TRANSACTIONS

—OF THE—

American

FISHERIES SOCIETY

FIFTEENTH ANNUAL MEETING.

HELD AT THE

PALMER HOUSE, CHICAGO, ILL

April 13th and 14th, 1886.

New York.

1886.

OFFICERS FOR 1886-7.

PRESIDENT,	DR W. M. HUDSON,	*Hartford, Conn.*
VICE-PRESIDENT,	W. L. MAY, - -	*Fremont, Neb*
TREASURER,	E. G. BLACKFORD, - -	*Brooklyn, N. Y.*
REC. SECRETARY,	FRED MATHER	*Cold Spring Harbor, N. Y.*
COR. SECRETARY,	W. A. BUTLER, JR -	*Detroit, Mich.*

EXECUTIVE COMMITTEE.

FRANCIS ENDICOTT, *Chairman.* -	*Staten Island, N. Y.*
F. N. CLARK, - - - -	*Northville, Mich.*
S. P. BARTLETT, - - - -	*Quincy, Ill.*
DR. R. O. SWEENY, - - -	*St. Paul, Minn.*
PHILO DUNNING, - - - -	*Madison, Wis*
A. N. CHENEY, - - - -	*Glens Falls, N. Y.*
LIVINGSTON STONE, - - -	*Charlestown, N. H.*

CONSTITUTION.

The following is the Constitution, as revised and accepted after the report of the committee, which was appointed at the last meeting, had been by sections.

ARTICLE I.—NAME AND OBJECTS.

The name of this Society shall be "The American Fisheries Society." Its object shall be to promote the cause of fish-culture; to gather and diffuse information bearing upon its practical success, and upon all matters relating to the fisheries; the uniting and encouraging of the interests of fish-culture and the fisheries; and the treatment of all questions regarding fish, of a scientific and economic character.

ARTICLE II.—MEMBERS.

Any person shall, upon a two-thirds vote and the payment of three dollars, become a member of this Society. In case members do not pay their fees, which shall be three dollars per year, after the first year, and are delinquent for two years, they shall be notified by the Treasurer, and if the amount due is not paid within a month thereafter, they shall be, without further notice, dropped from the roll of membership. Any person can be made an honorary or a corresponding member upon a two-thirds vote of the members present at any regular meeting.

ARTICLE III.—OFFICERS.

The officers of this Society shall be a President and a Vice-President, who shall be ineligible for election to the same offices until a year after the expiration of their terms, a Corresponding Secretary, a Recording

Secretary, a Treasurer, and a Executive Committee of seven, which with the officers before named, shall form a council and transact such business as may be necessary when the Society is not in session four to constitute a quorum.

ARTICLE IV.—Meetings.

The regular meeting of the Society shall be held once a year, the time and place being decided upon at the previous meeting, or in default of such action, by the Executive Committee.

ARTICLE V.—Changing the Constitution.

The Constitution of the Society may be amended, altered or repealed, by a two thirds vote of the members present at any regular meeting, provided, at least fifteen members are present at the said meeting.

FIFTEENTH ANNUAL MEETING

—OF THE—

AMERICAN FISHERIES SOCIETY.

FIRST DAY.

TUESDAY, APRIL 13th, 1886.

The Convention was called to order by Dr. William M. Hudson, the Vice-President, in the chair, at 11 o'clock A. M.

The CHAIRMAN.—Gentlemen, in the absence of Col. McDonald, the President of the Society, it devolves upon me to preside over this meeting to-day. Inasmuch as we are deprived of his presence by reason of a sudden death in his family, I would say I have not prepared any opening remarks. I can simply say that in this first meeeting in the West, I sincerely trust we may make up in quality what we apparently so far lack in numbers.

I notice, gentlemen, that in accordance with the course of our previous meetings, we have first to consider routine business, which will come up in its regular order, and I would ask the Secretary for any suggestions which he may have to offer in regard to this matter.

Secretary MATHER.—Mr. President, the usual routine business of the opening of the meetings has been the appointing of committees, and one of those committees, the most important I

believe, to be a committee for nomination of officers, which should report to-morrow. At the last meeting of the association there was a committee appointed to revise the Constitution of the Society. They did revise it and presented a draft of it, which is published in the beginning of last year's report, and it was decided to submit it to this meeting. Whether that will be considered in this morning's session or not is for the members to decide. Then there will be a committee, probably to decide upon the time and place of the next meeting, unless the association should see fit to go into a committee of the whole upon that subject, before we make our final adjournment on the last day of this Convention.

Mr. MAY.—If it is in order, I would move the appointment of a committee of five upon nomination of officers for the coming year. This being duly seconded was carried.

The CHAIRMAN.—Being comparatively unfamiliar with the names and faces of many of those who are present, it would be perhaps rather difficult for me to name five men here now without consultation, and I think we had best wait until the afternoon.

Secretary MATHER.—Mr. President, as you ask me about the order of business, I would suggest that members having papers in their possession to be read, should give the titles of them, in order that we may form some idea of the length of our programme, and of the order in which the papers should be read

Mr. CLARK.—I notice that Mr. Mather says "members." Now, to put matters right here—really I don't know that the local committee of arrangements were authorized exactly what to do in regard to that—I think the invitation has gone out to members and others. We took it upon ourselves to do that, and we have done it, and I would like to say, as chairman of that meeting, that unless there is objection to it, I would like to have that idea carried out, and make it open to all.

Secretary MATHER.—If any gentleman interested in the fisheries wishes to send a paper to be read, I certainly should be

the last man to object to it; we have have never confined communications to members. I would simply say if any gentleman wishes to send in a paper, I would like to have the title of it in order that we may cut out our work.

The CHAIRMAN.—We shall be glad to see or hear anybody who may be interested in this subject, and it is possible that any gentleman who may be sufficiently interested to have prepared a paper may desire to join this Society.

Mr. CLARK.—I would ask, if it is in order, to present names now for membership.

The CHAIRMAN.—Certainly; that is always in order.

The Convention then went into a committee of the whole on applications for membership, and the following gentlemen were nominated, and duly elected:

Dr. S. C. Adams, Peoria, Illinois; S. P. Bartlett, Quincy, Illinois; J. H. Bissell, Detroit, Michigan; A. Booth, Chicago, Illinois J. N. Dewey, Toledo, Ohio; Philo Dunning, Madison, Wisconsin; N. K. Fairbank, Chicago, Illinois; C. C. Hinchman, Detroit, Michigan; Dr. E. S. Holmes, Grand Rapids, Michigan; Walter D. Marks, Paris, Michigan; James Nevin, Madison, Wisconsin; Dr. R. O. Sweeney, St. Paul, Minnesota; W. D. Tomlin, Duluth, Minnesota; Herschel Whitaker, Detroit, Michigan.

The CHAIRMAN.—I would state that in the absence of Mr Blackford, our Treasurer, Mr Mather will act as Treasurer, and has the necessary blank forms of receipt for membership.

Secretary MATHER.—Mr. Chairman, I have here a letter directed to William A. Butler, Esq., of the Committee of American Fisheries Society, from Dr. E. C. Stearns, in which he says he will have a paper on "Intentional and Accidental Distribution of Fishes."

I also have a paper on "The Michigan Grayling," by Mr Herschel Whitaker. Those are the only papers I know of, except three which I have prepared, the titles of which are "Smelt Hatching," "Oyster Culture" and "Fish-cultural Work at Cold

Spring Harbor, Long Island." As I now fondly gaze upon some of the members here, I feel a little ashamed of myself for writing three papers when they have not written any.

Mr. CLARK.—Mr. Chairman, I would suggest that as Mr. Bissell has a paper, the title of which is "Fish Culture—a Practical Art," I would like to ask if it is a part of these deliberations, that they may be open to discussion?

The CHAIRMAN.—It is always our custom whenever a paper is read, to announce that it is open for discussion by the Society. It has also been the custom of the Society to listen to any matters which are germane to its ordinary scope and its interests at any time after the regular papers are completed, and the more discussion of that kind we have, the better; and, as I said before, in regard to each paper that is read, it is always pleasant for the Society, and generally interesting and profitable, to hear discussions from those who may have knowledge of the subject, and we sincerely hope that the custom may be carried out at this time, and that we may have the benefit of the same work at this meeting that we have had at previous ones.

Mr. BISSELL.—Mr. Chairman, in respect to the fisheries in the West, during the year 1885, if the Society wishes to have that presented, or any part of it, it can be done at any time when it is proper to discuss it.

The CHAIRMAN.—I think the Society would be very much pleased to hear a paper of that kind, and it would come in very properly with the discussion in regard to the fisheries on the lakes.

Mr. BARTLETT.—I feel interested in that matter for this reason: Illinois has never done anything toward re-stocking the great lakes. The fisheries, so far as Lake Michigan is concerned, are practically depleted of white-fish, and if there could be only one particular branch of that subject discussed, I would like to have the white-fish given the most prominent place. I will go to work and prepare a paper on it of five or six lines, if it is necessary, before the close of the meeting.

The CHAIRMAN.—The Chair will state that no question will

be more thoroughly discussed than that of white-fish. There are great States bordering on the lakes, and I am sure it will be exceedingly interesting to hear whatever may be said on that subject.

Whereupon, on motion, duly seconded, the Convention adjourned until 2:30 o'clock P. M.

AFTERNOON SESSION.

TUESDAY, APRIL 13th, 1886, 2:30 o'clock P. M

The Convention was called to order by the Vice-President, Dr. Hudson.

Mr. PHILO DUNNING.—Mr. Chairman, I would like to inquire what constitutes a member of this Society?

The CHAIRMAN.—All that is necessary for a man to become a member is to have his name presented at one of the regular meetings, to be elected by the members present, and to pay the annual fee of three dollars, for which he receives the annual report of the Society, and his name remains upon the records; he also receives the notices of all kinds which may be issued in connection with the Society.

The first business of the meeting will be the appointment of the nominating committee, which will report to-morrow morning. The Chair would nominate Mr. May, of Nebraska, Mr. Butler, of Michigan, Mr. Bartlett, of Illinois, Dr. Sweeney, of Minnesota and Mr. Dunning, of Wisconsin.

The Chair would state, also, that we have information that other papers which have not yet been received will be here in time for to-morrow's meeting, and such papers as are ready can be read this afternoon, and a discussion had upon them after the reading, and then we may adjourn until to-morrow, when we probably shall have a larger number present, and at the same time have more papers than we have had time to read to-day. The reading of papers is now in order, unless some gentleman has other business to propose.

The first paper which will be read will be on "The Hatching of Smelts," by Mr. Mather.

Mr. MATHER.—I would state that my first experiments in regard to the smelt appeared in the report of last year, and that very little has ever been done in smelt hatching. Professor Rice and Mr. Atkins have both made some experiments, but not on a large scale. Both succeeded to a limited extent, as I have. This year we had between two and three millions of eggs and may possibly be able to turn out a million of young fish.

SMELT HATCHING.

BY FRED MATHER.

At the last meeting of this Society I read a paper on "Hatching Smelt," giving the details of my first experiments, and stating at the same time that but little had been done with the eggs of this fish and that the literature of its culture was very limited. I have continued these experiments the present year and have but little to add to what I have before said. The eggs of the smelt are the most unsatisfactory of any fish eggs I have ever handled. Their glutinous character and small size forbids the separation of the dead from the living by the automatic jars or by hand picking, consequently they decay and become foul.

We have this year at the Cold Spring Harbor station of the

New York Fish Commission placed them upon the straw coverings of wine bottles, hung in ponds, and also placed them in the hatchery in running water. Others were put on tin pans hung in the ponds and the McDonald jars, under several different conditions; one of these was to place the newly taken eggs in jars and by slowly rotating it to leave a covering of eggs all around the inside. Another mode was to put them into jars and give them a strong circulation of water to prevent their adhering in masses as much as possible. The third method was to give a jar a very slight circulation and let them mass together.

The eggs exposed to light on the straw and tin pans in the open ponds out of doors, were soon covered with fungus and did the worst of all, although a few hatched

The first eggs obtained this year were taken on February 25th, to the number of 400,000. Some of these were placed upon the straw coverings, referred to above, and others were put in jars, the main portion being thus deposited. Both these lots began to hatch on April 5th, forty days after, and when I last saw them on April 9th, there were perhaps 10,000 already hatched; while the other eggs, taken on the same day and subjected to the same treatment, looked as though they would not hatch for four or five days yet. At this same date (April 9th) a lot of eggs taken on March 6th, nine days after the former lot, had already begun hatching. This seems to be a very wide margin of time for eggs which only take from thirty to forty days to hatch. The time occupied in hatching this year exceeds that of last season, on account of the severe cold weather we have had throughout March. The eggs which were taken in thin layers on the inside of the glass jars by rotating, as above described, have done very badly. The others are doing fairly well for smelt eggs.

I sent Mr. F. N. Clark some eggs this year, cautioning him not to throw them away, no matter how bad they looked on the outside, how much fungus there might be there, nor how foul an odor might arise from them. At the same time I had fears that he might do this; for in our experiments we had found that the decaying eggs on the outside masses were so foul, that nothing but previous experience could have convinced us

that any good could have come from the inside of such a mass.

After looking the eggs over carefully, I came to the conclusion that it was a possible thing that the outside eggs died because they were exposed to the light, and made an attempt to get more in order to test this theory, but we were unable to obtain them. I had arranged to divide the next lot of eggs into two portions, putting both into jars which were covered to exclude the light, and give one a strong and the other a feeble circulation of water to test this method, which I shall do next year if the opportunity offers, for so far, our work with smelt has not proved completely satisfactory. We can hatch forty or fifty per cent., and as each little adult smelt has from thirty to forty thousand eggs, we actually get a great number of young fish, but we don't begin to get the percentages of fry that we do in operating with the salmon, the trout and the whitefish. I believe that we will reach this result by continued experiment; and it is one of those interesting questions which stimulate a worker to try and discover the cause of this great mortality.

When we remember the fact that a smelt goes up in swift brooks and deposits its eggs on stones, it is hard to believe that the eggs require a feeble circulation, as was suggested by my friend, the late Professor Rice. I have never had the opportunity to examine a stream after the smelt had finished spawning, and see how the eggs are deposited in a state of nature. But the very fact that a little fish bears such a great quantity of eggs within it, shows that nature has provided for a great loss at some portion of the life of the young, either in the egg or afterward. Their exceedingly minute size when hatched, perhaps a quarter of an inch in length and the diameter of a thread of No. 36 sewing cotton, renders them subject to be preyed upon by exceedingly small fishes, and an ordinary brook trout, when first beginning to feed, could probably accommodate half a dozen young smelts just from the egg in its stomach without inconvenience to itself. The young can swim as soon as they are hatched, and we confine them with brass wire cloth, No. 30 mesh.

Mr. Carman, who supplies me with smelts from Brookhaven, L. I., wrote on April 3rd that he had taken a few more spawners,

the last of the season, and we sent for them immediately; but before the arrival of the can, the fish had spawned, therefore we can place the extreme limits of their spawning season on his stream, this year at February 25th and April 3rd. Some two weeks before the first-mentioned date, Mr. Blackford obtained some smelts from Long Island which were full of spawn, and I sent a man down there for more, but we failed to get any that were ripe. The fish which came to market had eggs extruding from their dead bodies; probably caused by handling and the jolting of the railway on their journey to the market. It is proposed this year, at the suggestion of Gen. R. U. Sherman, of the New York Commission, to plant a few in the Adirondack waters and see if they cannot be established there, as they have been in the fresh waters of Vermont; and the result of this experiment will be watched with great interest.

I have spoken of the egg of the smelt as "glutinous," but "adhesive" would be a better term. On one side of the egg there is a filmy appendage which is the means of attachment to whatever it comes in contact with, and under the microscope it appears like an empty egg shell folded over and attached to one side of the egg only, while the other side is clean and round.

Cold Spring Harbor, N. Y.

Mr. CLARK.—Mr. Chairman, I would say in regard to the eggs that Mr. Mather sent me at Northville, that I found them in just the condition that he said I probably would. The first glance would give to a fish culturist the idea that of course they were all bad; but upon further examination, when you dig into them, you find that there is a small percentage of them that are good. I should say of those eggs that were sent to us about 15 to 20 per cent. were good. While Mr. Mather was reading his paper, a thought occurred to me, and in the recital of his different experiments I listened to hear him say that he had tried one way, which he did not. About seven years ago, I think it was, I was at Gloucester, Mass., at the first time they were handling the cod for the United States Fish Commission. Among the other experiments which Professor Baird tried was that of taking eggs of the Labrador herring, which are adhesive. They stick solid,

and I tried a great many different experiments in taking eggs, and one of the ways was taking them on glass, which I found to be the best; and I think if a person is going to take adhesive eggs of any kind and let them stick to anything, he will find glass the best of anything. At that time I made a box for hatching on glass. It was a small trough, with places in the side for the glass to slide down. One glass went to the bottom and the top was half an inch under water. The next glass stood half an inch above the water like that, so on down through, keeping the eggs that adhered to the glass on the side toward the water, so that the water passed up right by the eggs, and in that way we succeeded in hatching a better percentage than in any other way. I should think it would be well to try experiments with the smelt the same as they do with the wall-eyed pike, which I think Mr. Nevins and others have tried. I have, and I think the Michigan Commission has tried the same thing.

Mr. MATHER.—Mr. President, I would say in connection with what Mr. Clark has said, that I had read very carefully his experiments with the herring, and thought that his arrangement of glass slides was an excellent thing. As I understand it, that is for hatching in troughs, we have put them on the inside of a jar, as I have described, keeping them whirling and letting them adhere on a thin layer. I have now a theory, which of course remains to be proved, that it is the light that is fatal, because we find where those eggs adhere in masses, perhaps the size of a hickory nut or larger, that all the outside eggs become bad after a while and are covered with fungus, but you take hold of this mass and break it open and you will find the little fellow inside there all right, protected not only from the action of the light, but from the water. I don't understand how water can get into this mass. If I had been going to hatch them in troughs I should certainly have used the apparatus that Mr. Clark devised, and which I think is an exceedingly good thing for that mode of hatching.

Mr. BISSELL.—I would like to say a word about that smelt business. If it is the light that affects the eggs of the smelt, would not the light affect them in their natural condition in a

small stream? May it not rather, or more likely be, the motion of the water? I have been told by our men in the Michigan Fish Commission that one of the reasons that brook trout eggs cannot be handled successfully in the jars, is that they have too much motion. Mr. Marks told me the other day when I proposed that during the first stages of handling the trout eggs they might be put into the jars and run in great numbers, and then as the bad eggs were worked off, place them on trays and hatch them there—he said no, that would not answer, because if they had too violent a motion of the water it would addle the eggs. He said that had been proved by experiment. It seems to me that is much more likely to be the cause of it than the action of the light, particularly at the season of the year when the eggs are cast.

Mr. MATHER.—As regards brook trout in jars, no doubt the violent motion would be injurious to them, but where you have a little stop-cock you can turn that, and you can give them as much or as little motion as you like, and you can have a flow. The trouble in hatching trout in jars begins after you have got them hatched; they lie down in masses on each other and smother.

Mr. CLARK.—Yes, but the jar is not the thing for handling brook trout.

Mr. BISSELL.—You must have a good strong current in order to carry them up and float them in the jars.

Mr. MATHER.—With regard to the smelt eggs, I have never seen the natural stream after the smelt eggs were deposited by the fish. I have been on the ground before the hatching season began, and have seen them take smelts in very swift water, and it is a possible thing that the smelt eggs that are taken and adhere to the top of the stones die, while those which get into the crevices may escape. I don't state it as a fact; I simply state it as a possible thing. They do spawn in tolerably swift water. That I know, for I know the streams where they spawn.

Mr. BISSELL.—Are they shallow streams?

Mr. MATHER.—Quite shallow and running over stones. I have seen them in New Jersey pretty well up on the Hackensack River, and I have seen them at Locust Valley on Long Island where they take them, and they are both rapid streams. The stream at Locust Valley is a trout stream, very swift, running very rapid, and the eggs which we took last year on stones and placed in our hatching troughs, where we hatch the brook trout eggs, all came to nothing—that is those in a single layer, but where there were four or five deep we could pick off the top layer of bad eggs and find them good underneath.

Mr. CLARK.—I would like to ask Mr. Mather a question. What percentage did I understand you to say—that you had forty to fifty per cent. good eggs?

Mr MATHER.—That is about what we have now.

Mr. CLARK.—Well, Mr. Chairman, I don't think with any adhesive eggs that were ever hatched, where you leave them to adhere, I don't think there is anybody ever hatched anything better than forty or fifty per cent. of any kind, and I don't think they ever will. We don't with the herring, and we call it good.

Dr. SWEENEY.—It seems to me that from all the eggs that are supplied in the spawning of these fish whose eggs are glutinous or adhesive, there is a provision of nature that the outer layer of the eggs act as a protective coat to the inner mass, and as the gas permeates through the tissues and the air reaches the eggs on the principle of displacement—as the internal layer of eggs consumes the air, it is resupplied from the outside, and this putrid mass of eggs on the outside which seems so unproductive, may be in part as a defense also against animals, and is not the experience of Mr. Mather going to show that these eggs that seem to be spoiled on the outside, work no detriment to those within. That may be the principle, that the adhering mass of eggs is a protective coat to the inner stratum. It may be the explanation that the gas or vitalized air from the water reaches the eggs through the outer stratum.

DEEP SEA DREDGING ON THE U. S. STEAMER "ALBATROSS."

BY F. L. WASHBURN.

Though the appropriateness of discussing the above subject in the Society of American Fisheries might at first be questioned, second thought assures me that the work now being done by the *Albatross* will, in the near future, prove of the greatest value to fish-culture and fishery economy.

Thus assured, I ask your attention for a few minutes, hoping not to tax too severely those who are familiar with the process of marine dredging, and trusting the article may be of some interest to our western friends, whose opportunities for deep sea fishing are naturally limited.

In the first place, a word about the *Albatross* and the purpose for which she was built. She is a twin screw iron steamer of 1,000 tons displacement, 235 feet in length, built in 1883 by the Pussey & Jones Co., of Wilmington, Del. She was constructed for the United States Fish Commission, and intended to make extensive trips along our coast and to other countries, for the purpose of making observations on the ocean fisheries. Her work, principally, consists in determining, by sounding operations, the temperatures of the water of the sea, the nature of the bottom, and the effect of the same on the migrations and breeding of the mackerel, cod, menhaden and other varieties of economic importance to our fisheries. When the vessel can be spared from the regular work of the Fish Commission, she is loaned to the Navy Department, who use her for the purpose of observing the ocean depths, surveying harbors, and especially in determining the existence of ledges and shoals hitherto unknown. Her crew numbers between fifty and sixty men. Her commander at present is Capt. Z. L. Tanner, U. S. N., and she is officered by lieutenants of the navy.

Mr. J. E. Benedict is the naturalist in charge, and there is generally associated with him on board a scientific staff of two or more to assist him in obtaining data and preparing specimens.

The ship is admirably planned and constructed. The captain's cabin occupies most of the after part of the deck, is spacious and well furnished with everything necessary for the commander's comfort. This cabin contains two staterooms, and is lighted during the day by port holes on the side and a skylight above on the poop deck. The officers' ward room is below this, having seven spacious staterooms, a bathroom, and other conveniences not generally found on steamships. The ship is lighted throughout with the incandescent electric light, which not only makes the wardroom particularly cheerful in the evening, but also illuminates the entire deck, so that at night the vessel, as seen from the shore, looks like a brilliantly lighted ball-room.

Another thing rendered possible by the presence of the electric light is surface collecting at night. Mr. G. W. Baird, chief engineer of the ship, is the inventor of a cable to which he attaches a screen-covered electric light. This, when the vessel is at anchor, can be lowered into the water just below the surface, and the numerous young fish, marine worms, squids and shrimp, attracted by the brightness of the light, are captured by means of a hand net and transferred to the laboratory table for examination. This laboratory is amidships. There are really two laboratories, an upper and lower; the first furnished with working tables, a sink, a library of books for reference, a microscope and convenient tanks of alcohol; the second, called the "lower laboratory," is below this, has benches for chemical work, and opportunities for general carpentry and work connected with the collections. Here guns are cleaned and mended, and here too are tiers of drawers in which specimens are stored. Beneath these drawers are large metal tanks filled with alcohol, for containing the larger fish and specimens whose size prevents them from being stored in the small glass jars. Below this second laboratory, in the hold of the vessel, is still a third storeroom, of much the same nature, and used for much the same purposes as the one above it.

The apparatus for deep sea sounding, which is placed on the port bow, consists of an easily running wheel supported in a frame. Over this wheel runs a steel piano wire from a cylinder

or drum, which holds about 4000 fathoms. When a sounding is to be made, a brass cup is attached to the end of the wire to catch and bring up some of the bottom, that its composition may be observed. Just above the cup is a thermometer which records the temperature of the deep water. To the above-mentioned cup a heavy shot is fastened to accelerate the downward motion. When a sounding is to be taken the ship is kept stationary, that the wire may be straight up and down, and everything being ready, the weight sinks rapidly to the bottom. The concussion caused by striking the bottom detaches the heavy weight, at the same time the cup grasps a portion of the bottom's surface, and a donkey engine turns the cylinder, whereby the wire is quickly reeled in. Each sounding station is given a number, and a record is kept of the depth of the water, the nature of the bottom and the temperature at that depth.

A long article might be written on the various appliances and mechanisms of the ship, but it would be too great a digression from the subject originally proposed. Most worthy of mention, however, are the annunciators on the upper deck, placed against the wheel house. These are two contrivances, one for the starboard engine and a similar one for the port engine, which indicate to the officer of the deck the movement of both engines. This is also an invention of Engineer Baird, as is, too, the process by which the ship is furnished with a never failing supply of pure, fresh drinking water distilled from the salt water. Neither must I omit to mention the ship's boats which form so important a part of her equipment. A steam launch, a steam "gig," and numerous row-boats render effective service when in harbors. Now, as to deep sea dredging. Just forward of the wheel house, attached by one end to the foremast, is a boom capable of being raised like a derrick and swung over the side. Just below this boom is a donkey engine, and below that, in the hold of the vessel, is coiled a strong, wire cable, about one-half inch in diameter and about four miles long. This runs along the under side of the boom and over a wheel at its free extremity. To this end of the cable is attached the dredge, or trawl, as it is sometimes called. This consists of a strong, baggy net, fastened to what looks like a pair of huge iron sleigh

runners, kept at a distance of about eight feet from one another by means of an iron rod. It is between these "sleigh runners," in the intervening eight feet of space, that the net is placed. To these sleigh runners is also attached by ropes a stout canvas bag, the mouth of which is kept open by iron jaws. The position of this bag is just behind the small end of the net, and on the sea bottom it is dragged along after the large net, scraping up mud or sand and rocks, thus relieving the meshes of the net from a strain which would be too heavy for them.

Everything being ready for dredging, and soundings having first been taken to ascertain the depth, the net is lowered carefully into the sea, the progress of the vessel being stopped. If the sounding gave 1,200 fathoms then 1,700 fathoms of dredge cable has to be let out, or even more than that before bottom is reached. This has to be done slowly and necessarily takes a long time. Sometimes when the water is 3,000 fathoms deep, as is often the case, four hours are consumed in one lowering and hauling. This process is also called "trawling." When the bottom is reached, the dredge is dragged slowly along for half an hour and then hoisted on board by means of the donkey engine, at first slowly, then, as it gets clear of the bottom, very rapidly.

It is an exciting moment when the huge net and canvas bag emerges from the water and hangs dripping over the deck. The net is then opened at the bottom and its contents allowed to roll out into tubs, while mud and sand and rock in the canvas bag are emptied into a large sieve on the forward deck, then to be carefully washed and examined for small marine animals.

The contents of the net which have been emptied into tubs consist of many curious forms of life from the deep sea, which are carefully picked out and sorted, each class by itself, and then placed in glass jars containing alcohol. A minute report of each haul is kept in a book for that purpose.

Sometimes the "catch" is extremely interesting, beautiful specimens of *Actinida* (sea anemones), Corals; *Echinoids*, or Sea urchins, varieties not found in shallower waters. Also specimens of *Octopus* (the cuttle fish), rare sponges and deep sea forms of Holothurians, or Sea cucumbers. These latter so much dis-

like being torn from their ocean bed, that they often use a power given them by nature and split into fragments before reaching the surface. Rare forms of starfish sometimes delight the eye of the naturalist who is sorting the contents of the dredge; and deep sea fish, which, on being released from the tremendous pressure to which they were subjected in the deeper water, become distended by the gases contained within them and often burst, reaching the ship's deck in a rather dilapidated condition. Often, however, the dredge comes up nearly empty, or with but little life in it. To my question as to whether such work was not very disappointing at times, the captain replied: "Not at all; we consider ourselves fortunate if we get the dredge back safely," for it occasionally happens that the dredge and many fathoms of cable are lost by the catching of the apparatus on the bottom.

When the bottom is supposed to be so rocky that lowering a dredge would be unsafe, "tangling" is resorted to, which consists in dragging over the bottom large bunches of hemp rope attached to iron bars. These bunches of rope catch and hold in their strands small marine animals with which they come in contact. In the April 2d number of *Science*, Mr. Benedict has described the method of surface collecting, so I need do nothing more than refer to it here. It consists in dragging a large but fine-meshed net from the end of a swinging boom, along the surface and through the water just below the surface. It is often done on the port side while dredging is going on on the starboard side. This secures all the surface life found in the seaweed and just below the surface of the water. Varieties of *Tautennarius*, a little, brown-mottled fish frequenting the masses of seaweed, are caught thus in large numbers, as well as small crabs, which also live in the seaweed; a great many marine worms, various kinds of molluscs and other forms lower in the scale of life.

Washington, D. C.

SECOND DAY.

WEDNESDAY, APRIL 14th, 1886, 10:30 A. M.

The Convention was called to order by the Vice-President, Dr. Hudson.

The CHAIRMAN.—I am pleased to state we have received this morning some very interesting papers by mail and express, which will be read in the course of the day. Unless the Society shall order otherwise, I would suggest perhaps that we first listen to some letters which Mr. Mather has received, and which will be of interest to the Society. No objection being made, that will be the sense of the meeting.

The Secretary then read the following :

WASHINGTON, D. C., APRIL 10th, 1886.

FRED MATHER, ESQ.,
Secretary Fisheries Society,
Palmer House, Chicago, Illinois.

SIR:—I am requested by Col. McDonald to inform you that his baby died this morning, and it will be impossible for him to attend the meeting of the Fisheries Society, which he exceedingly regrets.

I send you by to-day's express, package of papers, minute book, etc.

Very respectfully yours,
J. J. O'CONNOR.

Dr. SWEENEY.—Mr. Chairman, if it be in order, I would move that the Secretary express our regrets at Col. McDonald's inability to come, and also our sympathy with him in his bereavement.

Carried unanimously.

NEW YORK, APRIL 11th, 1886.

FRED MATHER, ESQ.,

DEAR SIR:—I regret exceedingly that other engagements will prevent my attending the annual meeting of the Fisheries Association.

I trust that you may have a successful session and a large attendance.

Yours truly,
FRANCIS ENDICOTT.

WASHINGTON, D. C., APRIL 9th, 1886.

COLONEL M. MCDONALD:

I am sorry I cannot be with you in Chicago. I send you two papers one by A. H. Clark, one by myself.

W. V. COX.

NEW YORK, APRIL 12th, 1886.

Mr. FRED MATHER,

Secretary American Fisheries Society,

Palmer House, Chicago, Illinois.

I regret being prevented attending meeting of the Society.

G. S. PAGE.

BAY CITY, MICHIGAN, APRIL 13th, 1886.

Mr. FRED MATHER,

Palmer House.

Unavoidably detained to-day. How long will you be there? Will come if possible.

D. H. FITZHUGH.

Mr. BARTLETT.—I would like to state that H. N. Russell, business manager of the Citrus Fair, now at Battery D Armory, has extended an invitation to the members of this organization to attend the Fair this morning, or at any time they may choose, in a body.

Dr. SWEENEY.—I move the invitation be excepted and that we proceed to the Fair immediately after the adjournment.

Which motion being duly seconded, was carried unanimously.

The CHAIRMAN.—I would inquire if the committee appointed yesterday is ready to report.

Mr. MAY.—Mr. President, the committee appointed to make nominations of officers for the ensuing year, beg leave to report the following:

For President, Dr. W. M. Hudson; Vice-President, W. L. May; Treasurer, E. G. Blackford; Recording Secretary, F. Mather; Corresponding Secretary, W. A. Butler. Executive Committee: Francis Endicott, chairman; F. N. Clark, S. P. Bartlett, Dr. R. O. Sweeney, Philo Dunning, A. N. Cheney, John Gay.

Mr. BISSELL.—I move the report be adopted, and that the

Secretary be requested to cast the ballot of the members present for that ticket.

Which motion being duly seconded, was carried unanimously.

The CHAIRMAN.—A matter which comes over from last year I suppose should be acted upon, and perhaps there will be no better time for it than the present. Those of you who were present last year, know that there was a proposed constitution read at the meeting of last year, and it has been published with the proceedings; it must be acted upon at this meeting. If the Society desires, the Secretary will read the proposed constitution, and then it may be acted upon either article by article or as a whole, as the Society deems best. The Secretary will read the constitution.

Secretary MATHER.—I would state by way of explanation that this Society has been known for years as "The American Fish-cultural Association," but that it was deemed best to change the title last year when the new constitution was formed.

It was moved by Mr. Bissell, and duly seconded, that each article be taken up separately and acted upon by the Convention.

No objection being heard this course was adopted by the Society. (See Constitution, page 3.)

Secretary MATHER.—Mr. President, I would like to say that we had a society called "The Central Fish-cultural Society," which met twice here in Chicago and died. Its first meeting was held in the Palmer House, on October 1st and 2nd, 1879, and the second was held in the Grand Pacific Hotel, on December 15th and 16th, 1880. We never met since.

Last evening there was a little meeting of the few survivors gathered in the Palmer House to view the remains, and this is the result, which I respectfully beg leave to submit :

THE CENTRAL FISH-CULTURAL SOCIETY.

A meeting of officers and members of the above Society was held in the Palmer House, Chicago, on the evening of April 13th, 1886. Present: Dr. R. O. Sweeney, S. P. Bartlett, F. N. Clark, Recording Secretary; and Fred Mather, Corresponding Secretary, all of the late Society. Mr. Bartlett was called to the chair. Mr. Mather stated that the object of the meeting was to determine what disposition should be made of the funds, if any, remaining in the hands of the Treasurer. Mr. Clark moved that they be paid into the treasury of the American Fisheries Society. Dr. Sweeney seconded the motion. Carried. The Secretary was instructed to inform Mr. Booth, Treasurer of the defunct association, of this action and the meeting adjourned.

Moved by Mr. Bissell that the thanks of the Society be tendered to the Central Fish-cultural Society for the donation of the remaining funds of that society, as soon as the treasurer acknowledges the draft and pays it.

Dr. SWEENEY.—As one of the mourners, I object to that kind of an acceptance. If we can't receive it with any more gratitude than that, I move we do not say anything until the money is paid over. Then they can pour out their affectionate regards for it.

Mr. FAIRBANK.—I think we can compromise this matter. I will amend Mr. Bissell's motion by moving that the members of this Society thank the other society for their kindly and benevolent *intentions*.

Mr. BOOTH, as custodian of remaining fund of the defunct society, stated that there was a small balance, the amount of which he was not at present prepared to state, but he would ascertain the amount of the same and turn it over to this Society.

The motion of Mr. Fairbank, receiving a second, was then put to a vote and carried unanimously.

The CHAIRMAN.—Unless there is an objection, Mr. Mather will proceed to read one of the papers before us.

Secretary MATHER.—Mr. Chairman and gentlemen: This is a paper on "Oyster Culture," from my own experiments at Cold Spring Harbor, Long Island, where I superintend one of the hatcheries of the State of New York, and also do a great deal of work for the United States Fish Commission, and this report I should preface by saying that while New York has four commissioners of fisheries, it has but one oyster commissioner, who is also one of the commissioners of fisheries—Mr. E. G. Blackford, and this paper is from my report to be made to him.

OYSTER CULTURE.

BY FRED MATHER.

Mr. E. G. BLACKFORD,
Commissioner of Fisheries of New York:

SIR:—I herewith submit to you the report on "Oyster Propagation" at Cold Spring Harbor, during the summer of 1885. I had watched the experiments of the late Prof. Henry J. Rice, the previous season, with great interest, and saw that while he hatched many oysters in the great tank, they came to nothing, because, as I believe, the temperature of the water was too high, the tank being in the sun without cover, and supplied with a very small stream of water through a ¼-inch hose. This tank was made of two-inch pine plank, twelve feet long six feet wide and three feet deep, coated with coal tar inside and out. I moved the tank to the north side of the fish-hatchery building where it would be shaded, and covered it with boards to keep it clean. The water for the experiments was supplied by a hot air engine belonging to the Fish Commission, and was pumped from our salt-water pond some 700 feet distant from the hatchery, and thrown up on the hill in a cemented reservoir, from whence it was brought into the building through two-inch pipes. Two to three hours pumping daily was all that was required for these operations.

We also made experiments in the large salt-water pond spoken of above. This pond is some 280 feet long, by 150 feet wide, and receives water at high tide through a flood gate which

holds it at all times. It will be noticed by the record given below, that the water in this pond, which has a depth of two to six feet, was warmer as a rule, than that in the wooden tank in the shade of the building, and it was in the pond that our greatest success was made.

We obtained oysters at the spawning season from the oystermen here, and these were opened, and all whose appearance denoted ripeness were selected and placed one side. The sign of ripeness was the peculiar fulness and milky appearance of the ovaries and spermaries which is readily seen by any person who is at all familiar with them. The oysters then, lying on one shell, were taken and the mantle and gills trimmed off with small sharp scissors; pressure was then applied with the scissors to the ovaries and the exuding drop was placed upon a glass slide under the microscope, where the eggs can readily be distinguished from the milt of the male, after a person has once had the difference pointed out to him.

The male oysters were separated from the female, so that we could see what proportion we had of each. Sometimes we would lack the male element and consequently could get no impregnation. At other times there was a fair amount of both sexes. The eggs were stripped from the female by pressure, and then the male was treated in the same manner, taking both the eggs and milt in an ordinary milk pan and adding water gradually. In a short time a drop of this water placed under the microscope would be seen swarming with the spat in the swimming stage of its existence, and then they were placed in the tank or in the pond. The bottom of the tank was covered with gravel, and scollop shells were suspended on strings across it. The current was very light and the spat seemed to sink and catch upon the gravel, for we caught none upon the hanging shells in this water. Toward the last of August, the tank was examined and the few oysters adhering to the gravel were removed and placed in the salt-water pond. The success in this wooden tank was not as complete as the experiment in the pond, and but few oysters were got from it.

During July and August, while the record was kept, the variations in temperature were very slight, while the density of

the water was remarkably uniform; the greatest specific gravity being 1,020 and the least 1,018, and the temperature of the water in the tank was at all times below that of the pond, in which the sun shone directly. We made no attempt to estimate the number of these minute eggs, which are only visible under the microscope, but took all we could get from the four bushels of oysters.

The bottom of the large pond was covered with scollop shells; stakes were driven about twenty feet apart all over its bottom and strings were stretched between these, while on the strings we hung perforated shells. We obtained a good "set" of oysters in this pond, the best on the shells at the bottom, and, while there was six feet of water in the center of the pond, we obtained no "set" whatever on the suspended shells beyond three feet from the bottom. At three feet we noticed an occasional oyster, within two feet of the bottom they were more plentiful, and increased as the bottom was approached. On September 19th, we drew off the pond and examined it for the last time before winter; there were thousands of young oysters of the size of a dime.

Prof. John A. Ryder, of the U. S. Fish Commission, has suggested an admirable way to collect spat, by means of a canal provided with ledges near the top to support receptacles for the cultch. These receptacles are formed by wooden strips and wire cloth, and hold about three bushels of shells each, the "basket" being three feet wide, three feet deep, and only six inches thick, so that the shells are thickly presented to the floating spat. The experiments of Prof. Ryder, have been very valuable, and so have those of Prof. Brooks, Lieut. Winslow, Prof. Rice and Col. McDonald in America, and those of Profs. Hock, Horst and Möbius, and M. Bouchon Brandeley in Europe. Prof. Ryder lays down the following principles:

1. "Oyster embryos under ordinary conditions in open water, diffuse and affix themselves throughout the three dimensions of such a body of sea water. This is a well-known and readily verifiable fact.

2. "The fry will adhere to smooth surfaces as well as to rough ones.

3. "The surface upon which spatting occurs must be kept as free as possible from sediment and organic growths, in order that the tiny young molluscs may not be smothered and killed during the most critical period of their lives.

4. "Artificial fertilization of the eggs of the oyster is feasible, and will become an important adjunct to successful spat culture.

5. "Water charged with embryo oysters may be passed through a steam pump without injury to such embryos.

6. "Oyster fry adheres to the under surface of shells or other collectors most abundantly, because the lower side is cleanest and most favorable to the survival of the animals.

7. "The spat of the oyster will grow and thrive with comparatively little light.

8. "The specific gravity of the water may range from 1.003 to 1.0235.

9. "The most favorable temperatures of the water for spatting seem to be from 68 degrees to about 78 or 80 degrees Fahr.

10. "Spatting will occur just as freely in ponds or tanks as in the open water.

"These are well ascertained elementary facts, and upon them we must base our new method, which is essentially a system of spat culture, or method of rearing seed oysters for the purpose of cultivation on the open beds or any suitable bottom. We must, however, first of all throw aside as too expensive any and all systems in which tiles or slates are used, especially if these must be fastened together in nests and coated with lime and cement, as practiced in Europe. Oysters are too cheap in America to be produced by any of the old fogy systems which are available there, as it will not pay to flake off the spat from the collectors under ordinary circumstances in cultivating the the American oyster for market, because of its low price."

The experiments at Cold Spring Harbor have attracted some attention from the oystermen about there, and some of them have expressed themselves pleased with the results, and incline to think that seed oysters could be raised in quantities by any person who had an inclosed pond such as ours, where the water came in at times of high tide, and that they would be reasonably certain to get a fair "set" on proper cultch.

The following is from the journal kept by my foreman, Mr. F. A. Walters:

July 1—Received first lot of oysters: opened one bushel, found 17 ripe females and 1 ripe male; took spawn from these. After 9 hours, as there was no sign of life, considered not good.

July 4—From half bushel, 9 females, 3 males, milt not active, no sign of life after 10 hours.

July 5—From half bushel, 11 females, 1 male. Three hours after taking spawn young were swimming; put in tank.

July 9—Put in tank 3 pans of spawn.

July 10—From 200 oysters 175 were ripe females, 18 not spawning, and 7 partly ripe males; had to lose all.

July 11—From 80 oysters 60 ripe females, 4 unripe males, and 16 not spawning.

July 14—Cleaned tank.

July 16—Ground-gate of salt pond had to be taken out owing to a leak, poor tides followed, pond did not fill for five days, could not pump and consequently no circulation in tank for that time.

July 20—Opened 70 oysters, found 20 ripe males, 30 females and 20 not spawning. Took two pans of spawn at 10:20 A. M., swimming at 2 P. M., put in salt pond.

July 22—Put spawn from 200 in salt pond.

July 26—Cleaned tank, could find no set.

July 28—Put in pond 4 pans of spawn in good condition.

July 31—Put in tank 4 pans of spawn, the best lot taken.

August 11—Cleaned tank, and put in spawn from 1 bushel oysters.

August 20—Discovered set in tank.

September 8—Cleaned tank, found a number of shells and about a peck of gravel with sets on, but all dead. There were no sets on the hanging shells; the reason for this, I think, is owing to lack of current, which should be quite strong; there is more danger of getting too little than too much. Lowered salt pond.

September 19—Found a good set; the hanging shells had sets three feet from the bottom, but the shells on the bottom did the best.

During July the temperature of the water in the tank ranged from 65 to 73 degrees, and during August from 70 to 74, while in the pond it ranged from 71 to 87 degrees. The density varying in each from 1.017 to 1.020, standing at the latter figure steadily from July 19 to the close of the season.

Cold Spring Harbor, N. Y.

Mr. BARTLETT.—Can you tell us what indicates the ripeness of the oyster?

Mr. MATHER.—The appearance of ripeness is a milkiness and swollen appearance of what you might call the body of the oyster, and when you press it you get a milky substance; in fact, the whole oyster is distended a great deal as a ripe fish is.

Mr. BARTLETT.—It is quite apparent then?

Mr. MATHER.—Very apparent to a person who is at all familiar with it, as I have explained in this paper.

Mr. CLARK.—I would like to ask Mr. Mather if any one has tried to make any computation of how much spawn there is in one female?

Mr. MATHER.—It has been done. I cannot give you the figures now, but I think if I were home and had access to my library I could very easily give that to you. I have an idea that perhaps an oyster of ordinary size may have nine or ten millions of eggs, and that it would vary as it does in the case of fish.

Dr. HUDSON.—The Chair would state in answer to that question that the estimates vary considerably, and many of them are made very much higher than what Mr. Mather has stated. It has been estimated in many cases as high as fifty millions.

Mr. CLARK.—Have you any idea of your own, Mr. Mather, what portion you impregnated?

Mr. MATHER.—I have not, because to get at this it will be necessary to go over the whole mass with the microscope, and you would have very few in the field at a time. We made no effort to estimate the amount of any impregnation. We recog-

nise the fact that this thing is in its infancy. Several gentlemen have experimented before I did, whose names I mention in the paper read, and from whom I obtained considerable knowledge before I attempted it. I don't know what percentage we did get. We were contented to just work along, the main thing being to get ripe oysters and hatch something, doing the best we can. There is no trouble in hatching them. Every year along our bays and harbors there is a greater or less amount of spawn.

Mr. FAIRBANK.—The set has been found to be best, I understand, on the bottom?

Mr. MATHER.—Yes, sir; but where there are swift tideways there comes a time in the life of the little oyster when it wants to settle down to steady habits and quit this roving life, and whatever it takes hold of must be clean, and if it falls down in the mud it is gone. You can easily see, gentlemen, that in a state of nature, many millions of spawn must be sent out and but few are impregnated. When the female oyster gets ready, she opens her shells and lets her eggs go, and they must run their chance of a current from somewhere bringing them to the milt of some male oyster who has also just reached the supreme moment, and the chances of their coming in contact at the proper instant of course are very small. The great mass must remain unimpregnated, and then, of those which are impregnated, many of them fall into the mud and into other unsuitable places, not to mention dangers after their shells grow.

A MEMBER.—Would the impregnation by artificial means be an economic way?

Mr. MATHER.—I think so, and I think Prof. Ryder thinks so too, and the means which he gives to catch the spat I think to be a better way of procedure than the process I have adopted.

Mr. BOOTH.—I think perhaps it may be interesting to some of you gentlemen to give you one of my little experiences. The results I have just heard are very good, very nice indeed. It shows that oysters can be propagated, but it can be done so much more cheaply and in a more practical manner. Some four years ago, I planted 12,000 bushels of shells that we had

thrown away in the week, in the water in Delaware bay, where there were no shells or oysters in the neighborhood. Last year we took up from those shells, without planting any oysters on them a little over 40,000 bushels of as fine oysters as you ever saw in your life, and I think there are quite as many left on that ground. I say this to give you a little idea of how rapidly oysters will grow. If they would only plant, as Mr. Mather says, the proper shell or material at the proper time, that is all that is necessary. The time oysters spawn is usually in June or July, varying according to the warmness of the atmosphere and the condition of the water. Those are the months that they spawn, and at the time that the oysters are ripe throw over your old oyster shells and try and have no fungus or vegetable matter on them and the spat adheres to those oyster shells and you have no difficulty in getting more oysters than you can handle. Just take oyster shells and scatter them and you will find oysters enough to re-supply the whole territory. I have done that on the Delaware and also on the Baltimore, but in Chesapeake bay we have no right to any grounds there, have no title and consequently no water. In the Connecticut waters this has been done for the last eight or ten years, so where there were no oysters a few years ago there are millions of bushels. Of the enemy to the oyster there is the starfish; they come sometimes in myriads and they kill all the oysters, unless they are taken up and removed to some other place. There is not the slightest trouble in the world to replenish our oyster product on this coast or any other section of the country where you have warm weather in June or July.

Mr. MATHER.—From Mr. Booth's remarks it may be inferred that our mode of artificial hatching is not adapted to practical work. We think that it is. The method which he speaks of is a very old one and often is all that is sufficient, but there are years when the oystermen will tell you "there is no set," meaning that the young failed to hatch or to catch on to something after hatching. Often a heavy rain kills the swimming oysters, or there may be currents which take the eggs to sea. It will readily be seen that the conditions must all be favorable in

order to secure a good set, and nature provides for the loss of immense numbers of eggs and embryo oysters, and it is this great waste which we are trying to save. If we do no more than to mix the eggs and milt together it is a great improvement on nature's methods which only brings an occasional egg within reach of the fecundating fluid.

Dr. HUDSON.—I could talk of course on this subject for hours, for this is a matter we have had a great deal to do with in Connecticut for the last six years. I would simply add to what Mr. Booth has said that in Connecticut and on Long Island Sound, the time for spawning oysters varies from about the middle of June to the first of September. It is governed entirely by the depth of the water. Where the water is shallow it becomes warm more rapidly than where it is deep water. Oysters there grow where it is ten feet deep out to where it is ten fathoms or sixty feet. Mr. Booth has described sufficiently for practical purposes the method of cultivation, which is the one universally carried on there, and were it not for the starfish, as he has said, I think the product would be almost unlimited. The only other enemy that we have on Long Island Sound is the drill, which is nothing like as dangerous in its effect as the starfish. There is another enemy to the oyster in portions of New York State—the drumfish, a very powerful fish with powerful jaws, which crushes the oyster and destroys a good many. It is called the drumfish owing to the peculiar sound which it emits, and which can be heard by those who are immediately over it.

Mr. BISSELL.—I would like to ask if your Commission have ever attempted to spawn the oyster, or have you simply attempted to catch them in the water?

Dr. HUDSON.—We have never done that as a general thing. Some of these experiments have been made, and the most interesting one in our water was by Lieut. Winslow, who has been engaged in this business. He came to Connecticut some four or five years ago; he had a can invented, and he could drop this can to the bottom of the Sound, and then when it reached the bottom by a peculiar contrivance he could pull out the bot-

tom, so whatever was inside was let loose. Just previous to that he had taken oysters in the same manner which Mr. Mather has described, and had hatched out a very large number. You gentlemen may be all aware, probably, that the great difficulty up to a very recent time has been to induce these young oysters to live beyond three days. There has been no difficulty about hatching out oysters and in keeping them alive through what is called the free swimming stage, which is about three days. At the end of that time it is their nature to attach themselves to something and they have invariably, up to a very recent period, died when they reached that stage. Some recent experiments have been made by which they have succeeded in carrying them beyond that. Prof. Rice, whom some of us have met, told me he had succeeded in carrying some of them three or four weeks

Mr. MATHER.—Yes, in a small aquarium, but they finally died.

Dr. HUDSON.—The experiment that was tried in Connecticut was to take these young oysters during this free swimming stage, put them down on good bottom on Long Island Sound and there release them. The product of that particular locality was remarkably good afterward, but the general set of the sound was so great that it was very difficult to appreciate just how much the set was increased by this peculiar process. As Mr. Booth has said, the system that was adopted in Connecticut of distributing clean shells has been attended with great success Some large dealers distributed as many as three thousand bushels of shells, during the season and the young spat cling to the "cultch," as it is called, in immense quantities, such quantities that in very many instances they have to be culled out and removed to other localities for fear that they will smother each other, and as I said before, were it not for the enemies, the amount of oysters which might be produced would actually be almost unlimited.

Mr. FAIRBANK.—When are they destroyed by starfish?

Dr. HUDSON.—Generally when they are very young. The starfish is a very peculiar animal. They have a faculty of extruding the stomach and covering the entire oyster or other

mollusk. They surround a little oyster, perhaps the size of a half dollar, more or less. The starfish puts its fingers round the oyster and it is supposed by some, smothers it, so that it has to open its shell; by others it is supposed that the starfish emits a peculiar acid, which obliges the oyster to open its shell and then the starfish protrudes one of its fingers into the shell and devours the stomach of the oyster.

FISH-CULTURE—A PRACTICAL ART.

BY JOHN H. BISSELL.

I do not forget, gentlemen of the American Fisheries Society, that I am but a student in the craft which we profess, and for the encouragement of which this Society exists; nor that many of you have grown gray in this honorable, nay, may I not also say, patriotic, service; and so I should be sitting at the feet of some piscicultural Gamaliel, instead of standing before you as an essayist, but for the summons of your committee which left me no room for excuses or refusal.

A younger generation is coming upon the field to take its part in carrying forward fish-culture, to apply the precious stores of knowledge, which have been laid up by the practical observation and scientific research of the past twenty-five years, to the practical solution of some very important economic questions that are beginning to clamor loudly for solution.

The question most urgent just now is not, can fishes be artificially hatched and reared, and acclimated in alien waters, but can the fisheries of this country now be saved? That the men of whom this question is being asked are the members of this Society, once called "Fish-cultural," may not improperly be regarded as evidence of the ability with which the elder generation, the pioneers of fish-culture, have done there work, as well as of the value of their work and the appreciation in which it is justly held by the people of this country.

At former meetings of the Society you have been favored by the eloquent speeches of statesmen who judged rightly that fish culture was worthy the statemen's consideration. Unless the statesmen of this generation have lost the art of wise and wholesome statecraft, we shall hear from them still further on this subject, if not in our deliberations, yet more potently in the State capitols and in the halls of Congress. You have been honored by papers and addresses from men of your own number who have won distinction by knightly deeds—no less knightly and honorable because won in the unromantic armor of waterproof coats and rubber boots—in conflict for the secrets of nature, wresting from nature's willing hands the knowledge that practical men have been gathering and storing up against the day when the millions that are peopling and are to people this continent, shall cry out for more and better and cheaper food. You all know the men to whom I refer, so there is no need of mention of their names. I know them, not by personal acquaintance and familiar discourse, but none the less really, through their writings and experiments, which have made it possible for men of the class to which I belong to accomplish something for the States which have honored us with the oversight of their fishing interests. Without the knowledge which has been gained and freely disseminated by these intelligent and devoted men, the fishery establishments of many of the States would have no existence, or their officers no reasonable and sufficient answer to make to their State governments when asked as they so frequently are, "Can fish-culture do anything worth the expense for the food supply of the people of this State?" Have we then any such answer to make? That we have,—that the answer is reasonable and sufficient I shall try briefly to show. While we have not learned all there is to know about the culture of fishes and artificial propagation of them, enough is known both scientifically and experimentally to place the practical art of fish-culture beyond the domain of mere curious research, and make it a useful, and to the same extent, a necessary department of the public business. To this practical aspect of fish-culture I invite your attention. In using the expression "fish-culture," I mean to be understood as including

artificial propagation of fish and the protection of them until they are marketable.

Consideration of fish-culture as a department of the public business is growing every year to greater prominence, particularly in the States bordering upon the sea and the great lakes. Of course I only profess to speak with accuracy about the condition or needs, of the fisheries of my own State—Michigan; but, the state of affairs there is in some measure analogous to the circumstances of other States, and the subject from my point of view may prove of more than merely local interest.

Are our fisheries worth saving?

Michigan has a coast line of more than 2,000 miles in length upon the great lakes and their connecting rivers, by actual measurement upon the Government charts. Its fisheries produce annually over 13,000 tons of food, the value of which is something over $800,000 at first cost. The capital invested in the prosecution of this industry is about $1,200,000; it gives employment to 1,800 men, which means that over 7,000 people are dependent upon the prosecution of the fisheries for their living. The pound nets used in this industry placed end on end will stretch 200 miles, the gill-nets placed end on end measure 1,588,852 fathoms—over 1,800 miles.

From this brief statement it appears that Michigan has industrial fisheries that are worth caring for. A few additional facts will show that they need care. Forty years ago at one of the seine fisheries on Detroit river, the number of whitefish constituting a fair catch was from 90,000 to 115,000 fish, averaging in size about four pounds. That fishery has been abandoned for more than fifteen years, and the last vestige of docks, houses and pounds have rotted away. Another fishery having as fine a plant as any on the lakes, about nine miles below Detroit, as late as the fall of 1883, had over 12,000 whitefish, which was thought the poorest catch ever known. In 1884, at the same fishery the total of whitefish was 3,400, and for the season of 1885, less than 2,000 whitefish were taken there by actual count. This we know, for we bought and handled the entire catch to take the eggs for the State hatcheries. At many points on Lake Michigan hundreds of thousands of whitefish under one pound

in weight, one, two or three years old, which have been planted, have been caught, shipped to market when worthless, or thrown upon the shore to rot as not worth handling, or salted and sold as herring. Such complaints have come to us by the fishermen themselves and by nearly every dealer who handles Michigan fish.

But there is not space here and now to multiply examples to prove, and I therefore content myself with stating the facts very generally. In Michigan waters every year, the area of fishing operations is greatly extended; miles of ground once productive are abandoned; the average size of whitefish is gradually growing less; the price is gradually getting higher in the market; and while some large firms are getting fairly profitable returns, the fishermen as a class are getting poorer; where formerly the nets were served by sailboats and rowboats, steamboats are fast coming into common use; the demand for fish is increasing steadily as the population increases; the total supply is comparatively stationary or falling below the increasing demand; and all this means that the fisheries of our lakes are fast becoming exhausted and ruined. These facts suggest some pertinent inquiries, just such as are being asked of the State Fish Commissioners by the representatives of the people every year. Has artificial propagation then been a failure? No, for it has not had a fair chance in several ways.

First—It has not been conducted upon a scale adequate to accomplish the results.

Where we are hatching about fifty millions of whitefish we need from six to eight times that number every year to restore the wasted and deserted grounds, as also to replenish and keep up the stock in others yet productive. Numerous early experiments were made of planting whitefish fry in interior lakes of various sizes, where we now know they will not thrive because the conditions of food and temperature are not favorable. This could not be known without trial. But it does not follow that the experiments should not have been tried. It was no waste of time or money. The lessons learned from such failures are perhaps more valuable than constant successes. There are large and deep lakes in the interior of Michigan and other States

where the whitefish are indigenous. In such lakes they can and should be grown to the utmost capacity of the food supply. Such lakes in Michigan we are planting now as preserves from which to draw a future stock of breeding fish, to furnish eggs for keeping up the supply for the industrial fisheries of the Great Lakes.

There are many localities on the Great Lakes where the planting of whitefish has resulted in the appearance of vast schools of small fish coming in upon the inshore feeding grounds, during the summer months, at points where that phenomenon had never before occurred within the memory of the oldest fishermen. That they were the planted fish is beyond question, as it is not doubted by the practical fishermen and others who have examined them, that these young fish are identical with the Lake Erie fish, that being the source whence all our ova and almost all of that used by the U. S. Commission are taken.

Second—Artificial propagation has not had a chance in point of time.

It is only within the first few years of the second decade of its existence—say from 1882 or 1883 that we ever hatched and planted over 15,000,000 of whitefish in any one year. The same period will cover also the most extensive operations of the U. S. Commission in this direction. The force of this point will be appreciated when it is understood that from our present knowledge we have no reason to expect important results from these plants before the expiration of four, I think probably five, possibly six years, from the time of planting. Operations during the first decade were, as I have said, only experiments, and they were successful beyond anything that we could in reason expect. In summoning this practical art to the judgment hall, it must not be overlooked that the ruin caused by wasteful and unconscionable fishing methods, which it is called upon to repair, has been going on for thirty or forty years. And it is always more difficult to cure than to prevent disease, whether physical, political or economic.

Again, fish-culture has not had a fair chance with us, and I am informed the same is true of almost all the States, because

we have lacked proper municipal regulation of the fishing industry.

It is not enough that the State Commissioners should be able, at very moderate cost, to hatch and release in the lakes enough young fish to take the place of the adults captured and marketed. The young fish so hatched and released in the waters must be protected until they come to maturity and are marketable; otherwise the wasteful fishing, which has once depleted the waters stocked by nature, will do the same thing, only more surely and speedily for the waters replenished artificially.

So the two things must go together. Artificial propagation cannot do it alone; municipal regulation cannot do it alone, within a period that will avail anything for one generation, possibly not even then. The two things are mutually dependent conditions, they must concur to assure valuable or lasting success. In the combinations of these two conditions we have the complete definition of the *practical art of fish culture*.

There is not time here to go minutely into the facts or the arguments which logically flow from them to support the necessity for proper inspection or regulation.

I can only point out generally that municipal regulation, to be of value in saving or extending the operations of the industrial fisheries of the great lakes, must cover these points, namely:

(*a*) The sizes of the meshes of the nets to prevent the destruction of immature fish.

(*b*) Market restrictions as to the size at which various kinds of fish may be handled or sold.

(*c*) Prohibition of inshore fishing during the season or at the points where the young fish are running in to feed.

(*d*) Discretionary authority to allow the use of nets below standard size at certain times, in certain localities, for certain kinds of fish.

(*e*) The demarcation of spawning grounds and their absolute rest from fishing at the spawning season; or, if that is impracticable, a "close season" at spawning time.

(*f*) Inspectors and wardens of the fisheries with ample means and powers to enforce all regulations, whether of apparatus, fishing operations, packing or marketing.

(*g*) A reasonable and equitable system of license, which will furnish the means to pay the cost of inspection and regulation, and also of replenishing and keeping up the stock by artificial propagation.

There is one more requisite which cannot be provided by statute law, the spread of reliable information of our purposes and operations among the fishermen and fishing communities, which will create a strong public opinion in support of the laws and their stict and just enforcement.

It has been urged that this whole business of fishery regulation should be undertaken by the Federal Government, so far at least as the fisheries of the Great Lakes are concerned. Is there any reason why the Federal Government should undertake the establishment and enforcement of fishery regulations in the States bordering the Great Lakes, that does not apply with equal force to the obligation of assuming the burden of the other department, that of restocking and maintaining the supplies of fish in the same waters?

The reasons for this course or the desirability of it are not to my mind clear. The subject of fishery regulation is one, even if it were a new and open question, which seems from the very necessities of the case to be so local, domestic and municipal in its character as to fall naturally within the police power of the several States, and not within any defined powers of the Federal jurisdiction, legislative or judicial. But it is no longer an open question. It has been passed upon by the courts of last resort in almost all the States, as well as by the Supreme Court of the United States. And this view seems to have been adopted by all the States that have established fishery regulations, however meagre and insufficient, as well as to have been acquiesced in by the United States Congress by a century of silence.

But what can the practical art of fish-culture as above defined (although but briefly and imperfectly outlined) do for the fisheries of the Great Lakes? What promise does it give which will warrant the expenditure of public funds in its prosecution? I hardly need to make answer before this assembly of its disciples, or rather its discoverers; but that same echo, however faint, of these questions and the answer, may possibly reach the

dull ears of our people, and their representatives who make the laws and provide the means, and who are charged by the law of the land with the responsibility of preserving the public weal, let it be said without hesitation. All barren waters may be made productive again! The ruin of the great industrial fisheries of these great public domains may be arrested! The fisheries that produced thirteen thousand tons of food in 1885, may be brought up to the production of thirty, and then fifty thousand tons of wholesome nutritious food within the reach of all men! The money value in yearly product may be increased from one to five millions of dollars, and contribute no mean share to the prosperity of a great State, and the well-being of its citizens.

Detroit, Mich.

Mr. BOOTH.—I would like to state for the benefit of some of the gentlemen here, to show the enormous results to be derived from fish-culture, that at the cannery I am interested in on the Columbia River, in the state of Oregon, they pack 600,000 cases of salmon per annum. It is worth four to five dollars a case on the ground. Now you can readily see that is $3 000,000. It takes three fish to the case. That is less than 2,000,000 of fish. Now the salmon there produce, I understand, from 15,000 to 20,000 fry, so you can readily see it doesn't take many salmon to re-supply by artificial propagation the salmon that are taken from that river to produce $3,000,000 per annum. In other words, we catch 3,000,000 of fish which produce $3,000,000, and they can be replaced by artificial propagation for at least $10,000 in money. Now if there is anything in this world you can speak of that will produce so much for so little investment, I should like to know it.

Mr. BISSELL.—Mr. Booth has spoken about the comparative cost of policing and artificial propagation. It is a very comprehensive subject, and I have stated in outline in my paper just what my conclusions are, drawn from a great many facts and a great deal of thought and consideration of the subject. It is true that artificial propagation, if carried on on a proper scale, can be done very cheaply. I made some figures for presentation to the committee by our register two years ago, and if I re-

member rightly it was something like this: That if we produced about three hundred millions of whitefish in the way that we were then and are now doing it, that the cost per thousand fish planted in the lakes wherever they were to be be planted, would be about one-third of a cent per thousand. I think it was that —one-third of a cent, or less, per thousand. After you get over a hundred millions you begin to scale down the average very rapidly. Even if it were a cent a thousand, I think that the cost of proper policing, inspection and regulation of the fisheries will not cost what Mr. Booth seems to indicate. We asked the last Legislature to give us $15,000 for two years' work. That was on a careful estimate of what we could get an inspector and probably four or five wardens for. It will not be necessary to police the entire 2,000 miles of coast to prevent the use of nets of improper size if we have the power of inspection. If we could go to Mr. Booth's packing house, if our inspector could go there with ample authority and power to seize and confiscate all fish that were under one pound in weight, then Mr. Booth would not buy those fish any more. It would not be necessary for us to go a thousand miles to prevent all intrenchment on the coast if we could go to the market and inspect there. That is one way. Another way is when the nets are being made up, we could inspect the nets and seize those which were under the size. Another thing I indicated in my paper was about forming a healthy state of public opinion. We have taken some pains in reference to that, and in the latter part of February or early in March, we succeeded in securing a meeting of representative fishermen of Detroit. I think there was something over fifty fishermen present. That meeting went so far as to perfect an organization, which I hope will be permanent among fishermen for the discussion of useful knowledge and practical good sense with reference to the purposes and and the objects, and this work among the fishermen will go as far as anything else towards the enforcement of the law. I doubt if among the three or four hundred fishermen in Michigan with whom we have been in communication the last year, there are half a dozen that would not be prosecuted if we had reasonable laws to regulate the fisheries; so that the cost of police power exercised

with reference to the fisheries I think is very slight, and the importance of preventing the capture of small fish is not by any means an insignificant part of rearing marketable fish in great numbers. A single man with a pound net, such as I know of near the straits of Mackinaw, where he couldn't find any net with a mesh that was small enough, he used sacking for the back of his pound net so nothing could get through. Such a man as that might destroy a quarter or a tenth of the product of one of our large hatcheries.

There is another thing in that connection. I say these fishers must be licensed, not only as a part of the exercise of police power, but to protect the citizens of the State. Now, it would not be fair if the State of Illinois were spending fifteen to twenty thousand dollars to stock the shores of Illinois and Michigan with whitefish, for my friend Dewey to come over here and catch all those fish and ship them to Toledo and Cleveland; neither is it right that the people of Illinois and of the city of Chicago, should be fed with fish which we have planted in the waters of Michigan. Now, for that reason I want the fisheries of Michigan to be licensed. I want a regulation which will prevent Mr. Booth from coming into our territory and catching our fish unless he pays a license. I know Mr. Booth will do it. He would be very glad for the right to use good fishing ground, just as any of us gentlemen would be very glad to pay for the right to fish in a pond where we knew there were three pound trout in great numbers. Now, when we get to that point, the fees that will result from a very reasonable and very low license, our fishing will not only pay all the cost of regulation and inspection, but it will pay all the cost of hatching and planting as many as Mr. Booth thinks we ought to plant in Lake Michigan. It will pay for hatching and planting six or eight times the fifty millions that we are now hatching.

One other thing has been alluded to and that is the question of what the United States Government should do. I said in my paper very briefly that the question of the regulation of the fisheries was officially settled. It has been settled for more than thirty years, although it has not been generally understood. The United States Supreme Court has passed definitely and

finally on that question. The regulation of the fisheries of each State out to the State border is a matter of municipal regulation, a matter of State legislation. That is so even in tide water. In the State of Maryland they passed a law preventing the dredging for oysters, and the State officers have seized a boat that was doing that, a vessel which was chartered and which was registered in the United States Customs office at Baltimore. She was replevined from the State constable who seized and condemned her, and under which proceeding she had been sold. That case went from the Supreme Court of Maryland to the Supreme Court of the United States. Benjamin Curtis being the justice who gave the opinion, said that the condemnation was right, that it was within the police power of the State to regulate fisheries of that State to the State border, and it was not a matter for the United States Government to interfere with, yet it was in tide water, and notwithstanding the vessel was one which was registered in the United States Customs Office, and although the United States Government had the right to regulate the navigation of those waters, the control of the fisheries was within the police power of the State. At a meeting of the Commissioners held in October, 1883, at Detroit, this subject was very fully examined and presented to the meeting by the Attorney General of the State of Michigan very clearly and forcibly. That I regard as entirely final.

There is one other thing I want to speak of that Mr. Fairbank referred to, and that is the work of the United States Fish Commission. Now, if any gentleman will take the pains to examine the law under which the United States Fish Commission is constituted, he will see that the sole purpose of the creation of that commission was to procure scientific researches with reference to the fishes, the fisheries and the food supply, and see what the causes of the decrease were. It was also deemed proper under the definition of that law to undertake experiments in artificial propagation, but it was not the purpose of the United States Fish Commission to stock the waters of the United States. The procuring of information by scientific research, which we could get in no other way, has been admirably done by the United States Fish Commission. The planting of whitefish in the Great

Lakes and the propagation of shad have only been incidental to the work of the United States Fish Commission. It was directed that under that law and the provisions to carry out that law that they should make experiments in artificial propagation, and because, in the course of their experiments, they were able at very slight increased cost, to get more eggs than they wanted for that purpose, it was thought to be perfectly right to return the fully developed eggs, young fry, to the waters where they were taken from, and also to plant some of the young whitefish in interior lakes where they did not exist, to see if they could not be propagated there; but it is not the purpose of the United States, and it is not the business of the United States Government, as I contend, to plant our own waters. That is our own business. The waters are ours; they are under our own control; they are just as much a part of the State as is the land of the State, and it is the business of the State, therefore, to see that its public waters, which are its only domain left, should be properly cultivated and properly used.

Mr. Booth.—I must beg to differ with my friend with reference to the amount of the cost of policing and propagation. From his own figures, and the most exaggerated estimate of the cost of propagation of whitefish or trout, it would be about one cent a thousand if we have gathered twenty-four millions of pounds, in other words, eight millions of fish. Now, at one cent a thousand, how much is that? It is about $800. It seems to me that is very much the cheapest way of reproducing the fish in these lakes. You could scarcely hire one man for less than $800 a year. I thoroughly indorse his ideas for exacting a license fee from any and everybody, from every man engaged in catching fish in the waters of the States of Michigan or Illinois or anywhere else. I believe that is a great source of revenue. I don't want to ask the United States Government to assist one dollar in this matter. I think the people that are making their money out of catching these fish are perfectly willing to pay a license for the privilege of doing so. I have a great many nets and a great many boats, and I am perfectly willing to pay a license if that amount is spent for the reproduction of the fish. These small meshes—you say they have put in canvas to catch

them—I would allow them to use canvas if they please to catch them. How long would it be if you put in fish at one cent a thousand in the waters—these small fish are comparatively worthless—before they would increase the size of the mesh and they would catch nothing but the big fish? It would be only four or five years before you would be willing to reduce the size of the net. There are a few unscrupulous men, I am sorry to say, belonging to the business I am connected with that would use those small meshes, but they are few. If there is any way you can reach them, you have my indorsement to do so.

Mr. BISSELL.—They are all in Wisconsin.

Mr. BOOTH.—Well, Wisconsin has not got so much territory to fish in as the State of Michigan. We tried that on the Columbia River. There was a law passed in the State of Oregan licensing every boat at so much a piece, and every fisherman. I think it was $10 for a boat, and $5 for a fisherman, to the fishermen who fished with a boat. The law was passed and they collected the license, and they agreed to spend the amount of money they collected to the propagation of salmon in that river, and one of these foreign knights of labor or communists—or other classical name, I don't know what they were—he discovered in his great learning that it was unconstitutional. We were getting along nicely and everybody was paying his little license, and he thought it was unconstitutional. Well, he refused to pay and we sued him and got a judgment against him and went up to the last court, and it was declared unconstitutional. Now, we may strike such a thing as that. I don't think the people of the States of Illinois or Wisconsin or Michigan would resort to such a course. I think they would be perfectly willing to pay a license; but I must say I think the cheapest way we can reproduce our fish is by artificial propagation, and not with this vast amount—I think you say it will take eight or ten thousand a year—for policing, and it will be only a few years before you accomplish all which you now seek to attain.

Mr. FAIRBANK.—I want to say one word on the subject of the general Government taking hold of the thing. I understand Mr. Bissell to state the purport of the law as it exists, and also

the expenditures of the money that are made. Now, a considerable amount of money has been expended in artificial propagation—more in shad than anything else—and I can see no reason why it is not a subject that the general Government should take up and spend money upon. There is an injustice in the State of Ohio, for instance, spending money in hatching shad and depositing them in the Ohio River, when they go down the river and are caught all the way down the river. Louisville, for instance, would spread her nets and take the fish propagated by Ohio, and the fish that Michigan propagates Illinois will catch, for whitefish migrate, and so they do in all the waters; and it is an expenditure from which all the people would reap an equal benefit, and an expenditure purely within the scope of the general Government to take hold of. I want to see the present law amended. I want to see some action on the part of parties interested in this matter with our representatives, to have some legislation on the subject, and some new restrictions put upon the appropriations. The scope of the United States Fish Commission, their labors and their work, have been very much enlarged since the passage of the first bill, since the appointment of the first commission. There is only one commissioner. There should be more than one commissioner. There should be three or five commissioners, representing the different interests. A larger amount of money should be appropriated, and the work and scope of the commission should be very much enlarged. That is the idea I want to get before the meeting.

Mr. CLARK.—In regard to this question—speaking as Mr. Bissell did in his paper in regard to showing results to the people and to his legislature and other legislatures, I wish to say to you who were present last spring when this paper—this poorly gotten up paper—was presented by myself, you will remember I gave you some facts in regard to what we could show that artificial propagation and planting of whitefish had done in the great lakes, and why I claimed it must be due to that, because it had shown quicker in that than in any other way. The figures I gave you go to show it. They show there that there was some 65,000,000 or 70,000,000 of whitefish that had been planted up to a certain day in 1882 in Lake Erie. From all the facts we

could learn in our gathering statistics a year ago last fall, it showed they were on the increase there. These fishermen say so here in the lower end of the lake, but not in the upper end of the lake. That goes to show again that whitefish do migrate; that the whitefish planted in the Detroit River by the State of Michigan and in the upper end of the lake by the United States Fish Commission show the increase more in the lower end of the lake. It goes to show your fish migrate. Now the fish that are hatched by the Michigan Commission are caught down in Erie, Pa. Is that right to do that?

Mr. BISSELL.—I would like to ask if whitefish are migratory to the extent it is claimed, why they don't migrate back to the grounds that have been once fished in Lake Michigan?

Whereupon, upon motion duly seconded, the convention adjourned until 10:30 o'clock A. M. to-morrow, Wednesday, April 14th, at the same place.

INTENTIONAL AND UNINTENTIONAL DISTRIBUTION OF SPECIES.

BY DR. R. E. C. STEARNS.

The geographical distribution of species is one of the most inviting fields which nature offers to the student. Once entered upon, every path is found to lead to new and attractive vistas, and to point the way to curious and interesting phenomena. At every step we receive delightful impressions, and from every side, hints and suggestions as to nature's methods.

Through the establishment of the United States Fish Commission and of Fish Commissions in many of the States, as well as by the organization of societies and various private enterprises, the propagation of food fishes has become an important protective resource, and the economic aspect of ichthyology has been made familiar to a great number of persons. Incidentally, too, but to a smaller extent, the scientific side has attracted increased attention from a class of persons who would not have

become interested in the biological aspect if the latter had been presented to them first. With the selection of species for propagation and distribution, there naturally followed the investigation as to the habits, habitat, etc., of each selected species; and one inquiry led to another, for in order to insure success from the business standpoint, it is necessary to pursue as closely as possible the various steps, and follow the various methods and order that nature follows. So a knowledge of the character or peculiarities of the environment or native haunts of the selected species has to be obtained.

Preceding the distribution and planting of the young fish, occur the inquiry and consideration of the factors or physical character of the region in which it is proposed to make a plant and so on. In this way much special and abstract knowledge is accumulated and brought to public attention, and more general notice; the laws of life are better understood and the relation of species to species, and of all life to its environment, are made more clearly perceptible and more widely known. It will be seen by the foregoing that fish propagating operations and enterprises, both from the scientific and natural history side, as well as from the economic point of view, are incidentally useful as promoters of public education.

I am sure it will not be an uninteresting digression if we turn for a few moments from the consideration of the distribution of species by natural methods, that is to say by the hand of nature, as well as that intentional and artificial distribution by the hand of man, which is such an important and interesting part of modern fish-producing operations, to take a glance or side view through the collateral vista of unintentional, accidental, or more properly incidental distribution, and see what or where it leads to.

The transplantation of animal and vegetable species from their native haunts to some other part of the earth, more or less distant from their indigenous habitat, as an incident of traffic or commercial intercourse and enterprise, has many peculiar and striking illustrations. We have a notable example in the geographical distribution of the common rat. With the extension of commercial intercourse and international trade, the brown rat

or, as it is often called, the Norway rat, as a species, became more and more cosmopolitan. At the beginning of the last century this rat, a native of India, made its appearance in Europe, having stolen a passage on the ships engaged in the India trade.

It first appeared in England in 1730, and twenty years later it had reached France. In Europe it drove out the black rat which appeared in that continent during the middle ages; the black rat coming from no one knew where, having previously driven out the native mouse which was the only representative of the family known to the ancients. At the present time the brown rat is everywhere, pretty much; on the main lands of the globe and the islands of all seas, wherever commerce sends its ships. So too with the cockroaches (*Blatta orientalis*), a very cosmopolitan and very disagreeable form of insect life. These two familiar species are exceedingly active animals, and make their way on board of vessels or hide in packages or merchandise, and are thus carried on ships or cars, their inconspicuous size enabling them to steal a passage.

Again we have other illustrations of unintentional distribution by man, where the trees, plants or seeds of one region are sent to another. Upon the trees and plants thus transported often occur forms like the scale bark lice, *Aspidiotus* and *Lecanium*; also the eggs of various insects. Many seeds contain the grub, maggot or larvæ of insect forms. If the roots of the trees or plants are protected by a ball of the earth in which they grew, and the earth if protected, by a cover of bagging, from crumbling away and separating from the roots, a precaution which is usually practiced by careful nurserymen, both earth and bagging afford a hiding place for small animals, such as insects (and larvæ of insects), worms, slugs and other small forms. If traffic, through the facilities of its machinery, assists in distributing plans that are useful to man, by the same system it contributes to his discomfort and pecuniary loss. It is highly probable that the scale bark lice, *Aspidiotus aurantia* (red scale) and *Lecanium oleæ* (black scale), now such great pests to the orange growers of California, found their way into the citrus orchards of that State, directly or indirectly, from the Australian acacias or some similar species of exotic trees, imported or planted for use or

ornament. The Australian acacias have long been popular in California, and many of these beautiful trees may be seen growing there in the towns and country places. In the same State, less than a dozen years ago, the inspection of a bushel or two of apples or pears would perhaps have resulted in finding one or two specimens of the larvæ of the codling moth (*Trypeta pomonella*, Walsh). Since that time the fruit growers have had to fight it as a pest, and have been put to great expense to cleanse their orchards of this and other injurious insects, the stock of which was incidentally introduced, as is generally believed, on trees from the East. In the climate of the west coast, which is particularly favorable to the development of this class of animal life, the increase of pestiferous insects has been surprisingly rapid.

The trade in plant seeds is enormous and extends throughout the entire world. The increase and spread of noxious plants is largely owing to their seeds being mixed with the seeds of desirable plants, and the weeds of one region thus become the weeds of another, remote from the original habitat. The May weed of the New Englander, *Anthemis cotula*, or European dog-fennel, has through the operations of nature and the incidental assistance of man, put a girdle around the earth. The *Chrysanthemum vulgare* is a pretty, but to the farmer an obnoxious cosmopolite, popularly known as white-weed and ox-eye daisy. Another plant pest, *Cnicus arvensis*, familiarly called Canada thistle, though of European origin, has spread it might be said to the uttermost bounds of the earth. So far as America is concerned, it, the latter country, has reciprocated by contributing the horse weed, *Erigeron canadensis*, to the pestiferous plant stock of Europe.

From mammalian, insect and vegetable forms, let us now briefly glance at molluscan species. The slowness of the snail's pace is proverbial. Yet we find that several species are widely dispersed, not by reason of their own means of locomotion, but as an incident of commercial intercourse. A species of slug, *Limax hewstowni*, Cp., has become quite common of late years in the grass plots and lawns of San Francisco and vicinity. There is good reason for regarding it as an incidental importation

Both, or rather all of these are pests, the insect forms especially, as they entail a heavy burden upon an important industry. The slugs are a pest, though the damage done by them is trifling, insomuch that they are slimy and disagreeable, and therefore a nuisance. There are other molluscan forms, which in this connection are worthy of notice.

The common land snail of Europe, *Helix hortensis*, which annoys the gardeners of portions of the old world by eating the lettuce and other tender vegetables, is found on several of the islands along the Atlantic coast from Newfoundland to Cape Cod, and on the main land, plentifully at Gaspe, Canada East, along the St. Lawrence River, also in Vermont, Connecticut, etc., etc. Another land snail, *Helix aspersa*, one of the principal European species, and largely used in France and elsewhere on the Connecticut as an article of food, has become naturalized in the gardens of Charleston, S. C., and vicinity, where it has existed for fifty years; it has also been detected at New Orleans and Baton Rouge, La.; Portland, Me., Nova Scotia, etc. In addition to those named another well known land snail, *Stenogyra decollata*, is numerous in Charleston, S. C., where it has been living for many years. It is also found in Cuba and Brazil. I found it abundant in January, 1869, in Charleston, among the ruins caused by the civil war. These three species of mollusks, as before mentioned, are indigenes of Europe, and have been incidentally introduced through commerce into the portions of Eastern North America I have indicated.

By the same medium, one of our American species of pond snails has been transported to England. In November, 1869, the late Dr. Jeffreys announced the discovery of *Planorbis dilatatus*, in the Bolton and Gorton canals at Manchester. Suspecting that this American species had been introduced into the canals through the cotton mills, he wrote for information and learned that in one habitat, the waste from the first process or "blowing machine," was discharged close to that part of the canal where the *Planorbis* occurs. This little mollusk was doubtless conveyed in the raw cotton, either in the egg state or otherwise, from some point in the Southern States.

It is not necessary to enlarge by adding to the illustrations

above presented. I have submitted but a few, a very few, and the few submitted relate only to such forms as have maintained themselves, and increased their numbers and extended their distribution in the regions into which they have been incidentally placed. Of the species thus unintentionally transplanted, it will be noticed that they are generally obnoxious or pestiferous. Some of them are harmless, others seriously detrimental to human interests. Rarely a highly useful species is incidentally planted. We have, however, one interesting instance on the profitable side in the accidental planting of the soft-shelled or long-neck sand clam or mananose, *Mya arenaria*, of the Atlantic seaboard, in the waters of California. Soon after the completion of the Central Transcontinental Railway, the oyster dealers of California, many of whom have a large capital invested in the business, commenced the importation of small oysters, *Ostrea virginica*, from the Atlantic coast by the car load, for planting in San Francisco Bay, where they soon grow to a merchantable size. This was somewhere about 1872 or 1873. The small oysters were obtained in part from Newark Bay. Among and adhering to them was the spat of the clam, for in November, 1874, several specimens of *Mya* half or two-thirds adult size, were collected by Mr. Hemphill on the eastern shore of the bay where the oyster beds are. Since that time it has multiplied so wonderfully and the environment has proved so favorable, that it has spread in every direction and attains a large size. It is now the principal clam; it has so monopolized the bay region that the indigenous forms that were previously sought for food, have become comparatively scarce, and the cockle, *Cardium corbis*, and the thin shell tellen, *Macoma nasuta*, once so abundant, are seldom seen on the market stalls and are not easily obtained. Outside the bay of San Francisco, the mananose (*Mya*) has either incidentally or intentionally been planted at Santa Cruz, at the northern end of Monterey Bay, and an intentional plant was made at Shoalwater Bay, Washington Territory, a few years ago, by Capt. Simpson, of San Francisco; he informed me that it resulted in an abundance of this excellent clam.

As proof of the previous non-occurrence of *Mya arenaria* on the West coast; it may be well to state that the shore from Cape

St. Lucas, northerly, has been explored by many competent naturalists at various times, extending back to nearly the beginning of the present century. Since the American occupation of California, commencing with 1849, several intelligent collectors have resided there, and others have visited the coast. It would have been impossible for so familiar a form, inhabiting, too, the easily accessible litoral zone, to have escaped detection: and corroborative of the above, we have the further evidence of the kitchen-middens or shell heaps of the aborigines, many of which have been examined by me without detecting any sign of this easy recognized species.

Washington, D. C.

TRANSPORTING FISH IN THE BRITISH ISLES.

BY W. V. COX.

The improved methods of refrigeration so extensively practiced in the meat and fish carrying trade of the United States, were not applied to those industries in England at the time of the International Fisheries Exhibition, London, 1883.

Even the old method of packing fish in boxes with ice for transporting purposes, was very defective, if we may judge by the condition of the fish when they arrived and the boxes were opened.

In the markets of London, I frequently saw whole boxes of fish that came from a comparatively short distance "packed in ice," that were spoiled and totally unfit for food. Very often the fish were discolored, and seldom were they very inviting in appearance. If it had not been that a fugitive piece of ice was occasionally discovered in the box with wet straw, there would scarcely have been a suspicion that there had been an attempt made to carry the fish in ice. It seems strange that there was such a lack of application of the well-known discoveries of preservation, not only in inland and local water transportation, but

in the markets themselves, when these methods are in such common use in ocean transit, whole cargoes of frozen meats, being daily brought to London from all quarters of the globe, even from New Zealand. Of the fish coming to London from adjoining waters, I found those that came by railway in a worse condition than those that came by water.

Aside from the more frequent handlings of railway-borne fish, the unwholesome condition of unsuitable cars had, doubtless, considerable to do with their deterioration. No objection could be made against many of the cars run on the special fish trains to London, for they were as good, perhaps, as any of an old and obsolete style; but there were others for sanitary reasons that would have not been permitted to run were it not for a blunted and indifferent public sentiment. I shall not speak of these myself, but state the case through the words of others.

A witness before the corporation said: "You all think we load our fish in proper fish trucks. That is a great mistake. We load it nearly all in bullock trucks not cleaned out. Seven out of ten come in ordinary bullock trucks."

Another witness stated that "most of the fish comes in old cattle trucks, lime trucks, manure trucks, or any kind of truck that happens to be handy at the station. I have had plenty of barrels which had contracted so much filth that my man had to wash them before taking them on his back."

"Were you ever on the platform when a return Grimsby fish van was being shunted?" asks an English editor. "If you were, you are not likely to forget it." Having stood on the platform, candor, a love of truth, and an olfactory not over-sensitive either, will not permit us to disagree with this gentleman, for truly, as he says, "the stench is abominable, and there is little wonder that fish are condemned when they arrive at the markets."

Such a nauseating condition of things seems almost incredible to us Americans familiar with the cleanly-kept refrigerator cars fitted up by Chase, Ridgway and others, thousands of which bear fresh meat and fish to and from island points hundreds of miles distant, yea, even from ocean to ocean. But still more incredible is it that railways in the British Isles have not long since found it to their selfish interests, if not the public welfare, to

adopt some modern methods of transporting perishable objects.

How far behind the age, and how short sighted it proves them to be when we find an English paper asking, "Cannot science persuade the railroad companies or large smack owners, or merchants, to have suitable fish vans, refrigerating or ice vans?"

The exhibition did much to educate the English people on this subject, and toward its close, in October, 1883, the Fish League, (limited) of London, placed refrigerator cars, (Knott's patent) on the London & Northwestern Railway. The trial trip proved successful, when sixty baskets of fresh herring were brought from Wyck, in North Scotland, to London. They were sixty hours *en route*, the shipment moving at the rate of nine miles an hour.

From an English standpoint it seemed wonderful that the fish came 550 miles inland in good condition, and one of the papers stating that "they were as dry and sweet, and clear about the eyes, as though they had only been drawn up from the North Sea a short half hour or so before." These fresh herring, the first ever brought from North Scotland to London, retailed in market at from four to six cents a dozen.

The Fish League contemplated extending the system from various important fishing ports to the chief centers of population. Extortionate rates of the railways were found to be the chief obstacle the League had to encounter. It was plain that if the companies would not make concessions that the era of the refrigerator car was almost as remote as before, and the problem of cheap fish would not be solved in this way. Since 1883, I am informed there have been some concessions by the railway companies, but with true proverbial conservatism, there has been but little progress made in adopting that which has proven such a boon to all classes in all parts of America.

Washington, D. C.

THE MICHIGAN GRAYLING.

BY HERSCHEL WHITAKER.

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

The waters of Michigan in which it has its habitat, may be generally described as within the territory bounded on the south by 43:30, extending as far north as 45:30. The streams included within this territory discharge their waters into Lake Huron and Lake Michigan. An imaginary line drawn from the mouth of the Muskegon on the western border of the State to the mouth of the Au Sable on the east, will perhaps better indicate the southern limit of the grayling. The waters most famous as grayling streams, owing to their magnitude, accessibility and their popularity with sportsmen, are the Au Sable and the Manistee. The Hersey, the Pere Marquette, the Maple, the Pigeon, with their tributaries, and numerous other streams of less importance included within the boundaries already mentioned, are also fairly stocked with this fish. The Boardman, the Boyne and the Jordan were once famous resorts for sportsmen who angled for the grayling, but their glory as grayling streams has long since departed, the grayling having given way to the predacious and combative trout, yet now and then an occasional grayling is taken.

Although the subject has often been discussed by writers upon game fishes, allow me briefly to refer to the general character of this fish. To the sportsman who has always angled for trout and is unfamiliar with the habits of grayling, this fish will excite some surprise upon first acquaintance. Unlike the trout you are not likely to find him in pool and shady haunt, but on the swift ripple and shallow, hovering like the hawk in air. While

you are adroitly seeking with your trout-fisherman's experience, to reach some shaded pool where you should expect to find him if he were a trout, you suddenly find your fly taken most unexpectedly in open water, and you are taken somewhat at a disadvantage. Once securely hooked comes the beauty of the fight, and here the grayling differs most radically from the trout. Instead of seeking shelter by retreating to the deep pool or beneath some root, he will perhaps leap clear of the water from two to three or more times, and with a vicious shake of the head seek to free himself from the hook. When landed you try in vain to determine which has the superiority, the grayling or the trout, but you finally conclude that you have forgotten exactly how the trout acts when hooked, and if you are a philosopher you inwardly argue that it is such a close question, you will leave its determination to such time as you shall catch your next trout.

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

As early as the year 1854 or 1855, the grayling was first called to the attention of local scientists in Michigan, by Mr. Wright Coffinbury, a gentleman in the employ of the general government, who was then making surveys of the wilderness lying adjacent to the Muskegon and Hersey rivers. At this time the grayling was plentiful in all these streams, and afforded the surveyor, explorer and hunter a grateful change from pork and hardtack, and the fish was known among them as "Michigan trout." Mr. Coffinbury had the grayling especially called to his attention, as he busied himself during his leisure hours in an

attempted classification of the fish found in the Muskegon and tributary waters, and as I have before mentioned he was instrumental in calling local attention to the grayling. Later on and about the year 1885 or '56, Dr. Parker of Grand Rapids, Michigan, (now president of the Michigan Fish Commission), succeeded in procuring a specimen of the grayling, beautifully preserved in homely salt and wrapped carefully in a newspaper, minus a few fins, and of course almost devoid of its natural color, and after a careful study of the specimen and a comparison with a cut of the English grayling, and a description of the same, he pronounced it a true *Thymallus*, and in a paper read before the local scientific society of Grand Rapids, named it *Thymallus michiganensis*, a patronymic by which it was known locally for some years; in fact up to the time that a specimen was sent by Prof. Miles to Prof. Cope in 1864. Specimens subsequently submitted to Prof. Agassiz through the efforts of Dr. D. H. Fitzhugh, of Bay City, Michigan, who is beyond question the greatest authority on grayling in the country, were classified by that eminent scientist, and determined beyond question, to be the grayling.

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

It would seem unaccountable that this state of things having once existed, that in late years the grayling should have so rapidly disappeared from these streams; yet the fact remains that many of the streams that once knew them now know them no more. This is notably true of such noble stacams as the Jordan, the Boyne and the Boardman. From those streams which flow

to and discharge their waters on the extreme northern coast of the Lower Peninsula the grayling have entirely disappeared, although now and then an occasional straggler may be found. The cause of this depletion is, however, directly traceable to the lumberman and the trout. The grayling cannot successfully run the gauntlet of log-running and the vicious attacks of the trout, who loves the dainty and succulent fry and the youngster grayling, and overcomes them both. It is a fact that until within the last thirty or forty years, brook trout were unknown in the northern streams of Michigan, while the streams of the Upper Peninsula, discharging their waters into Lake Michigan, are stocked almost exclusively with the trout. The theory advanced and generally accepted by those familiar with the facts, is that a migration of the trout has taken place from the streams emptying their waters into Lakes Michigan and Huron to those grayling steams. There is much reason, it would seem, for this argument. It is a peculiar fact that the waters of the Maple River, lying in the extreme northern portion of the Lower Peninsula, are well stocked with grayling. This stream flows in a southerly course, which is contrary to the direction of most of the streams in that portion of the State, discharging its waters into Burt Lake, one of the larger lakes of the "Inland Chain," which extends from Cheboygan to Petoskey, and is famous for its bass and pike fishing. To carry the argument to its seemingly just conclusion, it might be inferred with reason that the trout would be shy of entering upon waters in the possession of these voracious and predatory fish, and the probabilities are very strongly in favor of the theory that if they did enter upon such territory and lie down peaceably together, it would be that peaceful quietness of the trout lying down inside the bass or pike. On the other hand, the Maple is a swift, brawling, grayling stream; its waters are cold, a peculiarity of all grayling streams, offering no inducement to the bass or pike to take up their abode within its borders, and the consequence is that the grayling remains in full possession, having the advantage of the watchfulness of vigilant sentinels standing guard at the mouth of the river to prevent the entrance of the trout. The other streams I have mentioned discharge their waters either directly

into the Great Lakes or into tributary waters which are not infested with bass or pike.

Upon the formation of the Michigan Fish Commission the merits of the grayling were recognized, and the fact that it was a fish peculiar to Michigan, appealed strongly to the Board to investigate its possibilities of artificial propagation. Lack of funds and the knowledge that the commercial fish of the State demanded its first attention, compelled the Board to postpone attempts to solve this question. Not until the year 1877, was an attempt made to experiment in this direction and test the possibilities of success. In the spring of that year a camp was established upon the headwaters of the Manistee, and an effort was made to secure a stock of eggs, to be transported from the camp to the hatching station. Owing to the lateness of the season, the spawning period having passed, this attempt failed of any result, and the expedition returned with no further light. This party reached the Manistee April 14th. The following year an earlier start was made, the force arriving at Manistee, March 30th, but again found themselves too late, the fish having again passed the spawning period. A few fish were obtained which yielded a very small quantity of eggs and milt, but the eggs were imperfectly impregnated, the fry produced died early, and in the language of the superintendent, "much lamented." Before leaving the stream, however, it was decided to procure as many adult fish as possible, convey them to the station, and make the attempt to handle the fish in the succeeding year when the proper period should arrive. A number of fish were procured, but for unexplained causes no success was obtained. Adult fish have been obtained at three different times with the same object in view, but up to this time with no satisfactory results. The difficulties surrounding the taking of the grayling during the spawning period are very great. The fish spawn in about February and March, perhaps even earlier. The rivers in which they abound are remote from civilization, the roads almost impassable, and the streams filled with logs and ice, rendering it exceedingly difficult to procure the necessary fish. Experience has proven very clearly that the grayling will not stand domestication or confinement in ponds in which trout may be successfully

carried. Two years ago a number of adult grayling were procured by the Michigan Commission, and placed in the trout ponds of Paris. Out of the number not a single fish has ever spawned or showed the slightest inclination to do so. They have gradually died, and there are now but a very few remaining. The same care and attention has been given the grayling in these ponds that is ordinarily given to trout.

About the year 1878, Mr. Ira Metcalf, of Battle Creek, Mich., made some attempts at artificial propagation of the grayling, and claims to have been successful in raising a small amount of fry.

An instance illustrating the prolific character of the grayling, Mr. George H. Jerome, formerly superintendent of the Commission, states in his report that in transporting the first grayling taken to the station from the Manistee, it was observed by the men having charge of the fish while *in transitu*, that there was a fully ripe spawner in one of the cans; that she was removed and the eggs taken, but there being no milter with which to fertilize the ova, they were lost; that the eggs after being taken were counted by two reliable persons, and there were found to be 3,555 fully developed perfect eggs. The fish after being stripped weighed exactly 9 oz. This shows beyond question that the grayling is much more prolific than the trout, and under favorable circumstances good results should certainly be obtained.

The Michigan Commission has within the last year acquired the ownership of a fine spring stream upon property adjoining its trout station, to which the grayling had been natural, one or two having been taken in the stream within a year. This property affords opportunity for extended experiments looking to the solution of the question of whether the grayling may be successfully propagated. Arrangements are now being made to secure an ample supply of stock fish, which will be held in this stream in such a manner that the confinement will be felt as little as possible consistent with control. As far as possible the natural conditions of the stream will be preserved; pool and shallow, light and shade. At the same time care will be taken to afford an opportunity for experiments which may from time

to time suggest themselves, based on present knowledge, and such information as may be obtained by a careful observation of their habits. The experiments will extend over a sufficient period of time, and be followed up by earnest endeavor, until it shall be definitely determined whether successful propagation of the grayling can be carried out.

Detroit, Mich.

Mr. MAY.—I notice that Mr. Whitaker credits Mr. Metcalf with hatching grayling in 1878. I have seen in Prof. Goode's "Epochs in Fish Culture," that Fred Mather hatched the first grayling in 1874, just four years previous to Mr. Metcalf.

Mr. CLARK.—I think the grayling is the easiest fish to propagate and handle of any fish we had anything to do with, after we get the fish. Mr. Whitaker doesn't say this in his paper, but I will say that if a person can get the fish on the stream they can get five hundred thousand fish, which they can handle for one quarter of the cost of brook trout.

Mr. FAIRBANK.—How long are they in hatching?

Mr. CLARK.—From seventeen to twenty-five days. They are easy to handle. The fish are easy to take care of after they are hatched, and you can grow a greater per cent. of them than you can of trout.

A MEMBER.—Don't they require much cooler water.

Mr. CLARK.—I think you can put trout in a natural stream of warmer water than you can the grayling. I haven't tried the experiments on that. I got about twenty-five thousand eggs last spring from six or eight fish. A fish that weighed one and a quarter pounds we took five thousand two hundred eggs from. All we had to do was to get the fish, and you give me a thousand graylings, and if I don't take you over a million eggs I will miss my guess.

Mr. FAIRBANK.—It is difficult to get the fish at that season of the year.

Mr. CLARK.—It is difficult to get them, because the streams are fished out. The streams are not high, not at that time. You

want to be on the ground on the first of March, and you may not get any eggs until the 15th of April. I am speaking of hatching in seventeen to twenty-five days, that is, in water that is fifty to fifty-eight degrees.

Mr. FAIRBANK.—The water in those streams would be cooler at that time.

Mr. CLARK.—Yes, the water is cooler, and I think that the driving of logs is cleaning the grayling streams out of those fish in the State of Michigan. I think it is more from that cause than it from any other, either fish or fisherman.

Mr. TOMLIN.—Even granting what Mr. Clark says, notwithstanding the survival of the fittest, the grayling is being extinguished. In my mind there is no question about it. You take Sweden, Norway, Japan, Germany, Italy, France and England and you will find the trout and grayling side by side. You put the trout into any stream where the grayling is and in a little while the trout will clean them out. I have fished the streams that Mr. Whitaker has spoken of in his paper. Years ago I fished the Jordan, Pine River, the Pigeon, and the Sturgeon, and later years the Muskegon River. When I first went to the Jordan, way back in 1860, there used to be a considerable number of grayling. I got to paying frequent visits to Michigan, and I love it as much as my own State for its beauty. I found out that the history of the trout was a far more recent one than I had supposed. I had always imagined that trout was to be found in certain streams. There was an old man on the Jordan, long enough before Pine River was cleared out, who well remembers the coming in of the trout. He says when he first went there to fish—he was an old Methodist itinerant preacher I think—he used to catch one trout perhaps to ten graylings; in five years from that time they were equal. Well now, we know from the structural appearance of the fish, that the grayling doesn't stand the shadow of a chance beside our trout. You take for instance a body of water and put in trout and small black bass, and the trout will clean the bass out. They will chew him up, eat his tail and fins off, and by and by there isn't a bass there at all. This is the way the American trout are

cleaning out our grayling. So far as the two fish are concerned, I say if we can't have but one, let us have the trout. I have fished for them both carefully; I have waded up to my waist when I have been so blinded with mosquito and fly bites, that I have scarcely been able to see, yet I have kept on fishing, and my conscience never accused me of having caught them in large numbers. I don't think I ever caught over twenty at a time. Mr. Whitaker doesn't make any difference in his paper about the appearance of the grayling. You take the grayling found in the Sturgeon and Pigeon, and flowing through into the Cheboygan, you will find them very different in appearance from those on the west side of Michigan. You take the grayling found in Pine River flowing into the Manistee, and the Manistee itself, and compare them with rivers flowing into Lake Huron, and the western grayling are by far the smallest. The eastern trout, those in Pigeon River and Sturgeon River, sometimes weigh three pounds, whereas on the other side we have never got them weighing more than a pound and a half.

Mr. MATHER.—Trout and grayling have lived together in the streams of England and Germany for centuries. The trout were the brown trout, however, *S. Fario*, and not our American trout or charr, *S. fontinalis*, but I cannot think the latter more predaceous than the former Nor do I understand why certain grayling streams of Michigan were destitute of trout, and were full of grayling, because the lakes into which these streams empty contain trout which go into neighboring brooks. If any one can account for this we would like to hear him. If there are no further remarks, however, it might be well for us to adjourn.

On motion, duly seconded, the Convention here adjourned to attend the Citrus Fair at Battery D Armory, to meet again at three o'clock P. M.

AFTERNOON SESSION.

WEDNESDAY, APRIL 14th, 3 P. M.

The meeting was called to order by the Chairman, Dr. Hudson, and the Secretary read the following:

HISTORY OF THE ICED FISH AND FROZEN FISH TRADE OF THE UNITED STATES.

BY A. HOWARD CLARK.

The iced fish trade of the United States began about the year 1842. Prior to that date the inland trade in fresh fish was very limited, and could be carried on only in the winter months. In 1845 the fishing vessels of New England began to carry ice for keeping the catch fresh. Care was at first taken that the ice be kept separate from the fish, being placed in a corner of the hold. It was soon found, however, that packing the fish in crushed ice did not materially injure them, and this method was soon in general use on all the vessels, and largely superseded the trade in live fish north of Cape Cod. For many years it was thought impossible to transport fish inland, even if packed in ice, and it was not until 1859 or 1860, that Gloucester dealers could be induced to try the experiment of sending fish in ice to Boston and New York. Old sugar boxes were used for packing, and as the experiment was perfectly successful, a large trade was quickly developed, and iced fish were sent west as far as Minnesota and south to St. Louis, or even to more distant markets.

For ten years or more prior to 1842, Boston and Gloucester dealers had carried on a trade of frozen fish during the winter and early spring, sending the fish by teams inland as far as Albany and Montreal; but as warm weather advanced the frozen fish gave place to dry and pickled fish. In the winter of 1854 an enterprising Gloucester fisherman tried the experiment of bringing frozen herring, cod and halibut from Newfoundland to Gloucester, where the herring were sold to the cod fishermen

to be used for bait. From that experiment began a rapidly increasing trade in frozen herring from Newfoundland and New-Brunswick for the supply of the Georges codfishermen, and this bait is still the principal kind used by the fleets fishing from Gloucester in winter. The frozen herring also found a ready market in Boston, New York and other places as a cheap food supply. These fish have always been frozen by simple exposure in the open air, a warm spell interfering with the work. After freezing they are packed in bulk in the vessel's hold, snow being often mixed with them.

In Russia and other cold countries of Europe and Asia, for very many years there has been a trade in frozen fish, and other animal foods. In Thibet, as early as the year 1806, the flesh of animals was preserved by frost drying—not simply freezing—and in this condition it would keep in good condition for many months. Meat thus preserved did not have a raw appearance, but in color resembled that which had been well boiled, the ruddiness being removed by the intense cold.

Thus far I have spoken only of iced fish and of fish frozen by natural means. The first definite record we have of fish frozen by artificial method is the patent (No. 31,736) granted in March, 1861, to Enoch Piper, of Camden, Maine. It is described as a method of preserving fish or other articles in a close chamber by means of a freezing mixture, having no contact with the atmosphere of the preserving chamber. Mr. Piper states that the most important application of his invention is for the preservation of salmon, which had heretofore been preserved in a fresh condition only by being packed in barrels with crushed ice, which in melting had moistened and injured the fish. The ice, he said, could not keep them more than a month, whereas by the new method they could be kept in good order for years, if need be. The apparatus used by Mr. Piper is described as a box in which the fish are placed in small quantities on a rack, this box being surrounded by a packing of charcoal or other non-conducting material. Metallic pans filled with ice and salt are then set over the fish, and a cover shut over the box. About twenty-four hours is needed to complete the freezing, the ice and salt being renewed once in twelve hours. The fish

are then removed to be packed in the storage or preserving box. If desired, the fish may be coated with ice by immersion in iced water; they may then be wrapped in cloth and a second coating of ice applied, or they may be coated with gum-arabic, gutta-percha, or other material, to exclude the air and to prevent the juices from escaping by evaporation. The storage box is a double one, the inner one without a cover; the space between the sides and bottoms of the two being filled with charcoal or other non-conductor. Metallic tubes for the freezing mixture pass through the cover of the outer box and through the bottoms of both boxes, connecting with a small pipe to carry off the brine. The combined area of the tubes is required to be about one-fifth of the area of the inner box, in order to keep the temperature below the freezing-point.

Numerous and complex methods of freezing fish have been devised since Mr. Piper obtained his patent, but the simplest methods are perhaps as effective, and are surely more economical than the expensive machinery sometimes used.

In 1869 Mr. William Davis, of Detroit, patented a freezing pan for fish, which he describes as a thin sheet metal pan or box in two sections or parts, one made to slide over the other, the object being to place the fish or meat in one part of the box, and to slide the cover on to or in contact with the freezing mixture. The pans are packed on top of one another in a freezing box with iced salt over and around them. By this method from thirty to fifty minutes is said to be sufficient to complete the freezing, when the fish may be taken from the pans and stored in a keeping chamber, where the temperature is constant at six to ten degrees below the freezing point.

In 1869, Mr. Davis also patented a preserving chamber, which may be a room, box or chamber of any desired form. It has two walls with the intervening space filled with a non-conducting material. Within this are metal walls of less length than the outside walls, so that between the two a freezing mixture may be placed. Entrance is obtained through the top or side by closely fitting doors or hatches. Other methods of freezing fish have been patented, such as making a series of seven circular pans of a size to fit in a barrel, and of putting the fish in

rubber bags while they are being frozen. In 1880, Mr. D. W. Davis patented a method of packing fish in finely crushed ice in a barrel and freezing the mass solid, the fish being so stowed as not to come in contact with each other.

Freezing pans, with or without covers, are now in common use in most of the fishing centers of the Great Lakes, as also in some Eastern markets. In Boston, New York and at other points large buildings are devoted to the freezing and storage of bluefish, salmon and other species. The large species are frozen by hanging them in the freezing room or by ranging them on shelves. The improved systems of refrigerator cars and steamers render it feasible to transport frozen fish to any part of the United States, or to foreign countries whenever the trade may require.

Washington, D. C.

Secretary MATHER.—Mr. Chairman and gentlemen, I would like to say a little something not laid down in the programme nor embodied in a regular paper, and that is about work of the United States Fish Commission in its experiments of stocking the Hudson with salmon. For the past three years I have had the hatchery under my charge on Long Island, and been hatching some sea salmon from the Penobscot for Prof. Baird. They have been placed mainly in the Hudson, and some few in the Salmon river, in the State of New York, which empties into Lake Ontario, not the Salmon river entering the St. Lawrence, and also last year in the Oswego river. We have made some effort to find out if there was any prospect of getting evidence of the success or failure of these plans. The fish were taken away to the headwaters of the Hudson, and deposited in trout streams there where they would find food, which they would not find suitable for young fish in the main body of the river. It has been Prof. Baird's idea that the Hudson never was a salmon stream naturally, because of mechanical obstacles, such as the falls at Cohoes, which prevented the ascent to the tributaries of the Mohawk, and Baker's Falls on the upper Hudson, which prevented their ascent any further in that way, and any fish which entered the river before the white man put up his dams

were debarred from the spawning grounds; therefore we have deposited the young fish there. Last summer I wrote a letter to Mr A. N. Cheney, of Glens Falls, a member of this Association and a gentleman who takes a very great interest in anything of this kind, asking him if it would be possible to employ some man there to examine those trout streams, and see if there was any trace of those young fish left, and the following letter from him, tells of the success of last year's plant.

GLENS FALLS, N. Y., Oct. 9, 1885.—*Mr. E. G. Blackford*—Dear Sir: As requested in your letter of July 2, I send you to-day by National Express specimens of the young salmon from Clendon brook. I was absent when your letter came and have been home very little since, which is the cause of the delay. I told Mr. Mather that I would certainly get them before winter. I engaged a man to take the fish, but he was not successful, owing to high water. Yesterday I went to the brook with a friend, Mr. W. D. Cleveland, of Houston, Tex., and in a short time caught the number I send. You will, perhaps, remember that Mr. Mather sent me 40,000 salmon fry on May 21, 1884, and 60,000 salmon fry and 150 yearlings April 29, 1885, from Cold Spring Harbor, and all were deposited in Clendon brook, a tributary of the Hudson. The Clendon was once a famous trout stream, yielding trout of four pounds and upward, and still there are some few baskets of small fish taken from it. Yesterday the stream seemed fairly alive with salmon for a mile, and residents tell me that this is the case its entire length. As the trout were attending to their domestic duties up stream the brook was given over to the salmon. They were in the deep holes and at the foot of the riffs, but everywhere in numbers. There seemed to be two distinct sizes, one four to six inches long, the other two to three inches long. With the exception of a few chubs, silver chubs or fall fish, *S. bullaris*, I found no other fish than salmon in the stream. One bright-colored male salmon as I took him from the brook discharged milt from the pressure of my hand. This particular fish I caught in swift water where it ran over gravel. I hope Brother Mather will have an opportunity to interview these young things that were graduated from his University at Cold Spring Harbor before they are sent to Prof. Baird. It would have been an easy matter to catch a hundred yearlings during the time I was at the brook, and in their eagerness to take the lure they jumped clear above the water. After catching the first salmon, Mr. Cleveland exclaimed: "If that beggar weighed thirty-two pounds" (he had in mind a salmon caught

this summer by Mr. H. P. Wells) "and game in proportion, and I had fought and killed him, it would have taken just six months to recover from the excitement." The Clendon brook is posted its entire length and the people are interested in protecting the fry that have been deposited therein by the United States Fish Commission. I trust that you will receive the salmon in good order. I send but one of the smaller size, as the other and larger salmon gave no kind of show to take the hook. A. N. CHENEY

These salmon were seven or eight inches long, showing that they had lived there, and were about ready to go to sea that fall.

Mr. FAIRBANK.—Mr. President and gentlemen, I thought it might be of interest to say a word or two, to the gentlemen here in relation to the matter of planting fish in waters where they are not indigenous. We have made very great strides in artificial propagation of fish, and have mastered all the difficulties of hatching fish, procuring the eggs, hatching and obtaining the young fry, and a great deal of work and a great deal of money has been expended in planting fish in various waters in all of the States. We started off with a degree of enthusiasm eight or ten years ago, that was worthy of a better outcome than we have had, but it was done with more zeal than wisdom I think. We have planted shad, for instance, in the Calumet river here, which empties into Lake Michigan, and we have planted trout in the Kankakee river and brook trout in the streams of Iowa, and lake salmon in all the little lakes in Michigan and Illinois, and wherever there was a little stream we thought at that time all we had to do was to hatch the fish and put the young fry in there and we would have an abundance of fish. It is needless to say, at least I have not heard of any instance where any of these efforts have been successful. I was anxious to demonstrate the fact, and I decided to make an experiment in Lake Geneva, Wisconsin, which I did on a large enough scale to demonstrate thoroughly whether it was practicable. Lake Geneva is a lake about eight miles long and from half a mile to three miles wide. It is a very pure body of water, as blue as Lake Michigan. It is 185 feet deep, I have found in some places, but it averages 100 feet deep all over it, bold shores and very clean

There is not a bulrush or a lilly pad in it, and in every way is particularly adapted to the salmon-trout, because it seemed in all its characteristics just like the small lakes of New York State in which the salmon trout are indigeneous—Canandaigua lake, Cayuga lake, and several of the lakes there. Not feeling sure about it, I wrote to Mr. Seth Green, who was an old friend of mine, to come out and spend a week with me, which he did, because I wanted his judgment in the matter; and we sounded the lake and found the depth of the water and we dredged the bottom. We caught all the small varieties of fish to see what food there was for the salmon trout. Lake Geneva is somewhat celebrated for abounding in the small fish known as the cisco. There are in that lake and one or two other small lakes of Wisconsin, and they are there in great abundance, living in deep water. The cisco is the natural food of the lake trout, and we therefore very naturally came to the conclusion that Lake Geneva was particularly adapted, if any lake on the face of the earth was, for planting and growing the Mackinaw trout, or lake trout. So I built a hatching house and I employed one of Mr. Green's men, Mr. Welcher, who was afterward superintendent of the Wisconsin fish hatching establishment, and went to work. The first year I bought the eggs from the New York State Commission, 200,000, and after that Mr. Welcher went every fall to Lake Michigan and took the supply of eggs. I have laid in about 500,000 each winter, and I pursued that faithfully and put in about 500,000 good, healthy fry in the lake every spring for five years; but I have never seen, and no one else, as near as I can find out, has ever seen the shadow or sign of a salmon trout in Lake Geneva, large or small.

A MEMBER.—How deep is the water?

Mr. FAIRBANK.—About 150 feet or an average of 100ft.

QUESTION.—And what is the temperature?

Mr. FAIRBANK.—It is a cold lake. I don't know.

The SECRETARY.—They ought to be there, Mr. Fairbank.

Mr. FAIRBANK.—Well, they are not there. Mr. Green, said "They are there, but you don't know how to fish for them. They

are in deep water." "Well," I said, "you come out and spend another week with me and we will fish for them." He said he was not able to come, but replied, "I will send my son out." I offered to pay all his expenses, and his son came out. I think that was two years ago, and he spent a week with me, and we spent the week fishing faithfully in the deep water with Mr. Green's methods, with a heavy sinker and leaders, and we fished the lake thoroughly, and Mr. Welcher came down with some gill nets—that was three years ago. We set gill nets across the lake in four or five different places, and followed that up for a week, and we never took or saw one sign of a salmon trout. Now, the reason of it is this, and that is the reason I call the attention of you gentlemen to it. It is a subject we have got to look at fairly, and it is the main thing in planting fish, and that is, what food is there in the waters where you propose to plant the fish for the young fish or fry? Salmon trout would live in Lake Geneva if they could come to maturity. The cisco is there in great abundance, and furnish a most excellent and natural food—the fish that they live on in Lake Michigan, but in looking at it, I was satisfied that all the young fish died. The fry starved to death because their food was not there.

Now, in looking at it you will see what the trouble is. The salmon trout breed in the Great Lakes wherever there is a reef, and there you catch them in three, four, or five hundred feet of water, or less, wherever there are extensive reefs of rock, there the gill nets are set and there the salmon trout are taken. Here are the Racine reefs, you sail over those reefs any time in the summer and throw out a trolling line and you take salmon trout. My theory of it is that on the face of that rock there is some animal life, animalculæ, that the young fish stick their noses in and feed on until they are old enough to eat other fish. Lake Geneva has no reefs of rock. Where there are stones at all it is a boulder bottom, or it is a mud bottom, earth and clay covered largely with leaves. It is surrounded to a great extent with timber and the leaves blow in every year. You try it and you will find on the bottom of Lake Geneva to be a layer of dead leaves, so there is evidently nothing there for the young fry to feed upon and the fry have all died, and that has been the

case in hundreds of other instances. I have sent them to Crystal lake. Mr. Dole who lives there is a friend of mine, and I have sent several hundred thousands for two or three years. I always gave him a lot to put in there. That is a small deep lake of perhaps three or four thousand acres, very pure water, and very clear, but there never has been a young fish seen, and I think it is money and work thrown away, and that it is utterly useless to hatch fish and put them in waters unless we know to a certainty that the food for the young fry is there. I made still another experiment in the same line by going into one of the neighboring lakes near by in Wisconsin, and taking a large amount of the spawn of the wall-eyed pike, I brought those down and hatched millions of them, and put them into Lake Geneva, and there never has been a wall-eyed pike seen there. Evidently there is nothing for those young fish to live upon. They breed and live and thrive where all the conditions are right for them, or in trout lakes where they are indigenous and there is something for the young fish to live upon. You may take the fry and put them into waters where there is no food for the young fish, and you will never have any result. This is a thing we might as well look in the face and understand that it is useless work. Now, see the work of the Iowa Commission, and they did a great deal, they took a great deal of spawn, salmon trout, I don't know where they deposited them—all over Iowa—but I have yet to learn that one has appeared. The same way I did with whitefish. I took about an equal number of whitefish as lake-trout, taking the spawn the same time of year and hatched about as many. I suppose I put into Lake Geneva 2,500,000, both of whitefish and lake trout. I was determined to make the experiment thorough enough to demonstrate that one question, whether these small lakes could be stocked with the better classes of food fishes where they were not indigenous to the waters. I knew that of course by putting a few thousand in a lake occasionally, or every year, five to ten or twenty thousand, was not enough to demonstrate it. They could easily be destroyed ; but by putting enough in, piling them in year after year, it would demonstrate it, and I spent ten or twelve thousand dollars in the experiment. I think this is a question that is very vital for us

to consider in our work hereafter—what there is in the waters where we propose to put fish for the young to live upon, and I apprehend there is not much to be gained in trying to plant fish in waters where they are not indigenous, or where they have not been some time. I also procured from Professor Baird, and hatched, perhaps half a million of California salmon the same seasons that I was hatching the others, which I deposited in the lake; but there is a little stream entering Lake Geneva—the lake is fed by springs. There is really no inlet to it except the springs around it, but at the upper end of the lake there is about a mile of low land, and the springs running down through make a little creek. I deposited the young California salmon in those little streams, little springs, and they ran down into this creek. Some of them I kept—perhaps fifty to one hundred thousand, about half of the amount I hatched, I kept from the streams until they were yearlings, and then turned them out, and we have taken occasionally a California salmon, but they are not at all plenty. For the last two years there has not been any taken. Three years ago a boy took one, a very fine fish, which weighed twelve and three quarter pounds, as handsome a salmon as I ever saw anywhere—showing that salt doesn't enter into the question at all as to the life of the salmon; that they will grow just as well in fresh water as in salt, if they have enough to eat. There is an abundance of food there, and the California salmon are a very hardy fish. I have no doubt if I had put as many California salmon into Lake Geneva as I did salmon trout, that we would had more of a result from it, still I don't apprehend that they would do much. I think a lake of that size and purity of water, and with all the food there for the maturing of fish, the California salmon might be made to flourish there if we had two or three miles of good gravel bottom stream in which they could spawn. I found in this little stream which runs up through the marshy meadow, very low ground—it is only a small stream, and the bottom is mud and the water is very cold but sluggish—I found in there one day four or five large salmon that would run 8 to 10 lbs., splashing around up in there—it was evidently their spawning season—looking for a place to spawn; but if they did lay their eggs they sank down in the mud and were

lost. There is no place there for them to hatch. I couldn't get any spawning ground for them. I also made an experiment in brook trout in these little stréams, springs around those hills, and in this creek running down there, and established a fish farm up there, quite a trout pond, and stocked this little stream. This is eminently successful, because in the stream, in the weeds and growth in the bottom they are alive with the natural food of the brook trout, the little fresh-water shrimp, and now that mile and a half of stream running through this marsh is full of brook trout, as fine trout as I ever saw. In fact, I never saw fatter and finer brook trout than I find in there. I can go in there any time and take twenty-five or thirty trout in an hour or two. That experiment has been eminently successful, because the food is there for the fish. I thought I would give you gentlemen the benefit of my experience. I have never written anything about it, because it was a good deal of a question in my mind whether I ought to do it, and whether I ought to discourage the attempts that might be made; but I am so thoroughly satisfied that it is utterly useless that I think it should be made public.

Mr. DUNNING.—Mr. Chairman, I would agree with Mr. Fairbank in regard to Geneva Lake. He has taken a great deal of pains in stocking this lake, and it is as beautiful a lake as you ever saw in your life, and it is true, as he says—I have been there—that it has bold shores, deep water, and it would seem as though it was the most perfect place that ever was made for lake trout, but it is also true that they are not there. I am intimate with Mr. Fairbank and know about this matter, and there was no success whatever in the experiment, and it was very discouraging. Mr. Fairbank has done more to stock the inland lakes than any man I know of in the country, but I am satisfied, and I think Mr. Fairbank is, that is not the fault of the water, but it is the want of fish food. Now, Mr. Forbes in this State Professor Forbes, told me, in a conversation with him at our place in Madison, we had a great epidemic among our fish there the summer we was there, and he came there to investigate it, the perch died by the hundreds of thousands, and when he was

there we were talking about this same thing, and we dredged in our lakes to find the fish food, to see of what it was composed, to see if that was the cause of the epidemic in the fish. In the conversation he said to me, "Mr. Dunning I find in dredging in one haul more fish food than I would in Lake Geneva." It is mere nothing there, and the cause of the fish not doing any better I think is for the want of the food. Now, Mr. Fairbank in the lake you speak of, you will find your fishing is rather crude for a body of water as large as that.

Mr. FAIRBANK.—There is good black bass fishing there.

Mr. DUNNING.—They are not as plenty as they should be and they lack food, and it is a lack of the food more than anything else.

Mr. FAIRBANK.—Oh, there is an abundance of food for the black bass, and for the other fish that are indigenous to the place.

Mr. DUNNING.—Now, in our lakes, Madison—we are surrounded by lakes there, we have had the lake trout annually, and they were put in. We got discouraged because they were put in in unlimited quantities and we didn't see any result, but we continued to put them in and they began to show themselves. A year ago last season, and this last season, and this winter they have been caught in quite good numbers, because people have learned to know how to fish for them. There have been a great many of these fish caught by people who didn't know what they were and they put them back, supposing they were dogfish, not being a fish they had been in the habit of seeing in our waters. Last fall during the spawning season of the trout, I took as many as five, that were partially digested from the stomach of a pickerel, from half a pound to nearly a pound. I took five. Now I account for that in this way. The trout were spawning at the time and the fish taking advantage of it took them.

Mr. FAIRBANK.—Have the fishermen taken any salmon trout of any size in your lakes?

Mr. DUNNING.—Oh, yes, weighing 3 lbs. to 3¼ lbs.

Mr. FAIRBANK.—That is very encouraging, but your lakes

there bear out what I said. I think you have some lime formation and rocks.

Mr. DUNNING.- Yes, and some sandbanks. So I want the convention, as well as Mr. Fairbank, to think that Wisconsin inland lakes will produced fish - that is, the trout. There is no question about it.

Mr. FAIRBANK.- I have no doubt there are lakes where the food will be found. As I say, you find a lake where the proper stone formation exists, and you will undoubtedly find food for them; but I think in the majority of the small lakes it would be utterly useless to put lake trout in them. I have never heard what the success was there at the Madison lakes. I knew something had been done there, but not the result. So it you have succeeded there you ought to go on and put in a very large amount of them every year.

Mr. DUNNING. - As remarked, it requires different fishing to fish for the lake trout than for the salmon.

Mr. FAIRBANK.- Yes, you have got to fish for them in deep water.

Mr. MATHER.- Mr. President, there is one thing that strikes me that is a little singular about Geneva Lake, and that is this, as I understand it, the food of all these young fishes belonging to the salmon family, including the brook trout, the lake trout, etc., which are all grouped in one family, there are only three classes of food which they feed upon; one is the small crustaceans, another is the insects and flies on the surface, and the third is the larvae of those flies and worms in the water, and they all feed upon that class of food, and if there is food in Geneva lake for the brook trout and for the California salmon, I do not know why the lake trout should not be found there also.

Mr. FAIRBANK.- The brook trout and the California salmon were put into this little stream up above, and there is where they found their food. There is insect life of course that the cisco feeds on. The young of the cisco find their food there. I don't know what it is.

Mr. Mather.—It rather surprises me that there is food for all these and none for the lake trout.

Mr. Tomlin.—Within a few miles of Duluth some years ago, some very wise men petitioned for the deposit of two hundred thousand of these salmon trout, just as Mr. Fairbank speaks of seven years ago. Now, I have been up to the lake several times and fished there, especially to see if there was any chance of getting these fish, and I was puzzled beyond my comprehension to understand why in seven years there had not any of them turned up. I thought surely in that seven years there would have been some young ones taken. As Mr. Mather said, I think the salmon family live all the way through on the same kind of food, and if there was food for the brook trout there would be for the salmon trout. Now, after the first plant of two hundred and fifty thousand was put in, the next year they put in another plant of two hundred and fifty thousand, so there has been five hundred thousand put in there. This lake I speak of has all the properties of a good lake for fish, except the limestone formation. It is boulders there, but any quantity of lily-pads and what are called fresh water plantain, and in addition there are millions of chubs or shiners, and just as soon as you get the small fish over the preliminary stage of their existence, there is plenty for them to live upon. But in that seven years I have yet to hear of one salmon trout being caught. I have wondered a great many times why it is so.

Mr. Fairbank.—I think you have got to have the rock formation.

Mr. Clark.—I think there is one point that they all overlook—something I have been working on two or three years, and perhaps other fish-culturists, and that is we are planting our brook trout, salmon trout, young salmon and all of that class of fish in new waters too young. They should be grown or partially grown before we plant them. Another point which goes to prove that you get results quicker is, that wherever you have a hatching house on a stream that trout will live in it at all, you will get that stream stocked ten times quicker than any that you plant with fry, because your partially grown fish are always

getting away. Now, to stock new waters which are not trout streams proper, I think the way is to put the fish in from four months to six months, up to a year old; then you have a good stout healthy fish that has got something to live upon until it can accustom itself to the new class of food.

Mr. TOMLIN.—I would like to ask Mr. Clark to come back to the subject which Mr. Fairbank started on—is it possible to stock waters which are not indigenous to salmon or trout, with trout or salmon, and make it a success?

Mr. CLARK.—Certainly it is possible, because it has been done.

Mr. MATHER.—In regard to this matter which Mr. Tomlin has just brought up, and the question which he asks Mr. Clark about stocking with fish which are not indigenous to the water, I will say that within the past few years this lake trout, whose natural habitat is the great lakes and the small lakes of New York, has been introduced into Virginia. Col. McDonald has had success with them at Wytheville, and all of us who know anything about the distribution of this fish, know that our lake or salmon trout, never existed in Virginia in a state of nature. I am now hatching for Professor Baird one hundred and fifty thousand of these lake trout, which he has requested me to keep on Long Island for four or five months, in accordance with Mr. Clark's theory, and then distribute according to his order in the fall, and he tells me that Col. McDonald says that these lake trout will bear warmer waters than any of our salmon. That is not my experience. I have always believed them to be the most delicate in regard to temperature of any of our fishes, and have believed they require colder water; at the same time I am trying it, I am anxious to see if they will live in our warm waters on Long Island. Col. McDonald has raised them in Virginia, where there is not much difference in temperature.

Mr. CLARK.—I have one hundred and fifty thousand that we are keeping for the United States Commission to-day, from the same lot that Mr. Mather speaks about. Mr. Mather's one hundred and fifty thousand came from Northville. That is the pur-

pose of the United States Fish Commission from now on. Now, one remark that Mr. Dunning just spoke to me about—he thought that if you keep them in the troughs too long they become too much domesticated. Now, there is the point—you want to keep them long enough until they grow so that you have a good healthy fish, I mean a fish of two or three months about. Keep them there as long as you see fit and put them in your pond and feed them. That is my idea of it, keep them until you get a good healthy fish. We have had at Northville probably twenty-five thousand trout from a year old and upward, and next week shall probably plant one half of these fish. Some of them are probably at least a foot long.

Mr. FAIRBANK.—I have no doubt that these fish, kept until they become a mature fish, say a year old, will live in Lake Geneva, because there is enough food for them there, minnows and young fish that they can eat; but I don't believe that if they spawn there that the young fry which they hatch would ever come to maturity, because I don't think there is any food in that lake for them. The object of my making these remarks is that gentlemen when selecting a lake to put trout in, should look to the matter of the food for the fry, the young fish, and look particularly to the rock formation, the stone formation about it. I think that is the secret of it, and if you put your young fish in, keeping them until they are six months or a year old, and then put them in a lake where there is no food for the fry, it will never amount to anything. These mature fish will grow, but there will never be a second generation.

Mr. MATHER.—What Mr. Fairbank has said about planting fish in suitable waters is no doubt true, and what Mr. Clark says about raising these young fish is also true, but it has been my experience that a young lake trout would prefer to have the tail or fin of his brother, to anything you can offer him. These little devils eat each other up.

Dr. HUDSON.—I would inquire if there are any more papers to be read? If there are not, of course the more discussion we have, the better.

The SECRETARY.—There is but one more paper, and if it is in order I will now read it.

WORK AT COLD SPRING HARBOR, N. Y.

BY FRED MATHER.

THIS station of the New York Fish Commission, of which I am the superintendent, is on the north shore of Long Island and is intended for both salt and fresh water fish. Some work is also done for the United States Fish Commission, and the expense of this is borne by the general Government; the fish hatched are mainly distributed within the State. These latter fish are salmon, land-locked salmon and lake trout. In some cases such as the whitefish and shad, the eggs are given by the United States, and distributed by the State, an arrangement of great value to the latter.

During the past season we have had 262,000 trout fry at the station. Of these there were 40,000 eggs taken at the station, 112,000 eggs bought of Mr John D. Hewlett, of Cold Spring Harbor, from James Annin, Jr., and W. L. Gilbert, the fry from which went into the waters of the north and south sides of Long Island, and 110,000 fry were received from the New York hatchery at Caledonia, in charge of Mr. M. A. Green. We have on hand at present writing 3,000,000 eggs of the smelt, 1,000 eggs of the *Ogassa* trout from Sunapee lake, New Hampshire, a gift of Mr. Elliott B. Hodge, Commissioner of that State. One million whitefish from eggs sent from the Northville, Michigan station, of the U. S. Commission, under charge of Mr. F. N. Clark, by order of Prof. S. F. Baird, have been hatched and distributed to Great Pond, near Riverhead, Long Island, and to Lake Ronkonkoma, a large lake in the center of the island. Previous plantings have been made in these lakes, but we have been unable so far to learn the result of them. It is hoped, however, that this fish may find a suitable home in these waters.

On this subject the County Treasurer of Suffolk County writes me from Riverhead, under date of January 30, 1886, as follows:

Fr. Mather, Esq.: DEAR SIR—I will be very glad to assist you in any way. I have two parties out trying to get a specimen of the whitefish for you, but have failed so far on account of the ice, but will give it a thorough trial when the ice is gone and report to you. I am having a net fixed now to try to catch one or more. There is a pond

one and a half miles long just above Riverhead, good running water, which I hired two men to clean out of all worthless fish, such as catfish, suckers and what we call 'roach.' They caught about two and a half tons of turtles, which we carted off and buried. I was in hopes to get some black bass to place in this pond, and would like some whitefish for it now. We have a good place for lake trout, and if you will send us some and let us know when they will arrive, I will take especial pains for their care. Perhaps the brown trout might do well here. (Signed) J. HENRY PERKINS.

In the salt-water department, we have hatched and turned out over two million tomcods, or as they are sometimes called on the coast, frost fish, a small relative of the cod which seldom exceeds a pound in weight but is quite an important little food fish in our harbors. In January we had some 2,000,000 codfish eggs of which a very fair percentage were developing, until a blizzard blew through our old delapitated shanties, which we use for hatching houses, and froze up the pipes and the eggs in the jars. We had watched the development of these eggs daily under the microscope with great interest, and felt sure of success until the cold snap put a stop to all further development.

Of the brown trout, which by the way I believe to be the gamest trout in America, we had some three thousand eggs from our own fish, and have received some 25,000 from Germany through the courtesy of our good friend, Herr von Behr, president of the German Fishery Association, with a promise of 50,000 more from Herr von dem Borne, the well-known fishculturist of Berneuchen.

From the United States Fish Commission we have 500,000 salmon hatched from eggs received from the hatching station at Orland, Me., under charge of Mr. C. G. Atkins. These will go into the headwaters of the Hudson, the Salmon river emptying into Lake Ontario, the Oswego river and some 50,000 will go by request of State Commissioner R. U. Sherman, to the waters of the Saranacs, whose outlet is into Lake Chaplain and down into the St. Lawrence. These fish are now ready for distribution. We have also about 34,000 land-locked salmon from the United States works at Grand Lake stream, Me., in charge of Mr. H. H. Buck, also sent at request of General Sherman

for the waters near the Adirondack hatchery, either in Saranacs or in Lake Brandon, formerly known as Little Clear pond, now set apart for the State hatchery, on whose outlet it is located. The hatching season has been exceptionally good, and the losses of eggs and fry have been down to the minimum. The work at the station was done by two men and myself, until in February we were reinforced by Mr. F. A. Walters, superintendent of the Adirondack hatchery, who in former years had been my foreman, but who by an accident to the dam at the hatchery under his charge was relieved from duty there for the present. Last fall some new ponds were made; the only ones which were there when the State took possession, were drained and quantities of eels taken from them, which, do doubt, destroyed many fry in former years. A fence has been put around the place and the grounds greatly improved. A new hatchery is really needed, as the two buildings now used for this purpose are not only small but so decayed as to be ready to tumble down. The men have worked in these buildings with six inches of ice under their feet, and at times with water freezing within ten feet of a red hot stove, and while ice has occasionly formed to the depth of a quarter of an inch in the hatching troughs it has done no damage there. But the two-inch iron pipes which convey the salt water to the jars did freeze and the flow was stopped. The eggs of the cod being so light that they would not bear a strong current, consequently the flow had to be shut down to a very small quantity, and all froze, as did some small English soles also.

The station, with these advantages of fresh and salt water, could be made, with a proper expenditure of money, the most important one in the United States. Its flow of fresh water is not anything like as great as at some other stations, but the height from which this water is taken—some forty feet above the hatchery, renders it possible to use the water over many times—in fact, we do so now. The brick building on the hill, in which there are twelve troughs with a capacity for 30,000 salmon each, receives the water first; it then flows into a little pool, where egg shells and dirt may settle, and is conveyed on the upper floor of the main hatchery, in which there are eleven

troughs, and it then passes into the ponds. Another spring supplies the lower floor of the hatchery, which has nine troughs and hatching tables, on which twenty-five McDonald jars can be placed, and either salt or fresh water turned into them.

The fresh-water supply is capable of running more troughs than we now use, but the floor surfaces of the buildings will not permit them. The salt water which is within three hundred yards at low tide, is pumped into a reservoir on the hill and led into the buildings through a two-inch iron pipe, so that practically the sea is above us. The density of the water is sufficient to hatch codfish and oysters, and many oysters were hatched here last season by order of Mr. E. G. Blackford, of the New York Fish Commission, who is in charge of the oyster investigations of the State, an account of which is given in another paper. We have successfully hatched shad in the spring water here and may repeat the experiment this year. It is now three years since we began work here, and our last season's work will foot up to about six millions of fry of different species, hatched and distributed.

Cold Spring Harbor, N. Y., April 10, 1886.

The CHAIRMAN.—The treasurer's report has not yet been read, and perhaps that should be read now. If the gentlemen will listen the secretary will read the report of the treasurer.

After the reading, it was moved and seconded that the report of the treasurer be accepted and placed on file. Carried.

The CHAIRMAN.—Article IV. of the Constitution, which was adopted to-day, provides that the regular meeting of the Society shall be held once a year, the time and place being decided upon at the previous meeting, or in default of such action, by the executive committee. It will, therefore, devolve upon this meeting to determine the time and place of the next meeting of the Society. Will any gentleman present make a suggestion in regard to that matter?

Mr. TOMLIN.—Before this matter comes up there is one resolution here I would like to read and get an expression of opinion of the gentlemen present. Yesterday the preponderance of the evidence brought before us showed that it was better to propa-

gate fish than it was to police the great waters of the lakes. I should like to present this resolution for consideration:*

Resolved, That it is the sense of this meeting that the public good of the States bordering on the chain of upper lakes would be best served by the establishment of fish hatcheries for the propagation of the spawn of whitefish and lake trout, and we do pledge ourselves to urge on our Congressional representatives and Senators to obtain an appropriation from Congress at this session to be devoted to this purpose.

Mr. TOMLIN.—I will say this has been a matter of consideration in Duluth for some time. We have communicated with our representative there, and also with the Senators, and the matter is in their hands. Since I have been in the meeting here I have been making some inquiries as to the best method of procedure, and learn it can only be done by Congressional appropriation or grant. If it is the sense of the meeting, I would like to have the matter discussed, and would offer it as a resolution if it will be accepted.

The CHAIRMAN.—You have heard the resolution that has been read. What action will you take upon it?

Mr. MATHER.—I should rather think, Mr. President, that this was a matter more pertinent to the Commissioners of Fisheries of the States and to the gentlemen who are interested in the stocking of the great lakes really, than one that came within the scope of this organization, because it is a local matter, as much so as if the Society should move that the hatching of codfish be extended, or the stocking of the Mississippi or some other local stream be recommended. That is the view I take of the matter.

The CHAIRMAN.—It doesn't seem to me that there is any objection if the gentleman simply wishes to get the opinion of the members present, from the bordering States perhaps, but otherwise, as Mr. Mather has suggested, it would be just as proper to petition Congress to stock the Connecticut river with shad, it seems to me, as it would be in this matter. The matter belongs more particularly to the State Commissioners and the citizens,

* Mr. Tomlin was elected a member of the Society, but has failed to complete his membership.

the inhabitants of the various States in this immediate neighborhood and not for the Society, which is supposed to represent the whole United States. That is the idea that presents itself to the chair. It is open of course for discussion by the Society.

Mr. DUNNING.—I move that the resolution be laid aside until we get through with the business now under consideration.

The CHAIRMAN.—Will any gentleman make any suggestion as to the time and place of the next meeting, either in the form of a motion or remarks in regard to the matter?

Mr. MAY.—In order to bring the matter before the Society, I move that the next annual meeting of this Society be held in Washington, on the second Tuesday of May, 1887.

Mr. BARTLETT.—I move the next annual meeting of the Society be held at Quincy, Illinois, the "Gem City of the West," the speaker tendering the hospitalities of the city to the Society should they conclude to hold the meeting at that place

Mr. Dunning suggested that the Society meet at Madison, Wisconsin, at the next annual convention.

Mr. FAIRBANK.—I second the motion of Mr. May. I want to say here that I feel absolutely mortified at the lack of interest that our people have taken in this meeting. The Commissioners in the Western States, where they have a Commission, have not come here as I expected they would, and as they ought to have done, and they don't deserve another meeting. We could have had more interest from the general public if the matter had been a little better understood, and I supposed it would be. I don't know exactly where the fault is, but we have relied on Dr. Rowe to disseminate the matter in the press, and have the general public understand the full scope and intention of the meeting, and awaken some outside interest in it, but I have been absent myself and have been very much engaged in other things, and I supposed the matter was being attended to. I think we ought to rest on the laurels we have won this time, and try a meeting at Washington, which is really headquarters.

Mr. MATHER.—Mr. President, I agree with what Mr. Fairbank

has said about the advantages of Washington. Washington is a central point; it is at the head of the National Government, as some of you may know, and there is a vast museum of fishculture to be seen there. All the apparatus which has ever been devised is in the National Museum, and there are many advantages to be gained by having the meeting there. We have had the most successful meetings we have ever had in Washington, and while these questions come up about the East or West, I don't think it is worth while entertaining them. The Society is a national one in its scope and in its aim, and I do not hesitate to avow myself for Washington.

Mr. MAY.—I will amend my motion, Mr. Chairman, by moving that the next annual meeting of the Society be held at Washington, on the 12th, 13th and 14th days of May, 1887. Which motion, being duly seconded, was carried.

Mr. FAIRBANK.—I want to say a word or two more about the history of the Illinois Fish Commission, which the modesty of my associate, Mr. Bartlett, has prevented him from saying anything about. He has done all the work, and it is a little different work from what any other commission or State has done, and it has been so successful that I feel it is important to say something about it here, and call your attention to it, especially to the Commissioners from the Western States. You, most of you, know the character of the water we have here, and in my talks with him in relation to planting and hatching fish, I said I didn't think he could do much of anything in that work, and Mr. Bartlett suggested that as there were millions of fish that were left every year along the Mississippi river by the receding water, the young fish in the spring going to the shallow water near the shores, and as the river went down they were left on the bottom in the pools and ponds there, millions and millions of them to die, the best work we could do would be to gather up those fish, sort them out and distribute them, and that is the work we have been on for the past few years. We have a boat and a gang of men that go along the shores of the river and gather up these fish; and we have all varieties, from the small-mouthed black bass to the buffalo, and we take them up there by the bushel and

sort them out, and have a tank car, and that car is filled up with the young fish and is run over all the railroads in the State, and wherever we cross a river we stop and dump in our fish, and we have distributed a great many hundred thousand of fish with very gratifying success, as we get from all portions of the State reports of the pickerel, bass and perch where they never were known before. This is a work that is easily and cheaply done, and considering the numbers of the fish we have distributed, it is much cheaper than any other work that is done in that line. It is so very effective that I feel like suggesting it to the members, particularly of the Western States here, believing it is really a much more effective and profitable way of spending money than by hatching and attempting to plant the fish where they are not indigenous.

Mr. CLARK.—I understand they are planted in streams where they were not before. Do you think you would have got the same result if you had planted little fry in those same streams?

Mr. FAIRBANK.—Oh no, I agree with you the larger the fish the better, still the character of the water of the small streams is similar to the Mississippi. Before the fish are sorted he picks out the best varieties, thinking that is the best way to plant them, and last season he has taken all kinds and thrown them in, so that the poorer varieties may make food for the others.

Mr. DUNNING.—There is a fish that is becoming quite common all over the country, from north to south and east to west, and I would like to have an expression of this meeting in regard to the fish being a profitable one for propagation. It is the carp, and we read what a great size it attains in a very few years, and how prolific it is.

Mr. BARTLETT.—I would simply say that in my opinion it solves the question of the cheapest food for the greatest number of people, for the least amount of money. This question can be solved in the propagation of carp. In the state of Illinois there are now 6,000 carp ponds, and a great many of them are producing fish to-day. Applications this year on file for carp number 2,500, in round numbers, and they are increasing every day.

Out of that whole number I have not heard of twenty-five that have denounced it as a failure. I have one carp in my possession now that I think is among the first received from the general Government, a male carp, which measures 36 inches long and weighs 22 pounds. A large proportion of the ponds in the United States are ordinary farm ponds.

The resolution of Mr. Tomlin being called up for re-consideration, the same was read by the Chairman. The resolution and movement was supported by remarks from Dr. Sweeny, and opposed by Secretary Mather and President Hudson. The question occurring on the adoption of the motion, it was carried by a vote of the members present, standing six in affirmative to two in the negative.

Mr. BARTLETT.—I have a resolution I would like to offer:

Resolved. That the thanks of this Society be extended to Mr. Potter Palmer for his courtesies to the members of this Convention, and for the use of this room.

Carried unanimously.

Mr. MAY.—I do not think it will be out of place for the Society to tender thanks to the local committee here, Mr. Fairbank, Dr. Rowe, and Mr. Bartlett, for the exhibit of live fish, etc., made at the Exposition Building, for the benefit of the members in attendance upon this meeting, and I move that the thanks of the Society be tendered to them. The motion was seconded and carried unanimously.

Dr. SWEENY.—While we feel grateful in our return of thanks, if it has not already been done, I move that the thanks of the Society be tendered to the gentleman who invited us to look at his oranges, bananas, etc. The motion receiving a second, was carried.

Mr. BARTLETT.—I would move the thanks of this Society be tendered to the reporters of the papers for their courtesies and kindness to us during the sessions.

Carried unanimously.

On motion, duly seconded, the Convention here adjourned *sine die*.

TREASURER'S REPORT.

DR. EUGENE G. BLACKFORD, Treas., in acct. with AMERICAN FISHERIES SOCIETY. CR.

1886.				1885.	
April 9.	By amount of annual dues collected since May 1, 1885.		$342 00	May 30.	To W. V. Cox, expenses of annual meeting in Washington.	$20 60
				"	To R. J. Geare, stenographer.	26 00
				Dec. 11.	To Postal-cards.	3 59
				1886.		
				Jan. 14.	To J. M. Davis, printing reports.	143 75
				15.	To Postage, mailing reports.	4 85
				Apr. 7.	To J. M. Davis, printing receipts.	3 00
				"	To balance due Treasurer at last annual meeting.	102 58
						$304 37
					Balance in treasury.	37 63
			$342 00			$342 00

MEMBERS

OF THE

AMERICAN FISHERIES SOCIETY.

Honorary Members.

H. R. H., the Crown Prince of Germany.

Baird, Spencer F., U. S. Commissioner of Fish and Fisheries, Washington, D. C.

Behr, E. von, Schmoldow, Germany; President of the Deutschen Fischerei Verein.

Borne, Max von dem, Berneuchen, Germany.

Huxley, Prof. Thomas H., London; President of the Royal Society.

Jones, John D., 51 Wall Street, New York.

Corresponding Members.

Apostolides, Prof. Nicoly Chr., Athens, Greece.

Buch, Dr. S. A., Christiania, Norway; Government Inspector of Fisheries.

Birkbeck, Edward, Esq., M. P., London, England.

Benecke, Prof. B., Königsberg, Germany; Commissioner of Fisheries.

Brady, Thomas F., Esq., Dublin Castle, Dublin, Ireland; Inspector of Fisheries for Ireland.

Day, Dr. Francis, F. L. S., Kenilworth House, Cheltenham, England; late Inspector General of Fisheries for India.

Feddersen, Arthur, Viborg, Denmark.

Giglioli, Prof. H. H., Florence, Italy.

Hubrecht, Prof. A. A. W., Utrecht, Holland; Member of the Dutch Fisheries Commission, and Director of the Netherlands Zoological Station.

Juel, Capt. N., R. N., Bergen, Norway; President of the Society for the Development of Norwegian Fisheries.

Landmark, S., Bergen, Norway; Inspector of Norwegian Freshwater Fisheries.

Lauderdale, the Earl of, Stirling, Scotland.

Lundberg, Dr. Rudolf, Stockholm, Sweden; Inspector of Fisheries.

Marston, R. B., Esq., London, England; Editor of the *Fishing Gazette*.

Macleay, William, Sydney, N. S. W.; President of the Fisheries Commission of New South Wales.

Sars, Prof. G. O., Christiania, Norway; Government-Inspector of Fisheries.

Solsky, Baron N. de, St. Petersburg, Russia; Director of the Imperial Agricultural Museum.

Sola, Don Francisco, Garcia, Madrid, Spain; Secretary of the Spanish Fisheries Society.

Wattel, M. Raveret, Paris, France; Secretary of the Société d'Acclimatation.

Young, Archibald, Esq., Edinburgh, Scotland; H. M. Inspector of Salmon Fisheries.

Walpole, Hon. Spencer, Governor of the Isle of Man.

Deceased Members.

Chappel, George.
Garlick, Dr. Theodatus.
Lawrence, Alfred N.
McGovern, H. D.
Milner, Prof. James W.
Parker, W. R.
Redding, B. B.
Redding, George H.
Rice, Prof. H. J.
Smith, Greene.
Stuart, Robert L.
Shultz, Theodore.

MEMBERS.

Persons elected at last meeting and who did not pay their dues do not appear in this list

Adams, Dr. S. C., Peoria, Illinois
Agnew, John T., 284 Front Street, New York.
Anderson, A. A., Bloomsbury, N. J.
Annin, James, Jr., Caledonia, N. Y.
Atkins, Charles G., Bucksport, Maine.
Atwater, Prof. W. O., Middletown, Conn.
Bailey, W. E., U. S. Fish Commission.
Banks, Charles, 453 Fifth Avenue, New York.
Barrett, Charles, Grafton, Vermont.
Bartlett, S. P., Quincy, Illinois.
Bean, Dr. Tarleton H., National Museum, Washington, D. C.
Belmont, Perry, 19 Nassau Street, New York.
Benjamin, Pulaski, Fulton Market, New York.
Benkard, James, Union Club, New York.
Bickmore, Prof. A. S., American Museum, New York.
Bissell, J. H., Detroit, Michigan.
Blackford, E. G., Fulton Market, New York.
Booth, A., Chicago, Illinois.
Bottemane, C. J., Bergen-op-Zoom, Holland.
Brown, J. E., U. S. Fish Commission.
Brown, S. C., National Museum, Washington, D. C.
Bryan, Edward H., Smithsonian Institution.
Bryson, Col. M. A., 993 Sixth Avenue, New York.
Butler, W. A., Jr., Detroit, Mich.
Butler, Frank A., 291 Broadway, New York.
Butler, W. H., 291 Broadway, New York.
Carey, Dr. H. H., Atlanta, Ga.
Carman, G., Fulton Market, New York.
Cheney, A. Nelson, Glens Falls, N. Y.
Clapp, A. T., Sunbury, Pa.
Clark, Frank N., Northville, Mich.
Clark, A. Howard, National Museum, Washington, D. C.
Comstock, Oscar, Fulton Market, New York.
Conklin, William A., Central Park, New York.
Conselyea, Andrew, Springfield, Long Island, N. Y.
Cox, W. V., National Museum, Washington, D. C.
Crook, Abel, 99 Nassau Street, New York.
Crosby, Henry F., 18 Cliff Street, New York.
Develin, John E., 30 Nassau Street, New York.

Dewey, J. N., Toledo, Ohio.
Dieckerman, George H., New Hampton, N. H.
Donaldson, Hon. Thomas, Philadelphia, Pa.
Dunning, Philo, Madison, Wis.
Earll, R. E., National Museum, Washington, D. C.
Ellis, J. F., U. S. Fish Commission.
Endicott, Francis, 57 Beekman Street, New York.
Evarts, Charles B., Windsor, Vt.
Fairbank, N. K., Chicago, Ill.
Ferguson, T. B., U. S. Fish Commission.
Foord, John, *Brooklyn Union*, Brooklyn, N. Y.
French, Asa B., South Braintree, Mass.
Garrett, W. E., P. O. Box 3006, New York.
Gilbert, W. L., Plymouth, Mass.
Goode, G. Brown, National Museum, Washington, D. C.
Habershaw, Frederick, 113 Maiden Lane, New York.
Haley, Albert, Fulton Market, New York.
Haley, Caleb, Fulton Market, New York.
Hall, G. W., Union Club, New York.
Harris, Gwynn, Washington, D. C.
Harris, W. C., 252 Broadway, New York.
Haves, A. A., Washington, D. C.
Henshall, Dr. J. A., Cynthiana, Kentucky.
Hesse, Rudolf, U. S. Fish Commission, Washington, D. C.
Hewlett, Charles, Hewletts, Long Island, N. Y.
Hicks, John D., Roslyn, Long Island, N. Y.
Hinchman, C. C., Detroit, Michigan.
Holmes, Dr. E. S., Grand Rapids, Michigan.
Hudson, Dr. William M., Hartford, Conn.
Humphries, Dr. E. W., Salisbury, Md.
Hutchinson, E. S., Washington, D. C.
Isaacs, Montefiore, 42 Broad Street, New York.
Jessup, F. J., 88 Courtlandt Street, New York.
Johnston, S. M., Battery Wharf, Boston, Mass.
Kaufman, S. H., Washington, D. C.
Kelly, P., 346 Sixth Avenue, New York.
Kellogg, A. J., Detroit, Michigan.
Kingsbury, Dr. C. A., 1119 Walnut Street, Philadelphia, Pa.
Lamphear, George, Fulton Market, New York.
Lawrence, G. N., 45 East 21st Street, New York.
Lawrence, F. C., Union Club, New York.
Ledyard, L. W., Cazenovia, N. Y.

Lee, Thomas, U. S. Fish Commission.
Loring, John A., 5 Tremont Street, Boston.
Lowrey, J. A., Union Club, New York.
Lydecker, Major G. L., U. S. Engineers.
Lyman, Hon. Theodore, Brookline, Mass.
Mallory, Charles, foot Burling Slip, New York.
Mansfield, Lieut. H. B., U. S. Navy Coast and Geodatic Survey, Washington, D. C.
Mather, Fred, Cold Spring Harbor, N. Y.
May, W. L., Fremont, Nebraska
McDonald, Col. M., U. S. Fish Commission, Washington.
McGown, Hon. H. P., 76 Nassau Street, New York.
Middleton, W., Fulton Market, New York.
Milbank, S. W., Union Club, New York.
Miller, S. B., Fulton Market, New York.
Miller, Ernest, Fulton Market, New York.
Moore, George H. H., U. S. Fish Commission.
Murphy, W. W. J., U. S. Fish Commission.
Nevin, James, Madison, Wis.
O'Connor, J. P., U. S. Fish Commission.
Page, George S., 49 Wall Street, New York.
Page, W. F., U. S. Fish Commission.
Parker, Dr. J. C., Grand Rapids, Mich.
Parker, Peter, Jr., U. S Fish Commission.
Pease, Charles, East Rockford, Cuyahoga County, Ohio.
Pietmyer, Lieut., U. S. N., commanding Steamer *Fish-Hawk*.
Pike, Hon. R. G., Middletown, Conn.
Post, W., Knickerbocker Club, New York.
Ray, Hon. Ossian, M. C., New Hampshire.
Redmond, R., 113 Franklin Street, New York.
Reinecke, Theodore, Box 1651, New York.
Reynal, J., 84 White Street, New York.
Ricardo, George, Hackensack, N. J.
Riley, Prof. C. V., Agricultural Dept., Washington, D. C.
Robeson, Hon. Geo. M., Camden, N. J.
Rogers, H. M., Fulton Market, New York.
Roosevelt, Hon. Robert B., 17 Nassau Street, New York.
Ryer, F. R., New York City.
Schaffer, George H., foot Perry Street, New York.
Schieffelin, W. H., 170 William Street, New York.
Schuyler, H. P., Troy, New York.
Sherman, Gen. R. U., New Hartford, Oneida Co., N. Y.

Simmons, Newton, U. S. Fish Commission.
Smiley, C. W., Smithsonian Institution, Washington, D. C.
Spofford, Henry W., Smithsonian Institution.
Steers, Henry, 10 East 38th Street, New York.
Stone, Livingston, Charlestown, N. H.
Stone, Summer R., 46 Exchange Place, New York.
Swan, B. L., Jr., 5 West 20th Street, New York.
Sweeny, Dr. R. O., St. Paul, Minn.
Thompson, H. H., P. O. Box 25, New York.
Townsend, Isaac, Union Club, New York.
Van Brunt, C., 121 Chambers Street, New York.
Ward, George E., 43 South Street, New York.
Weeks, Seth, Corry, Erie Co., Penn.
West, Benjamin, Fulton Street, New York.
Whitaker, Herschel, Detroit, Mich.
Whitney, Samuel, Katonah, New York.
Wilbur, E. R., 40 Fulton Street, New York.
Wilcox, Joseph, Media, Penn.
Wilcox, W. A., 176 Atlantic Avenue, Boston, Mass.
Willets, J. C., Skeaneatles, N. Y., or 1 Grace Court, Brooklyn.
Wilmot, Samuel, Newcastle, Ontario.
Wilson, J. P., U. S. Fish Commission.
Wood, Benjamin, 25 Park Row, New York.
Woodruff, G. D., Sherman, Conn.
Woods, Israel, Fulton Market, New York.
Worth, S. G., Raleigh, N. C.