for another, and vice versa. Nor do I think this so good a reason to account for the decreased yield as either of the others. There can be but little doubt, however, that the weather during the year 1885 has been more unfavorable than for many years past. The early part of June witnessed fierce storms on Lake Michigan especially, which seemed to drive the whitefish almost entirely from the eastern coast of that lake, to which they did not return, and from about the first of September to the close of navigation, storm followed storm of so violent a character, and in such rapid succession,

as to make the occupation of pound net fishing, except in well sheltered localities, extremely dangerous and unprofitable.

While the total number of pounds of fish reported as the result of last year's catch is considerably in excess of the aggregate of any other year, it must be borne in mind that the number of fishermen making reports is fully five times greater than in any other year, and that the increased number of pounds bears no relative proportion to the increased number of reports. The following table shows the aggregate catch of the only firms (nine in number) submitting reports the three years last past, with the amount of twine in use each year:

Year.	Whitefish.	Trout.	Pound Nets.	Gill Nets, fath.
1883	524,561	400,189	33	48,100
1884	658,845	358,607	46	61,805
1885	407,903	426,064	50	52,005

The following table shows the catch and amount of twine in use of 29 firms which made reports for the years 1883 and 1885:

	Whitefish, lbs.	Trout, lbs.	Herring, lbs.	Gill Nets, fath.	Pound Nets.
1883	2,289,617	904,837	557,530	368,967	204
1885	2,028,630	1,239,403	381,461	316,609	208

These tables show a very marked decrease in the whitefish catch during the year 1885 from that of the years 1883 and 1884; while the amount of twine in use was largely in excess of that used in the former year, and about the same quantity as was in service in 1884. Again, the reports this year from a large majority of those firms and individuals who have been engaged in the business for a term of years, represent a falling off from that of last year. For instance: of 427 fishermen, but 68 report a favorable season, and nine say this year was about the same as last. On the other hand, five say their catch fell off one-third; five report a decrease of one-fourth in catch from that of last year; seventeen a reduction of one-half; while 239 report the season "unfavorable," and thirty-three "very poor." Fifty-two made no report on this inquiry. Of those whose returns indicate a falling off in catch, forty-eight attribute it to the stormy weather, seventeen complain of the fouling of the waters with mill refuse, or fish offal, and sixty-seven think the prime cause for the decreased catch and rapid depletion of our waters is the destruction of small fish by the use of fine-meshed pound nets, and they demand their enlargement. Two hundred and nineteen gave no opinion as to the cause of falling off in catch.

Seventy-seven pound net fishermen report in favor of making the meshes of pound nets three and one-half inches or more in the pot, seven favor three inches as the minimum size, and thirteen (all Saginaw Bay fishermen) recommend a law to punish dealers and fishermen who have small pickerel or whitefish in their possession, but do not favor a law to regulate the size

of meshes. Forty have no suggestions on the subject. Thus it will be seen that a large majority of the pound net fishermen themselves favor a mesh of at least three and one-half inches as the minimum size, notwithstanding the fact that nearly every man of them has and is using smaller twine than that. Gill net fishermen are unanimously of the opinion that pound nets, if their use is tolerated, should be of larger mesh, and many favor their abolishment altogether.

The number and class of fishermen reporting is as follows:

Pound net fishermen	139
Gill net fishermen	198
Gill and pound net fishermen	57
Seine and fyke net fishermen	33
	427

The total number of nets used by these fishermen is as follows:

Pound nets	982
Gill nets, 1,448,852 fathoms	24,270
Seines	57
Fykes	220

The number of boats used by them is as follows:

Tugs	66
Sail boats	318
Pound boats	232
Skiffs	165
Number of men employed	1,704

Reports have not been received of the catch of the following nets which are known to have been in use last year:

Pound nets	127
Gill nets, 140,000 fathoms	2,800
Fyke nets	52
Seines	4

Adding these nets to those from which returns have been received, we have the following as the total amount of twine in use in Michigan waters during the year 1885:

Gill nets	27,070
Pound nets	1,109
Fyke nets	272
Seines	61

A better idea of the dimensions of this twine may be formed by the statement that the total length of the gill nets is 1,588,852 fathoms, 9,533,112 feet, or 1,805½ miles. The length of the pound nets placed in a string would be not less than 1,064,640 feet, 177,440 fathoms, 201 8-11 miles. The total length of the seines is 4,909 fathoms or about 5½ miles. Thus it will be seen that the nets fishing in Michigan waters would, if placed in a continuous string, be long enough to completely reach around our 2,000 miles of lake coast.

An accurate statement of the total amount of money invested in the paraphernalia incident to the fishing business has been rendered impossible from

a variety of causes, chief among which was the suspicion prevalent among fishermen that the information imparted might be used as a basis for the purpose of taxation, or would disclose the nature of their business to perhaps their rivals. This was especially the case with some dealers and larger fishermen. From the partial returns furnished we have been able to glean the following statement, which is here submitted, not as an accurate showing but as calculated to convey a faint idea of the monetary importance of the industry:

Value of nets	$501,142 00
Value of boats	319,746 00
Value of docks and buildings	256,392 00
Value of other apparatus	56,690 00
Total	$1,133,970 00

The above figures do not embrace the value of lands for fishing coast, and few of the returns from which the table is made were complete in all the items mentioned. The item of "docks and buildings" especially is incomplete and falls far below the actual value of that class of improvements.

Returns from 427 fishermen show their total catch to have been as follows during the year 1885:

	Pounds.	Per Pound.	Value.
Whitefish	7,904,459	4½	$359,750 65
Trout	4,531,573	2½	113,289 33
Herring	4,568,135	1½	68,522 02
Pickerel	876,899	3	26,306 97
Sturgeon	617,449	4	24,697 98
Black bass	35,813	5	1,790 65
Other kinds	3,181,435	2½	79,535 87
Totals	21,805,763		$673,893 45

The number of pounds classified as "pickerel" and "sturgeon" is not reliable as going to show the extent of the catch of those species, for the reason that fishermen in making returns in many cases included their catch of those fish under the head of "other kinds," our blanks having no headings for pickerel and sturgeon. There are many points on Lakes Huron and Erie where the pickerel catch has been fully 50 per cent. of the gross number of pounds, and on much of the east shore of Lake Michigan the sturgeon catch has assumed equal or even greater importance.

In addition to the returns made, as stated above, there were 127 pound nets, 140,000 fathoms of gill nets, 4 seines and 52 fyke nets known to have been in service from which no returns have been received. Approximating the catch of this twine upon the basis of what other nets of like kind have caught in the immediate vicinity, we have as a result:

In pounds	1,854,000
To which add amount returned	21,805,763
	23,659,763

In addition to this, one firm of Detroit, whose returns have not been furnished up to this date (March 1), has caught at least 1,000,000 pounds; and ten buying firms return as having purchased from fishermen who have made no returns, and whose catch has not been computed above:

	Pounds.
Whitefish	734,856
Trout	435,959
Herring	279,425
Other kinds	271,872
	1,722,112
To which add catch of firm above mentioned	1,000,000
	2,722,112

Adding this result to the figures heretofore given, we have as a careful estimate of the total catch of Michigan fishermen for the year 1885 the grand total of 26,381,875 pounds, nearly 13,190 tons, which at the average price of 3 cents per pound (about what the fisherman receives) would realize a monetary value of $791,456.25.

Few persons realize what a wonderfully prolific source of food supply we have in the waters of the great lakes—one of the most bounteous storehouses of nature. Not subject to private ownership, requiring no cultivation and little labor for the gathering of its rich harvest, there is nothing strange in the fact that our waters have tempted the cupidity of a class of men to so use them as to almost destroy their resources. Blind to all interests save those of the immediate present, they have so prosecuted the industry as to threaten the complete depletion of the waters. The farmer who would plant his fields year after year with exhaustive crops, without seeking to replace the drainage upon the soil by the use of fertilizers, would soon find his acres barren, unproductive and worthless. His ownership prompts him to the pursuit of a different policy—one which keeps up the fertility and value of the soil. The waters of the lakes, in which the rights of private ownership cannot be acquired, have been used without regard to the wants of the future, or the rights of succeeding generations of men, who should have the right to draw upon them as an important source of food supply. Legislative interference is imperative, to the end that this wonderful natural resource may not be sacrificed to the greedy demands of the present. In the following pages will be found some suggestions of regulations which seem most needful.

In addition to what has already been stated in these pages, the following brief enumeration of the more valuable food fishes is submitted:

The most valuable of the food fishes inhabiting the great lakes is the Whitefish (*Coregonus Clupeiformis*), and it is common to all of them and to some of the inland lakes as well. There are, however, a few varieties of

the whitefishes which seem to be peculiar to certain waters. Among these varieties may be mentioned:

1. The Cisco (*Coregonus Hoyi*—called herring by some fishermen, also "Moon-eye"). It has only been noticed in Lakes Michigan, Erie and Ontario; is the smallest of all the whitefishes, rarely weighing more than half a pound; inhabits deep water, from thirty to seventy fathoms, and appears to be a principal article of food for the lake trout. It has, from its small size and scarcity, little economic value. Nothing distinctly is known of its food or breeding habits.

2. The "Black-fin" (*Coregonus Nigripinnis*) has been found in Lake Michigan, and inhabits the deepest portions of the lake, being taken in from forty to one hundred fathoms. It bears a close resemblance to the lake herring, although it reaches a larger size. While found in considerable quantities along the east shore of the lake, it is especially abundant about the neighborhood of Grand Travers Bay. In another portion of this report will be found some further remarks about this variety.

3. The Lake Herring (*Coregonus Artedi*), sometimes called Cisco and Michigan herring, is one of the most abundant fishes of the great lakes, probably ranking second only to the whitefish in importance. It travels in large schools and is taken in great quantities in shoal water. Its spawning season is during October or November. As a food fish it is greatly inferior to the whitefish.

4. A variety called the "Long Jaw" is met in all the waters of Lakes Huron, Superior, and Michigan, but is not taken in any considerable quantities save on the east shore of the latter lake. Little or nothing is known of its habits, and fishermen look upon it as a hybrid between the whitefish and herring. As a food fish it ranks about like the "Black Fin," and like it, appears to be on the increase.

5. The "Menominee Whitefish" (*Coregonus quadrilatoralis*) are found in Lake Michigan and the northerly part of Lake Huron, though only taken in considerable quantities in the former lake, principally in the neighborhood of Green Bay. As a food fish it ranks with the herring, but is larger in size, being longer and rounder. Nothing is known of its habits.

Probably the best history of the Lake Trout (*Namaycush*) yet contributed to fish literature is that of Mr. J. W. Milner, who, notwithstanding the tendency of the species to variation in size, shape, and color, inclines to the belief that they all belong to the same family, and that the structural character of these varieties would not admit their distinct classification. It is one of the most numerous species, is caught mostly in gill nets, and spawns in October and the early part of November. A great number of names have been given by fishermen to what appeared to be distinct varieties of this fish, and "Black Trout," "Gray Trout," "Reef Trout," "Deep Water Trout," "Shoal Water Trout," "Pot Bellies," and "Racers," could be learned of in various localities. Fishermen could easily distinguish each particular variety, but so far as I have been able to learn, no ichthyologist has yet made any classification of them, nor learned what, if any, peculiarities belong to each. One variety, however, has more distinguishing traits, viz., the Siskowet. This fish is peculiar to the waters of Lake Superior, it is smaller in head, body, and fins, than the other varieties, the flesh is a much lighter salmon color, and is very fat, so much so as to impair its value as a fresh fish, and to make it the choicest fish of the lakes for the purpose of salting. It inhabits only the

deepest water, and is taken entirely with gill nets in from 60 to 100 fathoms. When at Marquette, in September, I learned that good catches of these fish had been made during the entire summer from that place. It has been asserted that they spawn during the entire year, but I am inclined to think the statement is only a fisherman's legend. They evidently do spawn a little earlier than the other lake trout.

Of the Pike Perches (*Stizostedium*) but two varieties are common to our waters, the Wall-eyed Pike (*S. Vitreum*) and Sauger (*S. Canadense*). The Wall-eyed Pike is found in all the Great Lakes, but is most plentiful in Saginaw Bay, Thunder Bay, the head of Lake Erie, and Green Bay. It is a hard, firm fish, of good flavor, and perhaps will stand shipment long distances better than any other of our fresh fish. It was very plentiful a few years ago in St. Clair Lake and River, but is becoming scarce there now. The testimony of fishermen is that in size it is being rapidly fished down by the use of fine meshed pound nets. It should, naturally, equal the whitefish in size.

The Sauger is said to be common to the entire lake region, but I could learn of only two points where it had been taken in any considerable quantities—the head of Lake Erie and Thunder Bay. It is much smaller than the Wall-eyed Pike in size, and seldom reaches more than 1½ pounds. Its commercial importance is insignificant.

Of the Pike family, the Muskellonge (*Esox nobilior*) is known to the fishermen of the entire lake coast. It is frequently taken in pound nets, and with hook and line, but I have been unable to learn that a single specimen has ever been taken in gilling twine. It is very large (second only to the Sturgeon) and not plentiful in any locality. It is most abundant, perhaps, in the widenings of the Ste. Marie River, where it is caught in pound nets. One firm fishing there reports a catch of 8,600 pounds in 1885. It commands the highest price of any of the lake fishes. The other variety of the Pike family (*Esox lucius*), though known to our fishermen, is nowhere in the great lakes taken in such numbers as to give it any commercial significance.

In the immediate vicinity of large towns around the entire lake coast the common yellow perch (*Perca Americana*) is caught in large quantities. This is especially true of Lake St. Clair and the southerly end of Lake Michigan, where the close proximity to the Detroit and Chicago markets enables the fishermen to dispose of them for immediate local consumption at some seasons of the year. It is common to the shallow waters of the great lakes, but its unstable value makes it of little commercial importance. It is caught in all kinds of nets.

The regulation of the size of meshes of all kinds of nets is a matter of the greatest importance, if we would preserve our fisheries. At the same time, the subject is, perhaps, attended with greater difficulties than any other connected with fishery legislation, owing to the different conditions which prevail in the various localities. My own observations, fortified by the opinions of the fishermen themselves, leads me to the belief that the establishment of a uniform size of mesh for use on the entire fishing coast can but have a very damaging effect on the industry in some localities. What would be a suitable size for one place would be totally unsuited for another, where a different species of fish formed the catch. To illustrate, if the mesh be established at a small size, say 2½ inch for pound and 3½ for

gilling twine, in most of the waters of Lake Superior, the north and west shores of Lake Michigan and many parts of Lake Huron, where whitefish, trout and pickerel constitute the principal portion of the catch, the same destruction and waste of small and unmarketable fish of those species which has been going on for years, and which all fishermen concede has been a most prominent factor in the depletion of our fishing grounds, would continue. On the other hand, in waters where the herring, "long jaw" and "black fin" are a heavy percentage of the catch (notably the case on the eastern shore of Lake Michigan south of Big Traverse Bay), nothing but small twine would be serviceable. It may with truth be said that these species are of an inferior quality, and bear no relative commercial value to the whitefish, trout, pickerel and sturgeon. I am prepared to go further and declare as my opinion that, if there can be no means devised for the taking of those inferior kinds of fish without entailing as a consequence the destruction of the small fish of the more valuable species, then the taking of these less valuable kinds should be prohibited altogether. But I am inclined to think that a plan can be devised, with the intelligent assistance of the State Legislature, whereby the herring and "black fin" fisheries can be operated and at the same time the destruction of but few of the small fish of other species involved. This can be done, in my judgment, by the establishment of the legal sized mesh at say 3½ inches for pound nets and 4½ for gilling twine. This twine should be used in all waters where the whitefish, pickerel and trout are taken, but, in addition, discretionary power should be vested in the fishery officers, with the concurrence of the commission, to permit the use of smaller twine for the taking of "soft fish" such as herring, black fins, perch, suckers, bullheads, etc., but such discretionary power not to authorize the use of small twine for the taking of "hard fish." Permits to use small twine should be subject to immediate revocation whenever its use involves the waste of small fish of the valuable kinds. Something of this nature, followed by a law creating a sufficient number of inspectors or wardens to efficiently inspect the fishing coast and the results of the catch, and another law to punish dealers and fishermen for having in their possession fish of certain species which are under a given weight, would probably go as far towards stopping the destruction of the fishing grounds of the State as any plan which can be devised. Without the appointment of inspection officers, with ample powers, however, all attempts of regulation of fishing will prove flat failures, and the fishery laws will be ignored in the future as they have been in the past, or at best only observed so far as suited the convenience or interest of individuals here and there.

While gilling twine has been in use in all the lakes for more than half a century, the introduction of the pound net is of a much more recent date, and as a wasteful device for the taking of fish (as at present used), is much more effective than any other appliance yet invented. The introduction of these nets into the upper lakes was made a point of inquiry, as possibly having a bearing on the question of the future stability of our fishing resources. From an apparently authentic source I obtained the statement that the first pound net brought into the upper lakes came from Sandusky, Ohio, in 1859, and was fished that year in Naubinway Bay. For a number of years subsequent to that date their introduction was very slow, owing probably to their much greater cost than gilling twine, and the abundance of fish, which yielded a profitable harvest to the more primitive appliances of the gill net

fishermen. Shortly after the close of the rebellion, however, they be rapidly to come into general use, and their introduction has continued u they now occupy every available space on Lakes Michigan, Huron and E and are rapidly assuming a like prominence in the fishing operations of L Superior. As they are more subject to damage by the action of the eleme than other kinds of twine, many places on the latter lake are unsuited their use—a fact for which the fishermen of the future will probably h cause to be thankful. This class of nets, as generally used, is terribly structive of the fishing industry, and I have no hesitation in declaring t their long continued use, under the same conditions which now prev means nothing less than the utter extinction of the two most valuable of food fishes—the whitefish and pickerel. With meshes of 2½ inches (usual size) in the pot, they hold a fish of less than one-half pound weig Either the mesh should be enlarged to a size which will permit these sm fish to escape, or their use prohibited altogether. The destruction mai takes place in the spring and summer months, when the young fish come shore to feed and get away from the large fish. These nets, set in compa tively shoal water, destroy millions of fish so small as to be totally unfit the market. In the fall they are set on the spawning ground, or approaches to them, and the adult fish is caught just as it is about to depo its spawn. Under these conditions, artificial propagation is prevented fr developing its full results, by the destruction of the young fish at some s sons of the year; while at others, natural increase is interfered with by t capture of the breeding fish. Nothing can logically follow from this state facts but total extermination of the species. Nor am I alone in the opini above expressed; for the immense depletion of the waters from this i proper use of the pound net has long been known and commented upon practical fishermen and fish-culturists. As long ago as 1880 no less authority than Mr. Seth Green spoke of their use in these words: "T pound net is one of the great inventions for taking fish, *and they will depl any waters where they are used unless the meshes are made large enough that they will let the young fish through.*" The truth of this statement c be attested by fishermen in every portion of the State, whose personal e periences have forced them to realize its correctness.

One striking peculiarity which I observed in the statements of many the pound net fishermen interviewed (most of whom were using two and t and one-half inch twine) was, that while *they* did not catch any small a unmarketable fish themselves, their neighbors fishing the same sized twi in the immediate vicinity did destroy them in large numbers. Visiting t neighbors alluded to, I would be favored with a similar story, with its appl cation, however, reversed. From what I was able to observe for mysel aided by the statements of the honest fishermen, I am forced to the concl sion that in nearly every locality where small meshed twine is set in water a depth of, say fifty feet or less, the reckless destruction of small whitefi and pickerel is going on and will continue until the meshes are enlarged the waters are exhausted.

From many localities comes testimony from intelligent fishermen of lon experience to demonstrate the success of the work of the State in artifici propagation. Particularly have these results been noted on the east shore Lake Michigan and in Green Bay, both of which localities have becom notorious among fishermen for the numbers of small fish which have bee

destroyed there. The general opinion expressed was that they have been "Lake Erie" fish. When it is understood that the Lake Erie whitefish has marks which enable a practical fisherman to distinguish it from others of the same species, and that all the fish hatched by the State have been from the ova of Lake Erie or Detroit River fish, the relevancy of this evidence becomes apparent. It is also conceded, and must be self-evident to any one at all acquainted with the methods pursued and the results of our fisheries, that a realization of the full and legitimate results of artificial propogation has been prevented by the destruction of these small fish, which have yielded little or nothing to the fishermen at the time they were taken, and of course have decreased the catch of marketable fish the next or succeeding years to just that extent. Numerous instances have been adduced where the young fish so taken have been put upon the ground for fertilizing purposes.

From the foregoing remarks on the pound nets and the evils resulting from their improper use, it may be inferred that they are the only kind of nets whose use is followed with bad results. And so far as the destruction of small whitefish is concerned, this is true to a great degree. But the fyke nets and seines destroy large quantities of small pickerel, and the gill nets make their heaviest catches of adult fish during the spawning season and on the spawning beds. And this brings me to the subject of a "close season." The Canadian law provides a close season during the entire month of November—the spawning time of the trout and whitefish—and so far as I have consulted with fishermen who have felt its effects, they have not complained of it. In fact, the universal opinion has been that in the long run such a regulation must be to the interest of the fishermen; and that the steady yield of the fisheries on that side of the lakes is due in no small degree to this regulation, which allows the natural increase to go on without interruption. Time was, before our own waters became so depleted, that good catches could be made during the entire summer, and the opinion has been quite generally expressed that a few years of "close season" during spawning time would again restock the waters so as to make summer fishing profitable. If the fish could be not captured at that season it would be enabled to escape the bad weather of the later fall months and the consequent loss of twine and boats, and not unusually of human life. Whether or not a close season would restore summer fishing, that it would improve spring and early fall fishing would seem to be a logical inference. A number of intelligent fishermen favor trying the experiment of a close season, but probably a large majority of them would be opposed to it, more especially the heavy gill net men, the greater part of their catch being at that period.

From the foregoing facts and observations, fortified by the opinions of fishermen, I am induced to submit, in conclusion, the following summary of recommendations:—

That the commission should direct its efforts, so far as the lake fisheries are concerned, toward securing the enactment of laws:

First. Providing for the appointment of a system of fishery inspection officers adequate to the wants of the vast extent of lake coast, with sufficient powers vested in them to enable them to bring violators of such regulations as may now or hereafter be imposed to certain and speedy account therefor.

Second. That dealers and fishermen having in their possession whitefish, wall-eyed pike, or lake trout under the weight of one and one-half pounds should be guilty of a misdemeanor, and subject to a suitable penalty therefor.

Third. That the meshes of the pots of pounds nets for the taking of all other kinds of fish than herring should be at least 3¼ inches. That pound net pots of three inch bottom and 2½ inch back for the taking of herring may be authorized by the fishery officers between September 1 and the close of each year.

Fourth. That discretionary powers should be vested in the fishery officers to authorize or forbid the use of twine which may seem to them unsuited to the locality where contemplated to be used.

Fifth. That rigid fines should be imposed on persons fouling the waters of the great lakes and rivers tributary thereto with mill refuse or fish offal.

Sixth. That a law should also be enacted to authorize the fishery officers to prohibit the use of all kinds of nets on the spawning grounds of the whitefish from the 1st to the 30th days of November inclusive.

Seventh. That the meshes of gill nets should be fixed at 4½ inches, with power vested in the fishery officers to authorize the use of smaller meshes for the taking of "black fins" and other kinds, provided such authorization does not involve the taking of whitefish and lake trout.

Respectfully submitted,

LYMAN A. BRANT,
Statistical Agent.

DETROIT, March 1, 1886.

II. REGULATION AND INSPECTION OF THE FISHERIES.

A. INDUSTRIAL FISHERIES.

The general condition of the fishery laws ought to receive attention at the hands of the Legislature. There are many statutes in force referring to different branches of the subject that would be far more simple and serviceable for those having occasion to consult them, if they were embodied in a single statute. Act No. 350, Laws of 1865, entitled "An act to protect fish and preserve the fisheries of this State," is the principal statute, and all the others might be incorporated in it. There are twenty-four separate acts, besides the one referred to, now in force, some of them applicable to certain counties, some to certain lakes or rivers, and some against the use of particular methods of fishing. All are the product of good intentions and are in the right direction, but all would be improved by codification and amendment in accordance with the recommendations of this Board.

The particulars in which the Commissioners think changes should be made are indicated elsewhere in this Report, and will be pointed out in the recommendations submitted by them to the Fishery Committees of the Legislature, when that body is in session.

Any one who has read the report thus far, and particularly Mr. Brant's report to the Commissioners, must be satisfied that the preservation of our fisheries imperatively demands the enactment of a law authorizing the employment of an inspector and wardens of the fisheries, or some duly authorized State officers (no matter by what designation they are known), as recommended in our report of 1884, to enforce the fishery laws. The measure we recommend was passed by the House of Representatives in 1885, but failed in the Senate, which must have resulted from a misapprehension of

the true condition of the fisheries and the necessity of the proposed measure, or something equivalent to it.

That the recommendations of this Commission were in the main right and based upon an intelligent view of the needs of the case, we think is abundantly proved by the position taken by the leading fishermen of the State during the season of 1885 in approving the same measures, then recommended to the Legislature, and urging their adoption; and also by the unanimous approval of similar measures by the Michigan Fishermen's Association in 1886.

The meeting of the representative fishermen of the State, and their organization as an association for the purpose of securing proper legislation to protect the fisheries, we deem a most hopeful sign. They are at last aroused to an appreciation of the facts urged so strenuously in our last report, the alarming decrease in the quantities of marketable fish, the urgent necessity of good laws properly enforced to preserve what there is left, and of increased artificial propagation to restore the stock on the partially or wholly exhausted fishing grounds.

We again urge upon the Legislature the necessity of amendments to existing laws, regulating the size of meshes in gill nets and pound nets, so as to prevent the capture and destruction of immature fish, prohibiting the handling and marketing of the same; and also the enactment of a law providing for an inspector and wardens to enforce the laws.

The scheme proposed for the inspection and regulation of the fisheries is briefly this:

The enactment of a law authorizing the appointment by the Commission, with the concurrence of the Governor of the State, of an Inspector of Fisheries, who, with a limited number of wardens as his assistants, under the general direction of the Commissioners, shall be charged with the duty of enforcing the fishery laws. These officers should be clothed by law with authority to arrest offenders, make seizure of unlawful fishing apparatus, and prosecute all infractions of the fishery laws coming to their knowledge, or discovered by them: to inspect fishing apparatus, methods of fishing, fish markets and packing houses. An important service could be rendered by them in gathering a perfect census of fishing statistics. The importance of accurate information upon all topics connected with the fisheries is more keenly appreciated since Mr. Brant's work in that direction for the season of 1885 has thrown so much light upon the condition and needs of the fisheries. It would be of especial value in pointing out the localities that are gradually becoming depleted, and are in need of supplies of young fish to restore them to productiveness. The product of the hatcheries could thus be used to the utmost advantage. The cost of maintaining such a department in the work of this Commission would be very small in comparison with the value of the service rendered to the State.

As careful an estimate as can be made in a line of work where we have almost no experience to guide us, indicates that the sum of seven thousand five hundred dollars for each of the fiscal years ending July 1, 1888, and July 1, 1889, would be sufficient for the purpose. It must be remembered that the payment of traveling expenses would be quite equal to the salaries, for the principal part of the service would be required away from the homes of the officers.

In counting the cost of maintaining this service for the inspection and

regulation of the fisheries, as well as that of extended operations artificial propagation of whitefish, we must not lose sight of the fact th within a very few years the policy adopted by the State, in the direct line which all our recommendations are made, will inevitably lead to the adopti of a system of fishing licenses, which will eventually pay from the license fe collected upon the apparatus used in fishing, and more than likely too fro fees for fishing upon particular grounds, the entire cost of the inspecti service, as well as the entire cost of hatching and planting the young whit fish required to replenish the exhausted or failing fishing grounds. Tl question then is not, shall the State establish this department at an annu cost of seven thousand five hundred dollars a year, even if it is grant that its services are needed and will be worth all they cost; but the re question is this, is it not the part of wise economy to incur the initial expens even if it were double the amount proposed, for the sake of establishing department which promises first to preserve, and then to add indefinitely the product and value of our great fishing industry, and at the same time become self supporting out of the industry thus to be preserved and fostere The establishment of a license system is one of the common incidents of tl exercise of the police power of the State in regulating the subjects of tl exercise of that power. The regulation of the fisheries by State law is a new thing. The laws we have referred to above, some of which have been upo our statute book for thirty years, are for the regulation of the fisheries; on they are inadequate, and have never been even tolerably well enforced. Pu lic opinion upon this subject is so well formed that there will be no gre difficulty in the enforcement of the proper regulations; and if more or be ter defined public opinion is needed, there cannot be found any better wa of acquainting fishermen and fishing communities with the existence of tl laws, the benefits to flow directly to them from observance of the laws, an the policy of the State in its care of the fisheries, than by sending proper instructed State officers among the fishermen for the purposes contemplate by the proposed enactment.

The State by its legislation of the past thirty years stands committed t the regulation of the fisheries, just as by its legislation and appropriations does to artificial propogation of food fishes; why not make both as efficie and profitable as possible by taking this next and most logical step, in pra tical effect asserting that it is right to make laws, and it is right to enfor them, thereby rendering effective all measures taken by the State to resto and preserve the fisheries. Such laws are within the power of the Stat Legislature, and the State alone has jurisdiction to make and enforce then Our own Supreme Court has passed upon the validity of some of the fishin regulations in this regard and in so doing has asserted and defined the powe of the State, and the Supreme Court of the United States has decided tha regulation of the fisheries is within the police power of the State, and n within the jurisdiction of the Congress of the United States.

That the State has the requisite power, is settled beyond question; tha the interests of the State involved in the preservation of the fisheri require the exercise of that power the facts given in the report abundantl prove; the measures best adopted to a prudent and useful exercise of th power to attain worthy and permanent benefits of the fisheries we hav endeavored to show above as the results of our experience and best judg ment.

B. INLAND FISHERIES.—THE STREAMS AND LAKES.

While special attention is directed to the importance of the industrial fisheries by reason of their extent and commercial value, as well as their vast possibilities under proper regulation, as shown elsewhere, the importance of preserving and extending the cultivation of our inland fisheries is also a matter which concerns many citizens, and must not be overlooked. They need similar stringent but just laws conscientiously enforced, not only to preserve them for their value to the people of the interior as a source of food supply, but also as a means of furnishing healthful recreation and sport within the easy reach of all, so much needed by all classes of our generally industrious and hard worked people. The present condition of the great majority of our inland lakes as to supply of wholesome fish, is most deplorable. Let any man who has lived in Michigan fifteen or twenty years compare what he knows as matter of common report and experience about the lakes now, and what he knew of them less than a generation ago. The vast numbers of black and other bass and perch which were so readily obtained to vary the monotony of farm and village living, have shared the fate of the whitefish of the great lakes. Netting, indiscriminate spearing, and the use of poisons and explosives have done their work effectively, and have rendered almost barren these beautiful waters that were once so prolific of wholesome food, and so attractive for healthful recreation and sport. Their principal production now is of the kinds of fish that are neither valuable for the table, nor fit subjects for the purposes of angling. The systematic examination and survey of the inland lakes (more particularly described further on), although but fairly begun, has demonstrated beyond question the ability of the majority of our lakes to produce fish a hundred fold more abundantly than at present.

This assertion is based upon the character of the waters and the abundant supply of food for the nurture and growth of the fish, as disclosed by the survey. It is probable that proper methods of fishing would have diminished the natural supplies of the better class of fish, so that artificial supplies would from time to time be needed to keep up the maximum stock, but it is certain that the present depleted condition of the interior lakes is mainly due to the reckless use of nets and spears, and other destructive methods of fishing now prohibited by law. In addition to the valuable kinds of native fish in the interior lakes, bass, perch and blue gills, the wall-eyed pike can be supplied, by artificial means, and probably the German carp. Eels are already sufficiently introduced for the present.

More space has been devoted in our laws to the protection of fish in the inland lakes than for the protection of the commercial fisheries, but the same lack of enforcing the laws has been manifest, and the omission has worked its natural result. There is the same need for officers duly authorized to enforce the laws on the inland lakes that is so readily found with respect to the industrial fisheries of the great lakes.

III. ARTIFICIAL PROPAGATION AND DISTRIBUTION OF FOOD FISHES.

A. WORK IN FISHES.

1. *Whitefish.*

There is no occasion for discouragement at the results of planting whitefish. In the early years of the Commission, a large number of small plants were made in a great many lakes in the interior of the State, in almost all of which white fish were not known to be indigenous, and in only one or two of which it has ever been found, as the result of intentional or accidental planting. Such plants were made without any inquiry into the facts which constitute the essential conditions of success, as to whether the water was of sufficient depth, and of sufficiently low temperature, or whether it contained any of the food upon which the mature fish would feed, or the peculiar minute forms of life upon which the fry are known to feed and thrive in the waters of the lakes where whitefish are found native. But such experiments were perfectly natural, the amounts expended upon them were very small, and it is possible that such experiments may have been successful in a few instances. If two or three such should be found, it would be worth the cost of the whole. That such instances are found, see below, the subject of examination of waters.

With reference to the planting in the great lakes, the success which has been attained in the planting of our artificially hatched whitefish is no longer questionable. It is a well known and perfectly demonstrated fact. The fish have been seen at different stages of their growth. Yearlings, and two and three years old whitefish have been seen in large quantities and identified along the shores of Berrien and Van Buren counties, and, in fact, wherever fisheries exist upon the east shore of Lake Michigan, notably so at Ludington, the shores above Little Traverse Bay and along the great shoals, extending from the main land out to the Beaver Islands, as well as about the Straits of Mackinac. One fact which ought to satisfy even the most sceptical with reference to this matter, is that nine-tenths of all the practical fishermen upon the coast have become converted to a belief in the practicability of restoring to productiveness all our waters, when operations can be conducted upon a sufficient scale. A large majority of these fishermen a few years ago laughed at the idea of making any impression upon the waters of the great lakes with the deposits of whitefish. Now, however, frequent requests are made by fishermen for more and larger plants of whitefish fry, in the neighborhoods where they are fishing. At the meeting of the American Fisheries Society in Chicago, April, 1886, Mr. Booth, one of the most extensive fishermen on the lakes, argued at length that the principal duty of the State and National fishery authorities was to increase the number of young whitefish hatched artificially, as the great and all sufficient remedy for the decay of the fishing grounds. It was urged that if the State would hatch hundreds of millions where they now hatch tens of millions, there would be no need of the expense of policing the waters, or taking any other measures to keep good the supplies of whitefish for all the demands of the markets. That we do not entirely agree with the argument is apparent from what has been said above in regard to the necessity of measures for better regulation of the fisheries. But there is force in it, and it is a remarkable testimony to

the valuable results certain to come from planting of artificially propagated fish.

There are some of the larger inland lakes, such as Higgins, Pine and Torch Lakes, and others, where whitefish were indigenous, some of these lakes having pretty direct connection with the waters of the great lakes, like Pine and Torch lakes, to which may have been afforded access for the fish from the great lakes; while others, like Higgins lake, in Roscommon county, and Hubbard's lake, in Iosco county, have no such connection as would induce a belief in the migration of the whitefish from the great lakes, and where consequently the presumption would be in favor of there never having been any such migration.

For the past four or five years, with one or two minor exceptions, no whitefish have been planted in any but in the waters of the great lakes, the commissioners having become satisfied that the presumptions were against plants succeeding in the interior lakes, and sufficient having been planted for the experiments, concluded it would be time enough to continue such planting when they had some absolute proof that the whitefish had lived and thrived there. We except from this statement, however, Hubbard, Pine, Torch, Burt and Mullett lakes, where, as we have have said before, whitefish have been known to exist.

In the spring of 1886 quite large quantities of whitefish were planted in these four lakes, with the expectation that the stock in them might be very largely increased. The only question that there can be about Torch lake is as to the number which could be raised there upon the quantity of food which the lake possesses, that being a factor which we have had no means of determining.

In the case of Pine lake with its direct communication with Lake Michigan, if the lake should be over-stocked by the plants which have been made, in all probability the bulk of the fish would retire to Lake Michigan in search of feeding grounds of sufficient extent. In that case all of them that escape the pound and gill nets will, when grown, return to Pine lake for the purpose of spawning.

Our present intention with reference to these lakes is not that they should be stocked for the immediate industrial fisheries, but solely to furnish a safe and reliable place for the procuring of the large quantities of whitefish ova which will be necessary in the extended operations which we anticipate the State will think wise and prudent to engage in, for replenishing the depleted waters of the great lakes.

The necessity of providing such storehouses in advance will be the more readily appreciated when it is known that already the Commission is experiencing considerable difficulty in supplying enough white fish ova to run to their full capacity the hatching stations at Detroit and Petoskey. In 1884 the Detroit house was more than filled from the single fishery of Fort Wayne on the Detroit River, besides about ten millions which were sent to Petoskey to be hatched there. The total gathering of that year was about fifty millions.

In 1885, with the same fishery at Fort Wayne, and another fishery, that belonging to Mrs. George Clark, near the Grassy Island light, Detroit River, we failed to supply the Detroit and Petoskey houses. It will thus be seen that in the future contemplated extended work the procuring of sufficient ova is an essential consideration.

In considering the question whether the total results of planting in great lakes is a reasonable return or not upon the amount of fish used must not lose sight of the fact that it is only four years since any very l number of fish have been planted in a single year, and that from our pre experience we have no right to look for an appreciable result in the prod of the industrial fisheries within the period of four, and probably five, y from the time when the fry were planted. Of the 238,000,000 of white planted in the great lakes from 1875 to 1886, 150,000,000 being the l plants for the years 1883, 1884, 1885 and 1886, over one-half of the t must be excluded from the calculation of appreciable results until the season of 1887 or 1888. The fact is that the results so far have excee what the Commissioners believe to be a reasonable expectation.

It must be remembered that this work is not for a single season, but i be viewed in the light of a wise foresight for the future of the fisheries; however, a future so distant that the present generation has no interest in It is the policy of a great State to attain a lasting benefit in the direction the people, deliberately and wisely undertaken, and it must necessarily worked out in a way that will be of permanent benefit.

While we are dealing with large figures it may be well to explain, in or that persons unfamiliar with the size and habits of young fish may not misled. A person familiar with the vast extent of our lakes might fe some reasonable estimate of the effect to be produced upon such great wat by the deposit of a few millions of fish by visiting one of the State's hat eries, where he might see two or three million of fish living at ease, w plenty of room, in a tank forty-eight feet long, four feet wide and about t and one-half feet deep, or if, with the common dipper, he could pick up a single dip from five to seven hundred fish. The outcome of the wh matter, as we wish to put it as plainly as possible, is that this matter m be judged, not by the misconceptions or false expectations, either of any wise friends or others, but by the anticipations of those who have had const experience and study of the conditions of success. The Commission not claimed that it has yet filled the waters with sufficient quantities, even that it has made good the enormous waste going on year by year in fisheries of the great lakes. It does claim to have made, first, a fair beg ning in staying the waste, and secondly, that it has demonstrated beyo any question that artificial propagation of whitefish, if given anything li a fair chance, by legal regulations of the fisheries, can do all that can reasonably expected of it, and more than has ever been promised by its m enthusiastic friends.

The product of the whitefish hatcheries for 1884–5 was:

Petoskey Station	4,000,0
Detroit Station	36,000,0
Total	40,000,0

The details of the planting will be found in the appendix in table "A None of the fish this year were planted in the interior lakes. Their distr bution to the great lakes was in the following proportion:

Lake Erie, including Detroit River	7,520,0
Lake Huron	11,280,0
Lake Michigan	21,200,0
Total	40,000,0

The product of the whitefish hatcheries for 1885–6 was:

Petoskey Station	22,600,000
Detroit Station	33,890,000
Total	56,490,000

The details of the planting is given in the appendix in table "A." The distribution of this year to the great lakes was, to—

Lake Erie, including Detroit River	3,600,000
Lake St. Clair	3,400,000
Lake Michigan	23,890,000
Lake Huron	12,000,000
Total	42,890,000

And distributed to the interior lakes mentioned above, and for the reasons given there, as follows:

Torch Lake	2,500,000
Burt Lake	2,800,000
Mullett Lake	3,000,000
Pine Lake	5,300,000
Total	13,600,000

The first planting was from the Petoskey Station, made February 22, the last from the same house was made March 31 for the year 1886. In the same season the hatching and planting from Detroit Station was from April 7 to April 28.

The total of whitefish plants reported to and including 1884, as given in former reports and summarized on page 15 of the last report was	141,469,500
Adding the plant of 1885 and 1886	96,490,000
We have as the total to date	237,959,500

2. *Brook Trout.*

The stocking of streams with brook trout, and the re-stocking of streams where this fish was already established when the State undertook the business of fish culture, has given the greatest amount of satisfaction both to the Commissioners and the people of the State.

The fish is so popular, and deservedly so, for his food qualities no less than for his gamy instincts and strength, that even a moderate degree of success in hatching and planting it would have been generally applauded; but the work done by the State with brook trout having proved successful beyond all expectation, it has done more than anything else undertaken by this department, to gain the confidence and good opinion of the people of the State for all branches of the fishery work. The growth of the trout has been on the average more rapid than anything of the kind we have known

of anywhere in this country. This has been due mainly to the abundance of food found in the streams where the fish have been planted, and partly to having a constant infusion of new and young blood in the stock fish kept at the Paris Hatching Station. The number of streams in the State suitable for brook trout has been no less a cause of surprise than the rapid growth made by the fish in many localities. There are hundreds of streams not yet stocked, as available as those already planted. We have reports from Wexford, Newago, Osceola and Lake counties of trout which weighed all the way from two pounds to four pounds which were less than five years old. In Washtenaw county, there was a small spring brook, in which the Trout grew in one year from the planting to be six and seven inches in length.

More care has been exercised during the past two years than formerly, in selecting the streams where the trout were to be placed. It had been the custom to ship the fish to any applicant who asked for them and offered to see them deposited in the water. More care has also been exercised in seeing that the fish were placed at points advantageous for them. The planting for the past two years has been done mainly by our own men, who were more anxious to have the planting properly done than to avoid the necessary labor of doing it properly. It will not answer to deposit all the fish for a stream at a single place low down in the stream; they must be scattered about a few at a time in the upper waters on the shallows that are natural spawning grounds, and in the small spring runs coming into the main body of water. In such places they find natural hiding places and an abundance of the food upon which they are to live; and as they grow larger and better able to take care of themselves they gradually drop down the stream and find new feeding grounds and ranges better adapted to them as adult fish.

In order to secure as exact information as possible regarding the streams or other waters for which trout were asked, a circular of questions was prepared and is now mailed to each applicant, copy of which is given below:

MICHIGAN FISH COMMISSION.
Detroit, ... *188*..

DEAR SIR:—Your favor of the ..... is at hand. Please give me all the information you can in regard to the waters you desire to have planted with fish.

What is the name? .....
What township? .....
How long is it? .....
How deep? .....
How wide? .....
Are these waters public or private? .....
What is the bottom—mud, sand, or gravel? .....
Is the current rapid or otherwise? .....
Is it spring, swamp, or lake water? .....
Has it ever been planted? .....
Where does it empty? .....
Are there any other fish in it—if so, what kinds? .....
What is the average summer temperature? What the highest? .....
Is the stream dammed—if so, how many, and what height? .....
Are there any fish shutes in the dams? .....

N. B.—Please fill out the blanks as completely as possible. If you have not the facts yourself, get them from your neighbors. Remember the object of this inquiry is not to get the answers quickly, but to get accurate answers; and remember that upon such

answers depend permanent results, which will be of advantage to you and your community. In this you have a direct personal interest. Make soundings in a lake yourself. Measure a stream youself. Get a thermometer and try the temperature of the stecam yourself. You can afford to take a little trouble to insure the success of fish planting. If for lack of information a mistake is made, *you* are losing time.

Sign your name and give your P. O.

When this circular is received from the applicant, properly filled up with such answers as he can make from personal knowledge or investigations, the superintendent determines what fish should be supplied, and the application is then entered on the books. If the circular shows the water to be unsuitable for trout, where they have been asked for, the secretary writes the party explaining the change with the reasons for it. These circulars are preserved on file in the office, and constitute a record of value for future reference.

In the last report, December, 1884, we said that we should lay in about 450,000 brook trout eggs. The number of young fish planted in the late winter and early spring of 1885 was estimated at 441,000, including a sufficient quantity to rear in the stock ponds. This number was distributed to various streams and ponds in the Counties of Allegan, Bay, Branch, Barry, Berrien, Clare, Calhoun, Cheboygan, Crawford, Emmet, Gratiot, Ingham, Isabella, Jackson, Kalkaska, Kent, Kalamazoo, Lake, Mecosta, Menominee, Muskegon, Newaygo, Oakland, Osceola, Van Buren and Washtenaw; in all twenty-six counties. The details of this planting are given in table "B," appendix.

In the last report the estimated number of brook trout eggs for the season of 1885-6 was put at about 700,000, the number actually taken was 740,000, from our own fish at Paris, besides which we purchased from Mr. Chas. Holt, of Cascade, Kent County, 122,000.

The hatch of this season was very successful. During the previous season the men doing the work found the hatching troughs very much crowded on account of the large number of salmon trout eggs (about 600,000 having been brought there), and in process of incubation at the same time with the brook trout. That year, 1885, when the salmon trout began to hatch, they could not be accommodated in the troughs, and were taken out of the house and floated in screened boxes in the ponds. After the hatching and planting was over the hatching house was re-arranged, the old shop in the west end removed, the troughs extended throughout the entire length of the building, and they were also arranged in sets of three. This greatly facilitated the handling of the eggs and young fish, and gave more room. A discovery was made when the fish commenced hatching which nearly doubled the capacity of the house, and enabled us to go another season without building a new house. It was, that the young trout after hatching could be carried in double trays, one set over and upon the other. The trays are about two inches deep with wire screen bottoms, having an opening at each end on the lower side which is covered with the same sized wire screen, and when in place the trays are held together by wire clamps and wedges. Before this it had not been thought that the fish could be carried in this way or in any other way than on the gravel lined troughs or in single trays. The total capacity of the hatchery as now arranged is about 1,500,000 brook trout.

The number of brook trout hatched and planted in the winter of 1886 was 719,000.

They were distributed to the following counties:

Allegan, Alpena, Antrim, Berrien, Calhoun, Cheboygan, Genesee, Hillsdale, Ionia, Iosco, Isabella, Kalamazoo, Kalkaska, Kent, Lake, Mason, Mecosta, Montcalm, Muskegon, Newaygo, Oceana, Ogemaw, Osceola, Ottawa, Saginaw, St. Joseph, Van Buren, Washtenaw, Wexford.

The cost of carrying on all the trout hatching operations at Paris station for the year ending 1886, was, for salaries $1,560, and all other current expenses not including permanent improvements $1,329.92, in all $2,889.92. For the current season 1886-7 they will be slightly increased, probably to about $3,000.

3. *Schoodic Salmon.*

As indicated in the last report, we have continued the policy of planting the land-locked salmon mainly in tributaries of Torch Lake. Our supplies of eggs of this very valuable fish come entirely from gifts made by the United States Fish Commission, and are consequently dependent upon many conditions, such as the demands made from many parts of the Union, and the chances of a good take of eggs. In 1885 we received by direction of Prof. Baird, United States Fish Commissioner, 50,000 land-locked salmon eggs. They came as the other consignments we have received from the establishment at Grand Lake Stream, Maine, which is under the admirable superintendence of of Mr. Charles G. Atkins. The eggs were in fine condition, and yielded about 48,000 young fish. These eggs are always sent quite late in the season, the last of February or the early part of March, after they have been run on the trays at the Grand Lake hatchery for the first three or four months of their incubation with very cold water, and the percentage of bad eggs is almost entirely run off. This, together with the skillful manner in which they are always put up, accounts for the very small loss that is incurred after they have reached our hands. Five thousand of the fry were deposited in Round Lake, Kent county, and the remaining 43,000 were planted in the tributaries of the Rapid River, from whence they will find their way to Torch Lake.

In the winter of 1886, owing to a very light take of fish in Grand Lake Stream, the number of eggs Prof. Baird could allot to Michigan was 25,000, a much smaller number than we had expected and hoped to receive. However, as we are entirely dependent on his generosity, and extremely anxious to establish the schoodic salmon in our waters, we were thankful for even 25,000. Our planting of these salmon is for seed. If we can once fairly establish them in a large deep lake, like Torch Lake, we shall have the means at hand for trying the very important experiment of introducing them into the Straits of Mackinaw and Lake Superior. The reason why they were not placed at once in those larger waters is, that in Torch Lake which has every advantage of temperature, food, range and depth, the fish will be sufficiently confined to note their development, and when they have attained spawning age, they can be observed and taken by nets for the purpose of procuring their ova. A few thousand of these fish might exist in Lake Superior or the upper portions of Lake Huron or Lake Michigan for many years without being seen or captured, and they would very likely be so far separated that one or two generations might pass before sufficient quantities could be found together to make their pursuit for egg taking profitable in

the yield of ova. This would necessarily postpone our ulterior, object of stocking the Straits and a part of Lake Superior, indefinitely, so far as regards the benefit of the present generation. Again it seems necessary for their growth and reproduction that they should have a wild and natural range such as they can have in Torch Lake, as we have not been able to rear them with any measure of success in confined ponds, where they are fed in an artificial way, nor to get from them under those conditions any indication of reproduction.

The hatch of 1886 was deposited in the Cedar River, a tributary of Torch Lake; the number deposited was 23,000.

5. *Loch Leven Trout.*

By the kindness of the U. S. Fish Commission a small plant of Loch Leven trout was given us. About 8,000 were deposited on April 11, 1885, in Coldspring Lake near Harrison in Clare county, one of the sources of the Tobacco River. This trout is quite celebrated in Great Britain as one of the very best of the lake trout, being in its habits of feeding and game qualities more like the large brook trout of our rivers than like the salmon trout of our great lakes. The experiment with these fish is tried under favorable conditions in the water selected, and will be watched with interest as affording probably a fine addition to our stock of native fish. We speak with a qualification, for our experience in the introduction of new varieties of fish, which are only known under conditions very different from anything that we can afford them, has not been of a kind to permit us to hope that many such varieties can be permanently established in our waters. In the effort to secure varieties of fish not native to our waters we do not mean to imply any lack of appreciation and respect for our native fish. But until our examination of the interior lakes has progressed further, and some means has been adopted by the State to protect our inland lakes from the depredations of nets, dynamite and indiscriminate spearing, there is very little use in trying to do anything more than we are now doing with salmon trout, pickerel and what we most sincerely desire to do in distributing small mouthed black bass.

The experiments referred to are furthermore conducted without expenses beyond the traveling expenses of our men to make the deposits of the fish, as the eggs of the young fish are given us without cost.

6. *Salmon Trout.*

A supply of salmon trout eggs was obtained among the fishermen at Alpena in the fall of 1884. The loss of young fish was greater than it would have been, but for the over-crowded condition of the Paris Hatching House. The young fish were distributed in eight lakes in Antrim, Cheboygan, Gratiot, Kent, Mason, Mecosta and St. Joseph counties. In October and November, 1885, a little over 600,000 salmon trout eggs were procured from the fisheries about the Beaver Islands. With the additional room in the Paris Hatchery, they were handled much more conveniently than the winter before, and the loss of fry was not nearly so great, owing to their being kept in the house and nursed to their swimming age in the trays and troughs. They were distributed to lakes in Cheboygan, Crawford, Em-

met, Mecosta, St. Joseph and Wexford counties. These plants we sufficiently large to be a fair test of the suitableness of the waters But one of the plants was below 25,000, and many were of twenty-fiv five, sixty, sixty-five, and one of seventy-five thousand young fis examination of inland lakes in 1887 and 1888 ought to demonstrate the salmon trout is adapted to the waters where it was introduced and 1886. The pressing character of other more important work, was not in character experimental, determined the Commission t the hatching of salmon trout in the winter of 1886–7. When these taken in hand again some plants will be made in a few lakes in the so tier of counties, where the examination of 1886 has disclosed water o cient depth, temperature and food favorable to their existence and g

7. *California Trout.*

In the last report, by an oversight, no mention was made of the Cal or Mountain trout, as the *Salmo Iridea* is usually called here. Our of these fish had never been large, and we had no product to use in st until 1884. In July of that year we deposited in good condition 6, these trout in Beaver Creek, Ottawa county. Reports have been sent Superintendent several times that they had been seen in the strean from the reported length of the fish they are supposed to have don The stream will be inspected next summer, that being the third yea the planting.

The hatch in the spring of 1885 was better than in former years, June of that year 25,000 healthy young *Iridea* were released in the waters of the south branch of the Pere Marquette River. We have reason to believe that they will do well in that water, as we know the done for their first year. In August, 1886, Mr. Marks, the superinte visited the river in search of grayling and caught about a dozen Mountain trout, which in thirteen months had grown to seven and inches in length, and were strong, active and well fleshed. The ha 1886 was kept to rear as stock fish in the Paris ponds. The old stock, probably to a lack of pond room and range, have shown symptoms of ness, and quite a number of them have been lost. An examination dead fishes disclosed that they were being preyed upon by a diminutive parasite, which attached itself to the gills of the fish. During June, Jul August they suffered less, but on account of this tendency to disease the over-crowded condition of the ponds, the adult fish, to the num 210, were deposited in the Muskegon River. About 10,000 young fish kept at Paris to be reared as stock fish for the ponds.

THE GRAYLING.

Since the organization of the Commission, the attention of its me has been challenged to the possibility of artificially propagating this b ful and gamy member of the salmon family. Much effort and conside expense have been devoted to the solution of the question—can the gra be artificially propagated, and can it be introduced and made to li waters, the conditions of which are supposed to be favorable to its life growth? Its fine sporting qualities recommend it favorably to the rod fi

and the fact that Michigan waters are its native habitat, has been an added incentive to this Board to use its best endeavours to perpetuate it. While the grayling, like the speckled trout, and generally speaking the bass, does not belong to the class of fish properly known as commercial fish, like the trout and bass, it has challenged the attention of non-resident sportsmen and tourists to the State, as a desirable field for sporting. Beyond question the reputation of the Au Sable, the Manistee, and a few other of our grayling streams have attracted people who spend their money in the pursuit of sport, and thousands of dollars have been brought into the State on this account. But not alone upon this ground does its successful cultivation appeal to the State. It serves the purpose of affording a delightful, exhilarating, and invigorating pastime to our people, and to persons living in the immediate neighborood of the streams in which it abounds, it has been no mean source of supply of wholesome and valuable food. It would be no refutation of this statement to say that the species of fish called the game fish affords no return to the State for the means expended to maintain their existence in our streams. The history of the entire northern portion of the Lower Peninsula of Michigan, and particularly that portion known as the "Grand Traverse Region," most conclusively proves to those having knowledge of its development, that the exhilarating atmosphere, for which it so celebrated as a summer resort, was brought to the attention of the people by whom it is now frequented almost exclusively by sportsmen, who, but a few years since, sought its wildernesses for the gratification they derived from the angle. One of the great railway lines of the State in particular reckons an important source of its revenue to be the transportation of the sportsman and those who follow legitimately in his wake,—the summer idler who delights to spend his vacation in the higher latitudes, where the air refreshes and reinvigorates.

Having thus briefly referred to the pecuniary advantage resulting to the State from this source, let us briefly review the efforts that have been made to successfully propagate the grayling by the Commission.

Experience in fish culture shows that artificial production so far as it relates to the species of fish now most largely produced, viz: the whitefish and trout, has been reduced to two distinct classes of operations.

The whitefish are taken while moving to their spawning places, and are held crated until the proper period arrives when they may be "stripped" and the egg fecundated. On the other hand brook trout cannot be taken in the streams in sufficiently large quantities at the spawning period to afford a reliable source of supply for this purpose, and it becomes necessary in this class of work to carry the stock fish in ponds throughout the year, and when they are ripe they are taken out, handled, and returned to the ponds again. They are thus carried, as it will be seen, through the year in artificial ponds and are fed, attended to and cared for by the persons having them in charge. They stand confinement well and thrive and grow under this treatment as well as in the open streams. As yet there has been little or no difficulty experienced in obtaining the whitefish or trout from which the roe is taken for artificial propagation; but here has been experienced the chief difficulty in all previous experiments with the grayling. They have been taken at different seasons of the year and placed in the State ponds with the trout of the same ages and have received the same care and treatment, but invariably they have gradually died, and we have been forced to the conclusion that they will not under these conditions, if at all, stand domestication. The question then arises, whether under other and more favorable conditions this excellent fish may not be so treated as to conditions of life, that he shall not feel the confinement which seems to make life a burden, or whether after all we must relinquish all efforts to increase his numbers and reluctantly confess that he is beyond the domain now lying within the field of successful artificial propagation. Again, owing to the remoteness of the grayling streams from our present stations, the very early season at which the roe is cast (March) and even earlier, it is practically impossible to take the adult fish upon their natural spawning grounds in such quantities as to insure any degree of success whatever. Repeated attempts of this nature have been made in past years both by the Michigan Commission and others with uniformly the same result—very few or no fish.

Another and very serious difficulty is, that at the season of the year when the spawning period arrives, the force of the commission is busily engaged in planting and caring for the newly hatched whitefish and trout fry, and none of the men can be detailed for this work. In addition to this, the expense necessary to successfully take the spawn at this season is very great, and the difficulties of bad roads renders it a question of serious doubt whether transportation would be at all practicable.

It was determined, something over a year ago, by the present Board, that a systematic and thorough series of experiments must be made, looking to a successful solution of this hitherto unsolvable problem. To that end, and after deliberate and patient thought upon the subject, it was thought best to inaugurate, under the eye of the Superintendent at the Paris station, a series of experiments which should cover a sufficient period of time to allow the benefit of a careful study of the habits of life of this fish, his food, and all other points that might be of benefit.

It was believed that if the irksomeness and ill effects of confinement could be overcome, and yet a check be placed upon the fish so that he might be made subject to control, the greatest difficulty presented might be overcome. This, it seemed, could be best accomplished by devoting as large a portion of a natural stream as could be controlled, to this experiment, leaving its bed and all its surroundings as nearly in a state of nature as possible, with light and shadow, pool and ripple; a barrier to be erected at two places, between which the fish might have free range, yet limiting the territory beyond which they could pass. It was thought with a portion of the stream set apart in this manner for such a purpose, with means provided for diverting the flow of the stream when the fish were to be handled, on showing a disposition to spawn, they could readily be removed and handled; or, if deemed best, they might be permitted to spawn naturally, and the adults be afterwards removed as in carp operations. It may also hereafter be found desirable to place at some convenient point a properly constructed spawning race, upon which the fish may run at the spawning period. It has seemed to the Board that with such a place, some useful experiments might be made which in the end would afford, by experience and careful observation, a way to overcome all difficulties.

Upon the Buck-horn Creek, on the State property at Paris, acquired by the Board since the last session of the Legislature, we have an excellent opportunity to carry out the ideas outlined above. This stream a few years since abounded with grayling, and occasionally a stray grayling is taken there now.

In September of this year, 1886, a portion of this stream was devoted to the purpose above suggested. Two dams or barriers were thrown across the stream and an artificial canal was dug by which the water could be turned from this part of the stream. The space allotted to this wild experimental nursery or pond covers, including the sinuosities of the stream, a distance of 380 feet, which we hope will give sufficient range to overcome the ill effects of confinement and reduce it to the minimum. The stream at this point runs through the forest, and the bed remains as it was found in a state of nature, with admirable protection with the shelter afforded by fallen trees and brush.

After the barriers had been completed the water was turned from the bed of the stream and all living things that would prey upon the fish or their ova removed from the pools of water which remained, something like 400 trout being taken therefrom, which were placed in the stock trout ponds, making a valuable addition to our stock of trout.

Soon after, two expeditions were organized to go to the Pere Marquette River and if possible secure a stock of grayling for the new pond. Both of these expeditions failed of their object; in one instance a small number of fish were successfully transported over a very rough and difficult wagon road, and in the other nearly the whole number were lost before reaching the station. The few that were saved were put in the pond together with those that had been confined with the trout at the hatchery, and, in the language of the Superintendent, the grayling which had been confined with the trout seemed to feel the lack of restraint and to be gratified at the change. Owing to the lateness of the season when this experimental pond was completed and the urgent necessity of putting the force at other improvements that demanded immediate attention, no more expeditions were undertaken this fall to secure stock fish. Following close upon the completion of this work came the deluging storm, referred to elsewhere in this report, which took out one of the dams that had been put in to accomplish this work, and allowed the escape of the fish then confined there, so that the small start that we had made towards stocking the ponds was swept away. A small outlay of money will, however, replace the loss, and with the coming of another season we shall enter upon this work with a firm determination to succeed if it can be done.

These experiments can be conducted with economy, as no extra force will be required for the present at least, the whole plant being on the State property at Paris and under the immediate supervision of the superintendent.

9. *Eels.*

There can be no doubt of the success of planting eels in a large number of interior lakes and rivers in the southern part of the State. They have been caught with hook and line, speared and netted in many places, and of sizes that assure them a rapid growth. As yet we have no sufficiently authenticated account of their having bred in the waters they were placed in, although many verbal reports have been received that young eels were found in abundance in some of those places. The eel is hardy, and is excellent food, so that if he shall become habituated in our warmer lakes his addition to the list of native fishes will be one of value. In June, 1885, we distributed 319,000 silver eels to lakes and streams in the following counties: Allegan, Branch, Barry, Berrien, Cass, Calhoun, Eaton, Emmet, Genesee, Hillsdale, Ionia, Jackson, Kent, Lenawee, Lapeer, Livingston, Montcalm, Mecosta, Oakland, St. Joseph, Shiawassee, and Van Buren. The usual number planted at one time was 6,000, in some cases as many as 12,000, and in a few 3,000.

The getting and planting of eels was omitted in season of 1886. Further attention to them will be postponed until more is learned about their growth and habits in our waters from the continued examination of inland lakes. Like all other departments of our work experience has been a teacher of economy, as is well shown by the expense of the work for this season in gathering and distributing eels, being not much over one-third of the expense for each of the four or five years before.

10. *Carp.*

Since the beginning of fish culture, as a practical and an economic art in the United States, no one event has been so prominent as the introduction of carp, and the proper methods for the propagation and growth of no other fish has been so generally misunderstood. This, no doubt, arises from the fact of its being a domesticated fish, and all experiments hitherto have been with wild varieties. From the fact that carp could be successfully grown in warm and muddy waters, it was inferred that they would be just the fish to plant in our comparatively shallow lakes throughout the State, and from the published accounts of their amazing fertility, and rapid growth, it was confidently expected that in a very short time a large food supply would be furnished. To disabuse the public mind in regard to this fallacy, and to give the best information the Commission have in regard to the best methods for their propagation and growth, is the object of the following pages. The province of the Commission being to produce and distribute the young fish, but little practical knowledge, aside from that pertaining to this special department, has been arrived at through our direct observation. But so much has been done, in this and other countries, for so long a time, that to copy the experiences of others, in regard to the best means to insure success, seems thoroughly correct.

We have therefore given, in as concise a manner as possible, directions in regard to the making and management of ponds, and the care of the young and growing carp. In doing this we have copied from all available sources, but have been materially aided by the publications of the Missouri, and United States Fish Commissions.

While we believe that the carp will eventually prove a valuable addition to our food fishes, and especially fill a want amongst the rural population, still we would caution those desiring to engage in this industry to go slow, to test its value for food in comparison with our native varieties; to see whether they like carp to eat, before they spend any considerable sums of money in the construction of ponds, etc.

Nothing so much injures any enterprise as overestimating its importance. Estimates are still wanting as to the cost per pound for raising carp, and the fact that they can be so readily produced must in a short time make them so plentiful in the markets as to bring the price below the cost of production, if one-half of those designing to engage in their culture should realize their expectations.

There can be no doubt that the carp is a nutritious and healthy food fish,

but there is a doubt whether they will please the taste of the general public who have been accustomed to the taste of our native fish. In the trial made by the Commission and their friends, when direct comparison has been made with our native fish by cooking them in the same manner and at the same time, the decision was that they seemed inferior to the fish with which they were compared, namely, the black bass and the wall-eyed pike. But in the regions where fish, even poor ones, are a luxury they will prove a great boon. In a State so exceptionally well supplied, however, with the finest fresh-water fish in the world, as our State is, it is doubtful if the carp will become either a favorite food or a source of profit for many years to come.

The summer of 1885 was the first time our stock of carp had spawned under conditions favorable to securing the young for distribution. An account is given in the last report of how our stock of carp, got from the U. S. Fish Commission in 1880, had grown and multiplied. The Commission has a sufficient stock of carp to supply all applicants, and besides to make plants in suitable public waters to ascertain if that kind of distribution is profitable. In October and November, 1885, 1,070 carp were supplied to twenty-five private parties. In three instances the fish were used in public waters. In April and May, 1886, the overseer found so many young carp of the last summer's hatch still in the ponds that a distribution was again made to sixty-eight persons of 1,533 fish ten and eleven months old. In the cases in which we have heard of the fish from these plants they have all made a good growth, in some instances equal to that attained in localities further south. We are informed that some of the fish placed in a private pond in Cass county, near our station at Glenwood, which were hatched in the latter part of June and distributed in October, spawned in July of 1886.

For 1886 the distribution was made during the months of April and May of last year's hatch, and during July, August, September and October of the fish hatched in July of that year. The number of applicants supplied was 145, the number of fish 3,485. The names and addresses of the parties will be found in the tables in the appendix.

The spawning season of 1886 was later than usual. No spawn was cast before July. The spawning at the U. S. commission ponds, in Washington, this year was in May. Besides the young fish distributed there are quite a large number available for planting in public waters next spring, as was done in the spring of 1886.

B. NATIVE FISH THAT SHOULD BE PROVIDED FOR DISTRIBUTION.

1. *Black Bass.*

The time has come when this most excellent fish will be in great demand, as the species is growing scarcer every year. It is found native along the coasts of the great lakes and bordering straits, and in nearly all the inland lakes and many interior rivers. No native fish has a more extended range, and it holds a place in the estimation of all people, both for game qualities and as food, that entitles it to attention. The greatest success in the distribution of black bass, for stocking waters where the fish did not exist, and re-stocking waters where the supply had been exhausted, has been attained in New York, and some of the States bordering the Mississippi River, by a method at once economical and effective. It is by transporting

young fish, one or two years old (sometimes adults), which had been naturally spawned and grown. The bass are captured at some point where the fish had congregated and been left in confined places by the receding of high water on the rivers, or the drawing down of reservoirs for canal supply. The young fish so taken are strong and hardy, used to taking care of themselves, and within one or two years of the spawning age. In Minnesota, young bass, taken in the Mississippi, are carried to the State hatching station and kept in a large pond till they are distributed to the lakes for which they are intended. In Illinois, and we believe Missouri, they are at once transported to their future homes. The latter course is most economical, as the cost of the apparatus for such transportation is the same in either case, and it avoids the outlay for suitable pond room, and saves twice handling the fish. The examination of waters (described further on) furnishes us the opportunity to get such supplies of young bass, where they are yet plentiful, and also to transport them to points where they are needed in connection with the operations of the examining crews.

Other fish, such as perch and catfish, can be distributed where they are desired and needed in the same way.

When the regulations of net fishing are better enforced, so that the stock of bass at places like the St. Clair flats is not interfered with, measures can be taken to assist the natural re-stocking of such localities. The improvement of the Island Park at Detroit has not yet reached the point where anything can be done in this direction by the Commission, as suggested in our last report. But those improvements will be made very soon, with the means now being provided, and we are still of the opinion that coöperation between the two Boards might be established with great advantage to both.

2. *Muskallonge.*

There are still a few places where muskallonge can be got in sufficient quantities for artificial reproduction, or for transporting in the manner indicated above for bass. This has not been done before, because our funds have not been large enough to employ a special force for this purpose. It is quite likely that the further operations in examination of the interior lakes, will disclose some waters where the muskallonge yet remains under conditions favorable to securing them for transportation, as suggested, with reference to black bass. But at present the Board does not possess information enough on this subject to warrant asking an appropriation for this branch of work. If the general appropriation enables the Board to continue the examination of lakes, they will be in a position to experiment with the muskallonge, if a favorable opportunity is presented in the course of that work.

C. PRESENT EQUIPMENTS—THE STATIONS.

1. *Detroit.*

At the close of the last report, December 1, 1884, the Detroit Whitefish Hatchery was fairly started in its second season's work. It is one of the most complete and substantial houses of its kind in the country. That it is an eminently respectable-looking building is apparent from the fact that

it is frequently mistaken by strangers for a mission church or Sunday-school. We are sorry that we cannot afford to print with this report illustrations of the Detroit and other stations, with interior views exhibiting the general appearance of the hatcheries when in use. They are generally regarded as creditable of their kind and of a character befitting the workshops of a great State.

All the State hatcheries attract attention from the people and are constantly being visited by great numbers of citizens who manifest a lively interest in the State's operations in fish culture.

With a part of the appropriation for "special purposes"—which is for permanent improvement—the following changes were made in the Detroit hatchery: Additional tank room for storing young whitefish was the most urgent requirement. This was accomplished by detaching the long tank, which is 48 feet in length by 4 feet in width, and moving it a few feet laterally towards the southern tier of jar frames. Another long tank was constructed precisely like the one moved, which was placed parallel to the old one, and then both were attached to the large floor cross-tank, so that water could flow from it to them. The old tank had but a single overflow placed at the west end. The water was all received at one end, and flowed through the whole length of the tank, to be discharged at the further end, its only source of water supply being from the main cross-tank. At times, when the eggs are hatching rapidly, the water which flows mainly through the different tiers of jars, and then down into the lower tanks, where all the escaping shells and bad eggs gathered, become fouled and was thought by the Superintendent and Overseer to be detrimental to the fry in the storage tank. To remedy this, and also to modify the current flowing through the tank, an independent supply was introduced into the two large tanks by means of a pipe which tapped the general water supply before it entered the circulation in feed-troughs and jars. The same system had been introduced into the Petoskey house, and has produced perceptible and satisfactory results. A dead fish is now a rare thing, even when the tanks contain several millions of fry in a critical stage of their development. No other changes were made in the apparatus of this house. Some needed repairs were made to the concrete floor which had been injured by freezing.

The space over the office and lower bed-room was converted into a bed-room, connected to the office by a stairway carried up in what was before the office closet. This additional bed-room was much needed at times when more than the regular employés were quartered at Detroit. This occurs when whitefish eggs are being taken and brought to the house, and again when the planting of the young fish is going on. At the latter time two and sometimes three extra men are required at the station for from four to six weeks, and it has been found very convenient to have them quartered in the house, as their work must be done very often at night. A fire place has been built in the office which in spring and autumn furnishes all the heat required in the office, without affecting the temperature of the main house as the large coal stove would.

The Detroit house has now passed through three seasons, those of 1883–84, 1884–85, 1885–86, a sufficient trial to enable us to speak with confidence of its performance. It has proved eminently successful. Tests have been made each year to determine the ratio of eggs lost during the process of incubation, the results of which prove conclusively that the percentage of

loss from the time the eggs are set down in the house, coming directly from the fishery down the river, until the hatch is completed is between ten and twelve per cent. The season of 1885–86 it was nearer ten per cent. The tests of measurements are made by measuring in a standard graduated glass the eggs which are placed in seven or eight jars, the jars being marked, and the number of eggs, with the dates of putting up, being recorded. After the bad eggs are all run off, and just before the hatching begins, these marked jars are again emptied and their contents of good eggs measured and counted in the same way.

The overseer of this house last season tried substituting a metal tube for the glass tubes used for introducing the water into the glass hatching-jars, which worked well. It was tried in about one hundred jars. The metal tube is less than half the size of the glass tube, and consequently increases the capacity of the jar, besides contracting the stream of water and giving a more even circulation in the jars. The first experiment with metal tubes was tried the year before at Petoskey by the overseer of that house.

2. *Petoskey Station.*

By the biennial report of 1885 it will be seen that the supply of water to this house was wholly inadequate, and it therefore became necessary to devise some means by which the desired amount of water could be secured.

As early as June, 1884, negotiations were opened with the village authorities in order to ascertain what share of the expense the village would bear in laying a main down Division street, from Lake street to Rose, as the inhabitants along the line of that street, upon which the main would be laid, would secure by the laying of such pipe fire protection. It was also contemplated that connections might be made for private purposes. These negotiations were pending for some time, but no definite conclusion was reached until the month of August. About the first of that month Mr. Whitaker visited Petoskey and negotiations were again renewed which finally culminated in a contract whereby it was agreed that the village should dig the necessary trench for the laying of a four inch wooden pipe; that they should properly lay the same and refill the trench from Lake to Rose streets, and the Commission upon its part agreed to bear the expense of the necessary pipe. The village was granted the privilege of making connections with the main for the purpose of fire protection and private connections were also permitted to be made; the commission, however, reserved the right to disconnect all private connections if they should be found in any way to interfere with the supply necessary for the hatchery. It was further agreed that the title to the main should remain in the Commission and be subject to its control. This contract was ratified and accepted by the village authorities upon the 7th day of August.

Upon the completion of this arrangement Mr. Whitaker visited Bay City to investigate the practicability of using wooden pipe for the purpose required and it was decided after a careful investigation that it would meet the needed requirements and the necessary pipe was purchased and shipped to Petoskey.

On the 28th of September the work of laying pipe was commenced and the water brought into the house within twenty days. All necessary connections were made and the house is now supplied with a volume of water which

will meet all emergencies. In addition to the necessary supply of water for the work, we have also secured ample fire protection for all our buildings. The total length of pipe laid was 1,420 feet, which carries a four inch stream, under a pressure of about seventy-three feet head, and the cost to the Commission for this work was $514.20.

It was also found necessary to increase the tankage in the house in which to carry the fry, it having been found by experience that the tank-room would be insufficient. To accomplish this purpose the jars were removed to one side of the house, and two large tanks were built. By this change a tankage capacity was secured of 504 cubic feet, giving us an increase of 242 cubic feet of tank room. To sustain this additional weight it was found necessary to strengthen the floor, and four heavy bents were put underneath the floor for this purpose, and improvements were also made in the general drainage of the house.

There has also been built an addition to the hatchery, 17x32 in size, with 12-foot posts. This addition is sheeted and battened to correspond with the main building. It contains a bed-room and hall, which are wainscotted and painted, a wood-house with a capacity of sixty cords, a shop, a store-room for 100 cans overhead, and also a store-room for boats and other material. It was built of common lumber and adjoins the building. There has also been a storm house, 6x10, built over the south door of the cottage, which is shingled and battened.

Our past experience has proven that the practice of running the water through the tanks from the hatching jars, carrying as it does the shells of the eggs and other refuse matter, has proven injurious to the fry, and the current of water passing through the tanks from one end to the other had the effect of crowding the fry into the foot of the tanks and against the screens. In the fall of 1885 the Superintendent determined, if possible, to overcome this difficulty, and in both the Detroit and Petoskey stations a perforated iron pipe was laid lengthwise the tank, at the bottom, and an independent supply of fresh water, direct from the main, was fed from this pipe into the tanks. The result has proved eminently satisfactory. The fish, by this method of supplying the tanks, are evenly distributed throughout its entire length, and the crowding against the screens is thereby avoided. The introduction of the fresh water and the even distribution of the fish in the tank has had the effect of materially diminishing the loss that resulted from the old system of running the water directly from jars and the supply being fed from the ends of the tanks.

The hatchery now has a capacity of 215 jars, which will carry 33,000,000 eggs. In 1885, owing to the inability of the Board to procure a sufficient quantity of eggs, the Petoskey house was not filled, and but 171 jars were run for the season, containing 26,300,000 eggs. This quantity was successfully hatched, and they were largely planted in the inland waters of the northern part of the lower peninsula; the late opening of navigation, and the ice remaining so long in the great lakes, it was impossible to plant them in those waters. The waters in which they were placed, however, are known to be favorable to the growth of whitefish, and we confidently look for good results from these plants within a few years.

With this station in its present perfected condition, with the ample supply of water secured, and with the facilities which the Commission now enjoy to procure the ova of the whitefish from their three fisheries upon the

Detroit River, we believe the Petoskey station can be run to its full capacity and that the outlay made for this station will be found by results to have been warranted.

5. *Paris Station.*

At the last session of the Legislature an appropriation was asked to enable the Commissioners to purchase additional lands adjoining the property at Paris. The Legislature upon the report of the fisheries committee, agreed with the Commissioners, as to the necessity of the purchase, to give control of the waters that were so much needed in extending the operations of this station. The lands had already been bargained for and purchased before the session of the Legislature commenced; in fact one of the pieces of property, the 41 acres lying just north of the old State pond, had been in our possession since the summer of 1884. The money for the purchase of this piece of property was advanced to the Commissioners, with the understanding that if the appropriation was made for the purchase, the price which was agreed upon and approved by the Commissioners at that time, should be returned with interest or with a reasonable rental for the use of the property for the time. The house upon one of the lots was occupied by the assistant, and put in order under the direction of the Commissioners. The other property, the 40 acres immediately west of the one above mentioned, was necessary to our further extension, as it controlled quite a large meander of the Buck-horn stream as well as of the Little Buck-horn. The securing of this land served two very important purposes, in supplementing the supply of water in Cheney creek, and also furnishing additional grounds and water for our experiments in the preservation of the grayling. The Little Buck-horn supports a very large number of small trout, and is in fact while under our control a vast wild nursery for trout fry. The food in it is abundant; the bed of the stream itself is almost entirely covered with logs, branches and roots, making a most perfect hide and shelter for the young fish. The young trout that are reared here will either be got out from time to time by the men as they are fishing to replenish the ponds, or else will drop down to the Buck-horn, upon the property just between the highway and the railway, where they will be caught and held in the large wild ponds to be constructed there. The other advantage gained from the addition of a part of the water from the Little Buck-horn creek is not less important. We had reached about the limit of pond room and pond supply afforded by the volume of water in the Cheney creek for all purposes of convenience and safety. Additional stock ponds at this station should be constructed along the meander of the Cheney creek adjoining and connected with our present stock ponds, but as above remarked, we had reached the limit, and could not make any further extension in the number of ponds upon Cheney creek without some additional supply of water. This supply of water could only be obtained from the Little Buck-horn, and the right to use a part of the flowage of the Little Buck-horn of course depended upon our ownership, or the right to control it, below the point at which it was necessary to tap it for the supply to Cheney creek. The distance between the Little Buck-horn and Cheney creek at this point is about 650 feet. A little over half of this distance is upon that forty acre lot which we purchased. About one-third of the distance is across lands owned by Mr. Stearns of Big Rapids. The remainder of the distance after

crossing Mr. Stearns's land is upon our own property. After running the line and establishing the grade, which was done in 1885 by Mr. Orwig, we obtained permission from Mr. Stearns to carry the ditch across his premises for a nominal consideration. It was first contemplated to carry the water in an open ditch, but further consideration determined us to carry it through vetrified crock, or sewer pipe, completely covered.

The other work at Paris station which was more urgent than the construction of this ditch, occupied the time of the Superintendent and men until about the end of the summer of 1886, when the crock was purchased at Jackson at a reasonable figure, the ditch opened, and the crock laid. This means of conducting the water from one creek to the other, in the quantity required at first sight might appear expensive, but it is really far more economical in time and expenditure than by means of an open ditch, for when the crock are once laid and properly cemented, and the flow of water secured, the ditch is then filled in and will need no further attention; but if the open ditch had been employed, the expenditure of cutting that ditch to a sufficient depth required by the grade between the two creeks, and of a sufficient width to prevent its caving in the banks, would have cost all that the laying of pipe cost, and it would have required more or less attention each year to keep it in order, free of obstruction by the fall of branches or trees, and the fall of leaves in autumn.

Examinations of the different kinds of crock offered showed us that the first quality of crock was not needed for this purpose. A crock which was not perfect in all respects so that it would pass inspection for contract work in the sewerage of cities, but sound enough not to permit any leakage and perfectly strong, was found to answer our purpose, and was very much cheaper. The total cost of the ditch, the purchase of the crock and the laying of it, was $110.00. The crock is eight inches in diameter, which, with the fall from the Little Buck-horn to the Cheney creek, and the artificial head wwhich we can give it at its starting point, will give us a solid stream of about six inches in diameter at the discharge.

As soon as the work at the other stations permitted in the summer of 1885, the entire available force was ordered to Paris and set to work upon the improvements which will be here briefly detailed. Five new stock ponds were constructed adjoining and just northwest of the old ponds, and in continuation of the plan of improvement originally adopted. Two of the new ponds are 14x40, but having natural bottom, and sides laid up with a stone wall; each pond having a plank spawning pond connected with its upper end, and its flow of water received through a spawning race 38 feet in length by 4 feet wide, similar to the other spawning races, the uses of which have been fully described in the last report. The other three ponds just above are constructed of plank and are supplied with water through proper spawning races. These are used for younger fish. At all times, except just before the spawning season, these ponds are supplied with an artificial bottom of sand and gravel, just such as is found on the natural bed of the creek. As the spawning season approaches this artificial bottom is removed, in order to force the fish for the act of spawning into the races constructed to receive them. About the same number of ponds should be added during the season of 1887, just above these ponds for young trout, to accommodate the increased number of stock fish which will be required for the growing work of the station. It is to supply the additional ponds needed that the increased supply of water is to be brought from the Little Buck-horn.

The old barn has been removed to the north side of the hatchery on the road, and reconstructed into a very convenient office (which was very much needed), a suitable shop, with a storeroom in the loft, and is connected to the hatchery building by a passage way. This allowed us to dispense with the shop at the west end of the hatchery, and gave the entire length of the room for use in handling eggs and fry. The old wing to the barn was removed across the road north of the house, and used for a hen house. Just north of the house, along the road, a new barn was built, for the use of the station. The grounds between and around the ponds have been properly graded and seeded to timothy and clover. In the grading on the south and west side of the ponds a low terrace is employed, to relieve the otherwise rather sharp grade, and the natural terrace on the north of the ponds has been carried around to the natural level just before reaching the highway at the same grade as is now established for the road. The road in front of the hatchery and abreast of the ponds has been graded up about two feet above the level that it had three years ago. The ground south of the house, between it and the large pond, and between the highway and the G. R. & I. railroad, has been graded and terraced. The fence along the railroad right of way has been removed, between the house and the large pond, and the grading and terracing of that ground has been carried around to the railway embankment. This improvement has added greatly to the appearance of the grounds from the highway and from the railroad. A covered piazza has been finished around the west and north sides of the house, and the house has been painted.

On the east side of the highway, from the Buck-horn property down to the barn, a substantial board fence has been constructed, and young maple trees planted at proper distances along the entire front. Immediately in front of the house, a single painted post and rail fence has been constructed, going down the hill across in front of the large, wild pond to and across the creek, and about five rods on the opposite side of the creek. The same sort of fence was constructed from the office, on the west side of the road, opposite the house, to the north line of meander of the creek. This was rendered necessary to prevent visitors from driving on to the ground between the road and the first large pond. Proper hitching posts have been provided along this fence, and young trees have been planted on this side of the road. The strip of ground between the highway and the railroad, north of the house, has been logged and cleared up, as well as that between the railroad and the river, and the strip between the railroad and the highway south of the pond, has also been fenced and partly cleared. A fence has also been built from the highway, just south of the ice house, along the meander and through the woods, across the creek, to the north line of the meander, to prevent cattle running at large in the woods and trespassing on the ponds.

The other outdoor improvements on Cheney creek are upon that portion of the creek lying between the railroad and the Muskegon River. The distance in a direct line from the railroad to the river is about 400 feet, but in going that distance the creek measures a line about one-third more. A series of three ponds were constructed along the bed of the creek. These ponds, with the larger one just across the road from the hatchery, are the wild ponds so often spoken of, where the trout are grown under perfectly natural conditions, and without any artificial feeding, except such as they get from the wash of the stock ponds above, and are taken after their third

year, either by hook or net, for the purpose of supplying the stock ponds with breeding fish. In the summer of 1886 this system of wild ponds was completed by the construction of two others much larger and deeper than the other three, the lower one of which is built with a very strong dam, about five and one-half feet high, and comes down to the point to which the back-water from the Muskegon River rises.

No improvements were made upon the Buck-horn property beyond some underbrushing along the stream from the road down towards its junction with the Little Buck-horn, until the summer of 1886, then one large pond was constructed just east of the highway, which is nearly circular in shape, the length from end to end around the centre is about 385 feet, with an average width of about 35 feet, and the mean depth of about 2½ feet around the easterly and southerly sides; when filled to the usual level it will be 3 and 4 feet in depth.

The point of land around which the pond extends is well wooded. The banks on the north and east sides are high, with a natural growth of timber upon them, so that the pond on that side is well shaded. The dam is 96 feet long by 11 feet wide, and about 5 feet high, made of heavy frame work, extending well into the natural bank of the stream on either end, and having an opening 18 feet wide, or rather two openings of about 9 feet each, with a strong central support, so that each of the openings are controlled with separate "slash-boards." This pond is really the basis of all future work and improvement upon the Buck-horn. The ground immediately to the south of it, and also across a little tongue of land, around which the stream flows after leaving this dam, is low enough to furnish abundant opportunity for artificial ponds at a grade which can be supplied from this large pond. In anticipation of such further improvement, a sluice way is provided on the western side of the dam, through which as much water as is needed can be conducted for any stock ponds that may be required here. On the west side of the highway the other improvements were made. They are first the construction of a wild pond. This is made by damming the main Buck-horn creek at a point about 40 feet from the highway bridge, used to hold and control the water coming into the creek above that dam. The creek from above this dam makes a bold curve to the south, and around to a little east of north, to a point not more than 150 feet from the dam first mentioned, while the course which we have just described takes the creek a distance of about 380 feet. At this point another dam is constructed to control the flow of water into this wild pond. At the eastern end of this upper dam another dam is constructed nearly north of it, with a channel cut from that point a little south of east across to the highway, a culvert is then carried under the highway, and through this ditch a part of the stream is carried to the north branch of the large pond just above described. A fence has been made along the east side of the highway around to the fence by the railway track, to protect this part of the property from trespassers. The whole property ought to be enclosed by a neat and substantial fence along the highway, and by a strong wire fence on the other sides. It may seem at first sight that more money has been expended for land, in this recent purchase at Paris, than is necessary for the work, but any one to whom it so appears should remember that our work is confined necessarily to the water facilities, and that absolute control of them could not be had without absolute control of the fee of the soil. Again, this is all good agricultural land and the improvements which we are making for use in the immediate future, will not only be advantageous to our work while it is being carried on, but will render the property itself intrinsically valuable, so that if the State's work there should be discontinued, and the property offered for sale, the State would be able to realize all or more than it has expended in these improvements.

In the hatching house we now have a clear space 20x60 feet, well lighted; the troughs being arranged in sets of three supplied from an interior feed trough, carried along the north side of the building. By a recent discovery, alluded to above, *i. e.*, that the fry of the trout can be carried in double tiers of wire trays, the capacity of this house is now fifteen hundred thousand. Our experience in the rearing of young fish in the wild ponds and creeks above the ponds has been very satisfactory. We find that the young fry that are deposited in suitable places in the stream above the house make more rapid growth than those young fish which are retained in the house upon fine gravel, and fed for the first few months of their existence almost hourly during the day, and afterwards placed in the nursery races where they receive constant attention. This led to a plan, adopted this last season, of taking the smaller yearlings and two year olds in the stock ponds and turning them into the large, deep ponds below the railroad. It seems that the range which a young fish has is one of the necessary conditions of rapid growth. The experiments in hybridization between salmon and brook trout are still pursued, and so far as they have been conducted have been successful. During the spawning season of 1886, eggs will be taken from hybrids whose blood is three-fourths brook trout and one-fourth salmon trout. So far we have discovered no indications of barrenness. If the increase in the stock fish at Paris shall continue as it has through the years 1883–4–5 and 6, which is a reasonable expectation, and without the interposition of any unforeseen accident the product of eggs for this year should be about nine hundred thousand of brook trout. The amount of eggs taken at Paris, 1886, will reach twelve hundred thousand, and about eighteen hundred thousand for 1887, for the year 1887 from eleven to twelve hundred thousand, and for the year 1888 about one and a half millions. It is impossible to tell to what extent demands may be made upon this station for work with the land-locked salmon or the lake trout, but unless we are greatly disappointed in our opportunities for work with the other kinds of fish besides brook trout, the house will be taxed to its utmost capacity during the winter of 1887–8.

With reference to the means for extending the work of this station in something like the proportion in which it has grown, and which is still far within the limit that it should attain in the accomplishment of all that has been contemplated by the State's policy, we should have a series of ponds constructed, a few at a time, on the Buck-horn. If the experiments with the grayling in the wild pond, now projected at Paris, are successful, other ponds of a similar character will need to be constructed upon the Buck-horn, west of the highway. It is probable that with the future stock of California trout to be kept we shall reach better results by having ponds for their retention on the Buck-horn, and it may be that the principal operations conducted on the Buck-horn may be confined to the California trout and the grayling, both of which are spring spawning fish. The largest expenditure that will be required in any event, even with a maximum of extension suggested for the Paris station, has already been made. The only further need for the purchase of land is for narrow strips extending along the meander of our

streams, for the purpose of preserving the timber standing upon those lands, to prevent its being cut off, as the cutting of such timber would expose the waters of the stream to an increase in temperature, which for our purpose is not desirable. As a part of the lands, which in following out this suggestion would be purchased, are marshy, the cost would be inconsiderable. We ought to have each year, for a number of years, at least one thousand dollars available to be expended in the construction of new ponds as suggested just above. During the next two fiscal years we ought also to have about three thousand dollars for the rebuilding and enlargement of the present hatchery, or for the construction and fitting out of a new one.

Since the above was written the Paris station has been visited by a flood, which at one time threatened almost a total destruction of the improvements. On the 29th of September it had rained all day quite hard, until late in the afternoon when the volume of rainfall suddenly increased and continued to pour down a torrent of water for about four hours. The water fell so rapidly that it could not be carried off by the ordinary channels or absorbed by the ground. It overflowed the creek and stock ponds, and above the hatching house the water flowed a foot deep over the tops of the dams—in fact, the entire ground where the ponds are was for the time converted into one great pond. An estimate of the rainfall at Reed City, where the storm was of about the same severity, placed the fall of rain at five inches during the four hours. All the dams that had stood a year or more were strong enough to resist the pressure and cutting from the flowing water, but the new dams of this year's construction were washed out by side cuts. It seemed at first inevitable that the stock of fish would be almost an entire loss, but as the waters subsided and cleared up the loss was found to be less than was expected. The damage can not be certainly computed in money until the repairs are made, but as nearly as they can now be estimated will be not far from $1,000.

Crew No. 1, engaged in examination of waters, had just been ordered in, and crew No. 2 were also summonded to suspend their operations and go to Paris. Thus, within two days after the storm, the entire force were on the ground repairing damages under direction of the Superintendent. The trout were found to be very badly mixed in the different ponds and a large number had gone up the creek. The instinct of the trout to go up stream on high water at this season saved us the bulk of our stock fish. Only a few of the larger ones were lost and those probably because they were caught in the vortex of the current when the screens were broken out by the men to remove every obstacle that could relieve the pressure of water on the dam just above the house.

The most pressing repairs were completed at once and the fish sorted as well as possible, as the spawning season was just at hand; then all hands were set to work to catch the escaped fish. Within a week over 2,000 trout of all sizes were captured and restored to the ponds. So that by the time the spawning season began—about October 7—there were estimated to be more fish in the pond than before the storm; but the average was not quite so large. In consequence of which there will very likely be a falling-off in the product of eggs from what was expected from the stock as it stood September 23. The reason of a larger number being taken is that the wild stream upon which the ponds are situated is well stocked with trout, which are native to the stream, and such fry as naturally escape from the house and ponds.

This storm and consequent flood was a disaster that no prudence could have foreseen, and it emphasizes the statement made in another part of this report, of the necessity of having a little margin on our appropriation to provide for contingencies. It is not wise and it is not true economy to cut appropriations below an intelligent and honest estimate of the amount needed, because it always results in crippling the work at some point, or prevents the doing of all that is undertaken and that ought to be done, in carrying out the policy which the commission has laid out in doing what the State government has committed to it in the way the State has fully endorsed and approved. The first thing that was necessarily done after the storm in the way of permanent repairs and improvement was to enlarge the waste ditch around the stock ponds. The ditch was cut on the line of the old one. It was made ten feet in width on the botton and twelve feet in width on top, the walls being rip-rapped with cobble stones on the sides three and one-half feet high. The upper end is controlled by a bulk-head dam having a gate that can be lifted under any pressure of water, and at the lower end, where the grade is steep, near the hatching house, is made a strong plank sluice-way about sixty feet in length. A dam was thrown across the creek bed at the angle of the bulk-head of the waste ditch and the bed then filled with earth, the sluices to the upper pond being carried through this made ground and connected to the creek above this new dam. The new dam is carried up to the height of the bank of the ditch and a levee of the same level carried around the creek bank on the north, and across the low ground till it joins the high level north of the ponds. This levee will be sodded, and while it will add greatly to the beauty of the grounds will also make a perfect protection to the ponds against a flood of any dimensions that can occur here, even to the extent of the unprecedented storm of September 23.

Since the above was written, and just before this goes to the printer, the reports of getting brook trout ova at Paris have been very encouraging up to November 26, the number of eggs laid down in trays being 1,250,000. This quantity exceeds by over 500,000 the largest number ever before got from the trout in the State ponds, and more than confirms what has been said above of our hatching facilities being taxed to their utmost this year without anything being done in salmon trout. A proportionate increase for next year will give not less than 1,800,000 brook trout eggs, and for 1888 two and one-half millions.

4. *Glenwood.*

The ponds for rearing carp at this station are one large pond 38 by 18 rods for the range of the large fish, one smaller pond next below 12 by 12 rods, then a series of breeding ponds, eight in number, about 3 by 3 rods, with a narrow pond still further down about 30 rods long. All are fed by a spring stream flowing into the upper large pond, and from it into the others. A collecting ditch of plank runs through the spawning ponds, and each pond is screened. An overflow ditch is constructed around the series of ponds to protect them from floods; the second large pond being also connected with the ditch for the special protection of the spawning ponds below it.

The adult fish are taken at spawning time from the large pond and placed in the breeding ponds, and after the eggs are cast the fish are then removed.

The fry remain in the ponds where they are hatched until grown large enough for transportation.

This station is on the farm of Mr. Warden Wells, about three-fourths of a mile from the Michigan central depot at Glenwood, Cass county. How the fish came to be in Mr. Wells's care was explained in the last report. In looking about for a place suitable for a carp station none was found that could be brought to a state of usefulness as cheaply as to avail ourselves of the work Mr. Wells had done here. An arrangement was accordingly made by which Mr. Wells was employed as overseer, at a salary of five hundred dollars a year. The Commission also purchased of him his stock of fish and paid for the improvements, in all $250, which was much cheaper than a new station could have been constructed for, even if the land and water privilege were given or leased without cost to the State. Mr. Wells's experience with the carp made his services of value, and he was fortunately so situated as to give this business all the time it needed.

The table of fish distributed from Glenwood gives ample proof of its successful operation. Every citizen of Michigan can now receive from the Commission, upon application, a supply of carp.

D. SAULT STE. MARIE, OR UPPER PENINSULA.

In the last report an account is given of the efforts and negotiations which resulted in our acquiring for the State a lease-hold interest in a strip of land in the village of Sault Ste. Marie, between the old locks of the ship canal and the rapids. A quite full statement was also made of the surpassing advantages such location affords, not only for carrying on several branches of our work, the hatching of salmon trout, brook trout, whitefish, and landlocked salmon, but also for trying experiments in rearing the whitefish and the landlocked salmon in captivity for breeding purposes, which has never yet been done to an extent promising useful results. An appeal was made to the Legislature to grant an appropriation for improving the location thus secured, on a moderate scale, sufficiently so for experimenting with the water in handling and adopting it to our uses under the long continued low temperature prevailing there in winter, which is much colder than in any place where work of the Commission has been carried on, but the appropriation was not made.

All that was said in the last report of the necessity of extending our operations to the Upper Peninsula, and the peculiarly favorable conditions existing at the Sault Ste. Marie, we reaffirm.

The single condition that did not then exist (December 1, 1884), railway communication with the remainder of the State, will beyond question be supplied by next summer. The particular location secured from the United States government in 1884 will not now be open to our use; as appropriations have been made by Congress, and bids are now being made for the enlargement of the old ship canal locks, which will require the use of that property in the proposed improvement of the ship canal. Other locations can however be secured which will answer all requisites; and even if no suitable place is to be found in the village of Sault Ste. Marie, there are other points in the Northern Peninsula where water rights adapted to our uses can be found.

Such northern station, to meet what we conceive to be the requirements of that portion of the State, should have facilities and capacity for the following mentioned operations: water and pond room for a stock of brook trout sufficient to furnish about 2,000,000 ova annually; water and pond room for extended operations with whitefish and schoodic salmon; hatching house accommodation for handling one hundred millions of whitefish ova, capable of being further extended to increase that amount if needed in the future; hatching house accommodation for handling two millions of brook trout ova and fry, and one million of schoodic salmon ova and fry, with water enough to safely increase the hatching facilities if required in the future. Such a station could be operated with greater economy for the plant, and current expenses for wages of employés, than if two stations should be established; as the different kinds of work could be superintended by one man, saving the building of one dwelling-house and the salary of one overseer, the duplicating of considerable portions of the plant, and the employment of extra hands. The total cost of a station of the capacity described would be about $14,000. Not more than one-half of the amount would be needed for the first two years. That would give ample opportunity for laying out the trout work in a permanent and judicious manner, which could not well be done in any less time. The current expense of maintaining and operating this northern station, in full commission, would be about $5,500 per year, but for such operations as the preliminary improvements would warrant for the fiscal years of 1887–88, and 1888–89 would require not more than $2,300 for the first year and $3,000 for the second.

Our work must all be laid out in advance. This extension is already needed for replenishing the streams of the Upper Peninsula. The time required to equip and get into full operation a station of the dimensions must be considered, as well as the time required by the laws of nature to bring the fish to maturity after they have been hatched and planted. It will be four full years before any fish, even the first produced, will be of a size to affect the available product of any streams to be stocked from that station. That the establishment is already needed seems certain from the applications for trout coming to us from that part of the State, besides the general demand for keeping up the stock in the vast numbers of streams that are already regarded as fished out. The abundant success which has been attained in the Lower Peninsula in the same kind of work enables the board to speak with perfect confidence of what can be accomplished for the famous streams of the Lake Superior region.

In selecting a site for such northern station we should keep in view the more important consideration of its adaptability to operations with whitefish, knowing well that the time is not far off when the preservation of the industrial fisheries of Lake Superior will demand the equipment of an establishment for that work. And, also, being firmly convinced that the good sense and judgment of the people of this State will very soon be aroused to the necessity of such legal regulation and control of the industrial fisheries of the State as will preserve what is left of the fisheries and imperatively call for their extension by artificial aid.

E. EXAMINATION OF WATERS.

The Commissioners have long felt the want of accurate knowledge of the results of the early efforts at stocking inland lakes, and also the need of exact information of the characteristics of these waters, and their consequent

adaptability to different kinds of fish. This information could only be obtained by a careful examination of each body of water, a scrutiny of its inhabitants, a testing of its temperature, depth, quality of water and food supply, by men suitably provided with apparatus, and having the requisite knowledge from experience in such matters. It was, however, not until the summer of 1886 that we were able to organize and inaugurate this work upon an adequate scale. A beginning was made in 1885, and enough was then done to acquaint the Board with the necessity of deliberate preparation for its successful prosecution. Two crews, consisting of three men each, were organized and equipped for the examination of lakes the past summer. It was necessarily delayed until after the regular work of hatching and planting closed for the season, and some further delay arose from the condition of extensive improvements in progress at the Paris trout station, on which the entire force from Detroit and Petoskey were engaged. The first crew consisted of A. W. Marks, in charge, Eli Tinlan and F. C. Marks. This crew, called No. 1, began operations in Lenawee county, about July 20. A tabulated statement was prepared of the lakes planted, the dates, kinds and quantities of fish deposited, arranged in groups, by counties. It was decided that crew No. 1 should take the southern tier of counties, working across the State from east to west. Crew No. 2 was directed to begin on the west side of the State, in the tier of counties next north, and work east. As it was foreseen that crew No. 2 could not make a clean sweep of all the lakes in the second tier of counties, a selection was made of such as were deemed more important, from their local reputation, or the quantities of fish deposited in them, regard being had, as far as practicable, to finishing the work in each locality. Thus, in Van Buren county, the examination covers the four southeastern townships, and in Kalamazoo county, the four northeastern townships of each county. Crew No. 2 was composed of Orr D. Mailes, A. McClennan, and Wm. Sergeant.

Each crew is provided with a tent and camping outfit, a gang of gill nets of four different sizes of meshes, various kinds of fishing appliances, a deep sea self-registering thermometer, a dredge for examining the bottom and the various kinds of animal life inhabiting the bottom, and bottom vegetation, a lead and line for sounding, together with printed blanks for making full reports. The blanks for reports are made of convenient shape and size to be bound into volumes, and will thus constitute a permanent record for ready reference in the future on any question affecting the lakes examined. These examinations will determine, first, what has been the result of planting whitefish in the inland lakes; and secondly, for what kinds of fish the lakes are suitable, besides the native fishes.

As this is an entirely new department of the Board's work, a copy of the blank report, with the rules under which it is prosecuted, is given below, and a condensed statement of the examination of each lake.

Experience has shown that there are several conditions essential to the successful growth of different kinds of fish. Thus, whitefish require a good depth and range of fairly cold water, besides the kinds of food which its mouth and stomach are suited for. The peculiar food of the whitefish is found in great abundance in the great lakes, and in some of the inland lakes, but not in many. Where the food does not exist it is useless to place whitefish. A lake deep and cold enough for whitefish, but which lacks the whitefish food, may be found to be excellent water for black bass, pike, perch and

common perch, and probably for lake trout. It will be noticed that, while we speak sometimes with certainty and assurance on these subjects, we are often compelled to qualify our statements. The reason is, there are still very many things which we do not know about the culture and habits of fishes. As the work goes on, we are learning gradually one fact after another, and the knowledge which comes from experience is always guiding the students of fish culture, as it does all students of nature, to better methods and larger measures of success.

A condensed statement made from the reports, so far as the examination has gone, is here given:

Examination of Inland Lakes, 1886.

Lenawee County.

Sand Lake, Townships Cambridge and Franklin—*Crew No. 1:* (1)
Length, 1¾ miles; width, ½ mile; greatest depth, 54 feet.
Shores, gravel, high clay banks, wooded on south and west sides.
Bottom, mostly mud and gravel, clay on east side for ¼ mile.
Inlet, none; outlet, none.
Dates of examination, July 17 and 19.
Weather, warm.
Temperature—Surface, 71 to 74°; bottom, 68 to 72°.
Water, clear.
Fish are black bass, blue-gills, perch, sun-fish, rock bass, gars, pickerel.
Fish well fed, but small.

Wamplers Lake, Cambridge Township—*Crew No. 1:* (2)
Length, 3 miles; width, 1 mile; greatest depth, 36 feet.
Shores, sand and gravel, banks south side low, on northeast and west hilly and wooded.
Bottom, mud, sand and gravel.
Inlets, none except in spring, and then from Iron Lake; outlets, none except in spring, and then into Mud Lake.
Dates of examination, July 21, 22 and 23.
Weather, warm and cloudy.
Temperature—Surface, 76 to 79°; bottom, 73 to 75°.
Water, clear.
Fish are black bass, gars, blue-gills, perch, rock bass, eels, sun-fish, chubs, shiners, bull-heads.
Fish well fed.

Iron Lake, Cambridge Township—*Crew No. 1:* (3)
Length, ½ mile; width, ¼ mile; greatest depth, 58 feet.
Shores, south side high bluffs, on northeast and west sides low with stone and clay beach.
Bottom, mostly mud, the bars being stone and clay.
Inlets, none; outlet, head of Iron River.
Date of examination, July 24.
Weather, hot and clear.
Temperature—Surface, 70°; bottom, 68°.

Water, clear.
Fish are blue-gills, black bass, perch, pickerel, shiners, chubs.
Fish are well fed, but small on account of spearing in the spring.

Evans Lake, Franklin Township—*Crew No. 1:* (4)
Length, ¾ mile; width, ½ mile; greatest depth, 40 feet.
Shores, on east side sand and clay, north, south and west sides rushes and marl.
Bottom, mostly mud, but around islands gravel and rock.
Inlets, none; outlets, none.
Date of examination, July 24.
Weather, hot and clear.
Temperature—Surface, 70°; bottom, 67°.
Water, clear.
Fish are black bass, pickerel, perch, blue-gills, chubs, shiners.

Allen's Lake, Cambridge Township—*Crew No. 1:* (5)
Length, ⅓ mile; width, ¼ mile; greatest depth, 43 feet.
Shores, on north and west sides low and marshy, south and east sides high clay banks and a few rushes.
Bottom, clay and marl, with spots of stone and clay.
Inlet, a ditch from Heath Lake; outlet, a small ditch at south end which flows into a small lake of no name.
Date of examination, July 27.
Temperature—Surface, 76°; bottom, 48°.
Water, clear.
Fish are blue-gills, black bass, perch, chubs, shiners.

Wolf Lake, Cambridge Township, *Crew No. 1:* (6)
Length, ½ mile; width, ⅛ mile; greatest depth, 33 feet.
Shores, on north, east and west sides, low and marshy, south side high, clay banks, wooded.
Bottom, clay and marl with weeds close to shore, center of lake clear.
Inlets, none; outlets, a ditch that connects with Allen's Lake.
Dates of examination, July 27, 28, 29.
Weather, July 27, clear; 28, rainy; 29, clear and windy.
Temperature, surface, 73°; bottom, 46°.
Water, clear.
Fish are blue-gills, sun-fish, black bass, calico bass, perch, pickerel, chubs and shiners.
Fish well fed but the spear has taken all the large fish.

Deep Lake, Cambridge Township, *Crew No. 1:* (7)
Length, ¾ mile; width, ¼ mile; greatest depth, 45 feet.
Shores are marshy around entire lake.
Bottom, soft mud and sand mixed.
Inlets, one on south side, grown up with rushes; outlets, one on northwest side which flows into Crooked Lake which is full of rushes.
Date of examination, August 2.
Weather, clear and windy.
Temperature, surface, 72°; bottom, 50°.
Water, clear.
Fish are perch, bass, pickerel, sun-fish, blue-gills, rock bass and minnows.

Mahar Lake, Cambridge Township, *Crew No. 1.* (6 *d*)
Length, ⅓ mile; width, 20 rods; depth, 26 feet.
Shores, marl; bottom, marl.
Temperature, surface, 75°; bottom, 44°.
Fish are bass, perch, blue-gills, shiners and chubs.

Middle Lake, Cambridge Township, *Crew No. 1.* (6 *e*)
It is round, about 40 rods in diameter; greatest depth, 25 feet.
Shores, marl; bottom, marl.
Temperature, surface, 77°; bottom, 47°.
The fish are bass, perch, blue-gills, shiners and chubs.

Round Lake, Cambridge Township, *Crew No. 1.* (6 *f*)
About 40 rods long; width, 20 rods.
Shores, marl; bottom, muck and marl with a little gravel.k
Temperature, surface, 80°; bottom, 50°; depth, 40 feet.
Fish are perch, bass, blue-gills, shiners and chubs.

Washington Lake, Cambridge Township—*Crew No. 1:* (6 *a*)
Length, ½ mile; width, ¼ mile.
Shores are marl, bottom mud, with rushes and lily pads along the shore.
Greatest depth 54 feet; water clear.
Temperature—Surface, 77°; bottom, 45°.
The fish are blue-gills, black bass, perch, shiners, chubs.

Dewey Lake, Cambridge Township—*Crew No. 1:* (6 *b*)
Length, ¾ mile; width, ⅓ mile; greatest depth, 20 feet; bottom soft mud; shores marshy.
Fish are bull-heads, black bass, perch, blue-gills and sun-fish.

Round Lake, Rollin Township—*Crew No. 1:* (6 *c*)
Fine, clear water; shores on west side bold, on east side it is shallow for 10 to 15 rods from shore; gravel and sand beach all around.
Bottom is mostly mud, with sand and gravel bars.
Inlets, only from springs; outlet, a ditch which connects with Devil's Lake.
Greatest depth, 60 feet.
Temperature—Surface, 72°; bottom, 50°.
Fish are black bass (small-mouth), large-mouth black bass, rock bass, pickerel, eels, blue-gills, sun-fish, gars, chubs, minnows.

Devil's Lake, Townships Woodstock and Rollin—*Crew No. 1:* (8)
Length, 3 miles; width ½ to ¾ miles; greatest depth, 56 feet.
Shores mostly marshy, a little gravel and sand beach; banks are low and wooded in spots.
Bottom mostly sand; some mud in holes.
Inlets, one from Round Lake, a ditch, a few springs on the shores; outlets, one west side called Mill Creek.
Dates of examination, August 4, 5, 6, 7.
Weather, August 4, clear; 5, rainy; 6, cloudy; 7, clear and windy.
Temperature—Surface, 72°; bottom, 70°.

Water, clear.
Fish are black bass, blue-gills, perch, rock bass, pickerel, silver bass, eels, gars.
Fish are plump, well fed, but soft. Bass weigh from 1 to 4 pounds.

Goose Lake, Township Woodstock—*Crew No. 1:* (9)
Length, ¾ mile; width, ½ mile; greatest depth, 30 feet.
Shores marshy; low, wet banks for 80 rods back from lake.
Bottom, mud, bars, marl; whole bottom covered with moss and weeds.
Inlets, 4, all small but Goose Creek, which is the outlet of Goose Lake in Hillsdale county; outlet, one at east end of lake, which flows into the Raisin River.
Dates of examination, August 10 and 11.
Weather, August 10, rainy; 11, windy and warm.
Temperature—Surface, 75°; bottom, 50°.
Water, dark colored.
Fish are pickerel, bass, perch, blue-gills, bull-heads, eels, minnows, craw-fish.

Hillsdale County.

Crystal Lake, Somerset Township, *Crew No. 1:* (10)
Length, ¼ mile; width, ¼ mile; greatest depth, 48 feet.
Shores gravel and sand, except two small places, one on north side, one on south.
Bottom mostly mud covered with thick growth of weeds.
Inlets, none; outlets, one small stream grown up with grass flows into the Grand River.
Date of examination, August 13.
Weather, clear and windy.
Temperature—surface, 72°; bottom, 46°.
Water, clear.
The fish are bass, perch, sun-fish, rock bass, blue-gills, eels, chubs and minnows.

Goose Lake, Somerset Township—*Crew No. 1:* (11)
Length, one mile; width, ¼ mile; greatest depth, 51 feet.
Shores, on south side mostly gravel, sand and stone; north side, mud and marl.
Inlets, one small spring brook on southwest side, a mere ditch; outlets, one on east side, flows into Goose Lake, Lenawee county; mud bottom, and filled with weeds.
Date of examination, August 14, 15, 16.
Weather, cloudy and rained.
Temperature—surface, 70 to 72°; bottom, 42°.
Water, milky.
Fish are black bass, rock bass, blue-gills, sun-fish, perch, eels, pickerel, chubs and minnows.

Baw Beese Lake, Hillsdale, Cambria and Jefferson Townships:
Length, 1½ miles; width, ½ mile; greatest depth, 63 feet.

Shores, north end mostly gravel and sand covered with rushes; south end marshy, high banks back and wooded.
Bottom, north end gravel and sand with two sunken islands covered with stone and gravel; south end, mud.
Inlets, two, one from Boot Lake, one from Bass Lake, both cut through; outlets, one at north end the head of St. Joseph River.
Dates of examination, August 17, 18, 19, 20.
Weather, August 17, cloudy; 18, bright; 19, clear and hot; 20, cloudy.
Temperature—surface, 70 to 72°; bottom, 46 to 50°.
Water, dark.
Fish are whitefish, grass pike, bull-heads, eels, perch, black bass, silver bass, calico bass, chubs and minnows. Fish are well fed, and the white-fish are very fat.

erch Lake, Somerset Township, *Crew No, 1:* (13 *a.*)
The lake does not amount to anything. It has no outlet or inlet. The bottom is mostly marl, with a little mud at west end. Greatest depth, 14 feet.

Boot Lake, Cambria Township, *Crew No, 1:* (13)
Length, ¾ mile; width, ¼ mile; greatest depth, 36 feet.
Shores marshy all around the lake; very bold; 20 feet of water just off the marsh.
Bottom, all mud, except a small place on west side, which is marl.
Inlets, a ditch from Bass Lake, and by springs on bottom; outlets, one which flows into Baw Beese Lake.
Date of examination, August 19.
Weather, clear.
Temperature—surface 72°; bottom, 48°.
Water, dark.
The fish are calico bass, black bass, grass pike, perch, blue-gills, eels, sun-fish, gars.
Fish are well fed, there being a great quantity of chubs, minnows, etc.

Second in Bear Chain, or Wilson's Lake, Town of Cambria, *Crew No. 1.*
Length, ¾ mile; width, ½ mile; greatest depth, 54 feet. (14.)
Shores, on east side, rocky, high, wooded banks; west side, low and marshy.
Bottom, on west side, mud and sand; on east side, stone, gravel, sand and mud.
Inlets, one at north end, coming from 1st lake; outlets, one at south end; flows about 20 rods, into 3d lake.
Date of examination, August 21; weather, cloudy.
Temperature—surface, 72°; bottom, 50° at 40 feet.
Water, clear.
The fish are the same as in the other lakes (see 16, below); great quantity of food, clams, snails and minnows.

Third in chain, or Bear Lake, Cambria Township, *Crew No. 1:* (15)
Length, ¾ mile; width, ¼ mile; greatest depth, 45 feet.
Shores, marshy around entire lake, high banks back and wooded.
Bottom, mostly mud, few spots sand and soft mud.

Inlets, two, one from 2d lake; one from Pike Lake, a small lake of about ten acres; outlets, one, which forms one of the head branches of the Maumee river.
Date of examination, August 21.
Weather, cloudy.
Temperature—surface, 70°; bottom, 48°.
Water, clear.
The fish are black bass, herring and other varieties, as are found in the other lakes. Fish well fed, but small stomachs.

First in Bear Chain, or Big Bear Lake, Township of Cambria—*Crew No. 1*: (16)
Length, ¾ mile; width, ¼ mile; greatest depth, 39 feet.
Shores, marshy all around the lake, with low banks on west side, high and wooded on east side.
Bottom, marl, and the holes filled with pomace from a cider mill on the creek.
Inlets, one, a small spring brook and two ditches on north end; outlets, one at south end flows through 10 rods of marsh into second lake.
Dates of examination, August 20, 21, 22, 23, 24.
Weather, August 20, hot and clear; 21, cloudy; 22, rainy; 23 and 24, rainy.
Temperature, surface, 70 to 72°; bottom, 46 to 50°.
Water, clear two days, roily, balance.
Fish are black bass, herring, perch, blue-gills, grass pike, eels, calico bass, sun-fish, rock bass, chubs, shiners and minnows.
Fish were hard, well fed, good size; perch are extra large; food abundant.

Second in chain of Sand Lakes, Township Hillsdale—*Crew No. 1*: (17)
Length, ¾ mile; width, ¼ mile; greatest depth, 36 feet.
Shores are marshy all around the lake but 5 rods on south end, being sand and stone, west side, springs.
Bottom is marl and sand, covered with small shells and vegetation.
Inlets, one at south end coming from first lake, flowing through marsh; outlets, one at north end, flows into third lake, flows through marsh.
Dates of examination, August 24, 25, 26, 27.
Weather, August 24, cloudy and rain; 25, clear; 26 and 27, hot and clear.
Temperature, surface, 70 to 73°; bottom 49 to 53°.
Water for two days clear; two days roily.
Fish are herring, suckers, bass, bullheads, eels, blue-gills, perch, chubs, etc.
Fish are well fed, good growth, herring full of spawn.

First in chain of Sand Lakes, Township of Hillsdale—*Crew No. 1*: (18)
Length, ¾ mile; width, 60 rods; greatest depth, 30 feet.
Shores, marshy all around the lake.
Bottom, marl, with weeds and grass in spots.
Inlets, four—one in south end from a small lake, the other three are small streams full of springs; outlets, one at north end, flows into second lake.
Date of examination, August 26.
Weather, clear.
Temperature—Surface, 72°; bottom, 52°.

Water, clear.
Fish are herring, perch, blue-gills, suckers, black bass, eels, rock bass, sunfish.
Fish are hard and well fed, herring full of spawn.

Third in chain of Sand Lakes, Townships of Hillsdale and Fayette—*Crew No. 1*: (19)
Length, ¾ mile; width, 60 rods; greatest depth, 36 feet.
Shores, marshy on north, south and west sides, on east side stone and marl.
Bottom, on the bars marl, in the holes mud with vegetation.
Inlets, one from second lake—a ditch; outlet, one at north end, flows into the St. Joseph River.
Date of examination, August 26.
Weather, hot and clear.
Temperature—Surface, 79°; bottom, 52°.
Water, clear.
Fish are black bass, blue-gills, perch, suckers, bull-heads.

Hemlock Lake, Townships Allen and Reading—*Crew No. 1*: (20)
Length, 1 mile; width, ½ mile; greatest depth, 56 feet.
Shores, north end sand and stone, south side marl and loose stone.
Bottom, north side hard, south side soft mud and marl.
Inlet, one from Mud Lake; outlet, one flows into Hog Creek and that into St. Joseph River.
Dates of examination, August 28, 29 and 30.
Weather—August 28, warm; 29, clear; 30, rainy.
Temperature—Surface, 70 to 73°; bottom, 43 to 66°.
Water, clear two days, roily the third day.
Fish are all kinds of bass, perch, blue-gills, suckers, grass pike, shiners and great numbers of turtles.
Herring well fed, bass are small.

Long Lake, Township Reading—*Crew No. 1*: (21)
Length, 3 miles; width, ½ mile; greatest depth, 37 feet.
Shores, all marshy, pond lilies and grass.
Bottom, soft mud.
Inlet, one from Mud Lake, very small; outlet, one into Carpenter Lake, very large and filled with lilies.
Dates of examination, August 31, September 1 and 2.
Weather—August 31, rainy; September 1, clear; 2, cloudy.
Temperature—Surface, 70 to 74°; bottom, 44 to 46°.
Water, dark.
Fish are whitefish, suckers, grass pike, perch, herring.
Whitefish weigh 1 to 4½ pounds and are very fat and well fed.

Carpenter Lake, Township Reading—*Crew No. 1*: (22)
Length, ½ mile; width, ¼ mile; greatest depth, 36 feet.
Shores, soft mud all around, grass, etc.
Inlet, one from Long Lake; outlet, one flows into Hog Creek and that into the St. Joseph River.
Date of examination, September 1.
Weather, clear.

Temperature—Surface, 73°; bottom, 47°.
Water, dark.
Fish are all kinds of bass, blue-gills, perch, grass pike, herring, whitefish.
Fish well fed, whitefish weigh from 1 to 4½ pounds, plenty of larvæ and flies, crawfish and shellfish.

Branch County.

Marble Lake, Townships Quincy and Algansee—*Crew No. 1:* (23)
Length, 2½ miles; width, 2¾ miles; greatest depth, 58 feet.
Shores, sand and gravel on east side, with high land and timber; west side, marshy with grass and rushes.
Bottom, north end hard sand, south end soft in places, some weeds, bold shores.
Inlets, one from Middle Lake; outlets, one into Coldwater River, a tributary of St. Joseph River.
Dates of examination, September 3, 4, 5, 6, 7.
Weather, September 3 and 4, clear; 5, rain; 6 and 7, clear.
Temperature—surface, 68° to 73°; bottom, 43° to 48°.
Water, clear.
Fish are calico bass, small-mouth black bass, grass pike, bull-heads, perch, mullet, suckers. Plenty of food. Some eels have been taken. The fish are all fat but small.

Second Lake, Township Quincy—*Crew No. 1:* (24)
Length, ¾ mile; width, ¼ mile; greatest depth, 36 feet.
Shores, very low and marshy all around.
Bottom, soft mud and marl.
Inlets, one from Marble Lake; outlets, small ditch into First Lake.
Date of examination, September 6.
Weather, clear.
Temperature—surface, 72°; bottom, 46°.
Water, clear.
The fish are small-mouth black bass, rock bass, grass pike, perch, bull-heads, eels, gars.

Middle Lake, Township Algansee—*Crew No. 1:* (25)
Length, 1 mile; width, ½ mile; greatest depth, 36 feet.
Shores, soft mud; bold shores on east side.
Bottom, soft mud and some marl.
Inlets, one, flows from Bartholomew Lake by a ditch; outlets, one, flows into Marble Lake by a ditch.
Dates of examination, September 8 and 9.
Weather, September 8, warm; 9, rain.
Temperature—surface, 68° to 70°; bottom, 44° to 46°.
Water, clear.
The fish are bass, eels, grass pike, perch, dog fish. The fish are all large and well fed. Great numbers of minnows and chubs. It is well supplied by springs on the bottom.

Bartholomew Lake, Township Algansee—*Crew No. 1:* (26)
Length, ¾ mile; width, ¾ mile; greatest depth, 56 feet.

Shores, hard land all around, some rushes on sides.
Bottom, hard in spots, and stony.
Inlets, one small stream; outlets, large ditch flowing into Middle Lake.
Dates of examination, September 9 and 10.
Weather, September 9, cloudy; 10, clear.
Temperature—surface, 68° to 70°; bottom, 42°.
Water, clear.
The fish are bass, blue-gills, perch, eels, grass pike. The fish were feeding upon shrimp, shell-fish and worms.

Long Lake, Township Ovid—*Crew No. 1:* (27)
Length, 1½ miles; width, ½ mile; greatest depth, 42 feet.
Shores, marshy all around, low banks with rushes.
Bottom, soft black mud.
Inlets, one, a ditch from Little Mud Lake; outlets, one, flowing into Coldwater River by a ditch with a great flow of water.
Dates of examination, September 9 and 10.
Weather, September 9, stormy; 10, cold wind.
Temperature—surface, 69 to 70°; bottom, 46°.
Water, clear.
The fish are herring, bass, blue-gills, and perch; fish all well fed and were very fat.

Coldwater Lake, Township Ovid, *Crew No. 1:* (28)
Length, 3 miles; width, 2 miles; greatest depth, 87 feet.
Shores, all gravel and sand, east side high banks with timber, shoal water out for 15 rods; bottom, all hard sand and gravel.
Inlets, one very large from Mud and Long Lakes, with great flow of water north; outlets, one, into Coldwater River flowing north.
Dates of examination, September 10, 11, 12, 13.
Weather, September 10 and 11, clear; 12 and 13, cloudy.
Temperature—surface, 65 to 73°; bottom 45 to 47°.
Water, clear.
The fish are whitefish, bass (small-mouth), grass pike, blue-gills, strawberry bass, herring; fish well fed on crawfish and larvæ.
(No. 30 is a part of this same lake.)

Lake of the Woods, Township Ovid—*Crew No. 1:* (29)
Length, 1 mile; width, ½ mile; greatest depth, 78 feet.
Shores, high banks wooded, gravely on north, flat, sandy on south side.
Bottom, rocky and gravel on north, sand and some gravel ¾ mile on south side, muddy at west end.
Inlets, one small stream on southwest side, cool water, muddy bottom; outlets, one on northeast side, cool water, sandy bottom.
Dates of examination, September 14 and 15.
Weather, September 14, fair and warm; 15, cool and windy.
Temperature—surface, 68 to 71°; bottom, 44 to 48°.
Water, clear.
The fish are whitefish, pickerel, herring, sunfish, perch, black bass; fish are well fed, food abundant, shiners, chubs, and crawfish.

Coldwater Lake, Township Coldwater—*Crew No. 1:* (30)
Length 1¾ miles; width, ¼ mile; greatest depth, 32 feet.
Shores, flat and marshy all around the lake.
Bottom, black mud.
Inlets, two, one from Coldwater River, one from Mud Creek. Outlets, one, Coldwater River.
Dates of examination, September 16 and 17.
Weather, cloudy.
Temperature—surface, 70 to 72°; bottom, 46 to 47°.
Water, clear.
Fish are all small, the lake has been fished with nets and hooks so much it contains no large fish; food abundant.

Lake Morrison, Township Girard, *Crew No. 1:* (31)
Length, ¾ mile; width, ½ mile; greatest depth, 42 feet.
Shores, on south and west, low banks and rushes; east and north, high banks and wooded.
Bottom, hard, sandy and some stone.
Inlets, one, Coldwater river; outlets, one, Coldwater river.
Date of examination, September 18.
Weather, clear.
Temperature, surface, 68° to 71°; bottom, 46°.
Water, clear. No fish taken.

Lake Mattison, Township Mattison, *Crew No. 1:* (32)
Length, 1 mile; width, ½ mile; greatest, depth, 36 feet.
Shores, low banks, marshy on southeast and south end; west, hard; north, low banks.
Bottom, some hard, but greater portion muddy.
Inlets, one, large; outlets, one, called Swan Creek.
Dates of examination, September 22, 23 and 24.
Weather, September 22, cloudy; 23, rainy; 24, clear.
Temperature—surface, 70° to 71°; bottom, 48° to 49°.
Water, clear.
The fish are bass, suckers, perch. Food abundant; fish were in good condition and well fed.

Van Buren County.

Clear Lake, Colfax Township, *Crew No. 2:* (1)
Length, ¾ mile; width, ½ mile; greatest depth, 35 feet.
Shores, high clay banks, wooded on north and south; marshy for ten rods at outlet.
No visible inlet; one outlet at high water.
Bottom, mostly mud; on east end, sandy.
Dates of examination, August 17, 18, 19.
Weather, cloudy, 17; clear, 18 and 19.
Temperature—surface, 70°; bottom, 68° to 71°.
Water, clear.
Fish are silver bass, sunfish, stone rollers. Fish well fed and food abundant.

Hazzy Lake, Porter Township, *Crew No. 2:* (2)
Length, 1 mile; width, ½ mile; greatest depth, 40 feet.
Bottom, mostly mud.
Inlets, none; outlets, none.
Dates of examination, August 21, 22, 23, 24, 25.
Weather first four days, cloudy; fifth day, clear.
Temperature—surface, 70° to 75°; bottom, 56° to 59°.
Water, clear.
Fish are black bass, perch, blue-gills, suckers, shiners, bull-heads, eels. Fish all show great growth; food abundant.

Bankson's Lake, Township Porter—*Crew No. 2:* (3)
Length, 1½ miles; width, ½ mile; greatest depth, 50 feet.
Bottom, mostly mud, with very little gravel or sand.
Neither inlet or outlet.
Dates of examination. August 25, 26, 27, 28, 29, 30.
Weather, cloudy.
Temperature—surface, 66° to 82°; bottom, 51° to 68°.
Water, roily.
Fish are blue-gills, black bass, bull-heads, perch, mullets, sunfish, shiners. Fish well fed but do not show great growth.

Cedar Lake, Porter Township—*Crew No. 2:* (4)
Length, 1½ miles; width, ½ mile; greatest depth, 83 feet.
Shores, high; clay, with marl on north side; mud, west end.
Bottom, mostly clay and marl.
Inlet and outlet, only at high water.
Dates of examination, August 31, September 1, 2, 3, 4.
Weather, cloudy and windy.
Temperature—surface, 66° to 71°; bottom, 43° to 54°.
Water, clear.
Fish are black bass, perch, bull-heads, herring, dog-fish, blue-gills. Fish well fed, show great growth.

Grand Lake, Porter Township—*Crew No. 2:* (5)
Length, ¾ miles width, ¾ mile; greatest depth, 48 feet.
Shores, high clay banks, wooded on north and west sides; sand beach all around.
Bottom, mostly mud, some clay and marl.
Inlets, one small one on east side, sand and mud bottom; outlet, one at high water only on southeast side.
Dates of examination, September, 4. 5, 6.
Weather, 4, clear; 5, cloudy and windy; 6, clear and warm.
Temperature—surface, 68° to 72°; bottom, 64° to 69°.
Water, roily.
Fish are perch, blue-gills, a great many young black bass. Fish very well fed. Fish small, and do not show great growth.

Lake of the Woods, Hamilton Township—*Crew No. 2:* (7)
Length ¾ mile; width ½ mile; greatest depth 35 feet.
Shores low and marshy, except on southwest side which is sandy.

Bottom, mud; some marl, sand on southwest side.
Inlets, one on north side mud bottom; outlet, one large one on south side, sand bottom.
Dates of examination, September 10, 11.
Weather, 10, cloudy and rainy; 11, cloudy and windy.
Temperature—surface, 68 to 70°; bottom, 69°.
Water roily.
Fish are blue-gills, gars, black bass.
Food abundant, but fish do not show great growth.

Eagle Lake, Township Paw Paw—*Crew No. 2:* (8)
Length ¾ mile, width ½ mile, greatest depth 65 feet.
Shores, high clay banks, with sand and gravel beach; a little marshy on southwest side.
Bottom, mainly clay, with some mud and rock.
Inlets, none; outlets, one on south side at high water only.
Dates of examination, September 11, 12, 13, 14.
Weather, September 11, cloudy and windy; 12, rainy; 13, cloudy; 14, clear.
Temperature—surface, 60° to 70°; bottom, 48° to 49°.
Water, clear.
The fish are perch, blue-gills, bull-heads, suckers.
Fish are all large and well fed.

Prospect, or Christie Lake, Township Lawrence—*Crew No. 2:* (9)
Length 1¼ miles, width ¼ mile, greatest depth 35 feet.
Shores, high, sand and gravel beach.
Bottom, mostly mud, some little sand on west end.
Inlets, none; outlets, none.
Dates of examination, September 14, 15, 16.
Weather, September 14, clear; 15, cloudy; 16, rainy.
Temperature—surface, 62° to 68°, bottom, 62° to 68°.
Water, dark and roily.
The fish are perch, blue-gills, bull-heads, sun-fish, black bass.
Fish were well fed but small, except black bass, which were large.

Four Mill, or Cora, Lake, Township Lawrence—*Crew No. 2:* (10)
Length ¾ mile, width ¾ mile, greatest depth 65 feet.
Shores, high sandy banks, sand and gravel beach; banks mostly wooded.
Bottom, mostly mud, with little sand on west side.
Inlets, none; outlets, none.
Date of examination, September 16, 17, 18.
Weather, September 16, very stormy; 17, cloudy and windy; 18, clear.
Temperature—surface, 63° to 67°; bottom, 46° to 48°.
Water, cloudy.
The fish are blue-gills, suckers, black bass, rock bass.
Fish well fed, showed good growth.

Three Mill Lake, Township Paw Paw—*Crew No. 2:* (11)
Length, 1½ miles; width ¾ mile; greatest depth, 40 feet.
Shores, low sandy banks, with marsh around inlet on west side, sandy shores on north and south sides.

Bottom, mostly mud with a little clay and sand.
Inlets, one on east side at high water; outlets, one on north side at high water only.
Dates of examination, September 18, 19, 20.
Weather, September 18, clear and windy; 19 and 20, cloudy and windy.
Temperature—surface, 58 to 64°; bottom, 50 to 56°.
Water, cloudy and roily.
The fish are black bass, blue-gills, perch, sun-fish, suckers, dog-fish. The fish well fed and showed good growth.

Cass County.

Fish Lake, Township Marcellus—*Crew No. 2:* (6)
Length, 1 mile; width, ½ mile; greatest depth, 45 feet.
Shores, low and marshy, except east side, which are high clay banks, with little timber.
Bottom, mud mostly, with some marl.
Inlets, two, one on northeast side at high water, one on west side; wide marsh mud bottom.
Dates of examination, September 7, 8, 9, 10.
Weather, 7 and 8, clear and warm; 9, rain; 10, cloudy and windy.
Temperature—surface, 69° to 74°; bottom, 49° to 54°.
Water, roily.
Fish are perch, bull-heads, sun-fish, rock bass, black bass, dog-fish. Food abundant. Fish show good growth.

Kalamazoo County.

Long Lake, Township Richland—*Crew No. 2:* (12)
Length 1 mile; width ¼ mile; greatest depth, 31 feet.
Shores, high clay banks except on north and south sides, which is little marshy.
Bottom, clay.
Inlets, none; outlets, one on east side, large stream, high banks, clay and gravel bottom.
Dates of examination, September 22, 23, 24.
Weather, September 22, cloudy and windy; 23, cloudy and rainy; 24, cloudy and windy.
Temperature—surface, 62 to 64°; bottom 61 to 62°.
Water, clear.
The fish are black bass, perch, blue-gills, calico bass, gars. Fish show good growth and well fed.

Kalamazoo and Barry Counties.

Gull Lake, Townships Barry, Ross, and Richland—*Crew No. 2:* (13)
Length, 5 miles; width, 1 mile; greatest depth, 105 feet.
Shores, high, except around inlet and outlets which are marshy.
Bottom, clay.
Inlets, three, two large ones on west and south sides, one small one on southwest side.

Dates of examination, September 24, 25, 26, 27, 28.
Weather, September 24 and 25, cloudy and windy; 26, stormy; 27, rain; 28, windy and cloudy.
Temperature—surface, 63 to 75°; bottom 45 to 48°.
Water, clear.
Fish are pickerel, bass, perch, herring, suckers. Fish well fed and showed good growth, except the herring which are small.

As a part of the results of examination of inland lakes made in 1885 are of permanent value, extracts are here given from the report of Sidney H. Case, of Alpena, who was employed for a few months that season. No blanks were in use then, and the examination was conducted under written directions and without many of the appliances that have since been used:

Examination of Inland Lakes, 1885.

To the Honorable the Michigan Fish Commission:

GENTLEMEN—I hereby respectfully submit to you my report of the examination of Hubbard Lake.

Owing to favorable weather I was able to work on the lake every day while there and to make complete soundings and observations.

Hubbard Lake is situated in Alcona county and is twenty-four miles southwest of Alpena. It is nearly surrounded by high hills which were a few years ago covered by a heavy growth of white and Norway pine. Nearly all of this is cut down and very little left standing. The remaining timber, on the lower lands, is hemlock, oak, maple, cedar, white birch, and beach. There are several fine farms in the vicinity of the lake, and should a railroad be built through that part of the country Hubbard Lake would be one of the finest summer resorts in Northern Michigan.

It is at present alive with sportsmen from all parts of the country. The lake affords fine hunting and fishing, and the rifle and hound can be heard in all directions.

The lake is about fifty feet above the level of Lake Huron, is about eight miles long and its greatest width is three miles, while the greatest depth found was seventy-two feet, with a uniform depth of sixty-five feet throughout the center of the lake as shown on the map.

Stone and gravel are found only along and near the shore, the stones being small and round. No lime or sandstone is to be seen. Sand bottom is found in many places on the shore and in water from five to ten feet deep. Outside of this and in deeper water the bottom is soft mud and clay, the lead sinking its full length while sounding. No hard bottom was found where the water was more than fifteen or twenty feet deep. No reefs of any note were found, and those only near the principal points of land, and extending but a short distance from the shore. A sand shoal, putting out from Hardwood Point on the west side of lake, one-half mile from shore, is the largest flat on the lake.

Marshes were found at head of East Bay, Sucker Creek, West Branch, and near the outlet on the east side. Mud Bay, on the west side, is very soft bottom. Mud and East Bay are the favorite localities for bass and pike, which can be seen in great numbers when the water is still.

The lake is largely fed by springs, some of them falling over banks from

five to ten feet high, and can be heard a long distance in still weather, the largest being Noisy Spring on the west side, the other at Churchill's Point on the east side. A small creek empties into East Bay, and is nearly covered by weeds and grass, and has very little current. Sucker Creek, near the head of the lake, is fifty feet wide and two feet deep, at the mouth, in low water, and from four to six feet deep a few rods above. It is almost dead water at this season of the year. It is used by the lumbermen for running logs, and is navigable for that purpose for six or seven miles. There are two dams on this stream built to enable the lumbermen to drive their logs in low water. West Branch, at the head of the lake, is the largest stream flowing into the lake, and is also used for running logs. It has four dams and a large reservoir which covers about one hundred and fifty acres. It is eighty feet wide and ten to twelve feet deep a short distance up, but is shoal at the mouth. The stream is fed by springs, and the water clear. It is lumbered eight miles above the lake, and many million feet of logs are run down every season.

The south branch of Thunder Bay River and the outlet of the lake is fifty feet wide, and quite deep at high water. It has a rapid current, caused by a dam at the foot of the lake, which raises the water about three feet. All logs put into the lake are run over this dam and taken to Alpena. The logs are taken through the lake by means of a steam scow, in the following manner: A large line, two thousand feet long, is coiled up on the scow, one end of the line made fast to the raft, the scow started, and all the line paid out, a large anchor is let go, and the end of the line taken to a steam windlass and the raft is pulled up to the scow, which goes ahead again. In this way the raft is brought to the outlet and the logs sluiced over.

I intended to set the net near Hardwood Point, but could not on account of the scow coming down that side. The net was set the first time opposite Doctor Point and about the center of the lake in sixty-five feet of water. The net was set at night and lifted the following afternoon, and six whitefish were caught. The next time the net was set midway between East Bay and West Branch in sixty feet of water, and only two whitefish were caught, the fish evidently being near the other end of the lake and nearer their spawning beds. The whitefish resemble the gill-net fish caught in Lake Huron, but are more round and weigh from three to five pounds each. The fins and tail are dark yellow, some of them nearly red; are not as fat as the lake fish but much harder, and are of finer flavor. They are taken with spear and gill net when they come on their spawning beds, from the 10th to the 25th of November, and are taken in large numbers by the aid of a jack light and a spear. Gill nets are used every fall, but most of them are speared. The largest bed is located opposite Hardwood Point and is about one mile long by one-half wide, other beds being in different parts of the lake, as indicated on map. These beds are located in water from fifteen to twenty feet deep and on sand and soft bottom, which is thickly covered by a round weed that resembles a cat's tail and comes up to within four or five feet of the surface. It is impossible to see through them, and a net set on these beds catches them as they pass over, as the corks remain on the surface while the leads rest on the tops of the weeds. They are only seen in these beds during the spawning season, but a few are seen near the shore in the spring as soon as the ice is gone. There are none on the beds in the spring. A man informs me that he has speared as high as 150 fish in one

night and has caught sixty in a gill net one night out. This is corroborated by other residents, also by lumbermen and others who have speared and netted whitefish there. There is no question but what they are plenty. Others have gill nets there every fall and get from four to five barrels during the spawning season.

As near as I can ascertain, there are about twenty barrels of whitefish taken out every fall, and some are sold in Alpena and some in the lumber camps. There are no complaints of illegal fishing, as all are interested in doing a little fishing on their own account. A seine could be hauled in several places, but do not think the fish come near enough to shore for seining. As a net could not be hauled over the weeds, a trap net could be set to good advantage outside of their beds, as they go out over the tops of the weeds to deep water as soon as it is daylight; and when they come on the beds they come up through the weeds from the bottom.

Could not find out what they feed on, as nothing could be seen in those I dressed. I could see a great many small shells on the bottom and in many places something like moss, but in deep water there seemed to be no growth, nothing but mud and clay. A long weed grows along the shore and in water ten or twelve feet deep.

There are several places where a pond could be made, the only danger would be the ice shoving up; but there are bays where this danger could be avoided and a sheltered place found.

The lake abounds in grass pike, black bass, perch, herring, while sheepheads, bull-heads and muskallonge are sometimes caught. Gar, or bill-fish, are often speared.

All of the above named fish are speared or caught by trolling in large quantities. Bass, pike, suckers and perch are caught in Sucker Creek, West Branch and at the outlet below the dam on the South Branch.

The week I was there the thermometer stood at 70° and very warm nights, so there was very little difference in the temperature of the water mornings and evenings. The temperature of water was as follows: Hubbard Lake, at 65 and 70 feet—morning, surface 60°, bottom 50°; Sucker Creek, 60°; West Branch, 58°; outlet, 62°; Noisy Spring, 58°; spring at Churchill's Point, 48°.

All of which is respectfully submitted. S. H. CASE.

OCTOBER 7, 1885.

Higgins Lake.

Higgins Lake lies mostly in Roscommon county, only a small portion of the head being in Crawford county. It is reached by way of Roscommon, a small village on the Mackinaw division of the Michigan Central. The lake is five miles west of the village, and about the same distance from Cheney. The land around the lake is generally high, the lowest being on the southeast side near the foot, this being low Norway plains, with a light growth of Jack pines. These lands were formerly well-timbered, but have been cut over so that all left standing is burned timber on the southwest side near the outlet, and a grove of Norway on the east side near the head of the lake.

A few farmers have settled about the banks, but live chiefly on pure air, water, and the abundance of fine fish found in the lake, as the land is very poor sand, and nothing but a mortgage will hold it.

Higgins Lake is one of the finest in the State, the water being as clea and cold as that of Lake Huron. It is a fine resort, and is visited by partic from all parts of the State during the summer season, there being man camping grounds about the lake.

East Saginaw and Bay City parties have fine resorts on the east side of th lake near the head, each having from twenty-five to thirty buildings, man of them being very ornamental and quite costly.

The Bay City grounds command a handsome view of the lake, as th banks at this point are fifty feet high, the beach being reached by stair The East Saginaw resort is about one mile farther up the lake, on lowe ground. A sand flat extends out about three-fourths of a mile in front c these villages, and a person can wade out to the edge of the bank and dro off into forty feet of water if so disposed. A sand beach from one to tw rods wide extends over half-way around the lake, the remainder of the shor being stone and gravel.

A team can be driven entirely around it, as there are no marshes of not or soft places.

The lake is over seven miles long, and from one to three miles wide. Th lower part of the lake is narrow, but the deepest water is found there, bein ninety-two feet deep about the centre of the lake. The upper part is muc shallower, but has deep water in many parts of it, but the head of the lak is generally shallow.

A small island near the Bay City grounds contains twenty-three acre The bottom in the deep water is a soft marl with clay and sand in places.

In the shallower water sandstone and gravel are found. Rocks and smal stones are found around the island, Smith's Point and on the middle groun in the lower part of the lake. Gravel is also found in many places along th shore in patches.

A sand flat extends out from ten rods to one-half mile, and nearly aroun the lake with water upon it from four to ten feet deep to the edge of th bank, where it drops off into water forty feet deep in places. The lake i very free from weeds; all to be seen are along the banks of these sand flat A few rushes grow at points along the shore and at the island. The water i very clear and cold, temperature being 62° at surface and 59° at the bottor when examined about the last of September. This lake is undoubtedly fe by subterranean inlets, as there are no visible ones with the exception o two small creeks at the head and a small spring near the East Saginav grounds, with very little water flowing in from all of them.

The outlet or cut at the south end of the lake is about fifty feet wide an two feet deep with a rapid current. It is apparent here that there must b an underground feeder, as more water passes out in one day than comes i by all visible inlets in a month. A dam at the outlet raises the water in th lake about three feet. The sluice is closed during the winter in order to hav a good head in the spring to drive logs through the cut.

After the logs are all out of the lake in the spring the sluice is opened an left so until the next fall. Very few logs are put into the lake at presen and this winter's cut will about finish the lumbering in the vicinity of th lake. A few sunken logs and tree tops can be seen near the shore, and i places bark has washed up along the shore but the beach generally is ver free from debris. The lake is well supplied with black bass, grass-pike perch, rock bass, sun-fish, herring and gars. While I was at this lake

couple of men went through the cut into Marl Lake and speared thirty bass and pike in two hours.

Whitefish are also found in this lake and are caught with nets and many have been speared. A man who has spent his summers at the lake for the last eleven years, says that in 1864 a seine was hauled at his landing and a great many whitefish were caught and sold about the country. He has fished more or less every season he has lived at the lake and says he has speared as many as forty in one night, but thinks the whitefish have decreased very fast since the logs were put into the lake. An old resident informed me that he had speared as many as sixty in one night and had seen large schools of them a few years ago, but thinks there are not many in the lake now, as very few were speared last season. Parties that live opposite Parker's Landing speared a whitefish near the middle ground in the lower part of the lake while I was there. The net was set in the lower part of the lake and about the center in ninety-two feet of water, and when lifted contained one herring. I then set it in the narrow part of the lake, and caught one whitefish and three herring. The whitefish resembled the Lake Huron fish and weighed about four pounds. Their spawning beds are near the island in the upper part of the lake and on the middle ground in the lower part and opposite Watson's Landing. They are speared on these beds, and a few are seen near the outlet.

A party had a gill net set near the head of the lake about three years ago, but I could not learn how many he caught, as he had moved away. I do not think any nets have been set in the lake since he left. I think this and Hubbard are two of the finest lakes in the State and well adapted to whitefish and must contain their natural food. I hope you will conclude to largely restock these lakes with whitefish, and when spearing can be abolished I think you will have no difficulty in making a good showing.

Respectfully yours,

September 25, 1885. S. H. CASE.

Bear Lake.

Bear Lake lies mostly in Charlevoix county, a small portion of the upper part being in Emmet. It is a beautiful lake, fed by springs, the water being clear and cold. It is reached by the Grand Rapids and Indiana Railroad, the nearest station being Clarion, about one mile from the lake. It is entirely surrounded by high hills rising almost from the water's edge, leaving only a narrow beach of gravel and stone, with sand in places.

The main lake is nine miles long with an arm extending some miles to the northward; it is one and one-fourth miles wide at its widest point, with an average width of three-fourths of a mile; the deepest water found was ninety feet, with an average of twenty or thirty feet. The bottom is sand, stone, and gravel in the shoal parts of the lake, and a soft marl in the deep water, similar to most inland lakes. Many shells can be seen on the bottom, both large and small, mostly clam shells. It is very free from marshes or swamps around the shore, but has a few rushes about the narrows.

There are two mills on the lake, but as far as I could see no sawdust was deposited in its waters. A small tug is used to tow the logs to the mill where they are sawed, and the lumber hauled overland three miles to Pine Lake, where it is shipped.

There are several fine camping grounds about the lake, one of them

belonging to a party of railroad officials who visit it during the summer, a have a telegraph line to their camp.

The lake contains black bass, pike, perch, blue-gills, sun-fish and herri Brook trout are also found in its waters, having come from a small spri creek that empties into the lake on the east side, this being the larg inlet, but there are several small springs flowing into the lake at differ points. Bear Creek, the outlet at the foot of the lake, is about twenty f wide at its mouth, and ten inches deep, with a strong current. Some per has placed a wire screen across the mouth of the creek to prevent the from passing out of the lake, as they could have done before it was there. I am inclined to think that the salmon put in the lake a few ye ago have gone out into Lake Michigan through this creek, which empt into Little Traverse Bay at Petoskey. I can account for their disappeara in no other way, as the lake seems well adapted to both salmon and whitef the water being clear and cold with gravel and stony bottom. The net set in the deepest water but failed to catch anything but a few perch, few fish could be seen, and those only in very shoal water.

A great deal of spearing was done on this lake a few years ago. On the farmers who lives near the lake informed me that he had counted se jack lights in one night, and had seen a barrel or more of dead fish left the shore, just speared for amusement.

A railroad official at Grand Rapids told me that he had seen them tal away by bags full and large quantities left on the shores. The Indians u to set nets across the narrows in the spring when the fish were passing into shoal water and caught large quantities of them, but for the past y or two no nets have been set there and but little spearing done, as the fa ers are not generally in favor of it but do not like to make complai Owing to the lateness of the season and rough weather I could not mak thorough an examination of this lake as I wished to, and do not conside a fair test at this season of the year. During the summer the salmon whitefish if in the lake would naturally be in the deepest water where net was set, but late in the fall when the temperature of the water is ab the same in all parts of the lake it is more difficult to locate them requires more time, as the net would have to be set in shoal as well as d water in order to test it thoroughly so late in the season. There are sev fine farms about the lake, and the farmers are in favor of some legisla that will peserve the fish from total destruction.

Respectfully yours,

S. H. CAS

November 18, 1885.

Elizabeth Lake.

Elizabeth Lake, Oakland county, lies five miles west of Pontiac. surrounded by fine farming lands with several dwellings on its banks. land about the lake is high with very little marsh or low ground. The is a little more than one mile long, and is one-half mile wide. The wat clear and from thirty to sixty feet deep.

The bottom in the deep water is a soft mud. A sand and clay flat ext out from the shore from ten to twenty rods and nearly around the l This is covered with small stone and gravel, also with clam and snail sh Rushes grow all over this flat and to the edge of the bank where the wat

from twenty to thirty feet deep. A few weeds and rocks can be seen in the shoal water and in other parts of the lake.

A sand bar runs nearly across the lake near the outlet with deep water on both sides. The lake is fed by a small creek from Mud Lake, a few rods to the north and near the head of the lake on the north end.

The outlet near the foot of the lake is also a small creek flowing into Cass Lake about one mile to the south. These creeks are little more than ditches and have very little current.

The lake contains black bass, grass-pike, rock bass, perch, sun-fish, dog-fish, gars and lizards without numbers. A few eels have been caught in the lake. These are all taken with the spear, no nets have been set in its waters for some years.

Mr. Whitehead, living at the lake about ten years ago, had a gill net and used to catch a good many whitefish. Parties came from Pontiac and other places and speared a great many about that time. Spearing is done there spring and fall free to all, with no complaints as far as I could hear.

Residents have speared there more or less for the past ten years, but have not or do not know of a whitefish being speared or seen in the lake for the past three or four years, and think they are about exterminated.

Richard Smith, living near the lake, assisted in planting the first lot of whitefish put in the lake. He stated that he had not seen a whitefish there since about 1881, but has fished some every season.

He thinks the whitefish have about all been speared or devoured by other fish. Mr. Smith was with me when I lifted the net and had a curiosity to see a whitefish once more. The net was set in the center of the lake in sixty feet of water, and in the same place where Mr. Whitehead set his net. It was left nearly two days before lifting so as to give it a fair trial. When lifted only one grass pike was taken. The lake being small is run over by these pike and other fish, the whitefish being unable to get out of their way as they can in larger lakes.

I did not think best to stay longer at this lake, for I was pretty well satisfied that there were few whitefish in it.

Respectfully yours,

ELIZABETH LAKE, Oct. 24, 1885. } S. H. CASE.

F. PROPOSED EXTENSION OF EQUIPMENT.

1. *Paris Station.*

What was said above in reference to the recent improvements on the trout hatching station at Paris will indicate in outline the proposed extension which the station requires, and which we recommend. The purchase of the additional land with the appropriation two years ago of course contemplates a steady and gradual improvement of the property as required for the permament extension of this work. The new large pond on the Buck-horn, which has been already described, is the foundation of all the work upon that stream below the dam With the head of water in the large pond it is possible to supply a vast number of artificial ponds laid out along the general trend of the stream below. The results of next year's experiments with the grayling in the wild pond will determine to what extent it is necessary or

advisable to make further improvements upon the Buck-horn for that wor A small sum ought to be provided with which the improvements both bel and above the large pond could be made as found necessary; all of whic however, in the next two years would probably not exceed $600. Sor fencing should be done upon the property surrounding the Buck-horn, fact all of the State property at Paris ought to be properly fenced.

Respecting the other work at Paris, that upon the Cheney creek, which by far the more important, we have also indicated above what improvemen are needed. The present capacity of our trout hatching house is abo fifteen hundred thousand. The number of brook trout eggs laid down the fall just past was a little over thirteen hundred thousand, being increase of six hundred thousand over the take of 1885; even at the san rate of increase for the coming fall we shall have over eighteen hundr thousand eggs, but in all probability the increase will be much more. T reason of this increasing ratio is from the fact that the last season, 188 was the first one in which we have felt the effects of the large stock of f held at the hatching station for the purpose of increasing the stock spawning fish. Since 1883 much larger numbers of brook trout than befo have been deposited in the little Buck-horn and in Cheney creek, so th from those sources a very large supply of spawning fish is readily obtain each fall to supplement the product from the fish in the stock ponds. Fro five to fifteen thousand have been saved each year to be reared in the nurse races and the stock ponds. The predictions for the take of eggs for 188 1885 and 1886 made in earlier reports have each time been fully realiz and a little more. We expect, upon the same basis that our other calcul tions have been made, to lay down in the fall of 1887 two million of bro trout ova, and in 1888 about twenty-eight hundred thousand—of cour saving in case of unavoidable accident. It is thus apparent that to ke pace with the work already laid out and fairly in view we must ha increased hatching facilities. It may be remembered by readers of the la biennial report it was anticipated that a new house would be required to built out of the late appropriation, but by the timely discovery alluded above, by which the capacity of the house was greatly increased, the buil ing of a new house was postponed, and other equally necessary improvemen in the way of wild ponds, grading, etc., about the grounds was done. It now necessary to provide at once for the new house. After very caref consideration of the requirements, the Board has decided that a new hou at Paris should be not less than 40x80 feet, which would give a capacity more than three millions and a half, which with the old house as at prese in commission would give a total capacity for the station of about fi millions of the trout kind. That would cover about the maximum of th station for brook trout work, give room needed for work upon the graylin as well as land-locked salmon, for all that we could obtain from the Unit States Commission, and leave a margin for about one million of salmo trout eggs, if it should be deemed best to resume the hatching and distr bution of salmon trout. In order to estimate as nearly as possible t cost of a house of the size and capacity here recommended, we have prepar simple drawings and specifications, and procured the estimates of two con petent builders. The figures indicate that we must provide for the house least $2,500. The increased capacity of this station also requires addition new carrying cans for which we must provide at a cost of about $20

During the next two years we need to provide five or six new stock ponds adjoining our present upper ponds inside of the levee, which will require before the fall of 1888 not less than $500. There will be required to repair the damage to the large ponds done by the floods of September, 1886, and to finish clearing the ground, about $800.

2. *Detroit and Petoskey Station.*

Whether any further extension should be made to the whitefish work will depend mainly upon the legislation that is adopted for the government of the industrial fisheries. We are already doing enough at Detroit and Petoskey to stock to the fullest capacity those large inland lakes which we now think it practicable to stock as reservoirs for future supplies of eggs, and also to make such further demonstration of the ability of artificial means to increase the supplies at some points in the great lakes. We feel entirely sure that, in time, the good sense and wisdom of the State government will apply the remedies necessary to preserve the great industrial fisheries, but until that time arrives we should deem it unwise for the State to embark upon any more extended operations in the culture of whitefish: certainly not to the building and equipping of any other establishments. By a very small expenditure, say not exceeding $700, a new tank house can be constructed in connection with the hatchery at Petoskey, which would be ample for the needs of that station, if the present house were filled with the automatic hatching jars. The advantage of increasing the capacity of the present stations to a maximum will be appreciated, in considering the great saving which that course will make in the current expenses of maintaining and operating them. For instance, by an expenditure from about $2,500 to $3,000 the station at Petoskey can be increased about one hundred millions in production, but the cost of maintaining that station, even at the increased production, would not be beyond one thousand a year, while if a new station were built, of the same capacity, the original plant would cost not less than $5,000. The actual expense of maintaining and operating it would be from $2,500 to $3,000. In very much the same way as suggested for the increase of work at Petoskey, an increase of work could be made at Detroit by a different arrangement of the house, and perhaps utilizing the present shop and barn for tank room. The Detroit house might be increased in the way pointed out for the Petoskey house. We do not wish to be understood as recommending, at present, any appropriation for extension of the whitefish work until we know whether legislation, respecting the regulation of the fisheries, is to be adopted or not. And if measures for good government of the fisheries are adopted, we should deem it unadvisable to extend whitefish operations any further than the maximum equipment of the Detroit and Petoskey stations. This will be sufficient for the next two years. When estimates are submitted to the committees of the legislature, specifications of the cost of such extension will be submitted.

G. HELP FROM MICHIGAN RAILROADS.

The appreciation of the general benefits from the operations of the Commission shown by the railroads of the State is not only gratifying, but the manner in which it is shown is most helpful to the Board, and deserves more

than a simple acknowledgment of thanks. For instance, they haul our cars, during the time of planting whitefish, without charge; they carry our cans with trout and return the cans, besides passing the attendants; they move the boxes of eggs from Detroit to Petoskey, and, when our crews are on the road examining inland lakes, take baggage and camp outfit and men: in fact, whenever the men are going from one station to another on the board's business, furnish transportation *free*. The saving that thus results to the State is several hundreds of dollars a year, which enables the Board to accomplish just so much more work with the means provided by the legislature. In 1885 and 1886 the whitefish to be planted have been transported in baggage cars rented from the Grand Rapids and Indiana Railroad Company. The charter price for the cars has always been liberal to the board, no charge is made for any day when either of the cars are on the line of that road, and in settling the bills the company have always given credits, which were thankfully received, but which we could not have asked under our contract. The Grand Trunk, while not willing to draw our chartered cars, always furnish suitable baggage cars of their own for making shipments across the State, on their lines. The Detroit, Lansing and Northern, and Grand Rapids and Indiana have been called upon most frequently from the fact of our most frequent line of travel being from Detroit to Paris and Petoskey, and their response has always been prompt, generous, and courteous. The Michigan Central, while doing its full share in hauling cars and transporting our men free, has also given us most convenient facilities at the Detroit depot.

In addition to the railroads above mentioned the following have furnished men and cars free transportation, to whom, with the others, we desire to make suitable acknowledgment:

The Flint and Pere Marquette.
Detroit, Marquette, and Mackinac.
Michigan and Ohio.
Detroit, Bay City, and Alpena.
Chicago and West Michigan.
Chicago and Northwestern.
Detroit, Grand Haven, and Milwaukee.
Lake Shore and Michigan Southern.
Michigan Central, Leased Lines.
Marquette, Houghton, and Ontonagon.
Pontiac, Oxford, and Port Austin.
Saginaw, Tuscola, and Huron.

H. ORGANIZATION OF THE COMMISSION.

The Commission is organized as follows:

Commissioners: Joel C. Parker, president, Grand Rapids, whose term expires 1887; John H. Bissell, Detroit, term expires 1889; Herschel Whitaker, Detroit, term expires 1891.

During the past two years the Board has met regularly on the third Tuesday of March, June, September and December each year. The details of work requiring special supervision being committed from time to time to one or two members of the Board. Detailed reports being submitted by each commissioner at regular or special meetings. Special meetings have been

APPENDIX.

1.—SUGGESTIONS ON CARP CULTURE, FOR THOSE ENGAGED IN, OR WHO CONTEMPLATE, RAISING CARP FOR MARKET OR PRIVATE USE..

BY DR. JOEL C. PARKER, COMMISSIONER.

WATER SUPPLY.

Undoubtedly the best supply is that furnished by creeks and large streams, the water from springs being of too low temperature, unless warmed by exposure to the sun in shallow ponds or long ditches; the matter of temperature, rather than that of quality, being the governing factor in successful work.

LOCATIONS OF PONDS.

The first and most important consideration in choosing a location for carp culture is to select such a place that every pond can be thoroughly drained; if possible, perfectly independent of every other pond, and not from one into another.

Do not make a pond, or series of them, by damming the main stream; rather place them along the side of the stream, or of a ditch leading from a stream, on the higher ground; place the ponds close together for the sake of convenience, and bring the water to each pond through its own ditch or sluice, the water in the sluice being under control by means of some form of gate, by which it can be shut out at will.

If the water supply is limited, the ponds may be so constructed as to discharge from one to the other, but independent supply and drainage should be secured if possible.

CONSTRUCTION OF PONDS.

The first prime requisite is that the pond shall hold water.

called as occasion required. By regulations recently adopted the regular meetings of the Board are hereafter to be held on the third Tuesday of each month, at the office in Detroit. The increasing business requiring more frequent organic action. By the same regulations the work of the several stations has been parcelled amongst the Commissioners, the appointment to continue one year.

The staff of the commission is constituted as at the last report:
Treasurer—William A. Butler, jr., Detroit.
Superintendent—Walter D. Marks, Paris.
Secretary—Andrew J. Kellogg, Detroit.

Detroit station—Eli Tinlan, overseer, one assistant.
Paris station—O. D. Marks, overseer, two assistants.
Petoskey station—A. W. Marks, overseer, one assistant.
Glenwood station—W. Wells, overseer.

A constant improvement has been made in every department of the practical operations of the Board, which is mainly due to skillful and intelligent superintendence, seconded by industrious and willing cöoperation on the part of the men.

Great progress has also been made in systematizing the fiscal and clerical matters in the office. The correspondence grows each year, the numbers of reports, applications for fish and for information, come from every part of the State in greater numbers each year; so that without a convenient office and vault and a competent secretary the business of the Commission would be hopelessly blocked. From all indications this part of the Board's business is not likely to diminish but increase. The Commissioners visit and inspect the various stations from time to time so as to be personally familiar with the requirements and capacities of each, and find that their interest in and knowledge of the practical work encourages the men and tends to secure effective service.

Such cöoperation as the engagements of the Commissioners permit is given to general fish-cultural interests by correspondence with the United States and State Fish Commissions, and by participating in conferences of Commissioners, and in the meetings of the American Fisheries Society. The Board are convinced that the Commissioners of the States most interested in uniform fishery legislation for the great lakes are working to the same end, and that all appreciating the requirements of the situation will urge upon their respective State Governments substantially the same measures, so that practical uniformity will be attained to the extent that such suggestions are adopted.

Detailed estimates, based upon actual expenditures and the experience of the past two years, will be submitted to the committees of the Legislature at its approaching session. The appendix will contain the financial statement and such other matters of general interest in the Board's work as are considered worthy of preserving in permanent form.

All of which is respectfully submitted.

JOEL C. PARKER,
JOHN H. BISSELL,
HERSCHEL WHITAKER.

December 1, 1886.

APPENDIX.

1. Suggestions on Carp Culture.
2. The Michigan Grayling.
3. Fish and Fish-Culture in Michigan.
4. In Memoriam.
5. Tables of Plants, Temperatures, Condensed Inventories, Etc.
6. Financial Statement.
7. Other Commissions.

To secure this a clay or loam bottom is necessary; an alluvial or mucky soil will not do. If necessary to locate in such a soil, the "holding" qualities can be secured by covering the bottom with five or six inches of clay, evenly and well distributed.

In every pond, and near the drainage pipe—but not lower than it—should be formed a pool or basin, which should be the deepest spot in the pond. Extending from this should be a ditch running the full length of the pond, of such a grade that in draining the pond the water in this ditch shall all run into the pool; lateral ditches should be run from this main ditch to the sides of the pond, so that, as the water grows less in emptying the ponds, the fish will naturally find their way into the main ditch, and ultimately into the "basin" through these radiating ditches.

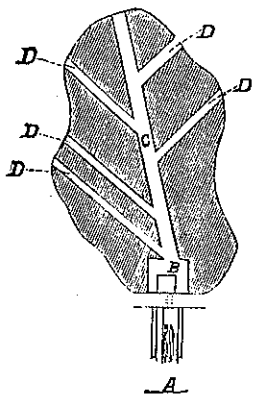

Fig. 1.

Fig. 1. represents the bottom of a typical pond, in which A is the drainage pipe, B the basin or pool, C the main ditch, and D, D, D, etc., the lateral ditches.

The size of the basin B and ditches C and D should be in proportion to the size of the pond. In a pond of an acre the basin should be from fifteen to twenty feet in diameter, and at least one foot deep, and the ditch C three feet wide and a foot in depth.

DAMS.

In constructing dams it is wise to build solidly. A poorly built dam will prove a constant source of vexation, if not of direct loss, and it is essential to build well. First decide as to the form of dam, whether by a solid earth embankment or by driving piles. If the first, commence by removing all alluvial earth, all sticks, stones, and roots down to the firm sub-soil; in this cut a ditch the full length of your dam from two to three feet in width and from one to two feet in depth. This should be compactly filled with clay—"puddling" is best; over this should be raised the dam proper. Clay is preferable, or a mixture of clay and loam, proportioning the width of the dam to the depth of water desired, but make it broad and solid. A strong and tight dam can be made by driving, as deep as possible, two rows of "sheet piling," or planks, with their edges in contact, the rows from eight to twelve inches apart, and the space well puddled with clay, the outside to be well banked with earth.

NUMBER AND CHARACTER OF PONDS.

The number and size of ponds will be determined by the extent to which the work is to be carried on. To those advantageously situated near a ready market, and with ample water facilities, ponds ample in extent and number will be provided. But to those who desire to breed carp, even in a small way, two ponds are necessary. But undoubtedly in this State the outcome of carp culture will be something like this: There will be those who will

breed carp for sale, and others who will purchase them, and grow them for home consumption.

The latter, and probably by far the larger number, could do so in a limited area, and in ponds without the facilities of drainage necessary for those who *breed* the carp, as all that would be necessary would be to put them in the ponds when they were, say a year old, and leave them to care for themselves, or to be fed as desired, and to take them out when wanted. But for those who *breed* carp, there must be one or more "spawning ponds," and one or more ponds for the adult fish.

THE SPAWNING POND.

The spawning pond should be so located as to afford the greatest facilities for being warmed by the sun, and protected from cold winds; for carp will not spawn in water of a less temperature than 68° Fahrenheit.

It should be not more than three feet deep in the deepest place—the pool, or basin—and slope gradually to a few inches at the edges. It should afford perfect facilities for drainage, as indicated in Fig. 1. Its extent should be in proportion to the work intended to be carried out. In France and Germany the proportion is one acre to two "spawners," in situations where only the natural food supply is to be used; when there is an abundance of water and it is designed to feed the fish, twice this number of "spawners" may be admissible.

STOCK PONDS.

These should be much deeper, six or eight feet at least in the pool, and with abrupt banks, with the water at least twelve inches deep at the edges.

A number of comparatively small ponds are preferable to one large one, as in draining the minimum number of fish will be left exposed, and the washing of banks by waves be much diminished.

WINTER PONDS.

The experience of the Commission has demonstrated the great value of spring in the winter pond.

Probably the greatest obstacle to successful carp culture in our northern latitudes will be excessive freezing. It is not uncommon for ice to be found from one to two feet, and even more, in thickness. This, while diminishing the water supply, also prevents the escape of poisonous gases that are always being evolved in greater or less quantities, at all seasons of the year, from the decomposition of organic matter; and in every winter pond some method must be adopted to keep one or more places open through the ice during the entire winter.

This can best be accomplished by a spring, whose constant temperature not only prevents freezing, but furnishes a continual supply of water containing oxygen for the nourishment of the hibernating carp. In situations where a spring is not available, a good plan is to cut holes through the ice as soon as it is sufficiently strong for safety, insert a barrel, upright, with both heads out, and fill the same with long rye or wheat straw. This should be examined often, and, if frozen solid, cut out and refilled. Constant care in keeping this "air-hole" open will be the only way in which success can be secured.

MANAGEMENT OF PONDS.

Premising that the ponds—two or more—have been properly constructed, filled with water, and found all right, and that you have on hand a sufficient number of adult carp—one, two, or more females and twice or three times as many males—and you are ready for business.

About the last of October drain the spawning pond, clear the ditches and pool of all sediment and refuse, and let it remain dry until the next spring. As soon as the season is sufficiently advanced to insure against hard freezing fill this pond, and so arrange the water supply as to have the water always at a uniform level, for if this is neglected, and the water recedes after the spawning has commenced, the exposure of the eggs to the sun and air would destroy them.

Plant the pond plentifully—in all parts except the ditches and the pool—with aquatic plants found growing in the lakes, rivers, and brooks in the vicinity such as water-cress, hornwort, duckweed, bulrush, etc., etc. These should be put in early so as to be well developed by the time the spawning commences, for it is on these that the female deposits her eggs, and only those eggs that find lodgment on plants will hatch.

The time in which to place the adult fish in the spawning pond will vary with the season, but probably in the southern and middle portions of the State from the first to the middle of April. The probabilities are that the spawning will commence about the first of May, according to the temperature of the water, and will continue at intervals through many weeks. The temperature of the water also exerts a marked influence on the development of the eggs. If in shallow water, well warmed by the sun, and the nights not too cool, they will hatch in from four to six days; but if in deeper water, or the weather be cold or stormy, they may be retarded for two or three weeks. The number of eggs laid by a healthy female three years old is nearly half a million; from these you may reasonably expect from one to two thousand healthy young carp in the following October if the pond is properly cared for and has sufficient area, with a plentiful food supply.

Remember that every other kind of fish, even to minnows, must be kept out of the spawning pond. Towards the last of October drain the water out of this pond, taking plenty of time, so that all the fish may find their way into the "collecting ditches" and the "pool," and so arrange the time that the final drainage shall occur in the morning, giving plenty of time through the day in which to distribute the young fish to the

WINTER POND.

A large number of these "summerlings" can be successfully cared for in a comparatively small space, if the precautions in regard to keeping open "air holes" be attended to. In France they make the proportion 50,000 to the acre of water.

In the following April, or as soon as they are through with their winter nap, the winter pond should be drained, and the young fish transferred to the

NURSERY PONDS.

The proportion should be not more than 1,500 to the acre of water, if the conditions are favorable in the way of a good growth of aquatic plants; and

in addition to those plants already mentioned, may be added the white and yellow water lily; the "cat-tail" flag; calunus, or sweet flag; arrow head; wild rice, etc., etc. Such plants, together with the insect life that finds a home in their foliage, furnishes the forage upon which these fish must subsist, and the over-stocking of the water would be as disastrous as the over-stocking of a pasture devoted to any of our domestic animals. If there is a good depth of water in the "nursery ponds," so that there is no danger from freezing, the fish might be allowed to remain in them until the following spring; but it is probably better that, in October, they be transferred to the "winter ponds."

STOCK PONDS.

In the spring these fish—now two summers old—should weigh from one and a half to two pounds, depending, of course, upon proper care and the food supply; and the number assigned to each acre of water should be no more than 100, and even less than this if the food supply is limited. In these ponds they are to remain until removed for market. Of course a much greater number than this can be put into these ponds for remaining through the winter, but not more than this for the purpose of being grown.

As amongst these there will be many that will spawn, and it is not desirable that the pond should be filled with the small fish, it is advised that there should be placed in these ponds from ten to twelve good sized black bass to each hundred carp, and it might be that other predaceous fish, such as pike, perch, sun-fish, or rock bass, might be added to good advantage.

Those designing to grow carp for market should also have a

SALE POND.

This should be large in proportion to the number of fish kept in it; should have a clay bottom, and the sides made smooth with plank or walled with stone, brick or cement, to facilitate the taking out of the fish with a seine and the fish when confined in such a pond should be well fed with cooked food and the water should be as pure as possible. Carp removed from muddy impure waters and kept for even a few days in good, pure water will be much improved in flavor.

HANDLING CARP.

Carp should always be carefully handled; being a quick and strong fish they struggle vigorously when caught, and unless care be taken will bruise themselves in the seine or against any solid object. Such wounds are apt to be troublesome and may become fatal through the growth of a fungus which is pretty sure to attack those confined in impure waters and which will sometimes extend to the healthy fish. When transferring the carp from pond to pond have tubs of water in readiness on a wagon, wash the mud from the fish and put them in the tubs. The young carp can be transported long distances in a comparatively small quantity of water without changing it.

ENEMIES OF THE CARP.

All aquatic wild birds, together with tame ducks and geese, will feed upon the spawn and should be banished from carp ponds. The blue heron (crane), bitterns (shide poke) and king-fisher are the especial pests of the ponds, and should be shot on sight. Mink and musk-rat also destroy both old and young. Snakes, especially the kind known as "water-snakes," feed on the young fish, and turtles will take their share; and frogs will feed on the spawn. So it is best that all animal life except the carp should be excluded from carp ponds. Devote the ponds *exclusively* to the propagation and growth of the carp, if you desire the best results.

2.—THE MICHIGAN GRAYLING.

BY HERSCHEL WHITAKER, DETROIT, MICH.

[Read before the Annual Meeting of the American Fisheries Society at Chicago, Illinois.]

The grayling (*Thymallus tricolor*) is found native to the waters of Michigan alone of all the *States* in the Union.* Vague rumors from time to time have hinted at its presence elsewhere, but the authenticity of such statements has never been verified. A few facts concerning the distribution of the grayling of Michigan, its habits and the experiments that have been made in Michigan looking to its artificial propagation may not be devoid of interest to this association.

The waters of Michigan in which it has its habitat may be generally described as within the territory bounded on the south by 43:30, extending as far north as 45:30. The streams included within this territory discharge their waters into Lake Huron and Lake Michigan. An imaginary line drawn from the mouth of the Muskegon on the western border of the State to the mouth of the Au Sable on the east will, perhaps, better indicate the southern limit of the grayling streams. The waters most famous as grayling streams, owing to their magnitude, their accessibility and their popularity with sportsmen, are the Au Sable and the Manistee. The Hersey, the Pere Marquette, the Maple, the Pigeon, with their tributaries, and numerous other streams of less importance included within the boundaries already mentioned, are also fairly stocked with this fish. The Boardman, the Boyne

*In response to a personal letter of inquiry addressed some weeks ago to Professor Tarlton H. Bean, curator of the National Museum at Washington, D. C., the following courteous reply was received. We have a loving inclination to try causes with the Montana grayling ere the summer is gone.—ED.

Washington, June 15, 1886.

Wm. C. Harris, Esq.—DEAR SIR,—In reply to your letter of the 12th, I desire to give you the following facts concerning the Montana grayling:

I cannot tell which of the streams to be mentioned offers the best fishing, but the species is known to exist in Jefferson, Madison and Gallatin Rivers. I would suggest Virginia City as a central point from which the upper waters of the Jefferson and Madison may easily be reached. Virginia City, as you know, is connected with Ogden, Utah, by a narrow gauge road.

On the line of the Northern Pacific road you will observe several places in proximity to the Gallatin River—for example, Fort Ellis, Bozeman, Central Park, Hamilton and Gallatin.

The Museum has the Montana grayling from Fort Shaw in Lewis and Clarke county, from Camp Baker in Meagher county (Camp Baker is on Smith or Deep River, a tributary of the Missouri), and from Willow Creek, which is a tributary of the Jefferson River.

It appears that all the head waters of the Missouri are supplied with the grayling, and it is, therefore, only a matter of choice as to the central point of departure. Virginia City seems to me to offer the best opportunity of reaching the centers of abundance. I am told that the country about Virginia City can be traversed very comfortably in wagons.

Very respectfully yours,
T. H. BEAN.

and the Jordon were once famous resorts for sportsmen who angled for the grayling, but their glory as grayling streams has long since departed, the grayling having given way to the predacious and combative trout, although now and then a grayling is taken.

Although the subject may be considered somewhat threadbare, by reason of its having been so much discussed by writers upon game fishes, allow me briefly to refer to the general character of this fish. To the sportsman who has always angled for the trout and is unfamiliar with the habits of the grayling, this fish will excite some suprise upon first acquaintance. Unlike the trout, you are not likely to find him in pool and shady haunt, but you will find him on the swift ripple and shallow, hovering like the hawk in the air. While you are adroitly seeking, with your trout fisherman's experience to reach some shaded pool where you should expect to find him, if he were a trout, you suddenly find your fly taken most unexpectedly in open water, and you are taken somewhat at a disadvantage. Once securely hooked comes the beauty of the fight, and here the grayling differs most radically from the trout. Instead of seeking shelter by retreating to the deep pool or beneath some root, he will perhaps leap clear of the water from two to three times or more, and with a vicious shake of the head seek to free himself from the hook. When landed you try in vain to determine which has the superiority, the grayling or the trout, but you finally conclude that you have forgotten exactly how the trout acts when he *is* hooked, and if you are a philospher you inwardly argue that it is such a close question you will leave its determination to such time as you shall catch your next trout.

The large dorsal fin is the distinguishing characteristic of the grayling. In repose the fin lies folded upon his back, but in a state of activity or when he is excited the anterior portion of the fin becomes rigid, and the posterior portion waves like a banner in the air. When freshly taken from the water the dorsal is iridescent, and its variegated coloring is gorgeously beautiful and vivid. The fish itself is covered with a smallish, light, steely-gray colored scale, and above the median line has a few faint brown mottlings about the size of the head of a pin. Its head is quite small and the general contour of its body is slim and graceful. A faint odor is discernable resembling the odor of the wild thyme, hence its name *Thymallus*.

As early as the year 1854 or 1855 the grayling was first called to the attention of local scientists in Michigan by Mr. Wright L. Coffinberry, a gentleman in the employ of the general government, who was then making surveys of the wilderness lying adjacent to the Muskegon and Hersey Rivers. At this time the grayling was very plentiful in all these streams, and afforded the surveyor, hunter and explorer a grateful change from his pork and hardtack, and was known among them as the "Michigan trout." Mr. Coffinberry had the grayling especially called to his attention, as he busied himself during his leisure hours in an attempted classification of the fish found in the Muskegon and tributary waters, and, as I have before mentioned, he was instrumental in calling local attention to the grayling. Later on and about the year 1855 or '56, Dr. Parker, of Grand Rapids, Mich. (now President of the Michigan Fish Commission), succeeded in procuring a specimen of the grayling "beautifully preserved" in homely salt and wrapped carefully in a newspaper, *minus a few fins*, and of course almost devoid of its natural color, and after a somewhat careful study of the specimen and a comparison with a cut and description of the English grayling, he pronounced it a true

"Thymallus," and in a paper read before the local scientific society of Grand Rapids named it "*Thymallus michigensis*," a patronymic by which it was known locally for some years; in fact up to the time that a specimen was sent by Prof. Miles to Prof. Cope in 1864. Specimens subsequently submitted to Prof. Agassiz, through the efforts of Mr. D. H. Fitzhugh, of Bay City, Mich., who is the best authority on grayling in the country, were classified by that eminent scientist, and determined beyond question to be the grayling.

During the period to which I have referred the streams embraced within the territory already indicated were swarming with this beautiful fish. So plentiful were they for many years that the settlers were accustomed during the spawning period to come to the dam, at or near the site of the present village of Hersey, and capture them with baskets, carrying them away by the wagon load. There are many people yet living in that vicinity who can vouch for the truth of this statement were it necessary, but I think I can presume that the courtesy of gentlemen who are interested in the propagation of fish and accustomed to fish stories will scarcely require the fortification of this statement by affidavit.

It would seem, this state of things having once existed, that it is almost incredible the grayling should have so rapidly disappeared from these streams; yet the fact remains that many of the streams that once knew them now know them no more. This is notably true of such noble streams as the Jordan, the Boyne and the Boardman. From those streams which flow to and discharge their waters on the extreme northern coast of the Lower Peninsula, the grayling has almost entirely disappeared, although now and then an occasional straggler may be found. The cause of this depletion is, however, directly traceable to the lumberman and the trout. The grayling can not successfully run the gauntlet of log-rolling and the vicious attacks of the trout, who loves the dainty and succulent fry and the youngster grayling and hope to overcome them both. It is a fact that until within the last thirty or forty years brook trout were unknown in the northern streams of the Lower Peninsula, Michigan; while the streams of the Upper Peninsula, discharging their waters into Lake Michigan, were, and are, stocked almost exclusively with the trout. The theory advanced and most generally accepted by those familiar with the facts, is, that migration of the trout has taken place from the streams emptying their waters into Lakes Michigan and Huron, to these grayling streams. There is much reason, it would seem, for this argument. It is a peculiar fact that the waters of the Maple River, lying in the extreme northern portion of the Lower Peninsula, are now well stocked with grayling. This stream flows in a southerly course (which is contrary to the direction of most of the streams in that portion of the State), discharging its waters into Burt Lake, one of the larger lakes of the "Inland Chain," which extends from Cheboygan to Petoskey, and is famous for its bass and pike fishing. To carry the argument to its seemingly just conclusion, it may be inferred, with reason, that the trout would be shy of entering upon waters in the possession of those voracious and predatory fish, and the probabilities are very strongly in favor of the theory that if they did venture upon such territory and lay down peaceably together, it would be that peaceful quietness of the trout lying down inside the bass or pike. On the other hand, the Maple is a swift, brawling, grayling stream, its waters are cold, which is a peculiarity of all grayling streams, and offers no inducement

3.—FISH AND FISH-CULTURE IN MICHIGAN.

BY JOHN H. BISSELL.

[Read at the Michigan Semi-Centennial Celebration, Lansing, June 15, 1886.]

The abundant natural supply of fish in the waters of this State has played so important a part in its settlement and development that any history of the State, or its people, which omitted mention of its fish or fisheries, would be incomplete. In the present and near future the operations of the State's establishments for fish-culture, are, and will be, useful and important factors in the further development of the State, and assist in solving one at least of the urgent economic problems which must be met by every community as its population increases,—that of cheap and wholesome food supply.

We know something of the great quantities of fish that were found in our waters by the early settlers, and those who came to trade with the Indians before any permanent settlements existed outside of the fur trading posts, from the accounts that have been happily preserved for us in that charming field of history, the discovery, explorations and settlement of "New France." The great abundance of fish during those times is also evident from the fact of their easy capture, in comparatively large quantities, by the rudest of fishing appliances. The Indians of this region lived very largely upon fish; and so, too, did the fur traders. Their highways were the lakes and rivers which served as well supplied larders, always at hand. Jacques Cartier says, in 1535, the Indians on the St. Lawrence River "had in their houses vessels as big as any butt or tun in which they preserved their fish." From which it is evident the fish were captured not only for the summer use, but to carry them through the winter. Other writers of the sixteenth and seventeenth centuries have told us of the periodical migration of Indian tribes, living in Upper Canada, to convenient places on the lakes and rivers, to lay in stores of fish for their winter use. La Hontan, a French officer who visited the lakes in 1688, mentions a tribe of Indians "who procured their subsistence mainly from the fish which abounded at the foot of the rapids" of the Ste. Marie's River. Pere Marquette (1671), La Salle (1679) and Charlevoix (1721) made frequent allusions in their narratives, to the bountiful supply of fish and its recognized importance to themselves and to the natives.

The earliest notice I have found of the fish in Lake Erie is by Baron La Hontan in 1688. La Hontan says: "It abounds with sturgeon and whitefish, but trouts are very scarce in it as well as the other fish that we take in

the lakes of Huron and Illinese" (Michigan). Down to the time of th organization of Michigan as a State, all sources of information now attair able agree in the statement that the fish were so plentiful the supply wa deemed inexhaustible. That was before the days of rapid and improve methods of transportation, the absence of which necessarily restricted th market. That was, also, before the introduction of modern fishing appl ances. Then the catching of fish was for home consumption entirely, an of course with a thin and scattered population the demand was a limited onc easily supplied from time to time. The apparatus then used in fishing wa limited in quantity, rude in construction, and as compared with modern fisl ng rigs as the boy's sail-boat to an iron steamship. From the earlie settlements to about 1830, industrial fishing was almost exclusively confine to the Indians and the employés of the Hudson's Bay, American and Nortl west Fur Companies; the former organized in 1696, the latter in 178 These companies were established for prosecuting fur trade with the Indian the first great incentive to exploration and settlement of the upper lakes but, as that industry became less profitable, they turned their attention t catching and trafficking in fish. Blois' Gazetteer of Michigan, published i 1835, says of the fish product of the great lakes: "Their quantities are su prising and apparently so inexhaustible as to warrant the belief that were population of millions to inhabit the lake shores, they would furnish ampl supplies of this article of food without sensible dimunition." We may smil at such a belief now with the experience of what fifty years of fishing hav done, but the statement probably embodied the general opinion of the con munity of that day upon this subject.

Mr. Lanman, in his history of Michigan, published in 1839, says th then the lakes abounded with fish of various kinds, mentioning sturgeo Mackinac trout, muskallonge, and whitefish, the latter only being impo tant as an article of commerce. At that time industrial fishing was main confined as to locality, to the Detroit, St. Clair and Ste. Marie rivers, tl Straits of Mackinac, the extreme southeastern end of Lake Superior an Saginaw Bay. "Whitefish," he says, "were caught in large quantiti around Mackinac, Sault Ste. Marie and the other waters connecting the gre lakes. They are packed in barrels and transported to New York and Ohio.

The Detroit river formerly maintained extensive and profitable white fis eries. The fish were not only abundant but of a superior quality. The fish, although sometimes called the Detroit River whitefish, are really Lal Erie fish. They pass the greater part of their lives in Lake Erie, feedi and living there, and only moving up the river late in October, throu November and part of December, for the purpose of spawning along tl channel banks of the river. It must not be understood that all the whitefi in Lake Erie make Detroit river their breeding grounds, for vast numbe of them found suitable spawning places on the reefs, ledges and shoals abo the islands at the western end of the lake. As the whitefish possesses common with all the members of the salmon family, to which it belongs, t instinct to return and deposit its ova in the place of its own nativity, it m not be inappropriate to designate such of the Lake Erie fish as seek t river for the purpose of reproduction as the Detroit River whitefis although no structural difference distinguishes them from the other whit fish of the lake.

As late as 1836 and 1837 such statistics as we have indicate that t

Detroit river yielded nearly one-half of the total number of pounds of fish caught in the great lakes for those years. In 1859 the value of the catch in the river was put at $75,000, all whitefish. In 1867 Mr. George Clark, a man of great experience and an accurate observer, estimates the yield of the river at 500,000, averaging in weight three pounds. The Board of Trade Review put the number of whitefish received at Detroit in 1863 at over 900,000. This would, of course, include nearly all of the fish caught in Lake St. Clair, besides those taken in the Detroit river.

Mr. Lanman's "Red Book" of 1871 notices that the whitefish are becoming scarce in all the rivers. The account says that "formerly as many as 8,000 fish have been taken at a single haul of a seine. At present (1871) 2,000 is considered a big haul." To note and emphasize the difference which has come about in these fisheries in the past fourteen years, let me call your attention to the fact that one of the best fisheries of the river, in 1885, produced less than 2,000 whitefish for the entire season's fishing.

The River St. Clair has always produced great quantities of fish, the pike-perch or wall-eyed pike being the most abundant. In 1830, and for a number of years thereafter, immigration to the shores of the Detroit and St. Clair rivers increased very rapidly. The settlers found it difficult to obtain a supply of other food, and from necessity were largely dependent upon the product of the fisheries. The Rev. O. C. Thompson, in a paper read before the Detroit Pioneer Society in 1828, says, "More and better fish were taken from the St. Clair river than at any other fisheries, and the fish were larger than those of the Detroit river," and they were sold at $1.50 per hundred fish. The St. Clair fisheries have passed into history (as have most of those on the Detroit river), excepting, perhaps, two or three points where the pike-perch or pickerel, as they are locally named, are caught by seining in limited numbers. The present season, which closed last week, has proved the poorest ever known. From the earliest times of which we have any record, the Lake and River St. Clair have been noted for the abundance and good quality of their fish, and even now the St. Clair flats are famous for black bass fishing.

The first industrial fishing on Lake Huron was commenced in 1835, with small sail boats and gill nets. The principal product was whitefish and salmon trout, which were salted and sold in Detroit.

The great fur trade which centered at Mackinac early brought into prominence the fishing grounds of that locality. From its great abundance there the lake or salmon trout was named the "Mackinac trout." Father Marquette mentions besides the whitefish, "sturgeon, herring and three varieties of lake trout," as abounding in the waters of the straits, and fifty years later Charlevoix was surprised by the number, and charmed by the qualities of the whitefish of those waters. The experience of one fisherman will illustrate most strikingly the change which the use of modern fishing apparatus has wrought in these waters.

Mr. Noel La Ville informs us, that he began fishing at Mackinac in 1843 with 12 gill nets, and could then take more fish than he can now with 240 gill nets. The value of the Mackinac catch has averaged about one-tenth of the total product of our waters until 1873, since which time its relative importance has steadily declined, though not in a more marked degree than other points once as prolific.

No figures representing the fishing products of Lake Michigan are found

earlier than 1859, at which time Mr. Strickland's "Old Mackinac" place the catch at 30,500 barrels, valued at $270,000, and the twine in use in th Michigan waters of the lake at 6,670 gill nets, no steam vessels being the used there.

As late as 1871 Lanman's "Red Book" classes Beaver Islands, Green Bay and other points on the east shore of Lake Michigan as inferior in produc to Mackinac, Detroit river, and the west shore of Lake Huron. A ver striking change is reported in the relative qualities of whitefish and herring in Green Bay, on the Menominee shore, during the past ten years. In 187 whitefish comprised three-fourths of the catch, in 1885 the herring wer about seven-eighths of the total.

But little is known of the fishing industry of Lake Superior prior to 1833 Blois' Gazetteer published that year reports "the only productions of th Upper Peninsula which are a source of profit, are the fish and furs, the latte is on a decline, but the former gives evidence of an inexhaustible supply o the finest quality." In 1841 the American Fur Company took two schoon ers over the rapids of the Ste. Marie to use in fishing on Lake Superior.

From the foregoing it appears that around our coast of two thousan miles, at the time Michigan became a State, the waters were teeming wit fish in quantities deemed inexhaustible by the people of that generation Fifty years have made as great a change in those fisheries as has been mani fested in some other industries, but the change here has been an unfortunat one. As reliable statistics as could be found of fishing product prior t 1875 are given in a note to this paper; a comparison of them very briefly with a valuable report made by Mr. Lyman A. Brant, as statistical agent o the State Board of Fish Commissioners, on the fishing season of 1885, wil enable us to gather a lesson worth learning. For example, take the eas shore of Lake Michigan. It appears that in 1859 this coast yielded 17,20 barrels of fish; in 1885, 12,789; in 1859 the fishing was done with 5,350 gil nets and 58 sail boats; in 1885 there were in use 11,074 gill nets, 107 poun nets, operated by 23 steam tugs and 91 sail boats. While the capacity of th apparatus was increased in efficiency more than 200 per cent., the produc fell off more than 35 per cent. The earlier operations were conducted com paratively near the shore, those of the last season, with improved sail boat and steam tugs, 25 and 30 miles out into the open lake. With a coast lin the same in both cases the acreage of waters covered is probably more tha trebled.

Mr. Lanman's "Red Book" of 1871 estimates the total fish product of th State as $1,000,000 per annum. The Michigan Census Report in 1874 place the catch of 1873 as 114,669 barrels, which at the prices ruling then woul make the value of the product something over $1,000,000.

The catch of 1885 was 26,381,875 pounds, or in barrels 109,923, valued at firs cost at $791,456, to gather which required over 1,800 men, 1,109 pound nets 27,635 gill nets, 333 fykes and seines, with 68 steam and 725 other boats, an an invested capital of $1,200,000 (the estimated amount of capital investc in our fisheries in 1873, by the census return was $334,091).

The most complete investigation into the value and extent of catch, capi tal invested, and other points connected with the fisheries, of which an record has been found, was that made under the direction of the State Fish ery Board in 1885; and it is desired to make public acknowledgement o the intelligent and untiring efforts of the agent, Mr. Brant, for the valuabl

service to the State. The common methods of fishing prior to 1830 were with spear, hook and line; dip nets, seines were used to some extent, and at a few points upon the upper lakes gill nets were used as early as 1781. The Indians of the upper lakes used gill nets made from strips of elm bark. In McKenzie's Voyages is found a good description of the stone and float gill nets, which correspond exactly to many nets of that kind still in use at points on the upper lakes. McKenzie's nets were sixty fathoms long by fifteen meshes of five inches in depth. The gill nets now generally used have a leaded line upon the bottom, with cork floats on the upper line to which the net is fastened.

Pound nets were introduced into Lake Erie between the years 1840 and 1850, and were first used in the upper lakes, about the Straits, in 1858 or 1859. Their increased use can be judged from the number reported in 1885, being 1,109.

A glance at the reported product after the introduction of pound net fishing, shows plainly the effect they have had upon the fisheries. In 1859, the year of their introduction, the product increased sixty-nine per cent. over the average preceding five years. In 1860, when they came into more general use, an increase of 244 per cent. over the average of the preceding six years was shown, and about 127 per cent. over that of 1859. The years 1861 and 1862 show a marked decrease from the yield of the two preceding years. Unfortunately we have no reliable figures at hand or to be obtained which would bring the comparison further down by years consecutively, but we have the general results of 1885, which show conclusively that with the increase of net and area of waters fished, the product has not risen in anything like due proportion, but on the contrary exhibits a large ratio of decrease. No waters can long withstand the indiscriminate use of this kind of net.

The area of land comprised in the State of Michigan is 56,457 square miles. The superficial area of water within the territorial limit of Michigan, over which the State has complete executive, legislative and judicial jurisdiction, is not far from 33,000 square miles. Our coast line, including bays and islands, is 2,000 miles in length. The value in money of the fishing product of these waters in 1885 was about $800,000. The product of the same fisheries with the same efficiency of apparatus as in 1885, if the quantities of fish available had been equal to what we have seen they were at any time previous to 1859, could not have been less than twelve to fifteen millions of dollars.

The varieties of fish indigenous to our waters in the order of their commercial value are: Whitefish, lake trout, pickerel, herring, sturgeon, perch, bass, pike, catfish and suckers. The literature of this subject is so complete in these days, when every State in the Union is publishing fishery reports, besides the numerous exhaustive treaties published by the United States government through its fish commission, that any description of the characteristics, qualities and habits of these well-known varieties would be an unpardonable repetition of what is generally known. I therefore pass to fish-culture, as it has been, and is, in Michigan, and as my experience and judgment teach me it ought to be in this great State in the near future.

The earliest effort to rear whitefish by artificial methods was made in 1857 by some gentlemen in Connecticut; but it failed, as most first experiments do.

The first experiments in Michigan were undertaken by Mr. N. W. Clark, at Clarkston, Oakland county, in 1869, and were attended with enough success to induce him to repeat them the following year. The eggs were procured from the fishery of Mr. George Clark, opposite Ecorce, Detroit river, and the result was better than in 1869. In 1871, having improved his quarters and learned that in temperature of water he must come as near as practicable to natural conditions, he impregnated about one-half million of eggs, and hatched, in a healthy condition, about fifty per cent. In 1872 the number of eggs taken was one million, of which nearly one-quarter million were successfully shipped to California in a partly developed state, for hatching and planting there, by the United States Fish Commission. These experiments were made with the apparatus then commonly used in hatching trout, consisting of a series of shallow trays having wire screen bottoms, upon which the eggs were spread, placed in a long trough, through which the water flows with a gentle current. Cotemporaneous experiments were being prosecuted in Canada and New York, which somewhat aided in the general results. In 1872, Mr. Holton, an assistant of Mr. Seth Green, in New York, devised a great improvement in hatching apparatus, which permitted the handling of a much larger quantity of eggs. It consisted of a deep box in which the trays were placed on each other, the water being introduced from the bottom, and circulating upwards through the wire bottoms of the trays. Shortly after that, Mr. N. W. Clark invented a hatching apparatus in which the water was taken from the top and run down through the trays, and was allowed to escape into the next box and repeat the same operation.

In 1870 some leading fishermen of Detroit had erected temporary troughs, which they supplied with ova, but it was readily seen that the work must be undertaken for the supply of the great lakes, if at all, by the State government, and efforts to that end were accordingly made, but without success. This effort to induce the State to engage in fish-culture was the best demonstration that could be made that the fisheries were declining, and resort to artificial aid was required to preserve the stock of fish. Mr. J. P. Clark, Mr. George Clark, Mr. A. M. Campau and Mr. James Craig of Detroit were the promoters of this effort. The success attending the whitefish experiments interested a number of observing men, who took the time to urge the subject of fish culture as a branch of public business upon the attention of the Legislature, with the result that in 1873 an act was passed constituting a State Board of Fish Commissioners. While this step was urged by many intelligent citizens, the influence of Gov. Bagley was probably more potent than that of any other, and by the act the Governor was made one of the Commissioners. Besides the Governor, the first Board consisted of Mr. George Clark, of Wayne, and Mr. A. J. Kellogg, then of Allegan county. Mr. George H. Jerome, of Niles, who had at first been appointed a Commissioner, resigned and accepted the position of Superintendent of Fisheries, and vigorously inaugurated the work which has since made Michigan somewhat conspicuous as a leader in this department.

During the winter of 1873-4, before the State had established its hatching stations, one million and a half of whitefish ova were hatched for the State by Mr. N. W. Clark, at Clarkston, and the following year about two millions were hatched in the same way. During these first years of the Commissioner's work, by the courtesy of the U. S. Fish Commission, Michigan received considerable allotments of ova of the Atlantic and California salmon, and of

the fresh water salmon of Maine, all of which were hatched at the State hatchery, then established at Pokagon, in Cass county. These fish were planted in many brooks and rivers, and some lakes.

True to their instincts, they left the streams, dropping down into Lakes Michigan, Huron and Erie, and not much trace of them has since been found. A few have been caught at different times for some years, and even last season two or three were reported by fishermen. We do not regard it as conclusively proved that the Atlantic salmon cannot be established in the great lakes above Niagara Falls. What we do know is that the experiment was made with so few fish, for the size of the waters, that it would only be surprising if it proved anything, which it does not. The Schoodic salmon, on the other hand, in the case of one lake in Kalkaska county, have made a marvelous growth, from which those competent to form an opinion are confident of the ultimate establishment of this fish in some of our large northern interior lakes, as well as in the waters of the Straits and Lake Superior.

In 1875 the whitefish work was started in Detroit, under the immediate supervision of Mr. Oren M. Chase. Nearly ten million of eggs were laid in that fall for hatching by the Holton Box method. The work of that and the three succeeding years is important, principally, for the experience it furnished Mr. Chase, leading, as such experience did, to the most valuable improvement which has yet been discovered in hatching whitefish eggs, or other fish eggs of similar specific gravity and habit. The older methods were expensive and cumbersome when applied to extensive operations. They were all, however, successive steps of progress.

The invention of Mr. Chase was a glass jar, with a capacity of from one to one and a half gallons, into which the water was introduced through a glass tube, bell-shaped at the bottom, resting on small knobs or feet, which permitted the water to escape upwards, through the jar, on all sides, to be discharged over a metal spout. This upward current of the water gives a gradual but constant motion to the eggs, which is necessary to prevent adhesion, and is more natural than nature. The flow of water separates the bad from the good eggs, and does away with constant manipulation, which is expensive and inconvenient, and makes it possible to handle a large number of eggs in a small space, the water doing the greater part of the work. The Chase Automatic Jar makes it possible to produce, at a very reasonable cost, enough young fry to restock the depleted fisheries of the great lakes. The average capacity of the glass jars used in the whitefish operations at Detroit and Petoskey, is 134,000 eggs. The present whitefish operations are conducted at Petoskey with 208 jars, and at Detroit 312 jars, giving a total capacity of 69,680,000 eggs each season, which exceeds the amount of any of the other States, and is only exceeded by the general government fishery work. The average loss on the first count is from 10 to 15 per cent.

The most popular department of fish-culture is the rearing of brook trout, because its results are more quickly seen. Already in many counties in the northern, central, and western parts of the lower peninsula good trout fishing is found in streams where this fish was unknown before it was planted by the State. The trout work was conducted at Pokagon until 1880, when that property was given up and a location made at Paris, Green township, Mecosta county, where the State has acquired title to 119 acres of land, for the purpose of controlling suitable streams. Here extensive ponds have been and are being constructed for the purpose of holding stock fish for

breeding, and the streams utilized as wild nurseries. The station at Paris is within a quarter of a mile of the depot of the Grand Rapids and Indiana railroad, convenient shipping facilities being important for the extensive work done there.

An abundance of brook trout serves two desirable purposes for the people, in furnishing them nutritious food to vary the monotony of farm fare, as well as giving an opportunity for healthful sport; and, secondly, in attracting visitors to the localities for fishing, whose expenditures of money help the business of the community.

The present State fishery establishment consists of a Board of three commissioners appointed by the Governor and a force of about nine men regularly employed, the Commission having an office in Detroit, with a secretary whose entire time is devoted to the work of the Commission. The stations are at Detroit, where the culture of whitefish and pickerel is conducted. This house has a capacity of 42,000,000 of whitefish. Its capacity for pickerel work is greater than the number of eggs obtainable has ever permitted, the largest take of pickerel eggs having been 28,000,000; at Paris, Mecosta county, where all kinds of trout work is carried on, including experiments with the grayling. This station has a capacity for handling 1,500,000 brook trout, 800,000 lake trout, and all the land-locked salmon and grayling that can be procured; at Petoskey, for whitefish, with a present capacity of 26,000,000; at Glenwood, Cass county, where there is located a station for the cultivation of German carp, which station has a capacity fully equal to any demands the State may make upon it. Extensions of this work, which are contemplated by the Commission as necessary, will be made as soon as funds are provided, enabling the Commission to engage in the propagation of muskallonge and black bass, for the rearing of which Michigan has most suitable waters. The time is near at hand when we shall be called upon to save the sturgeon fishing of the great lakes, the sturgeon bringing a higher average price in the market to-day than the whitefish or trout.

What is the significance of these facts? Ten times the space might easily have been filled without exhausting the authorities or facts. Such facts and their meaning, as one charged with a measure of responsibility in the supervision of the State fisheries, I deem it my duty to lay before this audience. Even the briefest historical notice of the fisheries leads inevitably to one conclusion, and forces upon us the urgent inquiry, can our fisheries now be saved, or is their ruin inevitable? While we have not yet learned all there is to know about the culture of fish and the artificial propagation of them, enough is known, scientifically and experimentally, to place the practical art of fish-culture beyond the domain of mere curious research, and its results are already sufficiently demonstrated to enable us to answer without hesitation, that if given sufficient support by the State government, we shall find a reasonable and sufficiently affirmative answer to the inquiry above suggested.

When I speak of fish-culture as furnishing the sufficient remedy for the evils already pointed out, I mean to include in the term not only the artificial propagation of fish, but also the protection of them by reasonable municipal regulation until they are marketable; and in the combination of these two things we have the complete definition of fish-culture as a practical art. The demonstration of what fish-culture can do for the State is not generally understood. There are sufficient reasons why it has not yet been able t

make a complete demonstration of what it can ultimately do by accomplishing all the results that some of its enthusiatic friends have looked for. To satisfy any reasonable man that fish-culture can again restore our fisheries and fill the great lakes with marketable fish, it is not necessary that that fact should be actually done. If it is possible to restore the fisheries at two or three average places, there is no reason to doubt that when carried on upon a sufficient scale, it will be able to work the same beneficial results, at least for all waters similarly situated. In the sense that a complete demonstration can only be made by accomplishing the whole result sought, fish-culture has not yet had a fair chance.

1. It has not been conducted upon an adequate scale. Where we are now hatching about 50,000,000 of whitefish per year, we need to hatch from six to eight times that number to restore the wasted grounds, as well as to replenish and keep good the stock in those waters that are yet productive.

2. Again, artificial propagation has not had a fair chance in point of time. It is only within the first three years of the second decade of its existence, say from 1882 or 1883, that the practical operations of fish-culture have been anything more than the merest experiments. It is only within that time that the State has hatched and planted over 15,000,000 of whitefish in any one year. The same period will also cover the most extensive operations of the United States Fish Commission in that direction. The force of this will be readily appreciated when it is understood that from our present knowledge we have no right to expect important results from these plants before the expiration of four, probably five, and possibly six years from the time they were made. Operations during the first decade were, as I have said, but experiments, and they were successful beyond anything we could in reason expect. The only places where they were not entirely successful were in some of the inland lakes, where, with our present knowledge of the habits and needs of whitefish, those fish would not now be planted. But there are, without doubt, quite a large number of interior lakes where whitefish can be grown successfully and in large quantities. It must be remembered in judging of the results of fish-culture that the ruin caused by wasteful and unconscionable methods of fishing, the results of which fish-culture is called upon to repair, has been going on for thirty or forty years; and it is always more difficult to cure than to prevent disease, whether physical, political or economical.

3. Again, fish-culture has not had a fair chance, because we have lacked proper municipal regulations of the methods of fishing. It is not enough that we should be able to put into the waters of the lakes each year enough young fish to take the place of the adults captured and marketed. The fish must be protected until they come to mature or marketable age, otherwise our work will be lost. Artificial propagation alone cannot accomplish the result. Neither can legal regulation do it alone, within a period that will avail anything for one generation, and possibly not even then. The two things are mutually dependent conditions. They must concur to assure valuable and lasting success.

There is not time here to review the arguments or state in detail what regulation is needed, but only to suggest that the destruction of immature fish must be prevented, and discretionary authority given to fishery officers to prohibit fishing at times and in places where unmarketable fish will be destroyed, and some equitable system of license as incidental to municipal

regulation which will furnish the means to pay the necessary cost, not only of regulation, but ultimately of artificial propagation.

An important condition, which cannot be provided for by statute law, is the spread of reliable information regarding the purposes and operations of the State's fishery department among the people of the State, which will create a healthy public opinion in support of the laws, and secure their strict and just enforcement. The practical art of fish-culture, carried on under the conditions above indicated, can make the barren waters of this State productive again; arrest the depletion of fisheries now valuable, and cultivate to its natural capacity of productiveness, for the benefit of the State, this great public domain. The waters are here and cannot be alienated. Shall not the State cultivate them?

SCHEDULE 1.

Fishing Statistics for the Year 1880.—From Census Reports.

Counties.	Capital.	Bbls.	Value.	Counties.	Capital.	Bbls.	Value.
Bay	$15,000	6,000	$48,000	Manitou	$7,000	6,000	$42,000
Berrien	6,200	3,375	25,500	Marquette	1,000	620	3,060
Chippewa	9,000	3,200	19,600	Mason	4,100	1,130	7,600
Delta	5,700	2,500	15,338	Oceana	2,200	950	6,650
Grand Traverse	200	86	688	Ontonagon	2,100	1,000	6,000
Huron	9,800	4,200	30,690	Ottawa	8,000	5,800	34,600
Leelanaw	4,050	1,328	10,608	St. Clair	725	850	5,090
Mackinac	47,000	17,843	103,938	Wayne	54,700	3,375	29,300
Manistee	1,600	793	6,344				
Total					$178,375	59,057	$395,636

SCHEDULE 2.

Statistics for the Year 1883, by Counties.

Counties.	Bbls.	Capital.	Counties.	Bbls.	Capital.
Alpena	2,000	$3,000	Mason	825	$1,200
Bay	792	1,750	Menominee	1,002	5,000
Berrien	1,750	3,000	Monroe	2,050	4,180
Cheboygan	1,200	1,200	Muskegon	1,000	1,200
Chippewa	1,216	4,095	Oceana	100	200
Delta	120	400	Ontonagon	85	300
Emmet	203	995	Ottawa	1,483	4,375
Houghton	347	725	Sanilac	2,045	3,600
Huron	700	3,000	Shiawassee	46	.....
Iosco	6,000	8,000	St. Clair	575	800
Keweenaw	50	200	Tuscola	100	800
Leelanaw	390	860	Van Buren	150	600
Mackinac	9,000	60,000	Wayne	3,322	21,649
Manistee	237	500	Unorganized Counties	2,600	8,500
Total				*39,488	$145,429

*It will be noticed that some of the most important counties in the State for fish product (St. Joseph, Saginaw and Grand Traverse) made no returns for this year.

SCHEDULE 3.

Statistics for Year Ending June 1, 1870, by Counties.

Counties.	Value.	Bbls.	Counties.	Value.	Bbls.
Alcona	$3,630	440	Leelanaw	$800	100
Allegan	1,461	143	Mackinaw	103,804	10,172
Alpena	37,700	3,800	Manistee	4,500	892
Antrim	3,080	561	Mason	5,544	503
Bay	9,850	1,015	Menominee	34,771	3,575
Benzie	1,200	120	Monroe	30,490	1,790
Berrien	37,750		Muskegon	3,950	375
Cheboygan	13,450	1,575	Oceana	2,000	200
Chippewa	16,663	2,660	Ontonagon	5,840	
Delta	15,399	1,711	Ottawa	98,990	8,100
Emmet	23,000	2,899	Sanilac	28,250	3,425
Grand Traverse	700		St. Clair	4,240	655
Houghton	19,400	1,650	Van Buren	6,550	675
Huron	15,905	2,128	Wayne	14,106	400
Iosco	92,800	9,300			
Totals				$569,623	58,854

Berrien, Grand Traverse and Ontonagon counties made no returns.
Number of fisheries reporting, 243.
Men employed, 961.

SCHEDULE 4.

The earliest statistics of the commercial value of the fisheries which have been obtained are from Blois' Gazetteer of Michigan (1838), and do not include returns from the Upper Peninsula:

	Barrels.	Per Bbl.
1830	3,000	$5 00
1836	11,460	10 13
1837	13,500	9 22

These fish were taken on the Detroit, St. Clair and St. Mary rivers, the Straits of Mackinaw, the southeastern part of Lake Superior and Saginaw Bay. The varieties are given for two years only, as follows:

	White and Trout.	Pickerel.	Herring.
1836	8,300	2,500	600
1837	9,500	3,400	600

The whitefish and trout are given together in the statistics. Of the whitefish, 4,000 bbls. in 1836 and 2,500 bbls. in 1837, were taken in the Detroit river. The trout were caught with hooks principally, the others with seines and gill nets. The pickerel were mainly from Saginaw Bay and St. Clair river.

Population of Michigan in 1830, 28,000; 1836, about 60,000.

SCHEDULE 5.

Roberts, in sketches of Detroit, estimates that 18,600 bbls. were shipped from there in 1854; that 35,000 bbls. were packed in the State in 1840, and 100,000 bbls. of all kinds in 1854.

Strickland's Old Mackinaw gives the following as the catch of the points named for the year 1859:

	Barrels.	Value.
Port Huron to Point Au Barques (mostly white)	3,000	$25,000
Au Sable (¾ white, ¼ trout)	6,000	50,000
Thunder Bay and vicinity (mostly white)	6,000	50,000
Saginaw Bay and River { pickerel	2,000	32,000
Saginaw Bay and River { trout and white	1,500	
Tawas (mostly white)	600	5,000
Thunder Bay to Mackinaw (mostly white)	500	4,500
Mackinaw (trout 1,875, white 6,525)	7,500	62,000
Beaver Island group (nearly all white)	7,000	59,000
Green Bay in Michigan (white)	3,000	25,500
Between Detour and Sault (⅔ white)	1,000	8,000
Little Traverse region	600	4,000
Ludington	1,500	12,000
Pentwater	2,000	16,000
Montague and Whitehall	1,500	12,000
Grand Haven	4,000	32,800
Saugatuck	2,000	16,000
South Haven	2,100	16,800
St. Joseph	3,500	28,000
New Buffalo	300	3,000
Michigan City (Michigan fish)	3,000	30,000
Totals	58,600	$402,100
The number of barrels caught in Lake Erie, including Maumee Bay, Detroit and St. Clair rivers and Lake St. Clair is not given, but its value is		106,000
		$508,100

The total value of the catch is given at $620,000, out of $900,000 for the entire chain of the great lakes, which would make an estimated value of $21,900 for those of Lake Superior points not mentioned. Prices averaged $8 per bbl. of 200 lbs., except in the vicinity of the Detroit and Chicago markets, where they were about $2 better. Whitefish brought about $1 more than trout or pickerel. Herring do not appear to have any commercial value.

The total capital invested in fisheries at points named above is given at $252,000.

The statistics for the year 1859 only give number of gill nets and boats in use on east shore of Lake Michigan, as follows:

	Nets.	Boats.		Nets.	Boats.
Little Traverse	300	6	Grand Haven	800	8
Ludington	600	8	Saugatuck	600	6
Pentwater	750	10	South Haven	600	6
Whitehall	500	5	St. Joseph	1,200	9
Totals				6,350	58

The same places on the east shore of Lake Michigan had in service in 1885 the following rigs:

	Gill Nets.	Pound Nets.	Steam Tugs.	Fish Boats.
Little Traverse region	1,010	33	2	21
Ludington	494	4	.....	9
Pentwater	131	19	1	11
Whitehall	445	14	1	11
Grand Haven	1,906	12	4	20
Saugatuck	1,017	12	5	9
South Haven	775	.....	1	2
St. Joseph	2,814	13	8	8
Grand Traverse region	2,482	25	2	53
	11,074	132	25	144

The Grand Traverse region includes Traverse Bay, Frankfort, and points on the Lake shore south to Manistee, for which no returns were given in 1859.

SCHEDULE 6.

The catch for the points named in 1855, was:

From whom Bought.	Whitefish, Pounds.	Lake Trout, Pounds.	Herrings, Pounds.	Other Kinds, Pounds.	Total Pounds.	Equivalent in Bbls.
Little Traverse region	198,457	150,539	31,995	28,378	409,369	1,706
Ludington	41,621	17,230	.....	500	59,351	245
Pentwater	52,347	23,189	2,650	68,258	146,744	611
Whitehall	15,386	8,037	7,927	80,438	111,838	466
Grand Haven	83,288	109,655	130,436	104,993	428,372	1,785
Saugatuck	146,237	52,750	100	116,000	315,087	1,313
South Haven	13,500	9,000	.....	1,000	23,500	98
St. Joseph	285,818	321,992	5,000	103,549	716,359	2,985
	836,654	694,442	178,408	503,116	2,210,120	9,209
Grand Traverse region	594,968	247,443	3,900	12,781	859,092	3,580
	1,431,622	939,885	182,308	515,897	3,069,112	12,879

The above table is made up from the returns actually made to the Michigan Fish Commission, and while probably falling some below the actual catch, is undoubtedly the fullest ever yet gathered. The returns for 1859 were in barrels of 200 pounds, while the returns for this year were in pounds, as the fish were sold fresh. For the purpose of comparison, the number of pounds has been reduced to barrels, allowing 20 per cent for shrinkage and offal, which is probably less than the actual loss. The calculation is based on 240 pounds of fresh fish with entrails only removed for 200 pounds of salt fish.

SCHEDULE 7.

The following figures are given in the Michigan Census Report for 1874 as the catch for 1873:

	Bbls.
Lake Erie and Detroit river	12,110
St. Clair Lake and River	1,217
Sanilac and Huron Co.'s (Huron Peninsula)	1,000
Saginaw Bay and River	12,370
Saginaw Bay to Cheboygan	25,170
Mackinaw	10,114
East Shore of Lake Michigan	27,052
Green Bay	9,901
North Shore of Lake Michigan to Detour	8,834
Sault Ste. Marie	5,683
Balance of Lake Superior	258
	114,669

About 28,000,000 pounds as at present sold fresh, estimating 200 pounds per barrel and a shrinkage of twenty per cent. between salt and fresh fish.

The amount of capital invested was given at $334,091, but nothing said of number or kind of nets or boats.

The shipments of fish from Alpena in 1874 were 3,749 packages of salt and 1,440 tons fresh. A fleet of 200 fish boats was engaged in and about the straits, including the Beaver Island group. Each boat had from 50 to 100 gill nets, and they averaged about 200 pounds per boat per day. The lake fisheries were then declared to be second only to the cod fisheries of the Atlantic coast.—*Vol. 6, Pioneer Reports, p. 188.*

J. A. Leggett, mayor of Grand Haven, reported that there were in the business at that place in 1875 five tugs and eight sail boats. The total product for that year was 1,185,000 lbs., at 4c., and 10,000 gallons of oil, at 55c. per gallon. Number of men employed, 114. The product of Saginaw Bay and river for the same year was 22,000 bbls.—*McCracken's Statistics of Michigan, pp. 75-6.*

Prices for salt whitefish for the years named averaged as follows at Detroit:

Year.	Price.	Year.	Price.	Year.	Price.
1856	$9 12½	1859	$7 44⅛	1864	$15 30
1857	9 86¼	1860	7 96	1867	11 00
1858	7 31¼	1862	6 05	1868	14 75

(From Haddock's Board of Trade Reports.)

SCHEDULE 8.

The catch for 1885 actually returned to the Fish Commission, by 432 firms, employing 1,789 men, was as follows:

	Lbs.
Whitefish	7,455,459
Trout	4,881,273
Herring	4,633,195
Bass	35,819
Other kinds	4,315,783
	21,321,469
Reported, but not classified	1,354,000
	23,675,469
Approximate catch of fishermen not reporting	2,706,406
	26,381,875
Or 13,190 tons, value at 3 cents per lb	$791,456 25

The following nets were in use:

	Reporting.	Not Reporting.
Pound nets	1,004	105
Gill nets	24,835	2,800
Seines	59	4
Fykes	220	

	Fathoms.	Feet.	Miles.
The gill nets measured	1,588,852	9,533,112	1,805¼
The pound nets measured	177,440	1,064,640	201⅔
The seines measured	4,909	29,454	5⅝

CAPITAL INVESTED.

This table is the best approximation that can be made, and is probably within the actual amount; it is based upon the observation of the agent, and not on reports of owners.

Value of nets	$501,142
Value of boats	319,746
Value of docks and buildings	256,392
Value of other apparatus	56,690
	$1,133,970

This includes no lands for fishing coast or grounds.

4.—IN MEMORIAM.

At a regular meeting of the State Board of Fish Commissioners l December 15, 1885, the following minute was adopted and ordered sp upon the records of the Commission, in memory of George Henry Jerc late of Niles, a former member of this Board, and the first State Supc tendent of Michigan Fisheries:

GEORGE HENRY JEROME

Was born at Pompey, Onondaga county, N. Y., October 23, 1818. parents, Ira and Irene (Cross) Jerome, were both of American birth English extraction. Mr. Jerome entered Hamilton college, where he gr ated in 1842, then entered upon the study of law. July 9, 1846, he mar Miss Charlotte J. Dana, of Oswego, N. Y., a sister of the late Cyrus D of Niles.

Soon after his marriage Mr. Jerome removed to Niles and entered u the practice of his profession, but he soon accepted a magisterial o which he found more lucrative than a practice, at Berrien, the remote c ty seat. As a magistrate he soon achieved the lasting friendship of brethren of the bar, and the confidence and respect of all his fellow citiz

In 1851 the growing greatness of Chicago attracted his attention, an abandoned a profitable business, and the most agreeable social relations cast his fortunes in the whirl of that city. He remained in Chicago 1856, engaging in real estate transactions; went from there to the capit Iowa, where he became the proprietor and managing editor of the *Iowa Republican*. While in this position Mr. Jerome was also for several y chairman of the Republican State Central Committee, and made himself in the affairs of the State and the policy of his party in the first years of war.

As an express recognition of his services in this behalf, at the pers instance of President Lincoln, he was appointed assessor of internal rev for a district embracing twelve counties, a position which he filled for years in the most creditable manner, and then voluntarily resigned in f of a meritorious and disabled colonel of the union army.

Returning to Niles, he selected a home, "Sabine Farm," in the sout suburb, overlooking the city and river and the highlands of the Potta tamie reservation. Here he made him a home, tasteful and elegant i appointments, and proverbial for its free-hearted hospitality. To those who have been fortunate enough to share his home life, can be known

peculiar charm and magnetism of his individuality. He impressed every one with his overflowing good humor and jollity, while his genial wit, fund of anecdote, and skill as a story teller, made him one of the most companionable of men. He possessed to a remarkable degree the happy faculty of making every one who shared his hospitality feel that under his roof-tree there was no ownership; what was there was theirs, to be enjoyed to the last touch. His public relations to the question of creating a State Board of Fish Commissioners commenced in the winter of 1871. At that time a bill for that purpose was brought before the Legislature, and Mr. Jerome, hearing of it, went on to Lansing, unsolicited, and before the committee on fisheries, and at an evening session of the committee of the whole, gave his views of the importance and ultimate success of fish-culture as a State enterprise. The committee on fisheries unanimously reported a bill, but enough friends of the enterprise could not be found to carry it through. In 1873 the matter was again brought forward, and through the united efforts of such friends of the measure as Mr. Eli R. Miller, of Kalamazoo, Mr. George Clark, of Detroit, Mr. George H. Jerome, of Niles, Rev. J. G. Portman, of Berrien, Mr. N. W. Clark, of Clarkston, and the persistent and unwearied efforts of the friends of the measure in the House and Senate, the bill was carried through and became a law. Mr. Jerome came on, as before, at his own expense, spending considerable time, and with his voice and pen contributing largely to the ultimate success of the work. Governor Bagley was very enthusiastic over the passage of the bill, and in recognition of services rendered, appointed as the Board, Mr. George H. Jerome and Mr. George Clark.

As soon as the Board was organized it became necessary to select some competent person as superintendent; a number of names came before them, but none whom the Board deemed suitable for the place. At length, after much persuasion from his associates, Mr. Jerome was induced to resign his position as commissioner, and was at once elected superintendent, and entered upon his duties with the energy and zeal that characterized all his undertakings.

Recognizing the necessity for skilled labor and intelligence in the work to be undertaken, he visited that pioneer in fish-culture in America, Mr. Seth Green, and made known his wants. Mr. Green introduced him to the different men in his employ, and told him to "take his choice." With seeming prophetic judgment he selected Oren M. Chase, Mr. Green at the time making the significant remark that "he would rather he had taken any other one in the lot."

Returning with Mr. Jerome, Chase became at once his senior captain, and executed with fidelity his orders.

The task of organizing the work of the Board was pushed rapidly forward, and in 1875 he published the first report of the Michigan Fish Commission, which was such a clever work as to call forth the most flattering notices from all parts of the Union, and which contributed more to bringing the State of Michigan to the front as a fish-cultural State than the effort of any other one individual. He continued in the active exercise of his duties until the fall of 1882, when he resigned his office.

But his interest in the work did not end with his official retirement. He was the constant and conscientious adviser of his *protegé*, Chase, when he assumed the duties of superintendent, and no one mourned the untimely death of Mr. Chase with a sincerer sorrow than this sympathetic friend.

Mr. Jerome lived to see his early efforts crowned with marked success, no heart in all the land rejoiced more sincerely than his in the recogni position accorded to the work he had done so much to forward.

Although he had reached the fullness of years usually allotted to li work, still death found him a hale, hearty man, and he literally "died in harness" at the age of 65, unvexed by lingering illness or the wasting deca either mental or bodily vigor, and in summing up our memories of friend no words seem more appropriate than those of the Persian poet:

> And when * * oh, Sáki, you shall pass
> Among the guests star-scattered on the grass,
> And in your blissful errand reach the spot
> Where he made one—turn down an empty glass!

5.—TABLES OF PLANTS, TEMPERATURE AND CONDENSED INVENTORIES, ETC.

TABLE A.—*White Fish Plant for Year 1885.*

Lake Michigan:		
South Haven	4,480,000	
Frankfort	4,480,000	
Ludington	4,480,000	
Montague	3,760,000	
Little Traverse Bay	4,000,000	
		21,200,000
Lake Huron:		
Cheboygan	3,760,000	
Bay City (Saginaw Bay)	3,760,000	
Caseville (Saginaw Bay)	3,760,000	
		11,280,000
Detroit River and Lake Erie:		
Fort Fishery	3,760,000	
Grassey Isle	3,760,000	
		7,520,000
Total		40,000,000

TABLE B.—*White Fish Plants, 1886.*

From Petoskey Station.

Where Planted.		Name of Planter.	Date.	Number.
Little Traverse Bay	Petoskey	A. W. Marks, F. N. Trask	Feb. 22	3,150,000
Torch Lake	Spencer Creek	A. W. Marks, W. H. Mills	March 3	1,575,000
Torch Lake	Spencer Creek	A. W. Marks, W. H. Mills	" 6	1,575,000
Burt Lake	Indian River	A. W. Marks, F. N. Trask	" 10	3,150,000
White Lake	Montague	A. W. Marks, W. H. Mills	" 14	3,150,000
Mullet Lake	Topinabee	Marks and Trask	" 19	3,150,000
Lake Michigan	St. Joseph	A. W. Marks, W. D. Sargent	" 24	3,150,000
Pine Lake	Boyne City	Marks and Sargent	" 27	3,150,000
Little Traverse Bay	Petoskey	A. W. Marks	" 31	3,150,000
Total				25,200,000

TABLE B.—*Continued.*

From Detroit Station.

Where Planted.		Name of Planter.	Date.	Numbe
Lake Michigan	Ludington	A. W. Marks	April 7	2,440
Lake Michigan	Grand Haven	A. W. Marks	" 12	2,700
Lake Michigan	Manistee	W. D. Sargent	" 14	2,800
Lake Huron	East Tawas	Eli Tinlan	" 15	2,350
Lake Michigan	Frankfort	W. D. Sargent	" 16	2,880
Detroit River	Fort Wayne	E. O. Chase	" 16	2,000
Lake Huron	Oscoda	M. J. McLennan	" 19	2,350
Detroit River	Grassery Isle	E. Tinlan	" 20	2,000
Saginaw Bay	Bay City	W. D. Sargent	" 21	2,880
Traverse Bay	Traverse City	A. W. Marks	" 22	2,320
Lake Huron	Cheboygan	W. D. Sargent	" 23	2,180
Lake St. Clair	Grosse Pointe	E. Tinlan	" 24	2,000
Straits Mackinac	Isle Mackinac	W. D. Sargent	" 25	2,880
Pine Lake	Boyne City	W. H. Mills	" 26	2,880
Lake St. Clair	Grosse Pointe	W. D. Sargent	" 28	1,760
Total				36,420

From Petoskey Station	25,200
From Detroit Station	36,420
Total	61,620

TABLE C.—*Plants of Brook Trout, 1885.*

County and Name of Waters.	Township Where Located.	Name of Depositor.	Date of Deposit.	Number of Fish.
Allegan County:				
Silver Creek	Plainwell	A. W. Whitcomb		10,000
Bay	Plainwell	Gilkey Bros.		10,000
Branch County:		O. D. Marks		10,000
Stream	Union City	A. W. Marks	M'ch 23, 1885	10,000
Barry County:				
Portage Creek	Parmelee	J. S. Miller	April 6, 1885	10,000
Berrien County:				
Private pond	Niles	P. B. Tuttle	M'ch 16, 1885	5,000
Calhoun County:				
Olinen's Lake, Spring and Harmon's Brooks	Battle Creek	N. A. Osgood	M'ch 23, 1885	10,000
	Tekonsha	A. D. Eldred	M'ch 26, 1885	10,000
Crawford County:				
Au Sable River	Grayling	R. S. Babbitt	M'ch 6, 1885	20,000
Clare County:				
Middle Branch Tobacco River	Harrison	A. W. Marks	April 3, 1885	10,000
Cheboygan County:				
Little Sturgeon River	Indian River	A. C. Babbitt	M'ch 6, 1885	10,000
Emmet County:				
Tributary to Crooked Lake	Conway	A. W. Marks	M'ch 9, 1885	5,000
Private pond	Petoskey	—— Hart	M'ch 13, 1885	2,000
Gratiot County:				
Head waters of Pine River	Riverdale	B. Blanchard	April 16, 1885	10,000
Ingham County:				
Private pond	Lansing	J. M. Turner		10,000
Isabella County:				
Little Cedar, Salt, and Stony Creeks	Mt. Pleasant	A. C. Babbitt	M'ch 13, 1885	10,000
Jackson County:				
Stream	Napoleon	A. C. Babbitt	April 23, 1885	10,000
Kalamazoo County:				
Silver, Augusta, and Portage Creeks	Kalamazoo	O. D. Marks	April 6, 1885	18,000
Kent County:				
Buckardson and Ball's Creeks	Grand Rapids	O. D. Marks	M'ch 27, 1885	10,000
Spring brooks	Grand Rapids	H. W. Davis	M'ch 9, 1885	24,000
Spring brooks	Sand Lake	O. D. Marks	M'ch 27, 1885	5,000
Spring brooks		S. Brenan	April 15, 1885	3,000
Spring brooks	Grand Rapids	J. M. Methceny	April 20, 1885	5,000
Lake County:				
Pies and Howell Creeks	Baldwin	J. Baker	M'ch 9, 1885	10,000
Private stream	Foreman	S. Thompson	April 18, 1885	3,000
Mecosta County:				
West Branch Big Creek	Morley	W. D. Marks	M'ch 30, 1885	10,000
Mac Creek	Stanwood	A. W. Marks	M'ch 16, 1885	10,000
Paris Creek	Paris	A. C. Babbitt and O. D. Marks	April 15, 1885	6,000
Cheney	Paris	A. C. Babbitt and O. D. Marks		10,000
Buckhorn	Paris	A. C. Babbitt and O. D. Marks		5,000
Hatchery ponds	Paris	A. C. Babbit and O. D. Marks		5,000
Muskegon County:				
Stream	Muskegon	W. D. Marks	April 30, 1885	10,000
Private pond	California	W. D. Marks	M'ch 30, 1885	2,000
Duck Creek		O. D. Marks	April 3, 1885	10,000
Menominee County:				
Stream	Menominee	O. D. Marks	April 29, 1885	10,000
Newaygo County:				
Colbaugh, Robinson, and Grass Mound Creeks	White Cloud	W. D. Marks	M'ch 16, 1885	10,000
Wilcox, Four Mile, and Warner's Creeks	Allerton	W. D. Marks	M'ch 16, 1885	10,000
Davis Creek	Woodville	A. W. Marks	M'ch 18, 1885	10,000
Brook's Creek	Newaygo	W. D. Marks	M'ch 16, 1885	10,000
West Branch Pere Marquette River	Woodville	T. McDuffie	M'ch 14, 1885	10,000
Oakland County:				
Paint Creek	Rochester	A. W. Marks	April 20, 1885	10,000
Van Buren County:				
Stream	Mattawan	A. W. Marks	M'ch 16, 1885	5,000
Washtenaw County:				
Spring brook	Ann Arbor	A. W. Marks	M'ch 25, 1885	10,000
Headwaters Saline River	Ypsilanti	A. W. Marks	M'ch 25, 1885	10,000
	Chelsea	O. D. Marks	M'ch 30, 1885	5,000
Total				408,000

TABLE D.—*Brook Trout Plants, 1886.*

Name of Waters.	County.	Plan
Silver Creek	Allegan	10,
Man's Creek	"	10,
Devil River	Alpena	10,
Spencer Creek	Antrim	10,
Beaver, Sykes, Big and Little Blue Creeks	Berrien	20,
Private Pond—P. J. Tuttle	"	5,
Austin's Brook	Calhoun	5,
Bear, and other streams not reported	Cheboygan	10,
Ore Creek	Genesee	10,
Perry Creek	Hillsdale	10,
Arnold Creek	Ionia	5,
Calvin and Mill Brooks	"	20,
Prison Ponds (yearlings)	"	5,
Cold, Silver, Sin's and Wilbert Creeks	Iosco	10,
Big Cedar and Strong's Creeks	Isabella	10,
Ellis Brook	"	10,
Tributaries to Kalamazoo River	Kalamazoo	5,
Harrison, Portage and Campbell Creeks	"	20,
Four Mile Creek	"	10,
Portage Creek	"	5,
Bean Creek	"	5,
Earle Creek	"	5,
Rapid River	Kalkaska	10,
Ellis Brook	Kent	10,
Callendar, Mill and Bear Creeks	"	25,
Big and Little Cedar Creeks	"	10,
Spring Creek	"	5,
Harold and Bull Creeks	"	10,
North Branch Pere Marquette River	Lake	10,
Tributaries to Little Manistee	"	10,
Little Manistee	"	15,
Farnsworth Creek	"	10,
Hatch's Run	Mason	10,
Swan Creek	"	10,
Kibbin's and Dun's Creeks	"	10,
Tributaries to California Lake	Mecosta	5,
Parish Creek	"	13,
Richie Creek	Montcalm	5,
Tamarack Creek	"	10,
Allen Spring	"	10,
Bear, Black and Green Creeks	Muskegon	20,
Buel Creek	"	10,
Rivard and Crockery Creeks	"	5,
Williams and Four Mile Creeks	Newaygo	10,
Spring Creek and outlet of Bills Lake	"	5,
Spring Creek	"	5,
Burton Creek	"	5,
Cole, Four-Mile, Whitmore and Bigelow Creeks	"	25,
Odd, Cushman and Martin Creeks	"	10,
Flower Creek	Oceana	10,
Wilcox and Minnie Creeks	"	5,
Crandall and Jermain Creeks	"	10,
Prisur Creek	Ogemaw	10,
Krebs Creek	"	10,
Johnson's Creek	"	10,
Kelley and Eddy Creeks	"	10,
Farrington, Klocking, Rogue Creeks	"	20,
Bull, Kill and Crock Creeks	Osceola	10,
Cedar Creek	"	10,
Rivard and Crockery Creeks	Ottawa	5,
Allison and Work Creeks	Saginaw	10,
Spring Creek	St. Joseph	10,
Not reported	"	6,
Head Paw Paw River	Van Buren	15,
Cold and Spring Creeks	"	5,
West Branch Paw Paw River	"	10,
Not reported	"	5,
Mallets Creek	Washtenaw	20,
Macon, Cross and Hall's Creeks	"	15,
Cedar Lake	Wexford	10,
Tributaries to Little Manistee	"	10,
Total		719,

TABLE E.—*Lake Trout, 1885.*

Name of Waters.	County.	Plant.
Mullet Lake	Cheboygan	20,000
Burt "	"	25,000
Blanchard Lake	Gratiot	10,000
Whitefish Lake	Kent. (Montcalm?)	25,000
Hopkins Lake	Mason	25,000
Sand Lake	Antrim	25,000
Klinger's Lake	St. Joseph	25,000
Clear Lake	Mecosta	25,000
Pickeral Lake	"	25,000
Total		215,000

TABLE F.—*Lake Trout, 1886.*

Name of Waters.	County.	Plant.
Mullet Lake	Cheboygan	60,000
Burt Lake	"	60,000
Whitefish Lake	No county or town given	75,000
Portage Lake	Crawford	65,000
Clear Lake	Mecosta	55,000
Chippewa Lake	"	65,000
Klinger's Lake	St. Joseph	65,000
Clam Lake	Wexford	55,000
Total		490,000

TABLE G.—*California Trout.*

Name of Waters.	County.	Year.	Plant.
Beaver Creek	Ottawa	1884	6,000
Pere Marquette	Lake	1885	25,000

TABLE H.—*Distribution of Wall-Eyed Pike for 1886.*

County.	Name of Waters.	Plant.
Emmet	Crooked Lake	761,256
"	Crooked Lake	945,000
Lenawee	Wampler's Lake	50,000
Oakland	Orchard Lake	50,000
Total		1,806,256

TABLE I.—*Schoodic Salmon. 1885 and 1886.*

Name of Waters.	County.	Year.	Plan
Round Lake	Kent	1885	5
Rapid River	Kalkaska	1885	43
Cedar River, tributary to Torch Lake	Antrim	1886	23
Total			71

TABLE J.—*Eel Plants, 1885.*

Name of Waters.	County.	Pla
Black River	Allegan	6
Hutchins Lake	"	6
Long Lake	Branch	6
Palmer Lake	"	6
Leland Lake	"	6
Loudin Lake	Barry	6
Thornapple Lake	"	6
Weaver Lake	Berrien	6
Dayton Lake	"	12
Old Man's Lake	Cass	6
Mumford and Pine Lakes	"	6
West Lake } Shield's Lake }	Calhoun	6
Blue Lake	Eaton	12
Not reported	"	6
Not reported	Emmett	36
Not reported	Genesee	6
Not reported	Hillsdale	6
Not reported	Ionia	6
Looking-Glass River	"	3
Sharp's and Vanderwater Lakes	Jackson	12
Duncan Lake	Kent	12
Not reported	"	12
Pine Island Lake	"	6
Duck Lake	"	6
Wampler's Lake	Lenawee	6
Bear Lake	"	6
Strawberry Lake	"	6
Nippison and Bronson Lakes	Lapeer	6
Not reported	Livingston	6
Not reported	"	6
Round Lake	Montcalm	6
Mud Lake	Mecosta	3
Muskegon River	"	3
Long Lake	Oakland	6
Cranberry Lake	"	6
Loon and Tucker Lakes	"	6
Not reported	"	6
Palmer's Lake	St. Joseph	12
Thompson's Lake	"	12
Meyers Lake	Shiawassee	6
Paw Paw River	Van Buren	6
Grass and Shanty Lakes	"	6
Total		325

TABLE K.—*Distribution of Carp for 1885.*

County.	Depositor.	Town.	Number.
Barry	G. R. Main	Banfield	35
Berrien	R. Clark	Pipestone	25
"	W. H. Mays	Milburg	25
"	Wm. Stevens	Dowagiac	25
"	F. Furst	"	18
"	Ira Branch	Eau Clare	25
"	J. Ammack	"	30
"	D. Boyington	Riverside	25
"	A. J. Carothers	Buchanan	30
Cass	E. Pardee	Dowagiac	50
"	C. C. Copply	Volinia	30
"	C. O. Hill	Keeler	25
"	H. E. Taylor	Wayne	25
"	C. C. Martin	"	25
"	R. Dopp	"	25
"	Geo. Hunter	"	25
"	Chas. Bakeman	"	25
"	Wm. Roth	"	25
"	C. Crawford	Lagrange	25
"	L. Hardy	"	25
"	J. L. Van Riper	"	25
"	I. Shurtz	"	25
"	T. Wells	"	25
"	C. H. Shurtz	"	25
"	H. Wells	"	25
"	C. Morehouse	Silver Creek	30
"	M. McHover	Pokagon	30
"	J. Green	Wayne	30
"	J. S. Griffiths	"	40
Emmet	H. O. Rose	Petoskey	50
Genesee	H. H. Bardwell	Mt. Morris	25
Hillsdale	F. B. Smith	Waldron	40
Ingham	W. H. Hunter	Lansing	25
Kalamazoo	Richard Chadwick	Augusta	25
"	P. F. Alexander	Schoolcraft	25
"	L. Alexander	"	25
Lenawee	L. Hubbard	Hudson	25
Mason	F. Gray	Free Soil	40
Manistee	A. Borenstein	Manistee	30
Monroe	W. A. French	Dundee	40
"	O. S. Bond	Toledo, O.	80
Marquette	Peter White	Marquette	50
Mecosta	W. D. Marks	Paris	50
Osceola	R. H. Bishop	Le Roy	30
"	W. D. Marks	Richmond	100
Oceana	J. K. Flood	Hart	25
Tuscola	W. McPherson	Millington	40
"	C. Chappell	"	30
Van Buren	J. Elyea	Lawton	25
" "	D. Smith	Bloomingdale	25
" "	Geo. Hannahs	South Haven	25
" "	W. H. Stanton	Lawton	25
" " Pub. waters	C. D. Lawton	"	25
" " " "	H. Lewis	"	25
" " " "	M. Gates	Decatur	25
" " " "	"	"	25
" " " "	A. Foster	"	25
" " " "	F. Furst	Pipestone	25
" " " "	H. J. Ray	Watervliet	25
" " " "	E. Pardee	Keeler	50
" " " "	C. O. Hill	"	25
" " " "	A. Klett	"	25
" " " "	F. Pitcher	"	25
" " " "	F. Somers	"	25
" " " "	L. White	"	25
Wexford " "	D. R. Ball	Olean	35
Total number planted in 1885			2,088

TABLE L.—*Distribution of Carp in 1886.*

County.	Name of Distributor.	Location.	Number.
Allegan	J. A. Newman	Glen	21
"	M. T. Smith	Hopkins	25
"	M. N. Hart	Otsego	25
"	S. J. Smith	Hopkins	25
Branch	F. B. Kennedy	Quincy	21
Barry	A. Caldwell	Cressey's Corners	25
"	J. C. Ketchum	Nashville	21
"	G. R. Main	Banfield	25
Berrien	C. Kendall	Eau Clare	21
"	W. Barclay	" "	25
"	J. H. Marsius	" "	25
"	D. J. Morrison	Milbury	21
"	W. Jenkenson	"	21
"	A. J. Easton	Berrien Center	25
"	S. L. Snauerley	" "	25
"	L. H. Cuddebeck	" "	25
"	J. M. Janes	Mills	25
"	L. P. Fox	Buchanan	25
Cass	W. Surte	Lagrange	20
"	T. Hampton	Glenwood	16
"	S. McKee	Waklee	21
"	F. M. Bent	Marcellus	20
"	T. B. Bennedict	Lagrange	21
"	V. D. Beach	Dowagiac	25
"	R. G. Wells	"	6
"	Mrs. Weeks	"	25
"	B. G. Buell	Little Prairie Ronde	25
"	J. A. Fritt	Summerfield	25
"	D. O. Harris	Little Prairie Ronde	25
"	Jas. Weeks	Dowagiac	25
"	B. Osborne	"	25
"	O. Cadwell	"	25
"	G. Whitbeck	"	5
"	W. Huff	"	25
"	D. H. Pond	Corry	25
Eaton	F. Spicer	Eaton Rapids	25
"	C. C. Hollenbeck	Vermontville	21
"	D. Hunt	Bellevue	25
Genesee	H. H. Bardwell	Mt. Morris	25
Grand Traverse	E. R. Wait	Traverse City	25
Hillsdale	D. Beebe	Hillsdale	21
"	M. Biles	Jonesville	21
"	E. R. Thompson	Moshierville	21
"	A. D. Eldredge	Reading	21
"	T. Spencer	Jonesville	25
Ingham	W. H. Hunter	Lansing	21
"	Agricultural College	"	21
"	W. A. Newton	"	21
"	G. B. Martin	"	21
"	E. J. O'Conor	"	25
"	H. N. Mixson	Mason	21
"	F. W. Webb	"	25
Isabella	H. S. Wheeler	Mt. Pleasant	50
Ionia	E. S. Moulton	Grand Blanc	21
"	Geo. A. Chatterton	Hubbardston	50
"	M. C. Green	Otisco	25
"	D. C. Upson	"	25
"	W. C. Durand	Portland	25
Jackson	C. L. Rogers	Leoni	25
"	E. L. Griffin	Napoleon	21
Kalamazoo	F. Ott	Oshtemo	25
"	D. Arnold	Kalamazoo	21
"	C. G. Kleinstock	"	25
"	P. F. Alexander	Schoolcraft	25
"	L. Alexander	"	25
Kent	C. S. Ford	Cedar Springs	21
"	T. S. Quiggle	Cascade	21
"	C. F. Holt	"	15
"	Walker & Sons	Grand Rapids	21
"	D. Osborne	" "	25
"	W. A. Parks	" "	25
"	D. McCoy	" "	25
"	W. H. Smith	Ada	21
"	E. Farnham	Casnovia	25

TABLE L.—*Continued.*

County.	Name of Distributor.	Location.	Number.
Lenawee	Matt. Burt	Hudson	21
"	E. A. Weston	Weston	25
Macomb	H. Barronds	Armada	21
"	W. A. Stone	Washington	21
Mason	S. W. Hurley	E. Rivington	21
Montcalm	N. M. Slawson	Greenville	21
"	G. W. Orem	Pierson	21
"	W. H. Walker	Trufant	21
"	J. F. Dodge	Gordon	25
"	Mrs. E. Angel	Howard City	25
"	G. W. Morgan	" "	25
Monroe	J. C. Sterling	Monroe	25
Marquette	Peter White	Marquette	63
Mecosta	M. Tinker	Remus	15
"	H. Davenport	Paris	25
"	J. Eldred	Remus	25
Monominee	M. J. Moore	Daggett	15
Newaygo	W. Jenkenson	Grove	21
"	M. Melonson	White Cloud	21
"	S. Biteley	Lilley	25
Oakland	J. A. Bigelow	Birmingham	25
Otsego	G. A. Hubbard	Elmira	31
Ottawa	G. H. Souter	Holland	42
"	Ira Kendall	Cooperaville	25
Osceola	R. F. Morris	Reed City	25
Oceana	E. D. Richmond	Hart	25
St. Clair	E. F. Haight	Brockway Center	21
"	C. A. Ward	Port Huron	15
"	W. A. Bailey	Ruby	25
Sanilac	Mrs. T. L. Ward	Charleston	15
Shiawassee	H. L. Bishop	Gaines Station	25
St. Joseph	Ira Chandler	Mottville	21
"	G. H. Slone	Burr Oak	25
"	J. Walter	"	25
"	O. P. Bush	Centerville	25
Van Buren	A. High	Decatur	25
"	Geo. Krause	"	25
"	F. Wood	"	25
"	L. Warner	"	25
"	F. M. Hayden	"	25
"	A. Hayden	"	25
"	G. W. Hillard	Lawrence	25
"	G. McFern	"	25
"	R. V. Lowe	Mattawan	25
"	J. T. Robinson	Bloomingdale	21
"	C. Burnham	"	21
"	C. Veley	"	21
"	L. Gorham	"	25
"	T. Mohard	Lawton	21
"	C. Meacham	Bangor	21
"	L. W. Hewett	Bloomingdale	21
"	G. A. Hunt	Paw Paw	21
"	G. R. Hunt	"	21
"	W. A. Loomis	Bloomingdale	25
"	H. Hall	Decatur	25
"	A. B. Cooley	Bloomingdale	25
"	H. R. Cooley	"	25
"	V. Robinson	"	25
"	T. Culverhouse	Decatur	25
"	F. Fisk	Lawrence	25
"	T. Dargan	Gobleville	25
Wexford	D. R. Ball—public waters	Olean	35
"	R. D. Cuddeback	"	25
Wayne	Board Water Works	Detroit	25
"	Geo. Lee	Redford	25
"	T. W. Palmer	Detroit	100
"	F. V. Smallidge	"	20
Total plants for the year 1886			3,422

INVENTORY.

Paris Station.

118 acres land, with overseer's house and meander of Cheney Creek			$3,000
Superintendent's house	$1,400		
Barn	315		
Ice-house	28		
Shop and office	100		
Hatchery	600		
		$2,443	
Ponds, races and other improvement to ponds		2,300	
			4,743
			$7,743
Pump logs		$260	
Apparatus and tools		690	
Two camp outfits		175	
			1,123
			$8,86[illegible]

December 1, 1886.

Detroit Station.

Buildings, with frames and tanks		$6,400 0[illegible]
Chase automatic glass jars		773 4[illegible]
Fish cans		510 0[illegible]
Tools, aparatus, and furniture		378 0[illegible]
Fishery at Fort Wayne		100 0[illegible]
		$8,161 4[illegible]
Insurance, house	$3,000	
apparatus	725	
	$3,725	

Petoskey Station.

Building, water pipes, and fixtures		$3,513 0
Residence of overseer		750 0
New 4-inch main water supply		514 2
Chase automatic glass jars		502 9
Fish cans		375 0
Tools, furniture, and apparatus		258 8
		$5,913 4
Insurance, residence	$300	
hatchery, etc	1,200	
apparatus	700	
	$2,200	

DETROIT STATION.

Average temperature of water from Nov. 10, 1883, to April 6, 1884.

Nov.	10	46°	Dec.	3-4	38°
	11-16	45		5-15	37
	17-20	44		16	36
	21-24	43		17-22	34
	25-26	42		23 to March 22	33
	27	41	M'ch	23-31	34
	28-29	40	April	1-4	35
	30	39		5-6	36
Dec.	1-2	39			

These temperatures were recorded during the whitefish hatching season, the first season of the new Detroit house.

Nov. 11, 1884, to April 30, 1885.

Nov.	11-16	44°	Jan.	7-10	34°
	17	43		11-17	33
	18-22	42		18 to March 26	32
	24-24	43	M'ch	27 to April 4	33
	25	38	April	5	34
	26-29	37		6	35
	30 to Dec. 1	36		7	36
Dec.	2-3	35		8	36
	4-5	36		9	35
	6-7	37		10-14	34
	8-11	38		15	33
	12-13	37		16-20	34
	14-15	36		21	35
	16	35		22	36
	17	34		23	37
	18-21	33		24-25	38
	22-24	34		26	39
	25-26	33		27-28	40
	27-30	34		29	42
	31 to Jan. 6	33		30	43

From November, 1885, to April 18, 1886.

Nov.	8-12	46°	Jan.	2-4	35°
	13	45		5	34
	14-21	44		6-7	33
	22	43		8 to March 4	32
	23	42	Mch.	5-6	33
	24	41		7-22	34
	25-26	40		23-24	33
	27 to Dec. 3	39		25-27	34
Dec.	4	38		28 to April 10	35
	5	37	April	11	36
	6	36		12	37
	7-8	35		13	39
	9-14	34		14-15	40
	15-17	33		16	42
	18-23	34		17	43
	24-25	35		18	44
	26 to Jan. 1	34			

Pike Hatching Season, 1886.

May	24-28	54°	June	5-6	58°
	29-30	55		7	59
	31	56		8-9	60
June	1-4	57		10-14	61

These temperatures were recorded while the wall-eyed pike (pickerel) eggs were in process of incubation.

PETOSKEY STATION.

Average Temperature of water from November 27, 1885, to March 4, 1886.

November		45 to 48°	Jan.	26-31	36°
Dec.	1-5	43	Feb.	1-7	35
	6-13	42		8-13	36
	14-20	41		14-21	35
	21-31	39		22-26*	34
Jan.	1-2	40		27-28	35
	3-23	38	Mar.	4	36
	24-25	37			

* The 25th marked 36°.

These indications are from instruments not yet tested by the standard thermometer owned by the Board, and will be corrected when this test is made in January, 1887.

PLANTS OF WHITEFISH.

1874	1,532,000
1875	2,211,500
1876	9,310,000
1877	8,001,000
1878	12,520,000
1879	14,545,000
1880	10,695,000
1881	3,000,000
1882	18,170,000
1883	23,735,000
1884	37,750,000
1885	40,000,000
1886	61,620,000
Totals	243,089,500

NOTE.—For 1883-4-5-6 the total is 162,105,000, more than one-half. That up to 1880, the larger part were not deposited in the Great Lakes. That up to and including 1880 none of the 162,105,000 planted since 1883 would be marketable fish. Of the seasons of 1879-80-81 and 1882 probably less than 40,000,000 only have been placed in the Great Lakes from which appreciable results could be expected.

APPLICATIONS FOR FISH FILLED IN 1885-6.

Carp	179
Brook Trout	131
Eels	84
Land-locked Salmon	4
Pickerel	79
Lake Trout	11
	488

On books, applications not yet filled:

Carp	64
Brook Trout	131
Eels	68
Land-locked Salmon	3
Pickerel	133
Lake Trout	5
Black Bass	5
	409

December 1, 1886.

EXAMINATION OF LAKE MICHIGAMME.

Set nets in 15 feet of water and caught suckers.
Set nets in west end in 60 feet of water and caught lawyers.
Set nets in southwest part in 90 feet of water and caught perch and suckers.
Set nets in north part in 35 feet of water and caught perch and suckers.
Set nets in north part in 6 feet of water and caught perch and suckers.
Set nets in north part in 20 feet of water and caught lawyers.
Depth of water in center of lake, 15 fathoms.

PARKER AND GOODWIN.

This blank must be filled out and sent to A. J. KELLOGG, Secretary, Detroit, Mich.

STATE BOARD OF FISH COMMISSIONERS.

REPORT OF SUPERINTENDENT OF FISHERIES.

[In Accordance with Act 141, Laws of 1883.]

ACT 141, LAWS OF 1883, OF MICHIGAN—*Section 4.* All persons having a residence in this State, engaged in fishing as a business, for a whole or any portion of a year, in any of the great lakes or Detroit River, shall, on or before the twenty-fifth day of November of each year, report to the Superintendent of Fisheries, at Detroit, the amount in pounds of all the food fish caught by them during the year, together with the average price per pound. Any person neglecting or refusing to make the report provided for in this section, shall, upon conviction thereof, pay a fine of ten dollars and costs of suit, to be recovered by the Superintendent of Fisheries, or any one of the Fish Commission, in an action before any justice of the peace in the State of Michigan.

Name of fishery, owner or operator..... | Location of fishing station.....

P. O. address..... | .....

This report covers fishing season from.....188...to.....188...

Species of Fish.	No. of Fish Taken.	Av. Pounds Per Fish.	Pounds.	Av. Price Per Pound.	Description of Nets Used.			
					Nets.	Number.	Length in Fathoms.	Size of Mesh.
Whitefish					Gill			
Trout (lake)					Pound			
Herring					Seine			
Bass					Trap and wier			
Sturgeon					Fyke			
Pickerel								
Caviare								
All other kinds								

No. of men employed..... Kind and No. of boats used.....

Remarks as to season—favorable or unfavorable; as to weather and catch.

Signature.....

6.—FINANCIAL STATEMENT.

Wm. A. Butler, Jr., Treasurer, in Account with Board of Fish Commissioners of the State of Michigan.

ON ACCOUNT OF CURRENT EXPENSES.

For fiscal year ending September 30, 1883. (From appointment as Treasurer to September 30, 1883.):		
Received from State Treasurer (July 18)	$2,500 00	
Disbursements as per vouchers		$1,920 56
Balance on hand		579 44
	$2,500 00	$2,500 00
For fiscal year ending September 30, 1884:		
Balance carried over	$579 44	
Received from State Treasurer	10,000 00	
" " other sources	611 21	
Disbursements as per vouchers	17 11	$11,407 76
Balance overdrawn		
	$11,407 76	$11,407 76
For fiscal year ending September 30, 1885:		
Balance overdrawn		$17 11
Received from State Treasurer	$11,200 00	
" " other sources	78 73	10,659 1[illegible]
Disbursements as per vouchers		602 4[illegible]
Balance on hand		
	$11,278 73	$11,278 7[illegible]

OFFICE OF BOARD OF STATE AUDITORS,
Lansing, February 10, 1886.

I hereby certify that the Board of State Auditors have this day examined the within account cu[illegible] rent of receipts and expenditures of Wm. A. Butler, Jr., Treasurer of the Fish Commission of t[illegible] State of Michigan, and have carefully compared the amounts therein with his vouchers, and fou[illegible] the amount to correspond, and the balance on hand at that date corresponds with the books of t[illegible] Auditor General, and settlement has been made with him on that basis.

H. A. CONANT,
Chairman Board of State Auditors

Wm. A. Butler, Jr., Treasurer, in Account with Board of Fish Commissioners of the State of Michigan.

ON ACCOUNT OF SPECIAL APPROPRIATIONS.

For fiscal year ending September 30, 1883. (From appointment as Treasurer to September 30, 1883.):		
Received from State Treasurer, July 26	$5,000 00	
" " " " September 26	5,000 00	
Disbursements as per vouchers		$5,355 42
Balance on hand		4,644 58
	$10,000 00	$10,000 00
For fiscal year ending September 30, 1884:		
Balance carried over	$4,644 58	
Disbursements as per vouchers		$4,644 58
	$4,644 58	$4,644 58
For fiscal year ending September 30, 1885:		
Received from State Treasurer	$5,000 00	
" " other sources	5 50	
Disbursements as per vouchers		$3,013 52
Balance on hand		1,991 98
	$5,005 50	$5,005 50

OFFICE OF BOARD OF STATE AUDITORS,
Lansing February 13, 1886.

I hereby certify that the Board of State Auditors have this day examined the within account current of receipts and expenditures of William A. Butler, Jr., Treasurer of the Fish Commission of the State of Michigan, and have carefully compared the amounts therein with his vouchers, and found the amounts to correspond, and the balance on hand at that time corresponds with the books of the Auditor General, and settlement has been made with him on that basis.

H. A. CONANT,
Chairman Board of State Auditors.

Wm. A. Butler, Jr., Treasurer of the Board of Fish Commissioners of the State of Michigan, in settlement with Board of State Auditors for year ending September 30, 1886.

CURRENT EXPENSES.

Quarter ending December 31, 1885:		
Balance on hand October 1, 1885		$602 46
Cash from State Treasurer		3,000 00
" " other sources		1,201 59
Disbursements	$5,369 15	
Quarter ending March 31, 1886:		
Cash from State Treasurer		2,000 00
" " other sources		70 60
Disbursements	3,013 82	
Quarter ending June 30, 1886:		
Cash from State Treasurer		3,000 00
Disbursements	3,004 61	
Quarter ending September 30, 1886:		
Cash from State Treasurer		3,000 00
" " other sources		50 10
Disbursements	1,640 99	
Balance	396 18	
	$13,424 75	$13,924 75

Wm. A. Butler, Jr., Treasurer of the Board of Fish Commissioners of the State of Michigan in Settlement with the Board of State Auditors, for year ending September 30, 1886.

SPECIAL EXPENSES.

Quarter ending December 31, 1885:		
Balance on hand October 1, 1885		$1,991 98
Cash from State Treasurer		3,000 00
" " other sources		36 75
Disbursements	$2,420 76	
Quarter ending March 31, 1886:		
Disbursements	927 04	
Quarter ending June 30, 1886:		
Disbursements	773 85	
Quarter ending September 30, 1886:		
Disbursements	904 36	
Balance	2 72	
	$5,028 73	$5,028 73

OFFICE OF BOARD OF STATE AUDITORS,
Lansing, October 27, 1886.

I hereby certify that the Board of State Auditors have this day examined the account current of the receipts and expenditures of William A. Butler, Jr., Treasurer of the Board of Fish Commissioners, and carefully compared the amounts therein with his vouchers for the fiscal year ending September 30, 1886, and find his account current to agree with the account current on file in the Auditor General's office, showing balance on hand at that date, and settlement was made with said treasurer on that basis.

H. A. CONANT,
Chairman of Board of State Auditors.