EIGHTH BIENNIAL REPORT

OF THE

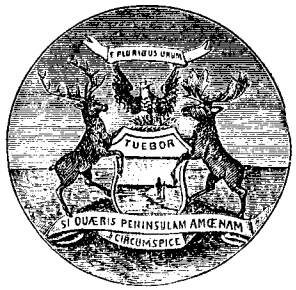
STATE BOARD

OF

Michigan

FISH COMMISSIONERS

FROM DEC. 1, 1886, TO DEC. 1, 1888.



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STATE BOARD OF FISH COMMISSIONERS.

1888.

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OFFICE OF THE BOARD.

NO. 33 MOFFAT BLOCK, DETROIT, MICH.

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STATE BOARD OF FISH COMMISSIONERS.

EIGHTH BIENNIAL REPORT.

To the Hon. Cyrus G. Luce, *Governor of the State of Michigan:*

Agreeably to the duty imposed upon the State Board of Fish Commissioners by law, they herewith respectfully submit their Eighth Biennial Report.

The Seventh Biennial Report brought the account of the affairs and operations of this board, down to December 1, 1886. This report, beginning at that date, covers all transactions down to the 1st of December, 1888.

I.—THE GENERAL WORK OF THE COMMISSION.

A.—LEGISLATION.

During the session of the Legislature in 1887 the commissioners were often at Lansing, attending meetings of the Fisheries Committees of the Senate and House of Representatives; and spent as much time as seemed to be required, in explaining to the members of both Houses the work and needs of this department; and, also, in presenting the legislation deemed necessary for the preservation of the fisheries of the state. The board prepared and submitted several bills, which it believed, from its experience, were required to be engrafted upon our statutes for the better protection of fish. The proposed legislation presented an entire scheme for revision of the fishery statutes and the enactment in their place of three statutes providing: (a), for the regulation of the fishing in inland lakes and streams, including all merely sporting fishing; (b), for regulation of the industrial fisheries, and (c), for the enforcement of the fishery laws. The Fishery Committee of the House reported the three bills favorably. Only one of them, however, was passed, that regulating the inland fisheries. The second was passed by the House, but failed of receiving consideration in the last hours of the Senate's session, the third was anticipated by the passage of the Act under which the present State Game and Fish Warden was appointed.

The law passed for the regulation of inland fisheries, being Act No. 265, Session Laws 1887, p. 350, requires amendment by adding a few words in the third line of section 9, which were in the bill as reported to and passed by the House, but by some oversight were omitted in the engrossed copy signed by the Governor. The journal shows no amendment in the Senate. That section, as it stands in the present law, reads as follows:

SEC. 9. "It shall not be lawful hereafter to kill or capture the black, strawberry, green, or white bass, except with hook and line, in any lake, river or stream in or bordering this State between the first day of March in each year and the fifteenth day of June thereafter, etc."

This section should be amended to read as follows:

SEC. 9. "It shall not be lawful hereafter to kill or capture the black, strawberry, green or white bass, except with hook and line, in any lake, river or stream in or bordering this State; *nor to kill or capture such fish in any manner* between the first day of March and the fifteenth day of June thereafter in each year; nor during, etc."

The words to be inserted are printed in italics. The journal of the last Legislature shows that no such amendment, as would warrant the omission of the words, was made, and in fact the entire wording of the section in the succeeding lines shows that the change actually made was not contemplated. The last eleven words of the section should be omitted as unnecessary. The point of the whole matter is this, that the black bass and muskallonge have become so scarce that it is necessary to protect them by what is generally known as a "close season." That is, a period covering, and just prior to, their spawning season is provided, during which they are not to be killed, or captured, in any manner; nor during the same time to be had in one's possession. They ought not at any time to be captured in any other manner than with hook and line. Both of these varieties are among our most valuable native fish for sporting purposes, both are becoming scarce, and unless they are protected, as this law contemplates they shall be, they will be substantially exterminated. The close season from March 1 to June 15, when these fish are not to be taken at all, and the prohibition of their capture at other times by nets, spears or any other appliance, except hook and line, will go far towards giving them opportunity to reproduce in sufficient quantities to maintain themselves in the waters where they are now found, and also give them an opportunity to become established in waters where they may be planted hereafter by the commission.

There is one other point which we now urge upon the Legislature to provide for the protection of black bass; it is to make it unlawful for any one to kill a bass of less than ten (10) inches in length. A similar provision for muskallonge of less than three (3) pounds in weight would furnish protection to a valuable fish.

A brief inspection of fish markets would show large numbers of bass that were not old enough to have passed their first spawning season. This should be stopped.

The Fisheries Committee of the House in 1887 devoted a large amount of valuable time to consideration of the measures presented and recommended by this board. They took great pains to inform themselves about the condition and needs of the fisheries, and listened with respectful attention to every statement and argument addressed to them bearing upon the important interests committed to them. We take the liberty of making mention of their action, as it resulted in their recommending the laws presented by this board, and in an intelligent approval of its work and action generally. The work of this commission has never failed of receiving liberal support and approval at the hands of the Legislature when it has been intelligently investigated and understood. We ought to add also that the bills presented by the commissioners were very much improved by suggestions and criticism at the hands of the committee.

B.—ORGANIZATION AND DIVISION OF THE BOARD'S WORK.

It was found convenient to systematize the work of this board by parcelling among the commissioners the different stations and kinds of operations. Acccordingly, at the meeting held in December, 1886, the following distribution was made: Dr. Parker took the stations at Glenwood and Petoskey; the Paris Station and trout breeding were assigned to Mr. Bissell; the Detroit Station and grayling experiments, to Mr. Whitaker. This division of work, originally made for one year, has been continued during 1888, and consequently covers the same period as the report. Monthly reports in writing are made by the overseers of the several stations to the Superintendent, which are forwarded by him to the commissioner in charge of the same; and these reports are included in the reports made by the commissioners at each monthly meeting. The reports are then filed in the Secretary's office and become part of the board's permanent records During the past two years the board has held its regular meetings monthly, and such special meetings as were required. The regular meetings are on the fourth Tuesday of each month, and are usually held at the office in Detroit. The residence of two commissioners in Detroit, which is necessarily the headquarters of the board's operations, has been found during the past six years a great convenience, as occasion frequently arises for consultation by a majority of the commissioners upon subjects that must be promptly considered and decided.

In March, 1888, Mr. A. J. Kellogg, who had been Secretary of the Commission since 1885, resigned that office, and the present incumbent, Mr. George D. Mussey, of Detroit, was appointed to fill the vacancy. Mr. Kellogg's long experience on the board as a commissioner and intimate acquaintance with the history of its operations was of service in systematizing the work of the office. The board was fortunate in securing the services of a competent and thoroughly trained man to supply his place, so that the business of the office has proceeded with little inconvenience from the change.

Mr. Walter D. Marks has continued as Superintendent of Fisheries during the two years, giving excellent service to the board, and at all times securing prompt and efficient service from the force under his direction. The board gladly make this public acknowledgment of their thorough appreciation of his intelligent, manly and skillful performance of all official duties to the state. The Superintendent has been fortunate in having the assistance of competent and thorough workers on the force, who deserve commendation for their skill and readiness to do all that their places require of them.

Mr. William A. Butler, Jr. has continued as Treasurer of the board, and has been of great service, not only in keeping the funds appropriated by the State safely and in a most business-like way; but also in furthering the interests of the commission at home, and among the fish culturists of the country, in ways not required by the duties of his office. As his important services have been voluntary they are all the more appreciated by the commissioners who have been greatly aided by them.

As at present organized the board is better equipped and working to better advantage than ever before in its efforts to develop and promote the fishery interests of the state.

C.—ENCOURAGEMENT IN FISH CULTURE.

1. There is good ground for encouragement in the various branches of this work. Each year the subject of fish culture, or "water culture," is being better understood by the people of the state. Year by year improvements are made in the methods of fish rearing and transportation, so that practical results are now being obtained, that a few years ago were not anticipated. The results are beginning to be generally appreciated; and the fishery officers are constantly seeing new opportunities for applying more effectively their methods and experiences to the increase of the fish supply. If one will take the pains to compare the product of the State hatcheries four and five years ago with what it has been for the past two years, and then consider that the results already attained are wholly from the smaller numbers of fish then hatched and planted, he will be better able to realize the grounds of our faith in far more inportant and permanent results. For instance, all the plants of brook-trout from which results have been yet observed are of the year 1885, and principally of the years prior to that. But the product of that year, 1885, was only 408,000 fry of brook-trout; the number planted in the following seasons of '86, '87 and '88, was over thirty four hundred thousand (3,400,000); the number in 1886 was 719,000, that of 1887, 1,085,000; that of 1888, 1,639,000.

There is every reason to expect that relatively the same ratio of increase can be maintained for the seasons of 1889 and 1890; if so, the product for for the former year should be about 2,300,000, and for the latter, about 2,800,000. After that time the Paris Station may be counted on, unless interfered with by some unforeseen accident, for an annual product of three millions and upwards. If the planting of four hundred thousand brook-trout or less each year (up to 1885) has produced unexpected and most satisfactory results in seventy or eighty streams, what may we not reasonably expect from the deposit of three millions in one hundred and seventy streams and rivers each year? The extension of railway lines has opened up more territory in which our operations can be extended, and it is hardly too much to say that nearly ever stream in the lower peninsula of the State, north of Montcalm, Gratiot, and Saginaw counties, is suitable for brook-trout. It is also probably within bounds to say that in this vast region, not one-half of the streams suitable for brook-trout have yet been planted.

It must not be understood that no streams south of the region thus indicated can be successfully stocked with trout, for up to the present time more streams south of the line mentioned have been planted with trout than north of it. It is, however, undoubtedly true that the proportion of suitable streams south of that line is much smaller than of those to the northward of it. During the period covered by the 6th and 7th biennial reports, that is from 1883 to 1886, both inclusive, brook-trout were distributed in more counties south of that line than north of it. And in some of those more southern counties have occurred many instances of remarkable growth of fish.

But why raise three millions of trout a year? Why aim at that figure, or, for that matter, at any other? Is it not enough to plant a stream once? That involves a discussion longer than most of our readers would have the patience to follow; so we must be content to state the problem and our answer to it as briefly as possible, leaving for oral answer anything more exhaustive on this subject. In the first place, nine-tenths, or over, of the streams in the

lower peninsula of the state which this board has stocked, or is now stocking with brook-trout, never were trout streams before they were made such by the State. They are therefore not streams in which the natural stock of trout has been exhausted by over fishing. So that, without knowing the exact conditions under which the trout exists in those streams, no one can surely say the supply will be unfailing, nor predict with certainty that in a given number of years the fish will not all be caught out. The most that any one can say is, the natural supply in other streams that we have known has become exhausted by unlawful, or excessive fishing, and the same causes will undoubtedly produce the like results on these waters under consideration. But here again the statement must be qualified, because in many of these streams there are reaches of water most admirably adapted to the protection of trout; as where they run a part of their course through alder, tamarack, or cedar swamps and thickets; places very difficult to fish in, and furnishing the largest amount of cover for adult fish, as well as cover for the young to grow in. Another condition is the state of public opinion on the subject of protecting the fish as prescribed by law. If the present laws remain in force, and are in the main respected and compiled with, there is little risk in saying that the supply of fish will be maintained for many years. Again, the rapidity with which the country increases its population has an important bearing on the subject. The ratio of growth of population, such as this State has experienced during the last twenty-five years, will each year make larger draughts upon the stock of fish, both as a means of sport and for the supply of food. In those portions of the state where trout-fishing is good, the trade in all branches will be stimulated, and the communities benefited by the amount of money that will be spent each year during the fishing season by visitors from other parts of the state, and from outside the state, who are attracted there by the fishing.

So that, taking the view that the majority of the streams will require re-stocking as often as once in seven or ten years, it will be perfectly apparent to any one making a deliberate and impartial examination of the subject, that for the very moderate expenditure required to maintain the Paris Station—less than five thousand dollars a year—the culture of the streams in the lower peninsula can be carried on in a way that will yield a valuable quantity of food for many citizens, and directly induce the expenditure of several hundred thousands of dollars each year which, but for the fishing, would never be put into circulation in those neighborhoods. It must not be forgotten that this culture of the trout streams is the cultivation of a public domain, and thus the appropriate work of the state; just as in the case of the great lakes. No private individual, and no smaller community, as a town, or county, can do this work. It must be done by the state. Provision being made for the whole state, the work is simplified, systemized, in the hands of skilled men, and on so large a scale that it is prosecuted with remarkable economy; and the same is true of the economy of the plant necessary to be maintained for rearing the fish. This will be thoroughly appreciated by any person who has visited the state trout farm at Paris during the past two years. We give in the appendix to this report some testimony from citizens of the state as to the success attained in the planting of streams with trout, but this is only a small part of the testimony that is constantly coming to the commissioners orally. The growth of public opinion on this subject is worthy of consideration, as it

indicates the sober judgment of the people of the state, for whom the work is done, regarding it. If the planting of brook-trout in so many localities had been a failure, we certainly should have heard of it. But the fact is that in almost every county of the state, if inquiry is made, the same answer will be returned, that it is a pronounced and appreciated success.

The planting of brook-trout has been the most popular work carried on by this board. It has been so successful in palpable results, results so easy of demonstration, in which so many people are interested, in so many widely separated localities, and the benefits to individuals and the community are so direct, that a permanent and decided impression has been made upon the public opinion throughout the state favorable to the continued culture of these fish. This public opinion is justified by the actual condition of very many trout streams which have been made so wholly by our artificial methods; and it will be much increased and intensified when the work of 1887 and 1888 begins to be realized.

2. Special attention is asked to the following report of the Secretary, which gives a complete and definite showing of the exact opinion of those engaged in the fishing business around the shores of the lower peninsula of the state (and also the same for the southern shore of Lake Erie) regarding the work of artificial propagation of whitefish. To fully comprehend the force of this report it should be remembered that five years ago the possibility of doing anything for the fisheries of the great lakes by artificial methods was not admitted by one in five of the men who are now convinced by what they have witnessed for themselves. The board had not the means at its disposal to undertake a complete statistical report, like that in 1885, and directed their investigation solely to the condition of public opinion amongst the fishermen and fish dealers. The following is the

SECRETARY'S REPORT.

To the State Board of Fish Commissioners:

GENTLEMEN,—In accordance with your instructions, I started on the 18th day of September, 1888, on a trip to investigate the condition of fisheries and fishing, particularly with regard to whitefish, on the shores of Lakes Huron and Michigan, and beg leave to report as follows:

At Bay City I saw a number of parties largely interested both as dealers and catchers, one of whom said whitefishing at Tawas, Alabaster, Au Sable and Gravelly Point was better now than at any time during the last ten years. The fish caught at these points were uniformly of good size, very few small fish having been taken. He thought the increase was due to artificial propagation. Another of them thought the planting of whitefish was the only thing that saved the industry from total destruction, and that with proper laws for their protection the supply of whitefish could be completely restored, while another said he was not at all sanguine that artificial propagation was a success. He was of the opinion, however, that with proper laws for protection, rigidly enforced, some good might come from the planting of whitefish fry. He was strongly in favor of a law prohibiting the catching and marketing of whitefish weighing less than one and one-fourth pounds.

At Alpena all the parties interviewed said the catch of whitefish had been steadily decreasing for a number of years. The decrease was, in their opinion, due wholly to the depositing of saw-dust and refuse from the mills in the waters of the lake. They all believe in artificial propagation and that the present supply of whitefish is the result, largely, of the planting of whitefish fry, but that no increase may be expected until the depositing of saw-dust and refuse is stopped, and unless it is discontinued whitefish will run out entirely.

At Cheboygan very little whitefishing is being done. Those with whom I talked stated that from their knowledge of different points above and below Cheboygan, the amount of whitefish being caught this season was largely in excess of that of any previous season for a number of years, and that much of the increase was due to the work of the commission and the partial enforcement of the present laws for protection. They believe the law is faulty and in many instances works great hardships to the smaller fishermen, many of whom have their all invested in one or two nets, which, to comply with the law, must be abandoned for larger mesh nets. The relinquishment of their present nets is a loss they could not bear because they have no means of procuring others.

At Mackinac Island, Mackinaw City and St. Ignace a number of fishermen and dealers were seen. The universal testimony is that there is an improvement there in the whitefish catch; that the increased supply is due to artificial propagation, and that with proper protection the planting of whitefish fry would be a perfect success and the number of whitefish be largely increased. All favor a law prohibiting the catching and marketing of whitefish weighing less than one and one-fourth pounds, and believe such a law would control the destruction of small whitefish to a greater extent, with less hardship to those engaged in fishing, than any other form of protection. Many of those interviewed are enthusiastic in the belief that the work of the Fish Commission is saving the whitefish industry, which would become worthless if the natural form of reproduction was alone depended upon to re-stock the waters.

Several firms were visited at Petoskey. The statements of all were that the supply of whitefish was materially increased, the increase being due to artificial propagation; that with reasonable protection in addition to the work of re-stocking the waters the supply could be increased indefinitely, and one of the most important enterprises fostered by the state restored and maintained to the great benefit of all the people.

The testimony of those interviewed at Traverse City is that not a large number of whitefish are caught there. Refuse and sawdust from the mills has done great damage, and until the depositing of it can be stopped very few whitefish will be caught. Those with whom I talked could not say they believed in artificial propagation of whitefish because they did not see how the results would be determined, the water in which the fry are deposited being so vast in extent. They did, however, believe in the artificial propagation of brook-trout because thousands could be seen in the bay that had come from the Boardman river in which they had been planted by this commission. They see no change in the quantity of whitefish caught from year to year. The number is never large.

The reports received at Manistee show a great scarcity of whitefish, owing to the fact that a large quantity of sawdust is deposited in the water there, destroying or driving away the whitefish. The Fishermen believe in artificial propagation, but do not believe that good results will follow planting there

while so much refuse is being put in the lake. At Ludington the reports received correspond very nearly with those at Manistee. A small increase in the number of whitefish has been noticed, and the fishermen believe that it is due to planting, but do not believe much good can be accomplished until the depositing of sawdust is stopped. Some of these fishermen are familiar with the condition of whitefishing at Frankfort and the Manitou Island, and say there has been a noticeable increase at these places; that the increase is not large but encouraging, and the fishermen there believe the present supply is the result of planting.

Those with whom I talked at Pentwater said there were no whitefish there worth mentioning. They catch lake trout and sturgeon only, and have no opinion as to artificial propagation. What they most desire is to be let alone so far as laws for protection are concerned. They have no objection, however, to having the result of planting thoroughly tested by putting any number of fry in the lake there, but do not want any restriction placed upon the time or manner of catching them.

At Montague, all the reports I received indicate that no kind of fishing is good. Sheepheads, suckers, trout, and a few sturgeon, are the only kinds caught. Whitefishing was once very good there; sawdust and refuse have entirely destroyed it. It is the opinion of all with whom I talked, that planting whitefish fry there will fail to be of benefit, so long as refuse from the mills is deposited in the water.

Reports received at Muskegon and Grand Haven show that there are no whitefish there worth mentioning, the scarcity being due wholly to the refuse from the mills. A few whitefish are caught and the fishermen believe them to have been planted by the commission. They have no doubt that artificial propagation would be a success, if the fry are put into water free from sawdust and refuse.

At St. Joseph, I met a number of gentlemen very extensively engaged, in catching and handling fish; they reported that in 1883 and 1884, quite a large number of whitefish were caught. In 1885, a great rise in the river and a heavy blow carried the refuse from the river into the lake, and in consequence 1885 was a very poor year for whitefishing. In 1886 this refuse began to disappear. Fishing improved and the present season it is very good, with every prospect of still greater improvement. They report the lake there full of small whitefish, too small to be taken with the legal mesh nets which they use. All believe these small fish to be those planted by the commission, and all are firm believers in artificial propagation. I found at St. Joseph some men largely engaged in fishing at Frankfort. From them I learned that whitefishing at Frankfort was very good; not so good, however, as in 1884, 1885 and 1886. They say there are large numbers of small whitefish in the lake at Frankfort and that a great many are caught in legal mesh pound nets by lifting the nets quickly. They are of the opinion that these small fish are planted fish, and they believe in artificial propagation.

The reports at South Haven correspond with those received at St. Joseph. The fishermen believe in artificial propagation, and like those at St. Joseph and Frankfort think the small whitefish in the lake in so great abundance are planted fish. They report a large increase in the number of whitefish there, but on account of the size of mesh used not so many are caught as in former years. They think planting should be continued and increased if possible.

I have also to report that after my return from Lakes Huron and Michigan I visited the southern shore of Lake Erie, stopping at Buffalo, Dunkirk, Erie, Cleveland, Sandusky and Toledo. The statements received at every place were alike and to the effect that the catch of whitefish this season is much greater than in any year for fifteen years; that about five years ago it was the opinion of all engaged in whitefishing there that the supply was exhausted, that the lake was cleaned out, and whitefish in paying quantities would not be caught on that shore again. Whitefish fry were planted in large quantities every spring by the United States, Ohio, Pennsylvania and Michigan Commissions and now whitefish are abundant. Every man with whom I talked was positive and enthusiastic in the belief that the restoration of whitefish to the waters of the southern shore of Lake Erie is due entirely to artificial propagation and the planting of whitefish fry by the different commissions.

A careful analysis of my notes of the interviews with the different fishermen shows as follows:

That at Tawas, Alabaster, Au Sable and Gravelly Point the catch of whitefish in 1887 and 1888 exceeded the amount caught in any year for the past ten years; that the gain has been steady and is the result of artificial propagation. That at Thunder Bay, Alpena and up to Presque Isle while whitefish are decreasing in number, the present supply is believed to be due to planting, and the fishermen believe in artificial propagation without which they think there would be no whitefish at all. That at Cheboygan and Hammond's Bay the whitefish catch has been steadily increasing since 1885, and the season of 1888 is the best since 1885, and the increase is due to planting. At Mackinaw City, Mackinac Island and St. Ignace there has been a noticeable gain, and more whitefish are caught now than for a number of previous years. A great number of small whitefish are seen there, and those engaged in the business believe these to be the result of planting. That at the Chenneaux Island large numbers of very small whitefish are taken, salted and sold for from one to one and one-fourth cents per pound, and ultimately reach the consumer as *herring*. That at Bois Blanc Island the whitefish catch is poor, two-thirds of those taken in the last three years having been very small, and salted and sold as *herring, or thrown away*. The fishermen at these places believe in artificial propagation and that the small fish caught so abundantly are planted fish. That in Lake Michigan above Point Au Chene, fifty miles above St. Ignace, there has been a steady increase for two or three years, and the catch of whitefish in 1888 is unusually good, and that artificial propagation is the cause of the increased supply. That at Mille Coquin Bay there is a marked increase over former years and whitefishing in 1887 and 1888 was good, and artificial propagation is considered a success. That from Mackinaw City to Freedom and Cross Village there is a decided gain due wholly to planting. That at Skillagallee, Little Traverse, Grand Traverse Bay and the Beaver Islands there has been a gradual improvement since 1885; that fishermen noticed the increase and attributed it to the planting of whitefish fry. At Frankfort an increase is also noticed. At Manistee, Lundington, Muskegon, Grand Haven, Pentwater and Montague, while whitefish are scarce in consequence of the depositing of refuse from saw mills, yet the fishermen believe in artificial propagation and that planting would be a success if the water was free from refuse. That at Free Soil whitefishing is good and the supply is due to planting. That on Lake Michigan, from Saugatuck to St. Joseph

and Michigan City whitefish were scarce for some years, but since July 1888 a great increase has been noticed in the number taken of good marketable size. The presence of immense number of small whitefish in the lake has also been noticed by all the fishermen, who consider it undeniable evidence of the success of artificial propagation. And, finally, that the complete restoration of whitefish to the waters of the southern shore of Lake Erie is proof, positive and unquestioned, of the wonderful success attending the planting of whitefish fry in fairly adequate numbers.

A comparison of the statements made at all points visited, with the records of this office, shows that where no planting has been done no whitefish are found or are found in such small quantities that fishing for them is unprofitable, and where comparatively little planting has been done, whitefish are found in paying quantities, while in Lake Erie, where large numbers of whitefish fry have been put they are caught in great abundance and a lost industry restored and made of great profit to those engaged in the business and of great benefit to the consumer by reason of the decreased price of the fish.

Very respectfully,
GEO. D. MUSSEY, *Secretary.*

Detroit, December 1, 1888.

D.—THE FISHERIES.

THEIR REGULATION AND LICENSE.

The necessity of having proper legislation for the protection of the Industrial Fisheries still exists and is made more apparent every year. All that our last two reports have contained on that subject, as to the necessity as well as to the manner of regulation we cannot refrain from urging upon the Legislature; with the single exception that for the enforcement of such laws as the Legislature may enact, we think it would be far more prudent to enlarge the powers of the present State Game and Fish Warden by appropriate amendment to give him substantially the duties and powers we have heretofore urged for an Inspector of Fisheries, instead of establishing another and very similar office. The work of this board has grown steadily and is all that it should be charged with. The duties of the Game and Fish Warden are such that for the next four or five years at least they will require his entire time. The work of each bureau is distinct and can probably be carried on to better advantage to the state as at present organized. This independence of the two departments will not work to the disadvantage of either. Such information as the State Warden acquires (if granted the extended powers which this board thinks he should have) as relates to any work conducted by the Fish Commission, can be readily furnished by him to the commission and will be as available as if procured by its own agents or employés. The additional powers which we think should be conferred upon the State Warden are the inspection of fishing apparatus and markets to prevent or punish the destruction of unmarketable and immature fish; the power of seeking and process for condemnation of unlawful nets and other fishing appliances; more adequate support of that department, which would enable the State Warden to maintain at least two permanent deputies charged with the special duty of looking after the industrial fisheries and procuring reliable statistics of the fishing product. The salaries and

expenses of the deputies assigned to work upon the industrial fisheries should be borne by the state at large, and they should have power to exercise their functions in every county of the state bordering the great lakes and on rivers where the operations of such fisheries are conducted. The able and intelligent efforts of the present State Warden to enforce the law, and the results accomplished in the present unsatisfactory condition of the fishery laws of this state, commend him to the confidence of the Governor and Legislature, and well warrant the granting of more extended powers, the exercise of which promise far more important and permanent benefit to the fisheries and the public interests involved in their preservation and extension than is commonly appreciated by the people.

This matter of regulation of the fisheries and the enforcement of the same is the more urgent as the time has undoubtedly come when the state should adopt a system of licensing the fishing industry. In former reports we have pointed out that one of the conditions precedent to adopting such a system was the demonstration that the state by its artificial propagation and distribution of whitefish could restore the wasted fishing grounds to productiveness, even on the great waters of our bordering lakes. Our anticipations in that direction have been more than fulfilled. In Lake Erie, in the face of the most extensive as well as the most destructive fishing operations, the stock of whitefish has steadily grown since the time that the product of the hatcheries deposited there has had time to mature. The demonstration on Lake Erie, as appears above, has been the most pronounced because there the efforts of the states of Ohio and Michigan have been supplemented by the work of the United States Fish Commission and Canada. The result in Lake Erie has also been most convincing because its extensive fisheries have been in operation longer than those on any of the upper lakes. The reports we have from parts of Lake Michigan, where the artificial planting has been carried on regularly for five (5) years, are equally convincing. The success attained is precisely what we anticipated, and has been of sufficient force to remove every doubt from the minds of the fishermen, and others who have observed the results. A glance at former reports of this board will show that the state fishery authorities had not claimed that all was being done in the way of replenishing the fisheries that could be done, or that ought in time to be done; but only that we are doing enough to show beyond any question that the artificial methods adopted by the state could stay the waste and the depletion of the fisheries in the localities selected, and make a complete demonstration that would justify the state in engaging more extensively in such operations; in fact upon a scale that would increase the product of the fisheries many times in value. The fact that the extent to which the production of whitefish can be carried is only limited by the capacity of the great lakes to furnish food to grow the fish, means that the actual value in money of the product that our waters will yield annually can be reckoned in the millions of dollars, and, also, that this industry fostered by the state can by a just system of license pay all the cost of producing the annual supply of young fish, as well as the expense incurred by the state in regulating the industry.

The proceeds of any license system adopted by the Legislature should in our judgment be apportioned by the State Treasurer between the State Warden and this Board, taking for the former all the expenses incurred in the inspection and regulation of the industrial fisheries, and the remainder

should be placed to the credit of the Fish Commission and used by it exclusively in extending its operations in the hatching and distribution of whitefish to the great lakes.

III.—ARTIFICIAL PROPAGATION AND PLANTING.

1.—WHITEFISH.

The great importance of the commercial fisheries of Michigan, furnishing employment as they do annually to a large number of men and requiring the investment of large sums of money to conduct them, demands of those engaged in the artificial propagation of fish, especial attention and the exercise of every effort to restock exhausted waters. By a reference to the statistics contained in the last biennial report of this board, it will be seen that the amount of money annually brought into the State derived from the sale of whitefish amounts to nearly or quite $1,000,000, as near as can be ascertained, although we are satisfied, from the difficulty of collecting reliable information on the subject, that this amount is considerably below the actual amount realized.

It is therefore of the first importance that the Michigan Commission in the conduct of its work should give special attention to the restocking of the great lakes and their connecting waters, which have been greatly depleted by constant fishing without limitations as to the capture of small and immature fish, since the settlement of the state.

It must be remembered that the improvements in the apparatus for taking whitefish have been greatly multiplied in the last ten or fifteen years, and that the destruction of the whitefish has more than kept pace in most localities with the effort to restock the waters. The business of fishing previous to the last decade was largely prosecuted with Mackinac boats and was carried on near the shore, but the business has been so revolutionized by newer and more destructive modes of capture, that the business as now conducted has fallen into the hands of men of larger means, and the fishing is now prosecuted by the use and employment of steam craft, and much of the fishing is done far from the shore.

As a consequence of this change the destruction of the whitefish has been quadrupled many times. The establishment of depots where fish may be frozen and preserved for future use, has within the last few years offered a temptation to those engaged in the business to prosecute their work during almost every season of the year, when not rendered impracticable by storms or other unfavorable conditions. Very many localities formerly known as good whitefish fishing grounds have by the multiplication of methods of capture been fished to death and now make but poor return, if any, to the fishermen, while many other grounds have been wholly abandoned because of their unproductiveness.

The vast extent of lake coast of the state causes it to stand first among the states bordering on the great lakes in the importance of her whitefish fishing industry, and the demands upon the Michigan Fish Commission for the reasons above referred to have been so imperative, and the product of the fisheries has been so profitable to those interested directly and indirectly in them that every effort has been exerted upon our part to enlarge to the fullest extent the possibilities of artificial propagation.

With an extent of coast of lake and river covering 2,000 miles, it can be imagined that the impression made by the commission in restoring unproductive waters, for the first few years of its existence was trifling. Hampered as it was by lack of means, methods and experience, the result of its work annually was insignificant as compared with the present output. Artificial propagation of fishes was then a new and in a large measure an untried experiment as to practical results, and comparatively small quantities of fry were placed in the great lakes up to the time of the completion of the new whitefish hatching station at Detroit in the year 1883, and the erection of the whitefish station at Petoskey in the same year. Since 1883 the work has been greatly increased and with the number of fry annually put into the waters of the great lakes the results of these plants must soon be manifest in all the waters, as recent results have shown its success in Lake Erie.

Prior to 1881 the method for hatching whitefish was by the use of trays, and the work that could be done in this manner was necessarily limited as to output, for the reason that it required one employé to every million of eggs thus cared for. But in 1881 the introduction of the Chase automatic jar entirely revolutionized the methods theretofore employed, and made the hatching of very much larger quantities practicable with a minimum amount of cost. By this device economy in labor has been gained until now, with the employment of two men during the hatching season, 100,000,000 whitefish eggs can be cared for, while the same number of eggs by the use of the old method would have required the attention of at least 150 persons.

In inquiring into the results of the efforts made to restore the waters of the great lakes to a condition where profitable fishing may be done, it must be borne in mind that while large numbers of fry have been put into the waters every year in good condition, they must necessarily run the risk of loss from predacious fishes and other natural enemies, and that the losses sustained in this manner must cut a large figure in determining what proportion will live to reach the spawning age. Increased facilities of capture, the duplication of nets, the smallness of the mesh of nets used by which the small fish are taken for market before coming to the age of maturity where they may reproduce their kind, are all elements which very materially affect the results of a re-stocking of the waters. It may be suggested in this connection that the enforcement of wholesome and proper regulations for the preservation of the smaller fish which are of little or no value in the market, might well occupy the attention of the law-making body, and that the State has a right to insist that its efforts to re-populate the waters shall not be counteracted by improper and unreasonable modes of capture.

2.—BROOK-TROUT.

The hatch of brook-trout at the Paris Station in the winter and spring of 1887, was the largest in the experience of the commission up to that time.

The first eggs were taken Oct. 4, 1886, and the egg-taking continued until January 15, 1887. The larger proportion were taken as usual during the month of November.

The first eggs of season 1886–87, hatched on the 6th day of December, 1886. Only a very few, and those of the eggs first taken in the early days of October, however, hatched so early as December; the overseer's report of January 15, 1887, shows that up to that time only 80,000 were out of the

egg. The hatching continued until April 15, 1887. This is probably the longest period of incubation that has been experienced at Paris Station, being 23 days longer than required in the following year, when about one-third more eggs were handled. The first trout were shipped out for planting on February 21, 1887, and the last shipment was made May 24. The total number of brook-trout eggs taken this season was 1,310,500. The number of females stripped was 3,460, giving an average for each female of 378.76. At that time there were about 7,600 trout in the stock ponds, 4,140 males and 3,460 females, over two years old. This average yield of eggs is quite low, and is readily accounted for by the great number of young fish in the ponds. The total number planted was 1,090,000

The loss of eggs during the incubation of this year was about ten per cent., and the loss on young fish while being carried till the unbilical sac was absorbed was about seven per cent., or total loss from the eggs and young fry about 17 per cent. This is a very good average, particularly when account is taken of the crowded condition of the troughs and trays. In hatching and rearing young trout for planting, the greatest difficulty is in the handling of the recently hatched fry. The umbilical sac of the brook-trout—that provision of nature for the sustenance of the fish during its period of helplessness—is large and heavy in proportion to the size of the body, so that for the first weeks the fish is scarcely able to keep himself afloat in the water, and spends the greater part of its time resting on the gravel, or wire screen bottom of the tray. The hatching fish consequently require much more room than the eggs. The capacity of a hatchery is predicated upon the number of young fish that can be safely carried to the planting age—30 to 50 days—not by the number of eggs that can be carried through the period of incubation. By March, 1887, the old hatchery at Paris was crowded beyond the point of convenience or safety. Fortunately there was no bad weather or other accident to prevent rapid shipment of fish, and the ratio of loss was less than in former years, owing largely to the experience and watchfulness of the overseer and his assistants. The average temperature of the water from October 4 to March 5 was 37°. They were distributed to the following named counties: Allegan, Alcona, Antrim, Arenac, Barry, Berrien, Branch, Calhoun, Cass, Charlevoix, Cheboygan, Clare, Eaton, Emmet, Genesee, Gladwin, Grand Traverse, Ingham, Ionia, Isabella, Kalamazoo, Kalkaska, Kent, Lake, Lapeer, Lenawee, Livingston, Manistee, Oakland, Oceana, Osceola, Ottawa, Roscommon, Saginaw, St. Clair, Shiawassee, Van Buren, Washtenaw, Wayne. In all forty-four counties. The number of streams planted being about one hundred and seventy. In streams of large size, say of five to seven miles and upwards in length, experience has shown that the best results are obtained by making plants on two or three successive years. With an abundant supply of fish there is no reason why this should not be done. In a river like the Boardman or Jordan frequent plants should be made, as those streams are capable of supporting a very large number of trout, and even if the food supply of the fish should be temporarily overtaxed, there is an opportunity for the fish to range into the lakes below, as they are known to do, where plenty of food will be found, and a large growth attained.

In the fall and early winter of 1887, the first trout eggs were taken on the 30th day of September, and the yield continued until the 11th day of January, 1888. The highest number taken on any one day was 123,000, on

November 2. The first fish hatched on the 12th day of December, and by the 28th day of March all were out. The total number of eggs laid down that season was 1,952,000. The total number of fish planted was 1,639,000, showing a loss of only 16 % which marks it at the most successful hatch ever made by the commission. This was attributed to the fact that it was the first season of the new hatchery (a full account of which is given below under the appropriate head) and the young fish were afforded ample room. The loss in young fish after the hatching, and while they were being carried until they were old enough for planting, which is far the most critical period in the young trout's life, was remarkably small.

Planting was begun on the 26th day of February, and finished on the 14th day of April. The handling of so large a number of trout impressed most strongly upon the board the immediate necessity of a car properly constructed and equipped for the safe, convenient and economical shipping of our trout, as well as other fish.

The number of brook-trout in the ponds in January, 1888, over two years old was 10,000; the number of females stripped was 4.817, showing an average yield of 405.231 for each female. The number of males was 5,183. The increase in average yield of eggs to each female, over the average yield of 1886 was 26.471. Between May and November, 1887, 3,906 brook-trout of various sizes, mainly two and three years old, were caught in the wild ponds and creeks on the state property, and were distributed to the stock-ponds. This is quite satisfactory evidence that our stock fish will receive quite large additions each year from these sources, and that we shall not be entirely dependent upon the rearing of young fish for that purpose in the nursery races and in the ponds.

In December we sent 25,000 brook-trout eggs to the Hatching Station of the United States Fish Commission at Northville, Wayne county, in exchange for the same number of eggs of brook-trout delivered by them on 16th February following. This exchange is for the purpose of introducing new blood. For that purpose the fish hatched from the eggs then exchanged will be kept and reared at Paris for breeding.

The young brook-trout of this season, the spring of 1888, were distributed to the following named counties: Allegan, Alpena, Antrim, Branch, Barry, Calhoun, Clare, Cheboygan, Cass, Clinton, Charlevoix, Crawford, Eaton, Emmet, Genesee, Grand Traverse, Hillsdale, Ionia, Ingham, Iosco, Isabella, Jackson, Kent, Kalamazoo, Kalkaska, Livingston, Lenawee, Lake, Lapeer, Mecosta, Montcalm, Macomb, Mason, Manistee, Muskegon, Marquette, Newaygo, Ottawa, Osceola, Oakland, Ogemaw, Saginaw, Van Buren, Wexford, Washtenaw. In all 46 counties. The number of streams in which plants were reported this year was 244. The number of persons supplied with trout on regular application was 162. The Jordan, the Cedar, the Boyne, the Boardman rivers and Carp lake, and two brooks in Mecosta county were planted by direction of the Board.

The number of streams planted was 106, in 1886, on 77 applications; in 1887, 163 streams were planted on 118 applications. The increasing number of applications from so many citizens is some indication of the appreciation on the part of the people of the state of the work of fish-culture. In considering the number of applications one must not fall into the error of supposing that each application represents only the applicant, for in nearly every case he represents a community. Often the applications are filed by a

number of citizens joining together for the purpose of securing something of common interest to many; frequently applications are made by clubs.

As this report goes to the printers' hands reports from the Paris Station shows that over 2,500,000 brook-trout eggs have been taken from the stock-fish, and a reasonable estimate promises to make the total this season of 1888 reach 2,850,000. This more than makes good the anticipation of the past two years.

3.—LAKE, OR SALMON, TROUT.

As announced in our last report, operations with the salmon trout had been temporarily suspended, partly because other work seemed more urgent, and until the completion of new hatchery at Paris, there was not enough available room in the troughs for handling any; but mainly in order that through the examinations of inland lakes we might learn as definitely as possible what had been the results of planting them in 1884 and 1885 in some small interior lakes. And, also, because the examination of inland lakes had not proceeded far enough to enable the board to decide what number of salmon trout could be used advantageously. We have now facilities for doing all in this line that may be proved to be desirable. The examination thus far has shown a number of lakes in the southern part of the state which are undoubtedly well adapted to rearing the lake trout, both because of their depth and the temperature of the water, and the existence in them of herring, which in the great lakes constitute a large share of their food.

4.—WALL EYED PIKE.

Among commercial fishes the wall-eyed pike, by reason of its edible qualities, ranks among the first. It enters largely into the food consumption of the people, and forms quite a percentage of the value of the marketable fish of the state. It is a spring spawner, and like all spring spawners, the period required for the hatching of the fry after the egg-taking or fertilizing process requires a much shorter time than is needed for the fall spawners. The average time required for the hatching of the fry after fertilization with wall-eyed pike is from 17 to 23 or 24 days, while with the fall spawners, like the whitefish, this time extends over a period from 100 to 130 days.

The wall-eyed pike begins to run in our rivers in May and June, varying somewhat with locality, and are most largely taken in the St. Clair and Saginaw rivers and bay. The larger portion of the eggs taken by the commission have been obtained from one or the other of these localities.

Much greater difficulty is experienced with the handling of wall-eyed pike eggs because of their being extremely viscid and having a tendency to cake or mass together, which can only be overcome by manipulation of the operator or spawn gatherer. Because of this tendency the percentage of impregnation is much lower than is experienced with the whitefish and brook-trout, so that in handling a given number of eggs the net result of impregnation is very largely in favor of the last two mentioned varieties. Another and serious difficulty with the hatching of the wall-eyed pike is encountered immediately after the fry is hatched, and while it seems almost incredible, it is a fact that they prey upon each other, and at almost any

time during this period of the operations it can be observed with the naked eye that each individual is trying to swallow his fellow and large numbers are lost in this way. This can only be overcome by making the plants at the earliest possible time consistent with safety after they are hatched.

While the work of hatching the wall-eyed pike has not been conducted for a sufficient length of time to warrant much return of evidence of the success of stocking the waters, yet we have been furnished with quite a number of evidences of success in this direction, and we look for their successful introduction into the inland lakes of the state, where they will constitute a large item of food. The board is receiving many applications for this fish, and steps are being taken to supply the demand as rapidly as possible.

The spawning period of the wall-eyed pike following as it does very soon after the completion of the plants of whitefish and brook-trout, permits the employment of the regular force so far as required in the carrying on of this work, and as the period from the season of egg-taking to the time of planting is comparatively short, covering only about two months, this work is usually completed by the first week in July.

The eggs of the wall-eyed pike are considerably smaller than those of the whitefish. An actual count of these eggs was made in the spring of 1888 and resulted as follows:

Number of eggs to the square inch, 2,197.

Number of eggs to the quart, 152,292.

Average number of eggs to a jar, 304,583.

The above figures were ascertained by actual count and can be relied on for accuracy.

In the spring of 1887 the egg-taking operations were conducted at Bay City, and the eggs were taken to Petoskey and hatched in the Chase jar at that station. The total number of eggs taken was 6,000,000 and the total number of fish planted was 3,280,000.

The fry were distributed in the counties of Branch, Eaton, Hillsdale, Kent, Kalamazoo, Lenawee, Emmet, St. Joseph, Wexford, Washtenaw and Osceola.

In the spring of 1888 the spawn was gathered at Linwood, on Saginaw bay, and at Port Huron, on the St. Clair river, and were shipped to the Detroit station, where they were hatched and from which point they were distributed.

The total number of eggs taken was 24,000,000. Of this number there were hatched and distributed 11,492,000 in the counties of Branch, Cass, Calhoun, Clare, Cheboygan, Genesee, Hillsdale, Ionia, Ingham, Jackson, Kalamazoo, Livingston, Lenawee, Macomb, Montcalm, Oakland and St. Joseph.

It will be observed that the percentage of loss was very high, although we believe that the percentage hatched is as high as that reached by any other commission in handling these eggs. The reasons for this loss have been above stated and need not be referred to again.

Very much difficulty is experienced in obtaining the spawn of these fish, as they are somewhat erratic in their spawning habits and it is impossible, owing to the shortness of the season, to always be upon the ground at the right time. It very frequently happens that the fish in Saginaw Bay and river spawn from one to three weeks earlier than the fish in the St. Clair river, although the latter stream is considerably further to the south. In the spring of 1888 the force was first sent to Saginaw Bay, but it was soon learned that the fish at

that point had already spawned and the force was transferred to the St. Clair river and Lake Huron.

Tabulated statements of the plants of the wall-eyed pike can be found in the appendix.

It should be stated here that owing to an accident to the water works at Petoskey in May, 1887, whereby the water supplying the house was interfered with, the eggs were very badly injured, and undoubtedly the percentage of success was considerably diminished for this reason.

5.—CARP.

There has been an increasing demand for carp since our last report, but nearly all orders have been filled, and this year many more might have been furnished on application.

The time since the carp was introduced in this state has been so limited, that but little can be said as to the ultimate result of the cultivation of this variety as a food fish, for with the present generous supply of our undoubtedly much better native fish, the question of the value of the carp will wait for its solution in the future; but the time is coming when the question of a supply of food for our better fish, notably the black bass, may find its solution in the wonderfully prolific powers of the carp. The quantity of fish that any given area of water can supply must to a great degree depend upon the quality and amount of food that the fish can find therein, and the time may come when to supply fish for the food of other fish may become an important part of the work of the commissions as is the present of fish in new and depleted waters; and in such an event the carp may come to assume a very important place in fish culture in America.

6.—BLACK BASS.

Distribution of Bass.

Many of the inland lakes of the state are naturally well stocked with the small-mouthed black bass, which stands without rival as a game and food fish, while other lakes well adapted to their habits are either now depleted of this variety, or in the original distribution by nature, never chanced to be stocked with them. The board has long had in contemplation the stocking of these waters with this valuable fish, but for lack of means by which they might be transported they have never been able to accomplish such restocking. The black bass is so radically different from almost all of the other fresh-water fishes in its spawning habit and in its watchful care over its ova and fry, that the percentage of loss of eggs cast in the natural way and of the fry when hatched is very much smaller than with most of the fish of our northern waters. It is a well established fact that the parent fish hover about the spawning bed constantly, from the time the eggs are cast, until the fry has been hatched and are in measure able to take care of themselves. This will largely account for the presence of this fish in nearly all our fresh-water lakes and streams, and for its wide distribution over the greater part of the United States.

For the reasons above stated these fish have never been artificially propagated, other than for the purpose of experiment, and it has been found that better

results can be reached by making the distribution of young fish, either yearlings or two year old, from one water to another. This work will be carried on during the late summer and fall of every year, the new car now at the command of the board enabling us to reach every part of the state where it is desirable and advantageous to make distributions of this fish. Owing to the lateness of the season, when the new car was received the distributions have been necessarily small this year, but the little experience we have had has demonstrated beyond doubt that the fish can be held in cans and the temperature of the car so reduced that without a change of water bass may be carried from any point in Michigan to San Francisco or any other remote part of the union, if necessary. Below will appear in detail the work done for the fall of 1888, in the distribution of black bass.

On the 12th of September Mr. A. W. Marks, the overseer of the Detroit station, with six assistants, left Paris with the car for Edwardsburg, in Cass county, to commence the taking and distribution of the small mouthed black bass. They arrived at Edwardsburg, near Eagle lake, at 3 A. M., side-tracked the car and established a camp at that point and proceeded to take the fish needed for distribution. The fishing was done with a small mosquito-bar seine, the men wading into the lake and drawing the seine near shore. After the seine was drawn, the fish were removed and placed in crates. The fish varied from two to three or four inches in length. Crates had before been prepared to receive the fish, being made of dry-goods boxes with a lid upon the top, which could be opened and closed at pleasure, and having a fine wire screen at each end, allowing free circulation of the water in the box and preventing the fish from escaping. The fish were held in these crates until a sufficient number had been procured for shipment, when they were removed from the crates and placed in the shipping cans in the lockers of the car, ready to be taken to point of destination.

The car left Edwardsburg with first shipment of 650 small-mouthed black bass on September 18, and they were distributed as follows:

September 18—	
Cass county, Cassopolis, Stone Lake	75
Cass county, Marcellus, Fish Lake	50
Kalamazoo county, Scotts, Scott's mill pond	50
Calhoun county, Battle Creek, Goguac Lake	200
September 19—	
Eaton county, Bellevue, to D. Hart	50
Jackson county, Jackson, to Geo. E. Beebe	75
September 20—	
Hillsdale county, Bawbeese Lake	100
Jackson county, Brooklyn, Clark's Lake	50

The car then returned to Edwardsburg, September 21, at 11 A. M. In the afternoon of the 22d it was found that the wind was killing the fish in the crates in the lake, and the camp was broken and everything was removed to the car. Another reason for removal was the lateness of the season, the young fish having moved into the deeper water, where it was impossible to take them with the net. The "Attikumaig" left Edwardsburg September 24, at 1:30 P. M., for Petoskey, via. Detroit, with the remainder of the catch of black bass taken after the first plant, 900. The car was sent to Detroit, as it was

desired to store the boats, camp equipage, etc., at the Detroit station for the coming year. The plants made upon this trip were as follows:

September 24—	
St. Joseph county, Colon	200
September 25—	
Branch county, Coldwater, Coldwater Lake	100
Branch county, Quincy	50
September 26—	
Oakland county, Birmingham, to Chas. D. Place	25
Oakland county, Lakeview Lake	100
Genesee county, Fenton	50
Kent county, Sand Lake	26
September 27—	
Charlevoix county, Clarion, Bear Lake	150
Emmet county, Levering, Douglass Lake	150

These fish were taken from the lake at Edwardsburg at 8 o'clock A. M. September 23, were taken to the car in cans, each can containing about 150 fish. After being received at the car the fish were divided, about 25 fish being put into each can. The time occupied in making these arrangements was up to noon of that day. At this time the temperature of the water in the cans was 60 degrees, and the temperature of the air was 80 degrees. After being divided in the cans, the cans were placed in the lockers of the car and broken ice was packed around the cans, this work being finished at 12:30 P. M. At 3 P. M. the temperature of the water had fallen 12 degrees and was gradually lowered until it reached 40 degrees, which was the lowest point indicated by the thermometer at any time during the trip.

The smaller fish were carried successfully and without loss. An experiment was made with larger bass, which was not so successful. Thirty-four bass weighing from a quarter of a pound to half a pound each, were placed in the car, but they commenced dying on the night of the 24th, and when the car reached Detroit on the morning of the 26th they were all dead. This failure to carry the larger fish is attributable to the fact that for lack of room they were much crowded in the cans. There is no question that with one or two fish placed in each can the larger fish can be transported with equal success.

The fish were carried without change of water, some of them being in the cans four days, being taken from the lake on the 23d, and not planted until the 27th. All the young fish were in good condition on leaving the car.

The examination of waters, which has been conducted by the commission for the last three years, shows out of 154 lakes examined, about 20 contained small-mouthed back bass and about 130 contained none at all, the most of which are well adapted to the habits of these fish. We are of the opinion that the distribution of the small-mouthed black bass in the waters of the different parts of the state will meet with general approval of the people and will greatly popularize the work of the commission.

7.—GRAYLING.

A reference to the last biennial report will show that measures were taken by the board in 1886-7 to successfully hatch and artificially propagate the

grayling. All former experiments in this direction had resulted in failure, which was largely owing to the fact that the grayling will not stand domestication.

In order to overcome this difficulty nearly 400 feet of stream on the Buckhorn creek on the state property at Paris was set apart for an experimental pond. This part of the stream was left almost in a state of nature, nothing being done beyond what was demanded to confine the fish within these limits. We believed under these circumstances, the conditions being so favorable and the fish being relieved largely from restraint, that at the proper season they would show a disposition to spawn, when they could be removed and the ova taken.

In August, 1887, an expedition was organized to the west branch of the Manistee river, where a camp was established and a sufficient force went up the river to secure the stock needed for the pond. About 300 grayling were taken and from this number there were selected and sent to Paris eighty-five grayling in good condition. As the spawning season approached they were closely watched, but gave no indication of spawning whatever. The result has been that this experiment has resulted in another chapter of failure in the propagation of the grayling.

Upon consultation it was deemed advisable by the board to make one more experiment under the same general plan. Accordingly, on the 10th of August, 1888, another force was sent to the same place upon the west branch of the Manistee river. The weather was very unfavorable owing to heavy rains, and but about one-half of the number of grayling were taken in a nine days' stay, of the number taken the year before. From the number taken there were successfully transported to Paris, 66 adult grayling, which arrived there in a healthy condition.

With these fish and those already in the pond, we shall conduct the experiment for another year, we trust with better results, although the encouragement is not great.

8.—LOCH LEVEN TROUT—THE TROUT OF THE SCOTCH LAKES.

By the courtesy of the United States Commissioner of Fish and Fisheries, we received on December 21, 1887, a consignment of 15,000 eggs of the Lock Leven trout, from the Cold Spring hatchery, Long Island. They were part of a batch imported by the United States Fish Commission. February 16 the young fish began to hatch out. During incubation 5,165 eggs were picked off, a loss of about 34 per cent. The survivors, about 9,000, were planted on the 24th day of May in Torch Lake.

The Loch Leven trout in its native waters is not only excellent food, but a first-rate game fish, and if it proves practicable to establish this variety in some of our colder interior lakes, will prove a great addition to our list of food fishes.

9.—LAND LOCKED, OR SCHOODIC, SALMON.

The efforts of the commission to prosecute the experiment of acclimatizing the fresh water salmon in Michigan waters has continued during the time covered by this report, as earnestly as opportunities would permit. As explained in former reports, the eggs of the land locked salmon have been given to us by the United States Commissioner of Fish and Fisheries from

the proceeds of a joint operation of that commission and some of the New England States, conducted at Grand Lake Stream, in the State of Maine. The proportion of the product of eggs from that station is not very large, and Michigan has been treated very generously by the United States Commission in making the distribution of its share of them.

There was received at the Paris station a shipment of schoodic salmon eggs on the 14th day of March, 1887, numbering 25,000. While the number seems small for our purpose, we were nevertheless thankful to receive them. The date at which they were received was somewhat later than usual, and on opening the package some of the eggs were found to have hatched. There were 247 dead eggs picked off on the arrival of the box. It may be remembered by former readers of the reports that the schoodic salmon eggs received from Grand Lake Stream are taken in October, or November, carried in troughs until the latter part of February, or first of March, and then, after the percentage of bad eggs has worked off and the eggs are nearly ready to hatch out, they are packed in a skillful manner and shipped to their various destinations. By April 13 the salmon eggs were all hatched. The umbilical sac was gone from the young salmon on May 14, and on the 19th they were planted. The total loss on this lot of eggs was 1,364, 247 being found dead on opening the package and 1,364 only were lost in the final process of incubation and in carrying the young fish until ready for being planted, the loss being a little over 6½ per cent. The temperature of the water used in hatching was 40° Fah. The young salmon were principally planted in Torch Lake and its tributaries. Torch Lake was selected for the experiment on account of its depth, temperature, the purity of its water, and the existence there of other fish of similar feeding habits, which indicated the presence of proper food for the young and for the growing salmon. Torch Lake is about 18 miles long and from one-half mile to one mile wide, almost entirely fed by springs and has very bright, clear water. The ultimate purpose in introducing the schoodic salmon is to make the attempt to establish them in the Ste. Mary's river, the Straits of Mackinaw and the northern waters of Lakes Huron and Michigan and Lake Superior, as well as to stock some of the larger and deeper interior lakes, like Torch, Bear and Higgins. But in order to obtain the young fish in anything like adequate numbers for the former purpose we must first rear them in sufficient quantities to procure the eggs, as we cannot get enough of them from the Maine lakes to make any impression on those large waters.

There are a few schoodic salmon in the ponds at Paris. A very few eggs were taken from them in the fall of 1887, but they failed of proper impregnation. The ova seemed to be in an unhealthy condition when taken from the fish.

On March 10, by the courtesy of the United States Fish Commission, we received from them a still larger consignment of schoodic salmon eggs, numbering 75,000. They were as usual in excellent condition. On opening the cases only 60 dead eggs were found; during incubation 643 were lost; and in rearing the hatched fish until they were planted 933 were lost, making a total loss in of only 1,636, or a percentage of less than 2¼. The temperature of the water when the eggs were placed in the trays in March was at 34 degrees and rose gradually, with the fluctuations usual at Paris station, to 40 degrees. The young salmon fry were planted May 24 in excellent condition, 73,424 in number, mainly in Torch Lake, where they have been

deposited for the past five years. In planting this year some of the fish were placed in the lake itself, some in small spring brooks flowing into the lake. It is hoped that the examinations to be made at Torch Lake will determine something definite as to the success of the planting of salmon in that water. The temperature of the moss in which they were packed was found on opening to be 50 degrees. The young salmon began to hatch on April 2, and were all out by April 15.

10.—CALIFORNIA, OR MOUNTAIN TROUT.—(*Salvelnius Irideus.*)

In the last report (p. 37) it was stated that the adult California trout were deposited in the Muskegon river, owing to a threatened loss of them by an insidious disease which did not yield to such treatment as could be given them. This was in August, 1886. In the following spring, May 14, nine or ten of these fish came from the Muskegon into Cheney creek and spawned naturally. Reports have been heard of quite a number of them that had been caught with hook and line in the river, and several of them have been caught near the station and placed in the pond with the largest sized brook trout. On March 22, 1887, we received from the United States Commission station at Northville 25,000 eggs of this trout. They were hatched by April 20. On May 10 they were feeding, and May 17 they were planted, numbering 20,000, in tributaries of the Muskegon river, near Paris.

11.—GERMAN OR EUROPEAN TROUT—THE SAIBLING—(*Salvelinus alpinus*).

The U. S. Commission sent us from its Northville Station in March, 1887, 25,000 eggs of the German trout. The eggs came in good condition and were hatched by April 13. April 20 the young fish were taken from the trays and placed in troughs on fine screened gravel. By May 10 they were feeding, and made rapid growth. They were placed in the nursery races, and are kept for a pond of stock fish. Another gift of German trout was made by the U. S. Fish Commission December, 1887, when the U. S. fish car brought the Loch Leven trout eggs, consisting of 600 yearling fish and 5,000 eggs, March 12, the eggs were all hatched out, 1,023 having been picked off dead, making a loss of 20%.

The German trout or saibling is closely allied to our brook-trout belonging to the same genus, Salvelinus. Dr. David Starr Jordan in his article on "The Salmon Family" in his admirable book entitled "Science Sketches," says: "The genus Salvelinus comprises the finest of the Salmonidæ, from the point of view of the angler or the artist. In England the species are known as char, in contradistinction to the black species of Salmo, which are called trout. The former name has unfortunately been lost in America, where the name "trout" is given indiscriminately to both groups, and still worse, to numerous other fishes wholly unlike the Salmonidæ in all respects. It is sometimes said that the American brook-trout is no trout, nothing but a char, almost as though char were a word of reproach. Nothing higher, however, can be said of a salmonoid than that is is a char. The technical character of the genus Salvelinus lies in the form of its vomer. This is deeper than in Salmo; and when the flesh is removed the bone is found to be somewhat boat-shaped above, and with the shaft depressed and out of the line of the chevion. Only the chevion is lined with teeth, and the shaft is covered by skin.

"In color all the chars differ from the salmon or trout. The body in all is covered with round spots which are paler than the ground color, and crimson or gray. The lower fins are usually edged with bright colors. The sexual differences are not great. The scales in general are smaller than in other Salmonidæ and they are imbedded in the skin to such a degree as to escape the notice of casual observers and even most anglers.

"The chars inhabit, in general, only the clearest and coldest of mountain streams and lakes. They are not migratory, or only to a limited extent. In the Northern regions they descend to the sea, where they grow much more rapidly, and assume a nearly uniform silvery gray color. The different species are found in all suitable waters throughout the northern parts of both continents, except in the Rocky Mountains and Great Basin, where only the black-spotted trout occur.

"The only really well authenticated species of char in European waters is the Red Char, Saibling or Ombre Chevalier (Salvelinus alpinus). This species is found in cold, clear streams in Switzerland, Germany and throughout Scandinavia and the British Islands. Compared with the American char, or brook-trout, it is a slenderer fish, with smaller mouth, longer fins, and smaller red spots, which are confined to the sides of the body. It is a gregarious and deep swimming fish, shy of taking the bait and feeding largely at night time. It appears to require very pure and mostly deep water for its residence. It is less tenacious of life than the trout. It reaches a weight of from one to five pounds, probably rarely exceeding the latter in size."

IV.—THE HATCHING STATIONS.

THEIR EQUIPMENT AND NEEDS.

1.—The Detroit Station.

The entire work of spawn gathering of whitefish of the Commission has been carried on for the last five years upon the Detroit river. It has been found by experience that this work can be more economically conducted on the Detroit river than elsewhere in the State. This is so because of the nearness of the fisheries to the Detroit station, and from the fact that the waters of the river are more sheltered than those of the open lakes, and the fish can be crated and kept until fit for handling in sheltered places, while it would be impracticable and impossible to carry on these operations at other and more exposed localities.

Because of these reasons we have deemed it best to discontinue the use of the Petoskey station for the present and confine the entire work of whitefish hatching to the Detroit station. From this point distributions can be made of the fry to as good, if not better, advantage than from any other point in the state. By this arrangement too the force formerly necessary to conduct the Petoskey station can be dispensed with, while the efficiency of the work will, we believe, be much increased. Such necessary changes have been made at the Detroit station as to accommodate the jars formerly carried at the Petoskey station, and for the present, the work heretofore conducted at Petoskey will now be done in Detroit.

The seventh biennial report closed with December, 1886, and a resumé of the work from that date down to Dec. 1, 1888, will now be given.

The whitefish spawn taken by the commission in the fall of 1886 to fill the Detroit and Petoskey stations, was all taken on the Detroit river from fish taken on the fishing grounds at Fort Wayne, Grassy Island and Bois Blanc Island. The total number of fish taken upon these grounds and handled was 6,494. The season was a poor one, severe storms interfering with the work, and at the Bois Blanc fishery, on account of the severe storms on the 18th of November, the fish in the crates at that point were lost, there yet remaining in the crates 358 unstripped females. Of the eggs taken from these fish, 31,000,053 were taken to the Petoskey station, and 47,424,000 to the Detroit house.

In order that a definite idea might be formed of the quantity of eggs being handled from year to year, it was determined by the Board to definitely determine, by actual count, the number of eggs in a given measure upon which estimates could be safely based. A pint of whitefish eggs were counted out and the number ascertained, and the jars in the houses being filled by measure a very close determination was thus made of the entire number taken. Upon this count it was found that a pint of whitefish eggs contained 18,300 eggs, and from this count the total number put in both houses was found to be 78,477,000. Of this number there was hatched and distributed from both stations 72,974,000. The details of the plants made are shown on the table of whitefish plants annexed to this report. The general result of the fishing upon the Detroit river during this year was very poor and unfavorable.

For the egg taking season of 1887–8 arrangements were made for the taking of spawn at Fort Wayne and Grassy Island fisheries upon the Detroit river. It was apprehended by the commission soon after the season's operations began that the fishing would be light, and that other arrangements must be made to fill the houses by securing additional fish. An arrangement was therefore made, after the fishing season had opened, with D. W. & S. H. Davis, for the handling of the fish taken by them at the Belle Isle fishery near Detroit. The season proved to be a very unfavorable one for holding the fish in the crates, which resulted in a considerable loss, and owing to the lateness with which the arrangement was made with the Davises for handling their fish, the season's operations resulted in a very much enhanced cost to the board in securing the necessary spawn for the season.

After the fishing season had commenced, it was found that the catch of fish was larger than had been anticipated, and much larger than it had been for several years. There was also a noticeable increase in the number of small fish taken. It was also observable that a large number of the females were spawning this season for the first time. As a result of the fall fishing the fishermen who had had twenty years' experience upon the river were uniformly of the opinion that the increase in the number of fish taken was the result of the plants made by the commission in former years.

The total number of eggs taken this year was 94,996,394. Of this number there were taken to the Detroit station 48,315,000 and to the Petoskey station 34,352,000.

In addition to these amounts there were taken and donated by this board to the United States Commission 12,329,394. This allotment was made to the United States Commission because of their inability to secure facilities during the season of egg taking to enable them to fill their houses. In return for this courtesy the United States Commission subsequently gave to the

Michigan Commission a large number of eggs of the land-locked salmon and of the German brown trout, as shown in another part of this report.

From the eggs sent to the Detroit and Petoskey stations there were hatched and distributed the following amount: From the Petoskey station 29,968,000 and from the Detroit station 43,000,000. The details of the distribution of these young fish shown by the tables in the appendix, together with the temperatures of the water at the different stations throughout the hatching season.

During this year about 12,000,000 eggs of the wall-eyed pike were hatched at the Detroit station and they were distributed at various points in the State, as shown by the table of wall-eyed pike plants in the appendix to this report.

During the summer of 1888 the Detroit station, buildings and fences have been repainted and a suitable sign has been placed upon the building, and some other minor repairs have been made.

Late in the spring of 1888 and nearly at the time when the whitefish eggs would begin to hatch an accident occurred to the water supply of the Detroit house which threatened serious results: anchor ice formed at the inlet pipes of the Detroit water works, shutting off the supply of water at the house and all over the city. For two hours and 53 minutes the constant supply of water which is necessary for the work was shut off from the Detroit station, and as a result fifty-three jars of eggs were prematurely hatched. But as it was near the hatching season, and as at the end of this time a fresh supply or water was obtained, there was comparatively little loss. Such of the fry as were hatched at this time proved to be strong and vigorous and the loss was very insignificant. This accident, however, came near resulting seriously, for if the water had remained shut off for an hour longer in all probability the entire number of eggs then in the house would have been lost. Credit is due to the force at the Detroit station for the prompt and intelligent measures taken by them in this emergency and to the citizens living in the neighborhood for their efficient help in keeping the water in motion as far as it could be done by bucket brigade which undoubtedly saved the entire hatch from total loss.

The board has directed that a force pump or engine be procured for use should another emergency of this kind arise. Relief can then be had by forcing the water from the tanks through the jars. This may not be necessary, however, as the Detroit Water Board has taken steps to prevent a recurrence of this trouble.

As intimated above the Detroit hatchery has now added to its former capacity the jars heretofore carried at the Petoskey station which will give to the Detroit station a present capacity of 525 jars. This will furnish the Detroit station a capacity for hatching between eighty and ninety millions of whitefish the coming season.

The efficiency of the artificial propagation of whitefish has been so completely demonstrated by the reports from Lake Erie and other points, as shown in another part of this report, that it is urgently requested that the legislature shall at the coming session allow a sufficient amount in the estimates of this board for the coming two years to allow the present capacity of the house at Detroit to be doubled.

2.—*Paris Station.*

On February 8 and 9, 1887, the Fishery Committee of the House of Representatives visited the Paris station. It seems a little unfortunate that

the Legislative Committee can not see this station when it is in its summer dress: it looks so much better when the grass and trees are green and the well kept flower beds are in bloom. The committee, however, saw the old hatchery full almost to overflowing with brook trout eggs and young fry, and appreciated at once the necessity of a new and larger hatchery. At the time of their visit nearly every available inch of room in the troughs was filled; there were about 900,000 young trout then in the house. Every year some improvements have been added about the premises, and every effort is made by the superintendent, the overseer and the assistants to make and keep the ponds and premises as attractive as possible for visitors, of whom there are hundreds during the summer. The citizens in that locality, for many miles around, seem to appreciate the attention they receive, and take pride in bringing their visitors to the station to see the ponds of trout.

In June of this year an effective sign was laid on the sloping lawn south of the house, plainly visible from the highway and railway, reading "State Fish Ponds." The letters are made of cobble stones of medium size painted white, the letters being about six feet long.

The improvements between the railroad and the river were completed in the summer. The ground there along the old bed of the brook is laid out with three good sized wild ponds, four ponds with rip-rapped stone walls, and three plank spawning ponds with spawning races, like those above. The additional water supply, brought through the crock drain, gives a good supply of the finest water, and makes it possible to carry safely the large stock of trout now in the ponds. All the damage done by the freshet of September, 1886, has been fully repaired, and the station is in better order now than before. The large waste ditch around the upper ponds has proved of ample size to take care of as large a flow of water as can come down Cheney creek. This waste way has been paved with stone from the back of the old hatchery to its entrance into the large wild pond; and the walls of it laid up in stone. The waste from the new ponds east of the railway, is made by a crock underground and empties into the second wild pond from the river. On the Buckhorn creek a levee has been constructed from the dam at the head of the grayling wild pond around to the high bank on the west side of the pond, to protect it from freshets. The west ditch around the grayling pond has been enlarged and the dam across the main creek widened. The action of the water when high has dug a fine large pool just below this dam. This waste way is 20 feet wide on the bottom.

A public drinking fountain has been placed on the edge of the highway in front of the old hatchery. Here considerable grading has been done on the road on both sides of the creek, raising the road level about two feet, and a new bridge constructed across the creek, and an extension of the neat rail fence carried across the bridge, on each side, to completely guard the bridge, which is now 28 feet wide.

The ice and feed house as been enlarged by lengthening it six feet, and placing a good chimney and fireplace in it. A large amount of cleaning up has been done on the premises which has materially improved the appearance of the property.

The most important improvement made at Paris station is the new hatching house. It is a model in general appearance, in substantial and suitable interior finish, in convenience of arrangement and in its complete adaptation to the requirements of the station. The house is placed south of the large

wild pond fronting on the highway. It is 82½ feet in length north and south, gabled at each end, and 40 feet wide, having a small gable midway on the east side facing towards the railway; and a gabled projection on the west side fronting the highway, about eight feet wide inside, in which the stairway to the loft is carried up. In the loft are two good rooms, one at each end, which serve as bed-rooms; and the space between the rooms is an unfinished attic affording ample room for storage.

The main hatching room is perfectly lighted from windows on all sides, those at each end being high. This room is the full size of the house. It is ceiled on the walls and overhead and neatly painted. It is warmed in winter by one large stove, and has also a good sized open fireplace where fire is kept during hatching season. The open fire ventilates the room perfectly, and keeps the room dry, making it much more comfortable to work in. Water is introduced into the house from the creek above the ponds through a 12-inch pump log, the connection at the house being made through two iron pipes coming up on the outside of the house, on both sides of the front entrance, then through the sides, and is discharged into two large tanks. The water supply on each side is independent of the other; each having its own valve to regulate the flow of water. From the receiving tanks the water is taken in to the smaller feed-troughs which are placed just under the windows, going around the house to the east side entrance. The hatching troughs are supplied from the feed troughs through brass faucets, so that the supply is under perfect control. These troughs are one foot wide by fourteen feet long, placed in groups of three, with a narrow alley between the groups. The water is wasted from the troughs through tin overflows down through the floor into open drains paved and cemented. Passing through the several drains, which all flow into one outlet, the water comes through an opening in the foundation, which is of stone, on the east side of the house, and flows into the creek below the large wild pond. All of the arrangements of the house are as complete as our experience could suggest, and during the last season's work proved to be most satisfactory in every respect.

The house is of frame, battened on the outside, set on a stone foundation. It is substantially built and it is believed will compare favorably with the best of modern hatching-houses. The first drawings were made by the commissioner in charge, after many consultations with the Superintendent; they were then placed in the hands of Mr. A. B. Cram, architect, of Detroit, and by him elaborated and perfected and complete specifications drawn. The plans were examined and fully approved by the Fishery Committee of the Legislature.

As soon as the appropriation bill had passed the Senate, coming from the House, bids were invited from builders in that part of the State, that of Mr. John G. Mosser, of Cadillac, being accepted a contract was made with him, and the statutory bond taken. The contractor was very prompt, and all his work was excellently done. The work was well under way by July 1, and the water was turned on for the first time October 4. The interior work could not very well be done by contract, so the material was all purchased by the commission, and a good local carpenter, Mr. Judkin, of Paris, employed by the day, under the Superintendent's direction, to put it together. This work was begun in August, in the old hatchery and was ready to put in place as soon as the painters could give possession. The total cost of the house ready for the season's operations was $4,123.51

The contract part was, for the house, without excavation	$2,951
The excavation and grading	125
The interior furnishings, pump log laying and all water supply	1,047.51
	$4,123.51

The house is insured for $2,500, and other property in the house, $650.

The total expenditure for permanent improvements at the station, for the two years was:

For the house and fittings, as above	$4,123.51
For new ponds, grading and fencing	676.29
For repairs, necessitated by the freshet of 1886	401.46
	$5,201.26

The development of the work at Paris requires some further expenditure during the coming two years, to bring the station to its utmost capacity. By making a connection from the Buckhorn creek to the Cheney creek above the stock ponds, five new ponds can be added to the plant, which will enable us to carry all the stock fish that the water supply can support.

The successful transfer of the Little Buckhorn waters to Cheney creek two years ago, demonstrates that this use of the water is by far the most economical that can be made of it. It concentrates the work of all kinds, the cleaning of ponds, feeding and sorting of fish, the protection of the fish from depredation of all kinds, and the taking of eggs. Both of the Buckhorn creeks play an important part in the rearing of trout in the wild state, and that use of them is not materially impaired by transferring so much of the water as can be used to advantage in supplying additional ponds on Cheney creek. This connection will be made by a 12 inch pump log, the entire cost of which laid ready for use will be about $280.

The other improvements required at the station to put the property in as good order as all state property should be kept in, are as follows:

a. An 80 barrel tank, 16 foot platform, connections and piping about 800 feet	$ 280
b. Fencing for 80 acres of land and meander of the Cheney creek	300
c. Clearing land, cut or burned over, and to finish the required grading	100
d. Five new stock ponds in connection with the present pond system on Cheney creek, stone walls, races and plank spawning ponds	500
e. Additional trays to complete equipment of the new house, new cans and current repairs	150
f. Buckhorn connection, mentioned above	280
	$1,510

3.—*Petoskey Station.*

The importance of the whitefish work as the leading feature of what should be the future work of the state was early impressed upon the minds of those who were appointed by the Governor to see that the work should be carried forward and from that time until now has been the prominent work

of the commission. One of the chief obstacles at the outset was the difficulty of obtaining ova. At first the only way was to go to some fishing station and as the nets were drawn or emptied, the fish were handled, and the ova of such as were ripe taken and fertilized and conveyed to the hatching station. The spawning season, coming as it does at one of the most inclement seasons of the year, made this a difficult and often a dangerous task. When later on, through experiments instituted by this commission, it was found to be thoroughly practicable to take the whitefish and hold them in captivity until such a time as the female fish should mature and the ova be obtained with comparative ease, and without necessitating the death of the fish, the whole plan of obtaining an adequate supply of eggs was necessarily changed. The purchase and equipment of a car expressly adapted to the work of the commission has added another factor to a change in the first thought of the commission. At the time of establishing the Petoskey station the question of obtaining ova and that of transportation were the paramount ones and it was thought that the work could be better carried on by having several stations situated near to those points where fish were caught in the largest quantities, and where the young fish when hatched could be the most advantageously planted. Consequently some place on the eastern shore of Lake Michigan, where a station could be located, seemed almost imperative. After a careful survey of different localities, the one at Petoskey seemed to offer the greatest facilities for successful work, the important question of a water supply was settled by the citizens of Petoskey generously granting to the commission the use of water from their city system, free of charge. It had been stated to the commission and believe by them, that the water from the well from whence the supply was drawn, was the water from the bay that found its way into the well by percolation through the comparatively small space between the well and the adjacent shore line, and consequently would be all that could be desired; but subsequent experiments proved this to be a mistake, as the water was found to have a temperature so much higher than the lake, one or two degrees, constantly, as to hasten the hatching of the eggs, so much as to bring them out from four to five weeks in advance of those at Detroit, and the planting had to be done in many cases through the ice. This was at first thought to be a fatal objection, but subsequent experiments seemed to prove that it might be otherwise. Within the last year it became apparent that the capacity of the house at Detroit could be so enlarged, at a small expense, as to receive all the jars in use at Petoskey and consequently all the expense of the equipping and maintaining of the Petoskey station could be saved; for but little extra expense would be incurred by the new arrangement. So in October the jars were brought to Detroit, and are now in successful operation. The possibility of again opening the Petoskey house is as yet an open question, to be more definitely settled by the experiments of this season.

4.—*Glenwood Station.*

A full description of Glenwood station was given in the last biennial report. To the station as then described has been added a house constructed in such a manner as to furnish conveniences for preparing the young fish for shipment as well as to provide a storehouse for the tools, apparatus and cans and winter quarters for the fish. The house is a frame building 18x24 feet in size,

substantially built upon a basement or cellar the same size as the house, and constructed around the main spring, from which it is constantly supplied with fresh water. The walls of this basement are laid in cement to keep out all enemies of the carp. It is divided into compartments for the different sizes of fish, and being supplied with living water from the spring furnishes admirable winter quarters. The temperature of the water during the winter is very uniform, averaging about 50 degrees. One hundred and sixty breeding carp, weighing from two to fifteen pounds, were carried in this spring house during the winter of 1887–8 without loss, and five thousand small fish in addition to these can be safely cared for during the winter if properly separated, according to size, in the compartments.

A large number of carp were hatched during the last season and many more could have been distributed if orders and shipping directions had been received. The superintendent experiences much difficulty in getting correct shipping directions and many orders have been canceled for want of them.

There is an impression among the people that it is difficult to get carp for their ponds. This is an erroneous idea, and it is the desire of this commission to correct it. The fish may be had upon proper application and no difficulty will be experienced in getting them if the persons who have made suitable application will, upon being notified by the overseer, send to him full directions for shipping and assure him that some person will be ready to receive the fish when they arrive at their destination; the only expense being the express charges on the fish and the return of the can in which they are sent.

The station is in good condition and well supplied with young fish that will be ready for shipment as early in the spring as they are taken from their winter quarters.

The commission hasa pamphlet containing valuable information in regard to the culture of carp which will be gladly sent to all who may apply for it.

V. EXAMINATION OF INLAND LAKES.

1. WORK OF 1887.

This department of the commission's work has improved in quality and facility as experience has gradually pointed to improved methods. The knowledge gained in the work of earlier years has made the work much more expeditious and exact. It has been found that certain conditions or characteristics are constant. So that by ascertaining essential characteristics of a given lake, say in the same water-shed with other lakes already examined, we can predict with practical certainty its present inhabitants, and the kinds of fish for which it is suited by the food supply. The most important factors are depth, temperature and food, with general quality of water and bottom. These are readily ascertained, and within reasonable limits enable us to judge of the capacity of the given water. Size is also a consideration, but is a question rather of degree than of kind. For instance, an examining crew go quite into a county in the second or third tier of the state, counting from the southern boundary, in the four northeastern townships the general characteristics of the country are the same. There are, say, seven lakes of fair size from three-quarters of a mile to three miles in length, varying in width from one-half to one and one-half miles. Two of these lakes are examined carefully, gill-nets set three nights, soundings

made, temperature of water taken at surface and bottom each morning and evening, the bottom dredged, the stomachs of all fish examined and contents observed, search made for the quantities of food similar to that found in the captured fish, the condition of the fish carefully observed, the similarity of the lakes and their fauna noted. All then that is necessary to learn about the other five lakes is the substantial correspondence in the essential particulars above mentioned, and we know what is to be found in the other five, and whether any but the native kinds of fish can be grown in them to advantage. If in taking the depth and temperature of the five lakes any one of them exhibits a marked contrast to the first two in any essential particular, that lake must be further examined. If there is substantial agreement in the conditions named, all that need be learned about the five lakes, with the depth and temperature ascertained, can be learned from the report on the two first examined.

In 1887 eighty lakes were examined and reported on. There is following this article a condensed statement of the reports, sufficiently full for most purposes. The reports are bound together in books of convenient size, indexed, and constitute a permanent record of great interest, which will serve as the basis for all future operations on the waters so examined. They enable Commissioners and Superintendent to answer all inquiries as to what can or will be done for the examined lakes which frequently come from persons living near or interested in any particular lake, and furnish information so exact and comprehensive as to make the answers conclusive, as well as satisfactory to the inquirers.

Of the 80 lakes reported on in the season of 1887 only five contained the genuine black bass, the small-mouthed bass, as usually denominated, while probably 20 or more of these lakes are well adapted to them. And about 18 appear to have the depth, temperature, food and bottom suitable to the growth of the brook trout. Whitefish were found in five lakes, herring in 13, and 16 of them are probably suitable for salmon trout.

EXAMINATION OF INLAND LAKES, 1887.

Berrien County.

Allen, or Long, Lake, Berrien Township—*Crew No. 1:*
Length, ½ mile; width, ¼ mile; greatest depth, 32 feet.
Shores, sandy on east and west, with high sandy banks and woods north and south; flat, marshy banks.
Bottom, soft, black mud.
Inlets, none; outlets, one during high water, emptying into Smith's Lake.
Dates of examination, September 28 and 29.
Weather, clear.
Temperature—Surface, 61° and 62°; bottom, 49°.
Water, clear.
Fish are perch, blue-gills, sunfish, shiners and chubbs. Fish small but fat.

Big Paw Paw Lake, Watervliet Township—*Crew No. 1:*
Length, 3 miles; width, 1 mile; greatest depth, 100 feet.
Shores, sandy and gravel; banks high except 3 miles on north shore, low, marshy and wooded nearly around lake.
Bottom, mostly hard sand, in deepest waters soft, covered with black sand.

Inlets, two, outlet of Little Paw Paw Lake, and Paw Paw river; outlets, one, Paw Paw river.
Date of examination, September 23, 24 and 25.
Weather, 23, clear; 24, cloudy; 25, clear.
Temperature—Surface, 63°; bottom, 47, 47, 49°.
Water, clear.
Fish are perch, blue-gills, grass pike, large mouth bass, straw bass, suckers, bull-heads, chubbs and German pike. Fish well fed, but small.

Clear Lake, Buchanan Township—*Crew No. 1:*
Length, 3 miles; width, 1 mile; greatest depth, 63 feet.
Shores, sandy on east and west; north and south flat and marshy.
Bottom, sandy near shore, soft and muddy in deep water.
Inlets, none except in high water, and no outlet except in high water.
Dates of examination, October 2 and 3.
Weather, 2, clear; 3, cloudy.
Temperature—Surface, 60°; bottom, 45°.
Fish are perch and blue-gills, large and fat. It is said there are plenty of small-mouth bass in this lake.

Hess Lake, Lake Township—*Crew No. 1:*
Date of examination, Oct. 1.
This lake is nearly covered with weeds, etc.

Little Indian Lake, Berrien Township—*Crew No. 1.*
Length ½ mile; width ¼ mile; geatest depth, 12 feet.
Shore, sandy.
Bottom, hard.
Inlets none; outlets none.
Date of examination, Oct. 1.
Temperature—Surface and bottom, 60°.
Water, clear.
Fish are said to be bass and blue-gills, none caught.

Long, Reggins, Webster, and Murphy's Lakes, Berrien Township—*Crew No. 1:*
Date of examination, Oct. 1.
All of these lakes are drained, so there is little left of them, and they are covered with pond lilies and weeds.

Meadow, Yellow, Weaver, and Pike Lakes in Berrien and Bertrand Townships—*Crew No. 1:*
Date of examination, Oct. 3.
These lakes have all been drained, so there is very little left of them. The bottoms are muddy, and they contain very few native fish.

Pipestone Lake, Bainbridge Township—*Crew No. 1:*
Length, 1 mile; width, ¼ mile; greatest depth, 36 feet.
Shores, soft and marshy, low flat banks.
Bottom, soft and muddy, covered with weeds.
Inlet, one small spring creek on north side; outlet, one large outlet on southwest side.

Dates of examination, September 20, 21 and 22.
Weather, 20 clear, 21 and 22 rainy.
Temperature—Surface, 67, 66 and 64°; bottom, 50, 49 and 49°.
Water, clear.
Fish, perch, blue-gills, sunfish, bull-heads, suckers and rock bass. Fish well fed, but small.

Smith Lake, Berrien Township—*Crew No. 1:*
Length, 1 mile; width half mile; greatest depth, 86 feet.
Shores, sandy on east and west, north and south muddy; bottom soft and muddy, covered with grass and weeds.
Inlets, one during high water only; outlet, one small stream emptying into Dowagiac Creek.
Date of examination, September 26, 27 and 28.
Weather, 26, rainy; 27, rainy; 28, clear.
Temperature—Surface, 63, 62 and 62°; bottom, 49, 50 and 50°.
Water, clear.
Fish, perch, blue-gills, sunfish, rock bass, shiners, dogfish and suckers. Fish were fat but small growth.

Lake View, Berrien Township.—*Crew No. 1:*
Length, 60 rods; width, 40 rods; greatest depth, 35 feet.
Shores, flat and marshy; bottom, soft mud.
No inlets or outlets.
Date of examination, Sept 28.
Temperature—Surface, 62°; bottom, 43°.
Water, clear.
Fish, black bass, perch and blue-gills.

No name, Berrien Township—*Crew No. 1:*
Length, 60 rods; width, 40 rods; greatest depth, 30 feet.
Shores, soft and marshy; bottom, soft, black mud.
No inlets or outlets. Nice springs on the shore.
Date of examination, Sept. 29.
Temperature—Surface, 61°; bottom, 43.
Water, clear.
Fish, bass, blue-gills, perch and bull-heads.

Cass County.

Bear Lake, Porter Township—*Crew No. 1:*
Length, 1 mile; width, ½ mile; greatest depth, 13 feet.
Shores sand and gravel. High banks all around the lake, wooded on south and east.
Bottom, soft and grassy.
No inlet or outlet.
Dates of examination, August 20 and 21.
Temperature, surface 74 and 73°; bottom 60 and 59°.
Water, clear.
Fish, large-mouth bass, perch and blue-gills; the fish taken were hard and well fed, blue-gills were very large.

Baldwin's Lake, Porter Township—*Crew No. 1:*
Length, 1½ miles; width, 100 rods; greatest depth, 57 feet.
Shores, sandy and gravel; high banks all around lake.
Bottom, hard gravel.
Inlets, two; one small spring in north end, and the outlet of Indian Lake on south end; outlet, one small channel running to Long Lake.
Dates of examination, Sept. 7 and 8.
Weather, clear.
Temperature, surface, 73 and 71°; bottom, 48°.
Water, clear.
Fish, herring, grass pike and perch; fish hard and well fed, herring showed large growth.

Barron Lake, Howard Township—*Crew No. 1:*
Length, 1 mile; width, ½ mile; greatest depth, 28 feet.
Shores, hard, sand and gravel, with high sandy banks, timber in small groves on the shore.
Bottom, greater part sand and gravel, some places mud.
Inlets, none; outlets, one, a 10 inch pipe which supplies the city of Niles.
Dates of examination, Oct. 4, 5, 6 and 7.
Weather, 4 and 5, cold and cloudy; 6, cloudy; 7, clear.
Temperature, surface, 58, 58, 59 and 59°; bottom, 52, 51, 52 and 51°.
Water, clear.
Fish, perch, sunfish, blue-gills, rock bass, large-mouth bass, and suckers; fish hard and very fat, but small growth, except suckers, which are large.

Birch Lake, Porter Township—*Crew No. 1:*
Length, 1½ mile; width, ¾ mile; greatest depth, 107 feet.
Shores, hard, sandy, with high banks.
Bottom, hard sand.
Inlet, none; outlet, one, small stream emptying into Shavehead Lake.
Dates of examination, Aug. 22, 23, 24 and 25.
Weather, 22, cloudy; 23, raining; 23 and 24, clear.
Temperature, surface, 22, 74; 23, 70; 24, 71; 25, 70°; bottom, 22, 43; 23, 43; 24, 43; 25, 43°.
Water, clear.
Fish, herring, hard and well fed, of large growth.

Cable Lake, Silver Creek Township—*Crew No. 1:*
Length, ½ mile; width, ¼ mile; greatest depth, 42 feet.
Shores, sand and gravel, high sandy banks, wooded.
Bottom, soft.
Inlets, none; outlets, none.
Date of examination, September 20.
Temperature—Surface, 60°; bottom, 49°.
Fish, blue-gills, perch, bass and shiners.

Chain Lake, Calvin Township—*Crew No. 1:*
Greatest depth, 23 feet.
Inlets, none; outlet, empties into Christian Lake.
Date of examination, September 8.
Temperature—Surface, 73°; bottom, 65°.

Water, clear.
A chain of lakes all connected, none over 60 rods long and about 40 rods wide. They extend down through a marsh and include Chain, Long, Thorpe's, Calkins and Curtis lakes.

Christian Lake, Ontwa Township—*Crew No. 1:*
Length, ¾ mile; width, ½ mile; greatest depth, 37 feet.
Shores, hard sand all along south shore; north shore marshy; east and west, low banks and marshy.
Bottom, hard on east, soft on west side.
Inlets, large channel running out of Juno Lake; outlets, one large stream called Christian creek.
Dates of examination, September 3 and 4.
Weather, clear.
Temperature—Surface, 3, 71°; 4, 70°; bottom, 3, 52°; 4, 52°.
Weather, clear.
Fish, strawberry bass. Fish in good condition, hard and fat.

Dewey's Lake, Silver Creek Township—*Crew No. 1:*
Length, 1¼ miles; width, ¾ mile; greatest depth, 56 feet.
Shores, sand and gravel; high sandy banks, woods extending nearly around the lake.
Bottom, hard, sandy, except through center; in deep water black, muddy bottom.
Inlets, none; outlets, none.
Dates of examination, September 12 and 13.
Weather, September 12, cloudy and cold; 13, clear and cold.
Temperature—surface, 12, 64°; 13, 65°; bottom, 12, 48°; 13, 49°.
Water, 13, clear; 14, muddy.
Fish, large-mouth bass, perch, blue gills, bullheads and shiners.
Fish, large growth and fat, except perch were small.

Diamond Lake, Penn and Jefferson Townships—*Crew No. 1:*
Length, 3¼ miles; width, 2 miles; greatest depth, 62 feet.
Shores, gravel and sandy, high banks all around lake.
Bottom, sand and gravel.
Inlets, none; outlets, one small stream.
Dates of examination, August 27, 28, 29 and 30.
Weather, clear.
Temperature—surface, 70°; bottom, 46°.
Water, clear.
Fish, wall-eyed pike, small-mouth bass, large mouth bass, perch, rock bass, blue-gills, grass pike. Fish hard, well fed and large growth.

Donell Lake, Penn Township:
Length 1¼ miles; width, ¼ mile; greatest depth, 62 feet.
Shores, soft and grassy; flat banks and marshy.
Inlets, one small one; outlets, one small stream running to Mud Lake.
Dates of examination, August 26 and 27.
Weather, clear.
Temperature—surface, 70°; bottom, 48°.

Water, clear.
Fish, herring, small-mouth bass and perch. Fish taken are hard and well fed. Herring show large growth.

Driskel Lake, Newberry Township:
Length, 100 rods; width, 80 rods; greatest depth, 34 feet.
Shores, sandy.
Bottom, soft on west end; east end hard, sandy.
Inlet, none; outlet, none.
Dates of examination, August 19 and 20.
Weather, clear.
Temperature, surface, 19, 74°; 20, 73°; temperature, bottom, 57°.
Water, clear.
Fish, blue gills.
Fish taken seem to be well fed and of large growth.

Eagle Lake, Ontwa Township:
Length, 1½ miles; width, ½ mile; greatest depth, 30 feet.
Shores, hard, sandy, except about 60 rods on west shore; high banks and wood nearly around lake.
Inlets, none; outlets, one small stream running into Indian Lake.
Dates of temperature, Sept. 6 and 7.
Weather, 6, cloudy; 7, clear.
Temperature, surface, 6, 72°; 7, 70°; bottom, 60°.
Water, clear.
Fish, blue-gills, grass pike, strawberry bass, perch and rock bass.
Fish fat and show large growth.

Fish Lake, Newberry Township:
Length, ¾ mile; width ¼ mile; greatest depth, 37 feet.
Shores, high banks all around.
Bottom, soft on west side; hard on east.
Inlets, none; outlets, none.
Date of examination August 23.
Temperature—surface, 74°; bottom, 50°.
Water, clear.
Black bass in large quantities, plenty of blue-gills and perch. The bass very large.

Forked Lake, Newberry Township:
Length, 100 rods; width, 80 rods; greatest depth, 12 feet.
Bottom, soft and muddy, lilies covering the most of the surface.
Date of examination, August 24.
Temperature—surface, 74°; bottom, 50°.
Large quantities of black bass.

Goff Lake, Marcellus Township:
Length, 80 rods; width, 60 rods; greatest depth, 40 feet.
Shores, flat and marshy; bottom, soft and muddy.
Inlets, none; outlets, none.
Date of examination, August 25.

Temperature—surface, 74°; bottom, 50°.
Fish blue-gills, perch and bull-head.

Goose Lake, Jefferson Township—*Crew No. 1:*
Length, about 60 rods; width, about 40 rods; greatest depth, 16 feet.
This lake has been drained to its present size.

Hemlock Lake, Marcellus Township:
Length, ½ mile; width, ¼ mile.
Shores, marshy on north side and high banks on south, east and west.
Bottom, hard.
Inlets, none; outlets, none.
Date of examination, August 23.
Temperature—Surface, 74°; bottom, 52°.
Water, clear.
Fish, bass, blue-gills and perch.

Indian Lake, Silver Creek Township:
Length, 1¼ miles; width, ¾ mile; greatest depth, 28 feet.
Shores, sand and gravel, high sandy banks and woods on north and east.
Bottom, sandy some distance from shore, but through center is muddy and covered with moss and weeds.
Inlets, one small stream on north end. Sandy bottom; water clear and cold. Outlets, one small outlet near south side during high water only.
Dates of examination, September 17, 18 and 19.
Weather, clear.
Temperature—Surface, 17 and 18, 64°; 19, 68°; bottom, 17, 60°; 18, 61°; 19, 62°.
Water, clear.
Fish, blue-gills, perch, straw bass, sunfish, suckers, bull-heads and shiners. The fish taken are hard, well fed and show very large growth, except perch, which are small.

Juno Lake, Mason and Calvin Townships:
Length, ¾ mile; width, 1 mile; greatest depth, 38 feet.
Shores are soft and muddy.
Bottom, soft and grassy in east end, near inlet and west end; hard on north side.
Inlets, two; one small stream emptying in on east end, one large channel coming in on the north side; outlet, one long channel emptying into Christian Lake.
Dates of examination, September 4, 5 and 6.
Weather, 4 and 5, clear; 6, cloudy.
Temperature—Surface, 4, 72°; 5, 70°; 6, 71°; bottom, 52°.
Water, clear.
Fish, blue-gills, rock bass and bull-heads. The fish taken are hard and well fed; blue-gills large and fat.

Lily Lake, Newberry Township:
Length, ¼ mile; width, 50 rods; greatest depth, 24 feet.
Shores, muddy, low banks.

Bottom, muddy,
Inlets, none; outlets, one small stream running into Hutchinson Pond.
Date of examination, August 23.
Temperature—surface, 74°; bottom, 62°.

Mulford Lake, Volnice Township:
Length, 75 rods; width, 20 rods; greatest depth, 12 feet.
Shores, flat, marshy banks.
Bottom, soft mud.
Date of examination, August 23.
Temperature—surface, 73°; bottom, 64°.

Long Lake, Porter Township:
Length, 1¾ miles; width, ¼ mile; greatest depth, 36 feet.
Shores, sand and gravel, except about 60 rods on east shore and 70 rods on west shore.
Bottom, hard, with rushes around the edge of water.
Inlets, two; one a small stream the outlet of Birch and Shavehead Lakes and one a small stream the outlet of Robbins Lake; outlets, one quite large stream, running down in the Indian Lake.
Dates of examination, September 7 and 8.
Weather, clear.
Temperature—surface, 7, 72°; 8, 70°; bottom, 51°.
Fish, herring, whitefish, perch, blue-gills and black suckers. The fish taken are well fed; herring show large growth; the white fish weighed 3 pounds.

Cass and Van Buren Counties.

Margican Lake, Silver Creek and Keeler Townships:
Length, 2½ miles; width, ¾ mile; greatest depth, 48 feet.
Shores, sand and gravel on north, south and east; west marl; high sandy banks, except on west; shores low, low banks; timber extending nearly around the lake.
Bottom, sandy around the islands and near shore; through the center is marl bottom.
Inlets, none; outlets, none.
Dates of examination, September 13 and 14.
Weather, clear.
Temperature—surface, 13, 66°; 14, 67°; bottom, 49°.
Water, clear.
Fish, blue-gills, perch, rock bass and bullheads. The fish taken were hard, well fed and show large growth.

Cass County.

Mud Lake, Calvin Township:
Length, 1 mile; width, 100 rods; greatest depth, 57 feet.
Shores are marshy all around, east, south and north; west end high banks and sand.
Bottom, hard.

Inlets, one, from Donell's Lake; outlet, asmall s tream running into some small streams in southern part of township.
Dates of examination, August 28 and 29.
Weather, clear.
Temperature, surface, 28, 70°; 29, 69°; bottom, 46°.
Water, clear.
Fish, herring, grass pike and perch.
Fish taken were in good condition and show very large growth.

Painter Lake, Calvin and Jefferson Townships:
Length, ½ mile; width, ¼ mile; greatest depth, 36 feet.
Shores, soft marshy shores extend all around the lake.
Bottom, soft and grassy.
Inlets, one large stream called Christian creek; outlets, one large stream emptying into Juno lake.
Dates of examination, September 5 and 6.
Weather, 5, clear; 6, cloudy.
Temperature, surface, 70°; bottom, 51°.
Water, clear.
Fish, blue-gills and suckers.
Fish taken were hard and well fed; blue-gills show large growth.

Pleasant Lake, Ontwa Township:
Length, 100 rods; width, 80 rods; greatest depth, 20 feet.
Shores, hard and sandy, high banks; bottom, soft and grassy.
Inlets or outlets, none.
Date of examination, September 6.
Temperature—Surface, 73°; bottom, 70°.
Water, clear.
Fish, bass, blue-gills and perch.

Portage Lake:
Length, 1 mile; width, ½ mile; greatest depth, 34 feet.
Shores, flat and marshy; bottom, soft and grassy.
Inlets, Portage and Bear rivers; outlet, Portage river.
Date of examination, August 15.
Temperature—Surface, 78°; bottom, 52°.
The surface is nearly covered with weeds.

Sister Lake, Silver Creek Township:
Length, 1 mile; width, ½ mile; greatest depth, 58 feet.
Shores, sandy and gravel, high sandy banks, woods extending around the greater part of the lake; bottom, near shore is sandy; through middle of lake is soft and muddy.
Inlet or outlet, none.
Dates of examination, September, 14, 15 and 16.
Weather, clear.
Temperature—Surface, 14, 65°; 15, 66°; 16, 68°; bottom, 14, 48°; 15, 49°; 16, 50°.
Water, clear.
Fish, perch and blue-gills. Fish taken were hard, well fed and show large growth.

Shavehead Lake, Porter Township:
Length, 1¼ miles; width, ¼ mile; greatest depth, 69 feet.
Shores, hard, low banks, wooded on east and north; bottom, soft.
Inlets, one small stream coming from Birch lake; outlets, one small stream running to Long lake.
Dates of examination, August 24 and 25.
Weather, clear.
Temperature—Surface, 70°; bottom, 42°.
Water, clear.
Fish, herring. The herring are hard, well fed and very large growth.

Twin Lake, east, Wayne Township:
Length, 1¼ miles; width, ¼ mile; greatest depth, 48 feet.
Shores, sandy on east side, marsh on south side, gravel on north, high banks all around; bottom, soft mud in center and east end, gravel and sand, very bold shores.
Inlets and outlets none; a small isthmus and the lakes are connected by a small overflow in spring and fall.
Dates of examination, September 18 and 19.
Weather, clear.
Temperature—Surface, 18, 72°; 19, 73°; bottom, 49°.
Water, clear.
Fish, perch, large-mouthed bass, blue-gills and sunfish. Fish small, but well fed and in great numbers.

Skyhawk Lake, Newberry and Marcellus Townships:
Length, 100 rods; width, 80 rods; greatest depth, 47 feet.
Shores, sandy with low banks.
Bottom, sandy, hard.
Inlets, two small spring brooks; outlets, one small stream.
Date of examination, August 24.
Temperature, surface, 71°; bottom, 47°.
Water, clear.
Said to contain grass pike, strawberry bass.

Miller Lake, Marcellus Township:
Length, 80 rods; width, 60 rods; greatest depth, 23 feet.
Shores high on north, east and west; low on south side.
Bottom, soft.
Inlets, none; outlets, none.
Date of examination, August 25.
Said to contain black bass, perch, etc.

Cheboygan County.

Mullet Lake, Burt and Grant Townships:
Length, 12 miles; width 2 to 3 miles; greatest depth, 180 feet.
Shores, sand and stone, with high banks, with the exception of the lowe end.
Bottom, south end on middle ground stone; north end mud, clay and gravel.

Inlets, Pigeon and Indian rivers and Burt creek; outlets, Cheboygan river.
Dates of examination, Oct. 9, 10, 11, 12, 13, 14, 15 and 16.
Weather, 9, 11 and 12 rainy; 10, 13, 14, 15 and 16 clear.
Temperature, surface, 9, 11, 12, 52°; 10 and 13, 54°; temperature, bottom, 9, 13, 46°; 10, 47°; 11, 44°; 12, 44°.
Water, clear.
Fish, white fish, herring, perch, wall-eyed pike, grass pike, suckers, and lawyers.
Fish taken were fat and in good shape.

Burt Lake, Burt and Tuscarora Townships:
Length, 9 miles; width 5 miles; greatest depth, 50 feet.
Shores, sand and gravel.
Bottom, sand, clay, mud.
Inlets, Crooked river, Maple river and Sturgeon river.
Outlet, Indian river.
Dates of examination October 18, 19, 20, 21, 22, 23 and 24.
Weather—October 18 and 19, clear; 20, rainy; 21, 22, 23, 24, stormy.
Temperature, surface, 18, 60°; 19, 57°; 20, 53°; 21, 50°; 22, 48°; 23, 48°; 24, 47°; temperature, bottom, 18, 59°; 19, 46°; 20, 42°; 21, 39°; 22, 38°; 23, 38°; 24, 38°.
Water, clear.
Fish, grass pike, perch, rock bass, suckers and wall-eyed pike.
Fish taken were fat and in good order.

Clare County.

Town Line Lake:
Length, ½ mile; width, ¼ mile; greatest depth, 57 feet.
Shores are low and swampy, covered with a thick growth of tamarack, cedar and white birch, all but 20 rods on east side, where bank is high and cleared.
Bottom is mostly black muck, but in south end there is gravel bottom.
Inlets, one coming in on north side, a small spring brook about 200 rods long, very rapid, temperature 46°.
Outlet, one on the south side which is 6 feet wide and 10 inches deep, flowing south into a small lake.
Dates of examination, September 27, 28, 29 and 30.
Weather—September 27, 28, fair; 29, smoky; 30, rainy.
Temperature—surface, 27, 62°; 28, 63°; 29, 60°; 30, 58°; bottom, 27, 29, 30, 42°; 28, 40°.
Water, clear.
Fish, large-mouth bass have been taken which weighed 6½ pounds, and perch; fish fat and well fed.

Roscommon and Crawford Counties.

Higgins Lake, Gerrish, Roscommon County, and Beaver Creek, Crawford County:
Length, 7 miles; width, from 1 to 2½ miles; greatest depth, 95 feet.
Shores are mostly sand, with gravel and stone in places.

Bottom is nearly all sand, with patches of stone, gravel and marl, with very little mud.
Inlets, two small streams, which dry up in summer, and three or four boiling springs; outlets, one at south end of lake, which flows south into Houghton Lake.
Dates of examination, October 1, 2, 3, 4, 5, 6 and 7.
Weather, rainy, showery, and strong wind.
Temperature—surface, 57°; bottom, 48°.
Water, 1, 2, 3, 4, clear; 5, cloudy.
Fish, wall-eyed pike, perch, grass pike, whitefish, herring and black suckers. Fish are plump and well fed.

St. Joseph County.

Aldrich Lake, White Pigeon Township:
Length, ¾ mile; width, ½ mile; greatest depth, 35 feet.
Shores, high banks and wooded, except on north it is marshy.
Bottom, hard, sandy.
Inlets, none; outlets, one small stream emptying into Pickerel Lake, thence into Fawn River.
Dates of examination, August 5 and 6.
Weather, clear.
Temperature—surface, 78°; bottom, 58°.
Water, clear.
Fish, small-mouth bass, grass pike, blue-gills and gar-fish. Fish taken in good condition, well fed, and pike show large growth.

Beaver Lake, Colon Township:
Length, ½ mile; width, ¼ mile; greatest depth, 18 feet.
Shores, high banks on east and north, west and south low banks and marshy.
Bottom, soft and grassy; pond lilies extend 40 rods into lake on south shore.
Inlets, none; outlets, none.
Dates of examination, July 27 and 28.
Weather, clear.
Temperature—surface, 27, 82°; 28, 81°; bottom, 78°.
Water, muddy.
Fish, strawberry bass, blue-gills, suckers, bullheads and dog-fish. Fish taken are poor and of small growth.

Carp Ponds Lakes, Fabius Township:
Length, No. 1, 40 rods; No. 2, 30 rods; width, No. 1, 25 rods; No. 2, 26 rods; greatest depth, 10 feet.
Shores, mud.
Bottom, bad.
Inlets, none.
Outlets, none.
Date of examination, Aug. 18.
Weather, clear.
Temperature, surface, 85°; bottom, 69°.

Water, clear.
Fish, none.

Chapin Lake, Sherman Township:
Length, ½ mile; width, ¼ mile; greatest depth, 22 feet.
Shores, high banks extend nearly around the lake; low banks and marshy on south shore.
Bottom, soft and grassy except along north shore which is sand and gravel.
Inlets, none.
Outlets, a small stream running into Hog Creek.
Dates of examination, July 25 and 26.
Weather, clear.
Temperature, surface, 25, 80°; 26, 78°; bottom, 73°.
Water, clear.
Fish, large-mouth bass, blue-gills, strawberry bass, bullheads and shiners.
Fish taken were in good condition.

Clear Lake, Fabius Township:
Length, 1½ miles; width, ½ mile; greatest depth, 41 feet.
Shores, hard, sandy, with high banks all around lake.
Bottom, hard.
Inlets, none; outlets, none.
Dates of examination, August 12 and 13.
Weather, clear.
Temperature—Surface, 12, 78°; 13, 76°; bottom, 51°.
Water, clear.
Fish, perch, blue-gills, small-mouth bass, suckers and bull-heads. Fish taken were fat and showed large growth.

Corey's Lake, Fabius Township:
Length, 1½ miles; width, 1¼ miles; greatest depth, 79 feet.
Shores, sand and gravel; high banks extend all around the lake, wooded on the east and south.
Bottom, hard gravel and sand; rocky in the west end.
Inlets, none; outlets none.
Dates of examination, August 10 and 11.
Temperature—Surface, 10, 77°; 11, 78°; bottom, 46°.
Water, clear.
Fish, herring, blue-gills, suckers, perch and large-mouth bass. Fish taken are harder than any we have found before; the herring show large growth.

Crotch Lake, Sherman Township:
Length, ¾ mile; width, ½ mile; greatest depth, 41 feet.
Shores, on north and south marshy; on east some high banks and sandy; west, high banks.
Bottom, north, south and center soft; some places on east and west hard and sandy.
Dates of examination, July 19, 20 and 21.
Weather, 19, 20, clear; 21, cloudy.

Temperature—Surface, 82°; bottom, 58°.
Condition of water, clear.
Fish, blue-gills, pickerel, suckers, bass, bull-heads and strawberry bass. Fish hard and well fed; great growth of young bass.

Crossman Lake, Sherman Township:
Length, 100 rods; width, 8 rods; greatest depth, 50 feet.
Shores, low banks, marshy all around lake.
Bottom, muddy, except a short distance on east side the water is shallow and sandy bottom.
Dates of examination, July 20, 21 and 22.
Weather, clear.
Temperature—surface, 84°; bottom, 54°.
Fish, blue-gills, suckers, strawberry bass and rock bass. Fish are well fed but small, except suckers, which are very large.

Fish Lake, Sherman Township:
Length, ¾ mile; width, ½ mile; greatest depth, 106 feet.
Shores, gravel and sandy, high banks all around lake.
Inlets, none; outlets, none.
Dates of examination, August 2 and 3.
Weather, clear.
Temperature—surface, 82°; bottom, 46°.
Water, clear.
Fish, perch, blue-gills, bullheads and shiners. Fish taken were well fed; perch extra large growth; blue-gills small growth.

Fish Lake, Burr Oak Township:
Length, ½ mile; width, 100 rods; greatest depth, 36 feet.
Shores, low banks, marsh extending nearly around the lake, except about 20 rods on north shore.
Bottom, hard and sandy, except in south end of lake.
Inlets, a small stream running out of Cross lake; outlet, a small stream emptying into Hog Creek lake, then in Prairie river to St. Joseph river.
Dates of examination, July 22 and 23.
Temperature—surface, 22, 81°; 23, 78°; bottom, 22, 47°; 23, 46°.
Water, clear.
Fish, blue-gills, whitefish, herring and bill-fish. Fish, herring soft, whitefish and blue-gills hard and in good condition.

Fisher's Lake, Park Township:
Length, 1 mile; width, ½ mile; greatest depth, 46 feet.
Shores, high banks and sandy shores.
Bottom, on north-east end hard, sandy bottom; south and west muddy.
Inlets, none; outlets, one little stream running down through a big marsh.
Dates of examination, August 13 and 14.
Weather—August 13, clear; 14, rainy.
Temperature—Surface, 76°; bottom, 54°.
Water, clear.
Fish, blue-gills, perch and grass pike. Fish well fed, but of small growth.

Hog Creek Lake, Burr Oak Township:
Length, 1 mile; width, ½ mile; greatest depth, 56 feet.
Shores, marsh extends northeast around to south shore, on the east are high banks wooded about half around shore.
Bottom, northern portion hard and sandy, southern part soft and grassy.
Inlet, Hog creek; outlet, Hog creek. It is quite a large stream, running into Prairie river, thence to St. Joseph.
Dates of examination, July 23, 24, 25 and 26.
Weather, clear.
Temperature—Surface, 23, 24 and 26, 78°; 25, 79°; bottom, 46°.
Water, clear.
Fish, suckers. There has been plenty of fish here, but constant fishing has taken them nearly all out.

Johnson's Lake, Sherman Township:
Length, ¾ mile; width, ¼ mile; greatest depth, 36 feet.
Shores, on east, stony; west, pond lilies; north and south marshy.
Bottom, muddy, except a little on east end, which is hard and stony.
Inlets, none; outlets, none.
Dates of examination, July 18 and 19.
Weather, clear and warm.
Temperature—Surface, 80°; bottom, 66°.
Water, clear.
Fish taken, 7 bass with minnows and four blue-gills with worms.
Condition, plenty of large-mouthed bass; all seemed to be about two years old.

Koser's Lake, Fabius Township:
Length, ¾ mile; width, ¼ mile; greatest depth, 18 feet.
Shores, sandy and gravel; high banks extend all around the lake, wooded on east and west.
Bottom, hard and sandy.
Inlets, none; outlets, none.
Dates of examination, August 9 and 10.
Weather, clear.
Temperature—Surface, 9, 80°; 10, 78°; bottom, 68°.
Water, clear.
Fish, large-mouth bass, blue-gills and perch. The fish were in good condition, but not very large.

Klinger Lake, White Pigeon Township:
Leuth, 2½ miles; width, 1 mile; greatest depth, 85 feet.
Shores, hard and sandy extending all around the lake; the banks are high and wooded nearly around the lake.
Bottom, hard and sandy, gravel in west end of lake.
Inlets, there are several small inlets and one large one, which is the outlet of Thompson's lake; outlet, one, a branch of Fawn river.
Dates of examination, Aug. 3, 4, 5, 6, 7 and 8.
Weather, 3, 4, 6, 7 and 8, clear; 5, cloudy.
Temperature, surface, 3, 4 and 7, 82°; 5 and 6, 81°; 8, 80°; bottom, 46°.
Water, clear.

Fish, small-mouth bass, blue-gills, herring, bullheads, suckers, rock bass and strawberry bass. The fish are all very fat and show large growth. The small-mouth bass are very large.

Long Lake, Fabius Township:
Length, 1 mile; width, ¼ mile.
Shores are hard and sandy, high banks extend all around the lake.
Bottom, soft through the center of the lake; near shores is hard and sandy.
Inlets, none; outlets, none.
Dates of examination, Aug. 17 and 18.
Weather, rainy.
Temperature, surface, 17, 76°; 18, 74°; bottom, 51°.
Water, clear.
Fish, perch, blue-gills, shiners, bullheads and rock bass. Perch in good condition, blue-gills are small.

Long Lake, Colon Township:
Length, 1½ miles; width, ¼ mile; greatest depth, 40 feet.
Shores, high banks extend nearly around the lake, marsh extends about 40 rods on south shore.
Bottom is mud all over the lake.
Inlet, Swan creek; outlet, a large stream emptying into Palmer's lake.
Dates of examination, July 26, 27 and 28.
Weather, clear.
Temperature—surface, 26 and 27, 78°; 28, 79°; bottom, 52°.
Water, clear.
Fish, grass pike, blue-gills, bullheads, suckers and strawberry bass. The fish taken are hard and in good condition; the grass pike show great growth.

Palmer's Lake, Colon Township:
Length, 1½ miles; width, ½ mile; greatest depth, 55 feet.
Shores, high banks all around the lake, sand and gravel on all shores.
Bottom, hard, sand in northern part, stony in southern part.
Inlets, channel from Long Lake; outlets, channel emptying into Sturgeon lake, thence into St. Joseph river.
Dates of examination, July 28 and 29.
Weather, clear.
Temperature—surface, 28, 80°; 29, 78°; bottom, 48°.
Water, clear.
Fish, grass pike, blue-gills, sunfish, bullheads, strawberry bass, gar pike and dog-fish. The fish are in good condition; the grass pike show great growth; sunfish are small.

Pickerel Lake, White Pigeon Township:
Length ¾ mile, width ½ mile, greatest depth, 20 feet.
Shores, marshy on south side, high banks on north and flat on east and west.
Bottom, muddy, except on north side, which is sandy.

Inlets, one small stream on south side, which is the outlet of Aldrich lake; outlet, into Fawn river.
The lake is said to contain grass pike, bullheads, perch and blue-gills.

Pleasant Lake, Fabius Township:
Length, 1 mile; width, 100 rods; greatest depth, 49 feet.
Shores, muddy; flat marshy banks extend all around the lake.
Bottom, soft muddy bottom.
Inlets, none; outlet, is a large ditch running into St. Joseph river.
Dates, August 15, 16 and 17.
Weather, clear.
Temperature—surface, 15, 76°; 16, 74°; and 17, 16°; bottom, 15, 16, 48°, and 17, 49°.
Water, clear.
Fish, perch, blue gills, whitefish and large-mouth bass. Fish in good condition and all show very large growth.

Sand Lake, Nottawa Township:
Length, ¾ mile; width ½ mile; greatest depth, 34 feet.
Shores, gravel and sand; high banks all around the lake.
Inlets, none; outlets, none.
Dates of examination, August 1 and 2.
Weather, clear.
Temperature—surface, 1, 82°; 2, 80°; bottom, 70°.
Water, clear.
Fish, large-mouth bass, blue-gills, gar pike and bull-heads.
The fish are all in good condition and well fed.

Sturgeon Lake, Colon Township:
Length, 1 mile; width, 100 rods; greatest depth, 34 feet.
Shores, marsh extends nearly around; high banks extend a short distance on east and west.
Bottom, soft and grassy, except near the inlet it is sandy.
Inlet, St. Joseph river; outlet, St. Joseph river.
Dates of examination, July 29, 30 and 31.
Weather, clear.
Temperature—Surface, 83°; bottom, 66°.
Water, clear.
Fish, grass pike, strawberry bass, large-mouth bass, blue-gills and suckers. Grass pike are hard and show great growth; blue-gills and strawberry bass show small growth; suckers are very large and all are well fed.

Sweet's Lake, Fawn River Township:
Length, ¾ mile; width ½ mile; greatest depth, 23 feet.
Shores, high banks and timbered on north and south sides; east, flat banks and west low banks.
Bottom, soft, grassy, and one sand bar.
Inlets, none; outlet, Fawn river.
Date of examination. July 22.
Weather, clear.
Temperature—Surface, 80°; bottom, 76°.
Water, clear.

Fish, large-mouth bass, blue-gills, perch, suckers, shiners, bull-heads and dogfish. Bass were in good condition; blue-gills were poor and small; suckers were in good condition.

Thompson's Lake, Sherman Township:
Length, ¾ mile; width, ½ mile; greatest depth, 36 feet.
Shore, marshy on east and west; north and south, high banks and sandy shores.
Bottom, hard and sandy, with rushes extending out from shore.
Inlet, one; a small inlet fed by springs around the marsh; outlet, small stream emptying into Middle lake, thence into Klinger lake.
Dates of examination, August 4 and 5.
Temperature—Surface, 4, 80°; 5, 79°; bottom, 4, 59°; 5, 58°.
Water, clear.
Fish, blue-gills and herring. Blue-gills were well fed and show large growth; herring were soft but in good condition.

Van Buren County.

Great Bear Lake, Columbia and Bloomingdale Townships:
Length, 1 mile; width, ½ mile; greatest depth, 54 feet.
Shores, gravel and sandy except about 20 rods at outlet, marshy; high clay and sandy banks; wooded on south and east.
Bottom, sand and gravel for 15 or 20 rods around the shores; through center clay covered 6 to 8 inches with black mud.
Inlet, there is one large inlet on east side coming from Lake Mill; outlets, one large outlet, a tributary to Black river, thence into Lake Michigan.
Dates of examination, Oct. 22, 23, 24 and 25.
Weather, 22, 24 and 25, clear; 23, rainy.
Temperature, surface, 22, 52°; 23 and 24, 50°; 25, 49°; bottom, 22, 48°; 23, 48°; 24 and 25, 47°.
Water, clear.
Fish, strawberry bass. The fish taken were fat and well fed, but show small growth.

Jep Lake, Columbia Township:
Length, 3 miles; width, ¼ mile; greatest depth, 44 feet.
Shores, sandy and high banks on south and east; north and west flat muddy banks.
Bottom, muddy all over the lake and covered with moss and weeds.
Inlets, none; outlets, one on north side, a large ditch cut to drain lake.
Dates of examination, Oct. 18 and 19.
Weather, clear.
Temperature, surface, 54°; bottom, 43°.
Water has a reddish color.
Fish, blue-gills, perch and large-mouth bass. The fish taken were in good condition but small growth.

North Lake, Columbia Township:
This lake has been drained.

Pleasant Lake, Bangor Township:
Length, 100 rods; width, 40 rods; greatest depth, 24 feet.

Shores, marshy.
Bottom, mud.
Inlets, none; outlets, none.
Date of examination, October 17.
Temperature—surface, 54°; bottom, 49°.
Fish, blue-gills, perch, bullheads and black bass.

Silver Lake, Columbia Township:
This lake has been drained by ditches so there is but little left of it.

Rush Lake, Bangor Township:
Length, ¾ mile; width, ¼ mile; greatest depth, 57 feet.
Shores, muddy, with flat marshy banks all around the lake.
Bottom, marl, covered with moss and weeds near shores.
Inlets, none; outlets, one, a ditch made to drain the lake.
Dates of examination, October 13 and 14.
Weather, clear.
Temperature—surface, 13, 56°; 14, 54°; bottom, 49°.
Water, clear.
Fish, blue-gills, bullheads, suckers and grass pike. The fish taken were hard and fat and show large growth.

Saddle Lake, Columbia Township:
Length, 1¼ miles; width, ½ mile; greatest depth, 28 feet.
Shores, sand and marl, with high banks all around, wood on north and east.
Bottom, marl.
Inlets, none; outlets, one small stream emptying into Black river.
Dates of examination, October 19, 20 and 21.
Weather, 19, clear, 20, rain, 21, snow.
Temperature—surface, 19, 54°; 20, 53°; 21, 50°; bottom, 50°.
Water, clear.
Fish, perch, blue-gills, sunfish, bullheads, shiners and gar-fish. The fish taken are well fed and show large growth.

School Section Lake, Bangor Township:
Length, ½ mile; width, 100 rods; greatest depth, 10 feet.
Bottom, muddy, weeds reach nearly to the surface. It has been drained.
Date of examination, October 17.
Some few native fish remain, such as blue-gills, sunfish and a few black bass, etc.

Lake 14, Bangor Township:
Date of examination, October 24.
This lake has been drained so low that no fish except carp can live in it.

Scott Lake, Arlington Township:
Length, 1 mile; width, ¼ mile; greatest depth, 54 feet.
Shores, sand, with high banks on north and south; wooded on the east and south.
Bottom, mostly marl; there are some places in deep water where there is a black mud bottom.

Inlets, there is one small inlet on east side, the outlet of some small marshes close to this lake. Outlets, there is one outlet on northwest corner. It is a county ditch running into Black river, thence into Lake Michigan.
Dates of examination, October 14, 15 and 16.
Temperature—Surface, 14 and 15, 56°; 16, 55°; bottom, 14 and 15, 50°; 16, 49°.
Water, clear.
Fish, perch, strawberry bass, bull-heads, blue-gills, grass pike, large-mouth bass, sunfish and red bass. The fish taken were in good condition, well fed, but small growth, except grass pike are very large.

Sister Lake, Keeler Township:
Length, ½ mile; width, ¼ mile; greatest depth, 32 feet.
Shores, sand and gravel; high sandy banks except about 20 rods on west, flat and marshy; wooded on south.
Bottom, sandy near shore, with sand bar crossing near west end; through center muddy and covered with weeds.
Inlets, none; outlets, none.
Dates of examination, September 11 and 12.
Weather, clear and cold.
Temperature—Surface, 11, 64°; 12, 63°; bottom, 11, 60°; 12, 59°.
Water, clear.
Fish, perch, blue-gills, sunfish, strawberry bass and large-mouth bass. The fish taken were hard and well fed, but show small growth.

Vanauken Lake, Bangor Township:
Length, 1 mile; width, ½ mile; greatest depth, 47 feet.
Shores, hard sand on east and south; north and west, flat muddy banks all around.
Bottom, nearly all hard and sandy except a small portion in northwest corner, which is soft and muddy.
Inlet, there is one small spring creek running in on south side; outlet, one on west side. It is a large ditch cut to drain the lake.
Dates of examination, October 11, 12 and 13.
Weather, cold; 11, cloudy; 12, rainy; 13, clear.
Temperature—Surface, 11, 58°; 12, 57°; 13, 54°; bottom, 11 and 12, 50°; 13, 49°.
Water in this lake has a reddish color.
Fish, grass pike, blue-gills, bull-heads, perch, strawberry bass and suckers. The fish taken were hard and well fed; the blue-gills and strawberry bass were small; the pike large.

V.—EXAMINATION OF INLAND LAKES

2. Work of 1888.

In December, 1887, the newly appointed United States Commissioner of Fish and Fisheries, Col. Marshall McDonald, had visited Detroit with Mr. Richard Rathbun, the Assistant in charge of Scientific Research, at which time they had discussed with members of this board the methods we had employed in examining the inland lakes. The systematic and thorough manner

of doing that work was specially commended by them and the results promised by it were regarded as of great practical value. Col. McDonald was so much interested in it, and the opportunities offered for extended scientific observation connected with the purpose of the examination that he proposed co-operating with us by furnishing a naturalist. The terms and objects of such co-operation were further considered by subsequent correspondence, and in May, 1888, at the meeting of the American Fisheries Society, at which Col. McDonald and Mr. Rathbun were present, arrangements were finally concluded by which the United States Commission agreed to furnish a naturalist, and bear one quarter of the actual expenses, not including salaries, and the Michigan Commission agreed to furnish a crew of four men and a cook, besides necessary camping outfit and our implements for fishing, sounding and recording temperatures.

The instructions of the United States Commission to the naturalist, and of this commission to the crew on the subject of the joint work, are printed in the appendix to this report. Mr. Charles H. Bollman, a student under Dr. Jordan at the University of Indiana, was employed as naturalist. His work was satisfactorily performed, and his report was expected in time for this publication.

Operations were commenced early in July in Kalamazoo county, where they were stopped the previous year. The regular work of the crew was prosecuted in Kalamazoo county and Calhoun county until August 6, when they were moved to Torch Lake for special work, which was deemed important. Abstracts of the reports of the crew are given in full below. While all of these reports will not be of special interest to all readers, each one of them will be of interest and practical value to some citizens of the state; and it is also a matter of great convenience to have them in print for reference.

The special examinations referred to above are those of lakes of unusual importance by reason of their size, the large plants made in them, or the promise, if we find some of them specially adapted, to making experiments on a large scale. It is the purpose of the board to continue the examinations year by year until the entire state has been covered. This course, if thoroughly carried out, will never require to be done again, and will result in placing on record all that need be known by the state fishery officers to enable them to deal justly and intelligently with the entire lake system of the state. The instructions, it will be seen, contemplate some investigations of the streams that are found by the crew while engaged in their lake work. This feature of the examinations becomes very important when it deals with the larger streams or rivers, because the physical characteristics of a large stream are less easily observed and less likely to be reported upon accurately in the circular reports which are received from individuals who apply for plants of fish. The utility of an exact record in our office of all the streams in the state is of the same kind as the record now being made of the inland lakes. It would be an unerring guide to the kinds and quantities of fish asked for, or sent out from the state hatcheries.

The co-operation of the United States Fish Commission in this kind of work was very acceptable to this board, as it enabled us to enlarge the field of our common labors, and afforded an opportunity to demonstrate the possibility of the two organizations uniting their efforts to attain a useful object of common interest with an important saving in the needful expenditure. The general subject of co-operation in fish culture by the existing agencies

employed in its prosecution is discussed at more length in an article contained in the appendix. This board has sought to enlist the interest of the University and the Agricultural College in the subject of these examinations, and to improve the character of the work by securing their co-operation. The proposal came too late in the season to be successful, but we have hopes of securing the co-operation of one, at least, of the state colleges for the next season, as President Willits, of the Agricultural College, has proposed to supply the position of naturalist in our crew with the Professor of Natural History of that college. If the proposed arrangement can be carried out it will result in a mutual advantage to both institutions.

The condensed reports of 1888, given below, show that the genuine black bass is found in three of the lakes reported upon; herring in three lakes; whitefish in two, and wall eyed pike in one.

Kalamazoo County.

Eagle Lake, Texas Township:
- Length, ¾ mile; width, ½ mile; greatest depth, 20 feet.
- Shores, sand and high banks: wooded on south and east.
- Bottom, soft, muddy, covered with weeds and grass.
- Inlets, none; outlets, none.
- Date of examination, July 18, 1888.
- Weather, clear.
- Temperature—surface, 75°; bottom, 70°.
- Water, clear.
- This lake contains a few native fish, but the water is very shallow and gets so warm that the fish get soft during the summer months and are not good to eat.

Long Lake, Pavilion and Portage Townships:
- Length, 2 miles; width, ¾ mile; greatest depth, 42 feet.
- Shores are generally marshy or springy, with patches of sand and gravel, with bulrushes all around the lake.
- Inlets, none; outlet, it has one that flows from the south end of lake into Austin lake, nothing more than a ditch.
- Dates of examination, July 8, 9, 10, and 11.
- Temperature—surface, 8 and 9, 73°; 10 and 11, 74°; bottom, 8, 10 and 11, 52°; 9, 53°.
- Water, clear.
- Fish, perch, blue-gills, sunfish, strawberry bass, large-mouth bass, small-mouth bass and bullheads. The fish taken were very fat, flesh hard and showed large growth.

Gourd Neck Lake, Portage and Schoolcraft Townships:
- Length, 1¼ miles; width, ½ mile; greatest depth, 50 feet.
- Shores, sandy on north and north-east, with high banks; flat banks and marshy on west, south and south-west.
- Bottom, hard, sandy in north end; black, soft mud in south end.
- Inlets, one spring creek emptying into west side, and a channel from Hogshead lake on north end; outlet, one small stream flowing south into Rawson lake.

Dates of examination, July 12, 13 and 14.
Temperature, surface, 12, 75°; 13 and 14, 73°; bottom, 12, 50°; 13 and 14, 49°.
Water, clear.
Fish taken, wall-eyed pike, blue-gills, grass pike and large mouth bass. The fish were hard, well fed and showed large growth.

Indian Lake, Pavilion and Brady Townships:
Length, 2¼ miles; width, 1 mile; greatest depth, 76 feet.
Shores, for from one to six rods all around the lake are low and marshy, back of that high banks.
Bottom, in east end soft mud; in deep water in body of lake, hard clay and marl.
Inlets, two; Portage and Beaver creeks coming in on the north side; mud bottom and grown with weeds; outlets, one; on south side of north arm, flowing into Portage river.
Dates of examination, July 11 and 12.
Temperature, surface, 11, 72°; 12, 73°; bottom, 54°.
Water, clear.
Fish taken, herring, suckers, rock bass, bullheads, black bass, grass pike and perch. The fish are well fed.

Crooked Lake, Texas Township:
Length, 1¼ miles; width, ½ mile; greatest depth, 50 feet.
Shores, sandy, with high sandy banks; wooded on south and about ¼ mile on north.
Bottom, sand and gravel for ten or fifteen rods out from shore; soft black mud through middle of lake.
Inlets, none; outlet, one; a small stream emptying into Bass lake.
Dates of examination, July 18 and 19.
Temperature—Surface, 18, 75°; 19, 73°; bottom, 18, 55°; 19, 54°.
Water, clear.
Fish taken, blue-gills, sunfish and bull-heads. The blue-gills and sunfish were hard and very fat, well fed and showed large growth.

West Lake, Portage Township:
Length, 1 mile; width, ¾ mile; greatest depth, 14 feet.
Shores, sandy; flat banks except about ½ mile on south shore, which is high banks; wooded on north and west.
Bottom, soft and muddy.
Date of examination, July 16.
Temperature—Surface and bottom, 73°.
Water, muddy.
This lake is said to contain blue-gills, sunfish, suckers, large-mouth bass and some other species of native fish. No net was put in this lake, as the water is shallow and the bottom covered with weeds. It has been lowered by ditching so that the lake is nearly destroyed.

Austin Lake, Portage and Schoolcraft Townships:
Length, 3 miles; width, 1½ miles; greatest depth, 14 feet.
Shores, flat and marshy; low banks all around the lake.
Bottom, soft and muddy; grass and weeds all over the bottom.

Inlets, one small inlet flowing from West lake; outlet, one channel flowing into Long lake.
Dates of examination, July 12 and 13.
Temperature, surface, 12, 75°; 13, 74°; bottom, 70°.
Water, muddy.
Fish taken, large-mouth bass, rock bass, blue-gills, bull-heads, gar pike, sunfish and dogfish.
The sunfish, blue-gills and bass, were well fed, but soft and of small growth.

Howard Lake, Schoolcraft Township:
Length, ¾ mile; width, ¼ mile; greatest depth, 46 feet.
Shores, soft and springy close to water's edge; high clay and sandy banks, wooded on north, east and south.
Bottom, on north soft and grass for ten or fifteen rods; balance of lake is marl and black mud.
Inlets, two; one a small spring creek emptying into west side, and one a large stream flowing in on east shore; outlets, one, a large stream flowing into Rawson lake.
Dates of examination, July 18 and 19.
Temperature, surface, 18, 73°; 19, 72°; bottom, 44°.
Water, clear.
Fish taken, long-jawed whitefish and perch.
The whitefish taken were in the best of condition.

Rawson Lake, Schoolcraft Township:
Length, 1¼ miles; width, ½ mile.
Shores, on north end are flat and marshy; on south side, tamarack swamp; on north side high banks.
Bottom, in deep water hard marl; in shallow places, mud covered with weeds.
Inlets, two, one in north end coming from Gourdneck lake, and one in south end coming from Howard lake; outlets, one on the south side flowing into Kimball's lake.
Dates of examination, July 16, 17, 18 and 19.
Temperature, surface, 16 and 19, 73°; 17, 72°; 18, 74°; bottom, 16, 51½°; 17, 52°; 18, 53°; 19, 51°.
Water, clear.
Fish, suckers, calico bass, blue-gills, sunfish, bullheads, herring, grass pike, and perch.
The fish taken were plump with stomachs full.

Calhoun County.

Goguac Lake, Battle Creek Township:
Length, 1¾ miles; width, ½ mile; greatest depth, 65 feet.
Shores are sand and gravel except on south end of lake, where it is low and marshy.
Bottom, is sand, gravel and marl in shallow water; in deep holes, mud.
Inlets, none; outlets, none.
Dates of examination, July 20, 21, 22, 23, 24 and 25.

Temperature—Surface, 20, 21 and 23, 73°; 22 and 25, 74°; 25, 75°; bottom, 20 and 23, 44°; 21, 48°; 22, 45°; 24, 51°; 25, 43°.
Water, clear.
Fish, gar pike, swamp bass, perch, bull-heads, blue-gills and sunfish. The fish were small but plump and well fed.

Barnum Lake, Leroy Township:
Length, 1¼ miles; width, ⅓ mile.
Shores, marshy or grown with rushes around the entire lake.
Bottom, soft mud and marl.
Inlets, one coming into south end from Pane's lake; outlets, one flowing from north end into Kalamazoo river.
Date of examination, July 22.
Temperature—Surface, 73°; bottom, 49°.
Water, clear.
Fish, suckers, perch, blue-gills, swamp bass, eels, sunfish and rock bass.

St. Mary's Lake, Pennfield and Bedford Townships:
Length, 1 mile; width, ¼ mile; greatest depth, 24 feet.
Shores, are sand, gravel and rocky all around the lake, with high, sandy banks.
Bottom, along the shore is hard, but after leaving the offset, is soft mud.
Inlets, none; outlets, none.
Dates of examination, July 24 and 25.
Temperature—Surface, 74°; bottom, 24, 54°; 25, 53°.
Fish, blue-gills, bull-heads, perch, swamp bass and chubbs. Fish are good size and well fed.

Hart's Lake, Battle Creek Township:
Length, ½ mile; width ¼ mile; greatest depth, 45 feet.
Shores, flat and marshy all around the lake.
Bottom, soft mud and marl, covered with a short growth of weeds.
Inlets, one, coming in on south side, a small spring brook; outlets, one, flowing into Kalamazoo river.
Date of examination, July 27.
Temperature—Surface, 75°, bottom, 48°.
Took no fish. The fish are all native.

Panes Lake, Le Roy Township:
Length, 1 mile; width, ¼ mile; greatest depth, 42 feet.
Shores, marl and mud, grown with pond lilies and rushes around the entire lake.
Bottom, mostly marl, with mud in the deepest parts.
Inlets, none; outlets, one, flowing from south end into Barnum lake.
Date of examination, July 24.
Temperature—Surface, 73°; bottom, 49°.
Water, clear.
Fish, small-mouth bass, suckers, perch, swamp bass, sunfish and blue-gills. Fish are plump and well fed.

Lyon Lake, Fredonia Township:
Length, ½ mile; width, ⅓ mile; greatest depth, 30 feet.

Shores are gravel and sand, with rushes on southwest side, with high banks all around the lake.
Bottom is hard sand and marl on offset and is a dark kind of marl or dirt in deep places, which is hard.
Inlets, none; outlets, none.
Dates of examination, August 1 and 2.
Temperature—Surface, 76°; bottom, 67°.
Water, clear.
Fish, perch, swamp bass, calico bass, blue-gills, bullheads, golden shiners and sunfish. The fish are of good size, the perch averaging one pound, and are well fed, their stomachs being found full.

Upper and Lower Brace Lakes, Townships of Fredonia and Eckford:
Length, Upper lake, ¾ mile; Lower, ½ mile; width, Upper lake, ½ mile; Lower, ¼ mile.
Shores are marl all around both lakes, except on the east side of the lower one, where is a little sand and gravel.
Bottoms are a sort of sand and marl mixed, which is soft and has a terrible smell when stirred up.
Inlets, none natural, but there is a ditch coming into the upper lake from a small lake; outlets, one, which is a ditch cut through to Wilder's creek to lower the lakes.
Dates of examination, July 30, 31 and August 1.
Temperature—Surface, 30, 78°; 31, 76°; bottom, 30, 56°; 31, 58°.
Water, clear.
Fish, blue-gills, swamp bass, grass pike, bullheads, suckers and red-horse. The fish are generally small, but well fed.

Antrim County.

Torch Lake:
Length, 18 miles; width, 2¼ miles; greatest depth, 320 feet.
Shores are sand and gravel around entire lake, with a few places of clay.
Bottom is a mixture of gravel, marl, clay, sand and stone covered in places with weeds.
Inlets, several small spring streams coming in on east side, and Clam river on same side; outlet, one, Torch river, flowing from south end of lake into Round lake.
Dates of examination, August 10, 11, 12, 13, 14, 15, 16, 17, 18, 25, 27 and Sept. 2, 3 and 4.
Temperature, surface, from 67° to 69°; bottom, from 48° in depth of 100 feet to 32½° in depth of 210 feet.
Fish, lake trout, whitefish, herring, lings, perch and suckers. The stomachs of the fish were full, but the fish were not as plump as those of the great lakes.
The food found in the stomachs of the lake trout consists entirely of small fish, chiefly young herring. The same was true of the ling except that they also contained more of the millers' thumbs found in deep water. Whitefish and herring were feeding on crustaceans and the little worm called the whitefish worm.

The land around the lake is generally high, it being mostly hilly, consisting of sand and clay in strips varying from one fourth to two miles wide, with still considerable timber along the east shore. The timber is a mixture of maple, beech, oak, hemlock, and in fact all species of forest timber of Northern Michigan. The shores have a narrow strip of gravel and sand all around the lake, where, in some places, it is mixed with clay and large boulders.

The offset is a gradual slope from the water's edge, in some places running out as far as one-fourth of a mile and in others only for a few feet, then dropping nearly straight down into from forty to sixty feet of water, and at Anderson's camping ground there are one hundred and ninety feet of water within eight rods of the shore.

The lake has been fished by the crew in all ways known to them. Trolling along offset with minnow and spoon. Small-mouth bass were taken, two on spoon and three on minnow, the minnows usually being perch from three to five inches long. Deep draft trolling was done in from one hundred to three hundred feet of water with live bait, by which eight lake trout were taken weighing from four to nine pounds.

VI.—1. RAILWAY CAR FOR USE OF THE COMMISSION.

CAR.

Since the organization of the commission the necessity has been apparent that the state should own a car for the transportation of the fry of the whitefish and trout hatched yearly. This work has always been done through the courtesy of some railroad—largely through the courtesy of the G. R. & I. in renting to the board during the planting season one or more baggage cars for its use. This means of transportation has been very uncertain. The distributions are usually made during the season of the year when roads have a heavy demand upon them for the use of their entire outfit of rolling stock. As a consequence, nothing but the poorest cars can be had, and as these cars are always run, when loaded with fry, in passenger trains, they must be in good condition or are liable to be set out of the train at any point where inspection of cars is had while in transit. The different companies demur very much to the hauling of these cars in passenger trains, and last spring it was only through persistent telegraphing on the part of the employés in charge of such a car, which was in a defective condition, that consent was finally obtained from the railroad authorities permitting the car to go on, and this was coupled with the statement that it was liable to be set out at the next place of inspection, although they would endeavor to see it was not done. If the car had been set out it would have resulted in the loss of between two and three million of fry.

It has always been necessary to procure passes for each trip for the employés sent over the road with the car, resulting in more or less friction and delay, and in one or two instances passes have been absolutely refused.

The commission has long been of the opinion that if it possessed a car of its own the possibilities of enlarging the work would be very greatly increased. Under the past order of things neither the German carp nor the wall-eyed pike could be distributed by the commission, parties desiring these fish being compelled to either be to the expense of going for the fish personally, or paying express charges thereon. The commission has also been precluded from making distributions of the black bass from waters which were well stocked to those that had been exhausted, which would be made possible provided it had a car of its own.

At the last session of the legislature and near the close of the session, the commission was notified by the various railroads in the state that under the Interstate Commerce Act they must withdraw all passes heretofore granted to employés of the board. The board at once upon consultation with the fisheries committee of the legislature, submitted an estimate additional to the amount already asked for to cover this item of expense, amounting to about $6,000, and the same was allowed to the board. The railroads took this precaution, being uncertain as to what effect the Interstate Commerce Act would have upon their business. Sometime after the adjournment of the legislature some of the roads expressed a willingness to grant passes and after a time the courtesy was renewed by nearly all the roads. This left at the command of the commission a portion of this amount of money, and after fully considering the matter it was concluded that the best interests of the state would be subserved if a car could be purchased or built that would answer the purposes of the board in its work. Plans were accordingly made and bids were solicited from various car companies throughout the country and a contract was finally entered into with the Litchfield Car Company of Litchfield, Illinois, who are largely engaged in constructing special cars, for the construction of a car according to the plans submitted by the board. None of the car companies in Michigan that were applied to would accept the contract at all, for the reason that they were too busily engaged upon other work. The bid of the Litchfield Car Company was $1,000 lower than the next lowest bidder, and the contract was finally let to them for the sum of $3,550.

The car was completed and delivered to the board on the 1st of August, 1888. It is 55 feet long, 9 feet 8 inches wide, is plainly and substantially constructed and is calculated for service. It is fitted out with first class passenger coach trucks, with air brake, platforms, coupler and buffers so that it can be easily hauled in any passenger train. It is provided in one end with an office, and in the other with a kitchen, thus enabling the men to live upon the car while upon the trips, materially reducing the expenses of traveling. It is fitted with five berths for the accommodation of the men and the body of the car is so constructed as to carry 175 cans. This largely increases the number of fry we have been able to carry in the ordinary baggage cars heretofore used. It will be thus seen that there is a material saving in the expenses of the men who accompany the car, they being lodged and fed on board the car. It also obviates the necessity of procuring passes for the men, as all that is necessary is to procure an order from the superintendent of the road to have the car hauled. The railroads over which our work is done express great satisfaction with the board in having a car made and say they are entirely willing to haul it in any train they may have. The exterior appearance of the car is very neat and attractive. The car has been named "Attikumaig,"

being the Chippewa name for whitefish, as given by Schoolcraft, its literal interpretation being "Deer of the water."

The car was finished and delivered as early as possible after the contract was made, but owing to the lateness of the season, we were not able to make as great use of it in the distribution of black bass as we shall be in future years. Distributions were, however, made of about 1,600 black bass, the details of which distribution appear in another part of this report.

At some time during the coming session of the legislature the car will be brought to Lansing for an inspection by the members of the legislature.

The board contemplates that the efficiency of the work in the distribution of food and game fishes will be greatly increased by the use of this car, and that the wisdom of its purchase will be apparent. The same company constructed a like car for the Missouri Fish Commission two years ago, which cost them $1,000 more than this car cost the Michigan Commission.

AID FROM MICHIGAN RAILROADS.

Nothing has been more gratifying to the board than the interest shown by the railroads of the state. Recognizing, as they do, the universal benefits which surely follow the work of the commission, they have been ever ready to help the board, carrying our men, our fish and cans, our camp outfit and baggage, hauling our cars and in every possible way contributing their full share of assistance, free of charge, saving to the state several thousands of dollars each year, thus enabling the board to increase the work by just the amount saved. The board being limited to the appropriations made by the legislature would sometimes have to leave important things undone if it were not for the hearty coöperation of the railroads.

The Grand Rapids & Indiana and the Detroit, Lansing & Northern roads have been most frequently called upon because the line of our most frequent travel is over these roads. No refusal has ever been received from either of these roads, in fact no road in the state has refused a request, but all have been prompt and generous to answer any demand made upon them.

Besides the railroads above named, the board are under obligations to the following for favors received and courtesies extended to the officers and men belonging to this commission:

The Detroit, Marquette & Mackinac; the Detroit, Bay City & Alpena; Detroit, Grand Haven & Milwaukee; Flint & Pere Marquette; Lake Shore & Michigan Southern; Michigan Central; Chicago & West Michigan; Marquette, Houghton & Ontonagon; Toledo, Ann Arbor & Northern; Michigan & Ohio; Chicago & Northwestern; Saginaw, Tuscola & Huron; Pontiac, Oxford & Port Austin; Wabash, St. Louis & Pacific.

Respectfully submitted,

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

GRANT OF FISHERY RIGHTS ON THE DETROIT RIVER.

In October, 1888, we became aware that persons who had been holding leases of fishing privileges for a number of years on the Detroit river, which were under the control of the Lighthouse Board, had been notified by the lessors that their privileges would terminate January 1, 1889, when there would be a re-leasing. These privileges had been enjoyed for a number of years by the parties in possession at a merely nominal rental. This board for the past few years has, under arrangement with the different lessees of these fisheries, had the privilege of handling the whitefish taken on these grounds for the gathering of ova, which right has cost the state in the neighborhood of $1,500 to $2,000 yearly. The fisheries which have thus been operated by the commission are known as Grassy Island and Mammy Judy.

In view of the facts that the state for the last ten or fifteen years has been planting large numbers of whitefish fry for the public benefit, at a considerable expense, and that the statistics of the past two years show that this money has been expended judiciously, and fishermen are now reaping an adequate benefit in the enhancement of the value of their fisheries, it has seemed but justice to the state that the operations of spawn gathering should be enjoyed by the commission without expense, and if necessary, authority should be given the board by statute, to enter upon any fishing grounds within the borders of the state, at their pleasure, for the purpose of gathering the ova of the whitefish without expense. Undoubtedly legislation of this kind would meet with some opposition were it proposed, and very fortunately the necessity for legislation of this kind has been obviated, for the present at least, by the securing of the right hereinafter mentioned.

To intelligently understand the value of the grant we have obtained it is only necessary to say that, owing to the sheltered locality of the fisheries on the Detroit river and the certainty with which the ova can be procured, it has grown to be a very desirable place to conduct such operations, and during the past fall, in addition to our own work done on the river, the United States Commission, the Wisconsin Commission and the Canadian authorities have all conducted spawn-gathering operations at different points between Detroit and the mouth of the river.

Upon learning the intention of the Lighthouse Board to relet these fisheries, steps were at once taken by us to ascertain if we could not secure the right to operate upon these grounds, for the purpose of gathering the ova without expense to the state, and the following petition was addressed to the Lighthouse Board:

DETROIT, MICH., *November 12, 1888.*

To the Lighthouse Board:

GENTLEMEN:—It has come to the knowledge of our board that parties holding leases of fishery rights on the Lighthouse Reserve on the Detroit river, have been notified that their leases would expire on the 1st of January, 1889, and that these rights will be open to competition after that date.

You are probably aware that the state of Michigan, through this board, has been engaged in the business of restocking the Detroit river and adjacent connecting waters with whitefish, for the last twelve or fourteen years, and that the result of this work is being felt very noticeably this present season.

Very many fisheries along the river that had been abandoned for a number of years, are being fished at a profit this year, which is attributable wholly to artificial propagation. For the past five years the principal part of our egg-taking operations have been conducted upon the Detroit river, and we have handled the fish taken at the fisheries along the river, which are leased from your board.

We desire very much to continue in the enjoyment of this right, and having been apprised of your notification to the parties now holding the leases, we desire to petition your board to secure to us, for the state, the right in the future to handle such fish as we may desire for the purposes of artificial propagation, at the various fisheries under the control of your board, without expense to the state. Our work is entirely in the interests of maintaining the whitefish industry of the great lakes and connecting waters, and our success results in the improvement and enhancement of the value of all the fisheries upon this river.

We would therefore respectfully request that your honorable board grant to the Michigan Board of Fish Commissioners, the right to enter upon the premises during the fishing seasons, and handle such fish as they may desire free of charge; and that in making leases, to such parties as may secure the right from your board to fish upon these premises, you will make it a condition of such leases that they shall be subject to the right granted to the state. We will also agree to plant upon these grounds each year a liberal supply of fry to maintain good fishing at these places.

Trusting our request will meet with your favorable consideration, I remain,

Very respectfully yours,
HERSCHEL WHITAKER,
Commissioner.

This petition was promptly considered and after a brief correspondence, and on Dec. 12, 1888, the following communication was received:

WASHINGTON, *Dec. 12, 1888.*

MR. HERSCHEL WHITAKER, *Michigan Fish Commission, Detroit, Mich.:*

SIR:—Referring to your letter of 12 Nov., '88, the Board has directed the engineer of the tenth light-house district, Cleveland, Ohio, to insert in any lease or leases that may be granted for the fisheries in the Detroit river, over which it has control, a condition that the premises leased shall be subject to entry, etc., for the purposes of your commission, as requested by you.

Respectfully yours,
JAMES F. GREGORY,
Major of Engineers, U. S. A. Engineer Secretary.

By this action the state has acquired a most valuable right, and the thanks of this board are due to the courtesy of the Lighthouse Board for their very prompt and cheerful compliance with our petition. The kind offices of Commander C. V. Gridley, of Buffalo, N.Y., officer in charge of this department, and of Commander Horace Elmer, of Detroit, for their assistance in this matter, are hereby duly recognized and our thanks are extended to them for their courtesy. The obligations of the commission to Senator Stockbridge for his kind offer of assistance are also hereby duly recognized.

In Memoriam.

In making our report of the results of the work of the board for the past two years, we should stop much short of our duty were we to pass by unrecognized the death of Seth Green, the most eminent fish culturist of America, without a fitting recognition of his great services in the development of the methods of artificial propagation of our food and game fishes.

It is of little consequence where such a man may have been born or where he died; he belonged to the world at large; in a sense he had become a public character by reason of his identification with a question in which the public is largely interested, and as he had in a measure become public property, the place of his birth or death are matters which concern none but those immediately connected with him.

It has been well said that "He who causes two blades of grass to grow where one had grown before is a public benefactor," and in this light Mr. Green was a public benefactor in the fullest sense. Of him it may be said that he caused to grow thousands, where one had grown before.

He loved nature in all her varying moods; he loved the sports of stream and field, and was an adept with rod and gun. He was a man of keen and close observation, and was possessed of that quality which makes men great—the power to grasp and apply acquired information to practical uses. For nearly or quite a quarter of a century he was engaged in experimental work connected with the artificial propagation of the food and game fishes of America, and without question it may be said that few, if any, were better acquainted with their habits, their distribution and peculiarities than he.

Mr. Green was not the discoverer of the artificial propagation of fishes, but up to the time he engaged in fish culture it had barely advanced beyond the field of pleasing and successful experiment. Under the methods then known and used the results of propagation had never

shown a greater percentage of impregnation in a given quantity than about 20 to 30 per cent. He at first succeeded no better than those who had preceded him, but his practical mind soon suggested to him that with such results no advancement adequately necessary to restock exhausted waters could be accomplished, and that the natural spawning habits of the fish were but little improved upon, if at all. Thought and devotion to the work finally suggested to him what is now known to fish culturists as "dry impregnation," and his experiments with this process were soon rewarded with a surprisingly gratifying result. Instead of a percentage of successful impregnation amounting to only about 20 to 30 per cent, he found that the percentage under most favorable circumstances might be raised to even 95 per cent. The necessary and logical result of this discovery suggested to those interested in fish culture, the entire practicability of the different states embarking upon the work of fish breeding upon a large scale, to renew or increase an important food item. State after state has entered upon this work until now there are very few of the states of the Union which have not engaged in fish breeding in some measure. The success of this work has been so manifest that it is entirely within reason to say that despite all obstacles, even those which the laws of well governed states ought to remove, fish culture can restock our depopulated waters.

Mr. Green contributed largely to the literature connected with the subject of fish culture, and was a recognized authority on disputed questions. For many years he was superintendent of the N. Y. hatchery at Caledonia, N. Y., and actively overlooked the general conduct of the station until his death. He has educated many of the best fish culturists of the United States in the rudiments of the business, who are now at the head of important work all over the country.

APPENDIX.